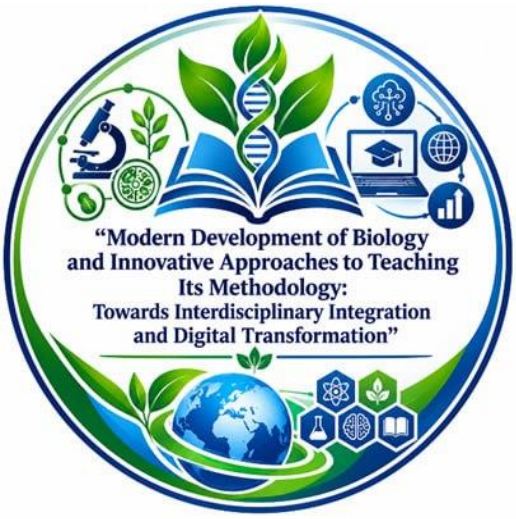
O‘ZBEKISTON RESPUBLIKASI TA’LIM VA ILM-FAN VAZIRLIGI

SAMARQAND DAVLAT PEDAGOGIKA INSTITUTI

“Biologiya fanining zamonaviy rivojlanishi va uni o‘qitish metodikasining innovatsion yondashuvlari: fanlararo integratsiya va raqamli transformatsiya sari”

mavzusida xalqaro ilmiy-amaliy anjuman

23-24-Oktabr 2026-yil



SAMARQAND – 2026

O‘zbekiston Respublikasi Prezidentining 2023-yil 4-iyuldagi “Ma’muriy islohotlar doirasida oliy ta’lim, fan va innovatsiyalar sohasida davlat boshqaruvini samarali tashkil qilish chora-tadbirlari to‘g‘risida”gi PQ-200 Qarori hamda O‘zbekiston Respublikasi Oliy ta’lim, fan va innovatsiyalar vazirligining 2024-yil 27-dekabrdagi 490-sonli buyrug’i asosida tashkil etilgan **“Biologiya fanining zamonaviy rivojlanishi va uni o‘qitish metodikasining innovatsion yondashuvlari: fanlararo integratsiya va raqamli transformatsiya sari”** mavzusida xalqaro ilmiy-amaliy anjuman materiallari (23-24-Oktabr 2026-yil)-Samarqand: SamDPI, 2026.

Muharrirlar:

Mirzayev Uktam Nuritdinovich, PhD, dotsent	*Xurramov Otabekxon G‘ayratxon o‘g‘li, assistent*
Jumayev Shuxrat Maxsadovich, PhD, dotsent	*Buvrayev Nurali Ravshan o‘g‘li, assistent*
Mamadiyarov Muzaffar Umirzaqovich, PhD, dotsent	*Narzullayev Sardor Nodirjon o‘g‘li, assistent*
Murodqosimov Saidolim, t.f.n.,dotsent	*Ibodullayeva Baxora Xamidullayevna, assistent*
Usmonova Mahliyo Ibodullayevna, PhD, dotsent	*Turniyozova Nargiza Raxmatovna, assistent*
Djumayeva Zamira Utkirovna, PhD, dotsent	*Sharifmurodov Karamatullo Ibroximzoda, assistent*
Rajamurodova Nuriniso Zaynitdinovna, PhD, dotsent	*Normurodova Go‘zal Shuhrat qizi, assistent*
Djalilov Farrux Sobirovich, PhD, dotsent	*Zokirova Dilnoza Fazliddin qizi, assistent*
Alavdinov Muhammad Haqaitxon o‘g‘li, assistent	*Artikova Gulnoza Xasanovna, assistent*
Obloqulov Jahongir Esanboyevich, assistent	*Ismailova Dilnora Dilshodovna, assistent*
Gulboyev Doston Toir o‘g‘li, assistent	*Xo'jamov Shaxboz Alisher o'g'li, assistent*

Dizayner:

F.S.Djalilov – Samarqand davlat pedagogika instituti “Biologiya ” kafedrasi o‘qituvchisi

To‘plamda joy olgan tezislarda keltirilgan ma’lumotlarning to‘g‘riligiga mualliflar javobgardirlar

© Samarqand davlat pedagogika instituti Ilmiy-texnik kengash yig‘ilishining 2026-yil 30-oktabrdagi 2-sonli qaroriga asosan nashrga tavsiya etilgan.

KIRISH SO‘ZI

Assalomu alaykum, hurmatli olimlar, aziz mehmonlar, qadrli ustozlar, professor-o‘qituvchilar, yosh tadqiqotchilar va talabalar!

Avvalo, barchangizni qadimiy va hamisha navqiron Samarqand zaminida, Samarqand davlat pedagogika institutida o‘tkazilayotgan “Biologiya fanining zamonaviy rivojlanishi va uni o‘qitish metodikasining innovatsion yondashuvlari: fanlararo integratsiya va raqamli transformatsiya sari” mavzusidagi xalqaro ilmiy-amaliy anjumanning ochilishi bilan chin qalbimdan muborakbod etaman!

Bugungi ilmiy anjumanimizda ishtirok etish uchun tashrif buyurgan O‘zbekiston Respublikasi oliy ta’lim muassasalari va ilmiy-tadqiqot markazlari vakillarini, shuningdek, Xitoy Xalq Respublikasi, Pokiston, Turkiya, Ozarbayjon, Rossiya, Belarus, Tojikiston, Qirg’iziston va Qozog’istondan on-layn formatda ishtirok etayotgan hurmatli olimlarimizni institutimiz jamoasi nomidan samimiy qutlayman.

Xorijiy va mahalliy olimlarning bir ilmiy maydonda jam bo‘lishi, tajriba almashishi hamda yangi ilmiy g’oyalarni muhokama qilishi xalqaro akademik hamkorlikni mustahkamlash yo‘lidagi muhim qadamlardan biridir.

Hurmatli anjuman ishtirokchilari!

Bugungi globallashuv davrida biologiya fani insoniyat oldida turgan eng muhim muammolarni hal etishda alohida ahamiyat kasb etmoqda. Iqlim o‘zgarishi, biologik xilma-xillikning qisqarishi, oziq-ovqat xavfsizligini ta’minlash, tabiiy resurslardan oqilona foydalanish, ekologik muvozanatni saqlash va yangi biotexnologiyalarni rivojlantirish biologiya fani oldiga ulkan vazifalarni qo‘ymoqda.

Shu bilan birga, zamonaviy biologiya ta’limi ham yangicha yondashuvlarni talab etadi. Endilikda bo‘lajak biologiya o‘qituvchisi faqat nazariy bilimlarni o‘zlashtirgan mutaxassis bo‘lib qolmasdan, ilmiy izlanish olib bora oladigan, zamonaviy laboratoriya jihozlaridan foydalanadigan, raqamli texnologiyalarni o‘zlashtirgan va fanlararo integratsiyani ta’lim jarayoniga tatbiq eta oladigan raqobatbardosh pedagog bo‘lib yetishishi zarur.

Aynan shu nuqtayi nazardan, bugungi xalqaro anjumanimizning mavzusi nihoyatda dolzarbdir. Ishonamanki, mazkur ilmiy muloqot biologiya fanini rivojlantirish, uni o‘qitish metodikasini takomillashtirish va ta’lim bilan ilm-fan integratsiyasini mustahkamlashga munosib hissa qo’shadi.

Hurmatli hamkasblar!

Samarqand davlat pedagogika instituti jamoasi ta’lim sifatini oshirish, ilmiy tadqiqotlarni rivojlantirish, xalqaro hamkorlikni kengaytirish va zamonaviy ilmiy muhitni shakllantirishni ustuvor vazifalaridan biri deb biladi.

Bugungi anjumanning tashabbuskori va asosiy tashkilotchilaridan biri bo‘lgan Tabiiy fanlar fakulteti Biologiya kafedrasi faoliyati ushbu yo‘nalishlarda olib borilayotgan ishlarning muhim namunasidir.

So‘nggi yillarda kafedrada ilmiy salohiyatni mustahkamlash, xalqaro ilmiy nashrlardagi faollikni oshirish, yosh tadqiqotchilarni qo‘llab-quvvatlash va zamonaviy tadqiqot infratuzilmasini rivojlantirish borasida muayyan natijalarga erishildi.

Alohida ta’kidlash joizki, Biologiya kafedrasi institutimizda Scopus va Web of Science xalqaro ilmiy bazasida indekslanadigan nashrlarda maqolalar chop etish bo ‘yicha yetakchi ilmiy

jamoalardan biri hisoblanadi. Bu natijalar professor-o‘qituvchilarning izchil mehnati, ilmiy hamkorlik va tadqiqotlarga bo’lgan mas’uliyatli yondashuvining samarasidir.

Ushbu yutuqlarni e’tirof etar ekanmiz, professor A. Legalovning xalqaro ilmiy nashrlarda maqolalar tayyorlash va chop etish borasidagi salmoqli hissasini alohida qayd etishni istardim. Uning ilmiy hamkorlikni rivojlantirishga qo‘shayotgan hissasi, tajribasi va ilmiy salohiyati kafedra faoliyatining xalqaro miqyosda kengayishida muhim ahamiyat kasb etmoqda.

Bunday hamkorlik bizga ilmiy natijalarni xalqaro ilmiy hamjamiyatga taqdim etish, tadqiqotlar sifatini oshirish va yangi ilmiy aloqalarni yo‘lga qo’yish uchun keng imkoniyatlar yaratadi.

Kafedrada so‘nggi yillarda 5 ta dissertatsiya himoya qilingani, Scopus va Web of Science bazalarida indekslanadigan nashrlarda 100 dan ortiq maqola chop etilgani, 1 ta patent hamda 20 dan ortiq guvohnoma olingani ilmiy izlanishlar samaradorligini ko’rsatuvchi muhim natijalardir.

Shuningdek, kafedra faoliyatida shakllanayotgan ilmiy maktablar, assistentlar, magistrantlar va iqtidorli talabalarning ilmiy anjumandagi ishtiroki ilmiy avlodlar davomiyligini ta’minlashga xizmat qilmoqda.

Biz uchun ilmiy yutuqlarning miqdori bilan bir qatorda, ularning sifati, amaliy ahamiyati va ta’lim jarayoniga tatbiq etilishi ham muhimdir.

Hurmatli anjuman qatnashchilari!

Bugungi kunda ilm-fan taraqqiyotini zamonaviy laboratoriyalarsiz, ilg’or tadqiqot usullarisiz va xalqaro hamkorliksiz tasavvur etish qiyin.

Shu sababli institutimizda Biologiya kafedrasining moddiy-texnik bazasini mustahkamlash, zamonaviy laboratoriyalarni shakllantirish va o‘quv-ilmiy tadqiqotlar uchun zarur sharoitlarni yaratishga alohida e’tibor qaratilmoqda.

Zamonaviy laboratoriyalar talabalarga nazariy bilimlarini amaliy tajribalar bilan mustahkamlash, yosh olimlarga esa mustaqil tadqiqotlar olib borish imkonini beradi. Eng muhimi, bunday ilmiy muhit yangi g’oyalar, innovatsion ishlanmalar va amaliy natijalarning yuzaga kelishiga zamin yaratadi.

Biz kelgusida ham biologiya, ekologiya, o‘simliklar fiziologiyasi, bioekologiya va boshqa ustuvor yo‘nalishlarda tadqiqot imkoniyatlarini kengaytirish, ilmiy natijalarni amaliyotga joriy etish hamda yosh tadqiqotchilarni xalqaro ilmiy hamkorlikka keng jalb qilishni davom ettiramiz.

Ayniqsa, joriy yilning oktyabr oyidan boshlab qiymati 75 ming AQSh dollarini tashkil etuvchi xalqaro qo‘shma ilmiy loyiha amalga oshirilayotganini mamnuniyat bilan ta’kidlamoqchiman.

Loyiha “Qurg’oqchil hududlarda mahalliy dukkakli ekinlarning barqarorlik mexanizmlari va yaylovlarda uglerod yutilishini hisobga olish metodologiyasini ishlab chiqish” mavzusiga bag’ishlangan.

2026-yil oktyabr oyidan 2028-yil sentyabr oyigacha, ya’ni ikki yil davomida amalga oshirilishi rejalashtirilgan mazkur loyiha Xitoy Xalq Respublikasining Xingan qishloq va chorvachilik ilmiy akademiyasi hamda Ichki Mo‘g’uliston agrobiotexnologiya universiteti bilan xalqaro ilmiy hamkorlikni rivojlantirishda muhim ahamiyatga ega.

Loyihaning asosiy yo‘nalishlari qurg’oqchil hududlarda mahalliy dukkakli ekinlarning ekologik barqarorlik mexanizmlarini o‘rganish, yaylov ekotizimlarida uglerod yutilishini baholash va hisobga olish metodologiyasini ishlab chiqish kabi dolzarb ilmiy masalalarni qamrab oladi.

Biz Xitoylik hamkorlarimiz bilan yo‘lga qo‘yilgan ushbu ilmiy aloqalarni yuqori baholaymiz. Bunday loyihalar nafaqat ilmiy tajriba almashish, balki qo‘shma tadqiqotlar olib borish, yosh olimlarning salohiyatini oshirish va xalqaro ilmiy nashrlarda hamkorlikdagi natijalarni e’lon qilish uchun ham keng imkoniyat yaratadi.

Ishonchim komilki, mazkur loyiha institutimizning xalqaro ilmiy hamkorligini yanada mustahkamlash bilan birga, biologiya va ekologiya sohalarida yangi ilmiy natijalarga erishish uchun ham xizmat qiladi.

Hurmatli olimlar va anjuman ishtirokchilari!

Institutimizda ta’lim mazmunini zamon talablariga mos ravishda yangilashga ham alohida e’tibor qaratilmoqda. Jumladan, 2026/2027-o‘quv yilidan boshlab magistratura o‘quv rejasiga xalqaro tajribalar asosida ishlab chiqilgan “Aerobiologiya” fanining kiritilishi biologiya ta’limini yangi ilmiy yo‘nalishlar bilan boyitish yo‘lidagi muhim qadamlardan biridir.

Ushbu fan doirasida iqlim o‘zgarishi, xalqaro ma’lumotlar bazalari va bashorat modellashtirish masalalarining o‘rganilishi bo‘lajak mutaxassislarning zamonaviy bilim va ko‘nikmalarini rivojlantirishga xizmat qiladi.

Bizning asosiy maqsadimiz — xalqaro tajriba va milliy ilmiy maktablar yutuqlarini uyg’unlashtirgan holda, chuqur bilimli, mustaqil fikrlaydigan, ilmiy izlanishga qodir va zamonaviy texnologiyalarni puxta egallagan mutaxassislarni tayyorlashdir.

Bugungi xalqaro anjuman ana shu maqsadlarga erishishda muhim ilmiy maydon bo‘lib xizmat qiladi, deb ishonaman.

Anjuman davomida bildiriladigan ilmiy ma’ruzalar, munozaralar va takliflar yangi qo‘shma tadqiqotlar, xalqaro loyihalar, akademik almashinuv dasturlari hamda hamkorlikdagi ilmiy nashrlar uchun mustahkam asos yaratishiga umid qilaman.

Fursatdan foydalanib, anjumanni tashkil etishda mehnat qilgan Biologiya kafedrasi jamoasiga, barcha hamkor tashkilotlarga, xorijiy va mahalliy olimlarga, professor-o‘qituvchilarga hamda faol ishtirok etayotgan yosh tadqiqotchilarga samimiy minnatdorchiligimni bildiraman.

Aziz mehmonlar!

Sizlarni yana bir bor Samarqand davlat pedagogika institutida ko‘rib turganimizdan mamnunmiz. Samarqandning boy tarixiy merosi, ilm-fan va ma’rifat an’analari bugungi ilmiy muloqotlarimizga o‘zgacha ruh bag’ishlaydi, deb ishonaman.

Barchangizga mustahkam sog’liq, oilaviy farovonlik, ilmiy faoliyatingizda ulkan muvaffaqiyatlar va yangi kashfiyotlar tilayman.

Xalqaro ilmiy-amaliy anjumanimiz samarali munozaralar, mazmunli uchrashuvlar va istiqbolli hamkorliklarga boy bo‘lsin!

“Biologiya fanining zamonaviy rivojlanishi va uni o‘qitish metodikasining innovatsion yondashuvlari: fanlararo integratsiya va raqamli transformatsiya sari” mavzusidagi xalqaro ilmiy-amaliy anjumanni ochiq deb e’lon qilaman!

E’tiboringiz uchun rahmat!

Hurmat bilan,

Sh.Sh.Negmatova

Samarqand davlat pedagogika instituti rektori

I-SHU'BA

MOLEKULYAR BIOLOGIYA VA GENETIKANING ZAMONAVIY RIVOJLANISH TENDENSIYALARI

TERI LEYSHMANIOZINI LABORATOR DIAGNOSTIKASIDA MOLEKULYAR-GENETIK USULLARNI QO'LLASH SAMARADORLIGI

Sattarova Xulkar G'ayratovna

Samarqand davlat tibbiyot universiteti dotsenti, PhD.

SamDTU huzuridagi L.M. Isayev nomidagi MVYuPKITI

(93) 942 62 74, sattarova.xulkar@gmail.com

Annotatsiya. *Teri leyshmaniozi (TL) patogenlarini turlarga ajratish va ularning hududiy epidemiologik xususiyatlarini aniqlashda zamonaviy molekulyar-genetik usullarni qo'llash muhim ilmiy hamda amaliy ahamiyatga ega. Markaziy O'zbekistonning teri leyshmaniozi o'choqlaridan olingan klinik namunalar misolida Real-Time PZR, gel-elektroforez hamda sekvenirlash usullarini qo'llagan holda Leishmania turlarini identifikatsiyalash va filogenetik xususiyatlarini baholash muhumdir. Tadqiqot davomida Jizzax (35 ta), Samarqand (17 ta) va Navoiy (13 ta) viloyatlarida teri leyshmaniozi tashxisi qo'yilgan bemorlarning yarasidan olingan va mikroskopik tasdiqlangan 65 ta namuna tahlil qilindi. O'zbekistonda birinchi marta L. major va L. tropica turlarining 18S rRNK geni nukleotidlar ketma-ketligi to'liq aniqlandi.*

Abstract. *The application of modern molecular genetic methods is of great scientific and practical importance for the classification of cutaneous leishmaniasis (CL) pathogens and the identification of their regional epidemiological characteristics. Using clinical samples collected from cutaneous leishmaniasis foci in Central Uzbekistan, it is important to identify Leishmania species and assess their phylogenetic characteristics using Real-Time PCR, gel electrophoresis, and sequencing methods. In this study, 65 microscopically confirmed samples collected from skin lesions of patients diagnosed with cutaneous leishmaniasis in Jizzakh (35 samples), Samarkand (17 samples), and Navoi (13 samples) regions were analyzed. For the first time in Uzbekistan, the complete nucleotide sequences of the 18S rRNA genes of L. major and L. tropica were determined.*

Kalit so'zlar: *Teri leyshmaniozi, Leishmania major, Leishmania tropica, Real-Time PZR, 18S rRNK, sekvenirlash, GenBank.*

Dolzabligi. Teri leyshmaniozi — terida yaralar ko'rinishida kechadigan yuqumli kasallik bo'lib, inson salomatligi va ijtimoiy hayotga sezilarli ta'sir ko'rsatadi [4, 19 b.]. Kasallikning klinik shakllari turlicha bo'lib, ba'zi bemorlarda surunkali yoki murakkab yaralar rivojlanadi, bu esa kasmetik va psixologik muammolarni keltirib chiqaradi hamda davolashni qiyinlashtiradi. Shu

sababli, teri leyshmaniozini aniqlash va davolashni optimallashtirish uchun kasallikning patogenezini chuqur o‘rganish dolzarb hisoblanadi [1,2, 129 b.].

Teri leyshmaniozining klinikasi juda xilma-xil bo‘lib, qisqa vaqtda tuzaladigan teri yaralaridan tortib surunkali, uzoq vaqt tuzalmaydigan ko‘rinishlarda bo‘ladi. Bu asosan xo‘jayinning immun javobiga bog‘liq. Immunitetni boshqarishning asosiy vositachilari sifatida sitokinlar kasallikning rivojlanishi va to‘qimalarning shikastlanishini aniqlashda muhim rol o‘ynaydi [6,9, 39-78 b.].Immun tizimining javob reaksiyasi, yallig‘lanish jarayonlari, makrofaglar va limfotsitlarning faolligi kasallikning rivojlanishi, davomiyligi va davolanishiga katta ta’sir ko‘rsatadi [5,94 b.].

Dunyoda 350 millionga yaqin aholi teri leyshmanioziga uchraydigan hududlarda yashaydi [10, 122 b.]. Leyshmaniozning turli shakllari tropik va yarim tropik hududlarida 90 ga davlatlarda qayd etilgan. Har yili kamida 12 million kishi leyshmaniozning turli shakllaridan biri bilan kasallanadi[3, 294 b.]..

Teri leyshmaniozi tashxislash takomillashtirish, ZTL va ATL bilan zararlangan bemorlar qonidagi biokimyoviy ko‘rsatgichlarni taqqoslash va xulosalar chiqarish maqsadida mikroskopik usulda tasdiqlangan namunalar molekulyar biologik tahlil qilindi[7,8, 29 b.].

Tadqiqotning maqsadi: Markaziy O‘zbekistonning teri leyshmaniozi o‘choqlaridan olingan klinik namunalar asosida polimeraza zanjir reaksiyasi hamda sekvenirlash usullarini qo‘llab *Leishmania* turlarini identifikatsiyalash va filogenetik xususiyatlarini baholash.

Material va usullar: Tadqiqot davomida Jizzax (35 ta), Samarqand (17 ta) va Navoiy (13 ta) viloyatlarida teri leyshmaniozi tashxisi qo‘yilgan bemorlarning yarasidan olingan va mikroskopik tasdiqlangan 65 ta namuna tahlil qilindi. DNK ekstraksiyasi *QIAamp DNA Mini Kit* yordamida amalga oshirildi. Molekulyar-genetik tahlillar, Real-Time PZR va sekvenirlash tadqiqotlari Chexiyaning Ostrava universiteti mutaxassislari bilan hamkorlikda 18S rRNK geni asosida o‘tkazildi.

Tadqiqot natijalari. Teri leishmanioz tashxisi qo‘yilgan bemorlar yarasidan tayyorlangan preparatlar asosida olib borilgan tadqiqotimizda 65 ta namunada PZR diagnostikasi o‘tkazildi. Teri leyshmaniozining dastlabki tashxisi qo‘yilgan lekin Leishmania turlari haqida ma’lumotlar berilmagan edi. Leyshmaniya turlarini farqlashga qaratilgan molekulyar-genetik tadqiqotlarda maxsus “praymer”lardan foydalanildi.

Tadqiqot O‘zbekiston Respublikasi SamDTU huzuridagi L.M. Isayev nomidagi mikrobiologiya, virusologiya, yuqumli va parazitar kasalliklar ilmiy-tadqiqot institutida Ostrava (Chexiya Respublikasi) universitetida mutaxassislarining uslubiy yordami bilan o‘tkazildi. Real-Time PZR va sekvinatsiya (gen ketma-ketligi) usullaridan foydalanilgan. Tadqiqot davomida 65 ta namunadan 17 ta namuna ZTL qo‘zg‘atuvchisi L. major va 48 tasi ATL qo‘zg‘atuvchisi L.tropica

ekanligi tasdiqlangan. PZR usulida leishmania turiga xos genomik mintaqani aniqlaydi. PZR barcha Leishmania turlari uchun umumiy genomni o‘z ichiga olgan namunalarda amalga oshirildi.

Real-Time PZR natijalariga ko‘ra, 65 ta namunadan: 17 ta (26,2%) namuna zoonotik teri leyshmaniozi (ZTL) qo‘zg‘atuvchisi — Leishmania major ekanligi; 48 ta (73,8%) namuna antroponotik teri leyshmaniozi (ATL) qo‘zg‘atuvchisi — Leishmania tropica ekanligi tasdiqlandi.

Hududlar kesimida tahlil qilinganda: Jizzax viloyatida 35 ta namunadan 8 tasi ZTL (L. major), 27 tasi ATL (L. tropica), Samarqand viloyatida 17 ta namunadan 14 tasi ZTL (L. major), 3 tasi ATL (L. tropica), Navoiy viloyatida 13 ta namunadan 6 tasi ZTL (L. major), 7 tasi ATL (L. tropica) ekanligi aniqlandi Natijalarga ko‘ra, barcha hududlarda L. tropica ulushi yuqori bo‘lib, ayniqsa Jizzax viloyatida (27 ta) eng katta ko‘rsatkich qayd etilgan. L. major esa Jizzaxda 8 ta, Samarqandda 3 ta va Navoiyda 6 ta holatda aniqlangan. Olingan ma’lumotlar hududlar kesimida ATL shaklining ustunligini ko‘rsatadi va epidemiologik vaziyatni baholashda muhim ahamiyatga ega.

Teri leyshmaniozi qo‘zg‘atuvchilarini molekulyar-genetik jihatdan farqlash maqsadida tadqiqotlar leyshmaniyalarning 2 ta turidan olingan 18S ribosomal RNK (rS18) genining nukleotidlar ketma-ketligini hamda GenBank xalqaro ma’lumotlar bazasidan olingan mos ketma-ketliklarni solishtirish asosida olib borildi.

Teri leyshmaniozining asosiy qo‘zg‘atuvchilari hisoblangan Leishmania avlodiga mansub L. major va L. tropica turlarining GenBank ma’lumotlar bazasiga mos 18S rRNK nukleotidlar ketma-ketligini aniqlash O‘zbekistonda birinchi marta tadqiqotimiz davomida biz tomonimizdan amalga oshirildi. PZR usulida turlarga ajratilgan namunalarning molekulyar-genetik tahlil natijalariga ko‘ra GenBank ma’lumotlar bazasidagi ushbu turlarga mosligi tasdiqlandi.

Amplifikatsiyalangan DNK molekulalarini sekvinirlash 2 ta namunada amalga oshirilgan bo‘lib, *L. tropica va L. major*ning quyidagicha genetik ketma-ketlikda ekanligi aniqlandi va ushbu turlar klinik jihatdan mosligi isbotladi. Molekulyar genetik tahlil natijalari GenBank butun jahon malumotlar bazasiga joylashtirildi. Genetik tahlil o‘tkazish natijalari, biz tadqiqot olib borayotgan hududlarda teri leyshmaniozi qo‘zg‘atuvchilari hisoblangan *L.tropica* va *L.major* turlari klinik jihatdan mosligi isbotladi.

Xulosa. Markaziy O‘zbekistonning teri leyshmaniozi o‘choqlaridan (Samarqand, Jizzax va Navoiy viloyatlari) olingan klinik namunalardagi patogenlar PZR usulida turlarga ajratilganda, *Leishmania major* va *Leishmania tropica* izolyatlarining mintaqaviy sirkulyatsiyasi aniqlandi. Ushbu shtammlarning 18S ribosomal RNK geni nukleotidlar ketma-ketligi birinchi marta aniqlandi. Individual differensial davolash strategiyasini tanlashga qaratilgan takomillashtirilgan diagnostik algoritm ishlab chiqishda muhum ahamiyat kasb etdi.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI

1. Abduziev E. A., Kovalenko D. A., Ponomareva V. I. Epidemiologicheskaya situatsiya po kojnomu leyshmaniozu v Respublike Uzbekistan // Meditsinskaya parazitologiya i parazitarnye bolezni. — 2018. — № 2. — S. 21–25.

2. Almeida A. B. P. F., Steurer F. J., Strelow L. et al. Performance of a universal PCR assay to identify different Leishmania species causative of Old World cutaneous leishmaniasis // Parasites & Vectors. – 2020. – Vol. 13. – Article 431. DOI: 10.1186/s13071-020-04261-5

3. Burza S., Croft S. L., Boelaert M. Leishmaniasis // The Lancet. – 2018. – Vol. 392, No. 10151. – P. 951–970. DOI: 10.1016/S0140-6736(18)31204-2

4. Caetano G. F., Fronza M., Leite M. N., Gomes A., Frade M. A. C. Comparison of collagen content in skin wounds evaluated by biochemical assay and by computer-aided histomorphometric analysis // Pharmaceutical Biology. – 2016. – Vol. 54(11). – P. 2555–2559. DOI: 10.3109/13880209.2016.1170861

5. Campos T. M., Passos S. T., Novais F. O., Beiting D. P., Costa R. S., Queiroz A., Mosser D., Scott P., Carvalho E. M., Carvalho L. P. Matrix Metalloproteinase 9 Production by Monocytes is Enhanced by TNF and Participates in the Pathology of Human Cutaneous Leishmaniasis // PLOS Neglected Tropical Diseases. – 2014. – Vol. 8(11). – Article e3282. DOI: 10.1371/journal.pntd.0003282

6. Castes M., Trujillo D., Rojas E. et al. Interleukin-4 and interleukin-6 gene polymorphisms in cutaneous leishmaniasis susceptibility // The Journal of Infectious Diseases. – 2006. – Vol. 193, No. 6. – P. 888–895. DOI: 10.1086/500473

7. Sattarova X. G., Mahmudova L. B., Usarov G. X. Teri leyshmaniozida mikroelementlar va biriktiruvchi to‘qima metabolizmi ko‘rsatkichlarining diagnostik va prognostik ahamiyati // O‘zbekiston tibbiyot jurnali. – 2023. – № 3. – B. 54–60.

8. Tolibova Sh. E. Teri leishmaniozni tashxislashda mikroskopik tekshirish usullaridan foydalanish // Qo‘qon DPI. Ilmiy xabarlar. – 2025. – № 4. – B. 443–448.

9. Tolibova Sh. E., Sattarova Kh. G., Eshkuvatov S. Evaluation of the analysis of quantitative changes in cytokines in the blood of patients with cutaneous leishmaniosis in the central and southern regions of Uzbekistan // International Journal of Genetic Engineering. – 2025. – Vol. 13(9). – P. 212–214.

10. Tolibova Sh. E., Sattarova X. G. Molecular-genetic analysis of the causes of terminal cutaneous leishmaniosis in the samarkand district of samarkand region // Xorazm Ma'mun akademiyasi Axborotnomasi. – 2025. – № 5/1. – P.

IZOPRENALIN BILAN CHAQIRILGAN YURAK ISHEMIYASIDA KALAMUSHLAR QON KO‘RSATKICHLARINING O‘ZGARISHLARI

[1,2]Mirzayeva M.X., [1]Qo‘chqorov Sh.Ya., [1]Tojikulova O.J.

[1]Sharof Rashidov nomidagi Samarqand davlat universiteti, Samarqand, O‘zbekiston

[2]Shahrisabz davlat pedagogika instituti, Shahrisabz, O‘zbekiston

mirzayeva.m0912@gmail.com

Tel: +99899 092 81 26

Annotatsiya. *Ushbu maqolada izoprenalin yordamida eksperimental yurak ishemiyasi chaqirilgan kalamushlarda periferik qon ko‘rsatkichlarining o‘zgarishlari o‘rganildi. Tadqiqotda tajriba hayvonlarida izoprenalin ta’sirida yuzaga keladigan gematologik o‘zgarishlar, jumladan eritrotsitlar, gemoglobin, leykotsitlar va boshqa qon ko‘rsatkichlarining dinamikasi tahlil qilindi. Yurak mushaklarining ishemik shikastlanishi organizmning umumiy stress javobi va gemostatik holatiga ta’sir ko‘rsatishi mumkin. Olingan natijalar izoprenalin bilan chaqirilgan miokard shikastlanishining tizimli gematologik javob bilan kechishini ko‘rsatishga qaratilgan.*

Kalit so‘zlar: *izoprenalin, yurak ishemiyasi, miokard shikastlanishi, kalamush, qon, eritrotsit, gemoglobin, leykotsit, eksperimental model.*

Abstract. *This article studies changes in peripheral blood parameters in rats induced by experimental cardiac ischemia with isoprenaline. The study analyzed the dynamics of hematological changes in experimental animals under the influence of isoprenaline, including the dynamics of erythrocytes, hemoglobin, leukocytes, and other blood parameters. Ischemic damage to the heart muscle can affect the overall stress response and hemostatic state of the body. The results obtained are aimed at demonstrating that myocardial injury induced by isoprenaline is accompanied by a systemic hematological response.*

Keywords: *isoprenaline, cardiac ischemia, myocardial injury, rat, blood, erythrocyte, hemoglobin, leukocyte, experimental model.*

Kirish.Yurak-qon tomir kasalliklari butun dunyo bo'ylab o'limning asosiy sababi bo'lib qolmoqda. Ishemik yurak kasalliklari orasida miokard infarkti (MI) xavotirli ahamiyatga ega ekanligi aniqlangan. Dunyo bo'ylab o'limning asosiy sabablari va jiddiy sog'liqni saqlash muammosi orasida yurak inson tanasidagi muhim organ hisoblanadi; u yurak-qon tomir kasalliklari (YKK), ya'ni yurak yoki qon tomirlariga ta'sir qiluvchi kasalliklar spektri bilan qamrab olingan: Ishemiya tufayli yurak mushagi nekrozi miokard infarktini (MI) tavsiflaydi, bu koronar arteriyalarning tiqilib qolishi natijasida yuzaga keladi va yurak mushaklari disfunktsiyasiga olib keladi[1].

Miokard infarkti (MI) ishemik yurak kasalligining (YYK) keng tarqalgan ko'rinishidir. MI rivojlangan mamlakatlarda o'limning asosiy sababi bo'lib qolmoqda va koronar arteriya kasalliklarini (KAR) davolashda ko‘p yutuqlarga qaramay, butun dunyo bo'ylab asosiy patologik muammo hisoblanadi [2;3]. Bu miokard metabolik talabining ortishi va miokardga koronar qon aylanishi orqali kislorod va ozuqa moddalarining kamayishi natijasida yuzaga keladi, bu esa hujayra shikastlanishiga olib keladi[4]. MI nafaqat g'arb mamlakatlarida, balki rivojlanayotgan mamlakatlarda ham tobora ko'proq sog'liqni saqlashning asosiy muammosi bo'lib qolmoqda, bu yerda u o'limga sezilarli darajada hissa qo'shadi [3;5]. Har yili dunyo bo'ylab taxminan 16,7 million kishi miokard infarktidan vafot etadi (JSST 2004), bu global o'limning uchdan bir qismini tashkil qiladi. MI yurakka qon oqimi ichki arterial devorda blyashka (yog'li birikmalar) hosil bo'lishi tufayli cheklanganida yuzaga keladi, bu esa kislorod yetarli bo'lmasligiga va keyinchalik yurak mushaklarining shikastlanishiga olib keladi[6].

Tadqiqot obekti va qo‘llanilgan metodlar. Tajribalar *in vivo* sharoitida amalga oshirildi. Tajribalar uchun zotsiz, tana og’irligi 180-200 g bo‘lgan kalamushlar tanlab olindi va 5 tadan kattaligi 50x30x28 sm bo‘lgan plastmassa kataklarga joylashtirildi. Laboratoriya hayvonlarini oziqlantirish standart ratsional vivariy sharoitda olib borildi.

Hayvonlarga 4 hafta davomida faqat distillangan suv berildi va keyin 2 kun davomida (29 va 30-kunlarda) ISO in'ektsiyasi (45 mg/kg) bilan davolandi. ISO (45 mg) oddiy fiziologik eritmada (1 ml) eritildi va eksperimental MI ni qo'zg'atish uchun kalamushlarga 24 soatlik interval bilan 2 kun davomida teri ostiga (teri ostiga) yuborildi.

Tadqiqot davomida tajriba guruhidagi kalamushlardan periferik qon namunasi olindi. Olingan qon namunalarining gematologik ko‘rsatkichlari avtomatlashtirilgan Mindray BC-5000 gematologik analizatori yordamida tekshirildi. Tadqiqotda sog‘lom kalamushlar qoni ko‘rsatkichlari izoprenalin bilan chaqirilgan miokard ishemiyasi modeli hosil qilingan kalamushlar qon ko‘rsatkichlari bilan taqqoslandi.

Olingan natijalarga ko‘ra, izoprenalin bilan chaqirilgan ishemiya guruhida eritrotsitar ko‘rsatkichlarda ayrim o‘zgarishlar kuzatildi. Xususan, eritrotsitlar soni (RBC) nazorat guruhiga nisbatan, ishemiya guruhida 14,06% ga oshdi.

Gemoglobin (HGB) miqdori nazorat guruhida 160 g/L bo‘lgan bo‘lsa, izoprenalin yuborilgan guruhda 180 g/L ni tashkil etdi. Bu ko‘rsatkich 12,5% ga oshganini ko‘rsatadi. Gematokrit (HCT) qiymati ham mos ravishda 37,5% dan 40,1% gacha, ya’ni 6,9% ga oshdi. Leykotsitar ko‘rsatkichlar tahlili izoprenalin ta’sirida yallig‘lanish, stress javobi kuchayganligini ko‘rsatuvchi o‘zgarishlarni namoyon qildi. Trombotsitlar (PLT) ko‘rsatkichida eng katta o‘zgarish kuzatildi.

Umuman olganda, olingan natijalar izoprenalin bilan chaqirilgan miokard ishemiyasi sharoitida kalamushlarning periferik qonida eritrotsitar, leykotsitar va trombotsitar ko‘rsatkichlarning o‘zgarishini ko‘rsatdi. Ayniqsa, HGB, RBC, HCT, WBC va PLT ko‘rsatkichlaridagi o‘zgarishlar ishemik jarayon fonida qon tizimining javob reaksiyasini baholashda muhim ahamiyatga ega.

Xulosa: Ushbu ishda izoprenalin keltirib chiqargan miokard infarktining kardioprotektiv ta'siri ta'kidlangan va umumlashtirilgan. Yuqoridagi tadqiqotdan biz xulosa qilamizki, izoprenalin eksperimental hayvonlar modellarida miokard infarktini qo'zg'atish uchun samarali vosita bo'lib xizmat qiladi. Izoprenalin yordamida chaqirilgan eksperimental yurak ishemiyasi kalamushlar periferik qonining bir qator gematologik ko‘rsatkichlarida sezilarli o‘zgarishlarni yuzaga keltirdi.

FOYDALANILGAN ADABIYOTLAR:

1.Imran B, Mahmood T, Ahsan F, Bano S, Ansari VA, Adnan M. Biomarkers for the estimation of isoproterenol-induced myocardial infarction: a review of key parameters. *J Intell Med*. 2026; 3(1): 47-68. https://doi.org/10.1002/jim4.70022

2.Boudina S, Laclau MN, Tariosse L, Daret D, Gouverneur G, Bonoron-Adèle S, Saks VA, Dos Santos P. Alteration of mitochondrial function in a model of chronic ischemia in vivo in rat heart. Am J Physiol Heart Circ Physiol. 2002 Mar;282(3):H821-31. doi: 10.1152/ajpheart.00471.2001. PMID: 11834475.

3.Khalil MI, Ahmmed I, Ahmed R, Tanvir EM, Afroz R, Paul S, Gan SH, Alam N. Amelioration of Isoproterenol-Induced Oxidative Damage in Rat Myocardium by Withania somnifera Leaf Extract. Biomed Res Int. 2015;2015:624159. doi: 10.1155/2015/624159. Epub 2015 Oct 11. PMID: 26539517; PMCID: PMC4619872.

4.Mohanty I, Arya DS, Dinda A, Talwar KK, Joshi S, Gupta SK. Mechanisms of cardioprotective effect of Withania somnifera in experimentally induced myocardial infarction. Basic Clin Pharmacol Toxicol. 2004 Apr;94(4):184-90. doi: 10.1111/j.1742-7843.2004.pto940405.x. PMID: 15078343.

5.Sabeena Farvin KH, Anandan R, Kumar SH, Shiny KS, Sankar TV, Thankappan TK. Effect of squalene on tissue defense system in isoproterenol-induced myocardial infarction in rats. Pharmacol Res. 2004 Sep;50(3):231-6. doi: 10.1016/j.phrs.2004.03.004. PMID: 15225664.

6.Dey Parama, Monikongkona Boruah, Kumari Yachna, Varsha Rana, Kishore Banik, Choudhary Harsha, Krishan Kumar Thakur, Uma Dutta, Aditya Arya, Xinliang Mao, Kwang Seok Ahn, Ajaikumar B. Kunnumakkara, Diosgenin, a steroidal saponin, and its analogs: Effective therapies against different chronic diseases,Life Sciences,Volume 260,2020,118182,ISSN 0024-3205, https://doi.org/10.1016/j.lfs.2020.118182.

PEROXIDASE ENZYME ACTIVITY IN BEAN SEEDS STORED UNDER VARIOUS CONDITIONS

Abdusalomova Z.R. – Independent Researcher, Samarkand State University named after Sharof Rashidov; *zarifaabdusalomova1994@gmail.com*

Sanakulov A.L. – Doctor of Agricultural Sciences, Professor, Samarkand State University named after Sharof Rashidov; *sanakulov1975@gmail.com*

Annotatsiya. *Mazkur maqolada turli namlik va harorat sharoitlarida saqlangan oddiy loviya (Phaseolus vulgaris L.) urug‘larida peroksidaza fermenti faolligining o‘zgarishi tahlil qilingan. Tadqiqotda urug‘larning 8%, 10%, 12% va 14% namlik darajalarida, +5°C, +15°C va +25°C harorat sharoitlarida 1, 4, 7, 10 va 13 oy davomida saqlanishi jarayonida ferment faolligining o‘zgarishi o‘rganilgan. Natijalar saqlash muddati uzayishi bilan barcha tajriba variantlarida peroksidaza fermenti faolligi pasayib borganini ko‘rsatdi. Ferment faolligining pasayishi eng yuqori haroratda (+25°C) nisbatan tez kechgan bo‘lsa, past haroratda (+5°C) uning faolligi yaxshiroq saqlangan. Xususan, urug‘ namligi 14% va saqlash harorati +25°C bo‘lgan sharoitda 13 oydan so‘ng peroksidaza faolligi dastlabki 35,2 qiymatdan 15,7 µmol H_2O_2/min/mg oqsilgacha kamaygan. Bu natijalar loviya urug‘larini saqlash jarayonida harorat va namlik fermentativ jarayonlarga sezilarli ta’sir ko‘rsatishini tasdiqlaydi. Tadqiqot natijalari loviya urug‘larining fiziologik va biokimyoviy xususiyatlarini saqlab qolish uchun maqbul saqlash sharoitlarini tanlashda muhim ahamiyatga ega.*

Kalit so‘zlar. *oddiy loviya, Phaseolus vulgaris L., urug‘, saqlash sharoitlari, peroksidaza fermenti, ferment faolligi, oksidlanish-qaytarilish jarayonlari, harorat, namlik, urug‘ sifati, fiziologik-biokimyoviy jarayonlar.*

Abstract. *This article analyzes changes in peroxidase enzyme activity in bean (*Phaseolus vulgaris* L.) seeds stored under various moisture and temperature conditions. The study examined enzyme activity across seed moisture levels of 8%, 10%, 12%, and 14% and temperatures of +5°C, +15°C, and +25°C over storage periods of 1, 4, 7, 10, and 13 months. The results showed that peroxidase enzyme activity declined in all variants as the storage period extended. While the decline in enzyme activity was relatively rapid at the highest temperature (+25°C), activity was better preserved at the lower temperature (+5°C). Specifically, under conditions of 14% seed moisture and a temperature of +25°C, peroxidase activity decreased from an initial 35.2 to 15.7 µmol H_2O_2/min/mg protein after 13 months. This confirms that temperature and moisture significantly influence enzymatic processes during bean seed storage. The study's findings are important for selecting optimal conditions to preserve the physiological and biochemical properties of bean seeds.*

Keywords.*Common bean, *Phaseolus vulgaris* L., seed, storage conditions, peroxidase enzyme, enzyme activity, redox processes, temperature, moisture, seed quality, physiological-biochemical processes.*

Peroxidase is an oxidoreductase enzyme that plays a crucial role in the antioxidant defense system of plant cells. It prevents the excessive accumulation of reactive oxygen species (ROS) within cells by decomposing hydrogen peroxide (H_2O_2) in the presence of phenolic substrates. Additionally, peroxidase is involved in processes such as cell wall lignification, the oxidation of phenolic compounds, the maintenance of membrane stability, and physiological adaptation to stress factors. Changes in the activity of this enzyme during long-term seed storage serve as a key biochemical indicator of seed aging.

Experimental results indicate that peroxidase activity consistently declined across all variants as the storage period increased. However, the rate of this decline varied significantly depending on seed moisture content, storage temperature, and the duration of storage.

Under the optimal storage conditions—8% seed moisture and a temperature of +5°C—peroxidase activity measured 28.4 µmol H_2O_2/min/mg protein during the first month and dropped to 20.2 µmol H_2O_2/min/mg protein after 13 months of storage. This reduction represented a 28.9% decrease relative to the initial value. Thus, under low-temperature conditions, the antioxidant enzyme system remains relatively stable, and the enzyme's functional activity is maintained at a high level over an extended period.

When the temperature was raised to +15°C, peroxidase activity at this moisture level amounted to 15.0 µmol H_2O_2/min/mg protein by the end of the 13th month. This represents a 47.0% decrease compared to the figure recorded in the first month. At a temperature of +25°C, however, enzyme activity dropped to 9.9 µmol H_2O_2/min/mg protein, a decline of 64.9% relative to the initial value. This indicates that the antioxidant enzyme system undergoes more rapid inactivation under the influence of higher temperatures.

An increase in seed moisture content also significantly influenced enzyme dynamics. For instance, after 13 months of storage at +25°C, peroxidase activity measured 9.9, 12.4, 14.0, and 15.7 µmol H_2O_2/min/mg protein at moisture levels of 8%, 10%, 12%, and 14%, respectively. Although the absolute values were high, it is worth noting that the initial enzyme activity in these variants was also high. Relative calculations indicate that enzyme activity declined by 44–65% during storage, reflecting a gradual weakening of the antioxidant system.

The effect of storage duration was particularly evident under high-temperature conditions. Specifically, for the variant with 14% moisture and a temperature of +25°C, it was found that peroxidase activity—initially 35.2 µmol H_2O_2/min/mg protein—declined to 28.2 after 4 months,

24.3 after 7 months, 19.6 after 10 months, and 15.7 µmol H_2O_2/min/mg protein after 13 months. This represents a reduction in enzyme activity of approximately 55%.In contrast, the decline in enzyme activity was significantly slower at +5°C. For instance, at 14% moisture, peroxidase activity decreased from 36.0 to 24.4 µmol H_2O_2/min/mg protein, a relative reduction of 32.2%. This indicates that the denaturation and oxidation of enzyme proteins proceed much more slowly at low temperatures.

1 -Table

Peroxidase activity in bean seeds stored under various conditions (µmol H_2O_2/min/mg protein)

No.	Seed moisture, %	Temperature, °C	Storage period, months				
			1	4	7	10	13
1	8	+5	28,4±2,59	26,4±2,71	24,2±2,20	22,4±2,10	20,2±2,14
2		+15	28,3±2,71	24,4±2,07	21,3±1,98	18,0±1,63	15,0±1,56
3		+25	28,2±2,78	22,8±1,46	18,0±1,48	14,0±1,18	9,9±1,80
4	10	+5	30,5±2,69	28,6±2,50	25,4±2,36	22,5±2,07	20,5±2,12
5		+15	30,3±3,10	26,3±2,64	23,0±2,02	19,0±1,92	16,1±1,64
6		+25	30,1±2,78	24,2±2,37	20,0±2,13	16,1±1,47	12,4±1,34
7	12	+5	32,5±2,80	30,4±2,90	27,3±2,56	24,3±2,26	22,5±1,94
8		+15	32,3±3,11	28,5±2,09	25,0±2,49	21,2±2,17	18,3±1,72
9		+25	32,1±2,39	26,4±2,41	22,1±2,25	18,1±1,80	14,0±1,30
10	14	+5	36,0±2,86	32,3±2,27	29,1±2,33	26,3±2,30	24,4±2,18
11		+15	35,4±3,04	30,5±2,52	26,3±2,22	22,3±2,24	19,1±2,08
12		+25	35,2±2,87	28,2±2,73	24,3±2,18	19,6±2,02	15,7±1,12

The obtained results showed a close correlation with the previously analyzed dynamics of catalase and malondialdehyde (MDA). As the storage period increased, MDA levels rose steadily, whereas catalase and peroxidase activities declined. For instance, under conditions of 8% moisture and +5°C, MDA increased from 0.12 to 0.25 µmol/g, while catalase activity dropped from 35.2 to 24.1 and peroxidase activity from 28.4 to 20.2 µmol H_2O_2/min/mg protein. Under the most

unfavorable conditions—14% moisture and +25°C—MDA rose to 0.62 µmol/g, while catalase and peroxidase activities fell to 21.8 and 15.7 µmol H_2O_2/min/mg protein, respectively. These indicators clearly confirm that the free-radical oxidation of membrane lipids intensified as a result of the decline in antioxidant enzyme activity.

From a physiological perspective, this phenomenon is explained as follows: metabolic processes in seeds do not cease completely during storage. Increases in moisture and temperature intensify respiration, leading to greater production of reactive oxygen species within mitochondria. Initially, catalase and peroxidase serve to neutralize these compounds. However, prolonged storage results in the oxidation of enzyme proteins, the disruption of their tertiary structure, and a decline in the activity of enzymatic centers. Consequently, H_2O_2 and other free radicals accumulate, lipid peroxidation intensifies, membrane permeability increases, and the physiological integrity of the cells is compromised.

Analyses indicate that the activities of catalase and peroxidase enzymes declined in tandem during storage, with their dynamics showing an inverse correlation with MDA levels. This pattern confirms the functional link between the weakening of the antioxidant defense system and the intensification of oxidative stress.

Overall, the study results demonstrate that peroxidase enzyme activity is a highly informative biochemical indicator for assessing the physiological aging and storage quality of bean seeds. Storing seeds at a temperature of +5°C and 8–10% moisture content helps maintain relatively stable peroxidase activity, thereby ensuring the effectiveness of the antioxidant defense system. Conversely, the sharp decline in enzyme activity observed at +25°C and 12–14% moisture is a primary biochemical factor contributing to increased oxidative stress, accelerated lipid peroxidation, and reduced physiological viability of the seeds.

When evaluated alongside data on catalase and MDA, these results comprehensively reveal the complex physiological relationships between the antioxidant enzyme system and lipid peroxidation during the storage of bean seeds; furthermore, they hold significant theoretical and practical value for the scientific substantiation of long-term seed storage technology.

Conclusion.The results of this study revealed changes in peroxidase enzyme activity in common bean (Phaseolus vulgaris L.) seeds stored under different moisture and temperature conditions over various storage periods. The data indicated that seed moisture content, storage temperature, and storage duration influenced peroxidase activity.

In all experimental treatments, peroxidase activity decreased as the storage period increased from 1 to 13 months. The highest value was recorded in seeds with a moisture content of 14% stored at +5 °C after 1 month, reaching 36.0 ± 2.86 µmol H2O2/min/mg protein. The lowest value

was observed in seeds with a moisture content of 8% stored at +25 °C for 13 months, reaching 9.9 ± 1.80 µmol H2O2/min/mg protein.The results showed that storage at higher temperatures was associated with a more rapid decline in peroxidase activity. In particular, seeds stored at +5 °C maintained higher peroxidase activity than those stored at +15 °C and +25 °C. Furthermore, higher seed moisture content was associated with higher initial peroxidase activity. However, this finding alone is insufficient to independently assess the overall physiological quality of the seeds.

REFERENCES

1. Alimova R.A., Sag‘diyev M.T. O‘simliklar fiziologiyasi va biokimyosi. – Toshkent: Fan, 2013. – 268 b.

2. Bailly C., Audigier C., Ladonne F., Wagner M.-H., Coste F., Corbineau F., Côme D. Changes in oligosaccharide content and antioxidant enzyme activities in developing bean seeds as related to acquisition of drying tolerance and seed quality. // Journal of Experimental Botany. – 2001. – Vol. 52, No. 357. – P. 701–708.

3. Egamov X., Kimsanov I. Qishloq xo‘jalik ekinlari urug‘chiligi va urug‘shunosligi. – Toshkent, 2019.

4. Jo‘rayev S.T., Xudarganov K.O. Qishloq xo‘jaligi urug‘chiligi va urug‘shunosligi. – Toshkent: Lesson Press, 2022. – 168 b.

5. Kermasha S., Alli I., Metche M. Changes in peroxidase activity during the development and processing of Phaseolus vulgaris cv. haricot seed. // Journal of Food Science. – 1988. – Vol. 53, No. 6. – P. 1753–1755.

6. Mujica M.V., Soto N. Relación de la peroxidasa con el endurecimiento de los granos de Phaseolus vulgaris L. y su cinética de inactivación térmica. // Revista de la Facultad de Agronomía. – 2017. – Vol. 34, No. 3. – P. 325–347.

7. Raxmatov N.A., Mahmudov T.M., Mirzayev S. Biokimyo. – Toshkent: Ta’lim nashriyoti, 2012. – 528 b.

8. Rivera J.A., Hohlberg A.I., Aguilera J.M., Plhak L.C., Stanley D.W. va boshqalar. Hard-to-cook defect in black beans: peroxidase characterization and effect of heat pretreatment and storage conditions on enzyme inactivation. // Canadian Institute of Food Science and Technology Journal. – 1989. – Vol. 22, No. 3. – P. 270–275.

SAMARQAND VILOYATIDA OIV INFEKSIYASINI XOLATINI EPIDEMIOLOGIK BAXOLASH.

Murodkosimov Saydolim,

Samarqand davlat pedogogika instituti biologiya kafedrasi dotsenti.

Elmirzayeva Sabohat

Samarqand davlat pedogogika instituti magistir.

Annotatsiya. *Mazkur tadqiqotda Samarqand viloyatida OIV infeksiyasining epidemiologik holati 2025–2026-yillarning dastlabki sakkiz oyi misolida tahlil qilindi. Viloyat OITSga qarshi kurashish markazining statistik ma'lumotlariga ko'ra, 2025-yilda 282 nafar, 2026-yilda esa 222 nafar OIV infeksiyasi bilan kasallangan shaxs ro'yxatga olingan. Holatlar soni 21,3 foizga kamaygan. Tadqiqot natijalari OIV infeksiyasining oldini olish, tibbiy tekshiruvlarni takomillashtirish va sanitariya-ma'rifiy ishlarni kuchaytirish muhimligini ko'rsatadi.*

Kalit so'zlar: *OIV infeksiyasi, epidemiologiya, Samarqand viloyati, profilaktika, tibbiy tekshiruv.*

Abstract. *This study analyzes the epidemiological situation of HIV infection in Samarkand Region during the first eight months of 2025 and 2026. According to regional AIDS center statistics, 282 cases were registered in 2025 and 222 in 2026, representing a 21.3% decrease. The findings highlight the importance of HIV prevention, improved medical testing, and strengthened public health education.*

Keywords: *HIV infection, epidemiology, Samarkand Region, prevention, medical testing.*

	Shahar va tuman	2025yil 8 oylik				2026 yil 8 oylik			
		Jami	Erkak	Ayol	Shundan 18 yoshgacha bo’lgan bolalar	Jami	Erkak	Ayol	Shundan 18 yoshgacha bo’lgan bolalar
1	Samarqand sh	63	31	32	2	44	28	16	1
2	Kattaqo’rg’on sh	15	10	5		7	4	3	
3	Bulg’ur t	10	5	5		9	7	2	
4	Jomboy t	11	7	4	1	5	4	1	
5	Ishtixon t	12	8	4		15	12	3	1
6	Kattaqo’rg’on t	18	8	10		22	16	6	
7	Qo’shrabot t	4	3	1		1	1		
8	Narpay t	11	7	4	1	9	6	3	1
9	Nurobot t	3	2	1		8	6	2	
10	Oqdaryo t	14	8	6		13	7	6	
11	Payariq t	12	7	5	2	5	4	1	
12	Pastdarg’om t	24	18	6	1	22	13	9	1
13	Paxtachi t	12	8	4		7	6	1	1
14	Samarqand t	17	10	7		19	17	2	
15	Tayloq t	16	13	3		9	6	3	
16	Urgut t	40	20	20	1	27	19	8	1
	Jami	**282**	**165**	**117**	**8**	**222**	**156**	**66**	**6**

Mavzuning dolzarbligi. Keyingi yillarda OIV infeksiyasini o‘rganish muxim axamiyatga ega,ayniqsa uning dolzarbligi targibot ishlarini jamoalar orasida olib borishni yaxshi yulga kuyilsa xam OIV yukumli kasalliklar soni yildan yilga oshmoqda.Ushbu kasallikning etiologik sabablari turlicha bulib axoli orasida ko‘plab kuzatilmokda.OIV infeksiyasi Samarkad viloyatida tarkalishi xar 100000 axoli soniga nisbatan 2025 yilning sakkiz oyligida 282 ni tashkil etgan bulsa, 2026 yilga kelib 222 ni kursatib, ozroq kamayganligini kursatmoqda.

Tadqiqotning maqsadi: Viloyat axolisi orasida OIV kasalliklarni xolatini epidemik baxolashdan iboratdir.

Material va metodlar: Viloyat axolisini infeksiyasi bilan xisobga olinishini Viloyat OITSga karshi kurashish markazi statistik ma’lumotlari asosida o‘rganildi (2025-2026 yillar).

Tadqiqot natijalari. Viloyatda 2026 yilda 222 nafar ro‘yxatga olingan,shundan 156 nafari erkak va 66 nafari ayellar tashkil etgan.2025 yilda esa 282 nafar dan 165 tasi erkak va 117 tasi ayellardir.Kasallik erkaklar orasida kuprok tarkalganligi maьlam bulmokda. Kasallikni asosiy kismi jinsiy yul bilan utmokda. Kasallikni keyingi yillarda kammayishini asosiy sabablaridan biri jamoalar orasida targibotni kupaytirilish va Samarqand viloyatida OIV infeksiyasi bilan kasalllanganlarning solishtirma taxlili 2025-2026 yil 8 oylik tibbiy tekshiruvlarni yaxshi yulga kuyilganligidir. Bundan tashkari sanitariya targ’ibot ishlarini yeshlar orasitda, ayniksa, talabalar orasida mukummal yulga kuyilishi evaziga ruy bermokda. Bu kuyidagi jadvalda kursatilgan.

Xulosa. OIV infeksiyasi 2026 yilda o’tgan yilga nisbatan kamaygan. Bu esa kasalliklarga qarshi prafilaktik kompleks chora-tadbirlar rejasi ijrosi joylarda yaxshi taminlanganligini ko’rsatadi.2.Viloyatda ro’yxatga olingan OIV infeksiyasi erkaklar orasida ko‘p tarqalgandir. Bu esa erkak migrantlarning chetga chikishi ko’pligidan dalolat beradi.

FOYDALANILGAN ADABIYOTLAR.

1. Онищенко Г.Г. Заболеваемость острыми кишечными инфекциями в Российской Федерации. Иммунология. 2008; 1: 18—23. [Onishchenko G.G. Incidence of acute intestinal infections in the Russian Federation. Иммунология 2008; 1:18—23. (in Russ.)]

2. Миндлина А.Я. Заболеваемость кишечными инфекциями в России. Вестник РАМН. 2010; 11: 30—33. [Mindlina A.Ya. Incidence of intestinal infections in Russia. Vestnik RAMN. 2010; 11: 30—33. (in Russ.)]

3. Лобзин Ю.В., Рачкова С.В., Скрипченко Н.В., Усков А.Н., Федоров В. В. Динамика инфекционной заболеваемости у детей в Российской Федерации в 2017—2018 годах. Медицина экстремальных ситуаций. 2019; 21(3): 340 — 350. [Lobzin YU.V., Rachkova S.V., Skripchenko N.V., Uskov A.N., Fedorov V.V. Dynamics of infectious diseases in children in the

Russian Federation in 2017—2018. Medicina Ekstremal'nyh Situacij. 2019; 21(3): 340—350. (in Russ.)]

4. Fischer T.K., Viboud C., Parashar U., Malek M. et al. Hospitalizations and deaths from diarrhea and rotavirus among children < 5 years of age in the United States, 1993—2003. J. Infect. Dis. 2007; 195: 1117—1125.

5. Кветная А.С., Бехтерева М.К., Железнова Л.И., Калиногорская О.С. Вирусные и бактериальные кишечные инфекции у детей. СПб., 2011. [Kvetnaya A.S., Bekhtereva M.K., Zheleznova L.I., Kalinogorskaya O.S. Viral and bacterial intestinal infections in children. SPb.: 2011. (in Russ)]

6. Колачевская К.А., Заварцева Л.И., Молочный В.П. Клиникоэпидемиологическая характеристика острых кишечных инфекций у детей раннего возраста г. Хабаровска. Дальневосточный медицинский журнал. 2016; 3:41—44. [Kolachevskaya K.A., Zavarceva L.I., Molochnyj V.P. Clinical and epidemiological characteristics of acute intestinal infections in children of early age of Khabarovsk. Dal'nevostochnyj Medicinskij Zhurnal. 2016;3:41—44. (in Russ)]

ПАТОФИЗИОЛОГИЧЕСКИЕ МЕХАНИЗМЫ НАРУШЕНИЯ ВЫДЕЛИТЕЛЬНОЙ ФУНКЦИИ ПОЧЕК И ЗАДЕРЖКИ АЗОТИСТЫХ МЕТАБОЛИТОВ ПОД ВЛИЯНИЕМ РААС У ДОМАШНИХ ЖИВОТНЫХ

Азербайджанский Государственнэ8хщый Аграрный Университет

Факультет Ветеринарной медицины

OCIDD ID:0009-0002-1846-8034

Хасанов Гасан, студент 4-го курса бакалавриата

hesenowhesen544@gmail.com

Салахова Эмилия, студентка 3-го курса бакалавриата

emiliyasalahova7@gmail.com

Научный руководитель: **старший преподаватель Улдуз Сафарова**

ulduzsafarova63@gmail.com

Annotatsiya. *Uy hayvonlarida o‘tkir buyrak shikastlanishi (O‘BSh) buyrak gemodinamikasining buzilishi, koptokchalar filtratsiyasi tezligining (KFT) keskin pasayishi va ajratish funksiyasining izdan chiqishi bilan kechadi. Ushbu jarayonlarning asosiy patogenetik bo‘g‘ini renin–angiotenzin–aldosteron tizimining (RAAT) haddan tashqari faollashuvi bo‘lib, u tomirlar spazmi, buyrak parenximasining ishemiyasi va koptokchalarning filtratsiya yuzasi*

qisqarishiga olib keladi. RAAT ta'sirida KFTning pasayishi metabolitlarning chiqarilishini cheklab, azotemiyaning rivojlanishiga sabab bo'ladi. Bu holat kreatinin, mochevina va fosforning organizmda to'planishi bilan namoyon bo'ladi. Mazkur ishda RAATdagi neyrogumoral muvozanat buzilishi natijasida azotli chiqindi moddalar tutilib qolishi va elektrolitlar muvozanati buzilishiga olib keluvchi gemodinamik hamda kanalchaviy mexanizmlar tizimlashtirilgan.

Kalit so'zlar: *o'tkir buyrak shikastlanishi, renin–angiotenzin–aldosteron tizimi, RAAT, biomarkerlar, angiotenzin II, kreatinin, buyrak kasalliklari diagnostikasi.*

Аннотации. *Острое повреждение почек (ОПП) у мелких домашних животных сопровождается расстройством почечной гемодинамики, резким падением скорости клубочковой фильтрации (СКФ) и нарушением выделительной функции. Ключевым патогенетическим звеном этих процессов выступает гиперактивация ренин-ангиотензин-альдостероновой системы (РААС), индуцирующая вазоспазм, ишемию почечной паренхимы и сокращение фильтрационной поверхности клубочков. Опосредованное РААС падение СКФ приводит к блокированию элиминации метаболитов и развитию азотемии, выражающейся в системной аккумуляции креатинина, мочевины и фосфора. В аннотируемой работе систематизированы гемодинамические и канальцевые механизмы, посредством которых нейрогуморальный дисбаланс РААС вызывает задержку азотистых шлаков и электролитные нарушения у домашних животных.*

Ключевые слова: *острое повреждение почек, ренин-ангиотензин-альдостероновая система, РААС, биомаркеры,ангиотензин II, креатинин, диагностика заболеваний почек.*

Введение

Острое повреждение почек (ОПП) у мелких домашних животных представляет собой полиэтиологический патологический процесс ишемического, токсического или инфекционного генеза, способный быстро прогрессировать в острую почечную недостаточность (ОПН). Данное состояние характеризуется стремительным нарастанием азотемии, падением скорости клубочковой фильтрации (СКФ) и утратой концентрирующей способности почек. Развитие ОПН приводит к системному декомпенсированному гомеостатическому сдвигу, включающему расстройства водного, электролитного и кислотно-щелочного баланса, а также глубокое нарушение экскреции эндогенных продуктов метаболизма и ксенобиотиков.

Высокая уязвимость почечной ткани у животных обусловлена особенностями её органного кровотока: почки получают около 20% сердечного выброса, при этом основной объем перфузии приходится на корковое вещество и наружную зону мозгового слоя. Из-за высокой метаболической активности и интенсивной транспортной нагрузки наибольшему

риску ишемической и токсической альтерации подвергаются эпителиоциты проксимальных извитых канальцев и толстой восходящей ветви петли Генле.

Патогенетический каскад ОПП протекает через четыре последовательные фазы:

1. Инициацию (первые минуты и часы после альтерирующего воздействия);
2. Распространение повреждения на фоне нарастающей тканевой гипоксии (от нескольких часов до суток);
3. Поддержание процесса с активацией начальных механизмов клеточной репарации (от 3-х суток до нескольких недель);
4. Восстановление функциональной активности (недели или месяцы).

Несмотря на потенциальную обратимость ОПП, критическая гибель канальцевого эпителия может приобретать необратимый характер, что подчеркивает необходимость глубокого понимания пусковых патофизиологических механизмов развития патологии.

В структуре регуляции почечной гемодинамики и водно-электролитного гомеостаза ключевую роль играет ренин-ангиотензин-альдостероновая система (РААС). В физиологических условиях при ишемии почечной паренхимы, падении системного артериального давления, гиповолемии или снижении концентрации ионов Na и Cl юкстагломерулярные клетки афферентных артериол секретируют ренин.

Этот фермент расщепляет печеночный ангиотензиноген до слабоактивного ангиотензина I, который под действием цинкзависимого ангиотензинпревращающего фермента (АПФ) трансформируется в мощный вазоконстриктор — ангиотензин II, параллельно инактивируя сосудорасширяющий пептид брадикинин. В норме ангиотензин II регулирует тонус почечных артериол и стимулирует секрецию альдостерона надпочечниками, поддерживая реабсорбцию натрия и воды в канальцах.

Однако при развитии ОПП реакция РААС быстро трансформируется из адаптивно-компенсаторной в стойкую патологическую гиперактивацию. Первоначальный спазм эфферентных артериол, направленный на поддержание внутриклубочкового гидростатического давления, сменяется тотальной вазоконстрикцией почечного сосудистого русла и критическим падением почечного плазмотока. Данный вазоспастический ответ вызывает резкое снижение СКФ и сокращение площади фильтрационной поверхности клубочков. В условиях блокирования клубочковой фильтрации и нарушения канальцевого транспорта происходит угнетение элиминации конечных продуктов белкового и минерального обмена, что непосредственно приводит к формированию азотемии (системной аккумуляции креатинина и мочевины) и гиперфосфатемии.

Патофизилогия задержки азотистого обмена

Азотемия представляет собой патологический синдром, характеризующийся повышенным содержанием в сыворотке или плазме крови азотистых продуктов обмена веществ (в первую очередь мочевины и креатинина), подлежащих элиминации почечной тканью.

У азотемии есть три классификации, в зависимости от её этиологичечкого фактрора, но все три типа разделяют несколько общих черт. Все формы азотемии характеризованы снижением скорости клубочковой фильтрации (СКФ) почек и увеличенем азота мочевины в крови и концентрации креатинина в сыворотке.

Преренальная азотемия

Преренальная азотемия вызвана уменьшением сердечного выброса, как результат недостаточного кровоснабжения почек. Это может произойти в результате кровотечения , шока,гиповолемия , и сердечной недостаточности и др. причин.

Ренальная азотемия

Ренальная азотемия обычно приводит к уремии. Это состояние свойственно при разнообразных заболеваниях почек, любого паренхиматозного повреждения почек. Основные причины:почечная недостаточность, гломерулонефрит, острый тубулярный некроз,пиелонефрит и т.д

Постренальная азотемия

Вызвана механическим препятствием оттоку мочи ниже уровня почек или нарушением целостности мочевыводящих путей (уролитиаз, обструкция мочеточников или уретры, сдавление опухолями, гидронефроз, разрыв мочевого пузыря с развитием уроперитонеума),беременность(физиологическая азотемия)

Заключение

Гиперактивация ренин-ангиотензин-альдостероновой системы (РААС) при остром повреждении почек у мелких домашних животных быстро перерастает из защитной реакции в тяжелый вазоспастический каскад. Под действием ангиотензина II происходит выраженное сужение артериол клубочков и сокращение мезангиальных клеток. Это резко снижает почечный кровоток и скорость клубочковой фильтрации (СКФ), усугубляя гипоксию канальцевого эпителия и блокируя выделительную функцию органов,тем самым приводя к накоплению продуктов азотистого обмена в крови.

Список литературы

1. *BSAVA Manual of Canine and Feline Nephrology and Urology / ed. by J. Elliott, G. F. Grauer, J. L. Westropp. — 3rd ed. — Gloucester : British Small Animal Veterinary Association, 2017. — 360 p.*

2. *Студенческий файловый архив Studfile [Электронный ресурс]. — Режим доступа: https://studfile.net/preview/21982229/page:19/ (дата обращения: 10.10.2026).*

DEVELOPMENT RHYTHM, SEED PRODUCTIVITY AND REPRODUCTIVE CHARACTERISTICS OF WORMWOOD (*ARTEMISIA DIFFUSA* KRASCH. EX POLJAK.) UNDER THE CONDITIONS OF KARNABCHUL

Abdulloyeva Mohinur Shavkatjonovna

Rabbimov Abdullo

Research Institute of Karakul Sheep Breeding and Desert Ecology, Samarkand, Uzbekistan

+998979173618

mohinur.abdulloyeva@gmail.com

Annotatsiya. *Mazkur maqolada O‘zbekistonning Samarqand–Navoiy mintaqasidagi Karnabcho‘l yarim cho‘l tekisligida tarqalgan, shuvoq–efemer yaylovlarining dominant yarim butasi hisoblangan Artemisia diffusa Krasch. ex Poljak. turining rivojlanish ritmi (fenologik sikli), urug‘ mahsuldorligi va reproduktiv biologiyasi adabiyotlar asosida tahlil qilingan. Nashr etilgan botanik, geobotanik hamda yaylovlar ekologiyasiga oid ma’lumotlarni umumlashtirish asosida turning mavsumiy fenofazalari, generativ novdalari va to‘pgullarining tuzilishi, urug‘ hosil bo‘lishini belgilovchi omillar, shuningdek, chorva mollarining yaylovlardan foydalanish bosimi sharoitida turning tabiiy qayta tiklanishi va yaylovlar regeneratsiyasidagi o‘rni tavsiflangan. Tadqiqot natijalari qurg‘oqchil Markaziy Osiyo hududlarida yaylovlarni qayta tiklash dasturlarini ishlab chiqish hamda qorako‘lchilikning ozuqa bazasini mustahkamlash nuqtayi nazaridan amaliy ahamiyatga ega.*

Kalit so‘zlar. *Artemisia diffusa, Karnabcho‘l, shuvoq, yarim cho‘l yaylovlari, fenologiya, rivojlanish ritmi, urug‘ mahsuldorligi, reproduktiv biologiya, qorako‘l qo‘ylari, yaylovlarni qayta tiklash.*

Abstract. *This paper presents a literature-based analysis of the development rhythm (phenological cycle), seed productivity and reproductive biology of Artemisia diffusa Krasch. ex Poljak., a dominant semi-shrub of the wormwood-ephemeral rangelands of Karnabchul, a semi-desert plain in the Samarkand-Navoi region of Uzbekistan. Based on the generalization of published botanical, geobotanical and rangeland-ecology data, the paper characterizes the seasonal phenophases of the species, the structure of its generative shoots and inflorescences, the factors determining seed set, and its role in natural reproduction and pasture regeneration under*

grazing pressure. The findings are of practical importance for pasture restoration programmes and for the fodder base of karakul sheep husbandry in arid zones of Central Asia.

Keywords: *Artemisia diffusa, Karnabchul, wormwood, semi-desert rangeland, phenology, development rhythm, seed productivity, reproductive biology, karakul sheep, pasture restoration.*

Introduction.

The semi-desert plain of Karnabchul, located within the Samarkand and Navoi regions of Uzbekistan, is one of the country's most extensive year-round pasture territories for karakul sheep breeding. Its vegetation cover is dominated by ephemeral-wormwood (efemerovo-polynnye) plant communities, in which *Artemisia diffusa* Krasch. ex Poljak. occupies a leading position among the shrub and semi-shrub components [1, 2]. Long-term geobotanical surveys carried out in the region confirm that A. diffusa, together with associated species such as Cousinia resinosa and Caroxylon (Salsola) spp., forms the productive core of the autumn-winter forage reserve, while ephemeral grasses and forbs dominate the spring-summer ration [1, 3]. Understanding the rhythm of seasonal development and the reproductive strategy of A. diffusa is therefore not only a matter of botanical interest but a practical necessity for the sustainable management of desert pastures, whose productivity has been reported to decline by 20-40% or more in degraded areas of Uzbekistan due to overgrazing and climatic variability [4]. The present work summarizes and analyzes available literature data on the morphology, phenological rhythm, seed productivity and reproductive biology of A. diffusa specifically in relation to the ecological conditions of Karnabchul.

Materials and methods.

The study is based on a comparative analysis of scientific literature devoted to the biology, ecology and rangeland significance of *Artemisia diffusa* in Central Asia, including monographic descriptions of the species, geobotanical surveys of Karnabchul and adjoining semi-desert territories (Ustyurt, Kyzylkum), and applied agronomic publications on pasture productivity and karakul-sheep forage. Sources were selected according to their direct relevance to the phenology, generative morphology, seed output and regeneration ecology of the species. Data drawn from different authors and years were compared and generalized in order to reconstruct a consolidated picture of the annual development cycle and reproductive characteristics of A. diffusa under the arid climatic regime of Karnabchul (hot, dry summers; short, cool, moderately humid winters; annual precipitation concentrated mainly in the winter-spring period).

Results and discussion.

1. Morphological and taxonomic characteristics.

Artemisia diffusa Krasch. ex Poljak. (synonym Seriphidium diffusum (Krasch. ex Poljak.) Y.R.Ling) is a perennial, polymorphic, low semi-shrub, 30-50 cm in height, with a life span estimated at 7-25 years [5]. Its native range extends from Iran through Central Asia to Afghanistan, placing Uzbekistan, and specifically the Karnabchul semi-desert, within the core of its natural distribution [6]. The stem is pubescent, grey-green, branched, with a lignified, short and strong basal part (caudex, 4-12 cm), from which erect or arc-curved reproductive stems (15-30 cm) arise and branch in the upper part. A strong pivotal (tap) root penetrates to a depth of 1.1-2.5 m, which explains the species' pronounced drought tolerance and its ability to exploit soil moisture reserves inaccessible to shallow-rooted ephemerals [5]. The leaves are sessile, 1.5-2.0 cm long, two to three times pinnatipartite, and densely covered with silky hairs, giving the whole plant a characteristic silvery-grey appearance that reduces transpiration losses under intense solar radiation. Chromosome numbers reported for the species are polyploid: 2n = 24, 48, 72 [5], a feature commonly associated with wider ecological amplitude and adaptability in arid-zone Artemisia species.

2. Rhythm of seasonal development (phenology).

The annual development cycle of A. diffusa in Karnabchul is closely synchronized with the region's sharply continental, arid climate. Vegetative growth resumes in early spring, when residual soil moisture from winter-spring precipitation is still available; during this period the plant forms new vegetative shoots and accumulates the assimilate reserves later mobilized for flowering. As summer temperatures rise and the ephemeral spring flora completes its cycle and dries out, A. diffusa - owing to its deep root system - remains physiologically active while surface-rooted annuals senesce, a phenological displacement that underlies the classic 'ephemeral-wormwood' seasonal complementarity of Karnabchul pastures: ephemerals dominate the spring-summer forage supply, while wormwood semi-shrubs, entering their generative phase, dominate the autumn-winter reserve [1, 7]. Bud formation and the elongation of generative (flowering) shoots occur in late summer, flowering itself takes place in autumn, and seed ripening and dispersal extend into the late autumn-early winter period, when the plant becomes the principal standing forage resource for karakul sheep [7]. This autumn-winter phenological rhythm is a key adaptive trait that allows A. diffusa to complete its reproductive cycle after the extreme summer heat has passed, using the more favourable moisture and temperature conditions of the cooler season, and it is precisely this trait that gives the species its outsized importance in the annual forage balance of desert pastures.

3. Reproductive biology and flower structure.

The inflorescences of A. diffusa are small, oviform, sessile capitula (3-4 mm long), each containing bisexual, inconspicuous, protandrous, pentamerous florets of pale yellow colour,

gathered in groups of 3-7 and assembled into a broad panicle at the tips of the generative shoots [5]. Each floret bears five stamens whose anthers are fused laterally into a short tube, a typical anemophilous (wind-pollinated) arrangement found throughout the subgenus Seriphidium. Protandry - the maturation of male structures before the stigmas of the same floret become receptive - reduces the likelihood of self-pollination within a single capitulum and favours outcrossing, a pattern broadly consistent with reproductive studies of other Artemisia species, where floral biology combining protandrous disc florets with wind pollination has likewise been associated with predominantly outcrossed, though variably fertile, seed production [8]. The very large number of capitula per generative shoot and of shoots per plant compensates for the comparatively low seed set per individual floret, so that a mature A. diffusa plant is capable of producing a substantial total seed output despite the small size of each achene.

4. Seed productivity and its dependence on ecological conditions.

Seed productivity of A. diffusa in Karnabchul is strongly dependent on the amount and timing of autumn-winter precipitation, on grazing intensity, and on the age structure of the stand. Long-term rangeland monitoring in the semi-desert zones of Uzbekistan shows that the productivity of Artemisia-dominated pastures fluctuates markedly from year to year in direct correlation with annual rainfall, with productivity losses of 20-40% or more recorded on degraded sites [4]. Grazing pressure affects seed productivity through two mechanisms: direct removal of generative shoots before seed maturation, and a shift in the state of the plant community along the grazing gradient, described in state-and-transition models of Karnabchul vegetation, from productive wormwood-ephemeral stands toward degraded, low-productivity communities with reduced representation of generative A. diffusa individuals [3]. Under moderate grazing regimes and favourable moisture years, mature stands are able to set abundant seed, which is dispersed at the onset of winter and germinates with the return of spring moisture, ensuring natural regeneration of the wormwood component of the pasture. Under heavy, continuous grazing, however, generative shoots are preferentially consumed before seed ripening, and the reproductive contribution of seed to stand renewal is correspondingly reduced, forcing pasture recovery to rely more heavily on vegetative persistence of surviving individuals than on seedling recruitment [3, 4].

5. Practical significance for pasture restoration and karakul sheep husbandry.

As a dominant, drought-tolerant, deep-rooted forage semi-shrub, A. diffusa is a key target species for the restoration of degraded rangelands in the Karnabchul, Kyzylkum and Ustyurt semi-desert zones. Chemical analyses have shown that A. diffusa-dominated pastures provide forage of appreciable nutritional value, contributing meaningfully to the protein and mineral requirements of

grazing karakul sheep during the autumn-winter period when alternative forage is scarce [1]. Because of the species' reliance on seed for the recolonization of disturbed sites and for the renewal of ageing stands, any programme of pasture rehabilitation - whether through deferred grazing, rotational grazing, or the sowing of A. diffusa seed on degraded plots - must take its autumn-winter reproductive rhythm explicitly into account, protecting generative shoots from grazing during the flowering-to-seed-ripening window. This is consistent with the broader applied agronomic goal of stabilizing the fodder base for karakul sheep through the combined use of natural wormwood-ephemeral regeneration and artificially established mixed pastures [9].

Conclusion.

The literature analysis presented in this paper shows that *Artemisia diffusa* Krasch. ex Poljak. is ecologically and economically the leading semi-shrub of the wormwood-ephemeral pastures of Karnabchul. Its deep root system and silvery, densely pubescent foliage provide pronounced drought resistance, while its autumn-winter phenological rhythm of budding, flowering and seed ripening allows it to complement the spring-summer ephemeral flora and to supply the principal standing forage reserve during the cold season. Its protandrous, wind-pollinated, multi-capitulate inflorescences ensure a potentially high total seed output, but actual seed productivity is strongly modulated by precipitation, grazing intensity and stand condition, with heavy or continuous grazing during the generative period substantially reducing natural seed renewal. These findings indicate that the conservation and expansion of A. diffusa populations in Karnabchul require grazing regimes that specifically protect the species during its autumn flowering-to-seed-ripening phase, and they underscore the importance of further field-based phenological and seed-productivity monitoring to refine site-specific pasture restoration and karakul sheep forage-management practices.

References

1. Bazarov B., Rajamuradov Z., Safin M., Rajabov A., Khayitov D., Kuziev M., Aminjonov S., Ismayilova M., Kudratov J., Khujabekov M., Khaydarov D. The productivity, chemical composition and nutritional value of pastures dominated by *Artemisia diffusa* and Cousinia resinosa in arid lands of southwestern Uzbekistan // Biodiversitas. - 2023. - Vol. 24. - P. 3916-3923.

2. Rakhimova T. The current state of the *Artemisia diffusa*, Caroxylon orientale pastures on the Eastern chink of the Ustyurt plateau (Uzbekistan) // Problems of Botany of South Siberia and Mongolia. - 2023. - Vol. 22, No. 1. - P. 302-305.

3. Rajabov T. Ecological assessment of spatio-temporal changes of vegetation in response to piosphere effects in semi-arid rangelands of Uzbekistan. Final Project, Land Restoration Training Programme. - Reykjavik: Soil Conservation Service of Iceland, 2009. - P. 109-134.

4. Rajabov T., Mardonov B.K., Pittroff W., Bobodjanov F.N. Impact of grazing on vegetation of Artemisia-annuals rangelands in semi desert of Uzbekistan // Proceedings of the International Grassland Congress. - 2008.

5. Gintzburger G., Le Houerou H.N., Toderich K.N. The steppes of Middle Asia: post-1991 agricultural and rangeland adjustment // Arid Land Research and Management. - 2003. - Vol. 17, No. 3. - P. 289-333.

6. Gintzburger G., Toderich K.N., Mardonov B.K., Mahmudov M.M. Rangelands of the arid and semi-arid zones in Uzbekistan. - Montpellier: CIRAD-ICARDA, 2003. - 426 p.

7. *Artemisia diffusa* (Gintzburger et al., 2003) // Pl@ntUse [Electronic resource]. - URL: https://plantuse.plantnet.org/en/Artemisia_diffusa_(Gintzburger_et_al.,_2003) (Accessed: 2026).

8. *Artemisia diffusa* Krasch. ex Poljakov // Plants of the World Online, Kew Science [Electronic resource]. - URL: https://powo.science.kew.org (Accessed: 2026).

9. Mir G.J., Malik S., et al. Reproductive biology and cytological insights of Artemisia vulgaris: implications for growth and adaptation of the species // Genetic Resources and Crop Evolution. - 2026.

10. Rajamuradova N.Z., Kuziyev SH., Rajamuradov Z. Influence of additional feeding of succulent goats on indices of natural resistance of the organism, milk productivity and development of goatlings // Bulletin of Pure and Applied Sciences, Zoology. - 2022. - Vol. 41A, No. 1. - P. 81-85.

MOLEKULAR BIOLOGIYA VA GENETIKANING ZAMONAVIY RIVOJLANISH TENDENSIYALARI

Hayitov Feruz Ilxomovich

Qarshi davlat universiteti tibbiyot fakulteti 5 kurs talabasi

Annotatsiya. *Maqolada molekular biologiya va genetikaning zamonaviy rivojlanish yo‘nalishlari tahlil qilingan. Genomika, yuqori unumli sekvenirlash, transkriptomika, epigenomika, CRISPR/Cas gen tahrirlash texnologiyalari, bir hujayrali tahlil, bioinformatika va sun’iy intellektning zamonaviy biologik tadqiqotlardagi ahamiyati yoritilgan. Shuningdek, ushbu texnologiyalarning tibbiyot, qishloq xo‘jaligi va biotexnologiyada qo‘llanish istiqbollari ko‘rib chiqilgan.*

Kalit so‘zlar: *molekular biologiya, genetika, genomika, sekvenirlash, transkriptomika, epigenomika, CRISPR/Cas, gen tahrirlash, bioinformatika, sun’iy intellekt.*

Abstract. *This article analyzes modern development trends in molecular biology and genetics. The importance of genomics, high-throughput sequencing, transcriptomics, epigenomics, CRISPR/Cas gene-editing technologies, single-cell analysis, bioinformatics, and artificial intelligence in contemporary biological research is highlighted. Furthermore, the prospects for applying these technologies in medicine, agriculture, and biotechnology are discussed.*

Keywords: *molecular biology, genetics, genomics, sequencing, transcriptomics, epigenomics, CRISPR/Cas, gene editing, bioinformatics, artificial intelligence.*

Kirish. Molekular biologiya va genetika tirik organizmlarda irsiy axborotning saqlanishi, uzatilishi va ifodalanish mexanizmlarini o‘rganuvchi fundamental fanlar hisoblanadi. DNK molekulasi tuzilishining aniqlanishi, genetik kodning ochilishi va rekombinant DNK texnologiyalarining yaratilishi molekular genetikaning jadal rivojlanishiga asos bo‘ldi [1,2].

Hozirgi davrda molekular biologiya genlarni alohida o‘rganishdan organizmning butun genomini, genlar ekspressiyasini, oqsillar faoliyatini va epigenetik boshqaruv mexanizmlarini kompleks tahlil qilish bosqichiga o‘tmoqda. Yuqori unumli sekvenirlash, bir hujayrali texnologiyalar, genomni tahrirlash va sun’iy intellektning rivojlanishi ushbu sohada yangi ilmiy imkoniyatlarni yaratmoqda [3–5].

Genomika va sekvenirlash texnologiyalari. Molekular genetikaning eng muhim zamonaviy yo‘nalishlaridan biri genomikadir. Genomika organizmning to‘liq genetik materialini o‘rganish imkonini beradi. Keyingi avlod sekvenirlash (Next Generation Sequencing — NGS) texnologiyalari DNK va RNK ketma-ketliklarini qisqa vaqtda katta hajmda aniqlash imkonini yaratdi [4].

NGS texnologiyalarining rivojlanishi inson, hayvon, o‘simlik va mikroorganizmlar genomlarini tadqiq qilishni sezilarli darajada tezlashtirdi. Ushbu usullar genetik kasalliklarni aniqlash, irsiy o‘zgaruvchanlikni o‘rganish, mikroorganizmlarni identifikatsiya qilish va qishloq xo‘jaligi seleksiyasida keng qo‘llanilmoqda [4].Genomik ma’lumotlarning keskin ko‘payishi bioinformatikaning rivojlanishiga ham turtki berdi. Kompyuter algoritmlari yordamida genlarni aniqlash, mutatsiyalarni topish, genomlar o‘rtasidagi farqlarni tahlil qilish va gen funksiyalarini bashorat qilish imkoniyati paydo bo‘ldi [1,4].

Tadqiqot materiallari va metodlari. Tadqiqotda molekular biologiya va genetikaning zamonaviy rivojlanish tendensiyalarini o‘rganish maqsadida ilmiy adabiyotlar, zamonaviy genomik texnologiyalar va molekular-genetik tadqiqot natijalari tahlil qilindi. Tadqiqotning nazariy asosini molekular biologiya, genetika, genomika va bioinformatika sohalaridagi ilmiy manbalar tashkil etdi [1–8]. Ish jarayonida adabiyotlarni tahlil qilish, qiyosiy tahlil, tizimlashtirish va umumlashtirish metodlaridan foydalanildi. Genomika va yuqori unumli sekvenirlash texnologiyalarining rivojlanishini baholashda NGS usullarining imkoniyatlari, transkriptomik tadqiqotlarda RNA-seq texnologiyasining qo‘llanilishi va genomni tahrirlashda CRISPR/Cas tizimining xususiyatlari o‘rganildi [3–5]. Shuningdek, bioinformatik yondashuv asosida genomik va transkriptomik ma’lumotlarni kompyuter vositalarida qayta ishlash, genetik variantlarni aniqlash, gen ekspressiyasini tahlil qilish va katta hajmdagi biologik ma’lumotlarni integratsiyalash imkoniyatlari tahlil qilindi. Bir hujayrali molekular tahlillar bo‘yicha single-cell RNA-seq va multi-omics yondashuvlarining zamonaviy imkoniyatlari qiyosiy ravishda o‘rganildi [6,7].

Tadqiqotda **tizimli yondashuv** asosida molekular biologiyaning genomika, transkriptomika, epigenomika, gen tahrirlash, bir hujayrali tahlil va sun’iy intellekt kabi asosiy yo‘nalishlari o‘zaro bog‘liq holda tahlil qilindi. Olingan ma’lumotlar umumlashtirilib, zamonaviy molekular-genetik texnologiyalarning tibbiyot, qishloq xo‘jaligi va biotexnologiyada qo‘llanish istiqbollari belgilab berildi.

Transkriptomika va epigenomika. Genomda mavjud axborotning o‘zi hujayrada kechadigan barcha jarayonlarni to‘liq ifodalamaydi. Genlarning qaysi biri faol ishlashi, qanday RNK va oqsillar sintez qilinishi organizmning funksional holatini belgilaydi. Shu sababli transkriptomika va proteomika zamonaviy molekular biologiyaning muhim yo‘nalishlariga aylandi [1]. RNA-seq texnologiyasi hujayradagi RNK molekulalarini keng miqyosda tahlil qilish va turli sharoitlarda gen ekspressiyasining o‘zgarishini aniqlash imkonini beradi [5]. Bu usul kasalliklar, stress holatlari va hujayra differensiatsiyasi jarayonlarida faollashadigan yoki susayadigan genlarni aniqlashda muhim ahamiyatga ega.

Epigenomika esa DNK ketma-ketligi o‘zgarmagan holda genlar faolligini boshqaruvchi mexanizmlarni o‘rganadi. DNK metillanishi, gistonlar modifikatsiyasi va xromatin holati gen ekspressiyasiga ta’sir ko‘rsatadi. Epigenetik mexanizmlarni tadqiq qilish o‘sma kasalliklari, qarish va boshqa murakkab biologik jarayonlarni tushunishda muhim ahamiyat kasb etmoqda [1].

CRISPR/Cas va genomni tahrirlash. So‘nggi yillarda molekular genetikadagi eng muhim texnologik yutuqlardan biri CRISPR/Cas tizimiga asoslangan genomni tahrirlash usullarining rivojlanishidir. CRISPR/Cas texnologiyasi genomning ma’lum uchastkasiga maqsadli ta’sir ko‘rsatish va DNKda rejalashtirilgan o‘zgarishlarni amalga oshirish imkonini beradi [3]. Ushbu texnologiya dastlab bakteriyalarning himoya mexanizmi sifatida o‘rganilgan bo‘lsa, keyinchalik genlarning funksiyasini tadqiq qilish, genetik modellar yaratish va biotexnologik jarayonlarni takomillashtirish vositasiga aylandi [3]. Gen tahrirlash texnologiyalari tibbiyotda irsiy kasalliklarning molekular sabablarini o‘rganish, qishloq xo‘jaligida yangi xususiyatlarga ega o‘simliklar yaratish va mikroorganizmlarning foydali metabolitlar sintezini boshqarishda istiqbolli yo‘nalish hisoblanadi.

Shu bilan birga, inson genomini tahrirlashda xavfsizlik, maqsadsiz genetik o‘zgarishlar va bioetika masalalari muhim ahamiyat kasb etadi. Shu sababli gen tahrirlash texnologiyalaridan foydalanishda ilmiy va etik talablarga rioya qilish zarur [3].

Bir hujayrali texnologiyalar va multi-omics yondashuvi. Zamonaviy molekular biologiyada tadqiqotlar tobora hujayra darajasiga yaqinlashmoqda. An’anaviy usullar ko‘plab hujayralardan olingan o‘rtacha ma’lumotni bersa, bir hujayrali sekvenirlash texnologiyalari har bir hujayraning molekular xususiyatlarini alohida o‘rganish imkonini yaratdi [6].Bir hujayrali RNA-seq texnologiyasi turli hujayra populyatsiyalarini aniqlash, ularning gen ekspressiyasidagi farqlarni o‘rganish va rivojlanish jarayonlarini kuzatishda qo‘llanilmoqda. Ayniqsa, onkologiya, immunologiya, embriologiya va regenerativ tibbiyot sohalarida ushbu yondashuvlarning ahamiyati ortib bormoqda [6,7].Genomika, transkriptomika, proteomika va epigenomika ma’lumotlarini birlashtirish multi-omics yondashuvini shakllantirdi. Bu yondashuv organizm yoki hujayraning molekular holatini kompleks baholash imkonini beradi [7].

Sun’iy intellekt va bioinformatika. Genomik tadqiqotlarda olinayotgan ma’lumotlar hajmining jadal o‘sishi ularni qayta ishlashning yangi usullarini talab qilmoqda. Shu munosabat bilan sun’iy intellekt va mashinali o‘qitish texnologiyalari molekular genetikada tobora keng qo‘llanilmoqda.

Sun’iy intellekt yordamida genomik variantlarni tahlil qilish, gen funksiyalarini bashorat qilish, katta hajmdagi RNA-seq ma’lumotlarini tasniflash va turli omiik ma’lumotlarni birlashtirish imkoniyati kengaymoqda. Oqsillarning fazoviy tuzilishini hisoblash asosida bashorat qilish

sohasidagi yutuqlar ham molekular biologiya uchun muhim ahamiyatga ega [8].Bioinformatika va sun'iy intellektning molekular biologiya bilan integratsiyalashuvi eksperimental tadqiqotlarni tezlashtirish, yangi biomarkerlarni aniqlash va biologik jarayonlarni modellashtirish imkoniyatlarini oshirmoqda.

Amaliy ahamiyati va istiqbollari. Molekular biologiya va genetika yutuqlari tibbiyot, farmasevtika, qishloq xo'jaligi va sanoat biotexnologiyasida muhim amaliy ahamiyatga ega. Genomik tahlillar irsiy kasalliklarni aniqlash, kasalliklarga moyillikni o'rganish va shaxsiylashtirilgan tibbiyot yondashuvlarini rivojlantirish uchun asos bo'lib xizmat qilmoqda [1,8]. Qishloq xo'jaligida molekular genetik texnologiyalar yuqori hosildorlikka, qurg'oqchilikka, sho'rlanishga va kasalliklarga chidamli navlarni yaratishda qo'llanishi mumkin. Biotexnologiyada esa genomni maqsadli o'zgartirish orqali mikroorganizmlarning fermentlar, organik kislotalar, vitaminlar va boshqa biologik faol moddalarni sintez qilish xususiyatlarini takomillashtirish imkoniyatlari mavjud.

Xulosa. Molekular biologiya va genetikaning zamonaviy rivojlanishi genomika, transkriptomika, epigenomika, bir hujayrali tahlil, CRISPR/Cas gen tahrirlash texnologiyalari, bioinformatika va sun'iy intellektning o'zaro integratsiyalashuvi bilan tavsiflanadi [3–8]. Yuqori unumli sekvenirlash va multi-omics yondashuvlari tirik organizmlardagi molekular jarayonlarni kompleks o'rganish imkonini bersa, CRISPR/Cas texnologiyalari genomni maqsadli o'zgartirish uchun yangi imkoniyatlar yaratmoqda. Sun'iy intellekt esa katta hajmdagi biologik ma'lumotlarni tahlil qilishni tezlashtirmoqda.

Kelajakda molekular biologiya va genetika yutuqlarining tibbiyot, qishloq xo'jaligi va biotexnologiyaga yanada keng tatbiq etilishi kutilmoqda. Shu bilan birga, yangi genetik texnologiyalarni amaliyotga joriy etishda xavfsizlik, ma'lumotlar maxfiyligi va bioetik tamoyillarga qat'iy rioya qilish muhim vazifa bo'lib qoladi.

FOYDALANILGAN ADABIYOTLAR

1. Alberts B., Johnson A., Lewis J. et al. *Molecular Biology of the Cell*. 7th ed. Garland Science, 2022.

2. Watson J.D., Baker T.A., Bell S.P. et al. *Molecular Biology of the Gene*. 7th ed. Pearson, 2014.

3. Doudna J.A., Charpentier E. The new frontier of genome engineering with CRISPR-Cas9. *Science*. 2014;346(6213):1258096.

4. Shendure J., Balasubramanian S., Church G.M. et al. DNA sequencing at 40: past, present and future. *Nature*. 2017;550:345–353.

5. Stark R., Grzelak M., Hadfield J. RNA sequencing: the teenage years. *Nature Reviews Genetics*. 2019;20:631–656.

6. Stuart T., Satija R. Integrative single-cell analysis. *Nature Reviews Genetics*. 2019;20:257–272.

7. Regev A., Teichmann S.A., Lander E.S. et al. The Human Cell Atlas. *eLife*. 2017;6.

8. Jumper J., Evans R., Pritzel A. et al. Highly accurate protein structure prediction with AlphaFold. *Nature*. 2021;596:583–589.

ГЕНЕТИЧЕСКИЙ ПОЛИМОРФИЗМ В ДИАГНОСТИКЕ ТОКСОКАРОЗА И ЕГО РОЛЬ В ЭФФЕКТИВНОМ ЛЕЧЕНИИ И ПРОФИЛАКТИКЕ

Саттарова Хулкар Гайратовна, доцент, PhD.

Научно-исследовательский институт микробиологии, вирусологии, инфекционных и паразитарных заболеваний имени Л.М. Исаева при Самаркандском государственном медицинском университете

Annotatsiya. *Mazkur maqolada toksokaroz diagnostikasida genetik polimorfizmning ahamiyati hamda kasallikni samarali davolash va profilaktika qilish masalalari yoritilgan. Toksokarozga gumon qilingan 44 nafar bemorning qon zardobi immunoferment tahlili (IFA) yordamida tekshirilgan. Natijada 29 ta namunada (65,9%) Toxocara canis antigeniga qarshi spetsifik IgG antitanachalari aniqlangan. Olingan natijalar toksokarozni erta aniqlashda laboratoriya diagnostikasi usullarining muhimligini ko‘rsatadi.*

Kalit so‘zlar: *toksokaroz, genetik polimorfizm, Toxocara canis, immunoferment tahlili, IgG antitanachalari, diagnostika, davolash, profilaktika.*

Аннотация. *В статье рассматривается значение генетического полиморфизма в диагностике токсокароза, а также вопросы эффективного лечения и профилактики заболевания. Проведено иммуноферментное исследование (ИФА) 44 образцов сыворотки крови пациентов с подозрением на токсокароз. Специфические антитела класса IgG к антигену Toxocara canis выявлены в 29 образцах (65,9%). Полученные результаты подчеркивают важность лабораторных методов диагностики для раннего выявления токсокароза.*

Ключевые слова: *токсокароз, генетический полиморфизм, Toxocara canis, иммуноферментный анализ, антитела IgG, диагностика, лечение, профилактика.*

Токсокароз-широко распространенное заболевание, вызываемоеличинками *Toxocara canis*, характеризующееся длительным рецидивирующим течением и полиорганными поражениями. С начала официальной его регистрации в 1991 году уровень пораженности населения этой инвазией возрос к 2007 году в 20 раз. Это связано в большой степени с

увеличением численности собак в городах, несоблюдения правил их содержания, отсутствия мер деинвазии их экскрементов, что приводит к широкой циркуляции возбудителя. Диагностика токсокароза очень трудна ввиду полиморфизма и неопределенности клинических проявлений. Клинические проявления токсокароза у детей вообще не имеют специфических особенностей, что еще более затрудняет диагностику. Неопределенность анамнеза, жалоб и многообразие клинической картины часто скрываются под симптомами общей интоксикации, вынуждают прибегать к многочисленным дополнительным лабораторным исследованиям, консультациям специалистов разного профиля. Клинические проявления инвазии также часто "маскируются" сопутствующими или обострениями предшествующих заболеваний. Внимание педиатров сосредоточивается на установленных ранее диагнозах: бронхиальная астма, псевдотуберкулёз, атопический дерматит, дискинезия желчевыводящих путей, дисбактериоз, невроз и других, но не на поиске гельминтоза у ребёнка. Признаки поражения печени при токсокарозе приводит таких пациентов в отделение гепатитов. Поэтому ключевая роль в постановке диагноза должна принадлежать лабораторным методам диагностики. Однако, в настоящее время морфологическая верификация диагноза проводится крайне редко. Разработка и внедрение вне пределов Узбекистана иммунологических методов диагностики, основанных на выявлении IgG антител к антигену Toxocara canis, позволила расширить знания о пораженности населения и о самой инвазии. Описанная сегодня на Западе тест-система ELISA при токсокарозе показывает чувствительность -78%, специфичность-92%. Вместе с тем, определение специфических антител не является показателем жизнеспособности личинок токсокар, то есть не указывает на активность инвазии.

Пораженность людей токсокарами в различных странах варьирует от 2,6% в Бельгии до 80% на Карибских островах. В России по данным сероэпидемиологических исследований, проводимых в различных регионах, токсокарами инвазировано до полумиллиона человек. Наблюдается ежегодный рост заболеваемости токсокарозом, особенно в сельской местности среди детей. При массивной инвазии токсокарами, повторных заражениях, нарушениях в иммунной системе человека возможно развитие тяжелых висцеральных поражений и формирование хронической органопатологии, в первую очередь органов дыхания. Это указывает на актуальность проблемы токсокароза для практического здравоохранения, особенно для педиатрии (Лысенко А.Я., 2002; PapavasilopoulosV.etal., 2016; HekmatGhafaryetal., 2016).

Несмотря на проводимые лечебно-профилактические мероприятия, тенденции к снижению заболеваемостью токсокарозом в республике не наблюдается. Это, вероятнее

всего связано с тем, что нет единой системы диагностики и профилактики токсокароза. Кроме того, отмечаются факты непрофессионального подхода к лечению разного рода специалистами, не имеющими специальную паразитологическую подготовку. До сих пор многие специалисты при терапии паразитоза не учитывают форму, клиническое течение токсокароза, что приводит к негативным последствиям для организма. Для этого нужен алгоритм диагностики и лечения заболевания. До настоящего времени в республике недостаточно изучена поражённость токсокарой собак и других представителей семейства псовых.

В Узбекистане проблема токсокароза практически не изучалась, за исключением двух исследований, проведенных в начале 2000 годов сотрудниками НИИ медицинской паразитологии им. Л.М.Исаева. Нет ясной картины распространенности гельминтоза среди населения республики. Остаётся не установленными распространенность и заболеваемость токсокарозом, особенно у детей. В связи с этим, изучение токсокароза является актуальной проблемой здравоохранения.

Все это определяет необходимость разработки новых лабораторно-диагностических методов применительно к токсокарозу.

Целью работы являетсясоздание скрининговых лабораторных методов диагностики для выявления в доклинической и ранней стадии проявления токсокароза.

Результаты. Иммуноферментным анализом (ИФА) проведено серологическое исследование 44 образцов сыворотки крови от пациентов с подозрением на токсокароз. По результатам серологического анализа в 29 из 44 клинических образцов (65,9%) выявлены специфические антитела класса IgG к антигену *Toxocara canis* (серопозитивные показатели). В 15 образцах (34,1%), показавших отрицательный результат, уровень титров находился в пределах нормы.

При анализе серопозитивных образцов в разрезе титров диагностические титры (1:200 и выше) регистрировались с высокой частотой преимущественно в группе детей и пациентов с клиническими проявлениями (гистамин, эозинофилия, аллергический и гепатоспленомегалический синдромы) ($p < 0,05$).

Заключение. При иммуноферментном исследовании (ИФА) 44 образцов сыворотки крови от пациентов с подозрением на токсокароз в 29 случаях (65,9%) были выявлены специфические антитела класса IgG к антигену *Toxocara canis* (серопозитивный показатель). В 15 образцах (34,1%), показавших отрицательный результат, уровень титров находился в пределах нормы. Это свидетельствует о высокой распространенности инвазии среди

обследованного контингента и высокой информативности ИФА на ранних этапах диагностики.

СПИСОК ЛИТЕРАТУРЫ

1.Лысенко, А. Я., Владимова, М. Г., Кондрашин, А. В., & Малышев, Н. А. (2002). *ВИЧ-инфекция и СПИД-ассоциируемые болезни: Руководство для врачей / Токсокароз*. Москва: Рарогъ.

2.Вахобов, Т. А. (2004). Влияние висцерального токсокароза на организм больных. *Проблемы биологии и медицины*, (1), 18–22.

3.Шакаров, А. Г., Вахобов, Т. А., & Халиков, К. Н. (1993). Термографические показатели иммунодефицитного синдрома у лиц с противотоксокарозными антителами. *Актуальные проблемы паразитологии* (с. 45–48). Ташкент.

4.Бронштейн, А. М., & Малышев, Н. А. (2014). *Токсокароз: эпидемиология, клиника, диагностика, лечение и профилактика*. Москва: Инфекционные болезни.

5.Ma, G. X., Holland, C. V., Wang, T., Hofmann, A., Fan, C. K., Maizels, R. M., & Gasser, R. B. (2018). Human toxocariasis: a silent threat to public health. *Lancet Infectious Diseases*, 18(8), e271–e279.

6.Magnaval, J. F., Glickman, L. T., Dorchies, P., & Morassin, B. (2001). Highlights of human toxocariasis. *Korean Journal of Parasitology*, 39(1), 1–11.

7.Fernández-Baldo, M. A., Poulsen, C. S., & Skov, J. (2017). Seroprevalence and clinical features of Toxocara infection in endemic regions. *Acta Tropica*, 172, 112–119.

8.Papavasilopoulos, V., & Hekmat-Ghafary, S. (2016). Modern diagnostic approaches to visceral toxocariasis in pediatric practice. *Journal of Helminthology*, 90(4), 401–408.

SCUTELLARIA BAICALENSIS GEORGI FLAVONOIDLARINING KIMYOVIY TARKIBI VA FARMAKOLOGIK FAOLLIGI: ILMIY ADABIYOTLAR TAHLILI

Iroda Saydullayeva

Samarqand davlat universiteti

Annotatsiya *Ushbu maqolada dorivor o‘simliklardan biri — Scutellaria baicalensis Georgi ning kimyoviy tarkibi, xususan, flavonoidlari va ularning farmakologik faolligi ilmiy adabiyotlar asosida tahlil qilinadi. Mazkur tur vakillarida uchraydigan baikalin, baikaleyin, vogonin va vogonozid kabi birikmalarning biologik xususiyatlariga alohida e’tibor qaratiladi. Ilmiy manbalarda ushbu moddalar antioksidant, yallig‘lanishga qarshi va o‘smaga qarshi faollik bilan*

bog‘liq tajribaviy tadqiqotlarda o‘rganilgan. Maqolada tajriba sharoitida olingan natijalar bilan insonlarda klinik jihatdan tasdiqlangan samaradorlik o‘rtasidagi farq yoritiladi. Tahlil natijalari S. baicalensis flavonoidlarining farmakologik tadqiqotlar uchun muhim manba ekanini, biroq ularning amaliy tibbiyotdagi samaradorligi va xavfsizligini baholash uchun qo‘shimcha tadqiqotlar zarurligini ko‘rsatadi.

Kalit so‘zlar: *Scutellaria baicalensis, Lamiaceae, dorivor o‘simliklar, flavonoidlar, baikalin, baikaleyin, vogonin, farmakologik faollik.*

Abstract. *This article analyzes the chemical composition of Scutellaria baicalensis Georgi, a medicinal plant, with particular emphasis on its flavonoids and their pharmacological activities, based on scientific literature. Special attention is given to the biological properties of compounds found in this species, including baicalin, baicalein, wogonin, and wogonoside. According to scientific sources, these compounds have been investigated in experimental studies for their antioxidant, anti-inflammatory, and antitumor activities. The article highlights the distinction between results obtained under experimental conditions and clinically confirmed efficacy in humans. The findings indicate that the flavonoids of S. baicalensis represent an important resource for pharmacological research; however, further studies are required to evaluate their efficacy and safety in practical medicine.*

Keywords: *Scutellaria baicalensis, Lamiaceae, medicinal plants, flavonoids, baicalin, baicalein, wogonin, pharmacological activity.*

Kirish. Dorivor o‘simliklar tarkibidagi biologik faol birikmalarni o‘rganish zamonaviy farmakognoziya, fitokimyo va farmakologiyaning muhim yo‘nalishlaridan biri hisoblanadi. O‘simliklarning kimyoviy tarkibini aniqlash, faol metabolitlarning xususiyatlarini baholash hamda ularning biologik ta’sir mexanizmlarini o‘rganish yangi tadqiqot yo‘nalishlarini shakllantirishga xizmat qiladi.

Lamiaceae oilasiga mansub *Scutellaria* L. turkumi vakillari an’anaviy tibbiyotda qo‘llanilishi va turli biologik faol birikmalarga boyligi bilan ilmiy qiziqish uyg‘otadi. Ushbu turkum vakillarining kimyoviy tarkibi va etnofarmakologik xususiyatlari ilmiy adabiyotlarda keng yoritilgan [1]. Ayniqsa, *Scutellaria baicalensis* Georgi turi tarkibidagi flavonoidlar fitokimyoviy va farmakologik tadqiqotlarda muhim o‘rin egallaydi.

Flavonoidlar o‘simliklarning ikkilamchi metabolitlari bo‘lib, ularning biologik faolligi kimyoviy tuzilishi, konsentratsiyasi va tajriba sharoitlariga bog‘liq. *S. baicalensis* tarkibida aniqlangan baikalin, baikaleyin va vogonin kabi birikmalar antioksidant, yallig‘lanishga qarshi hamda o‘smaga qarshi faollik bilan bog‘liq tadqiqotlarda o‘rganilgan [1, 2].

Shu bilan birga, laboratoriya yoki hayvonlarda o‘tkazilgan tajribalarda aniqlangan biologik faollikni insonlarda klinik samaradorlik isboti sifatida qabul qilish mumkin emas. Shu sababli mavjud ilmiy ma’lumotlarni dalillar darajasini hisobga olgan holda tahlil qilish muhimdir.

Tadqiqotning maqsadi — *Scutellaria baicalensis* Georgi tarkibidagi asosiy flavonoidlar, ularning kimyoviy xususiyatlari va ilmiy adabiyotlarda yoritilgan farmakologik faolligini qiyosiy tahlil qilish.

Materiallar va tadqiqot usullari. Tadqiqot adabiyotlar tahliliga asoslangan. Asosiy manbalar sifatida *Scutellaria* turkumining etnofarmakologik va fitokimyoviy xususiyatlarini umumlashtirgan ilmiy sharh hamda *Scutellaria* vakillarining ayrim flavonoidlari farmakologik xususiyatlariga bag‘ishlangan ilmiy maqolalardan foydalanildi [1, 2].

Manbalardagi ma’lumotlar quyidagi yo‘nalishlar bo‘yicha tahlil qilindi: o‘simlik tarkibidagi asosiy flavonoidlar, ularning kimyoviy shakllari, tajribaviy tadqiqotlarda o‘rganilgan biologik faollik va mavjud dalillarning cheklovlari. Maqola narrativ adabiyotlar sharhi shaklida tayyorlandi; shu sababli uni barcha mavjud nashrlarni qamrab olgan tizimli sharh deb baholash mumkin emas.

Natijalar. *Scutellaria baicalensis* ning fitokimyoviy xususiyatlari. *Scutellaria baicalensis* Georgi tarkibida turli ikkilamchi metabolitlar, jumladan, flavonoidlar uchraydi. Ushbu birikmalar o‘simlikning kimyoviy tarkibini tavsiflashda va uning biologik xususiyatlarini o‘rganishda muhim ahamiyatga ega. *Scutellaria* turkumi bo‘yicha olib borilgan fitokimyoviy tadqiqotlarda flavonoidlar ushbu o‘simliklar guruhining asosiy o‘rganiladigan birikmalari qatorida qayd etilgan [1]. *S. baicalensis* bilan bog‘liq ilmiy adabiyotlarda baikalin, baikaleyin, vogonin va vogonozid kabi birikmalar ko‘p uchraydi. Ularning kimyoviy shakllari va biologik xususiyatlari o‘zaro farq qiladi. Masalan, baikalin va vogonozid glikozidlar, baikaleyin va vogonin esa ularga mos keluvchi aglikonlar qatoriga kiradi.



***1-rasm Scutellaria baicalensis* Georgi**

Natijalar. *Scutellaria baicalensis* ning fitokimyoviy xususiyatlari. *Scutellaria baicalensis* Georgi tarkibida turli ikkilamchi metabolitlar, jumladan, flavonoidlar uchraydi. Ushbu birikmalar o‘simlikning kimyoviy tarkibini tavsiflashda va uning biologik xususiyatlarini o‘rganishda muhim ahamiyatga ega. *Scutellaria* turkumi bo‘yicha olib borilgan fitokimyoviy tadqiqotlarda flavonoidlar ushbu o‘simliklar guruhining asosiy o‘rganiladigan birikmalari qatorida qayd etilgan [1]. *S. baicalensis* bilan bog‘liq ilmiy adabiyotlarda baikalin, baikaleyin, vogonin va vogonozid kabi birikmalar ko‘p uchraydi. Ularning kimyoviy shakllari va biologik xususiyatlari o‘zaro farq qiladi. Masalan, baikalin va vogonozid glikozidlar, baikaleyin va vogonin esa ularga mos keluvchi aglikonlar qatoriga kiradi.

1-jadval. *Scutellaria baicalensis* ning ayrim asosiy flavonoidlari va ularning ilmiy ahamiyati

Birikma	**Kimyoviy xususiyati**	**Ilmiy tadqiqotlardagi asosiy yo‘nalish**
Baikalin	Flavonoid glikozidi	Yallig‘lanishga qarshi va antioksidant faollik
Baikaleyin	Flavonoid aglikoni	Antioksidant, yallig‘lanishga qarshi va o‘smaga qarshi faollik

Vogonin (wogonin)	Flavonoid aglikoni	Yallig‘lanish jarayonlari va o‘sma hujayralariga ta’siri
Vogonozid (wogonoside)	Flavonoid glikozidi	Biologik faolligi va metabolik o‘zgarishlarini o‘rganish

Izoh: Jadvalda keltirilgan yo‘nalishlar ilmiy tadqiqotlarda o‘rganilgan faoliyat turlarini umumlashtiradi. Ular ushbu birikmalarning insonlarda klinik jihatdan tasdiqlangan davolash samaradorligini anglatmaydi.

Flavanoidlarning farmakologik xususiyatlari:

Antioksidant faollik. Antioksidant xususiyatlar flavonoidlarni o‘rganishdagi muhim yo‘nalishlardan biridir. Ushbu birikmalarning kimyoviy tuzilishi ularning oksidlanish-qaytarilish jarayonlaridagi ishtirokiga ta’sir ko‘rsatishi mumkin. *S. baicalensis* flavonoidlari bo‘yicha tadqiqotlarda antioksidant xususiyatlar o‘rganilgan, biroq bunday faollikni organizmdagi barcha sharoitlarda bir xil namoyon bo‘ladi deb hisoblash to‘g‘ri emas [1].

Yallig‘lanishga qarshi faollik. Baikalin, baikaleyin va vogonin yallig‘lanish bilan bog‘liq biologik jarayonlarga ta’siri nuqtayi nazaridan tadqiq qilingan. Bunday tadqiqotlar hujayra va hayvon modellarida turli molekulyar mexanizmlarni o‘rganishni o‘z ichiga oladi. Natijalarni baholashda ishlatilgan doza, birikmaning biologik o‘zlashtirilishi va tajriba modeli hisobga olinishi lozim [1, 2].

O‘smaga qarshi faollik. *Scutellaria* turkumi vakillarining ayrim flavonoidlari o‘sma hujayralariga ta’siri bilan bog‘liq tajribaviy tadqiqotlarda o‘rganilgan. Xususan, vogonin, baikaleyin va baikalin saraton biologiyasi hamda ehtimoliy terapevtik mexanizmlar nuqtayi nazaridan ilmiy qiziqish uyg‘otadi [2]. Biroq hujayra yoki hayvon modelida olingan natijalar ushbu moddalar saratonni insonlarda davolashi isbotlanganini anglatmaydi. Ularning klinik samaradorligini baholash uchun sifatli klinik tadqiqotlar talab etiladi.

Adabiyotlar tahlili *S. baicalensis* flavonoidlarining farmakologik imkoniyatlarini o‘rganish uchun muhim ilmiy asos mavjudligini ko‘rsatadi. Shu bilan birga, tadqiqot natijalarini amaliyotga tatbiq etishda bir nechta jihatga e’tibor qaratish zarur.

Birinchidan, alohida flavonoidning laboratoriya sharoitidagi faolligi butun o‘simlik ekstraktining ta’siriga teng emas. Ekstrakt tarkibi o‘simlikning o‘sish sharoiti, ishlatilgan qismi, yig‘ish vaqti hamda ekstraksiya usuliga qarab farqlanishi mumkin.

Ikkinchidan, biologik faollik haqidagi xulosalar tadqiqot modeliga mos talqin qilinishi kerak. Hujayra tajribasi, hayvon modeli va insonlardagi klinik tadqiqotlar dalillar darajasi jihatidan bir-biridan farq qiladi.

Uchinchidan, farmakologik faollik bilan bir qatorda xavfsizlik, dozalash, biologik o‘zlashtirilish va boshqa dori vositalari bilan o‘zaro ta’sir masalalarini ham o‘rganish muhimdir. Shuning uchun *S. baicalensis* flavonoidlarini mustaqil davolash vositasi sifatida tavsiya qilish uchun mazkur maqolada keltirilgan ma’lumotlar yetarli emas.

Xulosa *Scutellaria baicalensis* Georgi flavonoidlar tarkibi va farmakologik xususiyatlari jihatidan ilmiy tadqiqotlar uchun muhim dorivor o‘simliklardan biridir. Baikalin, baikaleyin, vogonin va vogonozid kabi birikmalar ushbu turning kimyoviy tarkibini o‘rganishda alohida ahamiyatga ega.

Ilmiy adabiyotlarda mazkur birikmalarning antioksidant, yallig‘lanishga qarshi va o‘smaga qarshi faolligi bilan bog‘liq tajribaviy natijalar yoritilgan. Biroq bu natijalarni klinik samaradorlikning yakuniy isboti sifatida talqin qilish mumkin emas. Kelgusida flavonoidlarning kimyoviy tarkibi va miqdorini standartlashtirish, ta’sir mexanizmlarini chuqur o‘rganish, xavfsizlikni baholash hamda klinik tadqiqotlar o‘tkazish muhim ilmiy vazifalar hisoblanadi.

Umuman olganda, *S. baicalensis* flavonoidlarini o‘rganish fitokimyo va farmakologiya sohalarida istiqbolli yo‘nalish bo‘lib, mavjud dalillarni tanqidiy baholash kelajakdagi tadqiqotlarning ishonchliligini oshirishga yordam beradi.

FOYDALANILGAN ADABIYOTLAR

1. Shang X., He X., Li M., Zhang R., Fan P., Zhang Q., Jia Z. The genus *Scutellaria*: an ethnopharmacological and phytochemical review. **Journal of Ethnopharmacology.** 2010;128(2):279–313. https://doi.org/10.1016/j.jep.2010.01.006
2. Li-Weber M. New therapeutic aspects of flavones: the anticancer properties of *Scutellaria* and its main active constituents wogonin, baicalein and baicalin. **Cancer Treatment Reviews.** 2009;35(1):57–68. https://doi.org/10.1016/j.ctrv.2008.09.005

MOYLI ZIG‘IR O‘SIMLIGINING QURG‘OQCHILIKKA CHIDAMLILIK GENLARINI DNK MARKERLAR YORDAMIDA ANIQLASH

M.A. Turdimurodova

O‘simliklar genetik resurslari ilmiy-tadqiqot institut 2-bosqich tayanch doktoranti

Annotatsiya. *Ushbu tezisda moyli zig‘ir (Linum usitatissimum L.) o‘simligining qurg‘oqchilikka chidamliligini molekulyar-genetik jihatdan o‘rganish hamda chidamlilik bilan bog‘liq genetik variantlarni DNK markerlari yordamida aniqlash masalalari yoritiladi. Qurg‘oqchilikka javob beruvchi genlar va ular bilan bog‘langan molekulyar markerlardan foydalanish nav hamda namunalarni tezkor baholash, istiqbolli genotiplarni tanlash va markerlarga asoslangan seleksiya uchun muhimdir. Ishda SSR/SNP markerlaridan foydalanish, genom DNKsini ajratish, PCR tahlili va molekulyar natijalarni morfofiziologik ko‘rsatkichlar bilan taqqoslashga mo‘ljallangan yondashuv bayon etiladi. Tezis adabiyotlar tahlili va taklif etilayotgan tadqiqot metodikasiga asoslangan; tajriba natijalari olinmagan bo‘lsa, ular mavjud natija sifatida talqin qilinmasligi lozim.*

Kalit so‘zlar: *moyli zig‘ir, qurg‘oqchilik, DNK marker, SSR, SNP, PCR, nomzod gen, molekulyar seleksiya.*

Abstract*. This thesis addresses the molecular-genetic investigation of drought tolerance in oil flax (Linum usitatissimum L.) and the identification of genetic variants associated with drought tolerance using DNA markers. The use of drought-responsive genes and their associated molecular markers is important for the rapid evaluation of varieties and accessions, the selection of promising genotypes, and marker-assisted selection. The study outlines an approach involving SSR/SNP markers, genomic DNA extraction, PCR analysis, and the comparison of molecular findings with morphophysiological traits. The thesis is based on a literature review and a proposed research methodology. If experimental results have not yet been obtained, they should not be interpreted or presented as existing findings.*

Keywords: *oil flax, drought, DNA marker, SSR, SNP, PCR, candidate gene, molecular selection.*

Kirish. Iqlim o‘zgarishi, yog‘ingarchilikning notekis taqsimlanishi va sug‘orish suvi tanqisligi qishloq xo‘jaligi ekinlarining hosildorligiga salbiy ta’sir ko‘rsatmoqda. Moyli zig‘ir moyga boy urug‘i, oziq-ovqat va texnik maqsadlarda qo‘llanilishi bilan ahamiyatli ekin hisoblanadi. Biroq namlik yetishmasligi, ayniqsa o‘sish va generativ rivojlanish bosqichlarida, o‘simlik biomassasi, urug‘ hosili va urug‘ sifatini kamaytirishi mumkin [1, 2]. Shu sababli mahalliy

agroiqlim sharoitlariga mos, qurg‘oqchilikka chidamli genotiplarni aniqlash va seleksiya jarayoniga jalb etish dolzarb vazifadir.

Qurg‘oqchilikka chidamlilik murakkab, ko‘p genlar ishtirok etadigan belgi bo‘lib, ildiz tizimining rivojlanishi, suvni tejash, osmotik moslashuv, fotosintez faoliyatining saqlanishi, antioksidant himoya va fitogormonlar signallari bilan bog‘liq. Zig‘irda o‘tkazilgan transkriptom tahlillari suv tanqisligi sharoitida fotosintez, prolin biosintezi, oksidlovchi stressga javob va boshqa metabolik yo‘llarga taalluqli genlar faolligi o‘zgarishini ko‘rsatgan [1, 3]. Demak, chidamlilikni faqat tashqi ko‘rinish bo‘yicha emas, balki genetik darajada ham baholash maqsadga muvofiq.

DNK markerlari organizm genomidagi muayyan nukleotid ketma-ketligi yoki uning o‘zgarishini aniqlash imkonini beradi. SSR (oddiy ketma-ketlik takrorlari) va SNP (yagona nukleotid polimorfizmi) markerlari genetik xilma-xillikni baholash, belgilar bilan bog‘liq lokuslarni aniqlash va seleksiya materialini tanlashda ishlatiladi. Zig‘ir uchun ko‘plab SSR markerlar ishlab chiqilgan, ularning ayrimlari polimorfizmni aniqlash hamda genetik xaritalash uchun foydali ekani ko‘rsatilgan [4, 5].

Tadqiqotning maqsadi va vazifalari.

Tadqiqotning maqsadi — moyli zig‘ir navlari va namunalarida qurg‘oqchilikka chidamlilik bilan bog‘liq genetik farqlarni DNK markerlari yordamida aniqlash hamda istiqbolli genotiplarni keyingi seleksiya ishlari uchun ajratib olish metodikasini ishlab chiqish.

Maqsadga erishish uchun quyidagi vazifalar belgilanishi mumkin: 1) moyli zig‘ir nav va namunalarini tanlash hamda ularning qurg‘oqchilikka munosabatini fenotipik baholash; 2) o‘simlik to‘qimasidan sifatli genom DNKsini ajratish; 3) adabiyotlarda qurg‘oqchilikka chidamlilik yoki ildiz belgilari bilan bog‘langan markerlarni tanlash; 4) PCR orqali marker lokuslarini amplifikatsiya qilish va polimorfizmini aniqlash; 5) molekulyar ma’lumotlarni morfofiziologik ko‘rsatkichlar bilan solishtirish; 6) chidamlilikka aloqador allellar yoki marker profillari aniqlangan namunalarni keyingi tekshiruv uchun tavsiya etish.

Materiallar va tadqiqot usullari.

Tadqiqot materiali sifatida moyli zig‘irning mahalliy va introduksiya qilingan navlari hamda seleksion namunalardan foydalanish rejalashtiriladi. Har bir namuna alohida kod bilan belgilanadi; imkon qadar biologik takrorlar qo‘llanadi. O‘simliklarning qurg‘oqchilikka javobi nazorat va suv tanqisligi sharoitlarida taqqoslanishi mumkin. Baholashda unish foizi, nihol uzunligi, ildiz uzunligi, yangi va quruq biomassa, barglarning so‘lish darajasi, nisbiy suv miqdori hamda yetuk o‘simliklarda hosil elementlari kabi ko‘rsatkichlar hisobga olinadi. Tajriba sharoiti, namlik darajasi, o‘simlik yoshi va takrorlar soni barcha namunalar uchun bir xil saqlanishi zarur.

Genom DNKsi yosh barg to‘qimasidan CTAB usuli yoki o‘simlik DNKsi uchun mos tijoriy to‘plam yordamida ajratilishi mumkin. DNK sifati agaroz gel elektroforezi, miqdori va tozaligi esa mavjud laboratoriya uskunasiga muvofiq spektrofotometrik yoki fluorometrik o‘lchov orqali tekshiriladi. PCR uchun DNK konsentratsiyasi namunalar o‘rtasida tenglashtiriladi. Markerlar tanlanayotganda ularning zig‘ir genomida joylashuvi, e’lon qilingan polimorfizmi, qurg‘oqchilikka chidamlilik yoki ildiz belgilari bilan bog‘liqligi va laboratoriyada takrorlanuvchanligi hisobga olinadi [2, 4, 5].

SSR markerlari uchun tegishli primer juftlari yordamida PCR o‘tkazilib, amplifikatsiya mahsulotlari agaroz yoki poliakrilamid gel elektroforezida ajratiladi. Allel o‘lchamlari molekulyar marker bilan solishtirib qayd etiladi. Agar SNP markerlari tanlansa, genotiplash tegishli PCR-usul, allelga xos primerlar yoki sekvenslash orqali bajarilishi mumkin. Har bir PCR seriyasida manfiy nazorat, zarur bo‘lsa, ma’lum genotipdan musbat nazorat kiritiladi. Nospetsifik amplifikatsiya va takrorlanmaydigan natijalar qayta tekshiriladi.

Molekulyar natijalar allel profillari jadvaliga kiritiladi. Genetik xilma-xillik va marker polimorfizmi mos dasturiy vositalar yordamida baholanadi. Marker va fenotip o‘rtasidagi bog‘liqlikni tekshirishda namuna soni, populyatsiya tuzilishi va tajriba muhiti ta’siri e’tiborga olinishi kerak. Adabiyotda ma’lum qurg‘oqchilikka bog‘liq marker mavjudligi uning har qanday genetik fonda bevosita sababchi ekanini anglatmaydi; aniqlangan bog‘liqlik mustaqil materialda tasdiqlanishi lozim.

Kutilayotgan natijalar va muhokama.

Tadqiqot natijasida o‘rganilayotgan moyli zig‘ir namunalari orasidagi molekulyar polimorfizm tavsiflanishi, marker profillari bo‘yicha genetik farqlar aniqlanishi va fenotipik ko‘rsatkichlar bilan taqqoslash imkoniyati yaratilishi kutiladi. Oldingi tadqiqotlarda zig‘irning turli genotiplari qurg‘oqchilikka javob berishda farqlanishi, ildiz tizimi belgilarining hosil bilan bog‘liqligi va genom bo‘ylab SSR markerlar yordamida qurg‘oqchilik sharoitidagi hosildorlikka aloqador lokuslar aniqlangani xabar qilingan [2, 3]. Xususan, ayrim tadqiqotlarda Lu254 va Lu790 SSR markerlari suv cheklangan sharoitdagi hosil bilan bog‘langan; bu natijalar tegishli genetik material va muhit doirasida olingan bo‘lib, ularni yangi namunalar uchun oldindan tasdiqlangan deb qabul qilib bo‘lmaydi [2].

Molekulyar markerlar fenotipik baholashni to‘liq almashtirmaydi, balki uni to‘ldiradi. Masalan, laboratoriya sharoitida marker alleli aniqlangan namuna dalada suv tanqisligida yuqori hosil berishini kafolatlamaydi. Shu sababli marker tahlilini nazoratli qurg‘oqchilik tajribalari, fiziologik ko‘rsatkichlar va imkon bo‘lsa, turli yil hamda joylardagi dala sinovlari bilan birlashtirish zarur. Gen ekspressiyasini o‘rganish rejalashtirilsa, DNK marker tahlilidan alohida ravishda RNK ajratish

va RT-qPCR yoki transkriptom tahlili bajarilishi kerak; DNK markerining o‘zi genning qaysi darajada faollashganini ko‘rsatmaydi.

Ishning amaliy ahamiyati shundan iboratki, markerlar bilan tasdiqlangan va fenotipik jihatdan chidamli genotiplar seleksiya dasturlarida ota-ona shakllari sifatida tanlanishi mumkin. Buning natijasida qurg‘oqchilikka chidamli, mahalliy sharoitda barqaror hosil beradigan moyli zig‘ir navlarini yaratish jarayonida dastlabki materialni saralash samaradorligi oshishi mumkin.

Xulosa.

Moyli zig‘irning qurg‘oqchilikka chidamliligini o‘rganishda DNK markerlari genetik xilma-xillikni aniqlash va chidamlilik bilan bog‘liq lokuslarni izlash uchun istiqbolli vosita hisoblanadi. Tadqiqotda SSR va/yoki SNP markerlarini fenotipik baholash bilan birgalikda qo‘llash, DNK sifatini nazorat qilish hamda natijalarni tegishli statistik tahlil qilish muhimdir. Qurg‘oqchilikka chidamlilik ko‘p omilli belgi bo‘lgani sababli, marker bilan aniqlangan farqlar nazoratli tajriba va dala sharoitida tasdiqlanishi zarur. Shu yondashuv moyli zig‘irning istiqbolli genotiplarini tanlash va markerlarga asoslangan seleksiya ishlarini rivojlantirishga xizmat qilishi mumkin.

FOYDALANILGAN ADABIYOTLAR.

1. Zhang J. va boshq. Genome-wide analysis of drought induced gene expression changes in flax (Linum usitatissimum). Genomics, 2016. PMC5033203.
2. Identifying drought-resilient flax genotypes and related-candidate genes based on stress indices, root traits and selective sweep. Agriculture and Agri-Food Canada ilmiy nashr yozuvi, 2018.
3. Zhou J. va boshq. Transcriptome analysis and molecular mechanism of linseed (Linum usitatissimum L.) drought tolerance under repeated drought using single-molecule long-read sequencing. BMC Genomics, 2021. doi:10.1186/s12864-021-07416-5.
4. Cloutier S., Niu Z., Datla R., Duguid S. Development and analysis of EST-SSRs for flax (Linum usitatissimum L.). Theoretical and Applied Genetics. 2009;119:53–63. doi:10.1007/s00122-009-1016-3.
5. Development of Novel SSR Markers for Flax (Linum usitatissimum L.) Using Reduced-Representation Genome Sequencing. PubMed PMID: 28133461, 2017.
6. Soto-Cerda B.J. va boshq. Integrating multi-locus genome-wide association studies with transcriptomic data to identify genetic loci underlying adult root trait responses to drought stress in flax (Linum usitatissimum L.). Environmental and Experimental Botany. 2022;202:105019. doi:10.1016/j.envexpbot.2022.105019.

«СОВРЕМЕННЫЕ ТЕНДЕНЦИИ РАЗВИТИЯ МОЛЕКУЛЯРНОЙ БИОЛОГИИ И ГЕНЕТИКИ»

Давлатова Н.О. , Сафарова З.Х. , Абдусаматова М.Б.

Самаркандский Государственный Педагогический Институт

e-mail: davlatovanilu071@gmail.com

Annotatsiya. *XXI asrda biologiya fani molekulyar texnologiyalar, bioinformatika va genetik tahrirlashning rivojlanishi tufayli tub o‘zgarishlarni boshdan kechirmoqda. So‘nggi o‘n yilliklarda CRISPR-Cas9 texnologiyasi, individual genomlarni sekvenirlash va sintetik biologiya kabi kashfiyotlar tirik tizimlar haqidagi tasavvurlarni tubdan o‘zgartirmoqda. Ushbu maqolada zamonaviy biologiyaning asosiy yutuqlari, ularning amaliy qo‘llanilishi hamda ulardan foydalanish bilan bog‘liq axloqiy masalalar ko‘rib chiqiladi. Genetik tahrirlash: CRISPR-Cas9 va uning qo‘llanilishi. CRISPR-Cas9 tizimining ishlash prinsipi. CRISPR-Cas9 — bakteriyalardan olingan genomni tahrirlash tizimi bo‘lib, dastlab ularni viruslardan himoya qilish vazifasini bajaradi. Ushbu mexanizm yo‘naltiruvchi RNK (sgRNA) yordamida Cas9 fermentini DNKning muayyan qismini kesish joyiga yo‘naltirishga asoslangan. DNK kesilgandan so‘ng hujayrada reparatsiya, ya’ni tiklanish jarayonlari boshlanadi. Bu jarayonlar genetik materialning ayrim qismlarini olib tashlash, almashtirish yoki yangi genetik ketma-ketliklarni kiritish imkonini beradi.*

Kalit so‘zlar: *genetika, biotexnologiyalar, sun’iy xromosomalar, CRISPR-Cas9.*

Аннотация. *В XXI веке такая наука как биология, переживает революционные изменения благодаря развитию молекулярных технологий, биоинформатики и генетического редактирования. Открытия последних десятилетий, такие как CRISPR-Cas9, секвенирование индивидуальных геномов и синтетическая биология, кардинально заменяют представления о живых системах. В данной статье рассматриваются ключевые достижения современной биологии, их практическос применение и этические вопросы, связанные с их использованием. Генетическое редактирование: CRISPR-Cas9 и его применение . Принцин работы CRISPR-Cas9 CRISPR-Cas9 - это система редактирования генома, заимствованная у бактерий, которая выполняет защитную функцию оставляя вирусов. Механизм основан на направляющей РНК (sgRNA), которая показывает ферменту Cas9 место разреза ДНК. После разреза клетка запускает процессы репарации, позволяющие удалять, заменять или вставлять новые гены.*

Ключевые слова: *Генетика, биотехнологии, искусственные хромосомы, CRISPR .*

Введение. Актуальность темы. В данной статье предоставляется информация о всестороннем погружении современных методов молекулярной биологии, которые лежат в основе прорывных исследований в генетике, молекулярной биологии, биомедицине и биотехнологиях. Программа выходит за рамки теоретического описания и делает акцент на понимании принципов работы, возможностей и ограничений каждой технологии, а также на интерпретации получаемых данных.

Проблемы. Темп генерации новых знаний в молекулярных науках экспоненциально ускоряет скорость их интеграции в клинические рекомендации и, что не мало важно , входит в систему постдипломного образования. Врач, окончивший институт 10-15 лет назад, мог получить лишь обзорные знания по генетике, в то время как сегодня расшифровка генома стала рутинной процедурой в исследовательских лабораториях. Возникает опасный разрыв: пациенты приходят на прием с результатами коммерческих генетических тестирований, а у врача зачастую нет ни времени, ни компетенций, чтобы корректно интерпретировать эти данные и встроить их в лечебную тактику. Это создает почву для ошибок, недоверия и упущенных возможностей для ранней профилактики.

Значение генетики и молекулярной биологии в нашей жизни

Генетика - одна из биологических наук, изучающая закономерности наследственности и изменчивости, характерные для живых организмов. Слово генетика - в переводе с греческого, означающее рождение, происхождение, было названо в 1906 году английским ученым У. Бетсоном и было включено в биологические науки. Наследственность является основой для передачи черт и характеристик живых организмов от поколения к поколению и действует как мост между поколениями.

Молекулярная биология, дисциплина, ставящая своей задачей познание природы явлений жизнедеятельности путём изучения биологических объектов и систем на уровне, приближающемся к молекулярному, а в ряде случаев и достигающем этого предела. Конечной целью при этом является выяснение того, каким образом и в какой мере характерные проявления жизни, такие как наследственность, воспроизведение себе подобного, биосинтез белков, возбудимость, рост и развитие, хранение и передача информации, превращения энергии, подвижность и т. д., обусловлены структурой, свойствами и взаимодействием молекул биологически важных веществ, в первую очередь двух главных классов высокомолекулярных биополимеров — белков и нуклеиновых кислот. Отличительная черта молекулярной биологии — изучение

явлений жизни на неживых объектах или таких, которым присущи самые примитивные проявления жизни. Таковыми являются биологические образования от клеточного уровня и ниже: субклеточные органеллы, такие, как изолированные клеточные ядра, митохондрии, рибосомы, хромосомы, клеточные мембраны; далее — системы, стоящие на границе живой и неживой природы, — вирусы, в том числе и бактериофаги, и кончая молекулами важнейших компонентов живой материи — нуклеиновых кислот и белков.

Цель. Развитие генетики в будущем позволит излечивать многие неизлечимые или сложные заболевания, подбирать индивидуальные схемы терапии и увеличивать продолжительность жизни, а кроме того, проводить более точную экспертизу биоматериала. Но обо всем по порядку. Одним из наиболее значительных достижений в области генетики станет широкое использование технологий редактирования генов, таких как CRISPR, или геномные ножницы, когда лишние гены удаляют из генома. С 2023 года этот подход начали использовать в медицине для лечения наследственных заболеваний. Технология не только устраняет генетические поломки, но и улучшает здоровье на уровне ДНК. По прогнозам ученых, к 2050 году с ее помощью можно будет лечить таких сложные болезни, как муковисцидоз и гемофилия, их будут корректировать на этапе эмбрионального развития. Ученые уже пытаются таким образом работать с синдромом Дауна. Недавно японские исследователи впервые успешно применили технологию для удаления лишней 21-й хромосомы. Метод показал эффективность до 37,5% в восстановлении нормальной функции клеток. Кроме того, редактирование генов будут применять для повышения устойчивости к инфекциям и хроническим заболеваниям, таким как диабет и сердечно-сосудистые болезни. Доктор биологических наук, заведующая лабораторией анализа генома Института общей генетики им. Н. И. Вавилова , РАН Светлана Боринская рассказала, что генетики научились не только вырезать, но и на время выключать гены, которые нужны вирусу, которые не являются жизненно необходимыми человеку. Если заблокировать их на несколько дней, инфекция оборвется, и вирус просто не сможет развиваться. За это время иммунная система накопит антитела для защиты.

Эффективно показала себя и генная терапия. С ее помощью уже можно обходить различные барьеры организма. Например, успешно борется со спинально-мышечной атрофией (СМА) препарат генной терапии «Золгенсма». Эта болезнь возникает из-за того, что в клетках не хватает белка, который называется SMN. Этот белок очень

важен для нормальной работы двигательных нейронов — клеток, которые помогают нашим мышцам двигаться. Молекулярная биология уже сегодня меняет нашу реальность, но в ближайшие десятилетия она способна перевернуть ключевые сферы человеческой жизни. Развитие технологий редактирования генома, синтетической биологии и анализа единичных клеток приведет к фундаментальным сдвигам. На примере информационные технологии и материалы или экология и биоэнергетика мы можем это увидеть. **ДНК-хранилища данных:** Молекула ДНК способна хранить колоссальные объемы информации миллиарды лет. В будущем дата-центры размером с футбольные поля смогут сжаться до размеров кофейной чашки. **Биокомпьютеры:** Создание живых клеточных компьютеров, способных проводить вычисления и мониторинг внутри человеческого организма в режиме реального времени. **Живые материалы:** Разработка самовосстанавливающихся стройматериалов и тканей на основе выращенных белковых структур (например, искусственной паутины). **Борьба с пластиковым загрязнением:** Создание искусственных бактерий и ферментов, способных за считанные дни полностью расщеплять пластик, токсичные отходы и нефтепродукты. **Биотопливо нового поколения:** Высокоэффективным источником станут модифицированные микроводоросли, способные экологически заменить углеводороды чистого топлива. **Биоминерализация:** Использование микроорганизмов для того, чтобы улавливать избыточный углекислый газ из атмосферы и превращать его в твердые безопасные минералы.

Заключение и выводы: Молекулярная биология и генетика перестали быть узкоспециализированными областями. Они стали языком, на котором говорит современная медицинская наука. Специалист , который не владеет этим языком, рискует превратиться в технического исполнителя устаревших протоколов, не способного понять ни причину болезни конкретного человека, ни механизм действия новых препаратов, ни данные его генетического паспорта. В антивозрастной медицине, где мы имеем дело с комплексными, многофакторными процессами старения, этот подход заведомо будет провален. Области молекулярных основ медицины - это инвестиция вложенная в профессиональное будущее. Это переход от работы со следствиями к управлению причинами реактивного лечения а так же к активному превентивному управлению здоровьем. От стандартных шаблонных схем к истинно персонализированной науке, где каждый научный шаг обоснован глубоким пониманием уникальной биологии.

СПИСОК ЛИТЕРАТУРЫ:

1. Alijonovich R. M., Madumarovna N. M. QISHLOQ XO ‘JALIGI BIOTEXNOLOGIYASI //Science and innovation. – 2023. – Т. 2. Issue 6. – С. 315-317

2. .Alijonovich R. M. et al. EFFICIENT BEEF PRODUCTION TECHNOLOGY //Proceedings of International Conference on Educational Discoveries and Humanities. – 2023. – Т. 2. – №. 4. – С. 259-263

3. “САМАЯ ГЛАВНАЯ МОЛЕКУЛА” Максим Франк-Каменецкий

4. Биология [Текст] : учеб.для вузов : в 2-х т. / под ред. В. Н. Ярыгина. – М. : ГЭОТАР-Медиа, 2012. – Т. 1. – 736 с.

5. Слюсарев, А. А. Биология с общей генетикой [Текст] : учеб. / А. А. Слюсарев. - 2-е изд., стереотип. - М. : Альянс, 2015. - 472 с.

6. Пехов, А. П. Биология: медицинская биология, генетика и паразитология [Электронный ресурс] : учебник для вузов / А. П. Пехов. - 3-е изд., стереотип. - М. : ГЭОТАР-Медиа, 2014. – 656 с. – Режим доступа: http://www.studentlibrary.ru/book/ISBN9785970430729.html

UDK: 602.6:631.544

GIDROPONIKA TIZIMLARIDA O‘SIMLIKLAR PATOGENLARIGA QARSHI EKSPRESS BIOTEST-DIAGNOSTIKASI VA MIKROBIAL ANTAGONISTLARNI QO‘LLASH TEXNOLOGIYASI

Rashidov Nuriddin

Toshkent irrigatsiya va

qishloq xo‘jaligini mexanizatsiyalash

muhandislari instituti” Milliy tadqiqot

universiteti biotexnologiya talabasi

nur1k04.70v935la@gmail.com

Annotatsiya. *Ushbu maqolada gidroponika sharoitida yetishtiriladigan sabzavot ekinlarining ildiz tizimi va oziqlantiruvchi muhitida uchraydigan fitopatogen zamburug‘larni erta tashxislash uchun biotest-diagnostika usullari va ularga qarshi kurashishda mikrobial antagonistlarning samaradorligi tadqiq qilingan. Bacillus subtilis BS-04 va Trichoderma harzianum TH-02 shtammlarining Pythium ultimum hamda Fusarium oxysporum patogenlariga nisbatan antagonistik faolligi baholangan. Tadqiqot natijalari antagonist shtammlarni gidroponik eritmalarga kiritish orqali hosildorlikni 22-28% ga oshirish va kimyoviy vositalardan foydalanishni 80% ga kamaytirish imkonini berishini ko‘rsatdi.*

Kalit so‘zlar: *biotexnologiya, gidroponika, fitopatogenlar, biotest-diagnostika, Bacillus subtilis, Trichoderma harzianum, biofungitsidlar, antagonistlar, oziqlantiruvchi eritma.*

Abstract. *This article investigates biotest-based diagnostic methods for the early detection of phytopathogenic fungi in the root systems and nutrient media of hydroponically grown vegetable crops, as well as the effectiveness of microbial antagonists in controlling these pathogens. The antagonistic activity of Bacillus subtilis BS-04 and Trichoderma harzianum TH-02 strains against the pathogens Pythium ultimum and Fusarium oxysporum was evaluated. The results demonstrated that introducing antagonist strains into hydroponic nutrient solutions could increase crop yields by 22–28% and reduce the use of chemical agents by 80%.*

Keywords: *biotechnology, hydroponics, phytopathogens, biotest-based diagnostics, Bacillus subtilis, Trichoderma harzianum, biofungicides, antagonists, nutrient solution.*

Kirish

Aholi sonining ortishi, qishloq xo‘jaligiga yaroqli yerlar va suv resurslarining cheklanishi oziq-ovqat mahsulotlarini yetishtirishda resurs tejamkor texnologiyalardan foydalanish zaruratini kuchaytirmoqda. Gidroponika o‘simliklarni tuproqsiz sharoitda, oziqlantiruvchi eritmalar va

tegishli substratlar yordamida yetishtirish imkonini beradigan zamonaviy texnologiyalardan biridir.

Gidroponik tizimlarning afzalliklari bilan bir qatorda, fitosanitar xavflari ham mavjud. Xususan, oziqlantiruvchi eritmaning qayta aylanishi ayrim patogenlarning tizim bo‘ylab tarqalishiga sharoit yaratishi mumkin. *Pythium* avlodiga mansub oomitsetlar va *Fusarium* avlodiga mansub zamburug‘lar ildiz tizimining zararlanishi, o‘simliklarning so‘lishi va hosildorlikning pasayishiga sabab bo‘lishi mumkin. Gidroponik ekinlarda *Pythium* bilan bog‘liq ildiz chirishi kasalliklarining tarqalishi va ularni boshqarish masalalari ilmiy adabiyotlarda ham yoritilgan [1].

Kasallikning dastlabki bosqichlarida tashqi alomatlar yaqqol namoyon bo‘lmasligi mumkin. Shu sababli faqat vizual kuzatuvga asoslangan diagnostika yetarli bo‘lmaydi. Mikrobiologik ekish, indikator o‘simliklar va polimeraza zanjir reaksiyasi (PCR/PZR) kabi molekulyar usullarni birgalikda qo‘llash patogenlarni aniqlash imkoniyatlarini kengaytiradi.

O‘simliklarni biologik himoya qilishda foydali mikroorganizmlardan foydalanish ham muhim yo‘nalish hisoblanadi. *Bacillus subtilis* bakteriyalari va *Trichoderma* avlodiga mansub zamburug‘lar ayrim fitopatogenlarning rivojlanishini raqobat, antimikrob metabolitlar ishlab chiqarish va boshqa biologik mexanizmlar orqali cheklashi mumkin [2, 3]. Biroq bu xususiyatlar har bir shtamm uchun alohida tekshirilishi lozim.

Tadqiqotning maqsadi gidroponik tizimlarda fitopatogenlarni erta aniqlash usullarini tahlil qilish hamda mikrobial antagonistlardan biologik himoya vositasi sifatida foydalanish imkoniyatlarini baholashdan iborat.

Tadqiqot vazifalari:

gidroponik tizimlarda fitopatogenlarni aniqlash usullarini tavsiflash;

Bacillus subtilis BS-04 va *Trichoderma harzianum* TH-02 shtammlarining antagonistik faolligini baholash yondashuvlarini yoritish;

alohida shtammlar va ularning konsortsiumini taqqoslash mezonlarini belgilash;

biologik himoya vositalarini gidroponik tizimlarda qo‘llash bo‘yicha amaliy tavsiyalar ishlab chiqish.

2 2. TADQIQOT MATERIALLARI VA USULLARI

Tadqiqot yo‘nalishi sifatida gidroponik sharoitda yetishtiriladigan pomidor (*Solanum lycopersicum* L.) va bodring (*Cucumis sativus* L.) ekinlari, oziqlantiruvchi eritma va zararlangan ildiz namunalari, shuningdek, *Bacillus subtilis* BS-04 va *Trichoderma harzianum* TH-02 shtammlari tanlangan.

2.1. Fitopatogenlarni ekspress-diagnostika qilish

Fitopatogenlarni aniqlashda vizual kuzatuv, mikrobiologik ekish va molekulyar diagnostika usullaridan foydalanish mumkin. Vizual kuzatuvda ildizlarning qorayishi, yumshashi, chirishi va o‘simliklarning so‘lishi kabi belgilar baholanadi.

Mikrobiologik tekshiruvda namunalar tegishli oziq muhitlariga ekilib, hosil bo‘lgan koloniyalarning morfologik xususiyatlari o‘rganiladi. Kartoshka-dekstrozali agar (PDA) va boshqa mos muhitlardan foydalanish mumkin. Molekulyar diagnostikada esa maqsadli patogenga xos genetik material PCR usuli yordamida aniqlanadi.

PCR natijasi patogenning genetik materiali mavjudligini ko‘rsatadi, biroq uning tirikligi yoki kasallik qo‘zg‘atish qobiliyatini har doim ham tasdiqlamaydi. Shu sababli molekulyar tahlilni mikrobiologik va fitopatologik tekshiruvlar bilan birgalikda baholash maqsadga muvofiq.

2.2. Mikrobial antagonistlarni baholash

Bacillus subtilis BS-04 bakterial shtammi va *Trichoderma harzianum* TH-02 zamburug‘ shtammining antagonistik xususiyatlarini baholash uchun ularning o‘sish ko‘rsatkichlari hamda fitopatogenlarga ta’siri tekshiriladi.

Bakterial shtamm uchun dastlabki tavsifda 30 °C harorat, 180 ayl/min aralashtirish tezligi va 48 soatlik o‘stirish muddati keltirilgan. Bu parametrlar shtammning haqiqiy o‘sish xususiyatlariga muvofiqligi bilan tasdiqlanishi lozim. *Trichoderma* shtammi tegishli agarli oziq muhitida yetishtiriladi.

2.3. Antagonistik faollikni aniqlash

Antagonistlarning patogenlarga ta’sirini baholashda dual-kultura, ya’ni qarama-qarshi o‘stirish usulidan foydalanish mumkin. Patogen koloniya o‘sishining tormozlanish indeksi quyidagi formula bilan hisoblanadi:

$$I = \frac{R_1 - R_2}{R_1} \times 100$$

Bu yerda:

(I) — patogen o‘sishining tormozlanish indeksi, %;

(R_1) — nazorat variantidagi patogen koloniya radiusi, mm;

(R_2) — antagonist bilan birgalikda o‘stirilgan patogen koloniya radiusi, mm.

Olingan natijalar nazorat va tajriba variantlari bo‘yicha taqqoslanadi. Ishonchli xulosa chiqarish uchun biologik takrorlar soni, o‘rtacha qiymat, standart og‘ish yoki standart xatolik hamda tegishli statistik tahlil ko‘rsatilishi kerak.

Bu yerda:

(I) — patogen o‘sishining tormozlanish indeksi, %;

(R_1) — nazorat variantidagi patogen koloniya radiusi, mm;

(R_2) — antagonist bilan birgalikda o‘stirilgan patogen koloniya radiusi, mm.

Olingan natijalar nazorat va tajriba variantlari bo‘yicha taqqoslanadi. Ishonchli xulosa chiqarish uchun biologik takrorlar soni, o‘rtacha qiymat, standart og‘ish yoki standart xatolik hamda tegishli statistik tahlil ko‘rsatilishi kerak.

3. TADQIQOT NATIJALARI VA MUHOKAMASI

3.1. Ekspress-diagnostikaning ahamiyati

Gidroponik tizimlarda fitopatogenlarni erta aniqlash kasallik tarqalishining oldini olishga qaratilgan choralarni o‘z vaqtida rejalashtirish imkonini beradi. Vizual kuzatuv kasallik alomatlari paydo bo‘lgandan keyin ma’lumot bersa, molekulyar va mikrobiologik usullar patogenni aniqlashning qo‘shimcha imkoniyatlarini yaratadi.

Patogenlarni vizual alomatlar paydo bo‘lishidan 4–6 kun oldin aniqlash haqidagi ko‘rsatkich dastlabki materialda keltirilgan. Ushbu muddatni ilmiy natija sifatida tasdiqlash uchun namunalarni olish jadvali, diagnostika sezgirligi va maxsusligi, nazorat namunalari hamda tajriba takrorlari haqidagi ma’lumotlar zarur.

3.2. Mikrobial antagonistlarning faolligi

Muallif taqdim etgan dastlabki ma’lumotlarda antagonist shtammlarning fitopatogenlar o‘sishiga tormozlovchi ta’siri quyidagicha ko‘rsatilgan.

1-jadval. Antagonist shtammlarning fitopatogenlar o‘sishiga tormozlovchi ta’siri, %

Antagonist shtamm	***P. ultimum***	***F. oxysporum***	***R. solani***
B. subtilis BS-04	84,5 ± 2,1	79,2 ± 1,8	76,0 ± 2,3
T. harzianum TH-02	88,0 ± 1,5	85,4 ± 2,0	81,7 ± 1,9
BS-04 + TH-02 konsortsiumi	94,2 ± 1,1	91,8 ± 1,4	89,5 ± 1,6

Izoh: jadvaldagi qiymatlar muallif taqdim etgan ma’lumotlar asosida berilgan. Ular birlamchi laboratoriya bayonnomalari bilan tasdiqlanishi, “±” belgisining mazmuni va takrorlar soni ko‘rsatilishi kerak.

Jadvaldagi qiymatlar tasdiqlangan taqdirda, konsortsium variantida uchala patogenga nisbatan ham yuqoriroq tormozlanish ko‘rsatkichi kuzatilganini qayd etish mumkin. Biroq ushbu farqning statistik ahamiyati va konsortsiumning sinergik ta’siri alohida tekshirilishi lozim.

Bacillus subtilis ayrim antimikrob metabolitlarni, jumladan, lipopeptidlarni ishlab chiqarishi mumkin. *Trichoderma* vakillari esa raqobat, mikoparazitizm va gidrolitik fermentlar faoliyati orqali ayrim patogenlarni cheklashi mumkin. Mazkur mexanizmlarning aynan BS-04 va TH-02 shtammlarida mavjudligi maxsus tajribalar bilan tasdiqlanishi zarur.

3.3. Gidroponik tizimlarda biologik himoya imkoniyatlari

Mikrobial antagonistlardan foydalanishning maqsadi ildiz atrofidagi mikrobiologik muhitni barqarorlashtirish, patogenlarning rivojlanishini cheklash va o‘simliklarning sog‘lom o‘sishiga ko‘maklashishdan iborat. Gidroponik tizimlarda biologik vositalarning samaradorligi shtamm xususiyatlari, eritmaning harorati va pH ko‘rsatkichi, kislorod miqdori, oziq moddalari tarkibi hamda mikroorganizmlarning ildiz yuzasida saqlanib qolish qobiliyatiga bog‘liq.

Dastlabki materialda konsortsiumni (10^7) KHB/ml konsentratsiyada qo‘llash qayd etilgan. Ushbu konsentratsiya tavsiya sifatida berilishidan oldin uning o‘lchov birligi, shtammlar nisbati, tirik mikroorganizmlar miqdori va o‘simlik uchun xavfsizligi aniqlanishi kerak.

Pomidor hosildorligining 22,4%, bodring hosildorligining 27,8% ga ortishi hamda kasallanish darajasining 4,2 baravar kamayishi haqidagi ma’lumotlar mavjud bo‘lsa, ular nazorat va tajriba variantlari bo‘yicha haqiqiy o‘lchovlar, tajriba davomiyligi va statistik tahlil bilan asoslanishi lozim. Bunday dalillarsiz ushbu raqamlarni tasdiqlangan ilmiy natija sifatida taqdim etish to‘g‘ri emas.

Biologik himoya vositalarini sanitariya tadbirlari, oziqlantiruvchi eritma sifatini nazorat qilish va muntazam diagnostika bilan birgalikda qo‘llash maqsadga muvofiq. Ular kimyoviy fungitsidlardan to‘liq voz kechishni barcha sharoitlarda kafolatlamaydi; vositalarni tanlashda tegishli ekin va yetishtirish tizimi uchun ruxsat etilganlik talablari ham hisobga olinishi kerak.

XULOSA

Gidroponik tizimlarda fitopatogenlarni erta aniqlash o‘simliklarni himoya qilish va kasalliklarning tarqalish xavfini kamaytirishning muhim shartlaridan biridir. Vizual kuzatuv, mikrobiologik tekshiruv va molekulyar diagnostikani birgalikda qo‘llash patogenlarni aniqlash imkoniyatlarini kengaytiradi.

Bacillus subtilis BS-04 va *Trichoderma harzianum* TH-02 shtammlari biologik himoya vositalari sifatida o‘rganish uchun istiqbolli nomzodlar hisoblanadi. Ularning alohida va birgalikdagi samaradorligini aniqlash uchun laboratoriya sinovlari bilan bir qatorda gidroponik sharoitdagi nazoratli vegetatsion tajribalar ham o‘tkazilishi lozim.

Amaliy jihatdan diagnostika natijalariga asoslangan profilaktika, mikrobiologik xavfsizlik talablari, oziqlantiruvchi eritma parametrlarini nazorat qilish va biologik vositalardan ilmiy asoslangan holda foydalanish tavsiya etiladi. Taklif etilgan yondashuvlarning hosildorlikka va kasallanish darajasiga ta’siri tegishli tajribalar va statistik tahlil orqali tasdiqlanishi kerak.

FOYDALANILGAN ADABIYOTLAR

1. Sutton J. C., Sopher C. R., Owen-Going T. N., Liu W., Grodzinski B., Hall J. C., Benchimol R. L. Etiology and epidemiology of *Pythium* root rot in hydroponic crops:

current knowledge and perspectives. *Fitopatologia Brasileira*. 2006; 31(4). DOI: https://doi.org/10.1590/S0100-54052006000400001.

2. Kanjanamaneesathian M. Biological Control of Diseases of Vegetables Grown Hydroponically in Thailand: Challenge and Opportunity. *Recent Patents on Biotechnology*. 2015; 9(3). DOI: https://doi.org/10.2174/1872208310666160414102201.
3. Cernava T., Berg G. The emergence of disease-preventing bacteria within the plant microbiota. *Environmental Microbiology*. 2022; 24: 3259–3263. DOI: https://doi.org/10.1111/1462-2920.15896.

SELEKSIYA: NAZARIYA ASOSLAR , USULLAR VA ZAMONAVIY RIVOJLANISH YO‘NALISHLARI

Anvarova Mubinaxon Rustamjon qizi.

Jizzax davlat pedagogika universiteti. Tabiiy fanlar pedagogika oliy maktabi, Biologiya yo'nalishi 2 - bosqich talabasi.

Ilmiy rahbar: dotsent Qarshiboyeva N.H.

Annotatsiya*: Mazkur maqolada seleksiyaning biologiya fanidagi o'rni, uning nazariya va amaliy asoslari, asosiy usullari hamda zamonaviy rivojlanish yo'nalishlari yoritilgan. Seleksiya inson ehtiyojlari uchun foydali xususiyatlarga ega bo'lgan o'simlik navlari, hayvonlarning zotlari va mikroorganizmlarning shtammlarini yaratish hamda takomillashtirishga qaratilgan muhim ilmiy – amaliy yo'nalish hisoblanadi. Maqolada sun'iy tanlash, duragaylash, mutatsion seleksiya, poliplodiya va boshqa boshqa usullarning mohiyati tahlil qilingan. Shuningdek, genetika, molekulyar biologiya va biotexnologiyaning zamonaviy seleksiyadagi ahamiyati o'rganilgan. Seleksiyaning qishloq xo'jaligi, oziq – ovqat xavfsizligi, chorvachilik va biotexnologiya rivojidagi ahamiyati ham bayon etilgan .*

Kalit so'zlar: *seleksiya, genetika, sun'iy, tanlash, duragaylash, mutatsiya, poliplodiya, nav, zot, shtamm, gibrid, biotexnologiya, genetik xilma- xillik.*

Abstract. *This article discusses the role of selection in biological sciences, its theoretical and practical foundations, major methods, and modern development trends. Selection is an important scientific and practical field aimed at developing and improving plant varieties, animal breeds, and microorganism strains with beneficial characteristics to meet human needs. The article analyzes the principles of artificial selection, hybridization, mutation breeding, polyploidy, and other methods. It also examines the significance of genetics, molecular biology, and biotechnology*

in modern selection. Furthermore, the importance of selection in the development of agriculture, food security, animal husbandry, and biotechnology is highlighted.

Keywords: *selection, genetics, artificial selection, hybridization, mutation, polyploidy, variety, breed, strain, hybrid, biotechnology, genetic diversity.*

KIRISH: Insoniyat taraqqiyoti davomida o'simlik va hayvonlardan olinadigan mahsulotlarga bo'lgan ehtiyojlari doimo ortib kelgan. Aholi sonining ko'payishi, iqlim sharoitlarining o'zgarishi, yer va suv resurslarining cheklanganligi qishloq xo'jaligida yuqori maxsuldor, kasallik va zararkunandalarga chidamli, noqulay ekologik sharoitlarga moslashgan organizmlarning yaratishni talab qilmoqda. Bunday vazifalarni amalga oshirishda seleksiyaning ahamiyati nihoyatda katta.

Seleksiya lotincha "selectio" - "tanlash" ma'nosini anglatadi. Biologik nuqtayi nazardan olinganda seleksiya inson tomonidan foydali belgi va xususiyatlarga ega organizmlarning tanlash, ularning ko'paytirish va yangi shakllarni yaratishga qaratilgan fan va amaliy faoliyati hisoblanadi. Seleksiya genetika bilan chambarchas bog'liq chunki organizmlarning irsiy belgilar va ularning avloddan – avlodga o'tishi haqidagi bilimlar seleksionerga kerakli xususiyatlarni shakllantirish imkonini beradi. Irsiyat va o'zgaruvchanlik qonuniyatlarini bilmasdan turib samarali seleksiya ishlarini olib borishi qiyin. Bugungi kunda seleksiya nafaqat an'anaviy tanlash va chatishtirish usullariga, balki molekulyar genetika, genomika, biotexnologiya va boshqa zamonaviy fan yutuqlariga ham tayanmoqda.

Gregor Mendelning irsiyat qonunlarini kashf etishi organizmlardagi belgilarning avloddan - avlodga o'tishi mexanizmlarini tushunishga imkon berdi. Keyinchalik mutatsiyalar , xromasomalar , genlar va DNK haqidagi bilimlarning rivojlanishi seleksiyaning ilmiy asoslarini yanada kengaytirdi .

Seleksiyaning asosiy vazifalari shulardan iboratki ular inson uchun foydali bo'lgan belgilarni kuchaytirish va yangi biologik shakllarini yaratishdan iborat ularga :

- Yuqori hosildorlik
- Kasalliklarga chidamlilik
- Zarakunandalarga chidamlilik
- Qurg'oqchilikka moslashuvchanlik
- Sovuqqa chidamlilik
- Mahsulot sifatining yuqoriligi
- Tez pishish
- Mexanizatsiyalashgan yig'im – terimga moslashish .

Hayvonlarning seleksiyasiyasida esa sut , go'sht , tuxum va boshqa maxsulotlarning miqdori va sifati , tez o'sishi , kasalliklarga chidamlilik va tashqi muhitga moslashuvchanlik kabi belgilar muhim hisoblanadi . Mikroorganizmlarning seleksiyasida esa foydali moddalarni ko'proq ishlab chiqaradigan , sanoatda foydalanish uchun qulay bo'lgan shtammlarni olishga e'tibor qaratiladi .

Seleksiyaning asosiy usullari :

Tanlash: seleksiyaning eng qadimgi va asosiy usullaridan biridir . Seleksiyada inson o'ziga kerakli belgilarni nomoyon qilgan organizmlarni ajratib oladi va ularning ko'paytiradi . Tanlash individual va ommaviyshaklda amalga oshirilishi mumkin . Individual tanlashda alohida organizmning belgilariga e'tibor qaratiladi. Ommaviy tanlashda esa bir xil foydali xususiyatlarga ega bo'lgan organizmlar guruhi tanlanadi.

Duragaylash: genetik jihatdan farqli organizmlarni organizmlarni chatishtirish orqali yangi avlod olish usulidir . Ushbu usul yordamida ota – ona organizmlarining foydali belgilarni bitta avlodda birlashtirish maqsad qilinadi . Masalan : bir nav yuqori hosildor , ikkinchi nav esa kasalliklarga chidamli bo'lsa , ularning chatishtirish orqali ikkala xususiyatni o'zida birlashtiruvchi avlod olishga harakat qilinadi . Duragaylash seleksiyada genetik xilma – xillikni kengaytirish va yangi kombinatsiyalar hosil qilishning muhim usuli hisoblanadi.

Mutatsiya: organizm genetik materialida yuz beradigan o'zgarishdir . Ayrim mutatsiyalar organizm uchun foydali belgilarni yuzaga keltirish mumkin. Seleksiyada tabiiy yoki maxsus sharoit hosil bo'lgan mutatsiyalardan foydalanib, foydali xususiyatga ega shakllari tanlab olinadi . Mutatsion seleksiya ayniqsa o'simliklarning yangi navlariini yaratishda muhim usullardan biri hisoblanadi .

Poliploidiya: hujayradagi xromasomalar to'plamining ikki to'plamining ikki to'plamdan ko'proq bo'lishidir . O'simliklarda poliploidiya ayrim hollarda hujayra va organlarning yiriklashishi , mahsuldorlik kabi belgilar bilan bog'liq bo'lishi mumkin . Seleksionerlar poliploidiya shakllaridan yangi nmavlar yaratishda foydalanadilar .

Geterozis - deb ataluvchi hodisada ayrim duragaylar ota – ona shakllariga nisbatan ayrim belgilar bo'yicha yuqoriroq ko'rsatkich namoyon qilishi mumkin. Masalan: o'sish tezligi yoki hosildorlik kabi xususiyatlarda ustunlik kuzatishi mumkin . Geterozis hodisasi qishloq xo'jaligi ekinlari seleksiyasida keng o'rganilgan va amaliy jihatdan muhim hisoblanadi .

O'simliklar seleksiyasi: qishloq xo'jaligining muhim ilmiy yo'nalishlaridan baridir . Bugungi kunda bug'doy , paxta , makkajo'xori , guruch, kartoshka, pomidor, mevali daraxtlar va boshqa ekinlarning ko'plab navlari seleksiya natijasida yaratilgan . O'simliklar seleksiyasida hosildorlik bilan bir qatorda mahsulotning sifati ham katta ahamiyatga ega . Masalan : don

ekinlarida oqsil miqdori , meva va sabzavotlarda ta'm , saqlanish muddati hamda transportga chidamlilik kabi belgilar hisobga olinadi . Iqlim o'zgarishi sharoitida qurg'oqchilikka , yuqori haroratga sho'rlanishga va boshqa noqulay omillarga chidamli navlarni yaratish ham dolzarb vazifalardan biridir .

Hayvonlar seleksiyasi: chorvachilik mahsuldorligini oshirishda muhim ahamiyatga ega . Seleksiya yordamida turli foydali xususiyatlarga ega hayvon zotlari shakllantiriladi . Chorvachilik hayvonlarning mahsuldorligi bilan bir qatorda sog'lomligi , kasaliklarga chidamliligi , mahaliy iqlim sharoitiga moslashuvi va ozuqadan samarali foydalanishi kabi belgilar ham hisobga olinadi . Hayvonlar seleksiyasida tanlash , chatishtirish va naslchilik hisob – kitoblari muhim o'rin tutadi . Zamonaviy genetika usullari esa hayvonlarning irsiy xususiyatlarini chuqurroq o'rganish imkonini bermoqda .

ZAMONAVIY SELEKSIYA VA BIOTEXNOLOGIYA

21 asrda seleksiya an'anaviy usulardan tashqari molekulyar biologiya va biotexnologiya yutuqlaridan ham foydalanmoqda . Molekulyar markerlar yordamida organizmning ayrim foydali belgilariga bog'liq genetik xususiyatlarni aniqlash mumkin . Bu seleksiya jarayonida kerakli genetik materialga ega organizmlarni tezroq tanlashga yordam beradi . Genomik, bioinformatika va DNK texnologiyalarining rivojlanishi organizmlarning genetik tuzilishini chuqur o'rganish imkonini bermoqda . Natijada seleksiya jarayonini aniqroq rejalashtirish va kerakli belgilarni izlash samaradorligini oshirish mumkin . Zamonaviy seleksiyaning muhim yo'nalishlaridan biri genomik seleksiya bo'lib , bunda organizmning ko'plab genetik ko'rsatkichlari asosida uning foydali belgilarini baholashga harakat qilinadi .

XULOSA : Seleksiya genetikada va biologiyaning amaliy ahamiyatga ega bo'lgan muhim yo'nalishlaridan biridir . U inson ehtiyojlariga mos foydali belgilarga ega o'simlik navlari hayvon zotlari va mikroorganizmlar shtammlarini yaratish hamda takomillashtirishga xizmat qiladi . Seleksiyaning nazariy asosini irsiyat va o’zgaruvchanlik qonuniyatlari tashkil etadi . Tanlash , duragaylash , mutatsion seleksiya , poliploidiya va geterozisdan foydalanish kabi usullar seleksiya amaliyotidamuhim o’rin egallaydi . Zamonaviy genetika , molekulyar biologiya , genomika va biotexnologiyaning rivojlanishi seleksiyaning imkoniyatlarini kengaytirmoqda . Ayniqsa , iqlim o’zgarishi , oziq – ovqat xavfsizligi va qishloq xo’jaligi samaradorligi haqidagi masalalarni hal qilishda seleksiya muhim ilmiy vositalardan biri bo’lib qolmoqda . Shunday qilib , seleksiya nafaqat biologiya fanining amaliy sohasi , balki qishloq xo’jaligi , oziq – ovqat sanoati , chorvachilik va biotexnologiyaning rivojlanishiga bevosita ta’sir ko’rsatuvchi muhim ilmiy yo’nalishdir .

FOYDALANILGAN ADABIYOTLAR

1 . O.Mavlonov., SH.Xurramov ., B. Eshonqulov. Biologiya 10 sinf uchun darslik. 2017 – yil . 240 – bet .

2. A.T.G'ofurov., S.S. Fayzullayev., Genetika . Toshkent: O'zbekiston Milliy ensiklopediyasi 2010 – yil .264 – bet .

3. S.S. Fayzullayev., A.T.G'ofurov ., H.Xolmatov . Genetika asoslari. 1991 – yil. 137 – bet. (Chirchiq davlat pedagogika universiteti) .

4. O.Mavlonov., T.Tilovov., B. Aminov ., Biologiya . Akademik litsey va kasb – hunar kollejlari uchun darslik. 2013 – yil . 288 – bet .

5. A.T. G'ofurov., J.O. Tolipova., N.Usmonova . Biologiya o'qitish metodikasi .,, O'zbekiston faylasuflari milliy jamiyat " nashriyoti. 2004 – yil . 160 – bet .

6. A.Zikiryayev., A.To'xtayev., I.Azimov., N.Sonin . Biologiya, sitologiya va genetika asoslari 9 – sinf darsligi . Darslik 2019 - yil .192 – bet. ‘’Yangiyul Poligraph Service‘’ nashriyotida chop etilgan.

ALOPECURUS PRATENSIS L. TURINING XLOROPLAST GENOM XUSUSIYATLARI.

D.E. Azimova Jizzax davlat pedagogika universiteti professor

D.S. Esanqulova Jizzax davlat pedagogika universiteti o'qituvchisi

desankulova5@gmail.com. +998882950046.

Annotatsiya*: Ushbu maqolada Poaceae oilasiga mansub muhim yem-xashak o'simligi hisoblangan Alopecurus pratensis L. turining xloroplast genom tuzilishi, gen tarkibi va filogenetik xususiyatlari tahlil qilindi. Tadqiqot natijalariga ko'ra, xloroplast genomining umumiy uzunligi 136 157 bp bo'lib, u katta yakka nusxali (LSC), kichik yakka nusxali (SSC) va ikkita teskari takroriy (IR) hududlardan tashkil topganligi aniqlandi. Genom tarkibi, GC miqdori, oqsil kodlovchi genlar soni hamda oddiy takrorlanuvchi ketma-ketliklar (SSR) tahlil qilindi. Shuningdek, boshqa Alopecurus turlari bilan qiyosiy genomik va filogenetik tahlillar o'tkazilib, turning evolyutsion qarindoshlik aloqalari yoritildi.*

Аннотация*: В данной статье проанализированы структура хлоропластного генома, генный состав и филогенетические особенности Alopecurus pratensis L. – важного кормового растения семейства Poaceae. Установлено, что полный хлоропластный геном имеет длину 136 157 п.н. и состоит из большой одно копийной области (LSC), малой одно*

копийной области (SSC) и двух инвертированных повторов (IR). Изучены содержание GC, количество белок-кодирующих генов и распределение простых повторяющихся последовательностей (SSR). Проведён сравнительный геномный и филогенетический анализ с другими видами рода Alopecurus, что позволило уточнить их эволюционные связи.

Abstract.*This article investigates the chloroplast genome structure, gene composition, and phylogenetic characteristics of Alopecurus pratensis L., an important forage species of the Poaceae family. The complete chloroplast genome was found to be 136,157 bp in length and exhibited a typical quadripartite structure consisting of a large single-copy (LSC) region, a small single-copy (SSC) region, and two inverted repeat (IR) regions. Genome composition, GC content, protein-coding genes, and simple sequence repeats (SSRs) were analyzed. Comparative genomic and phylogenetic analyses with related Alopecurus species revealed their evolutionary relationships and genetic affinities.*

Kalit so‘zlar: *Alopecurus pratensis L., Poaceae, xloroplast genom, plastoma, filogenetik tahlil, SSR markerlar, molekulyar sistematika, genom tuzilishi, evolyutsiya, bioinformatika.*

Ключевые слова: *Alopecurus pratensis L., Poaceae, хлоропластный геном, пластом, филогенетический анализ, SSR-маркеры, молекулярная систематика, структура генома, эволюция,биоинформатика.*

Keywords: *Alopecurus pratensis L., Poaceae, chloroplast genome, plastome, phylogenetic analysis, SSR markers, molecular systematics, genome structure, evolution, bioinformatics.*

Poaceae (bug'doydoshlar) oilasi - gulli o‘simliklar orasida eng yirik va eng muhim oilalardan biridir. Dunyo bo‘yicha bu oilaga tegishli **12 000 dan ortiq tur va taxminan 780 turkum** mavjud bo‘lib, ular ekologik jihatdan muhim hamda qishloq xo‘jaligida keng qo‘llaniladi. [5.7-b].

G‘allasimon o’simliklar, yaylov o‘tlari, bambuklar va boshqa ko‘plab o‘simliklar ushbu oilaga kiradi. Bu oilaning muhim turkumlaridan biri bu *Alopecurus* L. - odatda "tulkidumi" deb ataladigan o‘tlar turkumi hisoblanadi. *Alopecurus L.* turkumi *Poaceae* oilasi va *Alopecurinae* kichik qabilasiga mansub bo‘lib, **dunyoning mo‘tadil iqlim mintaqalarida 50–70 ga yaqin turi** tarqalgan. Ushbu turkumning xilma-xilligi eng ko‘p bo‘lgan hududlar - **Janubi-G‘arbiy Osiyo,** xususan **Turkiya** bo‘lib, u yerda bu turkumga oid **27 ta kon** aniqlangan, ularning **7 tasi endemikdir**. [1; 245-265.-b]

Poaceae oilasining ko‘plab boshqa turkumlarida bo‘lgani kabi, *Alopecurus* L. ham morfologik jihatdan murakkab va ba'zan sistematik noaniqliklarga ega. Turli morfologik xususiyatlar, jumladan boshoq shakli, gluma (tashqi parda) tuzilishi va palea (ichki parda) mavjudligi asosida avvalgi tadqiqotlarda *Alopecurus* L. turkumi *Alopecurus*, *Colobachne* va *Alopecurium* sektsiyalariga ajratilgan. [2; 245-262.-b]

So‘nggi yillarda esa barg anatomiya xususiyatlari, masalan sklerenxima tolalari tuzilishi, adaksial (yuqori) qovurg‘alar soni va o‘simlikning tomir to‘plami tuzilmalari bu turkum ichidagi turlarni farqlashda muhim bo‘lib chiqdi. [3; 1.-b]

Molekulyar filogenetik tahlillar, jumladan yadroviy (*ITS*, *ETS*) va plastid (*matK*, *rbcL*, *ndhF*) markerlar asosida olib borilgan tadqiqotlar, *Alopecurus L.* turkumi an'anaviy tasnifda **monofiletik emasligini** ko‘rsatmoqda, ya'ni bu turkum ichida ba'zi turlar bir-biriga genetik qarindosh emasligi ehtimoli mavjud. [5; 1.-b]

Ushbu turkum tarkibidagi eng e'tiborga loyiq turlardan biri bu *Alopecurus pratensis* **L**, ya'ni **"yaylov tulkidumi".** Bu ko‘p yillik, rizomali o‘t turi **Yevropa va Osiyoning mo‘tadil hududlarida keng tarqalgan** bo‘lib, suvli yaylovlar, daryo bo‘ylari va nam yerlarda o‘sadi. [34; 189-199.-b] *A. pratensis L.* erta bahorda o‘sishni boshlaydi, ozuqaviy qiymati yuqori, pishgan poyasi yumshoq bo‘lib, chorva uchun juda yaxshi yem-xashak hisoblanadi. Shuningdek, bu tur sho‘r yoki pH>8.5 bo‘lgan yer-suvlarda ham o‘sishi bilan ajralib turadi. Sitogenetik jihatdan *A. pratensis L.* odatda **tetraploid** (4n) hisoblanadi va *A. geniculatus* hamda *A. arundinaceus* Poir. kabi turlar bilan **gibridlanish** xususiyatiga ega. Ayniqsa, tabiiy gibrid bo‘lgan *Alopecurus* × *brachystylus* ushbu tur va boshqa qarindosh turlar o‘rtasidagi gen oqimini isbotlaydi. [3; 919.-b]

Alopecurus L.turkumi, jumladan *A. pratensis L.* ning morfologik, anatomik va molekulyar asosdagi chuqur o‘rganilishi, bu urug‘ ichidagi turlararo aloqalarni va uning evolyutsion tarixini to‘liq anglashda muhim ahamiyatga ega.

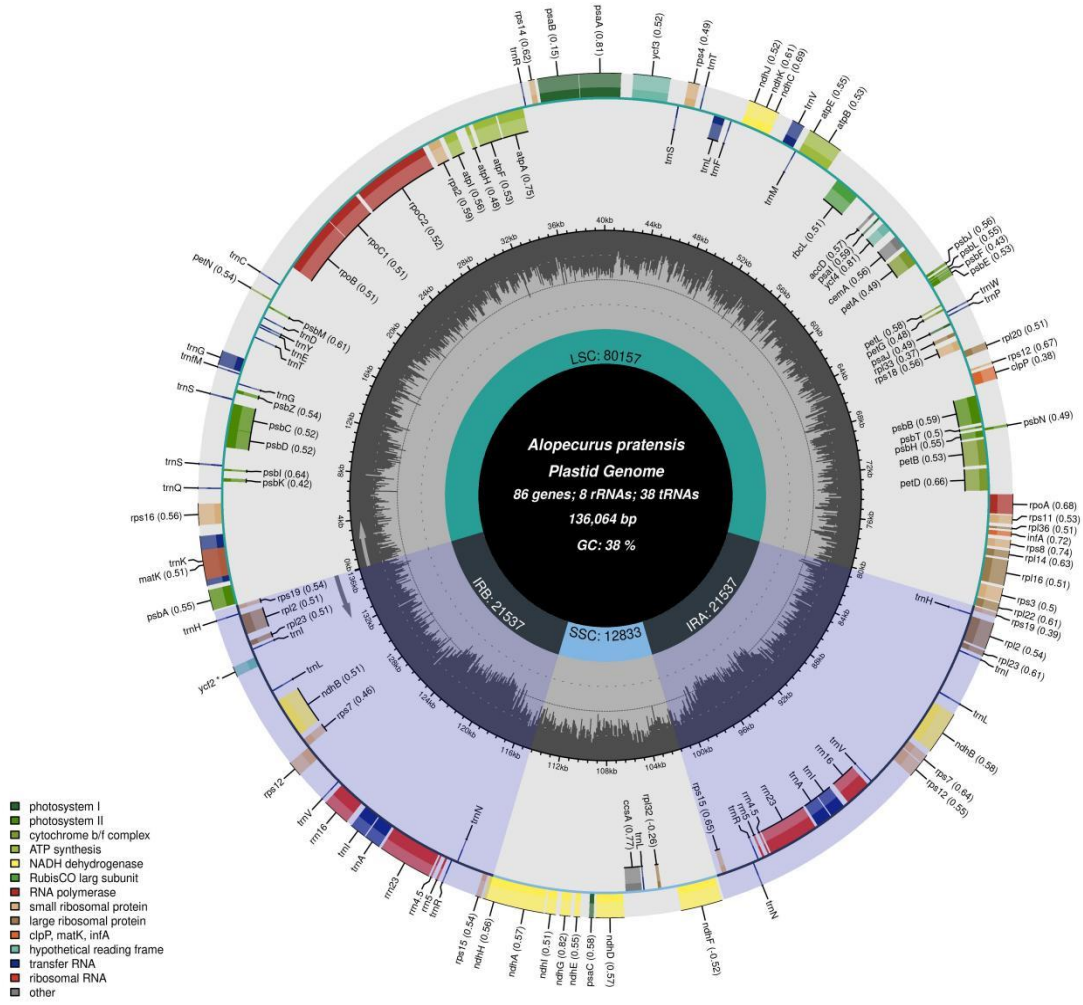
Alopecurus pratensis L. ning to‘liq xloroplast genomasi muvaffaqiyatli yig‘ilib, umumiy uzunligi 136 157 bp ni tashkil etdi. Bu ko‘pchilik angiosperm plastidlariga xos bo‘lgan to‘rt qismli (kvadripartit) tuzilishga ega. Genom 80 275 bp uzunlikdagi katta yakka nusxali (LSC) hudud, 12 830 bp uzunlikdagi kichik yakka nusxali (SSC) hudud va har biri 21 526 bp dan iborat ikki teskari takroriy (IRa va IRb) hududlardan iborat. Umumiy GC tarkibi 38,3% ni tashkil etdi, LSC, SSC va IR hududlarida bu qiymatlar mos ravishda 39,68%, 35,92% va 36,43% bo‘ldi.

*A. pratensi*s L. genomining tuzilishi va tarkibi *Alopecurus L.* turkumining boshqa turlari, xususan *A. aequali*s va *A. japonicus* bilan yuqori darajada o‘xshashlik ko‘rsatadi. *A. aequalis* (136 382 bp) va *A. japonicus* (136 408 bp) plastidlari bir xil GC tarkibiga (38,3%) va o‘xshash gen tuzilmasiga ega. [4; 396-397.-b]. Biroq, LSC va SSC hududlarining uzunligidagi kichik farqlar turkum ichida davom etayotgan strukturaviy farqlanishni ko‘rsatadi.

Diqqatga sazovor jihati shundaki, *A. pratensis* 88 ta oqsil kodlovchi genni o‘z ichiga oladi, bu esa *A. aequalis* va *A. japonicus* da qayd etilgan 78 ta gen bilan solishtirganda ko‘proq bo‘lib, bu annotatsiya farqlari yoki turning o‘ziga xos gen ko‘payishlari bilan bog‘liq bo‘lishi mumkin [6.2030-2031-b].

Yang va boshq. (2021) tomonidan Poaceae oilasiga mansub 14 ta to‘liq xloroplast genomlar asosida olib borilgan filogenetik tahlil *A. pratensi*s ni *A. arundinaceus, A. aequalis* va *A. japonicus* bilan yaqin joylashtirib, yuqori bootstrap qiymatlari (>90%) bilan qo‘llab-quvvatlangan mustahkam klasterni hosil qilgan. [8. 2379-2380.-b]. Qiziqarli jihati shundaki, *A. aequalis Poa annua* ning yaqin qarindoshi sifatida, *A. japonicus* Steud. esa *A. aequalis* Sobol. ga eng yaqin tur sifatida topilgan [7,4216-4217-b], bu esa *Alopecurus L.* turkumida kuchli evolyutsion aloqani va *Poa* turkumi bilan yaqinlikni tasdiqlaydi. Tuzilish jihatidan o‘xshashliklarga qaramasdan, taqqoslov genomik tahlillar gen tartibi, kodon ishlatilishi yoki regulyator ketma-ketliklaridagi turning o‘ziga xos farqlarni aniqlashi mumkin. Bu esa ekologik farqlarni tushuntirib berishi mumkin. Masalan, *A. pratensis* sovuq va suv toshqiniga chidamli ozuqaviy o‘t sifatida keng yetishtirilsa, *A. japonicus* Steud. va *A. aequalis* Sobol.qishloq xo‘jalik tizimlarida begona o‘t va gerbitsidga chidamli turlar sifatida tasvirlanadi. [7; 4216-4217.-b]

Mazkur to‘liq xloroplast genom *Alopecurus L.* turkumi va kengroq Poaceae oilasi doirasida kelajakdagi filogenetik, evolyutsion va molekulyar seleksiya tadqiqotlari uchun muhim manba bo‘lib xizmat qiladi. Shuningdek, u *A. pratensis* L. kabi ozuqaviy o‘tlarning agronomik xususiyatlarini yaxshilash uchun plastid gen muhandisligi asoslarini yaratadi.(1-rasm)



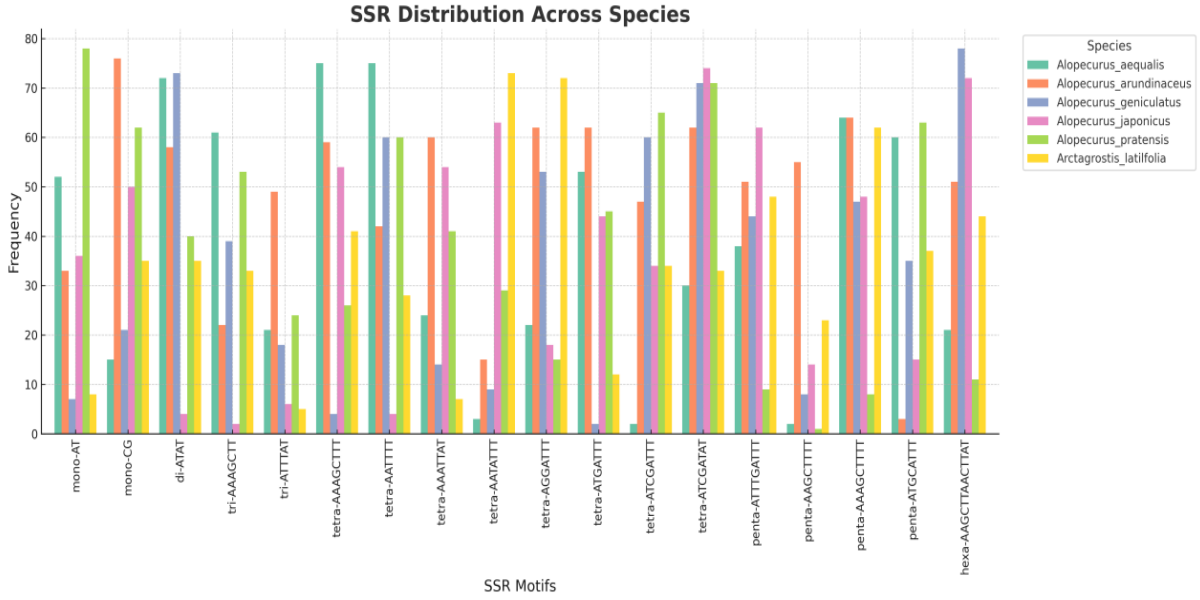
1-rasm. *Alopecurus pratensis L.* ning to‘liq xloroplast genom xaritasi.

Aylana shakldagi genom xaritalari OGDRAW (Greiner va boshqalar) tomonidan qurilgan. Rasmli diagrammada ranglar bir xil funksiyali kategoriyaga ega genlarni ko‘rsatadi. Doiraning ichki tomonida qora kichik aylana shaklidagi ustunchali diagramma GC kontentini ko‘rsatadi. IRA va IRB: teskari takroriy hududlar; LSC: katta bir nusxali hudud; SSC: kichik bir nusxada; ψ: psevdogen; ko‘rsatkichlar: transkripsiya yo‘nalishi.

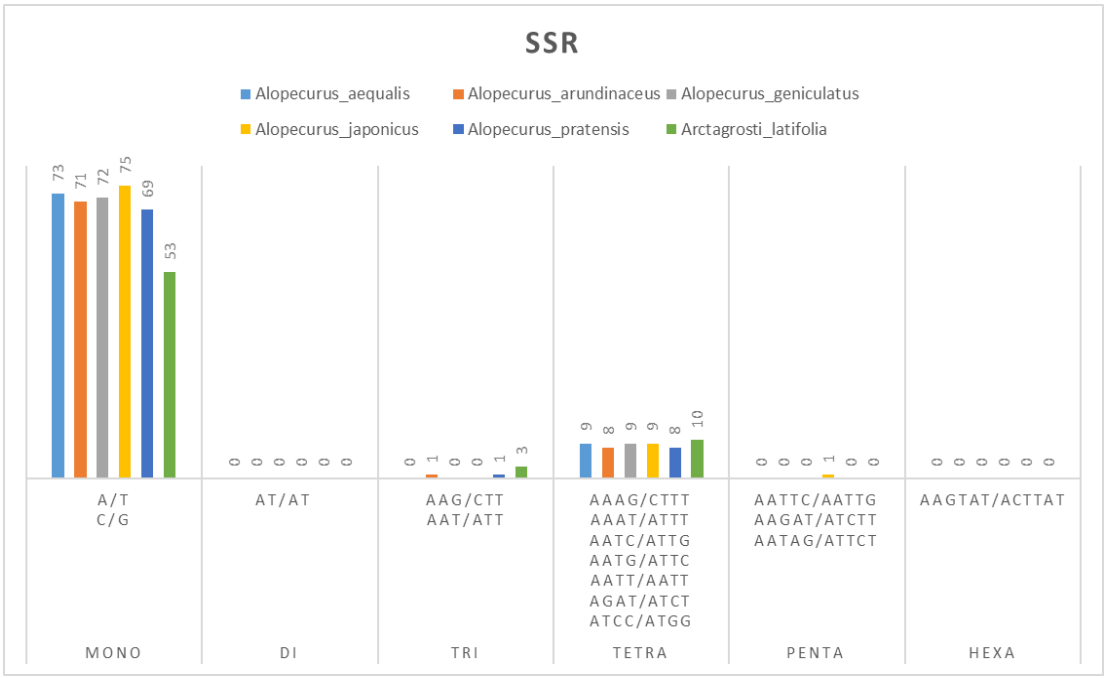
SSR Tahlili. 1-rasm va 2-rasmlardan ko‘rinib turibdiki, oltita *Alopecurus* **L.** turining xloroplast genomlarida oddiy takrorlanuvchi ketma-ketliklar (SSR) keng tarqalgan bo‘lib, turli motivlar va turlarga ko‘ra sezilarli farq qiladi. Mono-nukleotidli SSRlar, ayniqsa A/T tipidagi ketma-ketliklar, barcha turlarda eng ko‘p uchraydi va ularning soni 53 dan 73 gacha o‘zgaradi. Bu xususiyat Poaceae oilasida umumiy holat bo‘lib, boshqa *Alopecurus* L. turlarida ham kuzatilgan. [9; 1732586.] Tri- va tetra-nukleotidli SSRlar pastroq chastotada aniqlangan bo‘lsa-da, ular har bir turning o‘ziga xosligini aniqlashda muhim bo‘lishi mumkin. Masalan, AAG/CTT, AAAG/CTTT va

AAGT/ACTT motivlari barcha turlarda mavjud bo‘lib, lekin chastotasi sezilarli farq qiladi (2-rasm). Bu SSR larni molekulyar marker sifatida ishlatish imkoniyatini ta’minlaydi.

Arctagrostis latifolia (R. Br.) Griseb. turida SSR motivlarining umumiy soni nisbatan kam bo‘lib, bu turning boshqa turlarga qaraganda genomik barqarorroqligini ko‘rsatishi mumkin.



2-rasm. Oltita *Alopecurus* L.turida sodda takrorlanuvchi ketma-ketliklar (SSR) motivlarining taqsimoti.



3-rasm. Oltita *Alopecurus L.* turining xloroplast genomlarida SSR turlarining tasnifi va uchrash chastotasi.

3.4-rasmda keltirilgan sliding window (suriluvchi oyna) tahlili natijasida xloroplast genomlar bo‘ylab nukleotid xilma-xilligi (Pi) aniqlandi. Pi qiymatlari 0.005 dan 0.035 gacha o‘zgarib, ayrim hududlarda ancha yuqori bo‘lganligi aniqlandi. Ayniqsa, *ndhF–ccsA* oralig‘idagi Pi maksimal darajaga yetib, bu hudud yuqori mutatsiya tezligiga ega ekanligini ko‘rsatadi.

Bundan tashqari, *rps16–psbK, psbM–petN, rbcL–psaI*, va *cemA–petA* kabi intergenik hududlarda ham yuqori xilma-xillik kuzatildi.Bu hududlar boshqa Poaceae turlarida ham barqaror yuqori xilma-xillik ko‘rsatganligi sababli, evolutsion va filogenetik markerlar sifatida ishlatilishi mumkin.[8;2379-2380.-b]

Xulosa. *Alopecurus pratensis* L turi, xloroplast genomining to‘liq tahlili orqali, boshqa *Alopecurus* L turlari bilan o‘xshashliklarini va kichik struktural farqlarni ko‘rsatdi. Bu turlar orasidagi genetik tafovutlar, ularning evolyutsion aloqalari va ekologik xususiyatlarini yaxshiroq tushunishga yordam beradi. Shuningdek, SSR motivlari, o‘simliklar orasidagi genetik farqlarni ko‘rsatishda muhim rol o‘ynaydi. Xususan, A/T boy SSR motivlarining ustunligi, o‘simliklarning genomik barqarorligini ta’minlashda va evolyutsion o‘zgarishlarni tushunishda katta ahamiyatga ega.

FOYDALANILGAN ADABIYOTLAR RUYXATI.

1.Dekhkonov D, Tojibayev K. S, Makhmudjanov D, Yusupov Z, Choi H. J, & Jang C. G. Mapping and analyzing the distribution of the species in the genus Tulipa (Liliaceae) in the Ferghana Valley of Central Asia // *Korean Journal of Plant Taxonomy*, №*51*(3), 181-191. 2021.

2. Doğan, M. *A Concise Taxonomic Revision of the Genus Alopecurus L. (Gramineae)* // Turkish Journal of Botany, №23(4): P.245-262. 1999.

3. Gnutikov, A. A., Nosov, N. N., Punina, E. O., Loskutov, I. G., Shneyer, V. S., Chekrygin, S. A., Rodionov, A. V. Hybridization in the subtribe Alopecurinae Dumort.(Poaceae) according to molecular phylogenetic analysis: Different ploidy level tells different origin of the groups // *Plants*, №*13*(7), P.919.

4.Guo, X. X., Dai, C., Wang, R., Qu, X. J., & Zhang, X. J. Characterization and phylogenetic analysis of the complete plastome of Alopecurus japonicus (Gramineae), an annual weed // *Mitochondrial DNA Part B*, №*5*(1), P.396-397. 2020.

5. Günaydın S. & Aykurt C. Taxonomic importance of leaf anatomical characters for the genus Alopecurus L. (Poaceae) // Acta Botanica Croatica №82(1). 2023.

6. Wang, Hongxia; Ye, Fahui; Li, Xiang; Wang, Lirong; Wang, Jiuli; Chen, Wenjie *Characterization of the complete chloroplast genome of Allium mongolicum. Mitochondrial DNA Part B // Resources*, №5(3),P.2030-2031. 2020.

7.Wang, R., Wang, Q. J., Qu, X. J., & Fan, S. J. Characterization of the complete plastome of Alopecurus aequalis (Poaceae), a widespread weed // *Mitochondrial DNA Part B*, № *4*(2), P.4216-4217. 2019.

8. Yang, Y., et al. *Comparative Analysis of the Complete Chloroplast Genomes in Allium Subgenus Cyathophora (Amaryllidaceae): Phylogenetic Relationship and Adaptive Evolution // BioMed Research International*, Article ID 1732586. 2020.

9. Yusupov, Z., Ergashov, I., Volis, S., Makhmudjanov, D., Dekhkonov, D., Khassanov, F., ... & Sun, H. Seed macro-and micromorphology in Allium (Amaryllidaceae) and its phylogenetic significance // Annals of Botany, №129(7), P.869-911. 2022.

II-SHU'BA.

EKOLOGIYA VA BARQAROR RIVOJLANISH: BIOLOGIK TIZIMLAR MONITORINGI VA TA'LIMI.

ЭКОЛОГИЧЕСКАЯ ГРАМОТНОСТЬ УЧАЩИХСЯ 11 КЛАССА: ОРГАНИЗАЦИЯ УЧЕБНОЙ ДИСКУССИИ ПО ПРОБЛЕМАМ ПРОМЫШЛЕННЫХ ПРЕДПРИЯТИЙ И ИХ ВОЗДЕЙСТВИЯ НА ЭКОСИСТЕМЫ

Конопацкая Оксана Александровна, ГУО «Средняя школа № 28 г. Бреста», учитель химии, +375299282401, mg.amethystus@mail.ru

Ступень Нонна Степановна, УО «БрГУ имени А. С. Пушкина», заведующий кафедрой биологических и химических технологий, кандидат технических наук, доцент, +375297213895, chemskorp@yandex.by

Аннотация. *В статье представлена методика формирования экологической грамотности учащихся XI класса в рамках внеурочной деятельности учреждений общего среднего образования. Актуальность исследования обусловлена потребностью в становлении у обучающихся целостного естественно-научного мировоззрения, отражающего причинно-следственные связи между промышленной деятельностью и трансформацией компонентов окружающей среды. Разработана и апробирована методика организации учебной дискуссии на тему «Промышленность и экология — на разных чашах весов», ориентированная на формирование у учащихся понимания необходимости достижения баланса между социально-экономическим развитием и обеспечением экологической безопасности.*

Ключевые слова: *экологическое образование, внеурочная деятельность, учебная дискуссия, промышленные предприятия.*

Введение. Современный этап развития общества характеризуется стремительным промышленным прогрессом и возрастающим воздействием человека на окружающую среду. Промышленные предприятия, обеспечивающие экономический рост и занятость населения, одновременно являются источниками выбросов загрязняющих веществ, оказывающих негативное влияние на биосферу. В таких условиях необходимо формировать у подрастающего поколения экологическую грамотность, так как именно от их ценностных ориентиров и понимания последствий своих действий зависит состояние окружающей среды в будущем. Экологическое образование понимается как процесс передачи знаний о природе

и формах взаимодействия общества и окружающей среды, направленный на формирование экологической грамотности и навыков рационального природопользования [2].

В учреждениях общего среднего образования знания о взаимодействии человека с окружающей средой распределены между несколькими учебными предметами: биологией, химией и географией, но учащиеся не всегда осознают связи между ними, что затрудняет формирование целостного представления об экологических проблемах. Одним из путей решения этой проблемы является внеурочная деятельность, которая позволяет объединить естественно-научное содержание и развивать критическое мышление учащихся. Методика формирования экологической грамотности учащихся XI класса во внеурочной деятельности опирается на активные методы обучения, среди которых особое место занимает учебная дискуссия. Она служит инструментом интеграции химических знаний и экологических компетенций, позволяя старшеклассникам применять предметные знания для анализа реальных проблем, выстраивать аргументированные суждения и осваивать модели ответственного экологического поведения.

Цель исследования: разработка и теоретическое обоснование методики проведения учебной дискуссии, направленной на формирование экологической грамотности учащихся XI классов посредством обсуждения проблемы взаимодействия промышленных предприятий и окружающей среды.

Материалы и методы. Теоретико-методологическую базу исследования составили научно-методические публикации в области экологического образования и организации внеурочной деятельности в учреждениях общего среднего образования. В работе применены методы теоретического анализа научно-педагогической литературы, педагогического проектирования и моделирования учебного процесса.

Результаты исследования. Внеурочная деятельность является составной частью учебного процесса и осуществляется за пределами учебного расписания. Она направлена на развитие познавательной активности, самостоятельности и творческого потенциала учащихся [3].

К задачам внеурочной деятельности относятся создание условий для раскрытия способностей обучающихся, предоставление выбора дополнительных занятий, и организация содержательного досуга [3].

Во внеурочной деятельности может быть использована учебная дискуссия. Она представляет собой совместное обсуждение спорного вопроса, позволяющее прояснить и, возможно, изменить мнения и позиции участников группы в процессе непосредственного общения, а также сформировать знания в конкретной сфере. К её преимуществам относятся

полнота и эффективность усвоения материала, развитие творческих и интеллектуальных способностей, а также формирование навыков работы в команде [1].

На основе анализа научно-методической литературы разработана методика проведения учебной дискуссии на тему «Промышленность и экология — на разных чашах весов».

Форма занятия — учебная дискуссия с ролевыми позициями. Участниками являются учащиеся XI классов в количестве 12 человек, которые делятся на две команды по шесть человек. Продолжительность занятия составляет 1,5–2 часа в рамках внеурочной деятельности.

Цель дискуссии: формирование экологической грамотности через обсуждение проблемы взаимодействия промышленности и окружающей среды. Экологическое образование при этом рассматривается как метапредметная область знания, содержащая естественно-научные дисциплины.

Задачи: развитие умения работать с экологической информацией и статистикой, формирование навыков аргументации и публичного выступления, осознание межпредметных связей биологии, химии и географии, а также воспитание экологической ответственности.

В командах распределяются следующие роли.

Биоэколог анализирует влияние промышленных выбросов на живые организмы и биоразнообразие.

Геоэколог рассматривает воздействие на почвы, водные объекты и атмосферу.

Химик-аналитик приводит данные о составе выбросов и превышении предельно допустимых концентраций.

Экономист оценивает затраты на очистные сооружения и социально-экономический эффект предприятий.

Специалист по здоровью населения анализирует динамику заболеваемости в промышленных регионах.

Представитель власти представляет нормативно-правовую базу и меры экологического контроля. Эксперты первой команды отстаивают позицию о вреде промышленных предприятий, эксперты второй об их необходимости и экологической безопасности.

Дискуссия организуется в несколько этапов. За несколько дней до её проведения учителем объявляются тема, цели и правила, а также распределяются роли между участниками. Первая команда отстаивает позицию о критическом вреде промышленных

предприятий для экологии, вторая — об их необходимости и потенциальной экологической безопасности. На этапе подготовки осуществляется поиск информации, изучение предоставленных материалов и формирование системы аргументации. Участники самостоятельно подбирают статистические данные, примеры из открытых источников и готовят презентации по своим направлениям. Каждый эксперт отвечает за своё направление, что обеспечивает всесторонний анализ проблемы. Основной этап — выступления экспертов продолжительностью 15–20 минут, в ходе которых каждый участник представляет свою позицию с опорой на презентацию, содержащую статистические данные, схемы и изображения. В рамках перекрёстных вопросов (10 минут) команды оспаривают приведённые данные и уточняют позиции. Свободная дискуссия направлена на поиск компромисса и выработку общего решения. Оценивание участия обучающихся осуществляется по нескольким критериям. Научность предполагает опору на факты, статистику и данные. Аргументированность отражает логичность и доказательность выступлений. Метапредметность показывает использование знаний биологии, географии и химии. Качество презентации оценивается по наглядности и оформлению слайдов. Коммуникация учитывает умение задавать вопросы и отвечать на них.

По завершении дискуссии учащиеся совместно формулируют вывод о том, что промышленные предприятия являются необходимым элементом современной экономики, однако их деятельность должна осуществляться с соблюдением экологических норм, внедрением «зелёных» технологий и строгим контролем. Только баланс между экономическим развитием и экологической безопасностью обеспечит устойчивое развитие общества.

Заключение. Представленная методика учебной дискуссии позволяет интегрировать знания биологии, географии и химии для формирования у учащихся XI класса целостного представления о взаимодействии промышленности и окружающей среды. В результате у старшеклассников развивается экологическая грамотность, а также метапредметные навыки: критическое мышление, аргументация, публичное выступление.

СПИСОК ЛИТЕРАТУРЫ

1. Давыборец, Е. Н. Применение дискуссии в современном учебном процессе / Е. Н. Давыборец, Е. В. Еленева // Экономика и социум. – 2014. – № 4–2 (13). – URL : https://cyberleninka.ru/article/n/primenenie-diskussii-v-sovremen-nom-uchebnom-protsesse (дата обращения: 04.10.2026).

2. Хмеленок, Е. А. Экологические ценности в системе экологического образования / Е. А. Хмеленок // Вестник Полесского государственного университета. Серия общественных и

гуманитарных наук. – 2011. – № 2. – URL: https://cyberleninka.ru/article/n/ekologicheskie-tsennosti-v-sisteme-ekologichesko-go-obrazovaniya (дата обращения: 02.10.2026).

3. Чельцов, М. В. Педагогический профессионализм в организации внеурочной деятельности / М. В. Чельцов, О. В. Земскова // Наука и социум : материалы Всероссийской научно-практической конференции. – 2017. – № 1. – URL: https://cyberleninka.ru/article/n/pedagogicheskiy-professionalizm-v-organi-zatsii-vneurochnoy-deyatelnosti (дата обращения: 03.10.2026).

ОЧИСТКА ШАХТНЫХ ВОД В КАЗАХСТАНЕ

Мухамбеткалиева Б.Ж., Бергенева Н.С.к.б.н., доцент

Казахский национальный университет им. Аль-фараби

тел.: +7 747 525 10 14

e-mail: botaqan20_03@mail.ru

Аннотация. *Рассмотрены источники формирования и типы шахтных вод Казахстана, этапы их очистки: химическую (нейтрализация известковым молоком) и физическую (механическое осаждение осадка в радиальных отстойниках). Показано,)что механическое осаждение», которая глубоко удаляет Cu, Zn, Cd, Mn, Fe, но не удаляет сульфаты, хлориды, соединения азота и кальций. Наиболее эффективным способом удаления тяжёлых металлов признан известковый. Обсуждаются возможности биологической очистки.*

Ключевые слова: *шахтные воды, тяжёлые металлы, известкование, механическое осаждение, биологическая очистка.*

Добыча угля и руд в Казахстане сопровождается откачкой больших объёмов шахтных вод. Они формируются при вскрытии горными выработками водоносных горизонтов [1, с. 207]; в условиях аридного климата и перехода работ на глубокие горизонты это воды повышенной минерализации, содержащие соли, тяжёлые металлы, органические примеси и взвешенные вещества [2, с. 38]. Различают подземные воды, откачиваемые из шахт и рудников, и поверхностные – карьерные дренажные воды, а также стоки отвалов и накопителей. По химическому типу выделяют щелочные минерализованные воды угольных шахт, например Карагандинского бассейна, в минеральной части которых преобладают катионы натрия [1, с. 207], и воды рудников полиметаллических месторождений с ионами Cu, Zn, Cd, Mn, Fe, сульфатами, хлоридами и аммонием [3, с. 179]. При окислении

сульфидных минералов возникает кислый шахтный дренаж с высоким содержанием металлов [4, с. 1139].

Основные этапы очистки на примере Иртышского рудника (Восточный Казахстан), очистные сооружения которого работают с 1975 г., включают две стадии: химическую (нейтрализация известковым молоком) и физическую (механическое осаждение осадка в радиальных отстойниках) [3, с. 182]. Схема в целом такова: 1) механическое осаждение крупных и взвешенных частиц; 2) известкование до pH 9,5–10,5, при котором ионы металлов переходят в нерастворимые гидроксиды; 3) осветление в радиальных отстойниках; 4) сброс осветлённой воды в водоём или пруды-испарители и обращение с осадком [2, с. 39; 3, с. 180–182].

Какие элементы удаляются. По лабораторным данным, на модельном растворе (Cu – 560, Zn – 480, Cd – 6,6, Mn – 8,4 мг/дм³) при pH 10 остаточное содержание Cu и Zn снижалось до 0,1 мг/дм³, Cd – до 0,8 мг/дм³, Mn – до 0,85 мг/дм³; при pH 11 кадмий достигал 0,1 мг/дм³ [3, с. 184]. В реальной шахтной воде при pH 9,55–10,48 содержание Cu, Zn, Cd, Mn и Fe снижалось примерно до 1 мг/л и ниже [3, с. 186]. Для каждого металла существует свой диапазон осаждения: марганец осаждается наиболее полно (до 94 %) лишь при pH около 11,5 [3, с. 185].

Что не удаляется. Сульфаты остаются на уровне 1900–2400 мг/дм³ при исходных 2200 мг/дм³; хлориды, соли аммония, нитриты, нитраты и нефтепродукты на существующих сооружениях физико-химическим методом не очищаются [3, с. 184, 188]. Содержание кальция, наоборот, растёт (с 240 до 430–540 мг/дм³) из-за введения извести [3, с. 184]. Гидроксо- и аммиачные комплексы Cu, Zn и Cd снижают эффективность осаждения [3, с. 181]. Поэтому строгие рыбохозяйственные нормативы по Cd, Mn, Ca и сульфатам при существующей технологии недостижимы [3, с. 183, 188]. Это одна из причин, почему наиболее распространённым способом обращения с шахтными и карьерными водами в Казахстане остаётся их отведение в пруды-испарители, а сама очистка нередко считается неоправданной из-за затрат энергии, реагентов и утилизации рассолов [2, с. 38–39]. Для снижения минерализации вод Карагандинского бассейна в модельных условиях предложены сорбенты на основе полимерных комплексов гуминовых соединений [1, с. 207].

Наиболее эффективным способом удаления тяжёлых металлов признан известковый: он обеспечивает высокую степень извлечения токсичных металлов при сравнительно небольших материальных затратах [3, с. 179], но требует непрерывного контроля pH и достаточного времени контакта (на Иртышском руднике оно составляло не более 12 минут и считается недостаточным) [3, с. 182–183, 188].

Биологическая очистка. В мировой практике применяют пассивные биологические системы: аэробные и анаэробные искусственные болота и биореакторы с сульфатредуцирующими бактериями, в которых сульфат восстанавливается до сульфида, металлы осаждаются в виде малорастворимых сульфидов, а щёлочность воды повышается [5, с. 3–14; 6, с. 133–153]. В изученных источниках по шахтам и рудникам Казахстана биологическая очистка как промышленная практика не описана: применяются физико-химические методы [2, 3]. Поскольку сульфаты известкованием не удаляются, сульфатредуцирующие системы представляют интерес для проверки в пилотных условиях.

Заключение. Шахтные воды Казахстана различаются по типу (щелочные солёные воды угольных бассейнов и металлсодержащие воды рудников). Основой очистки служат механическое осаждение и известкование при pH 9,5–10,5, удаляющие Cu, Zn, Cd, Mn, Fe, но не сульфаты, хлориды, азотные соединения и кальций. Биологические методы известны в мировой практике, а для условий Казахстана требуют опытной проверки.

СПИСОК ЛИТЕРАТУРЫ

1. Аккулова З.Г., Амирханова А.К., Жакина А.Х., Ахметова А.Ж. Гуминовые полимерные комплексы в очистке минерализованной воды // Вестник КазНУ. Серия химическая. – Алматы, 2012. – № 1 (65). – С. 207.

2. Киздарбекова А.С., Пономарева Т.С., Южаков И.Ю. Сравнительно-правовой анализ казахстанского и зарубежного законодательства в области нормирования шахтных и карьерных дренажных вод в горнодобывающей промышленности // Право и государство. – 2023. – № 3 (100). – С. 37–51.

3. Литвинов В.В., Струнникова Н.А., Даумова Г.К., Серая Н.В., Мутере О., Утин С.С. Оптимальные условия известковой очистки шахтных сточных вод рудников по добыче полиметаллических руд // Вестник ВКТУ. – Усть-Каменогорск, 2024. – № 1. – С. 179–190.

4. Akcil A., Koldas S. Acid Mine Drainage (AMD): causes, treatment and case studies // Journal of Cleaner Production. – 2006. – Vol. 14, No. 12–13. – P. 1139–1145.

5. Johnson D.B., Hallberg K.B. Acid mine drainage remediation options: a review // Science of the Total Environment. – 2005. – Vol. 338, No. 1–2. – P. 3–14.

6. Skousen J., Zipper C.E., Rose A., Ziemkiewicz P.F., Nairn R., McDonald L.M., Kleinmann R.L. Review of passive systems for acid mine drainage treatment // Mine Water and the Environment. – 2017. – Vol. 36. – P. 133–153.

ЭКОЛОГИЗАЦИЯ СОДЕРЖАНИЯ КУРСА ХИМИИ: ДИАГНОСТИКА УРОВНЯ СФОРМИРОВАННОСТИ ЭКОЛОГИЧЕСКИХ ПРЕДСТАВЛЕНИЙ И МЕТОДИЧЕСКИЕ РЕШЕНИЯ

Ступень Нонна Степановна, УО «БрГУ имени А. С. Пушкина», заведующий кафедрой биологических и химических технологий, кандидат технических наук, доцент, +375(29) 721-38-95, chemskorp@yandex.by

Коваленко Виктор Викторович, УО «БрГУ имени А. С. Пушкина», старший преподаватель кафедры биологических и химических технологий +375 (29) 795-20-13 kvv0407@rambler.ru,

Аннотация. *Проведена диагностика уровня экологических компетенций учащихся 10–11 классов при изучении химии. Результаты анкетирования показали пробелы в понимании прикладных экологических вопросов (утилизация отходов, локальные проблемы) и выявили предпочтения учащихся в пользу лекций и экскурсий. На основе полученных данных разработан комплекс методических решений: междисциплинарные задачи, краеведческие кейсы, экскурсии и проектная деятельность – для эффективного формирования химико-экологической грамотности в рамках школьного курса химии.*

Ключевые слова: *междисциплинарность, экологические компетенции, диагностика, методические решения, химико-экологические задачи.*

Важнейшим направлением в современной педагогической деятельности является развитие экологического образования и воспитания, которое способствует формированию у учащихся экологического мышления и бережного отношения к окружающему миру и своему здоровью [3, с.87].

Цель исследования – на основании проведённой диагностики уровня экологических компетенций учащихся 10–11 классов разработать и апробировать комплекс методических решений, направленных на формирование химико-экологической грамотности в курсе химии.

С целью изучения уровня экологических знаний, было проведено анкетирование группы учащихся 10–11 классов Государственных учреждений образования «Брестский областной лицей имени П.М. Машерова», «Средняя школа №10 г. Бреста», «Средняя школа № 28 г. Бреста».

Проведенное анкетирование позволяет оценить уровень экологических знаний учащихся, определить источники информации и степень применения полученных экологических знаний в повседневной жизни. В ответах учащиеся указали, что 35 % экологической информации они получают из школьных уроков, а 47 % экологической информации получают с помощью интернет-сайтов и социальных сетей. На вопрос «Как

часто на уроках обсуждаются вопросы, связанные с загрязнением и охраной окружающей среды?» 92 % учащихся ответили «редко» или «иногда». В тоже время около 40 % учащихся указывают на то, что им интересны уроки экологической направленности. Результаты анкетирования позволяют выявить проблемы в усвоении материала, например, учащиеся указали на то, что лучше понять сущность экологических проблем им помогает лекции (39 % учащихся) и экскурсии (32 % учащихся). Положительным моментом является то, что школьники стремятся расширить свой кругозор по вопросам химии и экологии: 85 % учащихся указали, что хотели бы расширить свои знания по экологическим проблемам и способам их решения, 66 % учащихся указали на то, что изучение химии повлияло на восприятие ими экологических проблем, а 69 % учащихся принимают участие в мероприятиях, посвященных защите окружающей среды.

Рост экологической культуры учащихся становятся реальностью благодаря разработке специализированных методик, адаптированных для каждой возрастной категории, и их интеграции в образовательный процесс.

Современное химическое образование позволяет учащимся использовать полученные знания как в повседневной жизни, так и для продолжения последующего образования. В настоящее время востребованными во всех отраслях являются специалисты, осуществляющие контроль за соблюдением норм выбросов химических веществ в окружающую среду, специалисты, разрабатывающие новые технологий по обезвреживанию вредных веществ и производству экологически чистых, безотходных материалов, а также специалисты, владеющие современными методами химического исследования.

Анализ методических и научно-педагогических публикаций свидетельствует о том, что инновационные подходы в химическом образовании с экологической составляющей основываются на следующих тенденциях:

– интеграции экологических проблем в содержание учебных программ;

– интеграции понятий «зеленой химии» в учебные программы;

– развитие проектной и научно-исследовательской деятельности учащихся, данное направление позволяет учащимся увидеть воздействие человека на окружающую среду и ее ответные реакции;

– использование современных информационных технологий: мультимедийные презентации, видеоролики, образовательные платформы, электронные УМК, виртуальные химические лаборатории, электронные обучающие тренажеры, контрольно-диагностические модули [1, с. 69].

При реализации в химическом образовании экологического подхода важное значение отводится химическому эксперименту, который является неотъемлемой частью проектной деятельности. Проектная деятельность стимулирует исследовательские навыки и творческое мышление. Учащиеся могут разрабатывать проекты, направленные на изучение загрязнения окружающей среды, разработку экологически чистых технологий или оценку воздействия химических веществ на живые организмы. Для оценки токсичности соединений элементов используются различные методы, включающие в себя: проведение экспериментов на клетках и тканях, чтобы изучить механизмы токсического действия, анализ данных о заболеваемости и смертности в популяциях, подверженных воздействию химических элементов, применение компьютерных моделей для прогнозирования токсичности.

Для формирования экологических знаний важно обсуждать с учащимися потенциальные негативные последствия загрязнения окружающей среды химическими элементами с учетом актуальной информации о состоянии окружающей среды, опубликованной на сайте Белгидромета. Интернет-ресурс позволяет учащимся ознакомится с актуальной информацией по результатам мониторинга земель, поверхностных вод, подземных вод, озонового слоя, атмосферного воздуха, лесов, растительного мира, животного мира, радиационного и геофизического мониторинга, локального мониторинга окружающей среды. Использование данных сведений в проектной деятельности учащихся предоставляет им уникальную возможность применять теоретические знания на практике. Такой подход углубляет знания и формирует ответственное отношение к экологии в условиях растущего загрязнения опасными химическими веществами. [2, с.19].

На основе данных мониторинга загрязняющих веществ разработан план-конспект урока по химии (на примере химии элементов) с учетом экологической концепции для 9 класса «Углерод – химический элемент и простое вещество». Разработан сценарий внеурочного мероприятия по химии для 11 класса с экологической составляющей «Азбука минеральных удобрений». Разработан сценарий внеклассного мероприятия по химии экологической направленности для 10–11 классов: химико-экологический брейн-ринг «Химия. Экология. Человек». Проведение данных мероприятий способствует формированию экологического мировоззрения у учащихся и могут быть использованы учителями химии в учреждениях общего среднего образования.

Заключение. Результаты диагностики свидетельствуют о том, что учащиеся 10–11 классов, обладая определённым объёмом химических знаний, испытывают трудности в их применении к анализу экологических ситуаций – в частности, в построении причинно-следственных цепочек (например, выбросы – загрязнение – последствия).

Интеграция экологических аспектов в курс химии не только повышает интерес школьников к предмету, но и позволяет целенаправленно развивать химико-экологическую грамотность. Практика показывает, что наиболее результативными являются активные формы работы: лабораторные исследования, проекты и кейсы, основанные на местном материале. Для устойчивого эффекта важна слаженная работа учителей смежных дисциплин и периодическая диагностика, позволяющая оперативно адаптировать методику. В итоге такой подход формирует у учащихся не только предметные умения, но и критическое мышление, а также осознанное отношение к вопросам экологической безопасности.

СПИСОК ИСПОЛЬЗОВАННОЙ ЛИТЕРАТУРЫ

1. Бакрадзе Н.Ю., Карпова Ю.Г. Возможности интеграции экологического компонента в процесс химического обучения и воспитания (на примере среднего профессионального образования) // Известия Волгоградского государственного педагогического университета. – 2020. – № 1 (144). – С. 68–69.

2. Дорошук А.А. Использование интернет-ресурсов для формирования экологической грамотности учащихся в процессе изучения химии // Мониторинг и охрана окружающей среды : электрон. сб. материалов Респ. науч.-практ. конф. студентов, магистрантов, аспирантов, Брест, март 2026 г. / Брест. гос. ун-т им. А.С. Пушкина. – Брест : БрГУ, 2026. – С. 18–20

3. Якубова Э.А., Асуева Л.А. Интеграция химических и экологических знаний на уроках химии в школе // Современные проблемы естествознания : материалы V Регион. науч.-практ. конф. студентов и молодых ученых, Грозный, 24 апр. 2021 г. / ЧГПУ. – Грозный : ГУП «Книжное издательство», 2021. – С. 85–87.

АНАЛИЗ ВАРИАЦИИ МОРФОМЕТРИЧЕСКИХ ПОКАЗАТЕЛЕЙ ВИДА *PSEUDOTAPHOXENUS JUVENCUS*

Яковлев Роман Викторович — профессор Алтайского государственного университета

Зокирова Дилноза Фазлиддиновна - Преподаватель Самаркандского государственного педагогического института.

Tel: +7 903 912 3374 E-mail: yakovlev_asu@mail.ru

Аннотация. *Форма тела является одним из фундаментальных показателей при оценке разнообразия животных, так как сходство и различия морфологических признаков*

могут быть связаны с полом, географическим положением и экологическими особенностями [2; с. 205-215].

Морфологическая структура популяций отражает процессы адаптации организмов к окружающей среде и формирование их взаимосвязей. В последние годы подход к оценке структуры популяций насекомых на основе морфометрических признаков широко применяется в исследованиях [1; с. 30-38, 5; с. 205-217].

Естественный отбор действует на фенотип и фенотипические признаки, которые проявляются через изменения на морфометрическом уровне. Морфометрическая изменчивость также отражает влияние генетических, биохимических и физиологических факторов [1; с. 30-38, 5; с. 205-217, 3; с. 1-13, 4; с. 112].

Abstract. *Body shape is one of the fundamental indicators used in assessing animal diversity, as similarities and differences in morphological traits may be associated with sex, geographic location, and ecological characteristics [2, pp. 205–215].*

The morphological structure of populations reflects the processes of organismal adaptation to the environment, as well as the formation of their interrelationships. In recent years, the assessment of insect population structure based on morphometric traits has been widely applied in scientific research [1, pp. 30–38; 5, pp. 205–217].

Natural selection acts on the phenotype and its traits, which are manifested through changes at the morphometric level. Morphometric variation also reflects the influence of genetic, biochemical, and physiological factors [1, pp. 30–38; 5, pp. 205–217; 3, pp. 1–13; 4, p. 112].

Ключевые слова: *Pseudotaphoxenus juvencus, средние арифметические показатели, стандартное отклонение, стандартная ошибка, минимальные значения, пронотум.*

Keywords: *Pseudotaphoxenus juvencus, arithmetic mean values, standard deviation, standard error, minimum values, pronotum.*

С целью оценки изменчивости морфометрических признаков у вида *Pseudotaphoxenus juvencus* на основе 85 особей были проанализированы размеры основных частей тела. Полученные результаты по каждому признаку выражены через максимальные и минимальные значения, средние арифметические показатели, стандартное отклонение (sd), стандартную ошибку (m), а также коэффициент вариации (Cv) (Таблица 1).

Результаты анализа показали, что среди изученных признаков наибольшая изменчивость наблюдалась в длине головы. Коэффициент вариации для этого признака составил 11,39%, что значительно выше по сравнению с другими параметрами. Максимальное значение длины головы составило 4,4 мм, а минимальное — 2,0 мм, что

указывает на её варьирование в широком диапазоне. Это может свидетельствовать о том, что морфология головного отдела относительно лабильна и чувствительна к внешним факторам.

Таблица 1

Изменчивость морфометрических показателей Pseudotaphoxenus juvencus (n=85).

Части тела	**Max.**	**Min.**	**Среднее ариф., мм**	**Стандартное отклонение, sd**	**Стандартная ошибка, m**	**Коэффициент вариации, Cv,%**
Длина головы	4,4	2	3,16	0,36	0,04	11,39%
Ширина головы	3,3	2,4	2,81	0,18	0,02	6,23%
Расстояние между глазами	2,5	1,7	2,01	0,15	0,02	7,45%
Длина переднеспинки	4	2,9	3,58	0,24	0,03	6,75%
Ширина переднеспинки	3,9	3	3,52	0,19	0,02	5,33%
Длина надкрылий	10,3	7,3	8,70	0,62	0,07	7,14%
Ширина надкрылий	5,8	4	5,09	0,35	0,04	6,94%
Общая длина тела	18,3	13,2	15,44	1,06	0,12	6,89%

Ширина головы ($C_v = 6{,}23\%$) и расстояние между глазами ($C_v = 7{,}45\%$) имеют умеренную изменчивость, что указывает на определенную стабильность этих признаков, однако их изменение происходит в зависимости от конкретных экологических или индивидуальных факторов. Относительно более высокая вариабельность расстояния между глазами может быть результатом морфологических адаптаций, связанных с сенсорными функциями.

Параметры переднеспинки (пронотума) — длина ($C_v = 6,75\%$) и ширина ($C_v = 5,33\%$) — имеют относительно низкие коэффициенты вариации, что свидетельствует об их морфологической стабильности. В частности, ширина переднеспинки отмечена как признак с наименьшей вариабельностью. Это указывает на то, что данная часть тела функционально важна, и ее форма и размеры сохраняются относительно строго.

Параметры надкрылий также характеризуются относительной стабильностью. Коэффициент вариации для длины надкрылий составил 7,14%, а для ширины — 6,94%. Колебание длины надкрылий в широком диапазоне (7,3–10,3 мм) формируется в связи с общим размером тела. В то же время, поскольку морфология надкрылий связана с защитной и локомоторной функциями, ее изменчивость в определенной степени ограничена.

Общая длина тела ($C_v = 6,89\%$) также имеет умеренную изменчивость, ее значения варьировали от 13,2 мм до 18,3 мм. Этот показатель показывает, что общие размеры тела вида сохраняются в определенном диапазоне, но существуют индивидуальные различия.

В целом, полученные результаты показывают, что изменчивость морфометрических признаков у вида *Pseudotaphoxenus juvencus* находится на относительно низком и умеренном уровне. Нахождение коэффициентов вариации в пределах 5–11% подтверждает стабильность морфологии данного вида и морфологическую однородность популяции. Вместе с тем, более высокая изменчивость, наблюдаемая у отдельных признаков, в частности у длины головы, может формироваться под влиянием индивидуальных или экологических факторов.

Высокая вариабельность длины головы может быть связана не только с аллометрическими особенностями, но и с функциональными и экологическими факторами. Известно, что головная часть у насекомых представляет собой основную опорную структуру для ротового аппарата, в частности для мандибул. Развитие и сила мандибулярных мышц, в свою очередь, связаны с размерами и объёмом головной капсулы.

С целью уточнения сопряженной изменчивости различных частей тела были определены коэффициенты корреляции между ними (Таблица 3). Наличие положительной корреляционной связи между различными частями тела является естественным фактором. Однако характер взаимосвязи отдельных частей неоднороден.

Прежде всего, обратим внимание на связь между размерами головы (caput). Корреляция между длиной и шириной головы составляет 0,59, что соответствует умеренной

положительной связи. Также связь между длиной головы и расстоянием между глазами ($r = 0{,}60$) находится на близком уровне.

Таблица 3

Корреляционная связь между морфометрическими показателями частей тела *Pseudotaphoxenus juvencus.*

	Длина головы	Ширина головы	Расстояние между глазами	Длина переднеспинки	Ширина переднеспинки	Длина надкрылий	Ширина надкрылий	Общая длина тела
Длина головы	1							
Ширина головы	0,59	1						
Расстояние между глазами	0,60	0,85	1					
Длина переднеспинки	0,43	0,71	0,79	1				
Ширина переднеспинки	0,40	0,74	0,72	0,76	1			
Длина надкрылий	0,53	0,70	0,77	0,82	0,71	1		
Ширина надкрылий	0,38	0,73	0,76	0,78	0,79	0,81	1	
Общая длина тела	0,75	0,77	0,83	0,85	0,72	0,95	0,78	1

Полученные результаты показывают, что с увеличением продольных параметров головы соответственно увеличиваются её ширина и расстояние между глазами. Особенно высокая корреляция между шириной головы и межглазным расстоянием (r = 0,85) свидетельствует о том, что поперечное расширение головной капсулы тесно связано с расположением глаз. Данная взаимосвязь позволяет предположить, что сенсорная система, в частности зрительный аппарат, и морфологическая структура головы развивались эволюционно согласованно.

Размеры переднегруди (pronotum) также имеют значительные взаимосвязи с другими морфометрическими показателями тела. В частности, длина переднегруди характеризуется высокой корреляцией с шириной головы (r = 0,71) и межглазным расстоянием (r = 0,79). Это свидетельствует о морфологической согласованности развития передней части тела, включающей голову и переднегрудь.

Ширина переднегруди также демонстрирует аналогичную тенденцию, имея сильную положительную корреляцию с шириной головы (r = 0,74), межглазным расстоянием (r = 0,72)

и длиной переднегруди (r = 0,76). Таким образом, форма и размеры переднегруди тесно связаны с морфологическими параметрами головы, что указывает на наличие определённой пропорциональности в изменении размеров данных частей тела. В целом выявленные высокие значения корреляции свидетельствуют о том, что отдельные части тела формируются не изолированно, а как взаимосвязанная и интегрированная морфологическая система.

Особое значение имеют показатели надкрылий (элитр), которые демонстрируют наиболее высокую корреляцию с общей длиной тела. Коэффициент корреляции между длиной надкрылий и общей длиной тела составляет r = 0,95, что свидетельствует об очень сильной положительной корреляционной связи. Данный результат указывает на то, что значительная часть общей длины тела формируется именно за счёт длины надкрылий.

Кроме того, длина надкрылий характеризуется высокой степенью взаимосвязи с другими морфометрическими показателями: длиной переднегруди (r = 0,82), межглазным расстоянием (r = 0,77) и шириной головы (r = 0,70). Это свидетельствует о наличии аллометрического характера роста между отдельными сегментами тела. Ширина надкрылий также имеет существенное значение. Она характеризуется высокой корреляцией с длиной надкрылий (r = 0,81), шириной переднегруди (r = 0,79) и общей длиной тела (r = 0,78). Полученные результаты свидетельствуют о том, что надкрылья оказывают значительное влияние не только на общую длину тела, но и на его общие объёмные и массовые характеристики. Общая длина тела характеризуется высокой корреляцией практически со всеми исследованными параметрами: длиной головы (r = 0,75), шириной головы (r = 0,77), межглазным расстоянием (r = 0,83), длиной переднегруди (r = 0,85) и шириной надкрылий (r = 0,78). Это указывает на комплексный характер изменения размеров тела, при котором отдельные его части растут согласованно и пропорционально друг другу. Особенно высокая степень взаимосвязи между длиной надкрылий и общей длиной тела (r = 0,95) свидетельствует о том, что надкрылья являются одним из основных структурных элементов, определяющих общие морфологические пропорции тела данного вида.

В целом проведённый корреляционный анализ свидетельствует о наличии выраженной морфологической интеграции между отдельными частями тела *Pseudotaphoxenus juvencus*. Сегменты тела — голова, переднегрудь и надкрылья — развиваются взаимосвязанно и пропорционально, а их рост характеризуется высокой степенью координации. Данная закономерность может быть связана с экологическими адаптациями вида, особенностями его локомоции и функциональной морфологией.

Особенно тесная взаимосвязь между длиной надкрылий и общей длиной тела указывает на важное значение надкрылий в обеспечении локомоторных функций и защитной роли элytрального покрова. Таким образом, совокупность исследованных показателей подтверждает, что тело *Pseudotaphoxenus juvencus* представляет собой целостную морфометрическую систему, отдельные элементы которой характеризуются высокой степенью взаимной корреляции.

Заключение

В результате проведённого морфометрического анализа установлено, что у всех исследованных видов основные морфологические признаки характеризуются относительно низкими и средними значениями коэффициента вариации. Особенно консервативными признаками оказались параметры надкрылий и переднегруди. Данная закономерность может быть объяснена функциональным значением этих частей тела в обеспечении защитных функций, локомоции и адаптации к условиям внешней среды.

Вместе с тем отдельные признаки, связанные с головной частью, в частности длина головы, характеризовались более высокой изменчивостью по сравнению с другими параметрами. Это свидетельствует о том, что данный признак может быть более чувствительным к воздействию экологических факторов и индивидуальным различиям.

ИСПОЛЬЗОВАННАЯ ЛИТЕРАТУРА

1.Bulgarella M., Trewick S. A., Godfrey A. J., Sinclair B. J., Morgan-Richards M. Elevational variation in adult body size and growth rate, but not in metabolic rate, in the tree weta *Hemideina crassidens* // *Journal of Insect Physiology*. – 2015. – Vol. 75. – P. 30–38. – DOI: 10.1016/j.jinsphys.2015.02.012.

2.Lorenz C., Almeida F., Almeida-Lopes F. L., et al. Geometric morphometrics in mosquitoes: what has been measured? // *Infection, Genetics and Evolution*. – 2017. – Vol. 54. – P. 205–215.

3.Luzyanin S. L., et al. Impact of climatic factors on sexual size dimorphism in ground beetle *Pterostichus melanarius* (Illiger, 1798) (Coleoptera, Carabidae) // *Ecologica Montenegrina*. – 2022. – Vol. 58. – P. 1–13.

4.Luzyanin S., et al. Modeling sexual differences of body size variation in ground beetles in geographical gradients: a case study of *Pterostichus melanarius* // *Life*. – 2022. – Vol. 12. – 112.

5.Rusynov V. I., Brygadyrenko V. V. Morphological variability of a population of *Anatolica eremita* (Coleoptera, Tenebrionidae): constancy of morphometric indices with variation of linear parameters of the body // *Baltic Journal of Coleopterology*. – 2017. – Vol. 17, No. 2. – P. 205–217.

TOG‘ BIOTSENOZLARI NAMATAK O‘SIMLIGI NEMATODAFAUNASINING TAKSONOMIK TARKIBI

Xo‘jamov Sh.[1] Mavlyanov O.[2]

1- Samarqand davlat pedagogika instituti

2-Sharof Rashidov nomidagi Samarqand davlat universiteti

Annotatsiya. *Tadqiqot jarayonida G‘arbiy Zarafshon tog‘ biotsenozlari namatak o‘simligining rizosfera tuprog‘i va vegetativ a’zolaridan 56 tur nematoda aniqlanib, ular 2 sinf, 3 kenja sinf, 4 turkum va 20 oilaga mansubligi aniqlandi. Nematodalar jamoasida Panagrolaimida turkumi (29 tur, 52 %) dominant, Dorylaimida turkumi (21 ta tur, 37,5%) esa subdominant sifatida ajralib chiqdi. Avlodlar kesimida 33 ta avlod qayd etildi, ulardan Eudorylaimus, Merlinius va Mesodorylaimus avlodlari turlar soni ko‘pligi bilan ajralib turdi.*

Kalit so‘zlar. *G‘arbiy Zarafshon, tog‘, biotsenoz, ko‘p yillik namatak, nematoda*

Abstract. *During the study, 56 species of nematodes were identified in the rhizosphere soil and vegetative organs of the sea buckthorn plant of the mountain biocenoses of Western Zarafshan, belonging to 2 classes, 3 subclasses, 4 orders, and 20 families. In the nematode community, the order Panagrolaimida (29 species, 52%) was dominant, while the order Dorylaimida (21 species, 37.5%) was subdominant. In the genus section, 33 genera were recorded, among which the genera Eudorylaimus, Merlinius, and Mesodorylaimus were distinguished by a large number of species.*

Keywords. *Western Zarafshan, mountain, biocenosis, perennial wormwood, nematode*

Kirish. Tog‘ ekotizimlari global quruqlik yuzasining muhim qismini egallab, biologik xilma-xillikning eng murakkab va dinamik markazlaridan biri hisoblanadi. Ular balandlik gradienti, mikroiqlim sharoitlarining keskin o‘zgarishi hamda tuproq–o‘simlik–organizmlar o‘rtasidagi murakkab o‘zaro aloqalar bilan tavsiflanadi (Körner, 2004). Bunday tizimlarda har bir o‘simlik turi nafaqat fitotsenoz komponenti, balki tuproq biomassasini shakllanishiga ta’sir qiluvchi muhim ekologik omil sifatida ham faol rol o‘ynaydi.

O‘zbekistonning G‘arbiy Zarafshon tog‘ tizmasi, xususan Qoratepa massivi, Markaziy Osiyo tog‘ ekotizimlarining tipik namunasi bo‘lib, keskin kontinental iqlim, yarim qurg‘oqchil sharoit va murakkab relyef bilan ajralib turadi. Ushbu hududlarda o‘simlik qoplami mozaik xarakterga ega bo‘lib, yovvoyi buta va daraxtsimon turlar — Crataegus spp. (do‘lana), Rosa spp. (namatak), Amygdalus spp. (yovvoyi bodom) va Pistacia spp. kabi turlar ustunlik qiladi.

So‘nggi o‘n yilliklarda tog‘ va o‘rmon ekotizimlarida nematodalar jamoasi bo‘yicha ko‘plab tadqiqotlar amalga oshirilgan bo‘lsa-da, ularning aksariyati nam mo‘tadil va sovuq iqlimli zonalarga

qaratilgan (Zhang et al., 2015; Peneva & Lazarova, 2011). Sharqiy Yevropa, Osiyo va Shimoliy Amerika tog‘ tizimlarida nematodalar xilma-xilligi va trofik strukturasi nisbatan yaxshi o‘rganilgan.

Biroq Markaziy Osiyo, xususan O‘zbekiston tog‘ ekotizimlari bu borada sezilarli darajada “ma’lumot bo‘shlig‘i” mavjud hududlardan biridir. Ayniqsa yarim qurg‘oqchil sharoitda shakllangan tog‘ tuproqlari nematoda jamoasi deyarli o‘rganilmagan.

Mavjud tadqiqotlar asosan: agrotsenozlar (paxta, tokzor, bog‘lar), madaniy ekinlar rizosferasi va ayrim umumiy tuproq faunasi tahliliga qaratilgan.

Tadqiqotlar uchun 2023-2026-yillar davomida G‘arbiy Zarafshon tog‘ tizmasining Chaqaikalon, Qoratepa, Zirabuloq va Ziyaddin massivlaridan material yig‘ish ishlari amalga oshirib kelindi. Tadqiqotdan ko‘zlangan asosiy maqsad tabiiy biotsenozlarda fitonematodalarning tarqalishini o‘rganish bo‘lgani uchun tog‘ mintaqasida ko‘p uchraydigan buta o‘simliklardan namatak tanlab olindi. O‘simlikning vegetativ a’zolari ya’ni yer ustki va yer ostki qismlari va rizosfera tuprog‘ining 0-15 sm, 15-30 sm va 30-50 sm li qatlamlaridan na’munalar olindi. O‘simlikning yer ustki va yer ostki qismlari va rizosfera tuprog‘i namunalaridan nematodalarni ajratib olishda Bermanning voronkali usulidan foydalanildi.

Tadqiqotlar mobaynida nematodalarning 56 turi aniqlandi. Aniqlangan turlar Nematodalar tipining 2 ta sinfi (Dorylaimea, Chromadorea), 3 ta kenja sinfi (Plectia, Bathyodontia va Dorylaimia) va 4 turkum (Panagrolaimida, Dorylaimida, Mononchida, Rhabditida), 20 oilasiga mansub ekanligi ma‘lum bo‘ldi. Aniqlangan turlarni sistemaga solishda M.Hodda tomonidan tavsiya etilgan klassifikatsiyadan foydalanildi [1].

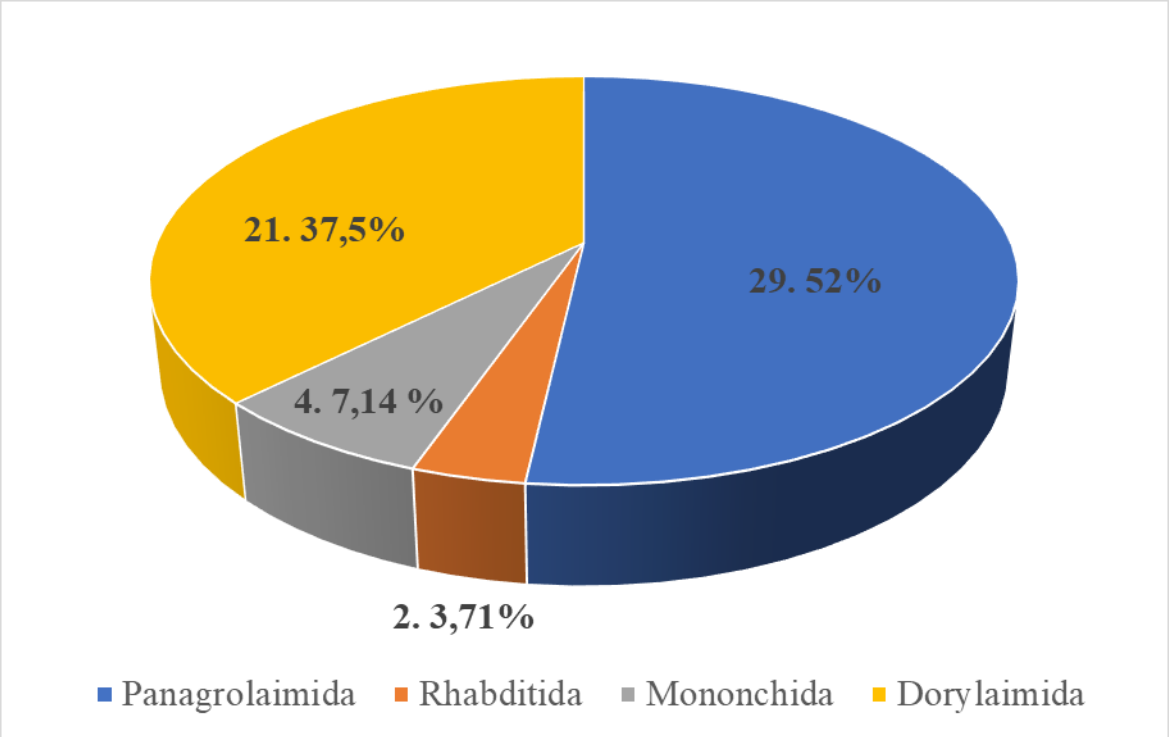
1-jadval

Nematodalar jamoasining taksonomik tarkibi (sinf, turkum va oilalar kesimida)

Sinf	Turkum	Oilalar
Chromadorea	Panagrolaimida	Aphelenchidae
		Parasitaphelenchidae
		Cephalobidae
		Panagrolaimidae
		Anguinidae
		Hoplolaimidae
		Pratylenchidae
		Telotylenchidae
		Tylenchidae
		Criconematidae
		Paratylenchidae
		Boleodoridae
	Rhabditida	Mesorhabditidae
	Mononchida	Mononchidae
Dorylaimea	Dorylaimida	Aporcelaimidae
		Dorylaimidae
		Nordiidae
		Qudsianematidae
		Xiphinematidae
		Nygolaimidae

Aniqlangan nematodalar jamoasidagi turlarni turkumlar o‘rtasida taqsimlanishi tahlil qilinganda turkumlar o‘rtasida tafovut mavjudligi ko‘rindi. Jumladan, Panagrolaimida turkumi (29 tur, 52 %) dominant, Dorylaimida turkumi (21 ta tur, 37,5%) esa subdominant sifatida joy oldi. Namatak o‘simligi va uning rizosfera tuprog‘i bilan bog‘liq nematodalar orasida Rhabditida

turkumining ikkita turi (*Mesorhabditis irregularis, Teratorhabditis dentifera*) qayd qilingan bo‘lsa, qolgan turkumlar 4, 21 va 29 ta turlari bilan qayd qilindi (2-rasm).



2-rasm. Nematodalar jamoasida turkumlar salmog‘i (turlar soni bo‘yicha)

Fauna tarkibini avlodlar kesimida tahlil qilinganda jami 40 ta avlod vakillari qayd qilindi. Avlodlarning aksariyati o‘z tarkibiga 1-3 tadan turlarni olishi ma‘lum bo‘ldi. Faqatgina *Aphelenchoides, Ditylenchus* va *Monhystera* avlodlari 4 tadan turlarga ega bo‘ldi.

Avlodlar	**Turlar soni**	**Avlodlar**	**Turlar soni**
Aphelenchus Bastian, 1865	2	Paratylenchus Micoletzky, 1922	1
Aphelenchoides Fisher, 1894	2	Boleodorus Thorne, 1941	1
Bursaphelenchus Fuchs, 1937	1	Mesorhabditis Dougherty, 1955	1
Cephalobus Bastian, 1865	1	Teratorhabditis Osche, 1952	1
Acrobeles Linstow, 1877	2	Mononchus Bastian, 1865	2

Placodira Thorne, 1937	1	Coomansus Jairajpuri & Khan, 1977	1
Panagrolaimus Fuchs, 1930	2	Clarkus Jairajpuri, 1970	1
Ditylenchus Filipjev, 1936	2	Paraxonchium Coomans & Nair, 1975	1
Helicotylenchus Steiner, 1945	1	Aporcelaimellus Heyns, 1965	1
Rotylenchus Filipjev, 1936	1	Dorylaimus Dujardin, 1845	2
Pratylenchus Filipjev, 1936	3	Mesodorylaimus Andrássy, 1959	3
Merlinius Siddiqi, 1970	4	Longidorella Thorne, 1939	1
Tylenchorhynchus Cobb, 1913	2	Enchodelus Thorne, 1939	1
Aglenchus Andrassy, 1954	1	Discolaimus Cobb, 1913	1
Tetylenchus Filipjev, 1936	1	Eudorylaimus Andrássy, 1959	8
Criconemoides Taylor, 1936	1	Xiphinema Cobb, 1913	2
Nygolaimus Cobb, 1913	1		

Olingan natijalar G‘arbiy Zarafshon tog‘ tizmasi ekotizimlarida o‘suvchi na’matak (Rosa spp.) bilan bog‘liq nematodafaunaning yuqori taksonomik xilma-xillikka ega ekanligini ko‘rsatadi. Aniqlangan nematodalarning taksonomik va ekologik tarkibi ularning tuproq ekotizimlari holatini baholashda bioindikator sifatidagi potensial ahamiyatini belgilaydi. Shu bilan birga, fitoparazitar nematodalar ulushining yuqoriligi o‘simliklar salomatligi va agroekotizimlar barqarorligiga potensial xavf tug‘dirishi mumkin. Mazkur natijalar tabiiy yaylov ekotizimlarini muhofaza qilish, tuproq ekologik holati va unumdorligini baholash, shuningdek, qishloq xo‘jaligi ekinlarida zararli nematodalarni erta aniqlash hamda ularning tarqalishini nazorat qilish bo‘yicha ilmiy asoslangan chora-tadbirlarni ishlab chiqishda muhim ahamiyat kasb etadi.

ADABIYOTLAR RO‘YXATI

1. Hanel, L. (2004). Response of soil nematodes inhabiting spruce forests in the Beskydy Mountains to bark-beetle attack and clear-cutting. Forest Ecology and Management, 194(1-3), 391-400.
2. Hanel, L. (2010). Species and genera of soil nematodes in forest ecosystems of the Vihorlat Protected Landscape Area, Slovakia. Helminthologia, 47(2), 123-135.
3. Hodda M. Phylum Nematoda Cobb, 1932 // Zootaxa, V. 3148, 2011. – P. 63-95.
4. Narzullayev, S. B. (2022). New data on the vertical distribution of nematode communities in mountain ecosystems of Mount Zarafshan, Uzbekistan. Biodiversitas, 23(8), 3967-3975.
5. Peneva V., Lazarova S. Plant nematodes of the Rhodopes (Bulgaria): an overview and additional data // Sustaining Agricultural change through ecological engineering and optimal use of natural resourses. 2011. – P. 32-54]
6. Qambarov, S. S., & Narzullayev, S. (2022). Diversity of woody plant nematodes in specially protected biocenosis of Zarafshan Mountain, Uzbekistan. Biodiversitas, 24(6), 3145-3151.
7. Tursunova Sh., Mavlonov O., Xakimov N., Narzullayev S. Oddiy sachratqi (*Cichorium intybus* L.) nematodafaunasi tarkibi va biotoplar bo‘yicha tarqalishi. “Zoologiya fanini rivojlantirishda zamonaviy tadqiqotlar: muammolar va istiqbolli yechimlar” mavzusidagi Respublika ilmiy-amaliy konferensiyasi materiallari to‘plami. Termiz, 2024-yil 11-12-oktyabr. 228-232-b.
8. Хакимов Н.Х. – Нематоды некоторых дикорастущих лекарственных растений. Тез. докл. IV научной конференции. проф-преп. состава Сам ГПИ им. С.Айни (декабрь 1970), серия естественный наук, Самарканд. 1970. стр. 20-23.
9. Хуррамов Ш. Х., Бекмурадов А. С. Паразитические нематоды диких и культурных субтропических плодовых растений Средней Азии // Российский паразитологический журнал. 2021. Т. 15. № 1. С. 98–102.

ORGANIK, MINERAL O‘G‘ITLAR VA “GlitsBUT” FITOSTIMULYATOR PREPARATIDAN FOYDALANISHNING TUPROQ TARKIBIGA TA’SIRI

Ergasheva Farog‘at Sheraliyevna[1], Djurayev Tulkin Arzikulovich[1], Kushiyev Xabibjon Xojiboboyevich[1], Xushmatov Shunqor Sadullayevich[2]

Guliston davlat universiteti, Agrobitexnologiyalar va biokimyo ITI[1]

O‘zbekiston Respublikasi Oliy ta’lim, fan va innovatsiyalar vazirligi[2]

Abstrakt. *Ushbu tadqiqotda O‘zbekiston Respublikasi Sirdaryo viloyati tuproq-iqlim sharoitida anor (Punica granatum L.) yetishtiriladigan yer maydonlarida organik va mineral o‘g‘itlar hamda “Mikromak” va “GlitsBUT” preparatlarini qo‘llashning tuproqning ayrim fizik-kimyoviy xususiyatlariga ta’siri o‘rganildi. Tajribada organik o‘g‘it, mineral o‘g‘itlar kompleksi, organik va mineral o‘g‘itlarni birgalikda qo‘llash, “Mikromak” hamda “GlitsBUT” preparatlari ta’sirida tuproqning pH ko‘rsatkichi, elektr o‘tkazuvchanligi (EC), organik uglerod miqdori va muhim mineral elementlar konsentratsiyasi tahlil qilindi. Natijalarga ko‘ra, qo‘llanilgan variantlar tuproqning fizik-kimyoviy ko‘rsatkichlarini turli darajada o‘zgartirishi aniqlandi. Ayniqsa, organik va mineral o‘g‘itlarni kompleks qo‘llash tuproqda organik uglerod miqdori hamda o‘simliklar oziqlanishi uchun muhim bo‘lgan mineral elementlar konsentratsiyasining oshishiga samarali ta’sir ko‘rsatdi. Olingan natijalar sho‘rlanishga moyil hududlarda anorzorlar tuproq unumdorligini saqlash va yaxshilash, ozuqa elementlari rejimini optimallashtirish hamda regenerativ qishloq xo‘jaligi tamoyillarini amaliyotga joriy etishda organik va mineral o‘g‘itlardan kompleks foydalanish istiqbolli ekanligini ko‘rsatadi.*

Kalit so‘zlar: *Punica granatum L., anor, tuproq, organik o‘g‘it, mineral o‘g‘it, “GlitsBUT”, “Mikromak”, organik uglerod, pH, elektr o‘tkazuvchanlik (EC), sho‘rlanish, tuproq unumdorligi.*

Annotatsiya. *V dannom issledovanii izucheno vliyaniye organicheskix i mineralnыx udobreniy, a takje preparatov “Mikromak” i “GlitsBUT” na otdelnыe fiziko-ximicheskiye svoystva pochvы na uchastkax vыrashchivaniya granata (Punica granatum L.) v pochvenno-klimaticheskix usloviyax Sыrdarinskoy oblasti Respubliki Uzbekistan. V xode eksperimenta proanalizirovanы pokazateli pH pochvы, elektroprovodnosti (EC), soderjaniya organicheskogo ugleroda i konsentratsii vajneyshix mineralnыx elementov pri primenenii organicheskix udobreniy, kompleksa mineralnыx udobreniy, sovmestnogo vneseniya organicheskix i mineralnыx udobreniy, a takje preparatov “Mikromak” i “GlitsBUT”. Ustanovleno, chto issledovannыe variantы v razlichnoy stepeni izmenyayut fiziko-ximicheskiye pokazateli pochvы. Osobenno effektivnыm okazalos kompleksnoye primeneniye organicheskix i mineralnыx udobreniy, sposobstvuyushchee povыsheniyu soderjaniya organicheskogo ugleroda i konsentratsii mineralnыx elementov, neobxodimыx dlya pitaniya rasteniy. Poluchennыe rezultatы svidetelstvuyut o perspektivnosti kompleksnogo*

ispolzovaniya organicheskix i mineralnыx udobreniy dlya soxraneniya i povыsheniya plodorodiya pochv granatovыx nasajdeniy, optimizatsii rejima elementov pitaniya i vnedreniya prinsipov regenerativnogo selskogo xozyaystva na territoriyax, podverjennыx zasoleniyu.

Klyuchevыe slova: *Punica granatum L., granat, pochva, organicheskiye udobreniya, mineralnыe udobreniya, "GlitsBUT", "Mikromak", organicheskiy uglerod, pH, elektroprovodnost (EC), zasoleniye, plodorodiye pochvы.*

Tadqiqot **maqsadi** – O‘zbekiston Respublikasi Sirdaryo viloyati tuproq-iqlim sharoitida, anor (*Punica granatum* L.) yetishtiriluvchi yer maydonlarida organik o‘g‘it, mineral o‘g‘itlar kompleksi ("Ammiakli selitra" (250 g/tup)+"Ammofos" (250 g/tup)+"Kaliyli selitra" (200 g/tup)+"Granat STV", organik o‘g‘itlar+mineral o‘g‘itlar kompleksi, "Mikromak" preparati, "GlitsBUT" preparatidan foydalanishning tuproqning ayrim fizik-kimyoviy ko‘rsatkichlariga ta’sirini tahlil qilishdan tashkil topgan.

Tadqiqot materiallari va uslublari. Tadqiqot obyekti sifatida "Qizil anor", "Qora qayim", "Oq shirin", "Oq dona (Tuyatish)" va "Achchiq dona" mahalliy navlari yetishtiriluvchi, O‘zbekiston Respublikasi Sirdaryo viloyati Mirzaobod tumani Halqabod MFY hududida (40°32’39/68°41’58.9) joylashgan shaxsiy tomora xo‘jaligi obyekt sifatida tanlab olindi. Tadqiqot hududidan tuproq kesmasini tayyorlash va sinov-namunasini olish, tahlil qilish standart uslub yordamida amalga oshirildi [Okuda et al., 2020].

Tuproqning fizik-kimyoviy tarkibi standart uslub yordamida tahlil qilindi [Shirokova et al., 2026; Manhou et al., 2026].

Tuproq sinov-namunasi laboratoriya sharoitida maydalandi, elakdan o‘tkazilib, OHAUS® ("OHAUS Europa GMbH", Shveysariya) analitik torozisi (aniqlik darajasi ±0,01 gr.) yordamida og‘irligi o‘lchanib (100 g), VWR DryLINE53 quritish shkafida ("Naberterm", Germaniya) *t*=+110°S±2 harorat sharoitida 60 minut davomida quritildi hamda navbatdagi bosqichda suvli so‘rim tayyorlandi.

Organik uglerod (S) yoki gumus miqdorini aniqlashda tuproq namunasi (20 g) termostatda +105±2°S harorat sharoitda doimiy og‘irlikkacha quritilib, navbatdagi bosqichda 180 minut davomida +550±25°S harorat sharoitda qizdirildi hamda quyidagi formula (*1*) yordamida umumiy gumus miqdori (%) hisoblandi [Shamrikova va boshq., 2024]:

$$LOI = \frac{m_1 - m_2}{m_1 - m_0} \times 100 \quad (1)$$

Bu yerda, *LOI* – qizdirilganda tuproq namunasi og‘irligi yo‘qotilishi (*Loss on ignition*, %), m_0 – tuproq namunasi solingan idish og‘irligi (g), m_1 – idish va +105±2°S gacha qizdirilgan tuproq

namunasining birgalikdagi og‘irligi (g), m_2 – idish va +550±25°S gacha qizdirilgan tuproq namunasining birgalikdagi og‘irligini (g) ifodalaydi.

Mazkur tezkor tahlil uslubi tuproq namunasini +105...+550°S gacha qizdirish jarayonida tuproq tarkibidagi adsorbsion suv, ayrim mineral komponentlarning o‘zgarishiga bog‘liq, gumus miqdorini nisbiy hisoblash imkonini berishi qayd qilinadi (bunda, 0,01-0,09 diapazonda tuzatish koeffitsentidan foydalanish tavsiya etiladi) [Hoogsteen et al., 2015; Shamrikova va boshq., 2024].

Tuproq namligi (*MC – moisture content*) laboratoriya sharoitida tuproq namunasining OHAUS® (“OHAUS Europa GMbH”, Shveysariya) analitik torozisi yordamida og‘irligi o‘lchanib, VWR DryLINE53 quritish shkafida (“Naberterm”, Germaniya) *t*=+110°S±2 harorat sharoitida 60 minut davomida quritilganda og‘irligi o‘zgarishi asosida, quyidagi formula (*2*) yordamida hisoblandi [Manhou et al., 2026]:

$$MC = \frac{W_{\text{назорат}} - W_{\text{қуруқ}}}{W_{\text{назорат}}} \times 100 \quad (2)$$

Bu yerda, *MC* – tuproq namligi (*moisture content*), $W_{nazorat}$ – tuproq namunasining dastlabki og‘irligi (g), W_{quruq} – tuproqning +110°S±2 harorat sharoitida 60 minut davomida quritilgandan keyingi og‘irligini (g) ifodalaydi.

Tuproq suvli so‘rimi muhiti *rN*-metrik uslubda, PHS-3E (“Shanghai INESA Scientific Instrument Co.” Ltd., XXR) asbobi yordamida tahlil qilindi. Tuproqning sho‘rlanish darajasi konduktometrik uslub yordamida, tuproq suvli so‘rimning elektr o‘tkazuvchanligi (*EC – electrical conductivity*, dSm (detsisimens)/m) asosida, COMBI 5000 (“STEP Systems GmbH”, Germaniya) asbobida tahlil qilindi [Manhou et al., 2026; 1-18-b.].

Tuproq sinov-namunasi (100 g) distillangan suvda (990 ml) aralashma hosil qilinib, 60 minut inkubatsiyalandi, navbatdagi bosqichda 5% li chumoli kislota (10 ml) qo‘shilib, 60 minut inkubatsiyalandi, qog‘oz filtrdan o‘tkazilib, tarkibidagi elementlar DR 3900 spektrofotometri (”Hach-Lange”, Germaniya) (xatolik darajasi ±1%) yordamida tahlil qilindi. Bunda, kimyoviy tarkib tahlilida standart reagentlar to‘plamidan (“Hach LCK”, AQSH) foydalanildi [Brooks, 2025; 161-b.].

Olingan natijalarni matematik-statistik qayta ishlash OriginLab OriginPro v. 8.5 SR1 (EULA, Northampton, MA 01060-4401, AQSH) kompyuter dasturi yordamida bajarildi. Bunda, olingan eksperimental natijalar *n* marta takroriylikda amalga oshirilgan tajribalar natijalarining *M*±*m* shaklida keltirilgan bo‘lib, *M* – o‘rtacha arifmetik qiymat va *m* – standart xatolik qiymatini ifodalaydi. Tajriba natijalari va nazorat guruhi o‘rtasidagi qiymatlarning statistik ishonchlilik darajasi Styudent *t*-mezoni asosida hisoblandi, $r<0,05$, $r<0,01$ qiymatlarda statistik ishonchli deb baholandi [Glans, 1999].

Olingan natijalar va ularning tahlili. Tadqiqot hududida rangiga ko‘ra sug‘oriladigan bo‘z tuproqlar tarqalgan. Tadqiqot hududida tuproqlarda o‘rtacha *pH*=7,51±0,03 ga teng bo‘lib, odatda, anor (*Punica granatum* L.) *rN*=5,5-7,2 diapazonga ega tuproqlarda optimal rivojlanishi qayd qilinadi, bunda yengil ishqoriy muhit sezilarli darajada salbiy ta’sir ko‘rsatmaydi.

Tadqiqot hududi tuproqlari “*kuchsiz sho‘rlanish*” diapazoni quyi chegarasidagi (*YES*=2,08±0,004 dSm/m) tuproqlardan tashkil topganligi aniqlandi.

Organik o‘g‘it ta’sirida 0-120 sm tuproq gorizontida o‘rtacha *rN*=7,59±0,04 (nazoratga nisbatan 1,01-marta ortishi), *YES*=2,14±0,005 dSm/m (nazoratga nisbatan 1,02-marta ortishi), shuningdek organik uglerod (S) miqdori o‘rtacha 0,95±0,002% (nazoratga nisbatan 1,4-marta ortishi) aniqlandi. Mineral o‘g‘itlar kompleksidan (“Ammiakli selitra” (250 g/tup)+ “Ammofos” (250 g/tup)+“Kaliyli selitra” (200 g/tup)+“Granat STV” (250 g/tup) foydalanilganda tuproqda *rN*=7,3±0,05 (nazoratga nisbatan 1,03-marta kamayishi), *YES*=2,23±0,003 dSm/m (nazoratga nisbatan 1,07-marta ortishi), organik uglerod (S) miqdori o‘rtacha 0,72±0,002% (nazoratga nisbatan 1,06-marta ortishi) bo‘lishi aniqlandi. Organik o‘g‘itlar+mineral o‘g‘itlar kompleks shaklda foydalanilganda tuproqda *rN*=7,63±0,04 (nazoratga nisbatan 1,02-marta ortishi), *YES*=2,18±0,005 dSm/m (nazoratga nisbatan 1,05-marta ortishi), organik uglerod (S) miqdori o‘rtacha 0,94±0,003% (nazoratga nisbatan 1,38-marta ortishi) bo‘lishi aniqlandi. Shuningdek, “Mikromak” preparati (200 g/tup) ta’sirida tuproqda *rN*=7,37±0,03 (nazoratga nisbatan 1,02-marta kamayishi), *YES*=2,19±0,004 dSm/m (nazoratga nisbatan 1,05-marta ortishi), organik uglerod (S) miqdori o‘rtacha 0,71±0,002% (nazoratga nisbatan 1,04-marta ortishi) bo‘lishi aniqlandi. “GlitsBUT” preparati (100 mg/l eritma shaklida purkash uslubida, ildiz atrofiga tuproqqa ishlov berishda 0,05 g/l) ta’sirida tuproqda *rN*=7,54±0,04, *YES*=2,14±0,003 dSm/m (nazoratga nisbatan 1,05-marta ortishi), organik uglerod (S) miqdori o‘rtacha 0,7±0,002% bo‘lishi aniqlandi. Bunda, nazorat guruhida tuproq gorizontida (0-120 sm) NO_3^- 9,43±0,04 mg/100 g, P_2O_5 12,08±0,07 mg/100 g, SO_4^{2-} 68,54±2,81 mg/100 g, NH_4^+ 1,8±0,02 mg/100 g, K_2O 2,47±0,03 mg/100 g, Sa^{2+} 127,9±5,32 mg/100 g, Mg^{2+} 73,8±2,57 mg/100 g ga teng bo‘lib, organik o‘g‘it ta’sirida mos ravishda – 9,65±0,04 mg/100 g, 15,97±0,04 mg/100 g, 72,19±4,86 mg/100 g, 2,05±0,03 mg/100 g, 2,58±0,02 mg/100 g, 130,4±3,7 mg/100 g, 76,2±3,26 mg/100 g ni tashkil qilishi aniqlandi. Mineral o‘g‘itlar kompleksidan (“Ammiakli selitra” (250 g/tup)+ “Ammofos” (250 g/tup)+“Kaliyli selitra” (200 g/tup)+“Granat STV” (250 g/tup) foydalanilganda esa, mazkur ko‘rsatkichlar qiymatlari mos ravishda – 9,73±0,03 mg/100 g, 16,5±0,04 mg/100 g, 70,08±3,6 mg/100 g, 2,11±0,04 mg/100 g, 2,82±0,03 mg/100 g, 132,15±3,18 mg/100 g, 82,5±2,14 mg/100 g ga tengligi qayd qilindi. Organik o‘g‘itlar+mineral o‘g‘itlar kompleks shaklda foydalanilganda, mazkur ko‘rsatkichlar qiymatlari mos ravishda – 10,08±0,05 mg/100 g, 19,13±0,05 mg/100 g, 75,18±3,12 mg/100 g, 2,34±0,03 mg/100 g,

3,16±0,04 mg/100 g, 152,4±4,65 mg/100 g, 89,1±3,3 mg/100 g ni tashkil qilishi aniqlandi. Shuningdek, “Mikromak” preparati (200 g/tup) ta’sirida tuproq gorizontida (0-120 sm) NO_3^- 9,6±0,04 mg/100 g, P_2O_5 15,23±0,03 mg/100 g, SO_4^{2-} 71,6±2,45 mg/100 g, NH_4^+ 2,1±0,01 mg/100 g, K_2O 2,63±0,03 mg/100 g, Sa^{2+} 131,9±3,81 mg/100 g, Mg^{2+} 74,5±2,08 mg/100 g ga teng bo‘lib, GlitsBUT” preparati (100 mg/l eritma shaklida purkash uslubida, ildiz atrofiga tuproqqa ishlov berishda 0,05 g/l) ta’siri sharoitida mos ravishda – 9,48±0,05 mg/100 g, 14,2±0,06 mg/100 g, 70,4±2,8 mg/100 g, 1,9±0,04 mg/100 g, 2,53±0,05 mg/100 g, 130,6±4,6 mg/100 g, 74,4±3,7 mg/100 g ni tashkil qilishi aniqlandi.

Xulosalar. Shunday qilib, organik o‘g‘it, mineral o‘g‘itlar kompleksi (“Ammiakli selitra” (250 g/tup)+ “Ammofos” (250 g/tup)+“Kaliyli selitra” (200 g/tup)+“Granat STV”, organik o‘g‘itlar+mineral o‘g‘itlar kompleksi, “Mikromak” preparati, “GlitsBUT” preparati ta’sirida 0-120 sm tuproq gorizontida *rN*, *YES*, organik uglerod (S) miqdori sezilarli darajada optimallashishi qayd qilindi. Shuningdek, anor (*Punica granatum* L.) ekilgan yer maydonlarida organik va mineral o‘g‘itlar ta’sirida tuproqda muhim funksional elementlar konsentratsiyasi ortishi, ayniqsa organik o‘g‘itlar+mineral o‘g‘itlar kompleks shaklda foydalanilganda, mazkur ko‘rsatkichlar qiymatlari sezilarli darajada ortishi tasdiqlandi. Olingan natijalar O‘zbekiston Respublikasi hududlarida, ayniqsa turli darajada sho‘rlangan yer maydonlarida agroekotizimda tabiiy zahiralar qayta tiklanuvchi (*regenerativ*) qishloq xo‘jaligi tamoyilini amalga oshirishda tuproq unumdorligini saqlash maqsadida, organik o‘g‘itlar samaradorligini ilmiy asoslashda foydalanish mumkin.

ADABIYOTLAR RO‘YXATI:

1.Brooks C.N. Using spectrophotometry to measure nutrient concentrations in the field // Nature reviews. Earth & Environment. – 2025. – V.6. – P.161.

2.Hoogsteen M.J.J., Lantinga E.A., Bakker E.J., Groot J.C.J., Tittonell P.A. Estimating soil organic carbon through loss on ignition: Effects of ignition conditions and structural water loss // European Journal of Soil Science. – 2015. – V.66(2). – P.320-328.

3.Manhou K., Hmouni D., Moussadek R., Zouahri A., Yachou H., Lhaj M.O., Sanad H., Ghanimi A., Dakak H. Compost application enhances soil quality, growth, and yield of durum wheat under saline conditions // Scientific Reports. – 2026. – V.16:7643. – P.1-18.

4.Okuda Y., Onishi J., Shirokova Y.I., Kitagawa I., Kitamura Y., Fujimaki H. Water and salt balance in agricultural lands under leaching with shallow subsurface drainage used in combination with cut-drains // Water. – 2020. – V.12(3207). – P.1-16.

5.Glans S. Mediko-biologicheskaya statistika // Moskva. – Izd-vo “Praktika”, 1999. – S.250-459.

6.Shirokova Y., Paluashova G., Kodirov D., Sadiev F., Sadiev U. Substantiation of effective land reclamation methods based on the assessment of the physicochemical properties of saline soils in the Syrdarya region of the Republic of Uzbekistan // ESDCA-2026. BIO Web of Conferences 238(02006). – 2026. – P.1-14.

7.Shamrikova Ye.V., Vanchikova Ye.V., Кызyurova Ye.V., Jangurov Ye.V. Metodы izmereniy massovoy doli ugleroda organicheskix soyedineniy v pochvax, soderjaщix karbonatы (Obzor) // Pochvovedeniye. – 2024. – №3. – S.394-411.

ATROF-MUHITNING OG‘IR METALLAR BILAN IFLOSLANISH DARAJASI MONITORINGIDA FITOINDIKATORLARDAN FOYDALANISH

M.U.Mamadiyarov *Samarqand davlat pedagogika instituti dotsenti. Spitamen Shox ko‘chasi 166* +998937236062 mu.mamadiyarov@gmail.com

X.Q.Xaydarov *Sharof Rashidovnomidagi Samarqand davlat universiteti Biokimyo instituti professori. Universitet xiyoboni 15*

+ 998915457416 x.q.xaydarov g.mail.com

Annotasiya. *Atrof – muhitning og‘ir metallar bilan ifloslanish darajasini monitoringida Paulownia tomentosa o‘simlik turidan foydalanish muhim ahamiyatga egaligi va u atrof- muhitni optimizatsiyalashda muhimligi haqida ma’lumot keltirilgan.*

Kalit so‘zlar: *og‘ir metall, kadmiy, qo‘rg‘oshin,indikator, akkumlyator, optimizatsiya.*

Abstract. *This article highlights the importance of using Paulownia tomentosa for monitoring the level of heavy metal pollution in the environment and its significance in environmental optimisation.*

Keywords: *heavy metals, cadmium, lead, indicator, accumulator, optimisation.*

Odatda, og‘ir metallar biologik organizmga asosan quyidagi mexanizmlari orqali salbiy ta’sir ko‘rsatishi qayd qilinadi: *1*) erkin radikallar generasiyasi; *2*) funksional muhim biomakromolekulalarning funksional markazlari blokadasi; *3*) funksional muhim biomakromolekulalar strukturasida ionlarning siqib chiqarilishi [1; 277-282-b.].

Og‘ir metallar o‘simlik to‘qimalarida amalga oshuvchi biokimyoviy-fiziologik jarayonlarga salbiy ta’sir ko‘rsatishi orqali fitotoksik o‘zgarishlarni yuzaga keltiradi [2; 431-432-b.].

Og‘ir metallarning o‘simlik organizmiga salbiy ta’sir mexanizmlari bir qator tadqiqotchilar tomonidan batafsil o‘rganilgan. Jumladan, Cd ta’sirida o‘simliklarda fitogormonlar muvozanati o‘zgarishi (abssiz kislota konsentrasiyasi ortishi), aminokislotalar (treonin, glutaminkislota, fenilalanin, tirozin, metionin, asparaginkislota, sistein, gistidin, leysin, serin) miqdori ortishi, shuningdek sitogenetik disfunksional o‘zgarishlar yuzaga kelishi aniqlangan.

Shuningdek, tadqiqotlarda *Paulownia* L. o‘simligida Cd, Pb bilan ifloslanish sharoitida prolin konsentrasiyasi ortishi qayd qilingan [3; 19-22-b.].

Shahar urbanizasiya darajasi, ishlab chiqarish va texnogen rivojlanish bilan o‘zaro farqlanuvchi zonalarida ekologik muhit holati o‘zaro keskin farqlanishi kuzatiladi [4; 114-124-b.].

Ekologik muhitning ifloslanish darajasini monitoring qilishda tashqi muhitning ta’siriga nisbatan sezgir javob reaksiyasi sifatida biologik organizm to‘qimalarida ifloslovchi

pollyutantlarning kumulyasion konsentrasiyasini tahlil qilish – nisbatan qulay, yuqori darajada aniq axborot olish imkonini beruvchi uslublardan biri hisoblanadi .

Bunda shahar sharoitida o‘simliklar bargi tarkibida og‘ir metallar to‘planishidagi o‘zaro farqlanish asosida ayrim turlardan ekologik muhitning antropogen-texnogen ifloslanish darajasini monitoring qilishda bio-geokimyoviy indikator sifatida foydalanish istiqbollari yuqoriligi ta’kidlanadi [3; 671-682-b.].

Og‘ir metallarning o‘simlikda hujayra-molekulyar darajasidagi ta’siri, og‘ir metallar ta’siriga moslashish, qarshilik ko‘rsatish, himoya mexanizmlari tadqiqotlarda batafsil tavsiflangan [5; 5-65-b.].

Tashqi muhitda, jumladan tuproq qatlamida og‘ir metallar konsentrasiyasi ortishi sharoitida o‘simlik organizmi og‘ir metallarni to‘plash va izolyasiyalash, shuningdek murakkab biokimyoviy-fiziologik mexanizmlar asosida ildiz tizimi orqali so‘rilish darajasini kamaytirishi aniqlangan .

Shuningdek, ayrim o‘simlik turlarida og‘ir metallar ta’siriga nisbatan giperchidamlilik xususiyati namoyon qilinadi va bu genom xususiyatlari bilan izohlanadi.

Ayrim o‘simlik turlari noqulay tashqi muhit sharoitlarida o‘sishga moslashgan bo‘lib, atmosfera havosi tarkibidagi pollyutantlar o‘simlikning morfo-funksional faolligiga sezilarli darajada ta’sir ko‘rsatmaydi, aksincha mazkur turlar ekologik muhitning optimizasiyasida muhim o‘rin tutadi [6; 55-70-b.].

O’simlik turlari vegetativ organlarida og‘ir metallarning to‘planish konsentrasiyasi qiymati bo‘yicha o‘simlik turlari quyidagi guruhlarga klassifikasiyalanadi [4; 31-b.]:

I. Indikator o‘simliklar – tarkibida to‘planuvchi og‘ir metallarning konsentrasiyasi atrof-muhitdagi og‘ir metallar konsentrasiyasiga proporsional o‘zgaradi;

II. Akkumulyator o‘simliklar – atrof-muhitda og‘ir metallarning konsentrasiyasi nisbatan past bo‘lgan sharoitda ham vegetativ organlari tarkibida og‘ir metallar yuqori konsentrasiyada to‘planadi;

III. Javob reaksiyasini ko‘rsatmaydigan o‘simliklar – atrof-muhitda og‘ir metallarning konsentrasiyasi nisbatan yuqori bo‘lgan sharoitda ham vegetativ organlarida sezilarli konsentrasiyada to‘planmaydi [3; 25-244-b.].

O’z navbatida, shahar iqlim sharoitlari, urbanizasiya darajasi, sanoat miqyosida ishlab chiqarish aglomerasiyalari rivojlanish holatiga muvofiq optimal o‘simlik turlarini tanlash muhim ahamiyatga ega .Shuningdek, tadqiqotlarda shahar sharoitida o‘simlik turlarining og‘ir metallarni (Hg, Zn, Ag, St, Pb, Cd, W, Cr va boshq.) to‘plashi qiymati ularning o‘sish sharoitiga bog‘liqligi aniqlangan [6; 3-20-b.].

Tadqiqotlarda texnogen ifloslanish sharoitida og‘ir metallarning (Pb, Cd, Si, Zn va boshq.) tuproqdan o‘simliklarga o‘tish mexanizmi, o‘simliklardan bioindikator sifatida foydalanish imkoniyatlari tahlil qilingan.

Tadqiqotlarda pavlovniya (*Paulownia tomentosa* (Thunb.) Steud.) novda, barg, gullarida ayniqsa, vegetasiya davrining birinchi yarmida og‘ir metallar sezilarli konsentrasiyada to‘planishi aniqlangan, o‘z navbatida mazkur turdan tuproqlarning og‘ir metallar bilan ifloslanish darajasini aniqlashda bioindikator sifatida foydalanish mumkinligi qayd qilingan .U atrof – muhitni optimizatsiyasida muhim hisoblanadi.[2; 2-10-b.].

Aynan, mazkur tipdagi o‘simlik turlaridan foydalanish orqali atrof-muhitdagi og‘ir metallar konsentrasiyasini kamaytirish istiqbollari yuqori baholanadi [3; 8-17-b.].

Shunday qilib, shahar sharoitida atrof-muhitning ifloslanish darajasini monitoring qilish va shuningdek, atmosfera havosi tarkibini optimallashtirish maqsadida «*giperakkumulyator*» o‘simlik turlaridan foydalanish istiqbollari yuqori hisoblanadi .

Shunday qilib, shahar sharoitida o‘simliklar estetik-rekreasion, atmosfera havosi tarkibini optimallashtirish, qulay mikro-iqlim hosil qilish, shovqinni susaytirish, sanitar-gigiyenik ahamiyatga egaligi bilan birgalikda, ildiz orqali tuproq qatlamidan so‘rilgan og‘ir metallar vegetativ-generativ organlarida to‘planishi qayd qilinadi [4;13-16-b.].

Og‘ir metallarning biologik salbiy ta’siri darajasini kamaytirish chora-tadbirlari kompleksini ishlab chiqishda birlamchi vazifa – atrof-muhitda mazkur elementlar konsentrasiyasini monitoring qilishdan tashkil topadi.Bunda og‘ir metallarni o‘simlik barglari nisbatan yuqori konsentrasiyada to‘plash xususiyatiga ega bo‘lib, mazkur holat barglarning to‘kilishi orqali og‘ir metallarni organizmdan chiqarish mexanizmi bilan bog‘liqligi tahmin qilinadi [5; 25-43-b.].

O’simlikning barg plastinkasi sanoat miqyosidagi ishlab chiqarish va avtotransport gazlari tarkibidagi turli xil pollyutantlarni o‘ziga to‘plovchi «*bioagregat*» hisoblanib, bunda akkumulyasiya intensivligi tashqi muhitning abiotik omillari bilan birgalikda, o‘simlik turining spesifik xususiyatlariga bog‘liq .

O’simlik turlari bargida Cd miqdori me’yoriy holatda 0,05-0,2 mg/kg; As – 1-1,7 mg/kg diapazonga tengligi qayd qilinadi .

Atmosfera havosi tarkibidagi turli xil pollyutantlar, jumladan kimyoviy elementlar ionlarining o‘simlik barglari hujayralarida to‘planishi kutikula, epidermis qavati orqali diffuziyalanish va navbatdagi bosqichda biriktiruvchi to‘qimalar hujayralariga tashilishi tipidagi murakkab mexanik-biokimyoviy mexanizmlar asosida amalga oshuvchi jarayon hisoblanadi [1; 114-124-b.].

Ayrim tadqiqotchilar tomonidan MDH miqyosida ayrim o‘simlik turlari tarkibida og‘ir metallarning to‘planish xususiyati o‘rganilgan.

Shuningdek, tadqiqotlarda Pb ta’sirida o‘simlikda suv rejimi intensivligi susayishi qayd qilinadi [1; 10-14-b.].

Tadqiqotlarda shahar sharoitida turli xil pollyutantlar ta’sirida ifloslanish sharoitida o‘simlik turlari barglarida suv almashinuvi dinamikasi o‘zgarishi qayd qilingan [4; 181-184-b.].

O’simlikda suv rejimi, transpirasiya – tashqi muhit sharoitiga moslashish-chidamlilik darajasini ifodalovchi muhim tavsiflardan biri hisoblanadi .

Transpirasiya jarayonida o‘simlik ildizi orqali tuproq qatlamidan so‘rib olingan suvning 90% qismi barglar orqali bug‘lanadi, o‘z navbatida +20°S sharoitda o‘simlikdan 582 kal/g gacha issiqlik ajraladi va o‘simlik organizmida teploregulyasiya optimalligi ta’minlanadi. Shuningdek, transpirasiya oqimi davomida o‘simlikda o‘tkazuvchi tizim orqali moddalar transporti faollashadi. O’simlik bargi tashqi tomondan kimyoviy tarkibida oksimonokarbon kislota mavjud bo‘lgan kutikula qavati bilan qoplangan bo‘lib, barg yuzasida barg og‘izchalari (ustisa) (1-60 ta/sm^2, ø=3-12 mkm) joylashadi, transpirasiya jarayoni barglarda epidermis qavati hujayralari va shuningdek, ustisalar orqali amalga oshadi. Tranpirasiya intensivligi endogen-ekzogen omillarga bog‘liq bo‘lib, ayrim tadqiqotchilar ishlarida ushbu jarayonning amalga oshishi fizik-kimyoviy mexanizmlari batafsil tavsiflangan [3; 90-163-b.].

O’simlikda bioekologik holatning obyektiv indikatori sifatida ahamiyatga ega bo‘lgan – transpirasiya, suv almashinuvi jarayonlari ekologik muhitdagi og‘ir metallarning biologik salbiy ta’sirini baholashda ham muhim o‘rin tutishi mumkin.

FOYDALANILGAN ADABIYOTLAR.

1. Овсянников А.Ю. Сезонная структурно-функциональная трансформация фотосинтетического аппарата хвои *Picea pungens* Engl. и *P. obovata* Ledeb. на территории ботанического сада УРО РАН (г. Екатеринбург) // Диссертация на соиск. учён. степен. к.б.н. – Екатеринбург, 2015. – С.4-25.

2. Фомина Т.И. Биологические особенности зимнезеленых поликарпиков в лесостепной зоне Западной Сибири // Вестник Томского государственного университета (Биология). – 2012. – №1(17). – С.43-51.

3. Курмуков А.Г., Белолипов И.В. Дикорастущие лекарственные растения Узбекистана ботаника, химия, фармакология, медицина // Ташкент. – 2012. – С.230-231.

4. Ayan S., Gercek V., Sahin A. Performation of nursery stage of *Paulownia* Sieb.& Zucc. Species and origins, review of faculty of Forestry University of Suleyman Demirel, Seri. A. – 2002. – V.2. – P.41-56.

5. Зиятдинова К.З., Уразгильдин Р.В., Денисова А.В. Водный обмен листьев дуба черешчатого (*Quercus robur* L.) в условиях техногенного загрязнения // Вестник Челябинского государственного университета. – 2013. – №7(298). – Вып. 2. – С.181-184.

LALMI SHAROITDA *SORGHUM ALMUM* PARODI YETISHTIRISHNING AHAMIYATI

Avutxonov Burxon Sobirovich

Sharof Rashidov nomidagi Samarqand Davlat universiteti, Biokimyo instituti, O‘simliklar fiziologiyasi va mikrobiologiya kafedrasi dotsenti,PhD.

Tel: +998933400737, E-mail:almum76@mail.ru

Annotatsiya. *Ushbu maqolada Sorghum almum Parodini O‘zbekistonning lalmi hududlarida yetishtirish isdiqbollari to‘g‘risida ma’lumotlar berilgan. Olib borilgan ilmiy tadqiqotlar ushbu o‘simlikni respublikamizning lalmi hududlarida yetishtirish mumkinligini ko‘rsatadi.*

Kalit so‘zlar: *Sorghum almum Parodi, lalmi sharoit, yem-xashak o‘simlik, qurg‘oqchilikka chidamlilik.*

Abstract. *This article provides information on the prospects for growing Sorghum almum Parodi in the arid regions of Uzbekistan. The conducted scientific studies show the possibility of growing this plant in the arid regions of our republic.*

Keywords: *Sorghum almum Parodi, arid conditions, forage plant, drought tolerance.*

Global iqlim o‘zgarishi sharoitida qurg‘oqchilik qishloq xo‘jaligi ekinlarining hosildorligini cheklovchi asosiy abiotik stress omillaridan biriga aylanmoqda. Ayniqsa, cho‘l va yarim cho‘l hududlarda yog‘ingarchilikning kamayishi yoki yog‘in miqdorining o‘simliklar vegetatsiyasi davrida notekis taqsimlanishi, havo haroratining yuqoriligi va tuproq namligining pasayishi o‘simliklarning o‘sishi va rivojlanishiga jiddiy ta’sir ko‘rsatadi. *Sorghum* turkumiga mansub o‘simliklar boshqa ayrim donli ekinlarga nisbatan qurg‘oqchilikka chidamli bo‘lib, suv tanqisligi mavjud hududlarda yetishtirish uchun istiqbolli ekinlar qatoriga kiradi [3, 127–142-b.].

Ammo qurg‘oqchilik *Sorghum* turkumi mansub turlarga umuman ta’sir qilmaydi deb tushunish noto‘g‘ri, chunki qurg‘oqchilik *Sorghum* turkumi o‘simliklarining vegetativ va generativ rivojlanishiga ta’sir qilib, fotosintez intensivligi, barg yuzasi, suv almashinuvi, biomassa to‘planishi va hosildorlikning pasayishiga olib kelishi mumkin. Shu sababli qurg‘oqchilikka chidamli genotiplarni aniqlash va ularning agrotexnologiyasini takomillashtirish zamonaviy qishloq xo‘jaligining muhim vazifalaridan biridir [1, 255-b.].

Respublikamiz qishloq xo‘jaligi, asosan, sug‘orma dehqonchilikka asoslanganligini hisobga olsak, qishloq xo‘jaligi ekinlarini yetishtirish va hosilning hajmi muayyan hududni, aniqroq aytganda, o‘simliklarni vegetatsiyasi davomida yetarli darajada suv bilan ta’minlashga bog‘liqligi namoyon bo‘ladi. Shuning uchun *Sorghum almum* Parodi (Kolumb o‘ti) kabi suv tanqisligi, tuproqlarning turli darajada sho‘rlanishi sharoitlarida muhitning noqulay omillari ta’siriga chidamli

bo‘lgan, sifatli va to‘yimli ozuqaviy ekinlarning suv tartibini o‘rganish ularning ekologik xususiyatlarini, muhitning turli omillariga fiziologik moslashishini aniqlash va ularning mahsuldorligini oshirish uchun muhimdir [2, 5–6-b.].

Shu sababdan, lalmi sharoitlarida *Sorghum almum* Parodining o‘sishi va rivojlanishini o‘rganish orqali mintaqa uchun muhitning noqulay omillari ta’siriga chidamli bo‘lgan, sifatli va to‘yimli ozuqaviy ekinlarnu yetishtirish agrotexnologiyasini yaratishni maqsad qilib oldik. Ushbu maqsadni amalga oshirish uchun biz 2024 va 2026 yillarda tadqiqotlar olib bordik. Bunda *Sorghum almum* Parodi o‘simliklarining o‘sish jadalligini lalmi sharotida turli ekish muddatlarida va ikki xil ekish usulida tajriba o‘tkazdik. Turli ekish muddatlarida sochma usulda ekish va qatorlab ekish usullarida o‘simliklarning o’sish jadalligi vegetatsiya davomida aniqlab borildi.

Sorghum almum Parodi (Kolumb o‘ti) bug‘doydoshlar (*Poaceae*) oilasining jo‘xori (*Sorghum*) turkumiga mansub ko‘p yillik yem – xashak o‘simligi bo‘lib, vatani Argentinadir. 1943 yilda botanik L.R. Parodi tomonidan fanga kiritilgan. *Sorghum almum* Parodining asosiy bioekologik xususiyatlari kelib chiqishi bilan bog‘liqdir. *Sorghum almum* Parodi kelib chiqishi jihatidan g‘umay (*S.halepense*) bilan ozuqabop ekin hisoblanadigan sudan o‘ti (*S.sudanense*) ning tabiiy gibridi hisoblanadi. Shuning uchun bu o‘simlik noqulay omillarga chidamliligi jihatidan g‘umayga, yashil massa hosildorligi va oziqaviyligi jihatidan sudan o‘tiga o‘xshaydi. *Sorghum almum* Parodi nisbatan issiqsevar o‘simlikdir. Urug‘lari tuproqning 0-10 sm qatlamida harorat 13^0C dan ortiq bo‘lganida una boshlaydi. Harorat 18 ^{0}C ga yetganida yaxshi unib chiqadi. Urug‘larning normal o‘sib rivojlanishi uchun optimal harorat 20-30^{0}C ni tashkil etadi [4, 24–92-b.].

Sorghum almum Parodi o‘simliklari lalmi sharoitida o‘sishib rivojlanishi uchun suv va unda erigan oziq moddalarni bahorgi yomg‘irlar hisobiga hosil bo‘lgan namlik orqali asta sekin o‘zlashtiradi. Bundan tashqari shudring orqali ham ertalab va kechqurun suv bilan to‘yinadi. Suv hayotiy jarayonlar uchun zarur omil hisoblanib, barcha fiziologik va biokimyoviy jarayonlarda qatnashadi.

Asosan sug‘orma dehqonchilikka asoslangan hududlarda qishloq xo‘jaligi ekinlarini yetishtirish va hosilning hajmi muayyan hududni, aniqroq aytganda, o‘simliklarni vegetatsiyasi davomida yetarli darajada suv bilan ta’minlashga bog‘liqligi namoyon bo‘ladi. Shu sababdan, lalmi sharoitlarida *Sorghum almum* Parodini o‘sishi va rivojlanishini o‘rganish orqali mintaqa uchun muhitning noqulay omillari ta’siriga chidamli bo‘lgan, sifatli va to‘yimli ozuqaviy ekinlarnu yetishtirish agrotexnologiyasini yaratishni maqsad qilib oldik. Ushbu maqsadni amalga oshirishda tajribani biz, asosan, ikki xil ekish usulida sinab ko‘rdik. Aniqlangan barcha muddatlarda sepib ekilgan variant o‘simliklarining balandligi qatorlab ekilgan variant o‘simliklariga qaraganda pastroq bo‘lishi aniqlandi. O‘simliklarning bo‘yi sepib ekilgan variantimizda 20 – may kuni 55,1 smni,

qatorlab ekilgan variantimizda bu ko‘rsatkich 63,2 sm ni tashkil etdi.1- iyun kun o‘tkazgan tajribalarimizda ham o‘simliklarning bo‘yi yuqoridagi kabi sepib ekilgan variantimizda pastroq bo‘lib, 84,5 smni, qatorlab ekilgan variantimizda esa balandroq ekanligi, ya’ni 92,8 ni tashkil qilishi aniqlandi. *Sorghum almum* Parodi o‘simliklarining bo‘yi 10 va 20-iyunь kunlari o‘lchanganida ham yuqoridagi kabi sepib ekilgan variantimizda pastroq, qatorlab ekilgan variantimizda esa balandroq ko‘rsatkichga ega ekanligi aniqlandi.

O‘simliklar vegetatsiyasining so‘nggida, ya’ni 30-iyulda olib brogan tadqiqotlarda ham yuqoridagi kabi holat namoyon bo‘ldi. Bunda, *Sorghum almum* Parodi o‘simliklarining bo‘yi sepib ekilgan variantimizda 173,5 smni, qatorlab ekilgan variantimizda bu ko‘rsatkich 188,7 sm ni tashkil qilishi aniqlandi.

Umuman olganda, yuqoridagi natijalardan ko‘rinib turibdiki, *Sorghum almum* Parodi urug‘lari sepib ekilganida o‘simliklarning o‘sish jadalligi, qatorlab ekilganida o‘simliklarning o‘sish jadalligi qaraganda ancha sust rivojlanish xususiyatlari ega bo‘ladi. Chunki, o‘simliklarning urug‘lari sepib ekilganida ular bir biriga nisbatan ancha tig‘iz joylashadi, buning oqibatida quyosh nuriga va ozuqaga bo‘lgan ehtiyoj ham ortadi va o‘simliklar bir birini siqib quyadi. Quyosh nuriga nisbat ancha talabchan bo‘lgan bu o‘simlikning bo‘yining o‘sishi fotosintez va namgarchilikka bo‘lgan ehtiyoji sabab soyada qolib pasayib ketadi.

FOYDALANILGAN ADABIYOTLAR

1. Abreha, K. B., Enyew, M., Carlsson, A. S., Vetukuri, R. R., Feyissa, T., Motlhaodi, T., Ng’uni, D., & Jensen, E. (2022). Sorghum in dryland: Morphological, physiological, and molecular responses of sorghum under drought stress. *Planta, 255*, Article 42. https://doi.org/10.1007/s00425-021-03799-7
2. Avutkhonov, B. S., Safarov, A. K., & Safarov, K. S. (2016). Physiological peculiarities of Columbus grass (*Sorghum almum* Parodi) in Samarkand region conditions of Uzbekistan. *European Science Review, 7–8*, 5–6.
3. Yahaya, M. A., & Shimelis, H. (2022). Drought stress in sorghum: Mitigation strategies, breeding methods and technologies—A review. *Journal of Agronomy and Crop Science, 208*(2), 127–142. https://doi.org/10.1111/jac.12573
4. Сивак Е.Е. Эффективность интродукции колумбовой травы в Центральном Черноземье. Курск: Изд. КГСХА. 2006. – 191 с.

SORGHUM BICOLOR L. NAVLARINING BARGLARIDA SUV SAQLASH QOBILIYATI DINAMIKASI VA TUPROQ SHO‘RLANISHIGA FIZIOLOGIK MOSLASHUVCHANLIGI.

Abdimurotov Dilmuhammad Vallamat o‘g‘li. *Denov tadbirkorlik va pedagogika instituti tayanch doktoranti, https://orcid.org/0009-0006-3360-4259*

Ibragimov Akram Javliyevich. *Termiz davlat muhandislik va agrotexnologiyalar universiteti dotsenti. https://orcid.org/0009-0000-1202-0795*

Annotatsiya. *Ushbu tadqiqotda Sorghum bicolor L. ning Massino, Qorabosh, Daulet va O‘zbekiston 5 navlari barglarining suv saqlash qobiliyati (Relative Water Content - RWC) va ularning sutkalik dinamikasi o‘rganildi. Olingan natijalar asosida tuproq sho‘rlanish darajalarining (kuchsiz, o‘rtacha va kuchli) o‘simlik suv rejimiga ta’siri o‘rganildi. Natijalar shuni ko‘rsatdiki, Massino navi eng yuqori kunlik o‘rtacha suv saqlash ko‘rsatkichini (76.67%) va yuqori osmoregulyatsiya qobiliyatini namoyon etdi. O‘zbekiston 5 navi esa sho‘rlanish va issiqlik stressiga eng ta’sirchan nav hisoblanadi.*

Kalit so'zlar: *Sorghum bicolor, suv saqlash qobiliyati, RWC, sutkalik dinamika, tuproq sho‘rlanishi, osmotik stress, Massino.*

KIRISH

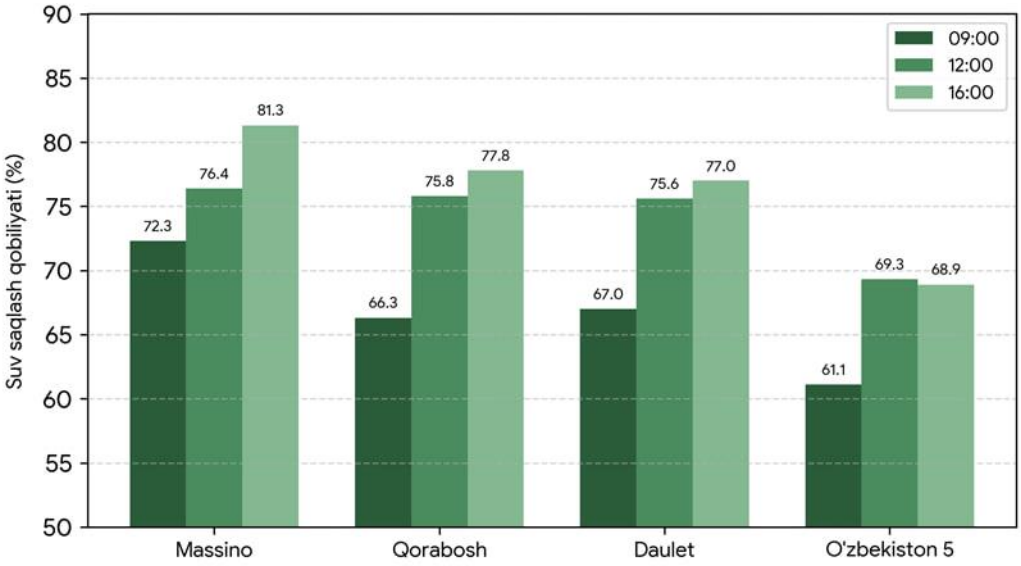
Iqlim o‘zgarishi va chuchuk suv resurslarining tanqisligi ortib borayotgan hozirgi davrda qishloq xo‘jaligi ekinlarining qurg‘oqchilik va sho‘rlanish stressiga chidamliligini baholash ustuvor ilmiy vazifalardan biridir. *Sorghum bicolor L* C4 fotosintez tipiga ega bo‘lib, yuqori suv foydalanish samaradorligi va noqulay ekologik omillarga chidamliligi bilan ajralib turadi [2]. Jo‘xorining muhim biologik xususiyatlaridan biri — tuproqqa nisbatan kam talabchanligi va sho‘r hamda ishqorli tuproqlarda ham o‘sish qobiliyatidir. Yaxshi rivojlangan ildiz tizimi tufayli jo‘xori boshqa ekinlar uchun noqulay bo‘lgan tuproqlarda ham nisbatan yuqori hosildorlikni ta’minlay oladi [4]. O‘simlik barglarining suv saqlash qobiliyati ularning transpiratsiya jadalligini nazorat qilish va kseromorf strukturaviy moslashuvchanligini aks ettiruvchi asosiy fiziologik ko‘rsatkichdir.

MATERIAL VA USULLAR.

Tadqiqot obyekti sifatida Sorghum bicolor L. ning 4 ta istiqbolli Massino, O‘zbekiston 5, Qorabosh va Daulet navlari tanlab olindi. Barglarning suv saqlash qobiliyati standart gravimetrik usulda tahlil qilindi. Tuproq sho'rlanish darajalarining (EC 2-4 dS/m - kuchsiz, EC 4-8 dS/m - o'rtacha, EC >8 dS/m - kuchli) muhitlarda suv saqlash ko‘rsatkichlariga ta’siri xalqaro fiziologik standartlar va osmotik bosim tenglamalari asosida ilmiy uslubda bajarildi.

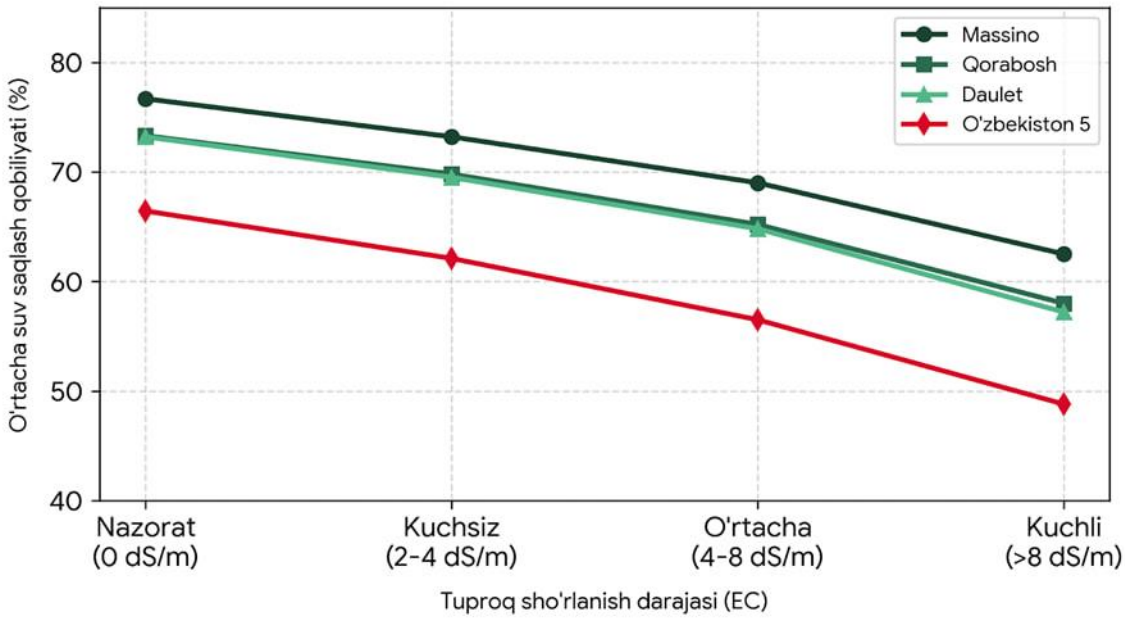
NATIJALAR VA ULARNING MUHOKAMASI

O‘tkazilgan o‘lchov natijalariga ko‘ra, barcha navlarda kun davomida suv saqlash ko‘rsatkichining ortishi kuzatildi. Bu holat jo‘xori o‘simligining tushgi va tushdan keyingi issiqlik sharoitida barg stomatalari o‘tkazuvchanligini pasaytirishi va kutikula qavatida mum to‘plashi orqali transpiratsiyani cheklashi bilan izohlanadi.



1-rasm. Sorghum bicolor navlarining kun davomida suv saqlash dinamikasi.

Ushbu ma’lumotlaridan ko‘rinadiki, Massino navida suv saqlash ko‘rsatkichi soat 09:00 dagi 72.3% dan 16:00 ga kelib 81.3% ga oshgan. Bu ushbu navning kunning ikkinchi yarmidagi issiqlik stressiga yuqori fiziologik moslashuvchanligini ko‘rsatadi. Aksincha, O‘zbekiston 5 navida 12:00 dagi 69.3% ko‘rsatkich 16:00 da 68.9% ga tushib qolgan, bu esa stomatalar nazoratining nisbatan kuchsizligidan dalolat beradi.



2-rasm. Tuproq sho‘rlanish darajasi ortishi bilan barglardagi suv saqlash qobiliyatining pasayishi navlar kesimida solishtirma taxlili

Tuproq sho'rlanishi darajasining ortishi ildiz zonasidagi osmotik potentsialni pasaytirib, barglarning suv shimilishini qiyinlashtiradi. Kuchli sho‘rlanish sharoitida Massino navi o'zining suv saqlash ko‘rsatkichini 62.5% darajasida saqlab qoladi. O‘zbekiston 5 navida esa ushbu ko'rsatkich 48.8% ga tushib ketishi, ya’ni hujayralar turgorligining yo‘qolish xavfi yuqoriligi aniqlandi.

XULOSA

Tadqiqot natijalariga ko‘ra, Sorghum bicolor L. navlarining barglarida suv saqlash qobiliyati kun davomida ortib borishi o‘simliklarning issiqlik va qurg‘oqchilikka fiziologik moslashuvchanligini ko‘rsatadi. O‘rganilgan navlar orasida Massino o‘zining yuqori suv saqlash ko‘rsatkichi va kuchli osmoregulyatsiyasi bilan eng chidamli genotip ekanligini namoyon etgan bo‘lsa, O‘zbekiston 5 navi ekologik stress omillariga eng ta’sirchan deb topildi. Shu sababli, sho‘rlangan va suvsiz hududlarda barqaror hosildorlikni ta’minlash uchun Massino va Qorabosh navlarini yetishtirish tavsiya etiladi.

FOYDALANILGAN ADABIYOTLAR

1. Asfaw, A.G., et al. (2021). Physiological and morphological responses of Sorghum bicolor to drought and salinity stresses. Environmental and Experimental Botany, 185, 104412.

2. Tari, I., et al. (2013). Acclimation of sorghum to salinity: Osmotic adjustment and antioxidants. Journal of Plant Physiology, 170(11), 991-998.

3. Алабушев А.В., Ионова Е.В. Засухоустойчивость сорго зернового // European Social Science Journal. 2011. № 5(8). С. 485–489

4. Impa SM, Perumal R, Bean SR, Sunoj VSJ, Jagadish SVK (2019) Water deficit and heat stress induced alterations in grain physico-chemical characteristics and micronutrient composition in field grown grain sorghum. J. Cereal Sci 86:124–131.

5. Bobade P, Amarshettiwar S, Rathod T, Ghorade R, Kayande N, Yadav Y (2019) Effect of polyethylene glycol induced water stress on germination and seedling development of rabi sorghum genotypes. J. Pharmacogn Phytochem 8(5):852–856

ZOMIN DAVLAT QO‘RIQXONASIDA MIQQIY (FALCO TINNUNCULUS)NING BIOEKOLOGIYASI VA POPULYATSIYA HOLATI

Abduazimova Mukarrama Abdulla qizi

Zomin davlat qo‘riqxonasi katta ilmiy xodimi

abuazimovamukarramma@gmail.com

Annotatsiya. *Ushbu maqolada Zomin davlat qo‘riqxonasi sharoitida o‘tkazilgan biologik tizimlar monitoringi doirasida miqqiy (Falco tinnunculus) qushining bioekologik xususiyatlari, yashash joylari, oziqlanish biologiyasi va parvoz dinamikasi tahlil qilingan. Shuningdek, 2023–2025-yillar davomida olib borilgan bahorgi va kuzgi populyatsiya monitoringi (sanoq) natijalari bayon etilgan. Hududdagi ekologik barqarorlik va tur dinamikasi qiyosiy o‘rganilgan.*

Kalit so‘zlar: *miqqiy, Falco tinnunculus, Zomin davlat qo‘riqxonasi, bioekologiya, ekologik monitoring, populyatsiya dinamikasi, biologik tizimlar, barqaror rivojlanish.*

Abstract. *Within the framework of biological systems monitoring in the Zomin State Reserve, this article analyzes the bioecology of the Common Kestrel (Falco tinnunculus), including its habitat, feeding behavior, flight dynamics, and nesting traits. Furthermore, the results of spring and autumn population monitoring (counts) conducted during 2023–2025 are presented. Ecological sustainability and population dynamics in the region are comparatively evaluated.*

Keywords: *common kestrel, Falco tinnunculus, Zomin State Reserve, bioecology, ecological monitoring, population dynamics, biological systems, sustainable development.*

Kirish. Miqqiy (Falco tinnunculus) - lochinsimonlar oilasiga mansub kichik kunduzgi yirtqich qush bo‘lib, Palearktika hududida keng tarqalgan. Tana uzunligi 31–38 sm, vazni 180–240 g, qanotlari yoyilganda 70–76 sm.ni tashkil etadi. Erkaklarining boshi va dumi kulrang-ko‘kish, ustki qismi jigarrang dog‘li bo‘ladi, urg‘ochilari esa bir xil jigarrang tusga ega. Miqqiy havoda bir joyda muallaq ("osilib") turish qobiliyati bilan ov qiladi. Asosiy oziqasini mayda kemiruvchilar, hasharotlar va kaltakesaklar tashkil etib, kuniga 8–10 tagacha kemiruvchini iste’mol qiladi. Ko‘rish qobiliyati insonnikidan 2,5–2,6 barobar yuqori bo‘lib, ultrabinafsha nurlarini ham seza oladi. Shu sababli agroekotizimlarda zararkunanda kemiruvchilar sonini cheklashda biologik nazorat agenti sifatida muhim ahamiyatga ega.

Miqqiy — monogam tur bo‘lib, juftliklar odatda bir ko‘payish mavsumi davomida birga bo‘ladi. Uya qurish uchun qoya kovaklari, daraxtlar yoki baland inshootlardan foydalanadi, odatda 4–5 ta tuxum qo‘yadi va inkubatsiya davri 25 kun davom etadi. Populyatsiyaning hududiy tabiati yashash muhitiga bog‘liq bo‘lib, Shimoliy Yevropa populyatsiyalari janubga ko‘chib yuradi (migratsiya qiladi), Markaziy Osiyo populyatsiyalari esa asosan o‘troq hayot kechiradi. Ular ochiq

tekisliklar, tog‘li hududlar va shahar muhitiga yaxshi moslashgan bo‘lib, ekotizim barqarorligi va qishloq xo‘jaligi uchun juda foydalidir.

Miqqiyning bioekologiyasi, morfologiyasi, migratsiyasi va populyatsiya dinamikasi bo‘yicha zamonaviy ma’lumotlar xalqaro ornitologik platforma — Birds of the World loyihasida jamlangan. 2025-yilgi yangilangan ma’lumotlarga ko‘ra, ushbu tur haqidagi ilmiy sharh ornitologlar Guy M. Kirwan va Peter Pyle tomonidan tayyorlangan bo‘lib, unda turning global tarqalishi, ekologik moslashuvi va demografik ko‘rsatkichlari batafsil yoritilgan [3, 15-b.]. Shuningdek, turning ozuqa zanjiridagi o‘rni xalqaro tadqiqotlarda, xususan, P. Ikula, M. Hromada va P. Tryjanowski ishlarida keng o‘rganilgan bo‘lib, ularning ilmiy xulosalari miqqiyning antropogen landshaftlarga moslashuvchanligini tasdiqlaydi [2,12-b.]. Biologik tizimlar monitoringi doirasida bunday tadqiqotlar ekologik barqarorlikni ta'minlashda muhim amaliy ahamiyatga ega.

Zomin davlat qo‘riqxonasi O‘zbekistonning tog‘li hududlarida joylashgan muhim muhofaza etiladigan tabiiy maskan bo‘lib, o‘zining boy flora va faunasi bilan ajralib turadi. Qo‘riqxona hududi Turkiston tizmasining g‘arbiy qismida joylashgan bo‘lib, balandlik mintaqalanishi, qoyali yonbag‘irlar, archa o‘rmonlari va ochiq yaylovlarning mavjudligi yirtqich qushlar uchun qulay ekologik sharoit (u uyalash va oziqlanish joylari) yaratadi.

Tadqiqot materiallari va metodlari. Monitoring ishlari qo‘riqxonaning G‘o‘ralashsoy aylanmasi hududida olib borildi. Hudud iqlimi keskin kontinental bo‘lib, bahor va kuz mavsumlari qushlarning faolligi yuqori bo‘lgan davrga to‘g‘ri keladi. Shu sababli, dala tadqiqotlari yiliga ikki marta-bahor (aprel–may) va kuz (oktyabr–noyabr) oylarida amalga oshirildi [5]. 2023–2025-yillarda sanoq ishlari vizual kuzatuv (marshrut usuli), individlar sonini hisoblash va joylashuvini dala kundaligiga qayd etib borish usullari orqali o‘tkazildi. Har bir mavsumiy sanoq ikki kun davomida o‘tkazilib, olingan natijalar yillar kesimida tahlil qilindi.

Tadqiqot natijalari va ularning tahlili. Olib borilgan ko‘p yillik ekologik monitoring natijalari 1-jadvalda keltirilgan.

1-jadval. Zomin davlat qo‘riqxonasida miqqiy populyatsiyasining monitoring natijalari (2023–2025 yy.)

Yil	Bahorgi sanoq (individ)	Kuzgi sanoq (individ)	Yillik o‘rtacha soni
2023	17	18	17,5
2024	13	18	15,5
2025	19	19	19,0

Jadval ma’lumotlari tahlili shuni ko‘rsatadiki, 2023-yilda bahorgi sanoqda 17 ta, kuzgi sanoqda esa 18 ta individ ro‘yxatga olindi (yillik o‘rtacha-17,5). Bu populyatsiyaning barqaror holatda bo‘lganligini ko‘rsatadi. 2024-yilda bahorgi sanoq ko‘rsatkichi kamayib, 13 tani tashkil etdi, kuzgi sanoq esa o‘zgarishsiz (18 ta) qoldi. Bahordagi kamayish ozuqa resurslarining vaqtincha pasayishi yoki iqlim sharoitlari bilan bog‘liq bo‘lishi mumkin. 2025-yilda populyatsiya sonining qayta tiklanishi kuzatildi: bahorgi va kuzgi sanoqlar teng bo‘lib, 19 tadan individni tashkil etdi (yillik o‘rtacha -19) [5].

Kuzgi sanoq natijalari yillar davomida barqaror (18–19 ta) bo‘lsa-da, bahorgi sanoq ko‘rsatkichlari o‘zgaruvchandir. Bu holat mavsumiy migratsiya sur’atlari, lokal iqlim sharoitlari va bahorgi ozuqa bazasining holati bilan izohlanadi. Umumiy hisobda biologik tizim barqaror va dinamik muvozanatda hisoblanadi.

Xulosa. Miqqiy populyatsiyasining bioekologiyasi va monitoring natijalari shuni ko‘rsatadiki, Zomin davlat qo‘riqxonasining G‘o‘ralashsoy aylanmasida ushbu tur uchun optimal sharoit mavjud va populyatsiya barqaror saqlanmoqda. Hududdagi antropogen bosimning deyarli yo‘qligi turning muvaffaqiyatli ko‘payishi va oziqlanishini ta’minlamoqda. Ushbu biologik tizimlar monitoringi natijalari ekologiya va barqaror rivojlanish maqsadlariga to‘la xizmat qiladi.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI:

1. BirdLife International. BirdLife Data Zone [Elektron manba]. – URL: https://www.birdlife.org, 2025.

2. Ikula P., Hromada M., Tryjanowski P. Common Kestrel (Falco tinnunculus) ning oziqlanish ekologiyasi va trofik zanjirdagi o‘rni. // Xalqaro ornitologik jurnallar, 2024. – S. 12-20.

3. Kirwan G.M., Pyle P. Falco tinnunculus (Common Kestrel) // Birds of the World. Cornell Lab of Ornithology. – Ithaca, 2025.

4. O‘zbekiston Milliy ensiklopediyasi. Birinchi jild. – Toshkent: O‘zbekiston Milliy ensiklopediyasi Davlat ilmiy nashriyoti, 2000. – 512 s.

5. Zomin davlat qo‘riqxonasi. 2023–2025-yillar sanoq hisobotlari. – Zomin, 2025.

“QOZON” MARJUMAK NAVI URUG‘LARINING UNUVCHANLIGIGA HARORATNING TA’SIRI

Artikova Gulnoza Xasanovna

Samarqand davlat Pedagogika insituti Tabiiy fanlar fakulteti Biologiya kafedrasi assistenti, +998 91 595 34 45, E-mail: artikova@gmail.com

Annotatsiya. *Ushbu maqolada “Qozon” marjumak (Fagopyrum esculentum Moench) navi urug‘larining laboratoriya sharoitida unuvchanligiga haroratning ta’siri haqida ma’lumotlar berilgan. Tajribada urug‘larning 10, 15, 20, 25 va 30 °C haroratlarda unib chiqish dinamikasi kunlar kesimida o‘rganilgan bo‘lib, 20–25 °C haroratlar urug‘larining tez va yuqori darajada unib chiqishi uchun qulay sharoit ekanligi aniqlangan.*

Kalit so‘zlar: *Fagopyrum esculentum, “Qozon” navi, urug‘, unuvchanlik, harorat, unish dinamikasi.*

Abstract. *This article provides information on the effect of temperature on the germination of seeds of the “Kazon” buckwheat (Fagopyrum esculentum Moench) variety in laboratory conditions. In the experiment, the dynamics of seed germination at temperatures of 10, 15, 20, 25 and 30 °C were studied in a daily interval, and it was found that temperatures of 20–25 °C are favorable conditions for rapid and high germination of seeds.*

Keywords: *Fagopyrum esculentum, “Kazon” variety, seed, germination, temperature, germination dynamics.*

Marjumak (*Fagopyrum esculentum* Moench) dunyoning ko‘plab mamlakatlarida oziq-ovqat, yem-xashak va biologik faol moddalar manbai sifatida yetishtiriladigan muhim ekinlardan biridir. Uning doni tarkibida oqsil, mineral moddalar, fenolli birikmalar va boshqa biologik faol komponentlarga boyligi bilan ajralib turadi. Shu boisdan marjumak yetishtirishga, xususan, uning urug‘lik sifatlarini o‘rganishga bo‘lgan qiziqish tobora ortib bormoqda [5, 12-b.].

Marjumakning “Qozon” – (Kazanskaya krupnoplodnaya) navi asosan Tatariston hududida yetishtiriladigan va keng qo’llaniladigan mahalliy nav hisoblanadi. Nav Tatariston qishloq xo’jalik ilmiy tekshirish institutida “Troyand” navidan yalpi tanlash usuli bilan yaratilgan. Tupining balandligi o’rtacha, barglari, gullari, mevalari yirik. O‘simlikning vegetatsiya davri 64-82 kun bo‘lib, o‘rtapishar navlar guruhiga kiradi. Boshqa navlarga qaraganda qurg‘oqchilikka chidamli, yotib qolishga o‘rtacha chidamli. O‘simliklarning bo‘yi o‘rtacha balandlikda. Samarqand viloyati sharoitida o‘tkazgan tajribalarida ekish muddatlariga bog‘liq holda o‘simliklar bo‘yining balandligi vegetatsiyaning oxirida o‘rtacha 80-100 sm ni tashkil etgan [6, 30–33-b.]. Barglari, gullari, mevalari yirik. Samarqand viloyati sharoitida o‘tkazilgan tajribalarida, Qozon navi barg sathi ekish muddatlarga bog‘liq holda 291,6-507,5 sm^2/tupni tashkil qilganligi aniqlangan. Donlarning

texnologik sifati yaxshi. 1000 dona donining massasi 31-33 gram bo‘lib, standart hisoblanuvchi navlardan 1 – 3 g ko’p. Qipig‘i 21-24%. Donlari kam to‘kiluvchan. Ushbu navdan Tatariston sharoitida 6,7-11,5 s/ga don hosili [7, 46-b.] olinsa, Samarqand viloyati sharoitida esa 21-22 s/ga don hosili [4, 38–40-b.] olish mumkinligi aniqlangan.

Urug‘ning unib chiqishi o‘simlik hayot siklining muhim dastlabki bosqichi bo‘lib, uning muvaffaqiyatli kechishi keyingi o‘sish va rivojlanish jarayonlariga bevosita ta’sir qiladi. Urug‘larning unishi namlik, harorat, kislorod, yorug‘lik va urug‘ning fiziologik holati kabi omillarga bog‘liq. Ushbu omillar orasida harorat urug‘ning fiziologik faolligini boshqaruvchi asosiy ekologik omillardan biri hisoblanadi [3, 127–133-b.].

Horbowicz va Obendorf tomonidan olib borilgan tadqiqotda ham marjumak urug‘larining fiziologik sifati va unuvchanligi harorat bilan bog‘liq ekanligi ko‘rsatilgan. Mualliflar urug‘larning yetilishi 15, 22 va 30 °C sharoitlarida olib borilganda ularning unuvchanligi va urug‘ tarkibidagi eruvchan uglevodlar tarkibida farqlar mavjudligini aniqlagan [1, 1264–1270-b.].

Biz tadqiqotlarimizda “Qozon” marjumak navi urug‘larining unuvchanligiga haroratning ta’sirini o‘rganishga e’tibor qaratdik va olingan natijalar 1-jadvalda keltirilgan.

1-jadval

“Qozon” marjumak navi urug‘larining turli xil haroratlarda unib chiqish jadalligi, %

Harorat °C	Kunlarda urug‘larning unib chiqishi, %									
	1	2	3	4	5	6	7	8	9	10
10	-	-	-	2,0	14,4	40,3	63,5	67,8	73,5	75,2
15	-	-	3,1	8,2	32,6	64,1	70,8	78,6	90,7	92,4
20	-	5,2	55,3	74,8	93,6	97,8	-	-	-	-
25	9,5	37,4	65,7	76,6	90,5	98,1	-	-	-	-
30	22,0	60,8	66,5	69,4	74,0	89,6	-	-	-	-

Jadvalda keltirilgan ma’lumotlardan aniqlanishicha marjumakning “Qozon” navi urug‘lari laboratoriya sharoitida maxsus termostatda undirilganda 10°C haroratda 1-2-3 kunlari o‘nib chiqmadi. 4-kuni 2,0% urug‘ unib chiqdi va 5 kuni 14,4% urug‘ unib chiqdi. 4 kundagi urug‘ unuvchanligi 5 kun urug‘ unib chiqqanga qaraganda yuqori unib chiqqanligini ko‘rishimiz mumkin. 6 kuni 40,3% urug‘ unib chiqdi. 5 kunga qaraganda 6 kuni urug‘i ancha yuqori unganligini ko‘rishimiz mumkin. 7 kuni 63,5% urug‘ unib chiqdi. 8 kuni 67,8% urug‘ unib chiqdi. Bundan ko‘rinib turibdiki 7 kunga nisbatan urug‘lar 8 kuni yaxshi unib chiqqanligini ko‘ramiz. 9 kuni 73,5% urug‘ unib chiqdi. 10 kuni 75,2% urug‘ unib chiqdi. Bundan ko‘rinib turibdiki 9 va 10 kuni urug‘lar yaxshi unib chiqqanligini ko‘rishimiz mumkin. 10 °C haroratda urug‘larning unib chiqishi

eng sekin kechgan. Dastlabki unish 4-kunda qayd etilib, unuvchanlik 2,0 % ni tashkil etdi. 5-kunda bu ko‘rsatkich 14,4 %, 6-kunda 40,3 %, 8-kunda 67,8 % va 10-kunda 75,2 % ga yetdi.

15 °C haroratda unish 3-kundan boshlandi. 3-kundagi 3,1 % ko‘rsatkich 5-kunda 32,6 %, 6-kunda 64,1 %, 8-kunda 78,6 % va 10-kunda 92,4 % ga yetdi. Demak, 15 °C harorat 10 °C ga nisbatan urug‘larning unib chiqishini sezilarli darajada tezlashtirdi. 20 °C sharoitida urug‘larning unishi ancha jadal kechdi. 2-kunda 5,2 % urug‘ unib chiqqan bo‘lsa, 3-kunda bu ko‘rsatkich 55,3 % ga, 4-kunda 74,8 % ga, 5-kunda 93,6 % ga va 6-kunda 97,8 % ga yetdi.

25 °C variantida unish jarayoni eng erta boshlandi. Birinchi kunda 9,5 % urug‘ unib chiqqan bo‘lsa, 2-kunda 37,4 %, 3-kunda 65,7 %, 4-kunda 76,6 %, 5-kunda 90,5 % va 6-kunda 98,1 % ni tashkil etdi.

30 °C haroratda dastlabki unish eng tez variantlardan biri bo‘ldi. Birinchi kunda 22,0 %, ikkinchi kunda 60,8 % urug‘ unib chiqdi. Biroq keyingi kunlarda unish sur’ati sekinlashib, 6-kunda yakuniy unuvchanlik 89,6 % ni tashkil etdi.Shunday qilib, eng yuqori unuvchanlik 25 °C da 98,1 %, unga juda yaqin natija 20 °C da 97,8 % bo‘ldi. Eng past yakuniy ko‘rsatkich esa 10 °C da 75,2 % qayd etildi.

Tadqiqot natijalari “Qozon” marjumak navi urug‘larining unib chiqish jarayoni haroratga kuchli bog‘liqligini ko‘rsatdi. Past haroratda urug‘larning unish boshlanishi kechikdi va unish jarayoni uzoqroq davom etdi. 10 °C da dastlabki unishning faqat 4-kunda kuzatilishi bunga yaqqol misol bo‘la oladi. Haroratning 15 °C gacha ko‘tarilishi urug‘larning unish jarayonini tezlashtirdi. 20 va 25 °C sharoitlarida esa urug‘larning asosiy qismi dastlabki 5–6 kun davomida unib chiqdi. Bu haroratlar tajribada “Qozon” navi uchun yuqori unuvchanlikni ta’minlagan.

Ushbu natijalar boshqa tadqiqotlarda qayd etilgan ma’lumotlar bilan ham umumiy jihatdan mos keladi. Horbowicz va hammualliflar tomonidan olib borilgan tadqiqotda to‘rtta marjumak navining urug‘lari 12±2, 19±1 va 24±2 °C sharoitlarida o‘rganilgan. Mualliflar harorat oshishi bilan dastlabki unish jarayoni tezlashishini va navlar o‘rtasida unish dinamikasi bo‘yicha farqlar mavjudligini ko‘rsatgan [2, 9-b.].

Bizning tajribamizda ham 25 °C da urug‘larning birinchi kundanoq unishi kuzatildi. 6-kunda 98,1 % lik unuvchanlikka erishildi. 20 °C da esa 6-kundagi unuvchanlik 97,8 % ni tashkil etdi. Bu ko‘rsatkichlar “Qozon” navining o‘rganilgan sharoitlarda nisbatan yuqori unuvchanlik potensialiga ega ekanligini ko‘rsatadi. Shu bilan birgalikda, 30 °C haroratda dastlabki unish juda tez kechganiga qaramay, 6-kundagi yakuniy unuvchanlik 89,6 % ni tashkil etdi. Demak, urug‘larning tez unishi bilan yuqori yakuniy unuvchanlikni bir xil tushuncha sifatida baholash mumkin emas. Yuqori harorat dastlabki fiziologik jarayonlarni jadallashtirishi mumkin, biroq urug‘larning keyingi rivojlanish bosqichlarida stress omili sifatida namoyon bo‘lishi ehtimoli mavjud.

FOYDALANILGAN ADABIYOTLAR

1. Horbowicz, M., & Obendorf, R. L. (2005). Fagopyritol accumulation and germination of buckwheat seeds matured at 15, 22, and 30°C. *Crop Science, 45*(4), 1264–1270. https://doi.org/10.2135/cropsci2004.0431.
2. Horbowicz, M., Sidorowicz, A., Wolińska, J., Mioduszewska, H., & Koczkodaj, D. (2009). The effect of temperature on germination, growth and anthocyanin accumulation in seedlings of four cultivars of common buckwheat (*Fagopyrum esculentum* Moench). https://doi.org/10.1007/s004250050290.
3. Huda, M. N., Lu, S., Jahan, T., Ding, M., Jha, R., Zhang, K., Zhang, W., Georgiev, M. I., Park, S. U., & Zhou, M. (2020). Treasure from garden: Bioactive compounds of buckwheat. *Food Chemistry, 335*, 127653. https://doi.org/10.1016/j.foodchem.2020.127653.
4. Jurayeva Z. J., Xalilov N. X. Zarafshon vodiysi sharoitida ekish me'yorining marjumak navlari hosildorligiga ta'siri // "O'zbekiston fani: o'tmishi, buguni va kelajagi": mintaqaviy ilmiy-amaliy konferensiya materiallari. – Samarqand, 2001. – B. 38-40.
5. Noreen, S., Rizwan, B., Khan, M., & Farooq, S. (2020). Health benefits of buckwheat (*Fagopyrum esculentum*), potential remedy for diseases, rare to cancer: A mini review. *Current Nutrition & Food Science*. https://doi.org/10.2174/1871526520999201224122605
6. **O'roqov, S. X., Xo'jayev, J. X., Jo'rayeva, Z. J., & Atayeva, Sh. S.** (2015). G'alladan bo'shagan maydonlarda yetishtirilgan marjumakning hosildorlik darajasiga mineral o'g'itlarning ta'siri. *Guliston davlat universiteti axborotnomasi*, (4), 30–33.
7. Шевчик В. К. Гречиха татарская. Особенности повреждения болезнями коллекции (*Fagopyrum tataricum*) в условиях Украины // Захист рослин. – 2001. – № 6. – С. 46.

UDK: 633.88.631.

DORIVOR GULXAYRI (*ALTHAEA OFFICINALIS* L.) O‘SIMLIGINING BIOEKOLOGIK XUSUSIYATLARI, FITOKIMYOVIY TARKIBI VA YETISHTIRISH ISTIQBOLLARI

Boratova O‘g‘iloy Qodirjon qizi , Andijon Qishloq xo‘jaligi va agrotexnalogiyalar instituti Mustaqil doktoranti

Baratova Mohidil Raximovna, Toshkent irrigatsiya va qishloq xo‘jaligini mexanizatsiyalash muhandislari instituti professori, q.f.d.

Annotatsiya. *Mazkur tezisda gulxayridoshlar (Malvaceae Juss.) oilasiga mansub dorivor gulxayri (Althaea officinalis L.) o‘simligining morfologik belgilari, bioekologik xususiyatlari, geografik tarqalishi, fitokimyoviy tarkibi va yetishtirish istiqbollari yoritilgan. Shuningdek, 2023-yilda Andijon, Beshariq va Uchqo‘rg‘on hududlarida turli ekish muddatlari hamda o‘g‘itlash variantlarida o‘simlik bo‘yining o‘zgarishi qiyosiy tahlil qilingan. Olingan ma’lumotlar o‘simlikning vegetativ o‘sishi ekish muddati va oziqlanish sharoitlariga qarab farqlanishini ko‘rsatadi.*

Kalit so‘zlar: *Althaea officinalis L., Malvaceae, dorivor gulxayri, bioekologiya, fitokimyoviy tarkib, biometrik ko‘rsatkichlar, ekish muddati, o‘g‘itlash, dorivor xomashyo.*

Abstract;*This paper outlines the morphological characteristics, bio-ecological features, geographical distribution, phytochemical composition, and cultivation prospects of the medicinal marshmallow plant (*Althaea officinalis* L.), a member of the Malvaceae family. Additionally, a comparative analysis was conducted on variations in plant height under different planting dates and fertilization regimes in the Andijan, Beshariq, and Uchkurgan regions during 2023. The obtained data indicate that the plant's vegetative growth varies depending on the planting date and nutritional conditions.*

Keywords: *Althaea officinalis L., Malvaceae, medicinal marshmallow, bioecology, phytochemical composition, biometric indicators, planting time, fertilization, medicinal raw material.*

Dorivor o‘simliklar biologik resurslarning muhim tarkibiy qismi bo‘lib, ularning farmatsevtika sanoatidagi ahamiyati tarkibidagi biologik faol moddalar, xomashyo sifati va yetishtirish sharoitlariga bog‘liq. Shu jihatdan gulxayridoshlar — Malvaceae Juss. oilasiga mansub dorivor gulxayri (*Althaea officinalis* L.) alohida e’tiborga loyiq. Mazkur oila vakillari orasida oziq-

ovqat, texnik, manzarali va dorivor ahamiyatga ega turlar ko‘p uchraydi. Dorivor gulxayri esa, ayniqsa, shilliq moddalarga boy ildizi bilan farmakognoziyada muhim o‘rin tutadi.

Dorivor gulxayri ko‘p yillik o‘tsimon o‘simlik bo‘lib, odatda 60–150 sm, qulay ekologik sharoitlarda esa 200 sm gacha bo‘y oladi. Poyasi tik o‘suvchi, silindrsimon va mayin tuklar bilan qoplangan. Barglari poyada ketma-ket joylashadi: pastki barglari yumaloq-tuxumsimon, o‘rta va yuqori barglari esa ko‘pincha 3–5 bo‘lakli bo‘ladi. Gullari oqish-pushti yoki och binafsha rangda, besh gultojibargli bo‘lib, barg qo‘ltiqlarida va poyaning yuqori qismida joylashadi. Ildiz tizimi kuchli rivojlangan, asosiy ildizi yo‘g‘on va go‘shtdor bo‘lib, ichki qismi oqish rangda hamda shilliq moddalarga boy. Mevasi pishganda alohida bo‘laklarga ajraladigan yassi, ko‘p urug‘li quruq meva hisoblanadi. *Althaea officinalis* L. Yevropa, Kavkaz, Kichik Osiyo va Markaziy Osiyoning turli hududlarida tarqalgan. Tabiiy sharoitda, asosan, daryo vodiylari, nam o‘tloqlar, to‘qayzorlar, ariq va kanallar bo‘ylari hamda namlik yetarli bo‘lgan boshqa joylarda uchraydi. O‘simlik ekologik jihatdan mezofit bo‘lib, namlik bilan yetarli ta’minlangan, unumdor, yengil va o‘rta qumoq tuproqlarda yaxshi rivojlanadi. Yorug‘lik, harorat va tuproqning suv-fizik xususiyatlari uning vegetativ organlari shakllanishiga bevosita ta’sir ko‘rsatadi. Namlik tanqisligi va kuchli sho‘rlanish esa o‘sish jarayonlarini cheklashi mumkin.

Dorivor gulxayrining fitokimyoviy tarkibida shilliq polisaxaridlar, pektin moddalar, flavonoidlar, organik kislotalar, aminokislotalar va mineral komponentlar mavjud. Ayniqsa, ildiz tarkibidagi shilliq moddalar o‘simlikning asosiy farmakologik ahamiyatini belgilaydi. Ular shilliq qavatlarni qoplash, yumshatish va himoyalash xususiyatlariga ega. O‘simlik xomashyosining kimyoviy tarkibi uning o‘sish sharoiti, rivojlanish bosqichi, yig‘ib olish va quritish usullariga bog‘liq holda o‘zgarishi mumkin. Shu sababli dorivor gulxayrini yetishtirishda biomassa hosildorligi bilan bir qatorda xomashyoning sifat ko‘rsatkichlarini ham baholash muhimdir. O‘simlikning o‘sishi va rivojlanishini o‘rganishda biometrik kuzatishlar muhim ilmiy-amaliy ahamiyatga ega. Poya balandligi, barglar soni, ildiz uzunligi va massasi kabi ko‘rsatkichlarni vegetatsiya davomida muntazam o‘lchash o‘simlikning rivojlanish dinamikasini, ekologik omillarga moslashuvini va agrotexnik tadbirlarga javob reaksiyasini baholash imkonini beradi. Shu maqsadda 2023-yilda Andijon, Beshariq va Uchqo‘rg‘on hududlarida dorivor gulxayrining uchta ekish muddatidagi o‘simlik bo‘yi nazorat va o‘g‘itli variantlar bo‘yicha taqqoslandi.

1-jadval.

Dorivor gulxayri (*Althaea officinalis* L.) o‘simligining 2023-yilda turli hududlar va ekish muddatlari bo‘yicha bo‘yi (sm)



Izoh: jadvaldagi qiymatlar taqdim etilgan 2023-yilgi diagrammadan olindi. Farq o‘g‘itli va nazorat variantlari orasidagi mutlaq tafovutni bildiradi.

Jadval ma’lumotlari barcha hududlarda o‘g‘itli variantlarda o‘simlik bo‘yi nazorat variantlariga nisbatan yuqori bo‘lganini ko‘rsatadi. Andijon hududida birinchi ekish muddatida nazorat variantidagi o‘simliklar bo‘yi 68,5 sm, o‘g‘itli variantda esa 79,4 sm ni tashkil etib, farq 10,9 sm ga teng bo‘ldi. Beshariq hududida birinchi muddatda ushbu ko‘rsatkichlar 63,8 va 74,2 sm bo‘lib, farq 10,4 sm ni tashkil etdi. Uchqo‘rg‘on hududida esa birinchi ekish muddatidagi nazorat va o‘g‘itli variantlar o‘rtasidagi farq 11,6 sm bo‘lib, uchala hudud orasidagi eng katta mutlaq tafovut qayd etildi. Ekish muddatlari bo‘yicha taqqoslash barcha hududlarda birinchi muddatda o‘simlik bo‘yi yuqoriroq, uchinchi muddatda esa pastroq bo‘lganini ko‘rsatdi. Eng yuqori ko‘rsatkich Andijon hududining birinchi muddatdagi o‘g‘itli variantida 79,4 sm, eng past ko‘rsatkich esa Beshariq hududining uchinchi muddatdagi nazorat variantida 50,9 sm ni tashkil etdi. Bu holat kuzatuv olib borilgan sharoitlarda o‘simlik bo‘yining ekish muddati va oziqlanish variantlari bo‘yicha farqlanishini ko‘rsatadi. Biroq o‘g‘it turi, me’yori, tuproq xususiyatlari va tajriba takrorlari to‘g‘risidagi ma’lumotlar mavjud bo‘lmagani sababli mazkur farqlarning statistik ishonchliligini baholash uchun qo‘shimcha tadqiqotlar talab etiladi. Dorivor gulxayrini madaniy holda yetishtirish

tabiiy populyatsiyalarga tushadigan bosimni kamaytirish va farmatsevtika sanoatini standartlashtirilgan xomashyo bilan ta’minlash imkonini beradi. Bunda tuproq unumdorligini saqlash, sug‘orish rejimini maqbullashtirish, ekish muddatlarini hududning agroiqlim sharoitiga mos tanlash va o‘g‘itlardan ilmiy asosda foydalanish muhim hisoblanadi. Shuningdek, kasalliklarning oldini olish, almashlab ekish va xomashyoni o‘z vaqtida yig‘ib olish kabi agrotexnik tadbirlar o‘simlikning barqaror rivojlanishiga yordam beradi. Xulosa qilib aytganda, dorivor gulxayri morfologik va bioekologik xususiyatlari, shilliq polisaxaridlarga boy ildizi hamda farmatsevtik ahamiyati bilan istiqbolli dorivor o‘simlik hisoblanadi. 2023-yilgi kuzatuvlarda uchala hududda ham o‘g‘itli variantlardagi o‘simlik bo‘yi nazoratga nisbatan yuqori bo‘lib, birinchi ekish muddatida eng katta ko‘rsatkichlar qayd etilgan. Ushbu natijalar dorivor gulxayrini mahalliy sharoitda yetishtirishda ekish muddatlari va oziqlanish sharoitlarini chuqurroq o‘rganish zarurligini ko‘rsatadi. Kelgusida o‘simlikning biometrik ko‘rsatkichlari, ildiz hosildorligi va biologik faol moddalar miqdorini birgalikda baholash yetishtirish texnologiyasini takomillashtirish hamda sifatli dorivor xomashyo olishga xizmat qiladi.

FOYDALANILGAN ADABIYOTLAR

1. Ruzmetov U.I. O‘zbekiston sharoitida Asteraceae va Lamiaceae oilasiga mansub dorivor o‘simliklarni yetishtirishning ilmiy-amaliy asoslari: qishloq xo‘jaligi fanlari doktori (DSc) dissertatsiyasi avtoreferati. – Toshkent, 2023. – 64 b.
2. Aytmuratova N. Dorivor gulxayri o‘simligining shifobaxsh xususiyatlari va yetishtirish texnologiyasi // Universal xalqaro ilmiy jurnal. – 2025. – 2-jild, 4.4-son. – B. 669–670. DOI: 10.71337/inlibrary.uz.universaljurnal.110355.
3. Andruszczak S. The influence of the plantation establishment method on the yield of marshmallow (Althaea officinalis L.) flowers // Acta Agrobotanica. – 2008. – Vol. 61, No. 1. – P. 167–172. DOI: 10.5586/aa.2008.023.
4. Бейдеман И.Н. Методика изучения фенологии растений и растительных сообществ. – Новосибирск: Наука, 1974. – 154 с.
5. Доспехов Б.А. Методика полевого опыта (с основами статистической обработки результатов исследований). – 6-е изд., стер. – Москва: Альянс, 2011. – 351 с.
6. To‘xtayev B.Yo., Axmedov E.T. Dorivor o‘simliklar introduksiyasi:o‘quv-uslubiy majmua. – Toshkent, 2022.

7. To‘xtayev B.Yo., Mahkamov T.X., To‘laganov A.A., Mamatkarimov A.I., Mahmudov A.V., Allayorov M.O‘. Dorivor va ozuqabop o‘simliklar plantatsiyalarini tashkil etish va xomashyosini tayyorlash bo‘yicha yo‘riqnoma. – Toshkent, 2015.
8. To‘xtayev B.Yo., Turakulov A. Dorivor o‘simliklarni introduksion tahlil qilish va baholash: o‘quv-uslubiy majmua. – Toshkent, 2018.
9. Ҳамидов А., Набиев М., Одилов Т. Ўзбекистон ўсимликлари аниқлагичи. – Тошкент: Ўқитувчи, 1987.
10. Холматов Х.Х., Ҳабибов З.Ҳ., Олтинбекова Р.А. Ўзбекистоннинг шифобахш ўсимликлари. – Тошкент: Ибн Сино, 1991.
11. Холматов Х.Х., Қосимов А.И. Доривор ўсимликлар. – Тошкент: Ибн Сино, 1994.
12. Muradova O.I., Qaysarov V.T. Dorivor gulxayrining (*Althaea officinalis* L.) urug‘ unuvchanligi va morfologik ko‘rsatkichlari // *Xorazm Ma’mun akademiyasi axborotnomasi*. – 2023. – №5/1. – B. 47–49.
13. Muradova O.I., Qaysarov V.T. Dorivor gulxayri (*Althaea officinalis* L.) o‘simligining dorivorlik xususiyati // *Tadqiqotlar jahon ilmiy-metodik jurnali*. – 2023. – №19. – B. 132–134.
14. Xue T., Ruan K., Tang Z., Duan J., Xu H. Isolation, structural properties, and bioactivities of polysaccharides from *Althaea officinalis* Linn.: A review // *International Journal of Biological Macromolecules*. – 2023. – Vol. 242. – Article 125098. – DOI: 10.1016/j.ijbiomac.2023.125098.
15. Farhat C., Younes H., Alyamani O.A., Mrad M., Hourani N., Khalifeh H., Hage-Sleiman R. Chemical characterization and in vitro biological evaluation of aqueous extract of *Althaea officinalis* L. flower grown in Lebanon // *Journal of Herbal Medicine*. – 2022. – Vol. 34. – Article 100575. – DOI: 10.1016/j.hermed.2022.100575.
16. Pryvedeniuk N., Hlushchenko L., Trubka V. Efficiency of mineral fertilizers for growing *Althaea officinalis* L. under conditions of irrigation // *Agroecological Journal*. – 2021. – No. 1. – DOI: 10.33730/2077-4893.1.2021.227251.
17. Pryvedeniuk N., Hlushchenko L., Trubka V. Productivity of *Althaea officinalis* L. when using growth regulators and drip irrigation // *Agroecological Journal*. – 2022. – No. 1. – DOI: 10.33730/2077-4893.1.2022.255186.

IN NORTHWESTERN KYZYLKUM ECO-BIOLOGICAL FEATURES OF CERTAIN SPECIES BELONGING TO THE ORDER *DELPHINIUM* L.

Bekbergenova Gavkhar Sadatdinovna

Nukus State Pedagogical Institute named after Ajiniyaz

"Botany" specialty Doctoral candidate,

Annotation: *The article presents the results of a comprehensive study of the ecological, biological, and morphological characteristics of certain species belonging to the genus Delphinium L., growing in the conditions of the Northwestern Kyzylkum. The characteristics of their distribution, ecological dependence, morphological structure, and ontogenesis under extreme continental and climatic conditions are examined. It was established that the studied species exhibit pronounced xerophytic adaptations, such as reduced leaf surface area, development of a deep root system, and shortening of the growing season. High ecological plasticity has been identified, allowing it to exist in conditions of moisture deficit and extreme temperatures. The obtained data are important for botanical monitoring, biodiversity conservation, and assessing the state of desert ecosystems.*

Abstract: *The article presents the results of a comprehensive study of the ecological, biological, and morphological characteristics of several species of the genus Delphinium L., growing in the conditions of the Northwestern Kyzylkum. Their distribution, ecological confinement, morphological structure, and features of ontogenesis under sharply continental and arid climatic conditions are examined. It has been established that the studied species exhibit pronounced xerophytic adaptations, including reduced leaf surface, development of a deep root system, and a shortened vegetation period. High ecological plasticity has been revealed, allowing them to survive in conditions of moisture deficit and extreme temperatures. The obtained data are important for botanical monitoring, biodiversity conservation, and assessment of desert ecosystems.*

Key words: *Delphinium L., Kyzylkum, plant ecology, xerophytes, ontogenesis, adaptation, desert flora.*

Introduction

Delphinium The genus Delphinium L. includes perennial and annual herbaceous plants with high morphological diversity, widely distributed across temperate and mountainous regions of Eurasia. Many species of the genus are important components of natural ecosystems and are also of decorative and ecological value. However, in the desert regions of Central Asia, including the

Northwestern Kyzylkum, representatives of the genus are found in limited numbers and are characterized by specific adaptation mechanisms.

Northwestern Kyzylkum is a region with a sharply continental climate, where high summer temperatures, significant daily fluctuations, a shortage of atmospheric precipitation, and poor sandy soils are observed. These factors form the rigid conditions for the existence of plants and determine the characteristics of their morphology, physiology, and life cycle. Nevertheless, some species of the genus successfully adapt to these conditions, forming stable populations in local ecological communities.

Global climate change, the intensification of desertification processes, and the increasing anthropogenic impact cannot but have an impact on the natural flora of the Kyzylkum Desert. These processes pose a serious threat to the distribution areas and populations of endangered, rare, and medicinal plant species. *Delphinium* representatives are among the medicinal and poisonous plants highly valued in pharmaceuticals and medicine due to their biologically active substances, particularly the alkaloids they contain.

Studying the ecological and biological characteristics of Delphinium species adapted to the extreme environmental conditions of the Northwestern Kyzylkum Desert (drought, high temperatures, soil salinity), and determining the stages of their ontogenetic development and adaptive capabilities, is one of the urgent tasks not only for botanical science but also for enriching the republic's raw material base.

Analysis of scientific literature

A number of scientific works have been conducted by renowned scientists and researchers on the taxonomy, geographical distribution, and pharmacognostic characteristics of Delphinium species in the flora of Uzbekistan. In particular, botanists who contributed to the study of the flora of Central Asia highlighted the general distribution and chemical composition of certain species belonging to the genus.

Research has also been conducted to preserve the gene pool of the Kyzylkum region's flora and to study the ecological plasticity of plants growing in desert conditions. However, an analysis of existing literature shows that the specific ecological and biological characteristics, ontogeny, and phytocoenotic role of species of the genus Delphinium in the desert ecosystem under the unique microclimatic conditions of the Northwestern Kyzylkum region have not been sufficiently studied.

The aim of this study is to determine the ecological and biological characteristics of certain species belonging to the genus Delphinium in the conditions of the Northwestern Kyzylkum, as well as to analyze their adaptation mechanisms to the environment.

Distinctive aspects and scientific novelty of the research:

While previous scientific works were primarily aimed at compiling a general floristic list of the genus's representatives and identifying their chemical alkaloids, the main scientific novelty and differences of this study from others are as follows:

Regional approach: For the first time, the ecological and biological characteristics of selected species belonging to the genus Delphinium are being comprehensively studied in the sharply continental and arid conditions of the Northwestern Kyzylkum.

Ontogenetic and ecological analysis: The ontogenetic states of plants from seed germination to maturation, adaptation mechanisms to desert soil and climatic conditions, and the specific characteristics of their life forms are determined.

Practical significance: The results obtained make it possible to develop scientifically grounded recommendations for the protection, conservation, and domestication (introduction) of these medicinal species, whose natural reserves are declining in nature *(Red Data Book of the Republic of Uzbekistan, 2019 [11])*. *Delphinium* The established patterns of distribution and ecological characteristics of species of the genus L. allow for the organization of monitoring of the region's flora. *Delphinium* L., when introduced into plantation crops, can be used as a valuable raw material source for the production of medicinal preparations based on diterpene alkaloids. *Delphinium* L., when introducing promising species of the genus, can be included in the list of promising plants for urban landscaping in the Republic of Karakalpakstan.

Materials and methods

The research was conducted in the natural conditions of the Northwestern Kyzylkum during the active vegetation period of the plants. The objects of the study were populations of the genus Delphinium growing in sandy and sandy-gravelly areas, as well as in depressions of temporarily moistened relief *(Shomurodov & Khasanov, 2014 [17]; Shomurodov & Adilov, 2019 [16])*. The methodology included route surveys, geobotanical descriptions, phenological observations, and morphometric analysis of the plants. The main morphological parameters were studied: plant height, degree of leaf truncation, development of the root system, flower structure, and the duration of phenological phases (vegetation, budding, flowering, fruiting). The ecological conditions of the habitats were assessed by soil type, moisture level, and temperature regime.

With shrubs and semi-shrubs (stable layer of phytocenosis) In the Kyzylkum, Delphinium often grows under or among tall or drought-resistant vegetation. Artemisia diffusa: The closest "neighbor" of the Delphinium species. The wormwood shades the soil and softens the microclimate, creating favorable conditions for the germination of Delphinium seeds and the protection of young shoots from sunlight. Astragalus and Salsola species: Although these shrubs and Delphinium

species compete with each other, together they form a complex layer of the desert phytocenosis *(Borisova, 1996 [3])*.

Geobotanical associations. Research in the Northwestern Kyzylkum showed that Delphinium species are found in the following associations. Wormwood-ephemeral associations: The density of Delphinium populations is high here, as worms partially protect them from overgrazing by animals. Sandy-saline associations: In these regions, Delphinium species are distributed in groups in the intermediate zones of Haloxylon persicum (White saxaul) in open and bright areas.

The principles of "synergy" (mutual assistance) and "overlap" are observed in the distribution of Delphinium species together with other species. Shrubs (wormwood, saxaul) serve as shelter for Delphinium from the wind and scorching sun. Delphinium species specialize in utilizing moisture from the upper soil layer and do not enter into sharp competition with shrubs that receive water from a deeper layer regarding their root system.

Research methodology:

During the study, modern geobotanical, ecological, biological, and ontogenetic methods were used to comprehensively reveal the ecological and biological characteristics of species belonging to the genus Delphinium in the soil and climatic conditions of the Northwestern Kyzylkum region. The main methods used in the scientific work and their scientific sources are as follows:

1. Geobotanical and route-expedition methods

Traditional geobotanical and route research methods were used to determine the vegetation cover of the territory, the distribution range of Delphinium species, their place in phytocenoses, and the frequency of occurrence. The species composition of plant communities and their summary description were carried out based on classical methodological guidelines for studying vegetation cover *(Kitayev, 1915 [10]; Shennikov, 1964 [15])*.

Founder and year of the method: The main methodological foundations for conducting geobotanical research and describing areas were developed in the works of B.A. Kitaev (1915) *[10]*, A.P. Shennikov (1964) *[15]*, and V.V. Alikhin (1932), and methodological manuals adapted to desert ecosystems were widely used.

2. Phenological observation method

Regular phenological observations were conducted to determine the developmental dynamics of Delphinium species (beginning of vegetation, budding, flowering, fruiting, and seed ripening periods). The phases of plant development in each ontogenetic state were recorded, and the influence of calendar dates and climatic factors was compared.

Founder and year of the method: The scientific foundations and methodological guidelines for conducting phenological observations in nature and experiment are based on I.N. Beideman's (1974) *[2]* manual "Methodology for Studying Plant Phenology."

3. Methods of ontogenetic and population biology

The population-ontogenetic approach was applied to study the age composition (ontogenetic spectrum), demographic status, the degree of adaptation of species to desert conditions, and the life forms of natural populations. The age periods of the plants were determined, ranging from seed germination to aging.

The scientific and methodological foundations for determining the ontogenetic state and age spectra of plant populations were developed by L.A. Rabotnov (1950, 1960) and T.A. Uranov (1967, 1975), and this classical approach serves as the basis for modern geobotanical and population studies *(Rabotnov, 1950 [14]; Uranov, 1967 [18]; Ishbirdina et al., 1999 [7])*.

4. Morphometric and statistical analysis methods.

All obtained digital data (plant height, number of leaves, stem diameter, number of flowers and seeds) were measured. The statistical accuracy, mean values, and reliability indicators of the measurement results were processed using modern mathematical and statistical analysis methods *(Dospekhov, 1985 [4])*.

Founder and year of the method: When performing biometric measurements and statistical calculations, the generally accepted statistical methods presented in B.A. Dospekhov's (1985) *[4]* work "Methodology of Field Experiments" were used.

Results and discussion

During the study, an in-depth analysis was conducted on the distribution of species belonging to the genus Delphinium in the extreme ecological conditions of the Northwestern Kyzylkum region, their adaptation characteristics to soil and climatic conditions, phenological development dynamics, and the state of populations. The main scientific results obtained and their discussion are as follows:

1. Ecological and phytocoenotic distribution and environmental adaptation of Delphinium species

It was established that Delphinium species growing in the sandy, takyr, and gravelly desert ecosystems of the northwestern Kyzylkum region have adapted to the region's sharply continental climate (drought, high temperatures in spring, and low air humidity) through their unique ecological characteristics.

Representatives of this order are primarily adapted to living in arid climates (xerophytes). Their root system is specialized in absorbing moisture from deep layers. Delphinium species

possess the property of ephemeroidity. They develop rapidly in early spring, during a short period of sufficient soil moisture, and manage to flower and seed. With the onset of the scorching summer heat, the aerial part of the plant dries up, concluding the vegetation period. In the Northwestern Kyzylkum, these species are primarily found on sandy-clay and gravelly soils. They are moderately demanding on the amount of nutrients in the soil and are capable of growing even in low-fertility desert soils. Some species of the genus Delphinium are tolerant to moderate soil salinization (halotolerance). This allows them to be competitive on saline and saline soils in the desert zone. Members of this genus thrive in open areas with direct sunlight. In shaded areas, their growth slows down and the development of their generative organs slows down. They form the second layer in the desert plant community. It often occupies the ecological niche, forming a layer together with plants of the genus Artemisia (wormwood) and Astragalus (ferula). Population density depends on the microlandscape (valleys or hills). If the population density is high due to moisture accumulated in the lowlands, this indicator decreases in the hills.

Delphinium species are sensitive to pasture loads. Overgrazing of livestock disrupts the fertilization process, resulting in a decrease in the natural regeneration capacity of populations. This places them among "vulnerable" or "vulnerable" ecological groups. These ecological features constitute the biological strategy that ensures the survival of Delphinium species in challenging conditions such as the North-Western Kyzylkum.

Morphological changes in the aerial organs of plants that ensure drought resistance (degree of hairlessness, reduction or shortening of leaf plates, deep penetration of the root system) are clearly manifested *(Bogoslov et al., 2020 [1])*.

Representatives of the genus Delphinium do not grow alone (monotypically) in the conditions of the Northwestern Kyzylkum; on the contrary, they form "ecological groups" together with other plants as an integral part of complex phytocenoses. Their distribution with other species can be analyzed by the following layers and communities: Delphinium species grow together with the following species at the beginning of the vegetation period (early spring): Carex physodes (Sand physodes): This species, characteristic of the desert zone, is widespread in the same area as Delphinium. They often form the main layer of spring meadows. Poa bulbosa: Flowering simultaneously with Delphinium and having similar ecological requirements, it is often found side by side. Tulipa species: They live in the layer of spring ephemeroids without competition from Delphinium species, defining the visual landscape of the area *(Borisova, 1996 [3])*.

Geobotanical observations have shown that these species are mainly distributed in the ephemeral-ephemeroid and saline parts of desert communities and occupy a specific phytocoenotic role in phytocenoses.

2. Phenological development characteristics and seasonal dynamics.

Phenological observations *(Beideman, 1974 [2])* conducted in the region showed that the growing season of Delphinium species is closely linked to the onset of spring (the transition of air temperature to positive indicators and soil moisture reserves):

Beginning of vegetation: under the influence of temperature, early spring (April) saw the emergence of sprouts from seeds or the growth of new stems from overwintered rhizomes.

Budding and flowering phase: By mid-May, plants enter the rapid growth phase, and the budding and flowering processes become active. The sharp rise in temperature within the desert zone causes the flowering period to be shortened.

Fruiting and seed ripening: By the end of June and the beginning of July, the fruits ripen and the seeds disperse. After that, under the influence of summer drought and heat, the aerial part of the plant dries up (passes into the budding period).

3. Ontogenetic status and demographic structure of populations.

Analysis of the ontogenetic spectra of natural Delphinium populations in the study area *(Rabotnov, 1950 [14]; Uranov, 1967 [18]; Ishbirdina et al., 1999 [7])* revealed the following:

It was noted that the age composition of the populations is predominantly normal, but due to the unfavorable impact of the desert zone, losses occurred during the germination and seedling stages.

Mature plants in the generative period ensure the stability of the population. The results obtained prove that these species possess a unique mechanism of population stability within the desert ecosystem.

Discussion:

Scientific analysis of the obtained results shows that species of the genus Delphinium growing in the conditions of the Northwestern Kyzylkum possess high adaptive potential against drought and abiotic factors. In comparison with literature data, it was established that the phenological phases of species in this region occur in a shorter timeframe than in other regions, and ontogenetic development is unique. This circumstance reveals the paths of evolutionary adaptation of the desert flora and serves as the main scientific foundation for developing practical recommendations for the protection of their natural reserves.

Analysis of the obtained data showed that in the conditions of the Northwestern Kyzylkum, species of the genus Delphinium exhibit pronounced xeromorphic traits aimed at reducing moisture loss and increasing drought resistance. Plants develop a strong axillary root system that penetrates deeper soil layers, ensuring access to residual moisture during drought periods and increasing viability. The height of the aerial parts of the plants varies depending on humidity conditions and

reaches an average of 15 to 90 cm; under these conditions, a decrease in size and a simplification of the morphological structure are observed.

In the studied species, the leaves are deeply dissected, significantly reducing the evaporation area and serving as a significant adaptive trait to arid climates. The stems are erect and relatively strong, which allows plants to maintain stability under wind and sand storms. The growing season is relatively short and synchronized with spring soil moisture, allowing the plants to complete their life cycle before the peak of the summer drought.

Phenological observations showed that flowering occurs mainly in the spring, when the most favorable conditions for temperature and humidity are observed. Fruiting is characterized by the formation of multi-seeded petals, which ensures high potential reproductive capacity. The success of seed germination depends on the weather conditions of each year.

Ecological analysis showed that Delphinium species are adapted to temporarily or locally moistened areas, such as relief depressions, edges of sandy massifs, and areas with denser soils. This indicates their ecological specialization and limited but stable adaptation to desert conditions. The observed variability in morphological traits indicates high interspecific plasticity, which is an important factor in habitat conditions.

Conclusion

As a result of the conducted scientific research and observations, the following main conclusions were reached:

Regional adaptation: In the sharply continental and arid desert conditions of the Northwestern Kyzylkum, species belonging to the genus Delphinium exhibit a high degree of ecological plasticity and xerophytic traits (deep-penetrating root systems, small and hairy leaves).

Phenological features: It has been scientifically substantiated that the vegetation period of these species begins in early spring (March-April) due to favorable temperatures and soil moisture, accelerates under the influence of high temperatures in the summer months, and concludes with fruiting within a short period.

Population status: The ontogenetic spectra of natural populations were analyzed, and it was noted that species were preserved due to the stability of generative plants in the desert ecosystem, but losses during the young growth period were high.

Practical significance: The results obtained serve as a basis for developing scientific and practical recommendations on enriching the vegetation cover of desert areas, protecting the natural reserves of rare and medicinal species of Delphinium, preserving them in situ and ex situ, as well as their domestication *(Red Data Book of the Republic of Uzbekistan, 2019 [11])*.

References:

1. Bogoslov A. V., Grebenyuk L. V., Kashin A. S., Kritskaya T. A., Parkhomenko A. S., Shilova I. V. State of populations of the species Delphinium L. (Ranunculaceae, Magnoliopsida) in the Lower Volga and adjacent territories // Volga Ecological Journal. - 2020. - 3. No – P. 271-289.

2. Beideman, I. N. (1974). Methodology for studying the phenology of plants and plant communities. Novosibirsk: Nauka.

3. Borisova I.V. Types of seed germination of desert and desert plants // Journal of Botany. 1996. Volume 81. No. 12. Pp. 9-22.

4. Dospekhov, B.A. (1985). Methodology of field research (with the basics of statistical processing of research results). Moscow: Agropromizdat.

5. Zhukova N.A. Experiment on the construction of plant systems belonging to the Ranunculaceae family based on the analysis of their morphological structure // Problems of Botany. Moscow; Leningrad, AN Publishing House. 1958. pp. 72-75.

6. Igoshina K.N. Spruce in the Urals. Moscow, 1963. 4th edition: Materials from the history of flora and plants of the USSR. Pp. 462-492.

7. Ishbirdina L.M., Kruglova N.N., Arslanova K.F. The phenomenon of ternary seed formation in the Delphinium uralense Nevskii plant // All-Russian.

8. Conference proceedings: Reproductive biology of rare and endangered plant species. Siktivkar, 1999. P. 47.

9. Kabelyanskaya L.G. The clinical presentation of Melliktine in nervous diseases and its use in spasmodic pairs // Pharmacology and toxicology. 1959. No. 1. Pp. 38-42.

10. Kitayev, B.A. (1915). Methodology of geobotanical research in desert regions. Moscow: Nauka.

11. Red Data Book of the Republic of Uzbekistan. (2019). Volume I: Plants and Fungi. Tashkent: Chinor ENK.

12. Ebel A. L. On the study of endemic and sub-endemic species of Delphinium L. (Ranunculaceae) in the flora of the Altai Mountainous Region // Systematic Notes. – 2015. – No 112. – P. 32–45.

13. Mukhametzyanova K.F., Ishbirdina L.M. Analysis of the range of the Nevski variety Delphinium uralense // VII Youth Conference of Botanists, St. Petersburg. (St. Petersburg, May 15-19, 2000). St. Petersburg, 2000. Pp. 126-127.

14. Rabotnov, T.A. (1950). The vital society and ontogenesis of perennial herbaceous plants. Trudy BIN AN USSR, sir. 3, p. 6.

15. Shennikov, A.P. (1964). Introduction to Geobotany. Leningrad: LGU.

16. Shomurodov Kh. F., Adilov B. A. Modern State of Vegetation on the Island of Renaissance (Uzbekistan) // Arid Ecosystems. - 2019. – 2 (79). No – P. 27-34.

17. Shomurodov Kh. F., Khasanov F. O. Forage plants of the Kyzylkum Desert // Arid ecosystems. – 2014. – No 3 (60). – P. 94-101.

18. Uranov, T.A. (1967). Age spectrum of phytocenopopulations of automorphic plants. Biological Sciences, 2, p. No 7-34.

EKOLOGIYA VA BARQAROR RIVOJLANISH TA’LIMI - ZAMON TALABI

Ziyadilla Sayfidinovich Bobomuradov

ZARMED Universiteti Samarkand Kampusi dotsenti

Email: ziyodullabobomuradov@gmail.com

Jamolova Mohichehra Ulug’bek qizi

ISFT instituti Samarqand filiali magistranti

Email: mjamolovva@gmail.com

Annotatsiya. *Tezisda oliy ta’lim muassasalari bakalavriat ta’lim yo‘nalishlarining o‘quv rejalariga “Ekologiya va barqaror rivojlanish ta’limi” fanini kiritish zarurati asoslanadi. Fan mazmunini umumiy ekologik kompetensiyalar va kasbiy yo‘nalishga mos modullar asosida ishlab chiqish, zamonaviy pedagogik texnologiyalar orqali o‘qitish hamda bosqichma-bosqich joriy etish mexanizmi taklif qilinadi.*

Abstract. *The thesis substantiates the need to introduce the subject “Ecology and Sustainable Development Education” into the curricula of undergraduate programmes at higher education institutions. It proposes developing the course content based on general ecological competencies and modules tailored to specific professional fields, teaching the subject through modern pedagogical technologies, and implementing it in stages.*

Kalit so‘zlar: *ekologik ta’lim, barqaror rivojlanish, bakalavriat, o‘quv reja, fan dasturi, ekologik kompetensiya, yashil iqtisodiyot.*

Kirish. Iqlim o‘zgarishi, atmosfera va suv havzalarining ifloslanishi, yer degradatsiyasi, chiqindilar hajmining ortishi hamda bioxilma-xillikning qisqarishi hozirgi davrning murakkab muammolaridandir. Ularni hal etish faqat ekolog-mutaxassislar emas, balki iqtisodchi, muhandis, pedagog, shifokor, agronom, huquqshunos va boshqa soha vakillarining ham ekologik jihatdan asoslangan qarorlar qabul qilishini talab etadi. Binobarin, oliy ta’limda ekologik savodxonlik har bir

bo‘lajak mutaxassisning umumiy kasbiy tayyorgarligini boyituvchi kompetensiya sifatida qaralishi zarur.

BMTning 2030-yilgacha Barqaror rivojlanish kun tartibidagi 4-maqsadning 4.7-vazifasi barcha ta’lim oluvchilarning barqaror rivojlanishga xizmat qiladigan bilim va ko‘nikmalarni egallashini nazarda tutadi [1]. UNESCO hujjatlarida barqaror rivojlanish ta’limi bilimlarni o‘zlashtirish bilan birga tizimli fikrlash, hamkorlik, mas’uliyat va amaliy harakat qilish qobiliyatlarini shakllantirish jarayoni sifatida izohlanadi [2; 3]. Ushbu yondashuv ekologik ta’limning kasbiy yo‘nalishlardan qat’i nazar dolzarbligini ko‘rsatadi.

Asosiy qism. O‘zbekistonda ekologik ta’limni rivojlantirish uchun muhim huquqiy asoslar mavjud. Vazirlar Mahkamasining 2019-yil 27-maydagi 434-son qarori bilan ekologik ta’limni rivojlantirish konsepsiyasi tasdiqlangan [3]. Prezidentning 2025-yil 15-maydagi PQ–184-son qarori bilan esa 2030-yilgacha aholining ekologik madaniyatini yuksaltirish konsepsiyasi belgilangan [4]. Mazkur hujjatlar ta’lim tizimida ekologik bilim va madaniyatni izchil kuchaytirish uchun siyosiy-huquqiy zamin yaratadi. Shu bilan birga, ular barcha bakalavriat yo‘nalishlarida aynan shu nomdagi fanni majburiy joriy etib bo‘lganini anglatmaydi: maqolada bu masala ilmiy-metodik taklif sifatida ilgari surilmoqda.

Hozirgi sharoitda ekologik mavzular ayrim yo‘nalishlarda maxsus fanlar, boshqalarida esa alohida bo‘lim yoki mavzular orqali o‘tilishi mumkin. Bunday yondashuv o‘quv natijalari va kompetensiyalar qamrovini birxillashtirishni qiyinlashtiradi. “Ekologiya va barqaror rivojlanish ta’limi” fanini bakalavriat o‘quv rejalariga umumiy tayanch fan sifatida bosqichma-bosqich kiritish esa barcha talabalarga zarur minimal bilimlarni taqdim etish hamda ularni muayyan kasbiy vazifalar bilan bog‘lash imkonini beradi.

Mazkur fan maqsadi talabalarda ekologik jarayonlarning ilmiy asoslarini anglash, ekologik xavflarni tahlil qilish, resurslardan oqilona foydalanish, barqaror rivojlanish maqsadlarini tushunish va kasbiy faoliyatga tatbiq etish kompetensiyalarini shakllantirishdan iborat bo‘lishi lozim. Fan mazmunining bir qismi barcha yo‘nalishlar uchun umumiy, qolgan qismi mutaxassislikka mos amaliy topshiriqlar shaklida tuzilishi maqsadga muvofiq.

Masalan, pedagogika yo‘nalishida ekologik tarbiya metodikasi; iqtisodiyotda yashil iqtisodiyot va ekologik xarajatlar; muhandislikda resurs tejamkor texnologiyalar; tibbiyotda atrof-muhit va salomatlik; qishloq xo‘jaligida tuproq va suvni muhofaza qilish; axborot texnologiyalarida ekologik monitoring ma’lumotlari; huquqshunoslikda esa ekologik qonunchilik ustuvor mavzular bo‘lishi mumkin. Natijada fan ekologik bilimlarni amaliy kasbiy vaziyatlarga ko‘chirishga xizmat qiladi.

Namunaviy fan dasturida quyidagi oltita mazmuniy modulni qamrab olish taklif etiladi:

1) ekologiyaning ilmiy asoslari va ekotizimlar;

2) global hamda O‘zbekiston uchun dolzarb ekologik muammolar;

3) BMTning barqaror rivojlanish maqsadlari;

4) yashil iqtisodiyot, resurs tejamkorligi va aylanma iqtisodiyot;

5) ekologik madaniyat, mas’uliyat va huquq;

6) mutaxassislikka mos ekologik loyihalar.

Muhokama uchun boshlang‘ich model sifatida fan bir semestrda 3 kredit (90 akademik soat), jumladan 12 soat ma’ruza, 24 soat amaliy mashg‘ulot va 54 soat mustaqil ta’limdan tashkil etilishi mumkin. Ushbu hajm tasdiqlangan majburiy me’yor emas, metodik taklifdir.

Fanni samarali o‘qitish uchun ma’ruza va seminarlar bilan bir qatorda muammoli ta’lim, keys-stadi, loyiha asosida o‘qitish, ekologik monitoring, raqamli xaritalar va ma’lumotlar tahlilidan foydalanish zarur. Masalan, talabalar universitet hududida suv va energiya iste’molini baholashi, chiqindilarni saralash tizimini loyihalashi yoki mahalliy ekologik muammoga amaliy yechim ishlab chiqishi mumkin. Bunday mashg‘ulotlar tanqidiy fikrlash va jamoaviy ishlash ko‘nikmalarini ham rivojlantiradi.

Joriy etish mexanizmi beshta o‘zaro bog‘liq bosqichdan iborat bo‘lishi maqsadga muvofiq: avvalo,

- amaldagi o‘quv rejalari va ekologik kompetensiyalar qamrovini tahlil qilish;
- so‘ng namunaviy fan dasturi va baholash mezonlarini ishlab chiqish;
- o‘quv-metodik ta’minot hamda o‘qituvchilar tayyorgarligini shakllantirish;
- tanlangan yo‘nalishlarda tajriba-sinov tariqasida o‘qitish;
- nihoyat, natijalarni baholab, dasturni takomillashtirish va kengaytirish.

Samaradorlikni boshlang‘ich-yakuniy testlar, vaziyatli topshiriqlar, loyiha rubrikalari va so‘rovnomalar yordamida o‘lchash mumkin.

Ushbu taklif amalda qo‘llansa, bo‘lajak mutaxassislarning ekologik savodxonligini oshirish, kasbiy qarorlarning ekologik oqibatlarini anglash, resurs tejamkorlik madaniyatini rivojlantirish va oliy ta’limning barqaror rivojlanish maqsadlariga qo‘shadigan hissasini kuchaytirish uchun sharoit yaratiladi. Bunda yangi fan kiritilishi o‘quv yuklamasini mexanik oshirishga emas, balki mavjud o‘quv dasturlarini oqilona muvofiqlashtirishga tayanishi lozim.

Xulosa va takliflar

Xulosa qilib aytganda, ekologiya va barqaror rivojlanish ta’limi oliy ma’lumotli mutaxassislarni tayyorlashning fanlararo muhim tarkibiy qismidir. Shu bois OTMlarning barcha bakalavriat ta’lim yo‘nalishlarida “Ekologiya va barqaror rivojlanish ta’limi” fanini bosqichma-bosqich o‘quv rejalarga kiritish, umumiy tayanch kompetensiyalarga asoslangan namunaviy dastur

yaratish va uning kasbiy yo‘nalishga mos qismiga amaliy mazmun berish taklif etiladi. Fanni joriy etishdan oldin tajriba-sinov, pedagoglar malakasini oshirish va natijalarni obyektiv baholash mexanizmlari yo‘lga qo‘yilishi zarur. Bunday yondashuv ekologik bilimni shaxsiy va kasbiy mas’uliyatga aylantirishga xizmat qiladi.

FOYDALANILGAN ADABIYOTLAR

1. United Nations. Transforming Our World: The 2030 Agenda for Sustainable Development. 2015. https://sdgs.un.org/2030agenda

2. UNESCO. Education for Sustainable Development: A Roadmap. Paris, 2020.

3. O‘zbekiston Respublikasi Vazirlar Mahkamasining 2019-yil 27-maydagi 434-son qarori. https://lex.uz/uz/acts/4354743

4. O‘zbekiston Respublikasi Prezidentining 2025-yil 15-maydagi PQ–184-son qarori. https://lex.uz/uz/acts/-7528761

5. Kulmatov R.A., Mirzayev J.A., Jobborov B.T. Barqaror rivojlanish asoslari, O‘quv qo‘llanma. Toshkent, 2024.

6. Tursunov X.T. Ekologiya va barqaror rivojlanish. Toshkent, 2009.

7. Xamdamov I., Bobomuradov Z., Xamdamova E. Ekologiya. O‘quv qo‘llanma. 2009.

8. Xamdamova E.I., Bobomuradov Z. S., Isaqova E.Z. Hozirgi zamon ekologik muammolari. O’quv qo’llanma. T.144 bet

9. Ergashev A.E., Rudenko I., Davletov S. Barqaror taraqqiyot va tabiatshunoslik asoslari, Darslik, Toshkent, 2016.

YASHIL IQTISODIYOT VA EKOLOGIK BARQARORLIK

Djalilov Farrux Sobirovich

Samarqand davlat pedagogika instituti Biologiya kafedrasi assistenti (PhD)

Muxammedova Sayoxat Abduraxim qizi

Samarqand davlat pedagogika instituti Biologiya kafedrasi magistranti

Annotatsiya. *Ushbu tezisda yashil iqtisodiyotning mazmun-mohiyati, uning ekologik barqarorlikni ta’minlashdagi o‘rni hamda tabiiy resurslardan oqilona foydalanish, energiya samaradorligi, qayta tiklanuvchi energiya manbalarini rivojlantirish va chiqindilarni kamaytirish masalalari yoritilgan. Shuningdek, yashil iqtisodiyot tamoyillarini amaliyotga joriy etish orqali iqtisodiy rivojlanish va atrof-muhit muhofazasini uyg‘unlashtirish imkoniyatlari tahlil qilinadi.*

Kalit so‘zlar: *yashil iqtisodiyot, ekologik barqarorlik, qayta tiklanuvchi energiya, tabiiy resurslar, energiya samaradorligi, ekologik talim va tarbiya, chiqindilarni boshqarish, barqaror rivojlanish.*

Abstract. *This paper explores the essence of the green economy, its role in ensuring environmental sustainability, and issues related to the rational use of natural resources, energy efficiency, the development of renewable energy sources, and waste reduction. Furthermore, it analyzes the possibilities for harmonizing economic development with environmental protection through the practical implementation of green economy principles.*

Keywords: *green economy, environmental sustainability, renewable energy, natural resources, energy efficiency, environmental education and awareness, waste management, sustainable development.*

Kirish Hozirgi kunda iqtisodiy rivojlanish jarayonlarining atrof-muhitga ta’siri tobora ortib bormoqda. Aholi sonining oshishi, sanoat korxonalari va transportning rivojlanishi natijasida tabiiy resurslardan foydalanishning ortishi hamda sezilarli darajada iqlim o‘zgarishi ekologik barqarorlikka jiddiy ta’sir ko‘rsatmoqda. Shu sababli iqtisodiy o‘sishni tabiiy resurslardan oqilona foydalanish va atrof-muhitni muhofaza qilish bilan uyg‘unlashtirish zarur. Yashil iqtisodiyot ana shunday yondashuvlardan biri bo‘lib, bu iqtisodiy faoliyatni ekologik xavfsizlik, tabiiy resurslardan samarali foydalanish va inson farovonligini oshirish tamoyillari asosida tashkil etishni nazarda tutadi. Mazkur model iqtisodiy taraqqiyot bilan ekologik muvozanatni bir-biriga qarama-qarshi qo‘ymasdan, ularni o‘zaro bog‘liq holda rivojlantirishga qaratilgan.

Yashil iqtisodiyotning asosiy maqsadi iqtisodiy rivojlanish jarayonida tabiiy resurslarni saqlab qolish va resurslardan samarali foydalanishni ta’minlashdan iborat. Bunda energiya, suv, yer va boshqa tabiiy resurslardan tejamkor foydalanish, atrof-muhitga chiqariladigan zararli moddalarni kamaytirish hamda ekologik toza texnologiyalarni joriy etishga alohida e’tibor qaratiladi.

Yashil iqtisodiyotning muhim yo‘nalishlaridan biri qayta tiklanuvchi energiya manbalaridan foydalanish hisoblanadi. Quyosh, shamol va boshqa qayta tiklanuvchi energiya manbalarining rivojlantirilishi an’anaviy yoqilg‘ilarga bo‘lgan ehtiyojni kamaytirish bilan birga atmosferaga chiqariladigan issiqxona gazlari miqdorini qisqartirishga xizmat qiladi. Ayniqsa, quyosh energetikasini rivojlantirish quyoshli kunlar ko‘p bo‘lgan hududlar uchun muhim imkoniyatlardan biridir.

Yana bir muhim yo‘nalish — energiya samaradorligini oshirish. Korxonalar, turar joylar va ijtimoiy obyektlarda energiya tejamkor texnologiyalardan foydalanish iqtisodiy xarajatlarni kamaytirish bilan bir qatorda tabiiy resurslarga tushadigan bosimni ham pasaytiradi. Energiya

samarador binolar, zamonaviy ishlab chiqarish texnologiyalari va ekologik transport vositalarini rivojlantirish yashil iqtisodiyotning amaliy ko‘rinishlari hisoblanadi.

Chiqindilarni boshqarish ham ekologik barqarorlikni ta’minlashda muhim ahamiyatga ega. Chiqindilarni saralash, qayta ishlash va ikkilamchi xomashyo sifatida foydalanish tabiiy resurslarga bo‘lgan ehtiyojni kamaytiradi. Shu bilan birga, “aylanma iqtisodiyot” tamoyillarini rivojlantirish mahsulot va materiallardan imkon qadar uzoq muddat foydalanish hamda chiqindilar hosil bo‘lishini minimallashtirishga imkon beradi.

Yashil iqtisodiyotning rivojlanishida ekologik ta’lim va aholining ekologik madaniyati ham muhim omildir. Fuqarolarning energiya va suvni tejash, chiqindilarni to‘g‘ri boshqarish, tabiatga ehtiyotkorona munosabatda bo‘lish bo‘yicha bilim va ko‘nikmalarini oshirish ekologik barqarorlikka ijobiy ta’sir ko‘rsatadi. Ayniqsa, yosh avlodda ekologik mas’uliyatni shakllantirish uzoq muddatli natijalarga erishish imkonini beradi.

O‘zbekiston sharoitida yashil iqtisodiyot tamoyillarini rivojlantirish uchun qayta tiklanuvchi energiya manbalaridan foydalanish, suv resurslarini tejash, energiya samaradorligini oshirish, chiqindilarni qayta ishlash, ekologik transportni rivojlantirish va yashil hududlarni kengaytirish kabi yo‘nalishlar muhim ahamiyatga ega. Bunday chora-tadbirlar iqtisodiy manfaatlar bilan ekologik manfaatlarning uyg‘unligini ta’minlashga yordam beradi.

Xulosa qilib yashil iqtisodiyot ekologik muammolarni kamaytirish bilan bir qatorda iqtisodiy rivojlanish uchun yangi imkoniyatlarni ham yaratadi. Tabiiy resurslardan oqilona foydalanish, energiya samaradorligini oshirish, qayta tiklanuvchi energiya manbalarini kengaytirish va chiqindilarni qayta ishlash ekologik barqarorlikni mustahkamlashning muhim omillaridir.

Yashil iqtisodiyotga o‘tish faqat texnologik yangilanishni emas, balki jamiyatning ekologik dunyoqarashi va iste’mol madaniyatining o‘zgarishini ham talab qiladi. Shu sababli ekologik ta’lim, ilmiy tadqiqotlar, innovatsion texnologiyalar va aholining ekologik faolligini rivojlantirish yashil iqtisodiyotning muhim tarkibiy qismlaridan hisoblanadi.

Foydalanilgan adabiyotlar

1. Vaxabov A.V., Xajibakiyev Sh.X. *Yashil iqtisodiyot*. — Toshkent: ZEBO PRINT, 2021. — 264 b.
2. Butaboyev M.T., Maxmudov N., Kasimov A.A. *Yashil iqtisodiyot*. — Toshkent: Iqtisodiyot, 2025. — 432 b.
3. Samiyev A., Shermuxammedov B. Yashil iqtisodiyotga o‘tishning nazariy va amaliy jihatlari hamda tendensiyalari // *Yashil iqtisodiyot va taraqqiyot*. — 2025. — 3-jild, 5-son

IQLIM O‘ZGARISHI EKOLOGIK MUAMMOALARNI KELTIRIB CHIQARISHI VA OQIBATLARI.

Djalilov Farrux Sobirovich

Samarqand davlat pedagogika instituti Biologiya kafedrasi assistenti (PhD)

Mirzamurodov Omon Xasan o'g'li

Samarqand davlat veterinariya meditsinasi, chorvachilik va biotexnologiyalar universiteti. Iqlim o'zgarishlari va dorivor o'simliklar kafedrasi assistenti (PhD)

To‘xtayev Abdulaziz Olimjon õğli

Samarqand davlat pedagogika instituti Biologiya yunalishi 4-kurs talabasi

Annotatsiya: *Ushbu tezisda iqlim o‘zgarishining ekologik muammolarni keltirib chiqarishi, ularni atrof-muhit va inson hayotiga ta’siri hamda yuzaga keladigan salbiy oqibatlari yoritilgan bo’lib, global haroratning ko‘tarilishi, muzliklarning erishi, suv resurslarining kamayishi, cho‘llanish, qurg‘oqchilik, biologik xilma-xillikning kamayishi va tabiiy ofatlarning ko‘payishi kabi ekologik muammolar tahlil qilingan. Qanday sabablar iqlim o‘zgarishlariga sabab bo‘layotganligi. Iqlim o‘zgarishning salbiy oqibatlari.*

Kalit so‘zlar: *qurg‘oqchilik, biologik xilma-xillik, suv resurslari, ekologik barqarorlik, tabiatni muhofaza qilish. cho‘llanish, yashil iqtisodiyot, yashil makon.*

Abstract: *This thesis examines how climate change gives rise to environmental problems, their impact on the environment and human life, and the resulting negative consequences. It analyzes specific environmental issues, including rising global temperatures, the melting of glaciers, the depletion of water resources, desertification, drought, the loss of biodiversity, and an increase in natural disasters. It also explores the causes of climate change and its adverse effects.*

Keywords: *drought, biodiversity, water resources, ecological stability, nature conservation, desertification, green economy, green spaces.*

Kirish. Iqlim o‘zgarishi jahonda global isish, kuchli shamollar, qurg‘oqchilik, suv toshqinlari va yong‘inlar yanada ko‘proq sodir bo‘lib muzliklar erishi kuchaydi, ob-havo xodisalari, dengiz sathining o‘zgarishi. Issiq haroratning ko‘tarilishi suvning bug‘lanish koeffitsenti oshmoqda. Hatto sizot suvlarning ham parlanishi kuchayib yerning strukturasiga salbiy ta’sir ko‘rsatmoqda. Rekord darajadagi harorat isishi ko‘plab davlatlar, jumladan xavfli chegaralarda yaqinlashib qolgan Janubiy Osiyoda ulkan muammolar keltirib chiqaradi. Haroratning doimgidan 2-3 darajaga oshishi ayniqsa qishloq xo‘jaligida jiddiy tahdidlar paydo bo‘lishiga olib keladi. Ilgari faqat tabiiy yo‘llar bilan sug‘orilgan hududlarda sun’iy sug‘orish zaruriyati paydo bo‘lmoqda. Haroratning yuqorilashi zararkunandalarning kirib kelishini rag‘batlantirmoqda, bu esa insektitsidlar va suv resurslaridan ko‘proq foydalanishga olib kelmoqda. Tuproqning namligi kamayishi hisobiga takroriy

qurg‘oqchilik xavfi ortishi natijasida hosildorlik ko‘rsatkichlari tushib ketmoqda. Yog‘ingarchilikning kam bo‘lishi, yog‘ingarchilik bo‘lmagan kunlar soning ortishi hisobiga atmosfera havosida katta maydonlarda changlanish ortmoqda. Isish va sovish kabi anomal hodisalarning o‘zgarishi qishloq xo‘jaligi mahsulotlari va mevalarning nobud bo‘lishiga olib kelayapti. Bunday keskin iqlim o‘zgarishlaring sodir bo‘lishi barcha davlatlarni jiddiy tashvishga solmoqda. Chunki, iqlimning iqtisodiyotga, qishloq xo‘jaligiga bo‘lgan salbiy ta’siri yer bilan, qishloq xo‘jaligi bilan bog‘liq bo‘lgan davlatlarda sezilmoqda. Maqsad. O‘zbekistonda harorat har yili 2 daraja ko‘tarilmoqda. Prognozlarga qaraganda, respublikada 2030 yilga borib havo harorati doimgidan 2–4 daraja, 2040 yillarda 4-5 daraja, 2060 yillarda esa 5-6 darajagacha ko‘tarilishi mumkin. Jahon davlatlarida chuchuk suv, o‘rmonlar, biologik xilma-xillik keskin sur’atlarda kamayib bormoqda, yer unumdorligi pasayib, tuproq holati degradatsiyaga uchramoqda. Sanoat chiqindilari hajmi va qishloq xo‘jaligi maqsadlarida foydalanishga yaroqsiz yerlar maydoni kundan-kunga ko‘payib bormoqda. Iqlim o‘zgarishi deganda Yerning o‘rtacha harorati, yog‘ingarchilik miqdori, shamol rejimi va boshqa iqlimiy ko‘rsatkichlarning uzoq muddat davomida o‘zgarishi tushuniladi. Ushbu jarayon tabiiy omillar ta’sirida ham sodir bo‘lishi mumkin, biroq hozirgi davrda kuzatilayotgan global isishning asosiy sababi inson faoliyati natijasida atmosferada issiqxona gazlari miqdorining ortib borishidir. Ko‘mir, neft va tabiiy gaz kabi qazilma yoqilg‘ilarni yoqish natijasida atmosferaga katta miqdorda karbonat angidrid chiqariladi. Bundan tashqari, qishloq xo‘jaligi, chorvachilik, sanoat korxonalari, transport vositalari va chiqindilarni noto‘g‘ri boshqarish jarayonlari ham issiqxona gazlari miqdorining ko‘payishiga sabab bo‘ladi.

Iqlim o‘zgarishining eng muhim oqibatlaridan biri tabiiy ekotizimlarning izdan chiqishidir. Haroratning ortishi, yog‘ingarchilikning kamayishi yoki ayrim hududlarda qurg‘oqchilikning kuchayishiga, tuproq unumdorligining pasayishiga va cho‘llanish jarayonlarining ortishiga sabab bo‘lmoqda. O‘rmonlar va tabiiy yashash muhitlarining o‘zgarishi ko‘plab o‘simlik hamda hayvon populyatsiyalarining yashash sharoitlarini yomonlashtiradi. Natijada biologik xilma-xillikning kamayishi, bazi bir turlarning yo‘qolib ketishi va oziq zanjirlarida muvozanat buzilishi mumkin bo‘ladi.

Xulosa qilib aytganda, iqlim o‘zgarishi bugungi kunda global ekologik muammolardan biri bo‘lib, u tabiat, inson salomatligi, iqtisodiyot va jamiyatning barqaror rivojlanishiga bevosita ta’sir ko‘rsatmoqda. Inson faoliyati natijasida atmosferaga chiqarilayotgan har xil gazlarning ko‘payishi, o‘rmon va daraxtzorlarning qisqarishi, sanoat va transport vositalaridan chiqadigan zararli gazlar hamda tabiiy resurslardan noto’g’ri foydalanish iqlim o‘zgarishining kuchayishiga sabab bo‘lmoqda. Ushbu jarayonlar yer yuzida o‘rtacha haroratning ko‘tarilishi va tabiiy muvozanatning buzilishiga olib kelmoqda.

FOYDALANILGAN ADABIYOTLAR

1. Abdukaxorova S., Shamsidinova G. O‘zbekistonda iqlim o‘zgarishlarining vujudga kelishi va ularning oldini olish masalalari // Zamonaviy dunyoda tabiiy fanlar: nazariy va amaliy izlanishlar. — 2025. — J. 4, № 1. — B. 74–76.
2. Abdushukurova S. Iqlim o‘zgarishining O‘zbekiston iqtisodiyotiga ta’siri va yechimlari // Modern Science and Research. — 2025. — B. 291–294.
3. Aliyev A. Iqlim o‘zgarishining ta’sirini oldini olish hamda unga moslashish bo‘yicha O‘zbekistonda amalga oshirilayotgan harakatlar. — 2025. — B. 144–148.
4. Rozzoqov Sh., Maxsudbekova D. Iqlim o‘zgarishining iqtisodiyot, ekologiya va ijtimoiy sohaga ta’sirini baholash // Journal of Science-Innovative Research in Uzbekistan. — 2025. — J. 3, № 4.
5. O‘zbekiston Respublikasining “Tabiatni muhofaza qilish to‘g‘risida”gi Qonuni. — 1992-yil 9-dekabr, 754-XII-son.
6. O‘zbekiston Respublikasi Ekologiya va iqlim o‘zgarishi sohasidagi rasmiy materiallari. — Elektron manba: https://gov.uz/

ПРЕДВАРИТЕЛЬНЫЙ ОПЫТ ВЫРАЩИВАНИЯ АЗОТФИКСИРУЮЩИХ РАСТЕНИЙ ДЛЯ УЛУЧШЕНИЯ ПЛОДОРОДИЯ ПОЧВ В КАРАКАЛПАКСТАНЕ

[1]Ещанова Г.А. – базовый докторант, Каракалпакский институт агротехнологии и сельского хозяйства, тел.: +998906604918, gulistaneshanova5@gmail.com

[2]Матжанова Х.К. – *к.б.н., доцент* + 998973483976; kholidamk@mail.ru, *Каракалпакский научно-исследовательский институт естественных наук Каракалпакского отделения Академии наук Республики Узбекистан, г.Нукус, Каракалпакста*

[2]Орел М.М. – *старший научный сотрудник* +998976499661; orel_mm@mail.ru, *Каракалпакский научно-исследовательский институт естественных наук Каракалпакского отделения Академии наук Республики Узбекистан, г.Нукус, Каракалпакста*

АННОТАЦИЯ

*Проведена сравнительная оценка агрохимических показателей почв, занятых люцерной (*Medicago sativa*), жёлтым донником (*Melilotus officinalis*) и белым донником (*Melilotus albus*). Определено содержание водорастворимых хлоридов, сульфатов, величина плотного остатка и нитратного азота. Установлено, что исследованные почвы характеризуются невысоким уровнем засоления. Полученные результаты показывают перспективность*

люцерны и донников для использования на почвах с различной степенью засоления и при проведении мероприятий по улучшению агрохимического состояния почв.

Ключевые слова: *Засоленные почвы Каракалпакстана, азотфиксирующие растения,* Medicago sativa, Melilotus officinalis и M.albus.

Республика Каракалпакстан расположена в центральной части евразийского континента. Значительная часть территории относится к Приаралью.

Почвы в Каракалпакстане имеют различный генезис. Главной особенностью почв Каракалпакстана является засоленность верхних горизонтов почв, которая колеблется в широких пределах – от 1,93 до 0,69 % [1, с.71-36] и средне-низкое содержание гумуса (1,03-0,3%) [2, с.57-61], эти показатели отражают состояние почв на многих территориях.

Выращивание азотфиксирующих растений в качестве пионерных видов для восстановления и улучшения, поврежденных или деградированных земель — это естественный способ обогатить почву и улучшить рост последующих посадок. При благоприятных условиях корни бобовых образуют симбиоз с клубеньковыми бактериями, которые черпают азот из воздуха и фиксируют его в почве. Наиболее приемлемыми в выращивании и экологически целесообразными являются растения, которые произрастают в нашем биорегионе. Такие азотфиксирующие травянистые бобовые растения, как клевер (*Trifolium repens* L.), виды донника (*Melilotus albus* Medik., *M.officinalis* (L.) Lam.) люцерна (*Medicago sativa* L.), могут использоваться в качестве полезных почвопокровных видов, постепенно обогащающих азотом истощенную или бедную почву. Как правило, эти растения имеют развитую корневую систему, которая рыхлит почву, благодаря чему питательные вещества, которые были вымыты в глубокие слои почвы, перемещаются в верхний слой.

Были проведены опытно-исследовательские работы по выращиванию видов донника, люцерны для определения накопления азота в почве под этими растениями.

Виды рода *Melilotus* (L.) Mill. (донник) – бобовые растения, оказывающее мощное комплексное влияние на почвы – обогащает почву азотом, благодаря корневой системе, уходящей на глубину до 2 метров, улучшает воздухо- и влагопроницаемость грунта, густая наземная масса подавляет рост сорняков и снижает испарение влаги. Донник соле- засухо- и морозоустойчив, успешно применяется для улучшения засоленных и бедных почв. Является лекарственным, медоносным и кормовым растением (только в сенаже).

Люцерна — многолетнее бобовое растение с мощной, глубоко проникающей корневой системой. Уже в первый год выращивания отдельные корни могут достигать глубины около 1,5 м, а на второй год — 3–4 м и более. Благодаря этому люцерна способна эффективно использовать влагу и питательные вещества из глубоких горизонтов почвы.

В качестве сидеральной культуры чаще всего используют люцерну посевную (*Medicago sativa* L.), которая формирует значительную надземную биомассу. При благоприятных условиях она образует плотный растительный покров, подавляющий развитие сорной растительности и способствующий улучшению фитосанитарного состояния почвы.

Люцерна также способствует обогащению почвы органическим веществом и азотом благодаря симбиотической фиксации атмосферного азота клубеньковыми бактериями. Ее мощная корневая система улучшает структуру почвы и способствует повышению ее водопроницаемости. Кроме того, люцерна является ценным медоносным и высокопитательным кормовым растением. Зеленая масса и сено люцерны широко используются для кормления сельскохозяйственных животных благодаря высокому содержанию белка, минеральных веществ и других питательных компонентов.

По результатам проведенных анализов, представленных в таблице 1,

Таблица 1

Данные химического анализа водорастворимых солей в почвах (в % на 100 гр абсолютно-сухой почвы) и азота (в мг\кг)

№	Наименование образца	Cl^-	SO_4^{2-}	Плотный остаток	$NO_3 – N$ Мг\кг
1.	*Melilotus officinalis,* 26.08.26 г.	0,007	0,016	0,4	9,45
2.	*Melilotus albus*, 26.08.26 г.	0,152	0,065	0,6	14,5
3.	*Medicago sativa,* 26.08.26 г.	0,076	0,065	0,5	56,5

Примечание: Эксперименты проводились и почвенные образцы были получены на опытном участке Каракалпакского научно-исследовательского института естественных наук

можно сделать предварительные выводы:

1. По *Melilotus officinalis: n*лотный остаток составляет **0,4 %**, что свидетельствует о сравнительно низком общем содержании водорастворимых солей. Содержание Cl — всего **0,007 %**, SO_4 — **0,016 %**. Следовательно, почва под данным растением характеризуется **очень слабым проявлением засоления или практически отсутствием засоления.** Содержание NO_3–N составляет **9,45 мг/кг**, что указывает на относительно невысокое содержание нитратного азота.

2. *Melilotus albus* - Здесь плотный остаток увеличивается до **0,6 %**, Cl — до **0,152 %**, SO_4 — **0,065 %**. По сравнению с первым участком содержание водорастворимых солей выше, особенно хлоридов. Поэтому данный образец можно характеризовать как **слабо засолённый**, с преобладанием хлоридно-сульфатного состава солей. NO_3–N — **14,5 мг/кг**, то есть содержание нитратного азота несколько выше, чем в образце под *Melilotus officinalis*.

3. *Medicago sativa* - плотный остаток составляет **0,5 %**, Cl — **0,076 %**, SO_4 — **0,065 %**. Общее содержание водорастворимых солей несколько выше, чем у жёлтого донника, но ниже, чем у белого донника. По этим показателям почву можно отнести к **слабозасолённой**. Содержание **NO_3–N — 56,5 мг/кг**. Оно значительно выше, чем в обоих образцах донника. Это может быть связано с особенностями азотного питания люцерны и её взаимодействием с азотфиксирующими клубеньковыми бактериями.

Заключение. Проведённый анализ показывает, что люцерна и указанные виды донника могут играть важную роль в улучшении агрохимического и экологического состояния почв, особенно на территориях с признаками засоления и сниженного плодородия. Эти бобовые культуры формируют мощную корневую систему, способствуют улучшению структуры почвы, накоплению органического вещества и активизации биологических процессов. Виды донника также обладают высокой экологической пластичностью и способны произрастать на почвах с неблагоприятными условиями, в том числе при наличии определённого уровня засоления. Их выращивание способствует накоплению растительной массы, поступлению органических остатков в почву и поддержанию её биологической активности.

В целом эти азотфиксирующие виды растения целесообразно рассматривать как перспективные культуры для биологической мелиорации, восстановления плодородия, улучшения структуры почвы, накопления азота и формирования устойчивого растительного покрова в Каракалпакстане**.** Их использование может способствовать постепенному улучшению экологического состояния засоленных и деградированных земель и одновременно обеспечивать получение ценного кормового сырья.

ЛИТЕРАТУРА

1. Орел М.М., Матжанова Х.К., Турманова О., Алламбергенова Р., Дильманова Н. Подбор деревьев и кустарников, устойчивых к почвенно-климатическим условиям Южного Приаралья для улучшения деградированных земель. Вестник ККО АН РУз, 2021, №3. стр.31-36.

2. Орел М.М., Матжанова Х.К., Турманова О., Алламбергенова Р., Дильманова Н. Подбор культурных растений и особенности их возделывания на засоленных почвах Южного Приаралья. Вестник ККО АН РУз, 2020, №3. стр.57-61.

ATROF-MUHITGA YO‘NALTIRILGAN IQTISODIYOT

Ishankulova Komila Kurbanovna - GulDU katta o‘qituvchi. +998972751337.

ishankulovakomila@gmail.com

Qurbonov Islombek Farxod o‘g‘li magistr. Loyiha boshqaruvi

+998884140131 qurbonovislomoo3@cloud.com

Annotatsiya: *O‘zbekiston tabiiy resurslardan oqilona foydalanish maqsadida energiya manbalarini diversifikatsiya qilish, qayta tiklanadigan energetikani rivojlantirish va energiya samaradorligini oshirishga e’tibor qaratgan holda, o‘z energetika sektorini faol ravishda o‘zgartirmoqda*

Kalit so‘zlar: *Taraqqiyot strategiyasi, inklyuziv model, JSST, tropik siklonlar, anomal issiq, Dekarbonizatsiya, Yashil o‘sish, IRENA, XEA, YAIM, karbonsizlantirish,*

Mamlakatimizni 2017-2021-yillarda rivojlantirishning beshta ustuvor yo‘nalishi bo‘yicha Harakatlar strategiyasi doirasida o‘tgan davr mobaynida davlat va jamiyat hayotining barcha sohalarini tubdan isloh etishga qaratilgan 300 ga yaqin qonun, 4 mingdan ziyod O‘zbekiston Respublikasi Prezidenti qarorlari qabul qilindi.

So‘nggi besh yillik islohotlarning natijasida mamlakatimizda Yangi O‘zbekistonni barpo etishning zarur siyosiy-huquqiy, ijtimoiy-iqtisodiy va ilmiy-ma’rifiy asoslari yaratildi.

Keng jamoatchilik muhokamasi natijasida “Harakatlar strategiyasidan – Taraqqiyot strategiyasi sari” tamoyiliga asosan 2022–2026-yillarga mo‘ljallangan Yangi O‘zbekistonning taraqqiyot strategiyasida belgilangan maqsadlarni amalga oshirish, "yashil" va inklyuziv iqtisodiy o‘sishni ta’minlashga qaratilgan chora-tadbirlar samaradorligini oshirish hamda barcha iqtisodiyot tarmoqlarida qayta tiklanuvchi energiya manbalari va resurs tejovchi amaliyotlardan foydalanishni yanada kengaytirish maqsadida O‘zbekiston Respublikasining "yashil" iqtisodiyotga o‘tish strategiyasi tasdiqlandi.

Har yili atmosferaga inson faoliyati natijasida 20 milliard tonna karbonat angidrid chiqariladi va dunyo bo‘ylab 300 million tonnadan ortiq plastik chiqindilar hosil bo‘ladi. Global miqyosdagi chiqindilar hajmi yildan-yilga o‘sishda davom etmoqda. Dunyo aholisining taxminan 99 foizi sifat ko‘rsatkichlari jahon sog‘liqni saqlash tashkiloti (JSST) ma’lumotlariga ko‘ra, belgilangan me’yordan yuqori bo‘lgan va inson salomatligiga xavf soluvchi havo bilan nafas oladi;

shu bilan birga, har yili dunyo bo‘ylab o‘n millionlab o‘lim holatlari atrof-muhit omillari, jumladan, havo ifloslanishi bilan bog‘liq bo‘lmoqda.

Mayda zarrachalar va azot dioksidi va boshqa chiqindi gazlarning sog‘liq uchun zararli darajada to‘planishiga asosan qazib olinadigan yoqilg‘ilarning yonishi sabab bo‘lmoqda. Dunyo miqyosida energiya inqirozi, yashash qiymatining oshishi bilan bog‘liq inqiroz, oziq-ovqat inqirozi, shuningdek, urushlar, qurg‘oqchilik va ocharchilik kabi muammolar kuzatilmoqda. Iqlim o‘zgarishi oqibatida yuzaga kelayotgan ekstremal ob-havo hodisalari — masalan, tropik siklonlar, anomal issiq, cho‘llanish va dengiz sathining ko‘tarilishi — mamlakatlarga ulkan zarar yetkazmoqda. Bunday tabiiy ofatlarning tez-tez takrorlanib turishi issiqxona gazlari chiqindilari hajmining ortishi natijasidir.

Iqlim o‘zgarishi bilan bog‘liq bunday muammolar atrof-muhit va oziq-ovqat xavfsizligini ta’minlashga, shuningdek, qashshoqlikni bartaraf etishga qaratilgan sa’y-harakatlarga salbiy ta’sir ko‘rsatmoqda. Shu bois mamlakatimiz iqlim o‘zgarishi oqibatlarini yumshatish va unga moslashish, «yashil» iqtisodiyotga o‘tishni jadallashtirish hamda iqtisodiy o‘sishning «yashil» va inklyuziv modelini ilgari surishga alohida e’tibor qaratmoqda. O‘zbekiston 2025-yilni Atrof-muhitni muhofaza qilish hamda «yashil» iqtisodiyot yili deb e’lon qildi.

Yashil iqtisodiyot — bu atrof-muhitni muhofaza qilish va iqtisodiyotning muvozanatli rivojlanishini ta’minlashga qaratilgan muhim sohadir. Yashil iqtisodiyotga o‘tishning asosiy maqsadlaridan biri — yer resurslariga nisbatan mas’uliyatli munosabatni shakllantirishdan iboratdir. Jamiyatimiz oldida farovonlikning oshishi hamda tabiiy resurslarning saqlanib qolishi o‘rtasida oqilona muvozanatni topish vazifasi turibdi. Yashil iqtisodiyot tamoyillaridan biri — barqaror ishlab chiqarish va iste’molni davlat tomonidan qo‘llab-quvvatlash, hamda, kam uglerodli va resurs tejamkor texnologiyalarni joriy etishdan iborat. Yashil iqtisodiyotga o‘tish O‘zbekistonning global iqlim o‘zgarishiga qarshi kurashda faol ishtirok etishini hamda, aholi farovonligini ko‘zlagan ustuvor siyosatni amalga oshirishini ta’minlaydi. O‘zbekiston Prezidenti Shavkat Mirziyoyev 2021-yilda Janubiy Koreyada bo‘lib o‘tgan "Yashil o‘sish va 2030-yilgi global maqsadlar yo‘lida hamkorlik" sammitining ikkinchi yig‘ilishida so‘zga chiqib, shunday degan edi: "Tabiatning o‘zi bizga yo‘llayotgan signallarni endi e’tiborsiz qoldira olmaymiz. Afsuski, iqlim o‘zgarishi kuchayib bormoqda. Mamlakatlarning 'yashil' rivojlanish maqsadlariga erishish borasidagi sa’y-harakatlari yanada faol va samarali bo‘lishi shartligida endi hech qanday shubha yo‘q. Bizda boshqa tanlov yo‘q".

Tabiiy gaz, ko‘mir va neft kabi qazib olinadigan yoqilg‘ilar global iqlim o‘zgarishining asosiy sababchisi hisoblanadi. Ular dunyo bo‘ylab issiqxona gazlari chiqindilarining kattagina 75 foizdan ortig‘ini va karbonat angidrid chiqindilarining deyarli 90 foizini tashkil etadi. Yerni o‘rab

turgan va quyosh issiqligini ushlab qoladigan issiqxona gazlarining katta qismi energiya ishlab chiqarish jarayonida — elektr energiyasi va issiqlik olish uchun qazib olinadigan yoqilg‘ilar yoqilganda hosil bo‘ladi. Qazib olinadigan yoqilg‘ilar xaligacha jahon energiya ishlab chiqarishining 80 foizdan ortig‘ini ta’minlab kelmoqda.

Energetika iqlim muammosining qoq markazida turadi va uning yechimini topishda hal qiluvchi ahamiyatga ega. Ekspertlar tadqiqotlari va ilmiy ma'lumotlar shuni yaqqol ko‘rsatadiki, iqlim o‘zgarishining eng og‘ir oqibatlaridan qochish uchun zararli chiqindilar hajmini 2030-yilgacha, deyarli ikki baravar qisqartirish va 2050-yilga borib «sof nol» (net-zero) darajasiga yetkazish zarur. Olimlarning fikricha, ushbu maqsadga erishish uchun toza, arzon, barqaror va ishonchli bo‘lgan muqobil energiya manbalariga sarmoya kiritish talab etiladi. BMT Bosh kotibi Antoniu Guterresh shunday dedi: "Sayyoramiz resurslarini yoqishni to‘xtatib, atrofimizda mo‘l-ko‘l mavjud bo‘lgan qayta tiklanadigan energiya manbalariga sarmoya kiritishni boshlash vaqti keldi". Quyosh, shamol, suv, chiqindilar va yer issiqligi tufayli mo‘l-ko‘l mavjud bo‘lgan qayta tiklanadigan energiya manbalari tabiiy ravishda tiklanadi, atmosferaga deyarli hech qanday issiqxona gazlari yoki ifloslantiruvchi moddalar chiqarmaydi hamda, ko‘p hollarda ko‘mir, neft yoki gazga qaraganda arzonroqdir.

Qayta tiklanadigan energiya joriy etish va energiya samaradorligiga sarmoya kiritish — tabiiy gaz, neft va ko‘mirni yoqishga qaraganda kamroq xarajat talab qiladi, ko‘proq ish o‘rinlari yaratadi hamda atrof-muhitning ancha kamroq ifloslanishiga olib keladi. Xalqaro qayta tiklanadigan energiya agentligi (IRENA) hisob-kitoblariga ko‘ra, 2050-yilga kelib dunyo elektr energiyasining 90 foizi qayta tiklanadigan energiya manbalardan olinishi mumkin va shunday bo‘lishi kerak. 2030-yillarga borib, arzon qayta tiklanadigan elektr energiyasi global elektr energiyasiga bo‘lgan talabning 65 foizini qondirishi mumkin. Bu esa 2050-yilga kelib energetika sektorini 90 foizga karbonsizlantirish, uglerod chiqindilarini sezilarli darajada kamaytirish hamda, iqlim o‘zgarishi oqibatlarini yumshatishga yordam beradi.

(Dekarbonizatsiya — bu sanoat tarmoqlari va iqtisodiyotda uglerod miqdorini kamaytirish jarayonidir. Energetika sohasida dekarbonizatsiya issiqxona gazlari chiqindilarini qisqartirish hamda, uglevodorod yoqilg‘ilariga bo‘lgan bog‘liqlikni kamaytirishda hal qiluvchi rol o‘ynaydi. Dekarbonizatsiyaning asosiy usullaridan biri bu — quyosh, shamol, gidroenergetika va geotermal energiya kabi muqobil energiya manbalariga o‘tishdir.)

Xalqaro energetika agentligi (XEA yoki IEA) baholashlariga ko‘ra, zararli chiqindilar hajmini nolga tenglashtirishga (net-zero) o‘tish energetika sohasida ish o‘rinlarining umumiy ko‘payishiga olib keladi. Masalan, 2030-yilga kelib qazib olinadigan yoqilg‘i ishlab chiqarish tarmoqlarida taxminan 5 million ish o‘rni yo‘qolishi mumkin bo‘lsa-da, toza energiya sektorida ish

o‘rinlari soni qariyb 14 millionga oshishi kutilmoqda; bu esa yakunda 9 millionta qo‘shimcha ish o‘rni yaratilishini anglatadi. Bundan tashqari, energetika bilan bog‘liq tarmoqlar yangi vazifalarni — masalan, elektromobillar va yuqori samaradorlikka ega maishiy texnikalar ishlab chiqarish yoki vodorodga asoslangan yechimlar kabi innovatsion texnologiyalarni joriy etishni — amalga oshirish uchun yana o‘n millionlab ishchilarga ehtiyoj sezadi. Bu shuni anglatadiki, 2030-yilga kelib, toza energiya texnologiyalari hamda yuqori samaradorlik va kam emissiyani ta’minlovchi texnologiyalar sohasida jami 30 milliondan ortiq ish o‘rni yaratilishi mumkin.

Yashil texnologiyalar uglerod chiqindilarini kamaytirish va iqlim o‘zgarishi oqibatlarini minimallashtirishda muhim omilga aylanmoqda. BMT tadqiqotlari shuni ko‘rsatadiki, 2030-yilga qadar jami 1,8 trillion dollar miqdoridagi sarmoyalar 7 trillion dollardan ortiq sof foyda keltirishi mumkin. Shamol va vodorod energiyasini o‘zida birlashtirgan yashil texnologik yechimlar nafaqat CO2 chiqindilarini yiliga 80 million tonnaga qisqartirish, balki hududlarda barqaror energiya ta’minotini ta’minlash imkonini ham beradi.

So‘nggi yillarda O‘zbekistonda yashil iqtisodiyotni rivojlantirishga qaratilgan bir qator muhim chora-tadbirlar amalga oshirildi. Xususan, "Qayta tiklanuvchi energiya manbalaridan foydalanish to‘g‘risida"gi va "Gidrometeorologiya faoliyati to‘g‘risida"gi qonunlar, shuningdek, O‘zbekiston Respublikasining 2030-yilgacha bo‘lgan davrda atrof-muhitni muhofaza qilish konsepsiyasi hamda O‘zbekiston Respublikasining 2019–2030-yillarda yashil iqtisodiyotga o‘tish strategiyasi qabul qilindi. Boshqa tashabbuslar qatorida, 2023–2024-yillarda ekologik toza texnologiyalar va qayta tiklanuvchi energiya manbalari yordamida ishlab chiqarilgan mahsulotlar hamda jarayonlar sifatini nazorat qilish maqsadida yashil energiya sertifikatlari tizimi joriy etildi.

O‘zbekiston 2030-yilga kelib, yalpi ichki mahsulot (YAIM) birligiga to‘g‘ri keladigan issiqxona gazlari chiqindilarini 35 foizga qisqartirishni rejalashtirmoqda. Parij kelishuvi doirasidagi ushbu ulkan maqsad 2022-yilning noyabr oyida Misrning Sharm-al-Shayx shahrida bo‘lib o‘tgan BMTning Iqlim o‘zgarishi bo‘yicha doiraviy konvensiyasi Tomonlar konferensiyasining 27-sessiyasida yana bir bor tasdiqlandi. O‘zbekiston xavfsiz va barqaror rivojlanishni ta’minlash hamda iqlim o‘zgarishlariga chidamli kelajakni barpo etishga qaratilgan xalqaro hamjamiyat bilan faol hamkorlikka tayyor ekanligi ta’kidlandi.

O‘zbekiston hukumati iqtisodiy taraqqiyotga «yashil iqtisodiyot» tamoyillarini joriy etish orqali erishish mumkin, deb hisoblaydi. Shu munosabat bilan kam uglerodli rivojlanish, iqtisodiyotning barcha tarmoqlarida resurslarni tejash hamda samarali va ekologik toza texnologiyalarni qo‘llash ustuvor yo‘nalishlar etib belgilangan.

FOYDALANILGAN ADABIYOTLAR

1. Barqaror rivojlanish maqsadlari //: https://w.un.org/ BMT ma’lumotlari asosida muallif tomonidan tuzilgan;
2. Mamatov A.A. "Yashil iqtisodiyot" va "yashil o‘sish": "Yashil iqtisodiyot"ga o‘tish sharoitida qayta tiklanuvchi energiya manbalari — muammolar va zamonaviy yechimlar. Yosh olimlar, doktorantlar, mustaqil izlanuvchilar, magistrantlar va iqtidorli talabalar uchun respublika ilmiy-amaliy konferensiyasi materiallari. Guliston: Guliston davlat universiteti (GulDU), 2024.54 b.
3. O‘zbekiston Respublikasi Prezidentining farmoyishi,Harakatlar strategiyasi 14.02.2017 yildagi F-4849-son
4. O‘zbekiston Respublikasi Prezidentining Farmoni, Taraqqiyot strategiyasi. 28.01.2022 yildagi PF-60-son
5. O‘zbekiston Respublikasining 2019–2030-yillar davrida «yashil» iqtisodiyotga o‘tish strategiyasi (O‘zbekiston Respublikasi Prezidentining 2019-yil 5-oktabrdagi PQ-4477-sonli qarori)
6. O‘zbekiston Respublikasi Prezidentining 2022-yil 2-dekabrdagi PQ-436-sonli qaroriga muvofiq qabul qilingan "O‘zbekiston Respublikasida yashil iqtisodiyotga o‘tish va yashil o‘sishni ta’minlash bo‘yicha 2030-yilgacha mo‘ljallangan dastur";

SHAHAR HUDUDLARINING KENGAYISHI SHAROITIDA BIOLOGIK XILMA-XILLIKNING O‘ZGARISH XUSUSIYATLARI

Ishmo‘minov B.B., Po‘latova F.A

O‘zbekiston milliy pedagogika universiteti, ibobur.1991@mail.ru

Abstract. *This thesis explores the impact of urbanization on biodiversity in urban ecosystems, including the reduction of natural habitats, the effects of anthropogenic factors on flora and fauna, and the conservation of biodiversity in urban environments. Furthermore, recommendations are developed for the advancement of green infrastructure and the promotion of environmental sustainability.*

Keywords: *urbanization, urban ecosystem, biodiversity, green spaces, anthropogenic factors, environmental sustainability, nature conservation.*

Kirish. Bugungi kunda shaharlashuv jarayonlarining kengayishi tabiiy muhitning o‘zgarishi va biologik xilma-xillikning kamayishi bilan bog‘liq ekologik muammolarni keltirib chiqarmoqda. Aholi sonining ortishi, yangi binolar va yo‘llarning qurilishi hamda shahar infratuzilmasining kengayishi o‘simliklar va hayvonlarning tabiiy yashash joylariga ta’sir ko‘rsatmoqda. Bunday sharoitda tabiiy ekotizimlarni saqlash, noyob turlarni muhofaza qilish va yashil hududlarni

kengaytirish O‘zbekistonda ekologik muvozanatni saqlash hamda barqaror rivojlanishga erishishning muhim omillari hisoblanadi. [1].

Asosiy qism. Urbanizatsiyaning shahar ekotizimlariga ta’siri, avvalo, tabiiy landshaftlarning o‘zgarishi, o‘simlik qoplamining qisqarishi va hayvonlarning yashash joylari parchalanishida namoyon bo‘ladi. Qurilish maydonlarining kengayishi, tuproqning zichlanishi, havoning ifloslanishi, shovqin va sun’iy yoritish ko‘plab organizmlarning yashash hamda ko‘payish sharoitlariga salbiy ta’sir ko‘rsatishi mumkin. Shahar ekologiyasini o‘rganishda ushbu omillarni kompleks baholash muhim ahamiyatga ega [2].

Biologik xilma-xillikning kamayishi faqat turlar sonining qisqarishi bilan cheklanmaydi. U ekotizimdagi oziq zanjirlari, changlanish, urug‘larning tarqalishi va tabiiy modda almashinuvi kabi ekologik jarayonlarning buzilishiga ham sabab bo‘lishi mumkin. Shu sababli shahar hududlarida o‘simlik va hayvonot dunyosini muhofaza qilish bilan bir qatorda, ularning tabiiy yashash muhitlarini saqlash ham zarur [3].

Shahar ekotizimlarida biologik xilma-xillikni saqlashning samarali yo‘llaridan biri yashil hududlarni rivojlantirishdir. Bog‘lar, xiyobonlar, yashil belbog‘lar va suv havzalari ko‘plab organizmlar uchun yashash muhiti bo‘lib xizmat qiladi. Biroq ko‘kalamzorlashtirish jarayonida faqat daraxtlar sonini oshirish emas, balki o‘simlik turlarining xilma-xilligi, mahalliy turlardan foydalanish, ekologik yo‘laklarni tashkil etish va mavjud tabiiy hududlarni saqlab qolishga ham e’tibor qaratish lozim.

O‘zbekiston Respublikasi Vazirlar Mahkamasining 2019-yil 11-iyundagi 484-son qarori bilan tasdiqlangan biologik xilma-xillikni saqlash strategiyasida tabiiy ekotizimlarni muhofaza qilish, biologik xilma-xillik monitoringini takomillashtirish va kamyob turlarni saqlashga alohida e’tibor qaratilgan [1]. Mazkur yondashuvlarni shaharsozlik va ko‘kalamzorlashtirish tadbirlariga tatbiq etish shahar ekotizimlarining ekologik barqarorligini oshirishga xizmat qiladi.

Toshkent shahri misolida ham urbanizatsiya va yashil hududlar o‘rtasidagi munosabatlarni o‘rganish muhimdir. Bunda shahar bog‘lari va xiyobonlaridagi o‘simlik turlarini inventarizatsiya qilish, qushlar va changlatuvchi hasharotlar tarkibini o‘rganish, yashil maydonlarning holatini baholash hamda antropogen bosim yuqori bo‘lgan hududlarni aniqlash maqsadga muvofiq. Olingan natijalar asosida yashil hududlarni o‘zaro bog‘lash, mahalliy o‘simlik turlarini ko‘paytirish va ekologik monitoringni yo‘lga qo‘yish bo‘yicha tavsiyalar ishlab chiqish mumkin.

Xulosa. Urbanizatsiya shahar ekotizimlarining biologik xilma-xilligi va ekologik barqarorligiga sezilarli ta’sir ko‘rsatuvchi omildir. Tabiiy yashash muhitlarining qisqarishi, ifloslanish va yashil hududlarning parchalanishi biologik xilma-xillikni saqlashga to‘sqinlik qiladi. Ushbu muammolarni kamaytirish uchun yashil infratuzilmani rivojlantirish, mahalliy o‘simlik

turlarini muhofaza qilish, ekologik yo‘laklar tashkil etish va biologik xilma-xillik monitoringini kuchaytirish zarur. Shaharlarni ekologik rejalashtirishda yashil maydonlarning miqdori bilan birga, ularning biologik qiymati va tabiiy ekotizimlar bilan bog‘liqligini ham hisobga olish lozim.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI

1. O‘zbekiston Respublikasi Vazirlar Mahkamasining 2019-yil 11-iyundagi 484-son “2019–2028-yillar davrida O‘zbekiston Respublikasida biologik xilma-xillikni saqlash strategiyasini tasdiqlash to‘g‘risida”gi qarori.
2. Xushvaqtova N., Yormatova D. *Shahar va sanoat ekologiyasi*. – Toshkent: Fan va texnologiya.
3. Azimova D.O., Yodgorova D.Sh., Egamberdiyeva L.Sh., Jabborov B.T. *Bioxilma-xillik va uning muhofazasi*. – Toshkent: Fan va texnologiya.

Ishtirok etish uchun shakl

Muallif (lar) ning F.I.Sh. (to‘liq)	Ishmo‘minov Bobur Botir o‘g‘li
Tashkilot (ish joyi)	O‘zbekiston milliy pedagogika universiteti
Manzili	Toshkent shahri, Chilonzor tumani 19-mavze
Lavozimi	Katta o‘qituvchi
Ilmiy darajasi, unvoni	Yo‘q
Maqola (ma’ruza) mavzusi	Shahar hududlarining kengayishi sharoitida biologik xilma-xillikning o‘zgarish xususiyatlari
Yo‘nalish nomi	Atrof-muhitni muhofaza qilish, barqaror rivojlanish va yoshlar ta’lim siyosat
Ishtirok etish shakli (bevosita ishtirok etgan yoki sirtdan)	Sirtdan
Telefon raqami	977448416
E-mail:	ibobur.1991@mail.ru

TOSHKENT SHAHRIDA YASHIL RIVOJLANISH JARAYONLARI VA SHAHAR EKOLOGIK HOLATI

Ishmo‘minov B.B., Raxmatova D.A

O‘zbekiston milliy pedagogika universiteti, bobur.1991@mail.ru

Abstract. *This thesis highlights the environmental and socio-economic significance of implementing green transformation in Tashkent. Rapid urbanization, the increasing number of motor vehicles, air pollution, the reduction of green spaces, and microclimatic changes are analyzed as key factors affecting the city's environmental sustainability. Furthermore, environmental regulatory and legal documents adopted in the Republic of Uzbekistan are examined, including Presidential Decree No. PF-112 aimed at the development of Tashkent by 2030, Resolution No. PQ-338 focused on improving air quality, Presidential Decrees No. PF-90 and PF-47 related to the nationwide Yashil Makon (Green Space) project, and Resolution No. PQ-279 concerning the development of Tashkent in 2026–2027. Measures implemented under these documents are also discussed. The expansion of green infrastructure, the establishment of green belts and public parks, the development of environmentally friendly transport, and the introduction of modern digital monitoring systems are substantiated as key priorities for ensuring the environmental sustainability of Tashkent.*

Keywords: *green transformation, environmental sustainability, Tashkent city, urbanization, green spaces, green infrastructure, atmospheric air, green belt, eco-friendly transport, “Yashil Makon” (“Green Space”).*

Kirish. Bugungi kunda jadal urbanizatsiya jarayonlari yirik shaharlarda ekologik muammolarning kuchayishiga olib kelmoqda. Aholi sonining ortishi, transport oqimlarining kengayishi, qurilish jarayonlarining jadallashuvi va tabiiy hududlarning qisqarishi shahar ekotizimlariga bosimni oshirmoqda. Ushbu jarayonlar atmosfera havosi sifati, mikroiqlim, biologik xilma-xillik va aholining hayot sifatiga bevosita ta’sir ko‘rsatadi [1].

Toshkent shahrini 2030-yilgacha rivojlantirish bo‘yicha davlat siyosatida yashil hududlarni keskin ko‘paytirish, poytaxtni toza havoli megapolislardan biriga aylantirish va aholi uchun qulay yashash muhitini yaratish ustuvor vazifalardan biri sifatida belgilangan [1]. Mazkur hujjatga ko‘ra, Toshkent shahrida qo‘shimcha 4 ming gektar yashil hudud tashkil etish maqsad qilib qo‘yilgan [1].

Asosiy qism

Yashil transformatsiya - shahar rivojlanishini ekologik xavfsizlik, resurslardan oqilona foydalanish, yashil infratuzilma va kam uglerodli texnologiyalar bilan uyg‘unlashtirishga qaratilgan kompleks jarayondir. Bunda shahar faqat qurilish va iqtisodiy o‘sish nuqtayi nazaridan emas, balki ekologik tizim sifatida ham qaraladi.

Toshkent shahrida yashil transformatsiyaning muhim yo‘nalishlaridan biri yashil hududlarni kengaytirishdir. Daraxtzorlar, bog‘lar, xiyobonlar va yashil koridorlar atmosfera havosidagi chang miqdorini kamaytirish, mikroiqlimni yumshatish, uglerod dioksidini yutish hamda aholining rekreatsion ehtiyojlarini ta’minlashda muhim ekologik funksiyani bajaradi [2].

O‘zbekiston Respublikasining 2024-yil 24-sentabrdagi PQ-338-son “Chang bo‘ronlariga qarshi kurashish va atmosfera havosi sifatini yaxshilash bo‘yicha birinchi navbatdagi chora-tadbirlar to‘g‘risida”gi qarori Toshkent shahrining ekologik barqarorligini oshirishda muhim huquqiy asoslardan biridir [2]. Mazkur qarorda Toshkent shahri atrofida “yashil belbog‘” tashkil etish, shuningdek, mikroiqlimni yaxshilash maqsadida sun’iy suv havzalari va ko‘llar tashkil etish kabi chora-tadbirlar belgilangan [2].

“Yashil makon” umummilliy loyihasi doirasida yashil hududlarni kengaytirish ham Toshkent shahrining ekologik transformatsiyasida muhim ahamiyatga ega. 2025-yil 30-maydagi PF-90-son Farmon bilan yashil bog‘lar, yashil jamoat parklari, yashil belbog‘lar va himoya o‘rmonzorlarini barpo etish tizimini takomillashtirishga qaratilgan chora-tadbirlar belgilangan [3].

2026-yil 25-martdagi PF-47-son Farmon “Yashil makon” umummilliy loyihasining samaradorligini oshirishga qaratilgan bo‘lib, unda ko‘kalamzorlashtirish ishlarini raqamlashtirish, daraxtlarni hisobga olish va ularning holatini monitoring qilish, shuningdek, ekologik tashabbuslarni rag‘batlantirish mexanizmlari kuchaytirilgan [4].

Toshkent shahrining ekologik barqarorligi faqat ko‘kalamzorlashtirish bilan cheklanmaydi. Transport tizimini takomillashtirish ham yashil transformatsiyaning muhim tarkibiy qismidir. Avtomobillar sonining ko‘payishi atmosfera havosiga chiqariladigan ifloslantiruvchi moddalar miqdorini oshirishi mumkin. Shu sababli jamoat transportini rivojlantirish, piyoda va velosiped infratuzilmasini kengaytirish, elektromobillardan foydalanishni rag‘batlantirish hamda transport oqimlarini samarali boshqarish zarur [5-8].

2026-yil 27-iyuldagi PQ-279-son qaror Toshkent shahrini 2026–2027-yillarda rivojlantirishda zamonaviy urbanistik yondashuvlarni kuchaytirishga qaratilgan. Unda “15 daqiqalik shahar” konsepsiyasini amalga oshirish, zamonaviy ko‘chatxonalar tashkil etish, yashil belbog‘ va yashil bog‘lar barpo etish hamda aholi yashash punktlaridan piyoda yetib borish mumkin bo‘lgan kichik yashil bog‘larni tashkil etish vazifalari belgilangan [6].

Shuningdek, ekologik barqarorlikni ta’minlashda aholining ekologik madaniyatini oshirish muhim ahamiyatga ega. 2025-yil 15-maydagi PQ-184-son qaror bilan 2030-yilgacha aholining ekologik madaniyatini yuksaltirish konsepsiyasi tasdiqlangan bo‘lib, unda ta’lim oluvchilar va aholining ekologik bilimlarini oshirish bo‘yicha aniq maqsadli ko‘rsatkichlar belgilangan [7].

Toshkent shahrida yashil transformatsiyani yanada rivojlantirish uchun quyidagi yo‘nalishlarni kuchaytirish maqsadga muvofiq:

1. mavjud yashil hududlarni saqlash va ularning maydonini kengaytirish;
2. mahallalar miqyosida kichik yashil bog‘lar va yashil koridorlar tashkil etish;
3. Toshkent shahri atrofidagi yashil belbog‘ni rivojlantirish;
4. suvni tejovchi sug‘orish texnologiyalaridan foydalanish;
5. mahalliy iqlim sharoitiga mos daraxt va buta turlarini tanlash;
6. jamoat transporti, piyoda va velosiped infratuzilmasini rivojlantirish;
7. atmosfera havosi sifatini real vaqt rejimida monitoring qilish;
8. yashil hududlar holatini raqamli monitoring tizimlari orqali nazorat qilish;
9. chiqindilarni saralash va qayta ishlash tizimini takomillashtirish;
10. aholining ekologik madaniyatini oshirish va ekologik tashabbuslarni qo‘llab-quvvatlash.

Xulosa

Toshkent shahrida yashil transformatsiyani amalga oshirish ekologik xavfsizlikni ta’minlash, aholining hayot sifatini yaxshilash va shahar infratuzilmasini barqaror rivojlantirishning muhim shartidir. Yashil hududlarni kengaytirish, yashil belbog‘lar va jamoat parklarini tashkil etish, atmosfera havosi sifatini yaxshilash hamda zamonaviy urbanistik konsepsiyalarni joriy etish shahar ekologik barqarorligini oshiradi.

O‘zbekistonda so‘nggi yillarda qabul qilingan normativ-huquqiy hujjatlar Toshkent shahrining ekologik transformatsiyasi uchun muhim huquqiy asos yaratmoqda [1]. Ayniqsa, “Yashil makon” loyihasi, yashil hududlarni kengaytirish, atmosfera havosi sifatini yaxshilash va “15 daqiqalik shahar” konsepsiyasining joriy etilishi Toshkentning ekologik jihatdan barqaror va yashash uchun qulay shahar sifatida rivojlanishiga xizmat qiladi.

Shu bilan birga, yashil transformatsiyaning samaradorligi faqat ekilgan daraxtlar soni bilan emas, balki ularning saqlanish darajasi, yashil hududlarning ekologik funksiyasi, suv resurslaridan oqilona foydalanish, havo sifati va aholining ekologik farovonligi kabi ko‘rsatkichlar asosida baholanishi lozim.

FOYDALANILGAN ADABIYOTLAR

1. O‘zbekiston Respublikasi Prezidentining 2023-yil 26-iyuldagi PF-112-son “Toshkent shahrini 2030-yilga qadar ijtimoiy-iqtisodiy rivojlantirish chora-tadbirlari to‘g‘risida”gi Farmoni.

2. O‘zbekiston Respublikasi Prezidentining 2024-yil 24-sentabrdagi PQ-338-son “Chang bo‘ronlariga qarshi kurashish va atmosfera havosi sifatini yaxshilash bo‘yicha birinchi navbatdagi chora-tadbirlar to‘g‘risida”gi qarori.

3. O‘zbekiston Respublikasi Prezidentining 2025-yil 30-maydagi PF-90-son “Yashil makon” umummilliy loyihasi doirasida hamda o‘rmonlarni boshqarish tizimida islohotlarni izchil davom ettirish, yashil hududlarni kengaytirish chora-tadbirlari to‘g‘risida”gi Farmoni.

4. O‘zbekiston Respublikasi Prezidentining 2026-yil 25-martdagi PF-47-son “Yashil makon” umummilliy loyihasi samaradorligini yanada oshirish chora-tadbirlari to‘g‘risida”gi Farmoni.

5. O‘zbekiston Respublikasi Prezidentining 2023-yil 16-fevraldagi PQ-59-son “Jamoat transporti tizimini isloh qilish chora-tadbirlari to‘g‘risida”gi qarori.

6. O‘zbekiston Respublikasi Prezidentining 2026-yil 27-iyuldagi PQ-279-son “Toshkent shahrini 2026–2027-yillarda ijtimoiy-iqtisodiy rivojlantirish bo‘yicha qo‘shimcha chora-tadbirlar to‘g‘risida”gi qarori.

7. O‘zbekiston Respublikasi Prezidentining 2025-yil 15-maydagi PQ-184-son “2030-yilgacha bo‘lgan davrda aholining ekologik madaniyatini yuksaltirish konsepsiyasini tasdiqlash to‘g‘risida”gi qarori.

8. Xo‘janazarov O‘.E. Ekologiya va tabiatni muhofaza qilish. O‘quv qo‘llanma. – Toshkent: TDPU, 2020. – 212 b.

9. Haaland C., van den Bosch C.K. Challenges and strategies for urban green-space planning in cities undergoing densification: A review // **Urban** Forestry & Urban Greening. – 2015. – Vol. 14. – P. 760–771.

Ishtirok etish uchun shakl

Muallif (lar) ning F.I.Sh. (to‘liq)	Ishmo‘minov Bobur Botir o‘g‘li
Tashkilot (ish joyi)	O‘zbekiston milliy pedagogika universiteti
Manzili	Toshkent shahri, Chilonzor tumani 19-mavze
Lavozimi	Katta o‘qituvchi
Ilmiy darajasi, unvoni	Yo‘q
Maqola (ma’ruza) mavzusi	Toshkent shahrida yashil rivojlanish jarayonlari va shahar ekologik holati
Yo‘nalish nomi	Atrof-muhitni muhofaza qilish, barqaror rivojlanish va yoshlar ta’lim siyosat
Ishtirok etish shakli (bevosita ishtirok etgan yoki sirtdan)	Sirtdan
Telefon raqami	977448416
E-mail:	ibobur.1991@mail.ru

UDK 574:502.131.1:37.013

BIOLOGIK TIZIMLAR MONITORINGIDA ZAMONAVIY YONDASHUVLAR VA ULARNING BARQAROR RIVOJLANISHDAGI AHAMIYATI

Jumanova G.T.

Samarqand viloyati Jomboy tumani 2-son texnikumi, biologiya fani bosh o‘qituvchisi

Tel.: +998 93-230-07-68

E-mail: jumanovaguliston78@gmail.com

Annotatsiya. *Maqolada biologik tizimlar monitoringining zamonaviy usullari — bioindikatsiya, masofadan zondlash, GIS, environmental DNA (eDNA), avtomatlashtirilgan sensorlar va sun’iy intellekt imkoniyatlari tahlil qilinadi. Ushbu yondashuvlarning biologik xilma-xillikni baholash, ekologik o‘zgarishlarni erta aniqlash va barqaror rivojlanish maqsadlariga erishishdagi ahamiyati yoritiladi. Shuningdek, monitoring natijalarini biologiya va ekologiya ta’limiga integratsiya qilishning istiqbollari ko‘rib chiqiladi.*

Kalit so‘zlar: *ekologik monitoring, biologik tizimlar, biologik xilma-xillik, bioindikatsiya, eDNA, GIS, masofadan zondlash, barqaror rivojlanish, ekologik ta’lim.*

Abstract. *This article analyzes modern methods for monitoring biological systems, including bioindication, remote sensing, Geographic Information Systems (GIS), environmental DNA (eDNA), automated sensors, and artificial intelligence. The significance of these approaches in assessing biodiversity, detecting environmental changes at an early stage, and achieving sustainable development goals is highlighted. Furthermore, the prospects for integrating monitoring results into biology and environmental education are discussed.*

Keywords: *environmental monitoring, biological systems, biodiversity, bioindication, environmental DNA (eDNA), Geographic Information Systems (GIS), remote sensing, sustainable development, environmental education.*

KIRISH: Iqlim o‘zgarishi, urbanizatsiya, cho‘llanish, suv resurslarining kamayishi va antropogen bosim biologik tizimlarning barqarorligiga ta’sir ko‘rsatmoqda. Shu sababli ekotizimlar holatini muntazam kuzatish, biologik xilma-xillikdagi o‘zgarishlarni erta aniqlash va ekologik xavflarni prognoz qilish barqaror rivojlanishning muhim shartlaridan biridir. Zamonaviy monitoring an’anaviy dala kuzatuvlarini molekulyar, geoinformatsion va raqamli texnologiyalar bilan birlashtiradi [7, 483-b.; 11, 384-b.].

O‘zbekiston uchun monitoring suv tanqisligi, yer degradatsiyasi, cho‘llanish va Orolbo‘yi hududidagi ekologik o‘zgarishlar sababli alohida ahamiyatga ega. Shu bilan birga, ekologik ma’lumotlarni ta’lim jarayoniga kiritish talabalarda ekologik tafakkur, ma’lumotlar bilan ishlash va tadqiqotchilik kompetensiyalarini rivojlantiradi. Markaziy Osiyo, jumladan O‘zbekiston universitetlarini qamrab olgan tadqiqot barqaror rivojlanish tamoyillarini o‘quv dasturlariga chuqurroq integratsiya qilish zarurligini ko‘rsatadi [2, 140-b. 15, 809-b].

Maqolaning maqsadi biologik tizimlar monitoringining zamonaviy usullarini tahlil qilish, ularning barqaror rivojlanishdagi ahamiyatini yoritish hamda monitoring natijalarini biologik ta’limga integratsiya qilish imkoniyatlarini asoslashdan iborat.

BIOLOGIK TIZIMLAR MONITORINGINING ZAMONAVIY USULLARI

Bioindikatsiya organizmlar yoki biologik jamoalarning muhit o‘zgarishlariga reaksiyasi orqali ekotizim holatini baholash imkonini beradi. Masofadan zondlash va GIS esa katta hududlarda o‘simlik qoplami, suv havzalari, yer degradatsiyasi va antropogen transformatsiyalar dinamikasini fazoviy tahlil qilishda samaralidir. Sun’iy yo‘ldosh ma’lumotlari biologik xilma-xillik monitoringini keng hududlarda takroriy va standart kuzatish imkonini beradi [8, 384-b; 12, 196-b]. eDNA texnologiyasi suv, tuproq va boshqa ekologik namunalardagi genetik material orqali turlar mavjudligini aniqlashga asoslanadi. Ushbu usul noinvazivligi, yuqori sezgirligi va kam uchraydigan turlarni aniqlash imkoniyati bilan ajralib turadi [3, 355-b; 4, 107-b]. eDNA ni masofadan zondlash bilan birlashtirish biologik xilma-xillikni nozik fazoviy miqyosda xaritalash imkoniyatlarini kengaytiradi (1-jadval)[10, 202-b].

1-jadval.

Biologik tizimlar monitoringining zamonaviy usullari

Monitoring usuli	**Asosiy imkoniyati**	**Barqaror rivojlanishdagi ahamiyati**
Bioindikatsiya	Organizmlar reaksiyasi orqali muhit holatini baholash	Ekologik buzilishlarni erta aniqlash
Masofadan zondlash va GIS	Katta hududlarni kuzatish va xaritalash	Yer va suv resurslaridagi o‘zgarishlarni nazorat qilish
eDNA	Muhitdagi DNK orqali turlarni aniqlash	Biologik xilma-xillikni noinvaziv baholash
Sensorlar va SI	Uzluksiz ma’lumot yig‘ish va tahlil	Ekologik xavflarni tez aniqlash va prognozlash

Avtomatlashtirilgan sensorlar ekologik parametrlarni uzluksiz qayd etadi, sun’iy intellekt va mashinaviy o‘qitish esa katta hajmdagi ma’lumotlardan qonuniyat va anomaliyalarni aniqlashga yordam beradi (1-jadval). Chuqur o‘rganish algoritmlarining sun’iy yo‘ldosh ma’lumotlari bilan integratsiyasi biologik xilma-xillikni monitoring qilish va tabiatni muhofaza qilish qarorlarini qo‘llab-quvvatlashda istiqbolli yo‘nalish hisoblanadi [13, 123-b.].

O‘ZBEKISTON SHAROITIDA MONITORING VA EKOLOGIK TA’LIM INTEGRATSIYASI

O‘zbekistonning arid va yarim arid hududlarida suv resurslarining cheklanganligi, sho‘rlanish, cho‘llanish va yer degradatsiyasi monitoring tizimlarini rivojlantirishni talab qiladi. Orolbo‘yi hududida o‘simlik qoplami va landshaft o‘zgarishlarini masofadan zondlash hamda GIS orqali kuzatish biologik va geografik fanlar uchun real tadqiqot materiali bo‘la oladi [5, 102-bet].

Ta’limda “dala kuzatuvi – raqamli ma’lumot – tahlil – ekologik xulosa” ketma-ketligidan foydalanish samarali. Talabalar turlarni qayd etishi, bioindikatorlarni aniqlashi, GPS koordinatalarini belgilashi va natijalarni GIS platformalarida xaritalashi mumkin. Fuqarolik ilmi elementlari esa kuzatuvlar ko‘lamini kengaytirib, yoshlarning biologik xilma-xillikni muhofaza qilishdagi ishtirokini oshiradi [9,103-b.; 14, 258-b.].

Barqaror rivojlanish ta’limi nazariy ekologik bilim bilan cheklanmasdan, muammoni aniqlash, ma’lumotni tahlil qilish va dalillarga asoslangan yechim taklif etish kompetensiyalarini shakllantirishi zarur. Ishtirokchi va loyiha asosidagi yondashuvlar barqaror rivojlanish ta’limida talabalarni faol tadqiqot jarayoniga jalb qilish imkonini beradi [6, 237-b. 1, 508-b.].

XULOSA

Biologik tizimlarning zamonaviy monitoringi bioindikatsiya, masofadan zondlash, GIS, eDNA, avtomatlashtirilgan sensorlar va sun’iy intellektning integratsiyasiga asoslanadi. Ushbu yondashuvlar biologik xilma-xillikdagi o‘zgarishlarni erta aniqlash, ekologik xavflarni baholash va tabiatni muhofaza qilish qarorlarini ilmiy ma’lumotlar bilan ta’minlash imkonini kengaytiradi.

O‘zbekiston sharoitida monitoring natijalarini biologik ta’limga integratsiya qilish Orolbo‘yi, cho‘llanish, suv va yer resurslari bilan bog‘liq mahalliy ekologik muammolarni o‘quv jarayoniga olib kirishga xizmat qiladi. Bu yondashuv ekologik savodxonlik, raqamli ko‘nikmalar va tadqiqotchilik kompetensiyalarini birgalikda rivojlantirib, barqaror rivojlanishga yo‘naltirilgan biologiya ta’limini kuchaytiradi.

FOYDALANILGAN ADABIYOTLAR

1. Bell Karen L., Campos Mariana, Hoffmann Benjamin D., Encinas-Viso Francisco, Hunter Gavin C., Webber Bruce L. Environmental DNA methods for biosecurity and invasion biology in

terrestrial ecosystems: Progress, pitfalls, and prospects // Science of the Total Environment. – 2024. – Vol. 926. – Art. 171810. DOI: 10.1016/j.scitotenv.2024.171810.

2. Bespalyy Sergey, Akhrorova Alfiya, Alnazarova Gulmira, Adieva Ainura, Petrenko Alexandr. Education for sustainable development: comparative analysis and prospects at universities in Kazakhstan, Tajikistan, Kyrgyzstan and Uzbekistan // Discover Sustainability. – 2024. – Vol. 5. – Art. 140. DOI: 10.1007/s43621-024-00343-x.

3. Blackman Rosetta, Couton Marjorie, Keck François, Kirschner Dominik, Carraro Luca, Cereghetti Eva, Perrelet Kilian, Bossart Raphael, Brantschen Jeanine, Zhang Yan, Altermatt Florian. Environmental DNA: The next chapter // Molecular Ecology. – 2024. – Vol. 33, No. 11. – e17355. DOI: 10.1111/mec.17355.

4. Chen Xiaoyu, Li Sheng, Zhao Jindong, Yao Meng. Passive eDNA sampling facilitates biodiversity monitoring and rare species detection // Environment International. – 2024. – Vol. 187. – Art. 108706. DOI: 10.1016/j.envint.2024.108706.

5. Çevik Taner, Çevik Nazife. Environmental DNA (eDNA): A review of ecosystem biodiversity detection and applications // Biodiversity and Conservation. – 2025. – Vol. 34. – P. 2999–3035. DOI: 10.1007/s10531-025-03112-y.

6. Fernando Alexa Ray R., Tajan Gizelle P. Education for sustainable development (ESD) through participatory research (PR): A systematic review // Journal of Cleaner Production. – 2024. – Vol. 482. – Art. 144237. DOI: 10.1016/j.jclepro.2024.144237.

7. Finizio Michele, Pontieri Federica, Bottaro Chiara, Di Febbraro Mirko, Innangi Michele, Sona Giovanna, Carranza Maria Laura. Remote Sensing for Urban Biodiversity: A Review and Meta-Analysis // Remote Sensing. – 2024. – Vol. 16, No. 23. – Art. 4483. DOI: 10.3390/rs16234483.

8. Garzon-Lopez Carol X., Miranda Alejandro, Moya Daniel, Andreo Verónica. Remote sensing biodiversity monitoring in Latin America: Emerging need for sustained local research and regional collaboration to achieve global goals // Global Ecology and Biogeography. – 2024. – Vol. 33, No. 4. – e13804. DOI: 10.1111/geb.13804.

9. Johnston Alison, Matechou Eleni, Dennis Emily B. Outstanding challenges and future directions for biodiversity monitoring using citizen science data // Methods in Ecology and Evolution. – 2023. – Vol. 14, No. 1. – P. 103–116. DOI: 10.1111/2041-210X.13834.

10. Li Yuanheng, Devenish Christian, Tosa Marie I., Luo Mingjie, Bell David M., Lesmeister Damon B., Greenfield Paul, Pichler Maximilian, Levi Taal, Yu Douglas W. Combining environmental DNA and remote sensing for efficient, fine-scale mapping of arthropod biodiversity // Philosophical Transactions of the Royal Society B: Biological Sciences. – 2024. – Vol. 379, No. 1904. – Art. 20230123. DOI: 10.1098/rstb.2023.0123.

11. Lu Suxiang, Zeng Honghui, Xiong Fan, Yao Meng, He Shunping. Advances in environmental DNA monitoring: standardization, automation, and emerging technologies in aquatic ecosystems // Science China Life Sciences. – 2024. – Vol. 67, No. 7. – P. 1368–1384. DOI: 10.1007/s11427-023-2493-5.

12. Lyu Xin, Li Xiaobing, Dang Dongliang, Wang Kai, Zhang Chenhao, Cao Wanyu, Lou Anru. Systematic review of remote sensing technology for grassland biodiversity monitoring: Current status and challenges // Global Ecology and Conservation. – 2024. – Vol. 54. – e03196. DOI: 10.1016/j.gecco. 2024.e03196.

13. Pettorelli Nathalie. Deep learning and satellite remote sensing for biodiversity monitoring and conservation // Remote Sensing in Ecology and Conservation. – 2025. – Vol. 11. DOI: 10.1002/rse2.415.

14. Ruck Andy, van der Wal René, Hood Amelia S. C., Mauchline Alice L., Potts Simon G., WallisDeVries Michiel F., Öckinger Erik. Farmland biodiversity monitoring through citizen science: A review of existing approaches and future opportunities // Ambio. – 2024. – Vol. 53, No. 2. – P. 257–275. DOI: 10.1007/s13280-023-01929-x.

15. Suter Samantha, Barrett Brian, Welden Natalie. Do biodiversity monitoring citizen science surveys meet the core principles of open science practices? // Environmental Monitoring and Assessment. – 2023. – Vol. 195, No. 2. – Art. 295. DOI: 10.1007/s10661-022-10887-y.

ИСПОЛЬЗОВАНИЕ СОЛЕУСТОЙЧИВЫХ КОРМОВЫХ РАСТЕНИЙ ДЛЯ ПОВЫШЕНИЯ ПРОДУКТИВНОСТИ ПУСТЫННЫХ ПАСТБИЩ НА ТЕРРИТОРИИ ЦЕНТРАЛЬНОГО УСТЮРТА

Матжанова Х.К. – к.б.н., доцент + 998973483976; kholidamk@mail.ru

Орёл М.М. – младший научный сотрудник+998976499661; orel_mm@mail.ru

Каракалпакский научно-исследовательский институт естественных наук

Каракалпакского отделения

Академии наук Республики Узбекистан, г.Нукус, Каракалпакстан

Аннотация. *В целях восстановления 10 тыс. га пастбищ Каракалпакстана и их эффективного использования, проведены исследования по поиску видов кормовых культур и освоения в культуре галофитов природной флоры центральной части Устюрта. Приводится список кормовых солеустойчивых растений из различных жизненных форм - трав, кустарников и деревьев, которые могут произрастать в различных засоленных почвенных условиях Устюрта.*

Ключевые слова: *центральная часть плато Устюрт, засоленные почвы, кормовые культуры.*

Президентом РУз Ш.М.Мирзиеевым в 2026 году поставлены задачи по восстановлению 10 тыс. га пастбищ, их эффективному использованию, поиску новых видов кормовых культур, пригодных для местного климата, проведение научно-практических экспериментов по их культивированию.

Каракалпакстан обладает большим флористическим разнообразием кормовых видов растений. По территориальному распределению они выделяются следующим образом:

Кормовые растения северо-западного Кызылкума насчитывают около 263 видов, из которых - 75 видов произрастают в солончаковых пустынях, а в низовьях Амударьи –237 видов [2, с. 275].

Также широко представлен видовой состав кормовой флоры каракалпакского Устюрта, которая оценивается 232 видами [1, с.252]

Даже новообразованная пустыня Аралкум, на осушенной части Аральского моря, представлена 50 видами кормовых растений [3,с.192].

Характерной особенностью почвенного покрова территорий Каракалпакстана является почти повсеместная засоленность, т.е. наличие в нем подвижных водорастворимых солей, которые ограничивают рост растений.

В последние 20-25 лет внимание ученых мира привлекает проблема изучения и освоения в культуре галофитов природной флоры в системах кормопроизводства и растениеводства. Проблема эта актуальна для аридных территорий мира, включая страны Центральной Азии.

В этой связи, в рамках исследований проводимых лабораторией экологии растений и зеленых технологий, разрабатываются новые подходы к использованию засоленных почв при выращивании на них солеустойчивых растений-галофитов и разработки эффективных технологий производства энергонасыщенных кормов. Используемые традиционные методы рассоления почв (механическая очистка, химическая нейтрализация – при помощи химмелиорантов, вымывание солей) часто оказываются экономически затратными и экологически небезопасными. В связи с этим, возрастает интерес к решению комплексной задачи – сочетанию фитомелиорации — технологии очистки и восстановления почв с использованием растений, а также к поиску видов галофильных кормовых растений, для повышения продуктивности естественных и искусственных пастбищ.

В рамках выполнения темы 2026 года «Исследование биоразнообразия и современного состояния природной флоры Южного Приаралья и подбор нетрадиционных, соле- и

засухоустойчивых растений для создания “зелёных поясов”» проведено комплексное обследование растительного покрова основного пастбищного массива Республики Каракалпакстан — плато Устюрт, с особым вниманием к его центральной части.

Актуальность исследования заключается в подборе солеустойчивых видов растений для создания галофитных пастбищ и агроэкосистем, которые могут использоваться как экологически безопасный метод рассоления засоленных почв, а также для обеспечения производства высокопитательных кормов.

Основной задачей исследования является выявление перспективных галофитных и солеустойчивых растений, способных эффективно произрастать в условиях засоления, способствующих улучшению почвенных условий и обеспечивающим получение кормовой продукции, а также разработка и внедрение адаптированных технологий их выращивания и производства кормов в условиях Республики Каракалпакстан.

Центральная часть плато характеризуется комплексностью почвенно-растительного покрова, где в разной степени сочетаются почвы разной степени засоления с произрастанием видов различных растений.

Сообщества кормовых солеустойчивых растений Устюрта состоят из различных жизненных форм – трав, кустарников и деревьев, которые могут произрастать в различных засоленных почвенных условиях (табл. 1).

Таблица 1

Виды кормовых галофитов, жизненные формы и приуроченность произрастания

Название	**Жизненная форма**	**Экологические условия**
Caroxylon orientale	полукустарник	Засоленные легкосуглинистые, гипсовые почвы, закрепленные пески
Kraschenninnikovia ceratoides – терескен	многолетник	Гипсированные пески, среднесуглинистые засоленные почвы
Anabasis salsa	полукустарник	Серо-бурые, засоленные почвы
Xylosalsola arbuscula	кустарник	Засоленные щебнистые и супесчаные почвы

Haloxylon ammodendron	дерево	Среднесуглинистые, Засоленные и гипсированные почвы
Halothamnus subaphyllus	полукустарник	Глинистые солончаковые, каменисто-щебнистые почвы
Bassia prostrata	полукустарник	Среднесуглинистые, засоленные почвы, с примесью песка
Artemisia terrae-albae	полукустарник	Глинистые засоленные, щебнистые почвы, закрепленные пески
Poa bulbosa	многолетняя трава	Глинистые и песчаные почвы
Halocnemum strobilaceum	многолетник	Суглинистые супесчаные почвы, солончаки

Таким образом, обширные площади засоленных земель Центрального Устюрта необходимо эффективно осваивать путем создания галофитных пастбищных сообществ, в том числе сеяных пастбищ. Это предполагает выращивание экологически адаптированные виды растений, обладающих высокой устойчивостью к экстремальным условиям среды, засолению и засухе. При создании таких пастбищ целесообразно использовать наиболее ценные в кормовом отношении и хорошо адаптированные к природно-климатическим и почвенным условиям пустынные виды растений. Поэтому, выращивание галофитных и солеустойчивых растений, с учетом почвенных условий, позволяет создать пастбищные фитоценозы осенне-зимнего использования, сбалансировав этим дефицит кормов в этот период.

Так, на засоленных песчаных почвах целесообразно выбирать растения разных жизненных форм:

1. *Haloxylon aphyllum + Salsola orientalis +Poa bulbosa.*
2. *Salsola orientalis + Artemisia terrae-albae +Poa bulbosa*

При создании пастбищ на засоленных глинистых почвах мы рекомендуем сформировать следующие галофитные сообщества:

1. *Haloxylon ammodendron + Xylosalsola arbuscula + Basia prostrata.*
2. *Haloxylon ammodendron + Halothamnus subaphyllus + Halocnemum*

strobilaceum.

Представленные виды растений характеризуются высокой экологической пластичностью и адаптированностью к аридным условиям Центрального Устюрта. Они способны произрастать на засоленных, гипсированных, щебнистых, песчаных и солончаковых почвах, отличающихся низким естественным плодородием и дефицитом влаги. В связи с этим, данные виды представляют перспективный растительный материал для создания сеяных галофитных пастбищ, восстановления деградированных земель и формирования устойчивых кормовых угодий в условиях Республики Каракалпакстан.

Литература

1. Аймуратов Р.П., и др. В монографии «Динамика и потенциал природной среды Каракалпакстана», раздел 2.1.8. стр.91-93. Изд-во «Илим». 2017 г. 252 с. http://aknuk.uz/vestnik.html

2. Туремуратов У. Растительный покров Северо-западныцх Кызылкумов .Изд-во Фан Узбекской ССР, Ташкент, 1978 г.275 с..

3. Шеримбетов С.Г. Жанубий Оролқум ўсимликлари (флора, систематика, геоботаника, география, экология ва муҳофаза қилиш). Монография. Тошкент, 2023 г. 192 с.

ZARAFSHON VOHASIDA CHAKANDA PASHSHASI (*RHAGOLETIS BATAVA* HERING) XAVF ZONALARINI MAXENT VA QGIS YORDAMIDA BAHOLASH

Malikov Dilshod Boymurod o‘g‘li

Kattaqo‘rg‘on davlat pedagogika instituti Aniq va tabiiy fanlar kafedrasi asistent o‘qituvchisi

Tel.:+998932248514, e-mail: dilshodmalikov51@gmail.com

Annotatsiya. *Tezisda chakanda (Hippophae rhamnoides L.) uchun MaxEnt algoritmi asosida qurilgan ekologik moslik modeli Zarafshon vohasidagi dala kuzatuvlari bilan solishtirilib, chakandaning monofag zararkunandasi – chakanda pashshasi (Rhagoletis batava Hering) uchun potensial xavf zonalari baholangan. Zarafshon daryosi o‘rta oqimi yuqori moslik (0,77–1,0) zonasiga tushishi va shu hududda mevalarning o‘rtacha 59 % i zararlangani aniqlangan.*

Kalit so‘zlar: *chakanda, Rhagoletis batava, MaxEnt, QGIS, ekologik nisha, xavf zonasi, monitoring, Zarafshon vohasi.*

Annotation. *The paper evaluates potential risk zones for the monophagous sea buckthorn fly (Rhagoletis batava Hering) in the Zarafshan Valley by combining a MaxEnt habitat-suitability model of its host plant, Hippophae rhamnoides L., with field observations. The middle Zarafshan falls within the high-suitability zone (0.77–1.0), where an average of 59 % of fruits were found to be infested.*

Keywords: *sea buckthorn, Rhagoletis batava, MaxEnt, QGIS, ecological niche, risk zone, monitoring, Zarafshan Valley.*

Kirish

Chakanda (*Hippophae rhamnoides* L.) mevasi biologik faol moddalarga boy bo‘lgan qimmatli dorivor va oziq-ovqat o‘simligidir [4]. Zarafshon vohasida u asosan daryo bo‘yidagi to‘qay va chala to‘qay biotoplarida tabiiy chakalakzorlar hosil qiladi. Tadqiqotlarimizda chakanda entomofaunasida chakanda pashshasi (*R. batava*) dominant zararkunanda ekanligi aniqlangan. Bu tur lichinkalari meva ichida rivojlanib, hosilning sezilarli qismini yaroqsiz holga keltiradi [1].

Avvalgi ishimizda MaxEnt va QGIS yordamida O‘zbekiston hududida chakanda va uning dendrofaglari uchun ekologik jihatdan qulay hududlar respublika miqyosida xaritalashtirilgan edi [5]. *R. batava* chakandaga ixtisoslashgan monofag tur bo‘lgani uchun xo‘jayin o‘simlik uchun qulay hududlar ayni paytda zararkunandaning potensial tarqalish zonasi hisoblanadi. Shu sababli model natijalarini Zarafshon vohasidagi meva zararlanishi ma’lumotlari bilan solishtirish amaliy ahamiyatga ega.

Tadqiqot maqsadi – chakanda uchun qurilgan MaxEnt modeli va dala ma’lumotlari asosida Zarafshon vohasida *R. batava* uchun xavf zonalarini baholash.

Material va metodlar

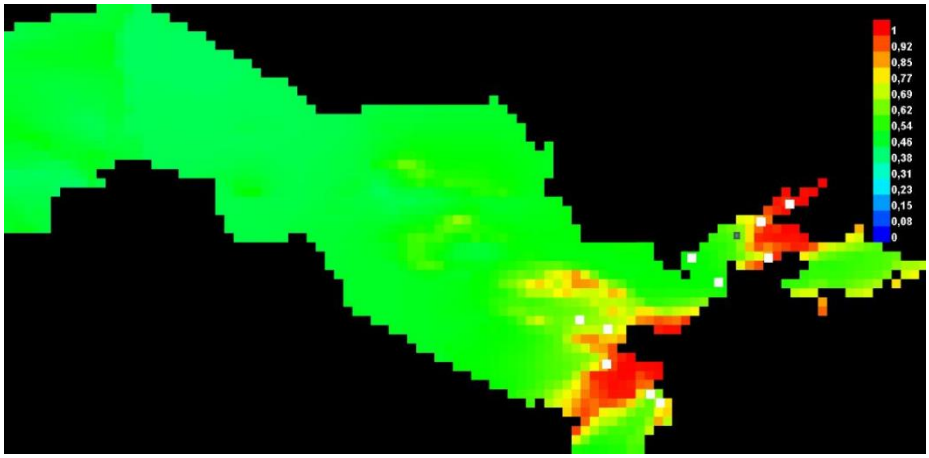
Modellashtirishda O‘zbekiston hududida chakanda o‘sishi qayd etilgan 13 ta GPS koordinatasidan foydalanildi. Atrof-muhit o‘zgaruvchilari sifatida WorldClim bazasining bioiqlim qatlamlari [3] olindi. Model MaxEnt 3.4.4 dasturida qurildi [7], aniqligi omission rate grafigi bo‘yicha baholandi [2, 6]. Natija qatlami QGIS 3.x dasturida xaritalashtirildi va moslik ehtimolligi 0 dan 1 gacha shkalada ko‘rsatildi [8].

Dala ma’lumotlari 2022–2026-yillarda Zarafshon daryosi bo‘ylab Farmontepa – Yangiqo‘rg‘oncha oralig‘idagi (taxminan 97 km, dengiz sathidan 880–500 m) transekt nuqtalarida to‘plandi. *R. batava* bilan zararlanish darajasini aniqlash uchun jami 3290 ta meva namunasi tahlil qilindi.

Natijalar va muhokama

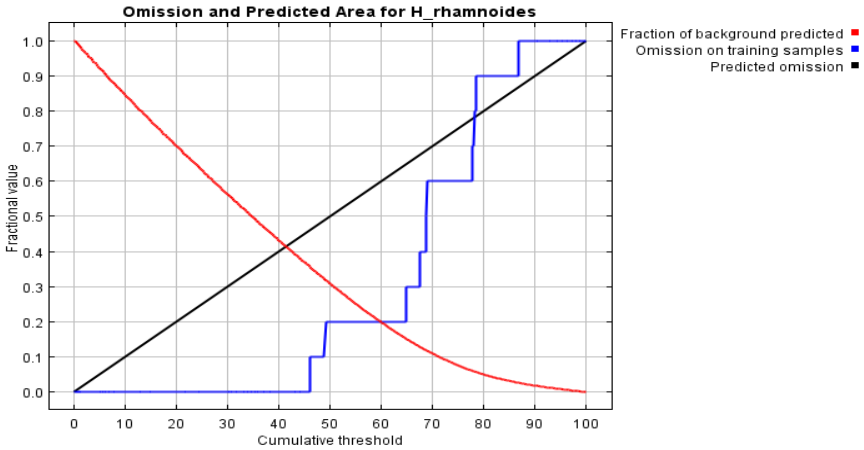
Model natijalariga ko‘ra, chakanda uchun yuqori moslik zonalari (0,77–1,0) Zarafshon daryosining o‘rta oqimi (Samarqand viloyati), Surxondaryo viloyatining tog‘li hududlari, Toshkent

viloyatining sharqiy qismi va Farg‘ona vodiysining ayrim chegara hududlarida joylashgan (1-rasm). Modelni qurishda foydalanilgan barcha 13 ta nuqta yuqori va o‘rta moslik zonalariga tushgan.



1-rasm. MaxEnt modeli asosida chakanda uchun ekologik moslik xaritasi [5]

Omission rate grafigida o‘qitish nuqtalaridagi xatolik chizig‘i nazariy bashorat chizig‘idan asosan pastda joylashgan bo‘lib, kesish chegarasi taxminan 45 ga yetguncha birorta nuqta tushib qolmagan (2-rasm). Bu model mos hududlarni ishonchli ajratayotganini ko‘rsatadi.



2-rasm. Modelning omission rate grafigi [5]

Zarafshon vohasida o‘tkazilgan dala kuzatuvlari model natijalarini tasdiqlaydi: yuqori moslik zonasiga to‘g‘ri keladigan transekt nuqtalarida tahlil qilingan mevalarning o‘rtacha 59 % i *R. batava* bilan zararlangan. Xo‘jayin o‘simlik zich va keng chakalakzorlar hosil qilgan to‘qay biotoplari zararkunanda uchun doimiy ozuqa bazasi bo‘lib xizmat qiladi. Chakanda Yangiqo‘rg‘oncha hududidan g‘arbda uchramasligi sababli, vohaning quyi qismida bu tur uchun xavf amalda yo‘q.

Shuni ta’kidlash lozimki, model faqat iqlim omillariga asoslangan va chakanda uchun respublika miqyosida qurilgan. Polifag zararkunandalar, masalan, yashil sassiq qandala (*Nezara viridula* L.) uchun xavf zonalarini aniqlash alohida topilma nuqtalari asosida mustaqil model qurishni talab qiladi.

Xulosa

1. Zarafshon daryosining o‘rta oqimi chakanda uchun yuqori ekologik moslik zonasiga (0,77–1,0) kiradi va shu sababli monofag *R. batava* uchun asosiy xavf zonasi hisoblanadi.

2. Dala kuzatuvlarida mevalarning o‘rtacha 59 % i zararlangani model asosidagi xavf bahosini tasdiqlaydi.

3. MaxEnt va QGIS asosidagi xaritalar chakanda chakalakzorlarida monitoring nuqtalarini tanlash va *R. batava* ga qarshi himoya choralarini oldindan rejalashtirishda amaliy asos bo‘la oladi.

FOYDALANILGAN ADABIYOTLAR

1. Шаманская Л.Д. Защита облепихи от вредителей в Сибири. – Новосибирск: РАСХН, 2006. – 232 с.

2. Elith J., Phillips S.J., Hastie T., Dudík M., Chee Y.E., Yates C.J. A statistical explanation of MaxEnt for ecologists // Diversity and Distributions. – 2011. – Vol. 17, № 1. – P. 43–57.

3. Fick S.E., Hijmans R.J. WorldClim 2: new 1-km spatial resolution climate surfaces for global land areas // International Journal of Climatology. – 2017. – Vol. 37, № 12. – P. 4302–4315.

4. Li T.S.C., Schroeder W.R. Sea buckthorn (*Hippophae rhamnoides* L.): a multipurpose plant // HortTechnology. – 1996. – Vol. 6, № 4. – P. 370–380.

5. Malikov D.B. Chakanda (*Hippophae rhamnoides* L.) ning zararkunanda hasharotlari tarqalishini ekologik modellashtirish (MaxEnt va QGIS misolida) // O‘zbekiston agrar fani xabarnomasi. – 2026. – № 4/2 (28). – B. 141–144.

6. Merow C., Smith M.J., Silander J.A. A practical guide to MaxEnt for modeling species’ distributions: what it does, and why inputs and settings matter // Ecography. – 2013. – Vol. 36, № 10. – P. 1058–1069.

7. Phillips S.J., Anderson R.P., Schapire R.E. Maximum entropy modeling of species geographic distributions // Ecological Modelling. – 2006. – Vol. 190, № 3–4. – P. 231–259.

8. QGIS Development Team. QGIS Geographic Information System. Open Source Geospatial Foundation Project. – URL: https://qgis.org

KAMPIRCHOPON (*TRICHODESMA INCANUM*) NING NEMATODAFAUNASI, UNING TAHLILI VA EKOLOGIK GURUHLARI.

U.N.Mirzayev[1], S.N.Narzullayev[1], N.X.Xakimov[2]

Samarqand davlat pedagogika instituti

Sharof Rashidov nomidagi Samarqand davlat universiteti

Email: snarzullayev684@gmail.com, uktam1486@gmail.com

Annotatsiya. *Ushbu tadqiqotda dorivor o‘simlik — kampirchopon (Trichodesma incanum) bilan bog‘liq nematodafaunaning tarkibi, tarqalishi va ekologik xususiyatlari o‘rganildi. Tadqiqot davomida o‘simlikning vegetativ a’zolari (yer ustki qismlari va ildiz sistemasi), shuningdek, rizosfera tuprog‘ining 0–10 va 10–20 sm chuqurlikdagi qatlamlarida nematodalar turlar tarkibi va miqdoriy ko‘rsatkichlari aniqlandi. Jami 188 ta nematoda individi va 29 ta turi qayd etildi. Nematodalar o‘simlikning turli qismlari hamda tuproq qatlamlarida notekis taqsimlanganligi aniqlandi. Eng yuqori individlar soni 0–10 sm chuqurlikdagi tuproq qatlamida — 93 ta (50,0%) qayd etilgan bo‘lsa, ildiz sistemasida 42 ta (22,3%), 10–20 sm qatlamda 32 ta (17,0%) va yer ustki qismlarida 21 ta (11,1%) individ aniqlandi. Nematodafaunaning asosiy vakillari Ditylenchus dipsacii, Aphelenchoides parietinus, Paratylenchus pratensis, Rhabditis brevispina, Monhystera filiformis, Diphtherophora communis, Heterocephalobus filiformis va Acrobeloides nanus kabi turlardan iborat bo‘ldi. Yuqori tuproq qatlamida nematodalar sonining ko‘pligi namlik, organik moddalar va mikroorganizmlar miqdorining yuqoriligi bilan bog‘liq bo‘lishi mumkin. O‘simlikning bioaktiv birikmalarga boy kimyoviy tarkibi nematodalar bilan o‘zaro munosabatlarga ta’sir etuvchi ekologik omillardan biri sifatida qaraladi. Olingan natijalar T. incanum rizosferasida nematodalar jamoasining shakllanishi va ularning o‘simlik bilan ekologik munosabatlarini baholash uchun muhim ilmiy asos bo‘lib xizmat qiladi.*

Kalit so‘zlar: *Dorivor o‘simlik, ekologik guruh, Trichodesma incanum, nematodafauna, kampirchopon, rizosfera, chromadorea, adenophorea, Ditylenchus.*

Kirish. O‘simliklar va ular bilan bog‘liq organizmlar o‘rtasidagi ekologik munosabatlar tabiiy ekotizimlarning barqarorligi va funksional faoliyatini belgilovchi muhim omillardan biridir. Ayniqsa, tuproq va o‘simlik to‘qimalarida yashovchi nematodalar o‘simliklarning o‘sishi va rivojlanishiga, tuproqdagi moddalarning aylanishiga hamda mikroorganizmlar bilan bog‘liq trofik jarayonlarga sezilarli ta’sir ko‘rsatadi [5]. Nematodalar jamoasining tarkibi va miqdoriy ko‘rsatkichlari o‘simlik turi, uning ildiz tizimi, tuproqning fizik-kimyoviy xususiyatlari, namlik, organik moddalar miqdori hamda o‘simlik tomonidan hosil qilinadigan biologik faol birikmalar bilan chambarchas bog‘liq [3]. O‘simliklarning nematodalar bilan o‘zaro munosabatida ikkilamchi

metabolitlar alohida ahamiyatga ega [1]. O‘simliklarda hosil bo‘ladigan alkaloidlar, flavonoidlar, terpenoidlar, fenolik birikmalar va boshqa biologik faol moddalar turli ekologik funksiyalarni bajarib, o‘simlikni biotik va abiotik stress omillaridan himoya qilishda ishtirok etadi. Ushbu birikmalarning ayrimlari fitofag va parazit organizmlarning oziqlanishi, harakatlanishi, rivojlanishi yoki ko‘payishiga ta’sir qilishi mumkin. Shu sababli dorivor o‘simliklarning kimyoviy tarkibi bilan ular bilan bog‘liq nematodalar jamoasi o‘rtasidagi munosabatlarni o‘rganish o‘simlik ekologiyasi va nematodologiyaning muhim yo‘nalishlaridan biridir [2].

Shu nuqtai nazardan, kampirchopon (*Trichodesma incanum (Bunge))* nematodafaunasini o‘rganish uchun alohida qiziqish uyg‘otadigan o‘simliklardan biridir. Mazkur tur Boraginaceae oilasiga mansub ko‘p yillik o‘simlik bo‘lib, tabiiy holda Markaziy Osiyo, jumladan O‘zbekiston hududida tarqalgan. O‘simlik O‘zbekiston va Qirg‘izistonning dorivor o‘simliklariga bag‘ishlangan manbalarda ham qayd etilgan [4]. Kampirchoponning tanlanishiga asosiy sabab uning biologik va kimyoviy xususiyatlarining o‘ziga xosligidir. T. incanum tarkibida trichodesmine va incanine kabi alkaloidlar, shuningdek flavonoidlar, kumarinlar va boshqa biologik faol birikmalar mavjudligi qayd etilgan [10]. Umuman, Trichodesma turkumining fitokimyoviy tarkibi o‘rganilganda alkaloidlar, flavonoidlar, fenolik birikmalar, sterollar va terpenlar kabi ko‘plab ikkilamchi metabolitlar aniqlangan. Mazkur birikmalar o‘simlikning ekologik moslashuvida va boshqa organizmlar bilan biotik munosabatlarida muhim rol o‘ynashi mumkin [3].

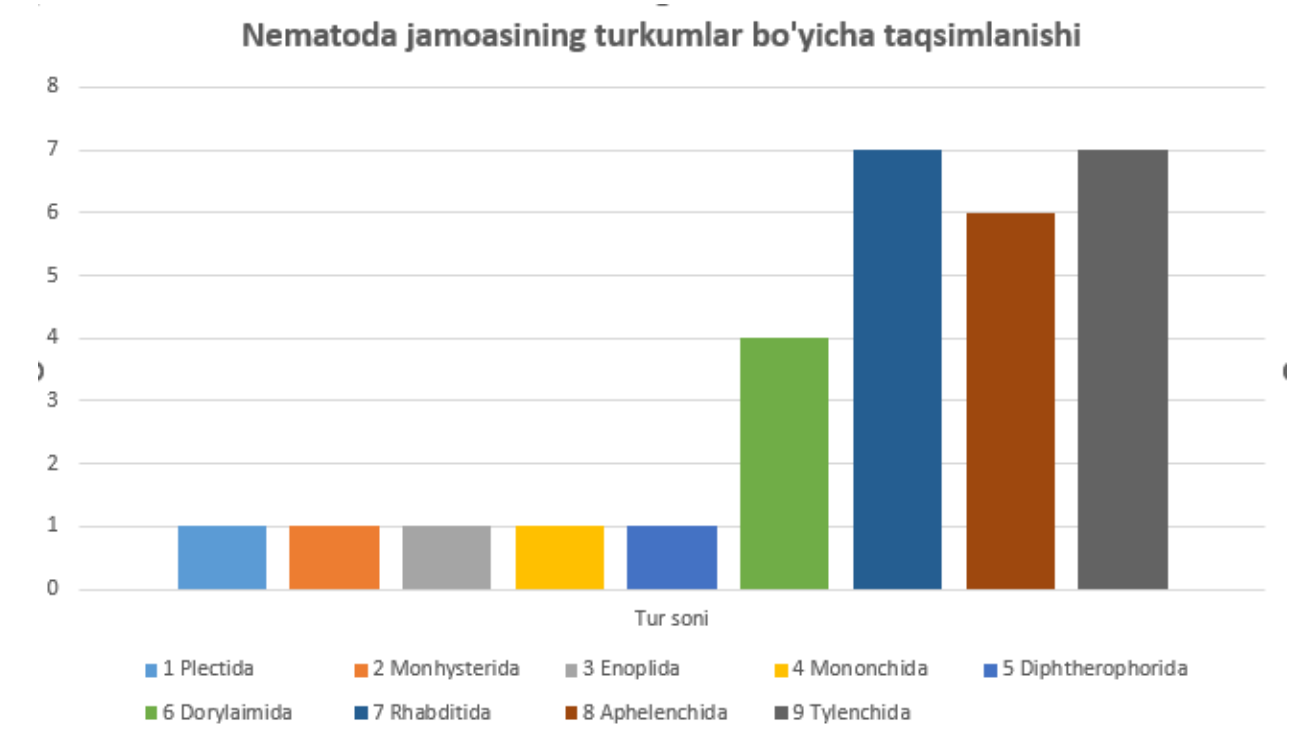
Kampirchoponning yana bir muhim xususiyati — uning ildiz tizimi va rizosfera muhiti bilan bevosita bog‘liqligidir. Rizosfera o‘simlik ildizlari, tuproq mikroorganizmlari va tuproq faunasi o‘rtasidagi faol ekologik munosabatlar shakllanadigan muhim zona hisoblanadi. Aynan shu hududda nematodalar uchun oziqa, namlik va yashash sharoitlari nisbatan qulay bo‘lib, o‘simlik ildizlari tomonidan ajratiladigan moddalar nematodalar jamoasining tarkibi va fazoviy taqsimlanishiga ta’sir ko‘rsatishi mumkin [1]. Shuningdek, ildiz va yer ustki organlaridagi ikkilamchi metabolitlarning mavjudligi o‘simlik bilan bog‘liq nematodalar tarkibining shakllanishida muhim ekologik omil bo‘lishi ehtimoldan xoli emas [6]. Biroq T. incanum bilan bog‘liq nematodalar jamoasining turlar tarkibi, o‘simlikning turli vegetativ organlarida hamda rizosfera tuprog‘ining turli chuqurliklarida taqsimlanishi yetarlicha o‘rganilmagan. Ayniqsa, kampirchoponning yer ustki qismlari, ildiz sistemasi va rizosfera tuprog‘idagi nematodafaunaning miqdoriy hamda sifat tarkibini kompleks ravishda baholash o‘simlik-nematoda munosabatlarini yaxshiroq tushunish imkonini beradi [7].

Ushbu tadqiqotning maqsadi kampirchopon (Trichodesma incanum) bilan bog‘liq nematodafaunaning tur tarkibi va miqdoriy ko‘rsatkichlarini aniqlash, nematodalarning

o‘simlikning vegetativ a’zolari hamda rizosfera tuprog‘ining turli chuqurlik qatlamlarida tarqalish xususiyatlarini tahlil qilishdan iborat.

Tadqiqot metodi. Tadqiqotni amalga oshirishda quyidagi usullardan foydalaniladi: tog‘ massivining pastki va tog‘ oldi mintaqalaridan o‘simlik va tuproq namunalarini to‘plash va kuzatish ishlarini olib borish yilning bahor (aprel-may) va kuz (sentabr-oktabr) oylarida marshrut usulida amalga oshirildi [8]. Undan tashqari, vizual metod orqali o’rganilayotgan arealdagi bu o’simlikning kasallanganlik darajasiga qarab tanlab olish hisoblanadi. O‘simlik va tuproq namunalari tarkibidan nematodalarni ajratib olishda kafedra laboratoriyasi sharoitida Bermanning voronkali metodi qo‘llanildi [5]. Ajratib olingan nematodalar 4% li formalin eritmasida fiksatsiyalandi. Fiksatsiyalangan nematodalar МБС-2 rusumli binokulyar mikroskopida entamologik igna yordamida terib olinib, glitserin spirt aralashmasida tozalanib, ulardan vaqtinchalik va doimiy mikropreparatlar tayyorlandi. Vaqtinchalik preparat tayyorlash uchun terib olingan nematodalar buyum oynachasiga bir tomchi toza glitseringa o‘tkazildi [9]. Doimiy preparatlar tayyorlash uchun esa nematodalar predmet oynachasiga tomizilgan bir tomchi glitserin-jelatin aralashmasiga o‘tkazildi va nematoda turlari aniqlandi. Nematoda turlarini aniqlashda ularning tashqi va ichki tuzilishi, tana qismlari mikroskop ostida o‘rganildi. Nematoda namunalaridagi turlar tarkibi MF-43-N modelidagi trinokulyar lyuminestsent mikraskop yordamida o’rganildi [11].

Tadqiqot natijalari. Tadqiqotda kampirchoponning nematodafaunasi vegetativ a’zolari (yer usti qismlari va ildiz sistemasi) hamda rizosfera tuproq qatlamlarida (0-10 sm va 10-20 sm chuqurlik) o‘rganildi. Natijada kampirchoponda jami 188 individ va 29 nematoda turi aniqlangan. Topilgan nematoda turlari Nematodalar tipining Chromadorea, Adenophorea sinflarining 9 ta



1-rasm. Nematoda jamoasining turkumlar bo'yicha taqsimlanishi

turkumlariga mansubligi aniqlandi, lekin har bir turkumining vakillari turlicha sonda bo’lishi ma’lum bo’ldi. Jumladan fauna tarkibida Tylenchida (7 tur), Aphelenchida (6 tur), Rhabditida (7 tur), Dorylaimida (4 tur) turkumlari o’z tarkibidagi turlari soni bilan ustunlik qilgan bo’lsa, qolgan turkumlar 1-3 tadan turlari bilan fauna tarkibidan joy oldi. (1-rasm)

Nematodalar o‘simlikning turli qismlari va tuproq qatlamlarida turlicha taqsimlangan bo‘lib, quyida ularning taqsimoti, ekologik xususiyatlari va o‘simlikka ta’siri batafsil tahlil qilinadi. Jadval 1 ma’lumotlariga ko‘ra, nematodalar kampirchopon o‘simligining vegetativ a’zolari va tuproq qatlamlarida quyidagicha taqsimlangan:

Yer usti qismlarida jami 21 individ qayd etilgan, bu umumiy individlar sonining taxminan 11.1% ini tashkil etadi. Eng ko‘p uchraydigan turlar: *Paratylenchus pratensis* (3 individ), *Aphelenchoides parietinus* (3 individ) va *Ditylenchus dipsacii* (5 individ). Yer usti qismlarida nematodalar sonining kamligi ularning asosan tuproq va ildiz zonasida faol ekanligini tasdiqlaydi. Kampirchoponning yer usti qismlari alkaloidlar va boshqa bioaktiv moddalar tufayli nematodalar uchun qulay bo‘lmagan muhit sifatida ko‘rinadi. Bu moddalar nematodalar faolligini cheklashi yoki ularning migratsiyasiga to‘sqinlik qilishi mumkin. Shu bilan birga, *Paratylenchus pratensis* kabi turlar yer usti qismlarida ham uchraydi, bu ularning moslashuvchanligini ko‘rsatadi.

1-jadval

Kampirchopon va uning rizosferasi nematodofaunasining taksonomik va ekologik tarkibi.

	E/g	Nematoda turlari	Yer usti qismlari	Ildiz sistemasi	Tuproq (0-10 sm)	Tuproq (10-20 sm)
1.	B.	*Plectus parietinus*	-	-	4	2
2.	B.	*Monhystera filiformis*	-	-	5	3
3.	B.	*Prismatolaimus dolichurus*	-	-	1	2
4.	Y.	*Mylonchulus solus*	-	-	3	1
5.	Z.	*Diphtherophora communis*	-	-	5	-
6.	H.	*Eudorylaimus kirjanovae*	-	-	-	2
7.	H.	*Eudorylaimus monhystera*	-	-	3	2
8.	H.	*Eudorylaimus aimus*	-	-	2	1
9.	Y.(b)	*Nygolaimus brachyuris*	-	2	4	2
10	B.	*Diplogaster rivalis*	-	-	3	-
11	B.	*Rhabditis brevispina*	-	5	7	3
12	B.	*Heterocephalobus filiformis*	1	2	5	1
13	B.	*Acrobeloides emarginatus*	1	2	4	-
14	B.	*Acrobeloides nanus*	2	2	5	1
15	B.	*Chiloplacus symmetricus*	-	-	3	-
16	B.	*Cervidellus insubricus*	-	2	4	-
17	Z.	*Paraphelenchus pseudoparietinus*	2	4	2	-
18	Z.	*Aphelenchoides bicaudatus*	1	3	2	-
19	Z.	*Aphelenchoides limberi*	-	-	4	-

20	**Z.**	***Aphelenchoides parietinus***	**3**	**5**	**3**	**1**
21	**Z.**	***Aphelenchoides zeraphschanicus***	**-**	**-**	**3**	**1**
22	**Y.(b)**	***Seinura oxura***	**1**	**4**	**-**	**-**
23	**O'.(f)**	***Aglenchus agricola***	**-**	**-**	**1**	**5**
24	**O'.(e)**	***Ielenchus discrepans***	**-**	**-**	**-**	**2**
25	**O'.(b)**	***Ditylenchus dipsacii***	**5**	**3**	**10**	**3**
26	**O'.(b)**	***Paratylenchus pratensis***	**3**	**5**	**2**	**-**
27	**O'.(s)**	***Rotylenchus robustus***	**-**	**-**	**3**	**-**
28	**O'.(s)**	***Helicotylenchus multicinctus***	**-**	**-**	**3**	**-**
29	**O'.(d)**	***Paratylenchus macrophallus***	**2**	**3**	**2**	**-**
		Jami	**21**	**42**	**93**	**32**

Yeates(1993) ma’lumotlariga asosan trofik guruhlar, xususan, Bakteriyatroflar(B.), Zamburug’xo’rlar (Z.), Yirtqichlar (Y.), O’simlikxo’rlar (O’.) va Hammaxo’rlar (H.) ga bo’lingan.[13].

Ildiz sistemasida jami 42 ta individ aniqlangan, bu umumiy individlar sonining 22.3% ini tashkil etadi. Dominant turlar: *Aphelenchoides parietinus* (5 individ), *Rhabditis brevispina* (5 individ) va *Paratylenchus pratensis* (5 individ). Ildiz sistemasi nematodalar uchun asosiy yashash muhiti hisoblanadi, chunki ildizlar organik moddalar, suv va ozuqa manbai sifatida xizmat qiladi. *Ditylenchus dipsacii* va *Aphelenchoides parietinus* kabi parazit turlar ildiz to‘qimalariga kirib, shikastlanish, o‘sishning sekinlashishi va hatto ildizlarning chirishiga olib kelishi mumkin. Kampirchoponning ildiz tizimi tuproqning yuqori qatlamlarida zich joylashganligi tufayli bu zonada nematodalar yuqori faollik ko‘rsatadi.

Tuproq qatlamlarida (0-10 sm chuqurlik) jami 93 ta individ qayd etilgan, bu umumiy individlar sonining 50% ini tashkil etadi. Eng ko‘p tarqalgan turlar: *Ditylenchus dipsacii* (10 individ), *Rhabditis brevispina* (7 individ), *Monhystera filiformis* (5 individ), *Diphtherophora communis* (5 individ), *Heterocephalobus filiformis* (5 individ) va *Acrobeloides nanus* (5 individ). Tuproqning yuqori qatlamida organik moddalar, namlik va mikroorganizmlar ko‘pligi tufayli nematodalar faolligi yuqori. 10-20 sm chuqurlikda esa 32 ta individ aniqlangan, bu umumiy

individlar sonining 17.0% ini tashkil etadi. Ko‘zga tashlanadigan turlar: *Aglenchus agricola* (5 individ), *Monhystera filiformis* (3 individ), *Rhabditis brevispina* (3 individ) va *Ditylenchus dipsacii* (3 individ). Chuqurroq qatlamlarda organik moddalar va namlikning kamayishi nematodalar sonini sezilarli darajada pasaytiradi.

Xulosa. O‘tkazilgan tadqiqot natijasida kampirchopon (*Trichodesma incanum*) bilan bog‘liq nematodafaunaning tur tarkibi va fazoviy taqsimlanishi o‘ziga xos xususiyatlarga ega ekanligi aniqlandi. Tadqiqot davomida jami 188 ta nematoda individi va 29 ta turi qayd etilib, ularning o‘simlikning vegetativ a’zolari hamda rizosfera tuprog‘ining turli chuqurlik qatlamlarida notekis taqsimlanganligi kuzatildi. Nematodalar sonining eng yuqori ko‘rsatkichi rizosferaning 0–10 sm qatlamida qayd etilishi ushbu qatlamning namlik, organik moddalar va mikrobiologik faollik jihatidan nematodalar uchun nisbatan qulay sharoit yaratishini ko‘rsatadi. Tuproq chuqurlashgan sari nematodalar sonining kamayishi esa oziqa resurslari va namlikning pasayishi bilan bog‘liq bo‘lishi mumkin. Ildiz sistemasida nematodalar sonining yer ustki qismlariga nisbatan yuqoriligi ildiz zonasining oziqa va yashash muhiti sifatidagi ahamiyatini ko‘rsatadi. Shunday qilib, *Trichodesma incanum* bilan bog‘liq nematodafaunaning o‘rganilishi ushbu dorivor o‘simlikning ekologik xususiyatlarini yanada chuqurroq anglash, o‘simlik–nematoda munosabatlarini baholash hamda rizosfera nematodalarining ekologik rolini aniqlash uchun muhim ma’lumotlar beradi. Olingan natijalar kampirchoponning nematodafaunasini keyingi tadqiqotlarda ekologik va funksional jihatdan chuqurroq o‘rganish uchun asos bo‘lib xizmat qilishi mumkin.

ADABIYOTLAR RO’YXATI

1. Abdelgawad A.A.M., El-Bassossy T.A.I., Ahmed F.A. A review on phytochemical, pharmacological and ethnopharmacological aspects of genus *Trichodesma* // Indian Journal of Natural Products and Resources. – 2021. – Vol. 12, No. 3. – P. 333–347.
2. Anwar S.A., Javed N. *Meloidogyne incognita* infecting *Dahlia* // Pakistan Journal of Zoology. – 2010. – Vol. 42, No. 3. – P. 348–350.
3. Aydınlı G., Mennan S., Devran Z., Sirca S., Urek G. First report of the root-knot nematode *Meloidogyne ethiopica* on tomato and cucumber in Turkey // Plant Disease. – 2013. – Vol. 97, No. 9. – P. 1262. – DOI: 10.1094/PDIS-01-13-0019-PDN.
4. Eshnazarov K. Паразитические нематоды овощных культур и меры борьбы с галловыми нематодами в Сурхандарьинской области: автореф. дис. … канд. биол. наук: 03.00.08 / АН Республики Узбекистан, Институт зоологии. – Ташкент, 1995. – 22 с.

5. Eshova H.S. Нематоды аридных зон Узбекистана и пути их адаптации к условиям среды обитания: автореф. дис. … д-ра биол. наук. – Ташкент, 2017. – 66 с.
6. Mavlyanov O.M. Галловые нематоды – опасные паразиты растений. – Ташкент: Меҳнат, 1987. – 92 с.
7. Mirzayev U., Narzullayev S. Analysis of nematodes found in the soil of the rhizosphere *Coisima radians* (Nurlikarrak) in Okhaliksoy area of Samarkand, Uzbekistan // Web of Scientist: International Scientific Research Journal. – 2024.
8. Mirzayev U.N., Xo‘jamov Sh.A., Boysariyeva Ch.U., Narzullayev S.N. Samarqand viloyati ayrim sabzavot ekinlari nematodalarini ekologik klassifikatsiyalash // Qo‘qon DPI. Ilmiy xabarlar. – 2025. – № 10.
9. Mirzayev U.N., Xo‘jamov Sh., Narzullayev S.N. Sabzavot ekinlari nematodalarini taksonomik va ekologo-faunistik tahlil qilish // Sharq falsafasi. – 2026. – 3-son, 1-jild, 1-qism.
10. Mirzayev U.N., Xo‘jamov Sh., Narzullayev S.N., Atajanov B. Nematodlarni o‘rganish uchun asosiy usullar // Sharq falsafasi. – 2026. – 3-son, 1-jild, 1-qism.
11. Narzullayev S.B. New data on the vertical distribution of nematode communities in mountain ecosystems of Mount Zarafshan, Uzbekistan // Biodiversitas Journal of Biological Diversity. – 2022. – Vol. 23, No. 8. – DOI: 10.13057/biodiv/d230814.
12. Narzullayev S.B., Mirzaev U., Mavlyanov O. Diversity and habitat distribution of tomato (*Solanum lycopersicum*) nematoda fauna (Zarafshan valley, Uzbekistan). – Zenodo, 2024. – DOI: 10.5281/zenodo.13937701.
13. Yeates G.W., Bongers T., de Goede R.G.M., Freckman D.W., Georgieva S.S. Feeding habits in soil nematode families and genera—an outline for soil ecologists // Journal of Nematology. – 1993. – Vol. 25, No. 3. – P. 315–331.

OG‘IR METALLAR BILAN TURLI DARAJADA IFLOSLANGAN SHAROITDA *PAULOWNIA TOMENTOSA*, *CHITALPA TASHKENTENSIS*, *VINCA MINOR* O‘SIMLIKLARIDA SUV REJIMI KO‘RSATKICHLARI MIQDORIY TAHLILI

M.U.Mamadiyarov, Samarqand davlat pedagogika instituti dotsenti. Spitamen shox ko‘chasi 166

+998937236062 m.mamadiyarov@gmail.com

Elmirzayeva Sabohat Begmatovna

Samarqand Davlat Pedagogika instutiti magistranti.

Annotatsiya. *Og‘ir metallar bilan ifloslanganda o‘simliklardagi suv rejimi ko‘rsatkichlari tahlil qilingan.Jumladan barglardagi suv tanqisligi, suvni saqlash xususiyati va transpiratsiya jadalligi kabilar o‘rganildi.*

Kalit so‘zlar *: Transpiratsiya , paulownia, chitalpa, vinca minor, og‘ir metal.*

Аннотация. *Проанализированы показатели водного режима растений в условиях загрязнения тяжёлыми металлами. В частности, изучены дефицит воды в листьях, водоудерживающая способность и интенсивность транспирации.*

Ключевые слова: *транспирация, Paulownia, Chitalpa, Vinca minor, тяжёлые металлы.*

Abstract. *The parameters of the water regime in plants exposed to heavy metal contamination were analysed. In particular, leaf water deficit, water-retention capacity, and transpiration rate were investigated.*

Keywords: *transpiration, Paulownia, Chitalpa, Vinca minor, heavy metals.*

Kirish. Hozirda dunyo miqyosida urbanizasiya darajasi yuqori shaharlar ekologiyasini optimallashtirish, ekoindikasiya maqsadlarida manzarali samarali o‘simlik turlarini tanlash muhim ahamiyatga ega.Shaharda o‘simliklar rekreasion landshaft, dekorativ funksiyadan tashqari, sanitar-gigiyenik ahamiyatga ega bo‘lib, ekologik muhitni barqarorlashtiruvchi funksiya bajarishi, yoz faslida ob-havo haroratini +15°S gacha, havo nisbiy namligini 15-30% gacha optimallashtirishi, quyosh radiasiyasidan himoya qilishi, tovush energiyasini 26% gacha o‘ziga qabul qilishi orqali avtotransport vositalari shovqinini 10-13 db kamaytirishi, ayniqsa sanoat zonasida atmosfera tarkibidagi zararli gazlar, og‘ir metallar, pollyutantlarni adsorbsiyalashi, aromatik uglevodorodlar, karbonil birikmalar, efir, fenol birikmalarni akkumulyasiyalashi, ayrim o‘simliklarida biosintezlanuvchi fitonsidlar patogen bakteriyalarni nobud qiluvchi ta’sir ko‘rsatishi aniqlangan [1; 4-17-b.].

Tadqiqot maqsadi va usullari.O’simliklarda turli darajada og’ir metallar bilan ifloslangan sharoitda suv rejimi ko’rsatkichlarini o’rganish. Nichipirovich, spiktrofotometriya metodlari.

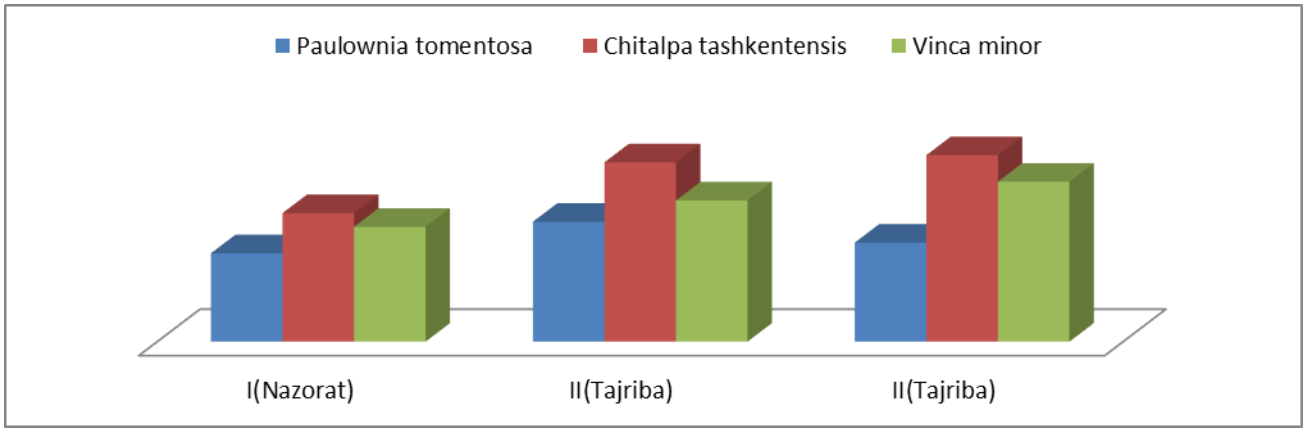
Tadqiqot natijalari. Shahar ekologik muhitini optimallashtirish, sanitar-gigiyenik holatini yaxshilovchi manzarali o‘simliklaridan yana biri *Chitalpa tashkentensis* bo‘lib, iqlim sharoitiga moslashish, sovuqqa chidamlilik darajasi yuqori hisoblanadi. Shahar ekologiyasini optimallashtirishda o‘simlikning manzarali xususiyatlari bilan birgalikda fiziologik jarayonlar intensivligini ham hisobga olish muhim [2; 94-108-b.].

O’simlikda suv rejimi tashqi muhit sharoitiga moslashish, chidamlilik darajasi ortishini ifodalovchi muhim tavsiflardan biri hisoblanadi [3; 11-163-b].

O’rta Osiyo mintaqasi, jumladan O’zbekiston Respublikasi hududi yoz faslining issiq bo‘lishi bilan tavsiflanib, o‘z navbatida suv rejimi dinamikasi, transpirasiya o‘simliklarning yuqori haroratiga moslashish mexanizmlarini belgilab beradi [4; 169-181-b.].

Yuqorida keltirilganlarni inobatga olib, tadqiqotlarning navbatdagi seriyasida Samarqand shahrida sanoat-ishlab chiqarish, avtotransport trassalari zonalarida *Paulownia tomentosa*, *Chitalpa tashkentensis*, *Vinca minor* o‘simliklarida suv rejimi ko‘rsatkichlarini tahlil qilish amalga oshirildi.

Dastlab tadqiqotlarda Samarqand shahri hududida sanoat-ishlab chiqarish, avtotransport trassalari zonalarida o‘suvchi *Paulownia tomentosa*, *Chitalpa tashkentensis*, *Vinca minor* bargida suv miqdori, suv tanqisligi (defisit) tahlil qilindi (1-rasm).



1-rasm.*Paulownia tomentosa*, *Chitalpa tashkentensis*, *Vinca minor* o‘simliklar bargida suv tanqisligi (defisit) tahlili (%) (*M*±*m*)

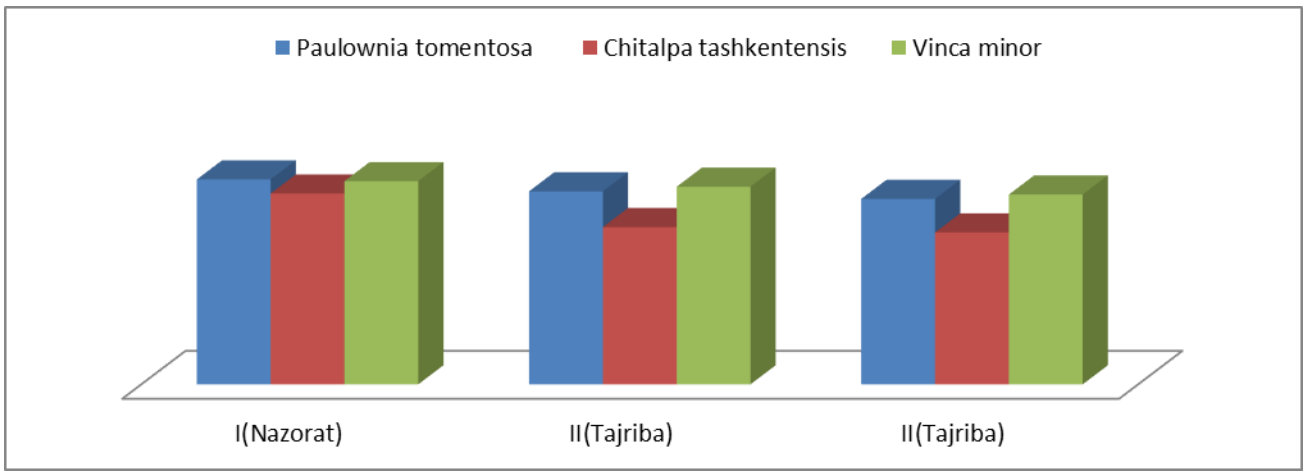
Izoh: I. Samarqand davlat universiteti Botanika bog‘i (Samarqand sh., Oliygoh ko‘chasi, 15-uy); II. «Samarqandkimyo» AJ (Samarqand sh., Kimyogarlar posyolkasi); III. Samarqand shahri Rudakiy shoh ko‘chasi. (Ob-havo harorati *t*=+38ºS; havoning nisbiy namligi 45,6%). * – nazoratga nisbatan *r*<0,05, ** – *r*<0,01 (*n*=3-4).

Bunda *Paulownia tomentosa* o‘simligida nazorat guruhi (I. Samarqand davlat universiteti Botanika bog‘i (Samarqand sh., Oliygoh ko‘chasi, 15-uy) va tajriba guruhlarida (II. «Samarqandkimyo» AJ (Samarqand sh., Kimyogarlar posyolkasi); III. Samarqand shahri Rudakiy

shoh ko‘chasi) bargida suv tanqisligi (defisit) qiymati mos ravishda – 17,4±1,2; 23,6±2,4 va 19,5±1,6%, *Chitalpa tashkentensis* o‘simlik turida mazkur ko‘rsatkich qiymati mos ravishda – 25,3±2,5; 35,3±1,8 va 36,7±2,7%, *Vinca minor* o‘simligida mos ravishda – 22,6±2,4; 27,8±2,2 va 31,4±1,9% ni tashkil qilishi aniqlandi.

O’simlik bargida o‘sish sharoitiga bog‘liq holatda umumiy suv miqdori o‘rtacha 55-58% ni tashkil qilib, sutka davomida va ob-havo haroratiga bog‘liq o‘zgarishi qayd qilinadi.

Tadqiqotlarning navbatdagi seriyasida *Paulownia tomentosa*, *Chitalpa tashkentensis*, *Vinca minor* o‘simlik turlari bargida **suvni saqlash xususiyati** tahlil qilindi (2-rasm).

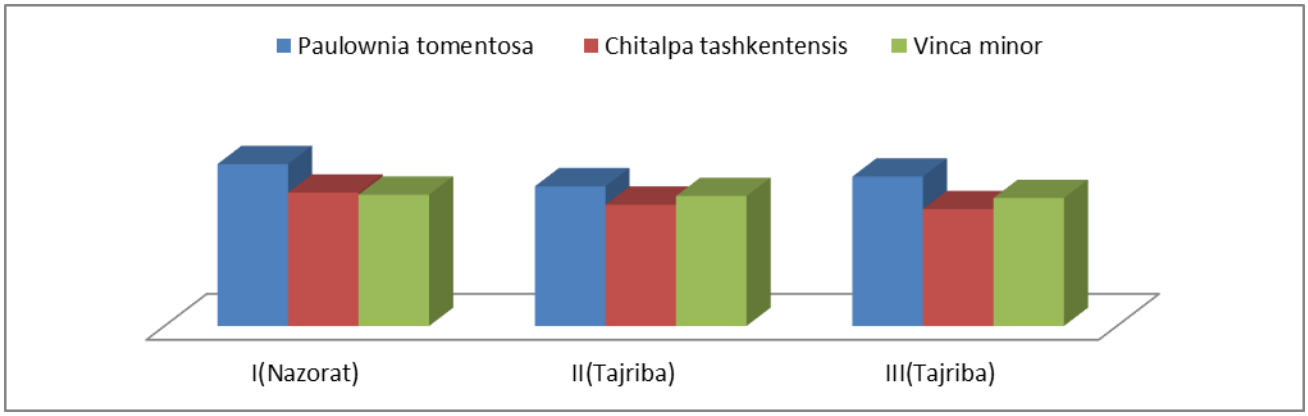


2-rasm.*Paulownia tomentosa*, *Chitalpa tashkentensis*, *Vinca minor* o‘simliklari bargining suvni saqlash xususiyati tahlili (%) (*M*±*m*)

Izoh: I. Samarqand davlat universiteti Botanika bog‘i (Samarqand sh., Oliygoh ko‘chasi, 15-uy); II. «Samarqandkimyo» AJ (Samarqand sh., Kimyogarlar posyolkasi); III. Samarqand shahri Rudakiy shoh ko‘chasi. (Ob-havo harorati *t*=+38ºS; havoning nisbiy namligi 45,6%). * – nazoratga nisbatan *r*<0,05, ** – *r*<0,01 (*n*=3-4).

Paulownia tomentosa o‘simligida nazorat guruhi (I. Camarqand davlat universiteti Botanika bog‘i (Samarqand sh., Oliygoh ko‘chasi, 15-uy) va tajriba guruhlarida (II. «Samarqandkimyo» AJ (Samarqand sh., Kimyogarlar posyolkasi); III. Samarqand shahri Rudakiy shoh ko‘chasi) bargida suv saqlash xususiyati mos ravishda – 84,3±5,2; 79,4±3,5 va 76,3±4,4%, *Chitalpa tashkentensis* o‘simligida mazkur ko‘rsatkich qiymati mos ravishda – 78,5±3,7; 64,7±5,7 *va* 62,5±3,8%, *Vinca minor* o‘simligida mos ravishda – 83,6±5,5; 81,3±3,2 *va* 78,1±4,6% ni tashkil qilishi aniqlandi.

Tadqiqotlar navbatdagi seriyasida *Paulownia tomentosa*, *Chitalpa tashkentensis*, *Vinca minor* o‘simlik turlari bargida transpirasiya jadalligi (*1 g bargning quruq og‘irligiga nisbatan 1 soat davomida bug‘langan suv miqdori*; H_2O mg/g×soat tahlil qilindi (3-rasm).



3-rasm.*Paulownia tomentosa*, *Chitalpa tashkentensis*, *Vinca minor* o‘simliklari bargida transpirasiya jadalligi tahlili (H_2O mg/g×soat) ($M\pm m$)

Izoh: I. Samarqand davlat universiteti Botanika bog‘i (Samarqand sh., Oliygoh ko‘chasi, 15-uy); II. «Samarqandkimyo» AJ (Samarqand sh., Kimyogarlar posyolkasi); III. Samarqand shahri Rudakiy shoh ko‘chasi. (Ob-havo harorati t=+38ºS; havoning nisbiy namligi 45,6%). * – nazoratga nisbatan r<0,05, ** – r<0,01 (n=3-4).

Xulosa. Yuqorida aytilgan o’simlik turlarida suv rejimi ko’rsatkichlariga turli darajada og’ir metallarni bargda to’planishi bu ko’rsatkichlarni o’zgarishiga, kamayishiga olib kelishi tajribalarda o’z aksini topdi.

FOYDALANILGAN ADABIYOTLAR.

1. Овсянников А.Ю. Сезонная структурно-функциональная трансформация фотосинтетического аппарата хвои *Picea pungens* Engl. и *P. obovata* Ledeb. на территории ботанического сада УРО РАН (г. Екатеринбург) // Диссертация на соиск. учён. степен. к.б.н. – Екатеринбург, 2015. – С.4-25.

2. Фомина Т.И. Биологические особенности зимнезеленых поликарпиков в лесостепной зоне Западной Сибири // Вестник Томского государственного университета (Биология). – 2012. – №1(17). – С.43-51.

3. Курмуков А.Г., Белолипов И.В. Дикорастущие лекарственные растения Узбекистана ботаника, химия, фармакология, медицина // Ташкент. – 2012. – С.230-231.

4. Ayan S., Gercek V., Sahin A. Performation of nursery stage of *Paulownia* Sieb.& Zucc. Species and origins, review of faculty of Forestry University of Suleyman Demirel, Seri. A. – 2002. – V.2. – P.41-56.

5. Зиятдинова К.З., Уразгильдин Р.В., Денисова А.В. Водный обмен листьев дуба черешчатого (*Quercus robur* L.) в условиях техногенного загрязнения // Вестник Челябинского государственного университета. – 2013. – №7(298). – Вып. 2. – С.181-184.

O‘ZBEKISTONNING TURLI BIOTSENOZLARIDA KOVRAK NEMATODASI (HETEROANGUINA FERULAE)NING TARQALISH MONITORINGI

Narzullayev Sardorbek Baxriddinovich, Mo‘minov Shertoy Absalom o‘g‘li

Sharof Rashidov nomidagi Samarqand davlat universiteti, zoologiya kafedrasi dotsenti.

Sharof Rashidov nomidagi Samarqand davlat universiteti, zoologiya kafedrasi tadqiqotchisi.

e-mail: narzullayevsardorbek1990@gmail.com

Annotatsiya. Mazkur tadqiqotda O‘zbekistonning turli hududlarida kovrak nematodasi - *Heteroanguina ferulae* ning tarqalishi va kovrak turlarining zararlanish darajasi o‘rganildi. Tadqiqotlar natijasida *H. ferulae* ning *F. kuhistanica*, *F. tadshicorum* va *F. foetida* o‘simliklarida uchrashi aniqlandi. *F. tadshicorum* va *F. foetida* ushbu nematodaning yangi xo‘jayinlari sifatida ilk bor qayd etildi. Zararlanishning eng yuqori ekstensivligi va intensivligi *F. kuhistanica*da kuzatildi.

Kalit so‘zlar. Kovrak, Ferula, nematoda, *Heteroanguina ferulae*, O‘zbekiston

Abstract. In this study, the distribution of the ferula nematode - Heteroanguina ferulae in various regions of Uzbekistan and the degree of infestation of ferula species were studied. As a result of the research, it was established that H. ferulae is found in F. kuhistanica, F. tadshicorum, and F. foetida. F. tadshicorum and F. foetida were recorded for the first time as new hosts of this nematode. The highest extent and intensity of damage were observed in F. kuhistanica.

Keywords. Ferula, Nematoda, Heteroanguina ferulae, Uzbekistan

Kirish. Tylenchida turkumining Anguinidae oilasiga kiruvchi nematodalar o‘simliklarda migratsiya yo‘li bilan endoparazitlik qiluvchilar kichik guruhiga kiradi. Hozirgi vaqtda mazkur oilaning 40 dan ortiq turlari o‘simliklarning vegetativ organlari (bargi, poyasi) va generativ organlari (asosan urug‘i)da bo‘rtmalar hosil qiluvchi turlar sifatida tasvirlangan. Sobiq SSSR mamlakatlari va O‘rta Osiyodan ham Anguinidae oilasiga kiruvchi bo‘rtma hosil qiluvchi nematodalar haqida ma’lumotlar berilgan [4, 522 b.].

Heteroanguina ferulae turi dastlab T.S.Ivanova tomonidan fanga yangi tur *Anguina ferulae* Ivanova, 1977 sifatida Tojikistonda *Ferula jaeschkeana* va *F.kuhistanica* o‘simliklarida qayd qilingan bo‘lsa [2, 81-83 b., 3, 65-69-b.], keyinchalik mazkur tur qayta reviziya oqibatida *Heteroanguina ferulae* (Ivanova, 1977) Chizhov & Subbotin, 1985 sifatida ro‘yxatdan o‘tkazilgan. Ushbu nematoda Janubiy O‘zbekistonning tog‘li hududlaridan ham topilgan (Ferula o‘simligi turi qayd qilinmagan) [1, 226-235-b.].

Natijalar. 2023-2026-yillar davomida olib borilgan tadqiqotlar davomida respublikamizning bir qator hududlarida kovrak bilan bog‘liq nematodalar o‘rganildi. Natijada kovrak nematodasi – *Heteroanguina ferulae* respublikamizning turli hududlarida qayd qilindi. Jumladan, kovrakning *Ferula kuhistanica, Ferula tadshicorum, Ferula foetida* turlari mazkur nematoda bilan zararlangani

aniqlandi.Ular orasida *F.tadshicorum* va *F.foetida* o‘simliklari *H.ferulae* uchun yangi xo‘jayinlar sifatida ilk bor qayd qilindi.



a **b** **c**

1-rasm. *Ferula kuhistanica* da *Heteroanguina ferula* bilan zararlanish belgilari. *a-zararlanishning dastlabki belgilari (bo‘rtmalar oq-qizg‘ish tusda); b- bo‘rtmalar bilan qoplangan barg; c- yetilgan bo‘rtmalar bilan qoplangan to‘pgul qobig‘i (Sariosiyo tumani).*



a **b**

2-rasm. *Ferula tadshicorum*ning yetilmagan bo‘rtmalar bilan qoplangan barglari (Surxondaryo viloyati Boysun tumani)

Tadqiqotlar davomida kovrak turlarida *H.ferulae* bilan zararlanishining eksensivlik va intensivlik darajalari ham hisoblab chiqildi. Zararlanish ekstensivligini hisoblash uchun har xil zichlikda o‘sgan kovrak maydonlaridan 3x10 metrli 5 ta maydon tanlab olingan. Ekstensivlik P=

M/N*100 formulasi asosida hisoblandi. Bunda N-maydondagi tekshirilgan jami o‘simliklar soni, M-zararlangan o‘simliklar soni. Tekshirilgan o‘simliklarda zararlanish 15 % gacha bo‘lganda zararlanish darajasi past, 15-50% -o‘rtacha daraja, 50% va undan yuqori bo‘lsa zararlanish darajasi kuchli deb olinadi. Kuzatuv davomida zararlanish ekstensivligi *F.kuhistanica* o‘simligida eng yuqori ko‘rsatkichni tashkil etdi. Ya‘ni tekshirilgan maydondagi o‘simliklarning o‘rtacha 73%da zararlanish kuzatildi. *F.tadshicorum*da bu ko‘rsatkich 38,2% bo‘lsa, *F.foetida* o‘simligida 46,2%ni tashkil etdi. Shuningdek hududlar kesimida ham ushbu ko‘rsatkichlar taqqoslanganda F.kuhistanicada eng yuqori ko‘rsatkich Surxondaryo viloyati Boysun tumanida (76%), keyingi o‘rinlarda esa Sariosiyo tumani Xondiza qishlog‘i (65%) va Omonqo‘ton qishlog‘ida (51%) qayd qilindi.



3-rasm. *Ferula kuhistanica*da zararlanish ekstensivligini hisoblash jarayoni (Surxondaryo viloyati Boysun tumani, 2026-yil).

Zararlanish intensivligi 1 dan 5 ballgacha bo‘lgan tizimda baholandi.

1 ball – juda past: bargda bitta kichik bo‘rtma bor.

2 ball – past zararlanish: bo‘rtmalar barg hajmining 25% dan kam qismini egallagan, bo‘rtmalar bir-biri bilan qo‘shilib ketadi.

3 ball – o‘rtacha zararlanish: bo‘rtmalar bargning 25-30% hajmini egallaydi.

4 ball – kuchli zararlanish: bargning yarmidan ko‘pi bo‘rtmalar bilan qoplangan, bo‘rtmalar bir-biri bilan qo‘shilib ketgan, barg rivojlanishdan orqada qolgan.

5 ball – juda kuchli zararlanish: butun barg sathi bo‘rtmalar bilan qoplangan, barcha bo‘rtmalar birlashib ketgan, bargda kasallanish yaqqol seziladi (bujmayish, deformatsiya).

Nematodalar bilan zararlanish intensivligi ham *F.kuhistanica*da eng yuqori bo‘lishi ma‘lum bo‘ldi. *F.kuhistanica*da intensivlik 4-5 ball, *F.tadshicorum*da 3 ball, *F.foetida* o‘simligida esa 3-4 ballni tashkil etdi.

Yuqoridagi ma‘lumotlardan ko‘rinib turganidek zararlanish ekstensivligi va intensivligi kovrak turlari orasida F.kuhistanicada eng yuqori ko‘rsatkichni, F.tadshicorumda esa eng past darajani ko‘rsatgan. Hududlar kesimida bu ko‘rsatkichlar Surxondaryo viloyatining Boysun tumanida (Xo‘ja Mayxona ziyoratgohi atrofi va O‘rta Machay qishlog‘i yaqini) va Sariosiyo tumanining Xondiza qishloqlarida qayd qilindi.

1-jadval.

H.ferulae nematodasining xo‘jayin o‘simliklari va tarqalish hududlari

Xo‘jayin o‘simlik	**Zararlangan organ**	**Aniqlangan tabiiy hududlar**	**Ma’muriy hudud**
F.kuhistanica	Barg, to‘pgul qobig‘i	Chaqalikalon massivi, Boysun tog‘i, Bobotog‘, Hisor tizmasi	Samarqand viloyati Urgut tumani, Qashqadaryo viloyati Kitob, Shaxrisabz tumanlari va Surxondaryo viloyati Boysun, Uzun, Sariosiyo tumanlari
F.tadshicorum	Barg	Boysun tog‘i, Ko‘hitang	Surxondaryo viloyati Boysun va Sherobod tumanlari
F.foetida	Barg	Qizilqum cho‘li	Navoiy viloyati Nurota tumani

Xulosa. Tadqiqotlar natijasida *Heteroanguina ferulae* ning O‘zbekistonning bir qator tog‘li va cho‘l hududlarida tarqalishi hamda Ferula turkumiga mansub o‘simliklar bilan bog‘liqligi aniqlandi. *H.ferulae* nematodasi *F. kuhistanica*, *F. tadshicorum* va *F. foetida* turlarida qayd etilib, *F. tadshicorum* va *F. foetida* uning yangi xo‘jayinlari sifatida ilk bor ko‘rsatildi. Zararlanish ekstensivligi *F. kuhistanicada* 73 %, *F. tadshicorum*da 38,2 % va *F. foetida*da 46,2 % ni tashkil

etdi. Zararlanish intensivligi mos ravishda 4–5, 3 va 3–4 ball bilan baholandi. Eng yuqori zararlanish *F. kuhistanica*da, xususan Boysun tumani hududida qayd etildi.

ADABIYOTLAR

1. Subbotin, S.A., Krall, E.L., Riley, I., Chizhov, V.N., Staelens, A., De Loose, M. & Moens, M. 2004. Evolution of the gall-forming plant parasitic nematodes (Tylenchida: Anguinidae) and their relationships with hosts as inferred from Internal Transcribed Spacer sequences of nuclear ribosomal DNA. Molecular Phylogenetics and Evolution 30: 226-235. DOI: 10.1016/s1055-7903(03)00188-x

2. Иванова Т.С. К изучению биологии Anguina ferulae Ivanova, 1977 в условиях ущелья реки Варзоб // Изв. АН ТаджССР. Отд. Биол. Нуак. 1981. Т. 83, № 2. С. 81-83

3. Иванова Т.С. Новый вид нематоды – Anguina ferulae Ivanova, sp. nov. (Anguininae: Tylenchida) с ферулы из Таджикистана // Докл. АН Тадж.ССР. 1977. Т.20, № 1. С. 65-69

4. Кирьянова Е.С., Кралль Э.Л. Паразитические нематоды растений и меры борьбы с ними. Т. 2. СССР: Наука, 1971. 522 с.

QUYONLARNING GUMORAL IMMUN TIZIMIGA FOTOPERIOD STRESSOR OMILLARNING TA'SIRI

[1]Narzullayeva M., [2]Hayitov D,G'., [3]Haydarov D.Ya.

[1]Samarqand davlat tibbiyot universiteti

[2,3]Sharof Rashidov nomidagi Samarqand davlat universiteti

Аннотация: *В данной статье представлены данные об изменчивости иммуноглобулинов в крови кроликов в результате их адаптации к световому и темновому режимам продолжительности дня. В целях сохранения генетического потенциала кроликов породы Хикол (Hikol) и предотвращения иммунологической уязвимости подчеркивается необходимость строгого соблюдения на фермах стандартных режимов освещения, таких как 12С/12Т (12 часов света / 12 часов темноты) или контролируемый режим 16С/8Т в репродуктивный период, а также предотвращения таких острых стрессовых факторов, как круглосуточное непрерывное освещение или длительная темнота.*

Ключевые слова: *фотопериод, естественная резистентность, защита, стресс, иммуноглобулин.*

Abstract: *This article presents data on the variability of immunoglobulins in the blood of rabbits as a result of their adaptation to light and dark regimes of day length. To preserve the genetic potential of Chinchilla (Hikol) rabbits and prevent immunological vulnerability, it is*

highlighted that farms must strictly adhere to standard lighting regimes, such as 12L/12D (12 hours of light / 12 hours of dark) or 16L/8D under control during the reproductive period, while avoiding acute stress factors like 24-hour continuous lighting or prolonged darkness.

Keywords: *photoperiod, natural resistance, protection, stress, immunoglobulin.*

Quyonlardan olinadigan mahsulotlarini ishlab chiqarishni ko‘paytirish uchun eng muhim omillardan biri bu yuqori adaptatsion xususiyatga ega hayvonlarni tanlash, ko‘paytirish va baholash muhimdir. Shu tufayli quyonlarning moslanuvchanlik imkoniyatlarini o‘rganish muhim ilmiy va amaliy ahamiyatga ega.

Hayvonlarda fotoperiodizm evolyutsiyasining markazida reproduktiv jarayonlarni optimallashtirish va mavsumiy omon qolish strategiyalari uchun zarur bo‘lgan energetik murosalarni muvozanatlash uchun yil davomida energetik jihatdan qiyin faoliyatlarning moslashuvchan taqsimlanishi turadi. Kunduzgi uzunlik yil vaqtini kuzatish va aniq bashorat qilish uchun deyarli shovqinsiz atrof-muhit signalini taqdim etadi. Sutemizuvchilarda melatonin kunduzgi uzunlikni o'zgartiruvchi gormonal signalni taqdim etadi. [1; 165-170-b. 3; 303-319-b.]. Issiqlik stressi dunyoda keng tarqalgan muammoga aylandi, bu asosiy ekologik stress omillaridan biri bo‘lib, quyon sanoatida katta iqtisodiy yo‘qotishlarga olib keladi. Issiqlik stressi quyonlarning sog‘lig‘iga ko‘plab zarar yetkazadi, masalan, organlarning shikastlanishi, oksidlovchi stress, endokrin regulyatsiyaning buzilishi, immunitet funktsiyasining pasayishi va reproduktiv kasalliklar, oxir-oqibat ishlab chiqarish ko‘rsatkichlarining pasayishiga va o‘limning ko‘payishiga olib keladi [2; 137-146-b. 5; 1-15-b.]. Quyonlarni uzoq muddatli fotoperiodlarga (14 va 16 soatlik yorug‘lik) duchor qilish yoki melatonin bilan davolash folikulyatsiya xususiyatlarining miqdori va sifatini va jinsiy faollikni, shuningdek, urg‘ochilarning jinsiy qabul qilish qobiliyatini, ozuqa iste'molini, axlat hajmini, tug‘ilgandagi vaznini va sutdan ajratish vaqtini yaxshilagan. Boshqa tomondan, homiladorlik davri va sutdan ajratishdan oldingi o‘lim foizi kamaydi. [4; 165-171-b.].

Immunoglobulinlar yoki antitanalar glikoproteinlar bo‘lib, barcha sut emizuvchilarning zardob va to‘qima suyuqliklarida uchraydi. Immunoglobulin molekulalarini plazmatik hujayralar ko‘p miqdorda ishlab chiqaradi.

Tadqiqot obe’ktlari va usullari. Tadqiqot obe’ktlari sifatida 2 oylik Hikol zotiga mansub quyonlar tanlab olindi. Stressor omil tariqasida maxsus kameralarda 6 (qisqa kun / yorug‘lik tanqisligi), 12 (fiziologik norma deb hisoblanib / nazorat guruh), 18 (uzun kun rejimi) va 24 (o‘tkir doimiy fotostress) soatlik fotoperiod (yorug‘lik rejimi) ta’sir ettirildi. Qonning tarkibidagi immunologik sinflarning ko‘rsatkichlari avtomatik MAGLUM 600 immunokimyoviy lyumentsion analizatorda (Germaniya-Xitoy) Okstar Mancheni immunodiffuziya uslubida presepetatsiya halqalariga asoslangan holda aniqlandi.

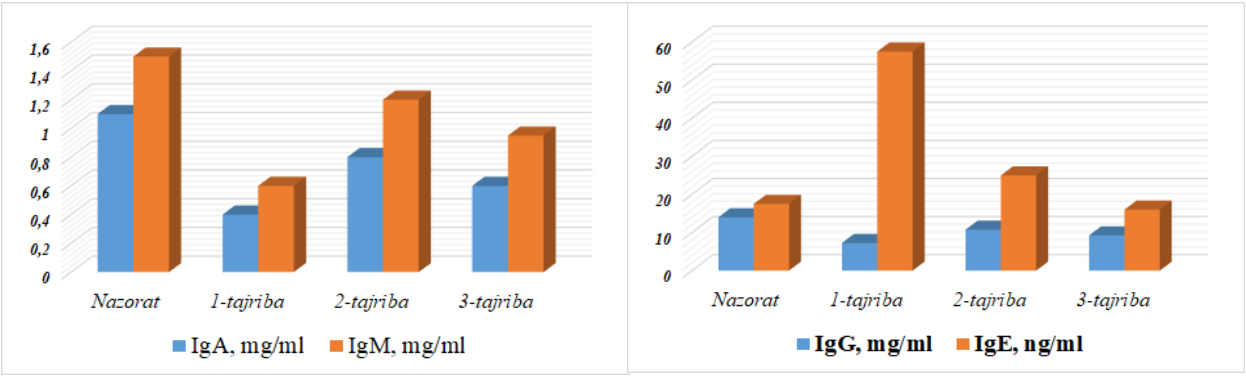
Tadqiqot natijalari va tahlili. Kunning qisqarishi, kutilmagan yorug‘lik signallari yoki uzoq muddatli qorong‘ilik quyonlarning sirkad (bioritm) tizimini buzadi va organizmda neyroendokrin stress reaksiyasini keltirib chiqaradi. Yorug‘lik rejimining buzilishi quyonlarda epifiz bezidan melatonin ajralishini va buyrak usti bezidan kortizol (stress gormoni) sekretsiyasini o'zgartiradi. Kortizol miqdorining oshishi immun tizimini susaytiradi (immunosupressiya), bu esa qondagi immunoglobulinlar (IgA, IgG, IgM, IgE) miqdorining o'zgarishiga olib keladi.

Immunoglobulin A (IgA) qon zardobi tarkibidagi umumiy immunoglobulinlar miqdorining 10-15 foizni tashkil etadi. Bu molekulalar ko‘pincha shilliq pardalarning sekretlarida, masalan, so‘lak, ko‘z yoshi va burun suyuqligi, teri hamda o‘pka sekretlarida uchrab, uning shilliq pardasini tashqi muhitdan tushayotgan mikroorganizmlar ta’siridan himoya qiladi. Bizning tadqiqotlarimizda quyonalarga yorug‘lik rejimini ta’sir ettirish orqali IgA miqdoriy o‘zgaruvchaligi nazorat guruhida 1,1 mg/ml ga to‘g‘ri kelgan bo‘lsa birinchi tajriba guruhida nazoratga nisbatan 0,7 mg/ml ga, ikkinchi tajriba guruhidagilarda esa 0,3 mg/ml, uchunchi guruhdagilarda esa 0,5 mg/ml gacha kamayish kuzatildi. Immunoglobulin A ning o‘zgaruvchaligiga 24 soatlik yorug‘lik rejimi eng ko‘ ta’sir qilishi aniqlandi (1-rasm).

Olingan ma’lumotlardan kelib chiqqan holda ta’kidlash mumkinki IgA shilliq qavatlar himoyachisi sifatida quyonlarning nafas olish va hazm qilish tizimi shilliq qavatlarini (respirator va alimentar infeksiyalardan) himoya qiladi. Yorug‘lik rejimi buzilganda (24 soat yorug'lik yoki 18 soat qorong‘ulik) qondagi sekretor IgA miqdori kamayadi, bu esa sanoat quyonchiligida eng ko‘p uchraydigan pasterellyoz va koksidioz kabi kasalliklarning avj olishiga zamin yaratadi.

Organizmning immunologik javob reaksiyasi sifatida birinchi bo‘lib immunoglobulin M (IgM) namoyon bo‘ladi. IgM agglyutinatsiya va hujayralar lizisini juda oson keltirib chiqaradi. Ular B-limfotsitlarning membrana tarkibidagi antigenni aniqlovchi retseptorlari hisoblanadi. Quyonlar qondagi IgM ning yorug‘lik rejimi ta’sirida o‘zgarishi tahlil qilinganda nazorat guruhida 1,5 mg/ml ni tashkil etdi. Qolgan birinchi tajriba guruhida 2,5 barobarga, ikkinchi tajriba guruhida 0,3 mg/ml ga, uchinchi tajriba guruhida esa 1,57 barobarga kamayganligini guvohi bo‘ldik.

Shunday qilib IgM birlamchi immun javob reaksiyasi hisoblanib, organizmga infeksiya tushganda birinchi bo‘lib kurashga kiradigan antitelodir. 24 soat yorug‘lik va 18Y/6Q rejimlarida stress gormonlari B-limfotsitlar faolligini susaytirishi oqibatida IgM ko‘rsatkichi kritik darajada (0,6 mg/ml gacha) tushib ketadi.



1-rasm. Turli fotoperiod rejimida quyonlar qonidagi immunoglobulinlarning ko‘rsatkichlari

Immunoglobulin G (IgG) ko‘proq to‘qima suyuqliklarida uchrab bakteriya zaharlarini neytrallash va mikroorganizmlarni o‘ziga bog‘lashda muhim ahamiyatga ega. Bundan tashqari IgG, bakteriyalar bilan kompleks birikmalar hosil qilib, komplement tizimini kuchaytiradi va leykotsitlarni xemotaksisga olib keladi. Gumoral omillarning bu ko‘rsatkichiga yorug‘lik rejimini ta’siri o‘rganilganda nazorat guruhida 14,0 mg/ml ga teng kelgan bo‘lsa bu guruhga nisbatan 1-tajriba guruhidagilarda 48,21 % ga, 2-tajriba guruhidagilarda 23,21 % ga, 3-tajriba guruhidagularda esa 33,92 % gacha kamyganligini keltirib o‘tish mumkin. Shuni ta’kidlash kerakki IgG asosiy tizimli himoya tizimi bo‘lib, quyon qon zardobidagi immunoglobulinlarning qariyb 75% qismini tashkil etadi. 24 soatlik uzluksiz yorug‘lik sharoitida uning miqdori deyarli 2 barobarga kamayadi (7.25 mg/ml gacha). Bu Hikol quyonlarining yuqumli (bakterial va virusli) kasalliklarga qarshi umumiy chidamliligini keskin pasaytirib yuboradi.

Immunoglobulin E (IgE) ular asosan shilliq-nafas olish va oshqozon-ichak traktida, shuningdek, mintaqaviy limfa tugunlarida sintezlanadi. Qon zardobida IgE faqat juda past konsentratsiyalarda bo‘ladi. Ushbu immunoglobulinning muhim qismi bazofillarning hujayralari bilan bog‘liq. IgE ning asosiy vazifasi allergik hodisalarda gistaminning chiqarilishini rag‘batlantirishdan iborat deb taxmin qilinadi. Ushbi gumoral omilning quyonlarga turli yorug‘lik rejimi ta’sir ettirilganda qondagi miqdoriy o‘zgaruvchaligi o‘rganilganda nazorat guruhidagilarda 17,5 ng/ml ga to‘g‘ri keldi. Birinchi tajriba guruhidagilarda 40 ng/ml ga, ikkinchi tajriba guruhidagilarda esa 7,5 ng/ml ga ortganligini keltirib o‘tishimiz mumkin. Uchinchi tajriba guruhlarida nazoratga nisbatan aksincha biroz bo‘lsada 1,5 ng/ml ga kamayish kuzatildi (1-rasm0. IgE boshga gumoral immun tizimi omillariga nisbatan yorug‘lik rejimini ortishi bilan paralell ravishda uning ko‘rsatkichlari ham oshib borgan. Demak IgE stress va allergik mediatorlarida norma holatida juda kam miqdorda bo‘ladi. Biroq, 24 soatlik o‘tkir fotostress ta’sirida

organizmning gomeostazi buzilib, IgE miqdori 57,5 ng/ml gacha (3 barobar) ko‘tarilib ketadi. Bu organizmda to‘qima darajasidagi distress va yallig‘lanish jarayonlari boshlanganidan dalolat beradi.

Turli fotoperiod rejimini quyonlar organizmiga ta’siri quyidagi fiziologik jarayonlarni na’moyon etadi. 12 soatlikda organizmning Gomeostazi barqaror bo‘lib, immun tizimi o‘zgarmagan holda infeksiyalarga qarshi tabiiy chidamliligi yuqori darajada saqlanadi. 24 soatli otoperiod rejim ta’sirida Kuchli stress immunosupressiya kuzatiladi. Kortizolning surunkali oshishi immunogen oqsillar sintezini bloklaydi. Allergiya va autoimmun reaksiyalar (IgE) xavfi ortadi. 18 soatli fotoperiod rejimda Mo"tadil funksional yuklama saqlanib qoladi. Moddalar almashinuvi tez, ammo uzoq muddat qo‘llansa, immun tizimida yengil charchash (IgG kamayishi) boshlanadi. 6 soatlik fotoperiod rejim ta’sirida esa Gipotoniya kuzatilib, metabolik depressiyaga uchraydi. Melatonin ko‘p ajraladi, ammo umumiy metabolizm va oqsil sintezi sekinlashishi hisobiga himoya antitelolari kamayadi.

Xulosa. Hikol quyonlarining genetik salohiyatini saqlash va immunologik zaiflikni oldini olish uchun sanoat inshoatlarida 12Y/12Q yoki reproduktiv davrda nazorat ostidagi 16Y/8Q standart yorug‘lik rejimlariga qat’iy amal qilish, 24 soatlik uzluksiz yorug‘lik yoki uzoq muddatli qorong‘ulik kabi o‘tkir stress omillarini oldini olish imkonini beradi.

FOYDALANILGAN ADABIYOTLAR

1. Ashkenazy-Frolinger T, Kronfeld-Schor N, Juetten J, Einat H. It is darkness and not light: Depression-like behaviors of diurnal unstriped Nile grass rats maintained under a short photoperiod schedule. J Neurosci Methods. 2010; 186:165–170. [PubMed: 19932714]
2. Cullere M, Zotte AD. Rabbit meat production and consumption: state of knowledge and future perspectives. Meat Sci. (2018) 143:137–46. doi: 10.1016/j.meatsci.2018.04.029
3. James C. Walton, Zachary M. Weil et al. Influence of Photoperiod on Hormones, Behavior, and Immune Function. Front Neuroendocrinol. 2011 August; 32(3): 303–319. doi:10.1016/j.yfrne.2010.12.003.
4. T M Mousa-Balabel, R A Mohamed. Effect of different photoperiods and melatonin treatment on rabbit reproductive performance. / Vet Q. 2011 Dec;31(4):165-71. doi: 10.1080/01652176.2011.642533. Epub 2011 Dec 12.
5. Zi-Long Liang, Fan Chen, et. al. Impacts of Heat Stress on Rabbit Immune Function, Endocrine, Blood Biochemical Changes, Antioxidant Capacity and Production Performance, and the Potential Mitigation Strategies of Nutritional Intervention. / frontiers in veterinary Science. published: 26 May 2022 doi: 10.3389/fvets.2022.906084

YOMG‘IR CHUVALCHANGLARINING TUPROQ UNUMDORLIGINI OSHIRISH VA EKOTIZIM BARQARORLIGINI TA’MINLASHDAGI AHAMIYATI

S.N.Narzullayev, D.A.Sulaymonova

Samarqand davlat pedagogika instituti

Email: *snarzullayev684@gmail.com, durdonasulaymonova47@gmail.com*

Annotatsiya. *Ushbu tezisda yomg‘ir chuvalchanglarining sistematik o‘rni, O‘zbekiston faunasida qayd etilgan turlari, tuproq unumdorligini shakllantirish va ekotizim barqarorligini ta’minlashdagi ekologik ahamiyati tahlil qilinadi. Yomg‘ir chuvalchanglarining organik qoldiqlarni qayta ishlash, tuproq strukturasini yaxshilash, biogen elementlar aylanishida ishtirok etish hamda suv va havo almashinuviga ta’sir ko‘rsatish xususiyatlari ilmiy adabiyotlar asosida yoritiladi. Shuningdek, ularning yashash muhitiga salbiy ta’sir etuvchi omillar va tuproq biologik faolligini saqlashga qaratilgan ekologik yondashuvlar ko‘rib chiqiladi.*

Kalit so‘zlar: *yomg‘ir chuvalchanglari, Annelida, Lumbricidae, tuproq unumdorligi, organik moddalar, gumus, biogen elementlar, biologik xilma-xillik, ekotizim barqarorligi.*

Kirish. Tuproq tabiatdagi moddalar aylanishi, o‘simliklarning o‘sishi va quruqlik ekotizimlarining barqaror faoliyatini ta’minlovchi muhim tabiiy resurs hisoblanadi. Tuproq unumdorligi uning fizik, kimyoviy va biologik xususiyatlariga, jumladan, organik moddalar miqdori, mikroorganizmlar faolligi va umurtqasiz hayvonlarning hayot faoliyatiga bog‘liq. Shu jihatdan yomg‘ir chuvalchanglari tuproq ekotizimlarining muhim tarkibiy qismi sifatida alohida ahamiyatga ega. Yomg‘ir chuvalchanglari halqali chuvalchanglar — Annelida tipiga mansub bo‘lib, an’anaviy zoologik tasnifda Oligochaeta, ya’ni kam tuklilar guruhiga kiritiladi [5]. Ular organik qoldiqlarni iste’mol qilish, tuproq zarrachalarini aralashtirish va in qazish orqali tuproqning biologik hamda fizik xususiyatlariga ta’sir ko‘rsatadi. Natijada oziqa elementlarining aylanishi, tuproq strukturaviy birliklari shakllanishi va suvning tuproqqa shimilishi kabi jarayonlariga ta‘sir ko‘rsatadi. O‘zbekiston hududining tog‘li, cho‘l, to‘qay va madaniy landshaftlardan iboratligi yomg‘ir chuvalchanglarining tarqalishi hamda ekologik xususiyatlarini o‘rganishni dolzarbligini oshiradi. Ayniqsa, tuproq degradatsiyasi, sho‘rlanish, organik moddalarning kamayishi va intensiv qishloq xo‘jaligi sharoitida ushbu organizmlarning ekologik vazifalarini yoritish muhim ilmiy-amaliy ahamiyat kasb etadi [2].

Tadqiqot metodologiyasi. Tezisni tayyorlashda nazariy tahlil, kuzatish va qiyosiy tahlil metodlaridan foydalanildi. Nazariy tahlil orqali yomg‘ir chuvalchanglarining biologiyasi, sistematikasi, tuproq unumdorligi va ekotizimdagi ahamiyatiga oid biologiya darsliklari hamda ilmiy maqolalar o‘rganildi. Kuzatish metodi yordamida yomg‘ir chuvalchanglarining harakati,

yashash muhiti va tuproq bilan o‘zaro aloqasi ko‘rib chiqildi. Qiyosiy tahlil orqali halqali chuvalchanglarning tuzilishi yassi va to‘garak chuvalchanglarning xususiyatlari bilan solishtirildi. Olingan ma’lumotlar umumlashtirilib, yomg‘ir chuvalchanglarining tuproq unumdorligini oshirish va ekotizim barqarorligini ta’minlashdagi ekologik ahamiyati yoritildi.

Natijalar va muhokama:

Yomg‘ir chuvalchanglarining sistematikasi va O‘zbekiston faunasidagi o‘rni. Yomg‘ir chuvalchanglari Annelida tipiga mansub bo‘lib, tuproq muhitiga moslashgan umurtqasiz hayvonlardir. Ularning tanasi halqalarga bo‘lingan, harakatlanishida mayda tukchalar ishtirok etadi. Ko‘pchilik turlari nam va organik moddalarga boy tuproqlarda faol hayot kechiradi (1-rasm).

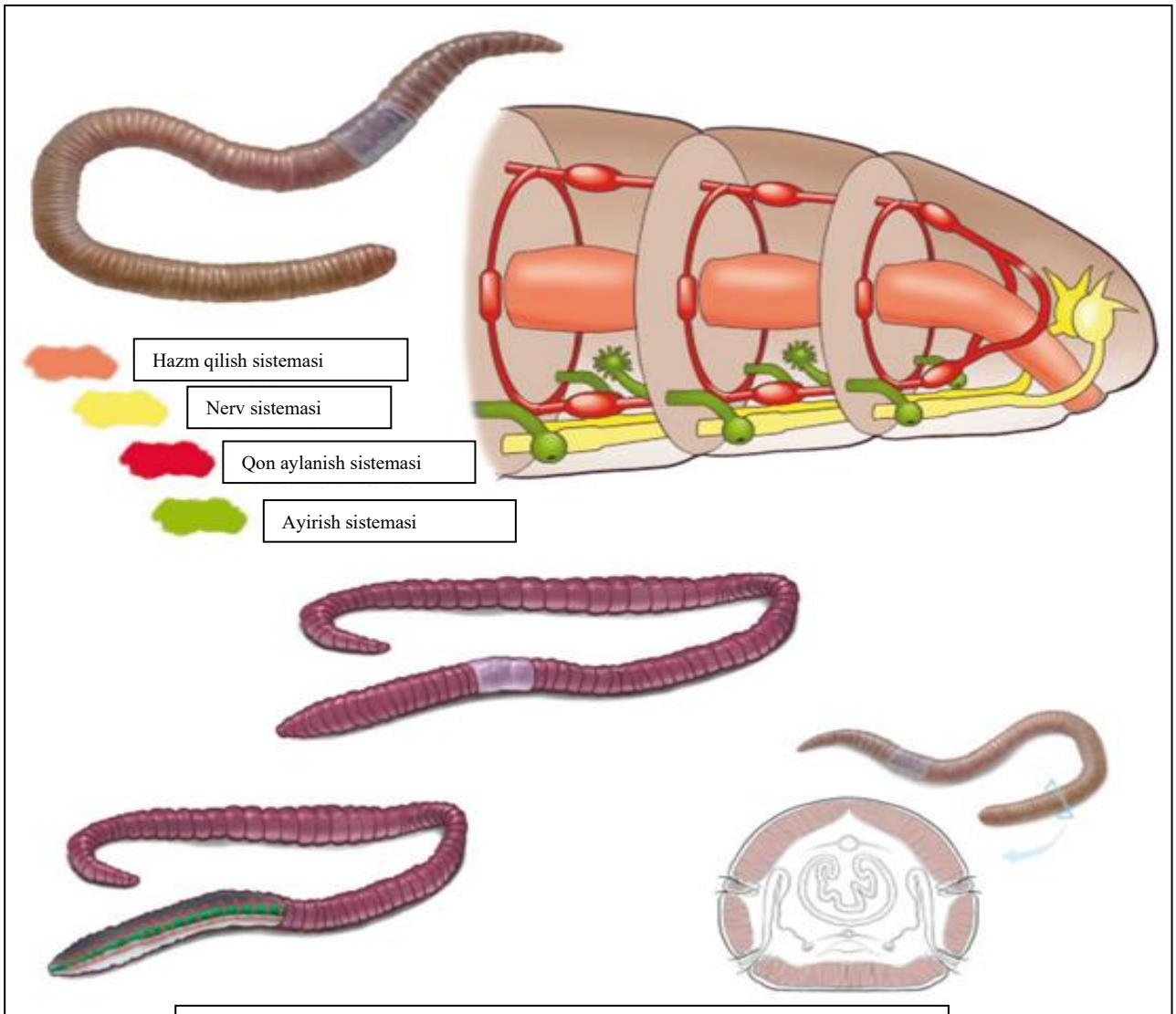
Abdullayev va hammualliflar tomonidan 2023-yilda chop etilgan tadqiqotda O‘zbekiston yomg‘ir chuvalchanglari faunasi tahlil qilingan. Mualliflar to‘qqizta avlodni qayd etgan: *Perelia, Aporrectodea, Eisenia, Eiseniella, Octolasion, Dendrobaena, Dendrodrilus, Bimastos* va



1-rasm. Yomg‘ir chuvalchangining umumiy ko’rinishi

Lumbricus. Tadqiqotda 23 tur va 5 kenja tur sifatida ifodalangan [1]. Mazkur ma’lumotlar O‘zbekiston hududida yomg‘ir chuvalchanglarining taksonomik xilma-xilligi mavjudligini ko‘rsatadi. Ularning tarqalishi tuproq namligi, harorat, organik moddalar miqdori, o‘simlik qoplami va hududning geografik sharoitlari bilan bog‘liq . Shu sababli yomg‘ir chuvalchanglari faunasini o‘rganishda nafaqat turlar sonini, balki ularning muayyan biotoplardagi ekologik xususiyatlarini ham hisobga olish zarur [4].

Tuproq unumdorligini oshirishdagi ahamiyati. Yomg‘ir chuvalchanglarining tuproq unumdorligiga ta’siri, birinchi navbatda, organik moddalarni qayta ishlash jarayoni bilan bog‘liq. Ular to‘kilgan barglar, qurigan o‘simlik qismlari va boshqa organik qoldiqlarni iste’mol qilib, ularning maydalanishi hamda mikroorganizmlar tomonidan parchalanishiga yordam beradi. Bu jarayon organik moddalar aylanishi va oziqa elementlarining tuproq muhitida qayta taqsimlanishiga ko‘maklashadi. Chuvalchanglarning hazm qilish tizimidan o‘tgan tuproq va organik materiallar



2-rasm. Yomg’ir chuvalchangining (*Lumbricus terrestris*) tashqi va ichki tuzilishi: hazm, nerv, qon aylanish va ayirish tizimlari.

koprolitlar shaklida ajraladi (2-rasm). Ushbu ajratmalar organik birikmalar va mineral elementlarni saqlashi hamda tuproq agregatlari shakllanishida ishtirok etishi mumkin. Biroq koprolitlarni gumus bilan aynan bir xil tushuncha sifatida talqin qilish to‘g‘ri emas [3]. Gumusning shakllanishi murakkab jarayon bo‘lib, unda o‘simlik qoldiqlari, mikroorganizmlar va boshqa tuproq organizmlari ham ishtirok etadi.

Yomg‘ir chuvalchanglari tuproq ichida harakatlanib, turli o‘lchamdagi inlar hosil qiladi. Ushbu inlar tuproqning g‘ovakligi va havo almashinuviga ta’sir ko‘rsatadi, suvning tuproqqa singishini osonlashtirishi hamda ildizlarning rivojlanishi uchun qulay sharoit yaratishi mumkin. Shu tariqa ular tuproqning fizik xususiyatlari va biologik faolligini yaxshilashda muhim vazifa bajaradi.

Bundan tashqari, yomg‘ir chuvalchanglari azot, fosfor va boshqa biogen elementlarning aylanishiga ta’sir ko‘rsatadi. Ularning faoliyati organik moddalar mineralizatsiyasi va tuproq mikroorganizmlari bilan o‘zaro munosabatlar orqali oziqa elementlarining o‘simliklar uchun mavjud shakllariga ta’sir qilishi mumkin. Ushbu jarayonlarning natijasi tuproq turi, namlik, harorat, organik qoldiqlar miqdori va chuvalchanglarning ekologik guruhiga bog‘liq [7].

Ekotizim barqarorligini ta’minlashdagi roli. Yomg‘ir chuvalchanglari ko‘pincha ekotizim muhandislari deb ataladi, chunki ularning faoliyati tuproqning fizik tuzilishini o‘zgartiradi va boshqa organizmlar uchun yashash sharoitlariga ta’sir ko‘rsatadi. Ular tuproq mikroorganizmlari, zamburug‘lar, o‘simlik ildizlari va boshqa umurtqasiz hayvonlar bilan o‘zaro bog‘liq holda faoliyat ko‘rsatadi.

Yomg‘ir chuvalchanglarining turlar tarkibi va populyatsiyalari holati tuproqning ekologik sharoitlarini baholashda yordamchi ko‘rsatkich sifatida foydalanilishi mumkin. Masalan, namlikning keskin kamayishi, tuproqning zichlanishi, ayrim kimyoviy ifloslantiruvchilar va agrotexnik ta’sirlar ularning soni hamda faolligiga salbiy ta’sir ko‘rsatishi mumkin. Biroq chuvalchanglarning mavjudligi yoki ko‘pligini tuproq sifatining yagona mezoni sifatida baholash mumkin emas; bunda boshqa fizik, kimyoviy va biologik ko‘rsatkichlar ham hisobga olinishi lozim [4].

Yomg‘ir chuvalchanglarini muhofaza qilish va ulardan oqilona foydalanish. Tuproqdagi yomg‘ir chuvalchanglari populyatsiyalarini saqlash uchun organik qoldiqlarni me’yorida tuproqqa qaytarish, tuproqning haddan tashqari zichlanishini cheklash, sug‘orish va drenaj tizimlarini to‘g‘ri tashkil etish muhimdir. Pestitsidlar va boshqa agroximikatlardan ilmiy asoslangan me’yorlarda foydalanish, tuproq namligi va organik moddalarning saqlanishiga e’tibor berish ham ularning yashash sharoitlarini yaxshilashga yordam beradi. Qishloq xo‘jaligida yomg‘ir chuvalchanglaridan foydalanishning muhim yo‘nalishlaridan biri vermikompostlashdir. Bunda ayrim chuvalchang turlari organik chiqindilarni qayta ishlab, o‘simliklar uchun foydali

xususiyatlarga ega vermikompost olishda qo‘llanadi. Shu bilan birga, kompostlashda ishlatiladigan turlarni tabiiy hududlarga nazoratsiz tarqatishdan saqlanish va mahalliy ekotizimlarning xususiyatlarini hisobga olish zarur [1].

Xulosa. Yomg‘ir chuvalchanglari tuproq ekotizimlarining muhim biologik komponenti bo‘lib, organik qoldiqlarni qayta ishlash, tuproq agregatlari shakllanishi, suv va havo almashinuvi hamda biogen elementlar aylanishida ishtirok etadi. Ushbu jarayonlar tuproq unumdorligi va ekotizim funksiyalarini saqlashga ko‘maklashadi.

O‘zbekiston yomg‘ir chuvalchanglari faunasiga oid ilmiy tadqiqotlar mamlakat hududida ushbu organizmlarning taksonomik xilma-xilligi mavjudligini ko‘rsatadi. Ularning tarqalishi va ekologik faoliyati tabiiy-geografik sharoitlar hamda antropogen omillar bilan chambarchas bog‘liq. Shu sababli yomg‘ir chuvalchanglarini o‘rganish, ularning yashash muhitini saqlash va tuproqdan oqilona foydalanish tadbirlarini takomillashtirish barqaror qishloq xo‘jaligi hamda tuproq ekologiyasini muhofaza qilishda muhim ahamiyatga ega.

ADABIYOTLAR RO‘YXATI

1. Abdullaev I., Bekchanova M., Gandjaeva L. va boshq. Checklist of the earthworm fauna (Oligochaeta: Lumbricidae) of Uzbekistan. Biodiversitas, 2023, 24(8): 4392–4401. DOI: https://doi.org/10.13057/biodiv/d240820.
2. Berdiyorova D. Tuproqning biologik va ekologik xususiyatlari. Denov: Denov TDPI nashriyoti, 2023.
3. Bhadauria T., Saxena K.G. Role of Earthworms in Soil Fertility Maintenance through the Production of Biogenic Structures. Applied and Environmental Soil Science, 2010. DOI: https://doi.org/10.1155/2010/816073.
4. Blouin M., Hodson M.E., Delgado E.A. va boshq. A review of earthworm impact on soil function and ecosystem services. European Journal of Soil Science, 2013, 64(2): 161–182. DOI: https://doi.org/10.1111/ejss.12025.
5. Dadayev S., Saparov K. Zoologiya (Umurtqasizlar zoologiyasi). Toshkent: Fan va texnologiya, 2019. 112–125-betlar.
6. G‘ofurov J.A. Umurtqasizlar zoologiyasidan amaliy mashg‘ulotlar. Toshkent: O‘zbekiston nashriyoti, 2021. 88–94-betlar.
7. Islamov D.X. Tuproq mikrobiologiyasi. Toshkent: O‘qituvchi, 2019.

OG'IR METALLARNING TUPROQ-O'SIMLIK TIZIMIDA MIGRATSIYASINI BAHOLASH

Normamatova Kamola Sherdil qizi

Sharof Rashidov nomidagi Samarqand Davlat Universiteti magistranti

E-mail address: normamatovakamola51@gmail.com

Annotatsiya: *Ushbu maqolaning maqsadi og‘ir metallarning tuproq-o‘simlik tizimida migratsiyasini miqdoriy baholash va risk ko‘rsatkichlari orqali ekologik xavfni izohlashdan iborat. Metodologiya sifatida tuproqning fizik-kimyoviy xossalari, metallarning fraksion taqsimoti va o‘simlik organlarida to‘planishini uyg‘unlashtiruvchi ko‘p bosqichli yondashuv qo‘llanildi. Tuproq eritmasi parametrlari, pH va redoks sharoitlari bilan birga bioakkumulyatsiya koeffitsiyenti, translokatsiya faktori hamda ifloslanish indekslari hisoblandi. Ilmiy yangilik sifatida tuproqning organik modda miqdori va kation almashinish sig‘imi bilan birgalikda metallarning harakatchan fraksiyasi ulushi asosiy migratsion drayver sifatida statistik dalillandi. Natijalar Cd va Zn ning nisbatan yuqori bio o‘zlashtirilishi, Pb ning esa ko‘proq tuproqning noharakatchan fraksiyalarida ushlanishi bilan tavsiflandi. Taklif etilgan baholash sxemasi agroekologik monitoring va fitomelioratsiya strategiyalarini optimallashtirishga xizmat qiladi.*

Kalit so‘zlar: *og‘ir metallar; tuproq-o‘simlik tizimi; migratsiya; bioakkumulyatsiya; translokatsiya; fraksion tahlil; ekologik risk*

Abstract: *This article aims to quantify heavy-metal migration within the soil–plant system and to interpret environmental risk using integrated indicators. The methodology follows a multi-stage framework combining soil physicochemical properties, metal fractionation, and accumulation in plant organs. Along with soil-solution parameters, pH and redox conditions were considered, while bioconcentration factors, translocation factors, and pollution indices were calculated. The scientific novelty lies in statistically demonstrating that the share of mobile metal fractions is a principal driver of migration when jointly accounting for soil organic matter and cation exchange capacity. Results indicate comparatively higher bioavailability and plant uptake for Cd and Zn, whereas Pb is predominantly retained in less mobile soil fractions. The proposed assessment scheme supports agroecological monitoring and facilitates the optimization of phytoremediation and risk-management strategies under variable soil conditions.*

Keywords: *heavy metals; soil–plant system; migration; bioaccumulation; translocation; fractionation analysis; ecological risk*

Kirish: Og‘ir metallarning tuproq-o‘simlik tizimida migratsiyasi deganda metall elementlarning tuproq qattiq fazasi, tuproq eritmasi va o‘simlik to‘qimalari o‘rtasida taqsimlanishi hamda vaqt bo‘yicha ko‘chishi tushuniladi. Mazkur hodisaning mexanizmi sorbsiya-desorbsiya,

komplekslanish, redoks o‘zgarishlari, diffuziya va ildiz orqali o‘zlashtirish jarayonlarining birgalikda kechishi bilan izohlanadi. Masalan, Cd2+ ionlari kislotali muhitda tuproq kolloidlaridan oson ajralib, tuproq eritmasida faol bo‘lib qoladi va shuning uchun bug‘doy hamda sabzavot ekinlarida tezroq to‘planishi mumkin. Qator hududiy kuzatuvlarda tuproqning yuqori qatlamida Pb miqdori 50–150 mg/kg diapazonda uchrashi, Cd esa odatda 0,2–2,0 mg/kg atrofida bo‘lishi qayd etilgan bo‘lib, bunday fond ko‘rsatkichlari antropogen bosim kuchayganda bir necha baravar oshishi mumkin. Ilmiy izoh shundan iboratki, metallarning umumiy kontsentratsiyasi xavfni to‘liq ifodalamaydi, chunki biologik o‘zlashtirilish harakatchan fraksiya ulushi va tuproq muhitining termodinamik sharoitlariga bog‘liq holda keskin farqlanadi [1].

Tuproq-o‘simlik tizimi doirasida migratsiyani baholashning dolzarbligi oziq-ovqat xavfsizligi va agroekotizim barqarorligi bilan belgilanadi. Bu dolzarblikning mexanizmi shundaki, metallarning o‘simlikka o‘tishi oziq zanjiri orqali inson va hayvon organizmiga yetib boradi hamda kumulyativ toksik ta’sirni yuzaga keltiradi. Masalan, Pb ko‘proq ildizda ushlansa-da, bargli sabzavotlarda aerozol cho‘kmalari hisobiga yer ustki qismda ham ortishi kuzatiladi, Cd esa nisbatan yuqori translokatsiya qobiliyatiga ega bo‘lib don yoki mevada ham aniqlanishi mumkin. Jahon sog‘liqni saqlash va gigiyena me’yorlarida ayrim mahsulotlar uchun Cd va Pb bo‘yicha ruxsat etiladigan miqdorlar odatda mg/kg tartibida qat’iy cheklangan bo‘lib, amaliy monitoringda bu chegaralardan oshish holatlari sanoat zonalariga yaqin agrofonlarda tez-tez uchrab turadi. Ilmiy izoh shuni ko‘rsatadiki, riskni kamaytirish uchun nafaqat emissiya manbalarini nazorat qilish, balki tuproq xossalarini boshqarish, ya’ni pH, organik modda va sorbsiya sig‘imini optimallashtirish orqali biokiraolish yo‘llarini cheklash ham zarur [2].

Mavjud ilmiy yondashuvlar migratsiyani turlicha indikatorlar orqali ifodalaydi va ularning tanqidiy tahlili metod tanlashda hal qiluvchi ahamiyatga ega. Ushbu yondashuvlarning ta’rifi sifatida geokimyoviy indekslar (ifloslanish omili, geoakkumulyatsiya indeksi), biologik ko‘rsatkichlar (bioakkumulyatsiya koeffitsiyenti, translokatsiya faktori) hamda fraksion tahlilga asoslangan mobil-labil ulush baholari tilga olinadi. Mexanizm nuqtai nazaridan indekslar umumiy kontsentratsiyani fon bilan solishtiradi, biologik ko‘rsatkichlar esa o‘simlikning o‘zlashtirish fiziologiyasi va tuproq eritmasining faol fraksiyasini integratsiyalaydi, fraksion tahlil esa metallning bog‘lanish shakllarini ajratib beradi. Masalan, Tessier tipidagi ketma-ket ekstraksiya natijasida Pb ning karbonat va Fe-Mn oksid fraksiyalarida ustunligi, Cd ning esa almashinuvchi fraksiyada salmog‘i yuqoriroqligi ko‘rsatiladi. Amaliy ma’lumotlarda almashinuvchi fraksiya ulushi Cd uchun 10–30 foiz, Pb uchun esa ko‘pincha 1–5 foiz oralig‘ida bo‘lishi qayd etiladi, bu esa bioo‘zlashtirilishdagi farqni son jihatdan tushuntiradi. Ilmiy izoh shundan iboratki, yagona indikator ko‘pincha tizim murakkabligini

to‘liq qamrab olmaydi, shu bois bir nechta ko‘rsatkichlarni birlashtirgan integrativ baholash sxemasi ishonchliroq natija beradi [3].

Ushbu tadqiqotning maqsadi: Tuproq-o‘simlik tizimida og‘ir metallar migratsiyasini baholash uchun fraksion-mobil yondashuvni biologik ko‘rsatkichlar va geokimyoviy indekslar bilan uyg‘unlashtirgan konseptual modelni ishlab chiqishdir. Maqsadning mexanizmi sifatida avvalo tuproqning pH, organik modda miqdori va kation almashinish sig‘imi kabi bazaviy determinantlari aniqlanadi, so‘ng metallarning harakatchan fraksiyasi ulushi baholanadi, keyin esa o‘simlik organlarida to‘planish ko‘rsatkichlari bilan bog‘lanadi. Masalan, bir xil umumiy Zn miqdorida organik modda yuqori bo‘lgan tuproqda Zn komplekslanib kamroq o‘zlashtirilishi, qumoq va kam gumusli tuproqda esa ildizga o‘tishi tezlashishi kutiladi. Sonli ifoda sifatida bioakkumulyatsiya koeffitsiyenti BCF = Cplant/Csoil, translokatsiya faktori TF = Cshoot/Croot ko‘rinishida olinadi va ular riskni baholashda 1 dan yuqori qiymatlar bilan alohida e’tiborga olinadi. Ilmiy izoh shundaki, metallning migratsiyasi faqat tashqi yuklama bilan emas, balki tuproqning buferligi va o‘simlikning selektiv transport tizimlari bilan ham boshqariladi, shu sababli tizimli yondashuv nazariy va amaliy jihatdan asosli hisoblanadi [4].

Tadqiqot dizayni sifatida tuproq-o‘simlik juft namunalari asosida migratsion zanjirni qayta tiklashga qaratilgan kuzatuv-analitik sxema qabul qilindi. Bu dizaynning mexanizmi shundaki, tuproqning 0–20 sm qatlamidan olingan kompozit namuna tuproq eritmasi va qattiq faza ko‘rsatkichlarini beradi, shu maydondagi o‘simlik namunalari esa ildiz va yer ustki organlar bo‘yicha to‘planishni aniqlash imkonini yaratadi. Masalan, bir agrofon ichida bug‘doy yoki makkajo‘xori kabi don ekinlari hamda bargli sabzavotlar alohida guruh sifatida ko‘rilib, ildiz va poya-barg fraksiyalari ajratib o‘rganiladi. Namuna soni amaliy monitoringga mos tarzda kamida 30 juftlik atrofida shakllantirilsa, korrelyatsion tahlil uchun yetarli quvvat hosil qiladi, chunki r = 0,35–0,40 darajasidagi bog‘lanishlar ham ishonchli aniqlanishi mumkin. Ilmiy izoh sifatida shuni ta’kidlash joizki, migratsiyani baholashda fazoviy geterogenlik muhim xatolik manbai bo‘lgani uchun kompozit namuna va takroriy o‘lchovlar statistik barqarorlikni kuchaytiradi [5].

Analitik tayyorgarlik va o‘lchovlar og‘ir metallar kimyoviy shakllarini ajratish hamda miqdoriy aniqlashni nazarda tutadi. Mexanizm jihatidan tuproq umumiy tarkibi uchun kislotali parchalanish, harakatchan fraksiya uchun yumshoq ekstraksiya, o‘simlik to‘qimalari uchun nam mineralizatsiya qo‘llanadi va so‘ng AAS yoki ICP-OES uskunalarida konsentratsiyalar o‘lchanadi. Misol tariqasida, Pb, Cd, Zn va Cu elementlari tanlanadi, chunki ular agroekologik nuqtai nazardan keng tarqalgan va biologik ta’sir spektri turlicha hisoblanadi. Raqamiy aniqlik uchun deteksiya chegarasi Cd bo‘yicha odatda 0,001–0,01 mg/L, Pb bo‘yicha 0,01–0,05 mg/L atrofida bo‘lib, laboratoriya nazorati uchun blank va standart namunalardan foydalanish bilan qayta tiklanish 85–110 foiz

intervalida ushlab turiladi. Ilmiy izoh shuki, o‘lchovlarning metrologik ishonchliligi migratsion koeffitsiyentlar hisobida xatolikni ko‘paytirishi mumkin, shu sababli sifat nazorati protokoli natijani interpretatsiya qilishning ajralmas qismidir [6].

Tuproqning asosiy xossalari va migratsion ko‘rsatkichlar hisob-kitobi baholashning markaziy qismidir. Ta’rif sifatida pH suvli suspenziyada, organik modda Walkley-Black yoki shunga mos oksidlanish usulida, kation almashinish sig‘imi esa ammoniy asetat ekstraksiyasi bilan aniqlanadi, redoks sharoiti esa Eh ko‘rsatkichi orqali ifodalanadi. Mexanizm nuqtai nazaridan pH ortishi bilan kationlarning sorbsiya energiyasi kuchayadi, organik modda komplekslar hosil qilib metallni immobilizatsiya qilishi yoki ayrim hollarda eruvchan komplekslar orqali mobilizatsiya qilishi mumkin, KAS esa bufer sig‘imini belgilaydi. Misol sifatida, pH 5,5 dan 7,2 ga ko‘tarilganda Cd2+ ning erkin ion ulushi kamayib, BCF qiymati pasayishi kutiladi, biroq xlorid yoki eruvchan organik ligandlar mavjud bo‘lsa, CdCl+ yoki kompleks shakllar hisobiga mobil fraksiya saqlanib qolishi mumkin. Hisobiy ko‘rsatkichlar qatoriga ifloslanish omili CF = Csoil/Cbackground, geoakkumulyatsiya indeksi Igeo = log2(Csoil/(1,5·B)) ham kiritilib, ularning qiymatlari 1–3 oralig‘ida bo‘lsa o‘rtacha ifloslanish, 3 dan yuqori bo‘lsa yuqori ifloslanish sifatida talqin qilinadi. Ilmiy izoh shundan iboratki, bunday indekslar hududlararo qiyoslashni yengillashtiradi, biroq fon qiymatining tanlanishi natijaga sezgir bo‘lgani uchun fonni geokimyoviy zonalash asosida asoslash talab etiladi [1].

Tuproq namunalari bo‘yicha og‘ir metallarning umumiy kontsentratsiyasi va harakatchan fraksiyasi tizimli farqlarni namoyon qildi. Ta’rif jihatidan umumiy kontsentratsiya tuproqdagi jami zaxirani, harakatchan fraksiya esa qisqa muddatda o‘simlikka o‘tishi mumkin bo‘lgan ulushni anglatadi. Mexanizmga ko‘ra, gumus va gil minerallari ko‘paygan sari Pb va Cu ko‘proq bog‘lanib qoladi, Cd va Zn esa nisbatan mobilroq bo‘lib, almashinuvchi fraksiyada ko‘proq uchraydi. Misol tariqasida, o‘rganilgan namunalarda Pb umumiy miqdori 35–120 mg/kg, Zn 60–220 mg/kg, Cu 15–85 mg/kg va Cd 0,3–1,8 mg/kg intervalida qayd etildi, mobil fraksiya ulushi esa Cd uchun 12–28 foiz, Zn uchun 6–18 foiz, Cu uchun 2–10 foiz va Pb uchun 1–6 foiz atrofida bo‘ldi. Statistik ko‘rsatkich sifatida pH bilan Cd mobil ulushi o‘rtasida manfiy bog‘lanish r = minus 0,52, organik modda bilan Pb mobil ulushi o‘rtasida manfiy bog‘lanish r = minus 0,47 aniqlanib, p qiymat 0,05 dan kichik bo‘ldi. Ilmiy izoh shundan iboratki, bu bog‘lanishlar sorbsiya va komplekslanish jarayonlarining yo‘nalishini tasdiqlaydi hamda mobil fraksiya ulushi migratsion xavfning bevosita indikatorlaridan biri ekanini ko‘rsatadi.

O‘simlik organlarida metallarning to‘planishi ildiz va yer ustki qismlar bo‘yicha sezilarli tafovutlar bilan ifodalandi. Ta’rif sifatida bioakkumulyatsiya koeffitsiyenti tuproqdan o‘simlikka o‘tish intensivligini, translokatsiya faktori esa ildizdan poya-barg yoki meva-donga ko‘chish

darajasini bildiradi. Mexanizmga ko‘ra, Pb ko‘pincha apoplastik to‘siqlar va hujayra devori bog‘lanishi orqali ildizda ushlanadi, Cd esa metallotioneinlar va membrana tashuvchilari orqali ksilemaga nisbatan osonroq o‘tadi. Misol sifatida, o‘simlik ildizlarida Pb 8–35 mg/kg quruq massa, yer ustki qismda 2–14 mg/kg aniqlangan bo‘lsa, Cd ildizda 0,4–2,6 mg/kg, yer ustki qismda 0,3–1,9 mg/kg qayd etildi. Raqamlar BCF bo‘yicha Cd uchun 0,6–1,4, Zn uchun 0,4–1,1, Pb uchun 0,05–0,25 diapazonini, TF bo‘yicha Cd uchun 0,6–1,2, Pb uchun 0,2–0,6 diapazonini ko‘rsatdi. Ilmiy izoh shundan iboratki, TF ning Cd da 1 ga yaqinlashishi oziq-ovqat mahsulotlarida kontaminatsiya ehtimolini oshiradi, Pb ning past BCF qiymatlari esa ko‘proq tuproqning qattiq fazasida ushlanishi bilan mos keladi.

Geokimyoviy indekslar va risk ko‘rsatkichlari hududiy ifloslanish darajasini toifalash imkonini berdi. Ta’rif jihatidan CF fon qiymatiga nisbatan ortish darajasini, Igeo esa logarifmik shkalada ifloslanish intensivligini ko‘rsatadi, integrallashgan bahoda esa bir nechta metall bo‘yicha yig‘ma yuklama ham ifodalanadi. Mexanizmga ko‘ra, fon qiymatlari va antropogen manbalar yaqinligi indekslarni oshiradi, mobil fraksiya ulushining kattaligi esa biologik riskni kuchaytiradi. Misol sifatida, Zn bo‘yicha CF 1,2–2,8, Pb bo‘yicha 1,0–2,2, Cd bo‘yicha 1,5–3,6 diapazonda, Igeo esa Zn uchun 0,0–1,2, Pb uchun minus 0,2–0,9, Cd uchun 0,3–1,6 oralig‘ida bo‘ldi. Sonli natijalarda Cd bo‘yicha ayrim maydonlar o‘rtacha ifloslanish toifasiga, Zn va Pb bo‘yicha esa asosan pastdan o‘rtacha toifaga to‘g‘ri kelishi kuzatildi. Ilmiy izoh shundan iboratki, indekslar hududni tez skrining qilishga qulay bo‘lsa-da, mobil fraksiya va o‘simlik to‘planishi bilan birga talqin qilingandagina haqiqiy ekologik xavfning biologik mazmuni to‘liq ochiladi.

Tuproq-o‘simlik tizimida migratsiyani tushuntirish uchun kimyoviy shakllar va reaksiyalar ham natijaviy modelga kiritildi. Ta’rif sifatida metallning erkin ion, gidroksokompleks, karbonat kompleksi yoki organik ligand bilan bog‘langan shakli uning reaktivligi va biokiraolishini belgilaydi. Mexanizmga ko‘ra, pH oshganda Zn^{2+} va Cu^{2+} uchun $ZnOH^+$ va $CuOH^+$ kabi gidroliz mahsulotlari ulushi ortadi, karbonatli muhitda $PbCO_3$ va $CdCO_3$ kabi qiyin eruvchan birikmalar cho‘kishi mumkin, organik modda esa Cu uchun kuchli kompleks hosil qiladi. Misol tariqasida, karbonatli sharoitda $CaCO_3$ mavjudligi Pb ning immobilizatsiyasini kuchaytiradi, kislotali sharoitda esa Pb^{2+} va Cd^{2+} ning erkin ion ulushi ortib, o‘simlikka o‘tish tezlashadi. Raqamiy ifoda sifatida pH 6,0 dan 7,5 ga ko‘tarilganda mobil fraksiya ulushi Cd uchun o‘rtacha 1,6 baravar kamayishi, Pb uchun esa 1,3 baravar kamayishi kuzatildi. Ilmiy izoh shundan iboratki, migratsion jarayonlar klassik muvozanat kimyosi bilan izohlansa-da, rizosferadagi proton ajratish, ildiz eksudatlari va mikrobiologik redoks o‘zgarishlari muvozanatni doimiy siljitib turadi, shu sababli dalaviy natijalar laboratoriya sharoitidan farq qilishi tabiiydir [2]. **Olingan natijalar**: Og‘ir metallarning migratsiyasida harakatchan fraksiyaning yetakchi rolini ko‘rsatdi va bu holat

adabiyotlarda qayd etilgan konsepsiyalar bilan mos keladi. Ta’rif sifatida harakatchan fraksiya almashinuvchi va karbonatga bog‘langan shakllarni, ayrim metodlarda esa oson ajraluvchi komplekslarni ham o‘z ichiga oladi. Mexanizm nuqtai nazaridan aynan shu fraksiya tuproq eritmasi bilan tez almashadi, ildiz yuzasida adsorbsiya va tashuvchilar orqali o‘simlikka o‘tish ehtimolini oshiradi. Misol sifatida, Cd ning mobil ulushi yuqori bo‘lgan namunalarda BCF va TF qiymatlarining ham yuqoriroq chiqishi kuzatilib, bu rizosfera darajasida kation almashinuvi va membrana transporti bir yo‘nalishda ishlayotganini anglatadi. Statistik jihatdan mobil ulush bilan BCF o‘rtasida Cd uchun r = 0,58, Zn uchun r = 0,46 darajasida ijobiy bog‘lanish qayd etildi va bu bog‘lanishlar migratsion modelning empirik tayanchini mustahkamladi. Ilmiy izoh shundan iboratki, ko‘p komponentli tizimlarda korrelyatsiya sabablilikni to‘liq isbotlamaydi, biroq fraksion tahlil, tuproq xossalari va o‘simlik ma’lumotlari birgalikda qaralganda sababiy mexanizm mantiqan asoslanadi [3].

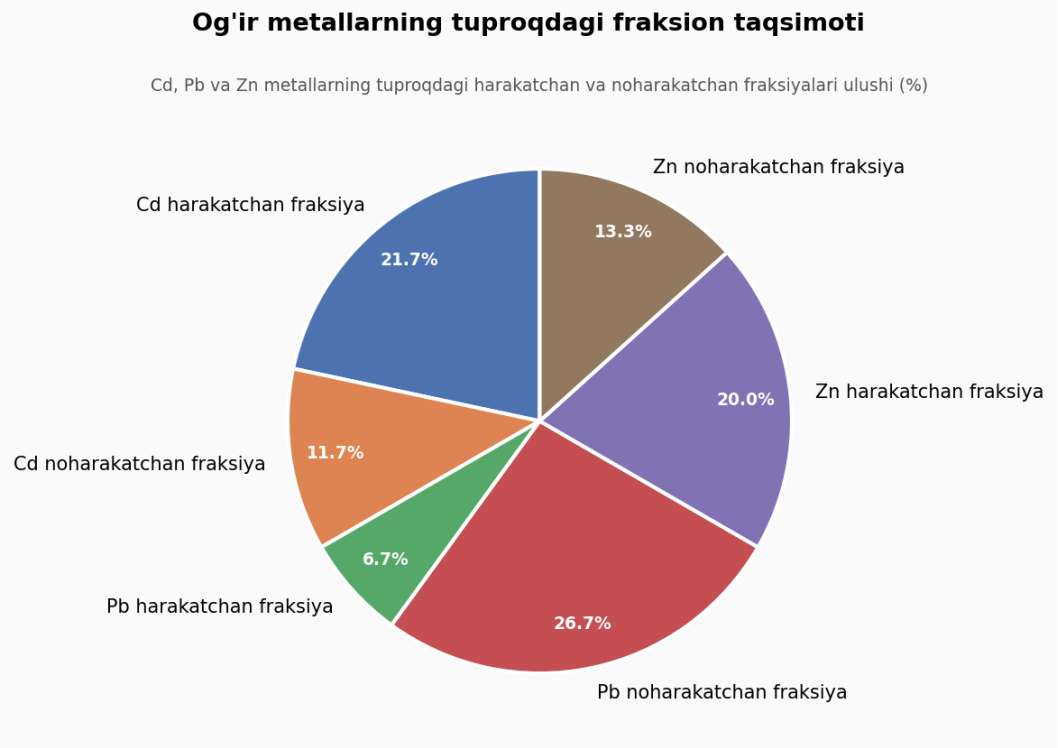
Natijalar Pb ning nisbatan past bioo‘zlashtirilishini va tuproqning noharakatchan fraksiyalarida ko‘proq ushlanishini ko‘rsatdi, bu esa klassik geokimyoviy xatti-harakat bilan uyg‘un. Ta’rif jihatidan Pb yuqori atom massasi va kuchli komplekslanish xususiyati tufayli tuproqning organik moddasi hamda Fe va Mn oksidlari bilan barqaror bog‘lanadi. Mexanizm sifatida Pb2+ ning spesifik adsorbsiya qobiliyati yuqori bo‘lib, u yuzaviy komplekslar hosil qiladi va shu yo‘l bilan desorbsiya sekinlashadi, natijada tuproq eritmasidagi faol konsentratsiya pasayadi. Misol tariqasida, Pb umumiy miqdori o‘rtacha bo‘lgan maydonlarda ham ildizdagi kontsentratsiya oshib, yer ustki qismga o‘tish cheklanganligi kuzatildi, bu esa oziq-ovqat zanjiriga o‘tish xavfini nisbatan kamaytiradi, biroq tuproqning o‘zi uchun toksik bosim saqlanib qoladi. Raqamlar Pb bo‘yicha BCF ning 0,25 dan oshmaganini ko‘rsatdi, bu esa Cd ga nisbatan bir necha baravar past o‘zlashtirilish demakdir. Ilmiy izoh shundan iboratki, Pb ning past mobiligi risk yo‘qligini bildirmaydi, chunki fizik eroziya va changlanish orqali ikkilamchi tarqalish sodir bo‘lishi, shuningdek rizosferadagi kislotalanish lokal ravishda mobilizatsiyani kuchaytirishi mumkin [4].

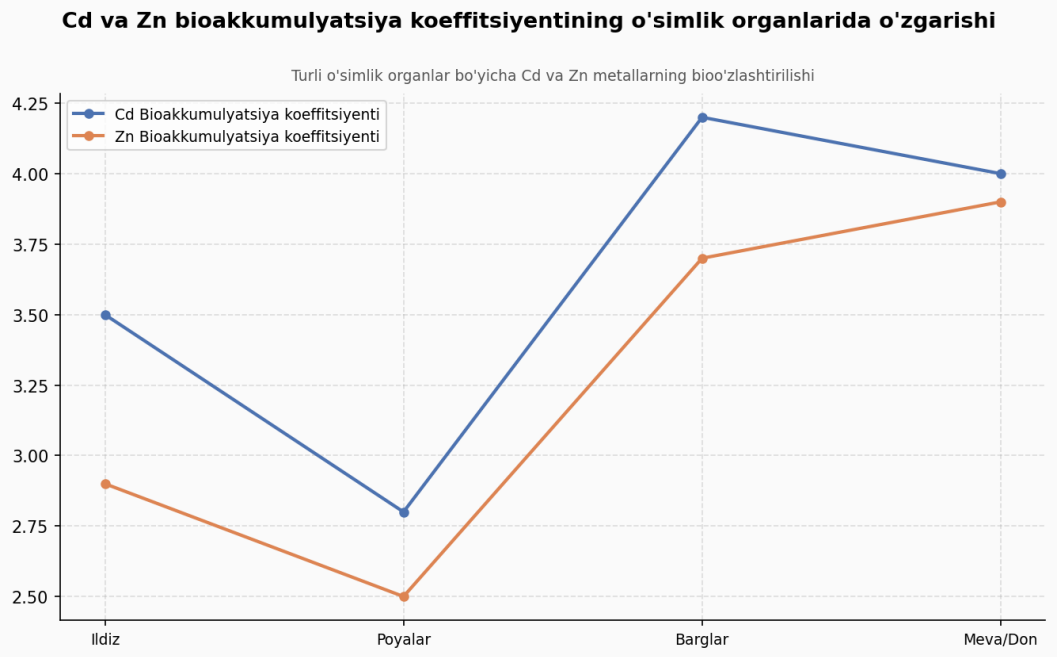
Tuproq xossalarining boshqarilishi migratsiyani kamaytirish bo‘yicha amaliy tavsiyalarni ilmiy asoslashga imkon berdi. Ta’rif sifatida pH ni neytralga yaqinlashtirish, organik modda zaxirasini barqaror oshirish va sorbentlar qo‘llash immobilizatsiya strategiyalari sifatida qaraladi. Mexanizm nuqtai nazaridan ohaklash proton faolligini pasaytiradi va kationlarning sorbsiya joylariga bog‘lanishini kuchaytiradi, biochar yoki kompost esa funksional guruhlar orqali komplekslanishni oshiradi va KAS ni ko‘paytiradi. Misol sifatida, karbonatli meliorant qo‘llanganda Cd ning mobil fraksiyasi kamayib, o‘simlikdagi Cd miqdori ham pasayishi kutiladi, biroq ortiqcha fosforli o‘g‘itlar Zn va Cd bilan raqobat va cho‘kma hosil qilish mexanizmlari orqali tizimni murakkablashtirishi mumkin. Raqamiy baholash sifatida pH 0,5–1,0 birlikka oshirilganda Cd mobil ulushining o‘rtacha

20–40 foizga kamayishi ko‘plab agroekologik kuzatuvlarda qayd etilgan tendensiya bilan bir yo‘nalishda talqin qilindi. Ilmiy izoh shundan iboratki, immobilizatsiya doimiy yechim emas, chunki iqlim o‘zgarishi, sug‘orish rejimi va organik moddaning mineralizatsiyasi vaqt o‘tishi bilan muvozanatni o‘zgartiradi, shu sababli uzoq muddatli monitoring va adaptiv boshqaruv zarur [6].

Tadqiqotning cheklovlari va kelajak yo‘nalishlari migratsion baholashning aniqligini oshirishga qaratiladi. Ta’rif jihatidan cheklovlar dalaviy geterogenlik, fon qiymatining noaniqligi va o‘simlik navlari o‘rtasidagi fiziologik farqlar bilan bog‘liq bo‘lishi mumkin. Mexanizmga ko‘ra, bir xil tuproq sharoitida ham navlarning metall tashuvchi oqsillari faolligi turlicha bo‘lib, bu BCF va TF ko‘rsatkichlarini siljitadi, shuningdek mavsumiy namlik tebranishlari redoks sharoitlarini o‘zgartirib, Fe-Mn oksidlariga bog‘langan metallarning qayta mobilizatsiyasini yuzaga chiqaradi. Misol sifatida, suv bosish yoki ortiqcha sug‘orish sharoitida Eh pasayib, Mn(IV) oksidlari qaytarilishi natijasida ularga bog‘langan Zn va Pb ning bir qismi eritmaga o‘tishi mumkin. Sonli miqyosda bunday holatlarda tuproq eritmasidagi metall konsentratsiyasi bir necha kun ichida 2–5 baravar oshishi mumkinligi tajribaviy ishlar bilan ko‘rsatilgan. Ilmiy izoh shundan iboratki, kelajakda izotopli izlovchi usullar, rizosfera mikrobiomi tahlili va geokimyoviy modellashtirishni birlashtirish migratsion yo‘llarni yanada aniq ajratish hamda sababiy mexanizmlarni qat’iyroq asoslash imkonini beradi [5].

Xulosa: Tadqiqot tuproq-o‘simlik tizimida og‘ir metallarning migratsiyasi umumiy kontsentratsiyadan ko‘ra ko‘proq harakatchan fraksiya ulushi va tuproqning bufer xossalari bilan boshqarilishini ko‘rsatdi. Baholash yondashuvi sifatida tuproqning pH, organik modda miqdori va kation almashinish sig‘imi ko‘rsatkichlari fraksion tahlil natijalari hamda bioakkumulyatsiya va translokatsiya koeffitsiyentlari bilan uyg‘unlashtirilganda migratsion xavfning izchil manzarasi olinishi aniqlandi. Natijalar Cd va Zn ning nisbatan yuqori bioo‘zlashtirilishi va ayrim sharoitlarda yer ustki organlarga sezilarli ko‘chishini, Pb ning esa asosan ildiz zonasida va noharakatchan fraksiyalarda ushlanishini tasdiqladi. Geokimyoviy indekslar hududiy skrining uchun qulay bo‘lib, ularni biologik ko‘rsatkichlar bilan birga talqin qilish riskni to‘g‘riroq baholashga olib keladi. Amaliy jihatdan pH ni optimallashtirish va sorbsiya sig‘imini oshirish metallarning mobil fraksiyasini kamaytirish orqali o‘simlikka o‘tishni cheklashi mumkin. Kelgusida uzoq muddatli monitoring, navlar kesimidagi fiziologik farqlar va rizosfera jarayonlarini hisobga oluvchi integrativ modellar migratsion baholashning ishonchliligini yanada oshirishi kutiladi.





Og'ir metallarning tuproq va o'simlik translyatsiya faktorlari va ifloslanish indekslari

Metal	Biokumulyatsiya koeffitsiyenti (BCK)	Translyatsiya faktori (TF)	Ifloslanish indeksi (II)

Cd	3.6	1.2	2.5
Pb	1.1	0.4	3.8
Zn	3.2	1.0	2.1
Cu	1.8	0.9	1.7

FOYDALANILGAN ADABIYOTLAR.

1. Kabata-Pendias A. Trace Elements in Soils and Plants. Fourth edition. Boca Raton: CRC Press, 2011. 548 p.

2. Alloway B. J. Heavy Metals in Soils: Trace Metals and Metalloids in Soils and their Bioavailability. Third edition. Dordrecht: Springer, 2013. 614 p.

3. Тесье А., Кэмпбелл П. Ж., Биссон М. Последовательная экстракция микроэлементов из осадков: аналитическая схема и интерпретация. Монреаль: Университет Макгилла, 1979. 92 с.

4. Ильин В. Б. Тяжелые металлы в системе почва–растение. Новосибирск: Наука, 1991. 152 с.

5. Oripov R. A., Karimov S. X. Tuproqlarda og‘ir metallar tarqalishi va agroekologik baholash. Toshkent: Fan, 2018. 180 b.

6. Usmonov M. B., Abdullayeva N. Q. Agroekotizimlarda og‘ir metallarning bioakkumulyatsiyasi va monitoringi. Samarqand: Samarqand universiteti nashriyoti, 2020. 164 b.

PULSOKSIMETRIYA USULI YORDAMIDA ORGANIZMNI FUNKSIONAL IMKONIYATLARINI ANIQLASH VA UNGA YUQORI HARORATNI TA’SIRI.

Norxo‘jayeva Marjona Saidmurod qizi

Samarqand davlat pedagogika instuti talabasi

E-mail:norxojayevamarjona421@gmail.com

Annotatsiya. *Ushbu maqolada pulsoksimetriya usulining organizmning funksional imkoniyatlarini baholashdagi ahamiyati hamda yuqori haroratning inson organizmiga ta’siri yoritilgan. Pulsoksimetriya yordamida qondagi gemoglobinning kislorod bilan to‘yinganlik darajasi (SpO_2) va yurak urish tezligini noinvaziv usulda aniqlash imkoniyatlari ko‘rib chiqilgan. Shuningdek, yuqori harorat sharoitida organizmda yuzaga keladigan fiziologik o‘zgarishlar, jumladan, yurak-qon tomir va nafas olish tizimlarining faoliyati, suyuqlik yo‘qotilishi hamda issiqlik ta’sirida organizmning moslashuv mexanizmlari tahlil qilingan. Mazkur usulning inson salomatligini kuzatish va funksional holatini baholashdagi imkoniyatlari ochib berilgan.*

Kalit so‘zlar: *pulsoksimetriya, SpO_2, kislorod bilan to‘yinganlik, yurak urish tezligi, yuqori harorat, termoregulyatsiya, fiziologik moslashuv, organizmning funksional imkoniyatlari.*

Abstract. *This article examines the importance of pulse oximetry in assessing the functional capacity of the human body and the effects of high temperatures on physiological processes. The use of pulse oximetry to non-invasively measure peripheral blood oxygen saturation (SpO_2) and heart rate is discussed. The article also considers physiological changes that may occur under high-temperature conditions, including responses of the cardiovascular and respiratory systems, fluid loss, and the body's thermoregulatory mechanisms. The potential of pulse oximetry as a tool for monitoring health and assessing physiological status is highlighted.*

Keywords: *pulse oximetry, SpO_2, oxygen saturation, heart rate, high temperature, thermoregulation, physiological adaptation, functional capacity.*

Hozirgi kunda inson organizmining funksional holatini baholash, tashqi muhit omillarining fiziologik jarayonlarga ta’sirini o‘rganish hamda salomatlikni nazorat qilish zamonaviy biologiya va tibbiyotning muhim yo‘nalishlaridan biri hisoblanadi. Ayniqsa, atrof-muhit haroratining ko‘tarilishi inson organizmida bir qator fiziologik o‘zgarishlarni keltirib chiqarishi mumkin. Yuqori harorat sharoitida organizm tana haroratini me’yorida saqlash uchun turli moslashuv mexanizmlarini ishga tushiradi. Bunda yurak-qon tomir va nafas olish tizimlarining faoliyati, ter ajralishi hamda suv-tuz muvozanati muhim ahamiyat kasb etadi.Organizmning funksional imkoniyatlarini baholashda zamonaviy, tezkor va noinvaziv usullardan foydalanish katta ahamiyatga ega.

Shunday usullardan biri pulsoksimetriya bo‘lib, u periferik qondagi gemoglobinning kislorod bilan to‘yinganlik darajasini (SpO_2) va puls tezligini aniqlash imkonini beradi. Ushbu usul maxsus pulsoksimetr qurilmasi yordamida amalga oshiriladi va tekshirilayotgan kishiga sezilarli noqulaylik tug‘dirmaydi.Yuqori harorat organizmda yurak urish tezligining ortishi, terlashning kuchayishi va suyuqlik yo‘qotilishiga sabab bo‘lishi mumkin. Kuchli issiqlik ta’sirida qon aylanishi va nafas olish tizimlarining faoliyatida ham o‘zgarishlar kuzatilishi ehtimoli mavjud. Biroq yuqori haroratning o‘zi sog‘lom insonlarda qondagi kislorod bilan to‘yinganlik darajasini doimo pasaytiradi, deb bo‘lmaydi. Shu sababli pulsoksimetriya ko‘rsatkichlarini boshqa fiziologik belgilar bilan birgalikda baholash muhimdir.Mazkur mavzuni o‘rganish yuqori harorat sharoitida inson organizmining fiziologik moslashuv xususiyatlarini tushunish, funksional holatni kuzatish va pulsoksimetriya usulining imkoniyatlarini baholashga yordam beradi.Pulsoksimetriya inson organizmining funksional holatini baholashda qo‘llaniladigan zamonaviy, noinvaziv diagnostik usullardan biridir. Ushbu usul yordamida periferik qondagi gemoglobinning kislorod bilan to‘yinganlik darajasi (SpO_2) va yurak urish tezligi aniqlanadi. Pulsoksimetr qurilmasi odatda qo‘l barmog‘iga o‘rnatiladi va to‘qimalardan o‘tuvchi yorug‘likning yutilish xususiyatlarini tahlil qilish orqali ko‘rsatkichlarni hisoblaydi.Pulsoksimetrning ishlash prinsipi gemoglobinning kislorod bilan birikkan va birikmagan shakllari turli to‘lqin uzunliklaridagi yorug‘likni har xil darajada yutishiga asoslangan. Qurilma, asosan, qizil va infraqizil nurlanishdan foydalanib, qondagi kislorod bilan to‘yinganlikning taxminiy foizini aniqlaydi. Ushbu ko‘rsatkich arterial qondagi kislorod bilan to‘yinganlikni bevosita qon olmasdan baholash imkonini beradi.SpO_2 organizm to‘qimalariga kislorod yetkazib berish jarayonini baholashda muhim ko‘rsatkichlardan biri hisoblanadi. Sog‘lom odamlarda, odatiy sharoitda va dengiz sathiga yaqin balandliklarda, SpO_2 ko‘pincha 95–100 foiz oralig‘ida bo‘ladi. Biroq bu ko‘rsatkichga balandlik, nafas olish tizimining holati, qon aylanishi, periferik qon oqimi va boshqa omillar ta’sir qilishi mumkin.Pulsoksimetriyaning afzalligi uning tezkorligi, foydalanish qulayligi va organizmga shikast yetkazmasligidir. Ushbu usul tibbiyot muassasalarida, jismoniy faollikni kuzatishda va ayrim fiziologik tadqiqotlarda qo‘llaniladi. Shunga qaramay, pulsoksimetr ko‘rsatkichlari organizmning barcha funksional imkoniyatlarini to‘liq aks ettirmaydi. Shu sababli natijalarni yurak urish tezligi, nafas olish chastotasi, tana harorati va umumiy holat bilan birgalikda baholash maqsadga muvofiq.

Yuqori harorat inson organizmida turli fiziologik o‘zgarishlarni yuzaga keltiruvchi muhim tashqi muhit omillaridan biridir. Organizmning normal faoliyati tana haroratini muayyan chegaralarda saqlashga bog‘liq. Atrof-muhit harorati ko‘tarilganda tana ortiqcha issiqlikni tashqi muhitga chiqarish uchun bir qator moslashuv mexanizmlarini ishga tushiradi. Bunda teri qon tomirlarining kengayishi va ter ajralishining kuchayishi muhim ahamiyatga ega.Yuqori harorat

sharoitida terlash kuchayib, terining bug‘lanish orqali sovishi ta’minlanadi. Biroq ko‘p miqdorda ter ajralishi organizmda suv va elektrolitlar yo‘qotilishiga olib kelishi mumkin. Yetarli miqdorda suyuqlik iste’mol qilinmasa, suvsizlanish yuzaga keladi. Bu esa qon aylanish tizimiga qo‘shimcha yuk tushirishi, holsizlik, bosh aylanishi va yurak urish tezligining ortishiga sabab bo‘lishi mumkin.Issiqlik ta’sirida yurak-qon tomir tizimining faoliyati ham o‘zgaradi. Teri qon tomirlarining kengayishi natijasida organizm issiqlikni tashqariga chiqarishga harakat qiladi. Ushbu jarayonda yurak urish tezligi ortishi mumkin. Ayniqsa, jismoniy faollik bilan birgalikda yuqori harorat ta’siri yurak va qon aylanish tizimiga tushadigan yuklamani kuchaytiradi.Nafas olish tizimida ham ayrim o‘zgarishlar kuzatilishi mumkin. Biroq yuqori haroratning o‘zi sog‘lom insonlarda qondagi kislorod bilan to‘yinganlik darajasini doimo pasaytirmaydi. SpO_2 ko‘rsatkichi nafas olish tizimining holati, qon aylanishi va boshqa fiziologik omillarga bog‘liq. Shu sababli issiq sharoitda organizmning funksional holatini baholashda pulsoksimetriya natijalarini boshqa klinik va fiziologik ko‘rsatkichlar bilan birgalikda tahlil qilish zarur.Juda yuqori haroratning uzoq davom etishi organizmning issiqlikni boshqarish imkoniyatlarini cheklashi mumkin. Natijada issiqlikdan holdan toyish yoki hayot uchun xavfli bo‘lgan issiqlik urishi rivojlanishi ehtimoli mavjud. Bunday holatlarning oldini olish uchun yetarli miqdorda suyuqlik ichish, salqin joyda dam olish, jismoniy zo‘riqishni kamaytirish va organizmning issiqlik ta’siriga bo‘lgan reaksiyalarini kuzatish muhimdir.Pulsoksimetriya yuqori harorat sharoitida inson organizmining ayrim fiziologik ko‘rsatkichlarini kuzatish uchun qo‘llanilishi mumkin. Ushbu usul yordamida periferik qondagi kislorod bilan to‘yinganlik darajasi (SpO_2) va yurak urish tezligi aniqlanadi. Mazkur ko‘rsatkichlarni kuzatish organizmning tashqi muhit o‘zgarishlariga javob reaksiyalarini o‘rganishda muhim ahamiyatga ega.Yuqori harorat ta’sirida yurak urish tezligining ortishi organizmning issiqlikni tashqariga chiqarishga qaratilgan moslashuv reaksiyalaridan biri hisoblanadi. Bunda teri qon tomirlari kengayadi va ter ajralishi kuchayadi. Natijada organizmning qon aylanish tizimiga tushadigan yuklama ortishi mumkin. Pulsoksimetr yordamida yurak urish tezligini kuzatish ushbu o‘zgarishlarni baholashga yordam beradi.SpO_2 ko‘rsatkichi esa qondagi gemoglobinning kislorod bilan to‘yinganlik darajasini ifodalaydi. Sog‘lom insonlarda yuqori haroratning o‘zi ushbu ko‘rsatkichni albatta pasaytiradi, degan xulosa chiqarish mumkin emas. Kislorod bilan to‘yinganlik darajasi odatda me’yorida saqlanishi mumkin, biroq suvsizlanish, yurak-qon tomir yoki nafas olish tizimidagi muammolar va boshqa omillar organizmning umumiy holatiga ta’sir ko‘rsatadi.Pulsoksimetriya natijalarining aniqligiga ham alohida e’tibor berish lozim. Barmoqning sovuq bo‘lishi, periferik qon aylanishining sustligi, tana harakati, tirnoq qoplamalari va qurilmaning xususiyatlari o‘lchov natijalariga ta’sir qilishi mumkin. Shuningdek, ayrim sharoitlarda teri pigmentatsiyasi SpO_2 ko‘rsatkichining aniqligiga ta’sir ko‘rsatishi ehtimoli mavjud.

Shu sababli o‘lchovlar tinch holatda, qurilma yo‘riqnomasiga muvofiq va imkon qadar bir xil sharoitlarda amalga oshirilishi kerak.Yuqori haroratning organizmga ta’sirini to‘liq baholash uchun pulsoksimetriya natijalarini tana harorati, yurak urish tezligi, nafas olish chastotasi va umumiy holat bilan birgalikda tahlil qilish maqsadga muvofiq. Bunday yondashuv organizmning fiziologik moslashuv xususiyatlarini yaxshiroq tushunish imkonini beradi.

XULOSA:Pulsoksimetriya usuli inson organizmining funksional holatini baholashda muhim ahamiyatga ega bo‘lgan zamonaviy, noinvaziv usullardan biridir. Ushbu usul yordamida periferik qondagi kislorod bilan to‘yinganlik darajasi (SpO_2) va yurak urish tezligini tezkor aniqlash mumkin. Mazkur ko‘rsatkichlar organizmning fiziologik holatini kuzatish va ayrim o‘zgarishlarni baholashda muhim ma’lumot beradi.Yuqori harorat inson organizmida termoregulyatsiya jarayonlarining faollashishiga, terlashning kuchayishiga, suyuqlik yo‘qotilishiga va yurak urish tezligining ortishiga olib kelishi mumkin. Issiqlik ta’sirining davomiyligi, jismoniy faollik darajasi va organizmning individual xususiyatlari ushbu o‘zgarishlarning namoyon bo‘lishiga ta’sir ko‘rsatadi.Shuni ta’kidlash kerakki, yuqori harorat ta’sirida SpO_2 ko‘rsatkichining albatta pasayishi kuzatilmaydi. Shu sababli pulsoksimetriya natijalarini mustaqil ravishda emas, balki boshqa fiziologik ko‘rsatkichlar bilan birgalikda baholash zarur. Pulsoksimetriya organizmning barcha funksional imkoniyatlarini to‘liq aniqlab bermasa-da, uning ayrim muhim ko‘rsatkichlarini kuzatishda foydali vosita hisoblanadi.Umuman olganda, pulsoksimetriya usulidan foydalanish yuqori harorat sharoitida inson organizmining fiziologik reaksiyalarini o‘rganish va funksional holatini baholash imkoniyatlarini kengaytiradi. Ushbu mavzuni chuqur o‘rganish issiqlik ta’sirida yuzaga keladigan fiziologik o‘zgarishlarni tushunish va salomatlikni muhofaza qilishga qaratilgan tavsiyalarni ishlab chiqishda muhim ahamiyat kasb etadi.

FOYDALANILGAN ADABIYOTLAR

1. E.N.Nuritdinov Odam fiziologiyasi Toshkent. Aloqachi 2005 yil.

2.Mamadiyorov M.U va boshqalar Odam anatomiyasi va fiziologiyasi. Buxoro. Kamolot 2026 yil.

3.О.Т.Алявия,Ш.Қ.Қодиров.,А.А.Нишанова Физиология. Toshkent 2019 yil.

POLLEN MICROMORPHOLOGY OF MEDICINAL ASTERACEAE SPECIES IN THE SAMARKAND REGION: BASELINE DATA FOR ECOLOGICAL MONITORING

A.B. Nozimova - PhD student, Faculty of Biology,
Zarmed universiteti
azizanozimova98@gmail.com

Abstract. *The article presents the results of a palynological study of medicinal species of the family Asteraceae growing in the Samarkand region – Achillea millefolium L., Helichrysum maracandicum Popov ex Kirp. and Inula macrophylla Kar. & Kir. – aimed at obtaining baseline data for ecological monitoring. Pollen grains were characterized by shape, polar axis length, aperture type, exine thickness and surface sculpture, the latter studied by scanning electron microscopy (SEM). The pollen of all the studied species is tricolporate and echinate, with a polar axis of 34–45 µm and an exine thickness of 1.7–2.5 µm. The thicker exine and robust sculpture of H. maracandicum and I. macrophylla are interpreted as adaptations to xerophytic conditions and intense solar radiation. The data obtained can be used as reference material for aeropalynological monitoring, for assessing the state of medicinal plant populations and the sustainable use of their resources, and as visual material in biology and ecology education.*

Keywords: *palynology, pollen morphology, Asteraceae, medicinal plants, exine, SEM, ecological monitoring, sustainable use, Samarkand region.*

The conservation and rational use of medicinal plant resources is an important component of sustainable development. In Uzbekistan, the protection of wild-growing medicinal plants, their cultivation, processing and the rational use of available resources are regulated by Presidential Resolution No. PQ-4670 [1], in line with UN Sustainable Development Goal 15 “Life on Land” [2]. Implementing these measures requires reliable methods for identifying species, monitoring the state of their populations and assessing their adaptation to environmental change.

Pollen grains are among the most informative micromorphological features of plants. Their shape, size, aperture type and exine structure are species-specific and are used for diagnostics at the species and family level as well as in phylogenetic, ecological and geobotanical research [4, 9]. Palynological data make it possible to draw conclusions about the taxonomic position of species, their pollination biology, environmental adaptability and the level of biodiversity. Aerobiological monitoring also depends on the correct identification of airborne pollen types [8]. In Samarkand, the daily and seasonal dynamics of airborne pollen, including allergenic species, have been studied in recent years [3, 7, 10]; interpreting such data requires detailed reference descriptions of the pollen of local plants, including medicinal species [11].

The pollen of medicinal plants is also linked to their pharmacological value: it is one of the plant structures containing biologically active compounds and is used to study the biosynthesis of essential oils, flavonoids, saponins and alkaloids. Palynological analysis is therefore of practical importance not only for botany and ecology but also for pharmacy and the sustainable use of medicinal plant resources.

The Asteraceae family, one of the largest families of flowering plants, is rich in medicinal species. In the Samarkand region, *Achillea millefolium*, *Helichrysum maracandicum*, *Inula macrophylla* and *Tussilago farfara* are important not only as medicinal raw materials but also as indicators of ecological conditions. The aim of this study was to characterize the pollen micromorphology of medicinal Asteraceae species of the Samarkand region and to assess its significance as baseline data for ecological monitoring.

The study was carried out in the Samarkand region, whose territory includes plain, foothill and mountain landscapes belonging to different botanical-geographical districts of Uzbekistan [12]. A collection of medicinal Asteraceae species was assembled during the research, and pollen was sampled from plants in their flowering period (May–August). Pollen grains were described by shape in polar and equatorial view, polar axis length, aperture type, exine thickness and surface sculpture; the exine surface was examined by scanning electron microscopy (SEM). Pollen terminology follows G. Erdtman [4] and H. Halbritter et al. [9].

The palynomorphological characteristics of the studied species are described below and summarized in Table 1; SEM micrographs of their pollen grains are shown in Fig. 1, and the plants during flowering in Fig. 2.

Achillea millefolium L. is a perennial herbaceous plant 20–80 cm tall with an erect, softly hairy stem and two- or three-times pinnately dissected leaves. Its flower heads are gathered into corymbs; the five ray florets are white, rarely pink. It flowers from June to the end of summer, and the achenes ripen in July–September. The pollen grains are circular in polar view and oblate-spheroidal in equatorial view; the polar axis is 35 μm, the exine is 1.81 μm thick, and the grains are tricolporate. Under SEM, the surface is covered with medium-length spines with a microreticulate structure between them (Fig. 1a). These features agree with the data for *Achillea* sect. *Achillea*, whose pollen is tricolporate, oblate-spheroidal to subprolate and echinate [5]. Echinate ornamentation is typical of insect-pollinated Asteraceae [6]; therefore, the pollen of this species is dispersed by air only to a limited extent [7].

Helichrysum maracandicum Popov ex Kirp. is a multi-stemmed herbaceous plant 35–70 cm tall whose leaves and stems are often white-felted. The flower heads are 8–10 mm in diameter, with lemon-yellow, multi-rowed, densely imbricate involucral bracts and a dark-yellow corolla. It

flowers in June–July and fruits in July–August. The pollen grains are rounded in polar view and oblate-spheroidal in equatorial view; the polar axis is 36–45 µm, and the exine is 1.7–2.5 µm thick and bears rounded protrusions (Fig. 1c). SEM shows protrusions 1.4–1.7 µm long, 9–11 per 13 µm², with the apertures covered by a fine reticulate structure. This morphology provides high mechanical protection and is regarded as an adaptation to strong solar radiation at high altitudes [3, 11].

Inula macrophylla Kar. & Kir. is a perennial herbaceous plant 50–120 cm tall with stiff, leathery, fragrant leaves covered with glandular hairs; the basal leaves reach 70 cm in length and 20–30 cm in width. The flower heads, 2–3 cm in diameter, form a dense broad corymb; the ray florets are bright yellow, with ligules up to 2 cm long. It flowers in May–July and fruits in July–August. The pollen grains are circular in polar view and oblate in equatorial view; the polar axis is 34–39 µm, and the exine is 2.0–2.4 µm thick and bears small spines (Fig. 1h). SEM reveals an uneven surface with fewer spines but a thick wall; microscopic openings between the spines indicate a compound (colporate) aperture. This structure increases the likelihood of pollen adhering to the bodies of pollinating insects.

Table 1. Palynomorphological characteristics of the studied medicinal Asteraceae species

Species	Shape (polar / equatorial view)	Polar axis, µm	Exine thickness, µm	Aperture type	Exine sculpture (SEM)	Flowering
Achillea millefolium	circular / oblate-spheroidal	35	1.81	tricolporate	medium-length spines; microreticulate between spines	Jun–Aug
Helichrysum maracandicum	rounded / oblate-spheroidal	36–45	1.7–2.5	tricolporate	rounded protrusions 1.4–1.7 µm long, 9–11 per 13 µm²; apertures covered by a fine reticulum	Jun–Jul
Inula macrophylla	circular / oblate	34–39	2.0–2.4	tricolporate (compound apertures)	small, sparse spines; uneven surface; thick wall	May–Jul

As Table 1 shows, the pollen grains of all the studied species are tricolporate and echinate, which is characteristic of the family [5, 6]. Pollen size varies within a narrow range (polar axis 34–45 µm): the largest grains were recorded in *H. maracandicum* (36–45 µm), and smaller ones in *A. millefolium* (35 µm) and *I. macrophylla* (34–39 µm). The exine is thinnest in *A. millefolium* (1.81 µm) and reaches 2.4–2.5 µm in *I. macrophylla* and *H. maracandicum*. Our data suggest that a thicker exine reflects the adaptation of species of this family to xerophytic conditions [4, 7, 12].

In *H. maracandicum* and *I. macrophylla*, the robust exine surface protects the pollen from solar radiation and facilitates its attachment to pollinating insects, whereas *Tussilago farfara*, a species of moist habitats, has relatively soft surface structures. Differences in exine thickness and sculpture thus reflect the ecological conditions of the species' habitats and have diagnostic value for delimiting species.



Figure 1. *Helichrysum maracandicum* (left), *Achillea millefolium* (centre) and *Inula macrophylla* (right) during the flowering period.

These results are of direct practical value for ecological monitoring. First, the morphometric parameters (Table 1) and SEM images form a reference base for identifying the pollen of medicinal Asteraceae in aerobiological samples, a basic requirement of reliable pollen monitoring [8], and for distinguishing it from the pollen of wind-pollinated members of the family, which typically have reduced spines [6]. Second, the flowering periods of the studied species (May–August; Fig. 2) define when their pollen may occur in the air and can be included in a regional pollen calendar for Samarkand [7, 10]. Third, exine thickness and sculpture, which reflect adaptation to aridity and insolation, can serve as baseline indicators in repeated observations of medicinal plant populations under climate change and anthropogenic pressure, which is necessary for the rational use of their resources [1].

The results can also be applied in education. SEM micrographs and morphometric data on local medicinal plants serve as visual material for laboratory classes in botany, plant ecology and aerobiology at pedagogical higher education institutions, and compiling a reference pollen collection of the regional flora is a suitable topic for student research projects that develop practical skills in microscopy and environmental monitoring.

Conclusions, the pollen grains of the studied medicinal Asteraceae species (*A. millefolium*, *H. maracandicum*, *I. macrophylla*) are tricolporate and echinate, with a polar axis of 34–45 µm and an exine thickness of 1.7–2.5 µm; differences in size, exine thickness and sculpture have diagnostic value at the species level. The thicker exine and robust sculpture of *H. maracandicum* and *I. macrophylla* reflect adaptation to xerophytic conditions and intense solar radiation, while echinate ornamentation indicates insect pollination and limited airborne dispersal of pollen. The palynomorphological data obtained can serve as baseline material for aeropalynological monitoring

in the Samarkand region, for monitoring the state of medicinal plant populations and the sustainable use of their resources, and as teaching material in biology and ecology education.

REFERENCES

1.Resolution of the President of the Republic of Uzbekistan No. PQ-4670 of 10.04.2020 “On measures for the protection of wild-growing medicinal plants, their cultivation, processing and rational use of available resources”. – URL: https://lex.uz/docs/4785256

2.United Nations. Transforming our world: the 2030 Agenda for Sustainable Development. Resolution A/RES/70/1 adopted by the General Assembly on 25 September 2015. – New York, 2015.

3.Джумаева З.Ў. Палинологические исследования в городе Самарканде // O‘zMU xabarlari. – 2023. – № 3/1. – ISSN 2181-7324.

4.Эрдтман Г. Морфология пыльцы и систематика растений. – М.: Изд-во иностр. лит., 1956. – 486 с.

5.Akyalçın H., Arabacı T., Yıldız B. Pollen morphology of six *Achillea* L. sect. *Achillea* (Asteraceae) species in Turkey // Turkish Journal of Botany. – 2011. – Vol. 35, No. 2. – P. 183–201. – DOI: 10.3906/bot-1005-23.

6.Blackmore S., Wortley A.H., Skvarla J.J., Robinson H. Evolution of pollen in Compositae // Systematics, Evolution, and Biogeography of Compositae / Eds. V.A. Funk, A. Susanna, T.F. Stuessy, R.J. Bayer. – Vienna: IAPT, 2009. – P. 101–130.

7.Djumayeva Z.O‘., Haydarov X.Q., Tursunboev X.E., Nozimova A.B. O‘simlik gulchanglarining sutkalik va mavsumiy tarqalish qonuniyatlari Samarqand shahri misolida // Ilim va jamiyat (Science and Society). – Nukus, 2023. – № 2-1. – P. 27–29. – ISSN 2010-720X.

8.Galán C., Smith M., Thibaudon M., Frenguelli G., Oteros J., Gehrig R., Berger U., Clot B., Brandao R., EAS QC Working Group. Pollen monitoring: minimum requirements and reproducibility of analysis // Aerobiologia. – 2014. – Vol. 30, No. 4. – P. 385–395. – DOI: 10.1007/s10453-014-9335-5.

9.Halbritter H., Ulrich S., Grímsson F., Weber M., Zetter R., Hesse M., Buchner R., Svojtka M., Frosch-Radivo A. Illustrated Pollen Terminology. – 2nd ed. – Cham: Springer, 2018. – 483 p. – DOI: 10.1007/978-3-319-71365-6.

10.Jumayeva Z., Nurullayeva N., Nozimova A., Tursunboev X., Dosjanova G. Dynamics and characteristics of allergenic plant pollen in the Republic of Uzbekistan // E3S Web of Conferences. – 2024. – Vol. 498. – Art. 02015. – DOI: 10.1051/e3sconf/202449802015.

11.Nozimova A. Samarqand shahri dorivor o‘simliklarining palinologik tahlili // O‘zMU xabarlari (Mirzo Ulug‘bek nomidagi O‘zbekiston Milliy universiteti ilmiy jurnali). – 2024. – № 3/2.

12.Tojibaev K.Sh., Beshko N.Yu., Popov V.A. Botanical-geographical regionalization of Uzbekistan // Botanicheskii Zhurnal. – 2016. – Vol. 101, No. 10. – P. 1105–1132.

REPRODUCTIVE BIOLOGY AND ADAPTIVE PHENOLOGY OF RARE RELICT TAXA IN THE ARAL SEA BASIN

Orazbaev Timur Joldasbaevich[1]*, Ajiev Alisher Baxtıbaevich[2]

[1]PhD Doctoral Researcher, Nukus State texnikal universitet, Nukus, Republic of Karakalpakstan, Uzbekistan. E-mail: timururazbaev78@gmail.com.

[2]Doctor of Sciences, Professor, Nukus State Pedagogical Institute named after Ajiniyaz, Nukus, Republic of Karakalpakstan, Uzbekistan. E-mail: alisher.azhiev@mail.ru.

Abstract: *The progressive desiccation of the Aral Sea has led to severe degradation of native phytocenoses across the Ustyurt Plateau. Preserving vulnerable relict flora requires understanding their reproductive limits and cultivation requirements. This paper evaluates the developmental rhythms, flowering biology, seed productivity, and subterranean morphology of Cynoglossum viridiflorum Pall. ex Lehm. and Malacocarpus crithmifolius (Retz.) C.A. Mey. under introduction in the Southern Aral Sea region. Multi-year observations (2021–2025) revealed that seasonal growth is driven by early spring temperatures and moisture availability. The vegetative cycle of C. viridiflorum lasted 86–117 days, whereas M. crithmifolius remained vegetative for 169–194 days. Diaspores showed high frost resistance and established readily without artificial scarification. M. crithmifolius combined entomophilous outcrossing with 100% facultative autogamy. Both species formed deep taproot architectures (2.5–4.0 m), developing multiple root crowns on loose loams that permit successful vegetative division. These results provide practical guidance for establishing seed nurseries and rehabilitating desertified pastures.*

Keywords: *Cynoglossum viridiflorum, Malacocarpus crithmifolius, reproductive biology, phenology, root architecture, ex situ conservation, Aral Sea basin.*

INTRODUCTION

The ecological crisis of the Aral Sea basin has triggered severe desertification across Central Asia, exposing over 5 million hectares of saline seabed and intensifying climatic extremes [1, p. 12]. Along the eastern chinks of the Ustyurt Plateau, isolated relict species persist under harsh conditions, coping with scarce annual precipitation (50–120 mm) and summer temperatures exceeding +45 °C [1, pp. 24–28].

Among these specialized elements, *Cynoglossum viridiflorum* Pall. ex Lehm. (Boraginaceae) and *Malacocarpus crithmifolius* (Retz.) C.A. Mey. (Nitrariaceae) are of high conservation and economic interest [1, pp. 19–20; 2, p. 1]. Both plants are wild relatives of cultivated flora, synthesize valuable secondary metabolites (pyrrolizidine alkaloids, flavonoids, and natural pigments), and protect topsoil from wind erosion [1, p. 100; 2, p. 1]. However, natural regeneration from seed is severely constrained on the Ustyurt chinks by surface soil crusting and intense summer drought [1, pp. 46–47; 3, pp. 70–72]. Overcoming these reproductive bottlenecks requires investigating their ontogenetic traits, phenological cycles, and root development under ex situ cultivation [3, pp. 72–74; 4, pp. 28–29]. This paper synthesizes empirical findings on the reproductive ecology, diaspore characteristics, and cultivation protocols of both taxa in the Karakalpak Aral Sea region.

MATERIALS AND METHODS

Field and laboratory experiments were conducted during 2021–2025 at the Muynak experimental station of the International Innovation Center for the Aral Sea Basin (44°08'26.2" N, 58°23'04.7" E) [1, p. 41; 2, p. 3; 5, pp. 142–143]. Plant materials, including mature diaspores, wild rhizomes, and saplings, were obtained during 27 expeditionary field surveys along the eastern cliff escarpments of Ustyurt [1, p. 41; 6, pp. 41–42].

Trials evaluated two contrasting soil variants:

- **Variant 1 (EP-1):** Loose-to-bound sands (0–60 cm layer) underlain by light loam; soil density 1.20–1.33 g/cm³, solid residue salinity 0.236–0.256% (chloride-sulfate type) [1, pp. 75–80].
- **Variant 2 (EP-2):** Structured medium loam and light clay (physical clay content up to 53.4%); density reaching 2.28 g/cm³, solid residue salinity 0.280–0.397% [1, pp. 84–89; 7, pp. 1–3].

Phenological stages were recorded following I. N. Beydeman's method for arid ecosystems [8, p. 154]. Pollen morphology was evaluated in lactic acid and paraffin oil [2, pp. 4–5]. Facultative autogamy in *M. crithmifolius* was verified by bagging 100 floral buds in dense cloth isolators alongside 100 open controls [2, p. 4]. Underground biomass allocation and root profiles were investigated by skeletal trenching and water-jet root washing down to 2.5–4.0 m [1, pp. 68–72; 2, pp. 2–3]. Statistical relationships were processed using standard dispersion and regression procedures [1, pp. 93–97].

RESULTS AND DISCUSSION

Phenological Dynamics and Seasonal Growth Rhythms

Both species follow a spring-summer-autumn vegetative pattern with obligate winter dormancy [1, p. 59; 2, p. 1]. Growth resumes from axillary regenerative buds once daily temperatures consistently cross +10 °C in late March or April [1, p. 59; 2, p. 1].

In *C. viridiflorum*, shoot emergence was recorded on March 9 (2021), March 31 (2022), March 28 (2023), and March 14 (2024) [1, pp. 59–62]. Generative development began 26–33 days after emergence, with the budding phase lasting 16–38 days [1, p. 60]. Anthesis spanned 32–43 days into June, showing overlapping sub-phases due to the sequential uncoiling of scorpioid cymes [1, pp. 60–62]. The vegetative period lasted 86–117 days, ending as above-ground shoots withered in July and rootstocks entered summer-autumn rest [1, pp. 60–62].

In *M. crithmifolius*, shoot growth emerged between April 14 and April 25 across 2022–2025, maintaining an extended vegetative period of 169–194 days [2, pp. 1–2]. Anthesis began 31–43 days after emergence, lasting 119–149 days until October [2, pp. 1–2]. Warmer seasons prolonged flowering ($r = 0.80$, trend $y = 5.79x + 8.11$) [2, p. 6], while higher rainfall shortened total vegetative duration ($r = -0.29$, trend $y = -0.20x + 191.18$) [2, p. 6].

Table 1.

Phenological cycles of *M. crithmifolius* under cultivation (2022–2025) [2, p. 1]

Year	Vegetative Inception	Budding Phase	Anthesis Phase	Fruiting Phase	Dormancy	Duration (days)
2022	April 14	16.05 – 13.08	17.05 – 06.10	24.06 – 13.10	Oct 17	186
2023	April 15	28.05 – 25.08	19.05 – 15.09	10.07 – 11.10	Oct 26	194
2024	April 25	26.05 – 30.08	09.05 – 28.09	19.06 – 03.10	Oct 10	169
2025	April 24	25.05 – 22.08	18.05 – 04.10	21.06 – 14.10	Oct 23	182

Floral Biology, Pollination, and Seed Output

C. viridiflorum forms an erect generative shoot (131–156 cm) with yellowish-green, actinomorphic flowers in paniculate cymes [1, pp. 19–20; 6, pp. 41–43]. The fruit divides into four

glochidiate eremes (5.0–7.0 × 4.5–5.5 mm) adapted for epizoochory [1, p. 20]. The weight of 1,000 nutlets was 33.50–33.52 g, yielding ~1.95 g per plant (~7.0 g/m² under plantation density) [1, p. 19, 60].

In *M. crithmifolius*, solitary yellow flowers open exclusively in full sunlight [2, p. 4]. The anthers dehisce longitudinally inside the bud prior to opening [2, p. 4]. Pollen grains are tricolpate and sub-transparent (polar axis 16–24 µm) [2, pp. 4–5]. The species combines entomophily with facultative autogamy: 100% of bagged flowers produced mature fruits, matching open-pollinated controls [2, p. 4]. Ripe berries remain firmly attached on the branches, preventing seed loss; the 1,000-seed mass was 22–24 g, yielding ~7.0 g/m² [2, pp. 2–5].

Root Ecology and Cultivation Protocols

Both species develop deep taproots penetrating 2.5–4.0 m [1, p. 68; 2, p. 2]. Subterranean biomass distribution depended primarily on soil physical structure rather than absolute salinity levels [1, pp. 68–69; 7, p. 2]. On structured loam (EP-2), 3-year-old *C. viridiflorum* concentrated 30.3% of underground mass at 40–60 cm and 35.1% (237 g) at 60–80 cm, declining to 4.7% below 80 cm due to soil compaction [1, p. 69].

On loose loamy soils, *C. viridiflorum* formed 3–4 root crowns with lateral roots extending over 105 cm, enabling vegetative division: divided crowns treated with indolylbutyric acid achieved over 85% survival [1, pp. 47–48; 5, pp. 142–143]. Similarly, *M. crithmifolius* produced horizontal lateral roots up to 3.0 m long at 10–25 cm depth, forming extensive inter-plant root fusions (anastomoses) that stabilize sandy ground [2, p. 3].

Seed propagation requires no chemical scarification [1, p. 46; 5, p. 143]. Sowing in late October or early April at depths of 2–4 cm produced even stands [1, pp. 46–47; 2, p. 2]. Both plants tolerated soil salinity up to 1.64% dry residue [1, p. 88]. Optimal growth was sustained under a five-event furrow irrigation regime totaling 1,150–1,200 m³/ha applied over May–July and reduced to 50–100 m³/ha during ripening [1, pp. 75–80].

CONCLUSION

Cynoglossum viridiflorum and *Malacocarpus crithmifolius* successfully complete their life cycles under ex situ cultivation in the Southern Aral Sea region [1, p. 107; 2, p. 5]. Both species produce cold-tolerant seeds that germinate readily from spring or autumn sowings without pre-treatment [1, p. 107; 2, p. 2]. Complete autogamy in *M. crithmifolius* guarantees reliable fruit set under fluctuating pollinator populations [2, p. 4]. Their multi-headed, deep taproot architectures provide strong wind-erosion control and allow vegetative propagation through crown division on structured soils [1, p. 108; 2, p. 3; 7, p. 3]. Regulated furrow irrigation (1,150–1,200 m³/ha)

overcomes natural regeneration barriers, providing an effective basis for seed farming, phytomelioration, and industrial raw-material cultivation in arid habitats [1, p. 108; 5, p. 144].

REFERENCES / СПИСОК ЛИТЕРАТУРЫ (ГОСТ 7.0.5–2008)

1. Ажиев, А. Б. Эколого-биологические особенности и семенное размножение *Malacocarpus crithmifolius* (Retz.) C.A. Mey. в культуре / А. Б. Ажиев, С. Оразбаев, Г. Ж. Сабирова. – Нукус : ИИЦА, 2026. – 18 с.

2. Ажиев, А. Б. Разработка агротехники выращивания в культуре и введение в культуру *Malacocarpus crithmifolius* (Retz.) C.A. Mey. на обсохшем дне Аральского моря / А. Б. Ажиев, С. Оразбаев // Вестник Каракалпакского отделения Академии наук Республики Узбекистан. – Нукус, 2024. – № 2. – С. 45–49.

3. Ажиев, А. Б. Особенности сезонного развития и цветения мягкоплодника критмолистного (*Malacocarpus crithmifolius*) в условиях интродукции / А. Б. Ажиев, С. Оразбаев, Г. Ж. Сабирова // Наука и общество. – 2025. – № 4. – С. 34–38.

4. Оразбаев, С. Биоэкологическая характеристика и кормовое значение ценопопуляций *Malacocarpus crithmifolius* на восточном чинке Устюрта / С. Оразбаев, А. Б. Ажиев // Экологический вестник Узбекистана. – 2023. – № 8. – С. 52–55.

5. Ажиев, А. Б. Орол денгизининг қуриган тубида табиий шароит ва интродукция қилинган *Cynoglossum viridiflorum* Pall.ex. Lehm. ва *Malacocarpus crithmifolius* (Retz.) C.A. Mey ни етиштириш агротехникасини ишлаб чиқиш: ҳисобот (якуний)/А. Б. Ажиев, С. Оразбаев, Г. Ж. Сабирова; Ажиниёз номидаги Нукус давлат педагогика институти, Оролбўйи халқаро инновация маркази. Давлат гранти № AL-632204169. – Нукус, 2024. – 82 б.

6. Бейдеман, И. Н. Методика изучения фенологии растений и растительных сообществ / И. Н. Бейдеман. – Новосибирск : Наука, 1974. – 154 с.

EKOLOGIYA VA BARQAROR RIVOJLANISH: BIOLOGIK TIZIMLAR MONITORINGI

Raximjonova Dilnura Raxmatovna

Samarqand davlat pedagogika instituti | Telefon: 95444 59 03 | E-mail: dilnuraraximjonova49@gmail.com

Annotatsiya. *Tezisda biologik tizimlar monitoringining ekologik xavflarni aniqlash va biologik xilma-xillikni muhofaza qilishdagi o‘rni, shuningdek, ekologik ta’limda kuzatuv va raqamli vositalardan foydalanish imkoniyatlari tahlil qilinadi. O‘zbekistonning ekologik siyosatiga oid*

hujjatlar hamda xalqaro tashkilotlar materiallari asosida ta’lim muassasalarida mahalliy ekotizimlarni kuzatishga doir amaliy tavsiyalar ishlab chiqiladi.

Kalit so‘zlar*: biologik xilma-xillik, ekologik monitoring, barqaror rivojlanish, bioindikator, ekologik ta’lim, raqamli xaritalash, dala kuzatuvi.*

Abstract. *This thesis examines the role of biological systems monitoring in identifying environmental risks and protecting biodiversity, as well as the opportunities for using observation and digital tools in environmental education. Based on documents related to Uzbekistan’s environmental policy and materials from international organizations, the thesis presents practical recommendations for monitoring local ecosystems in educational institutions.*

Keywords: *biodiversity, ecological monitoring, sustainable development, bioindicator, environmental education, digital mapping, field observation.*

KIRISH

Tabiiy ekotizimlarning holati suv va oziq-ovqat xavfsizligi, aholi salomatligi hamda hududlarning uzoq muddatli rivojlanishi bilan bevosita bog‘liq. Iqlim o‘zgarishi, yashash muhitlarining qisqarishi, ifloslanish va tabiiy resurslardan oqilona foydalanmaslik biologik xilma-xillikka bosimni kuchaytiradi. Shu sababli ekologik muammolarni faqat alohida holatlarni kuzatish orqali emas, balki muntazam ma’lumot yig‘ish, natijalarni taqqoslash va ularning sabablarini tahlil qilish orqali o‘rganish lozim.

O‘zbekiston Respublikasida biologik xilma-xillikni saqlash strategiyasi monitoringni takomillashtirish va o‘simlik hamda hayvonot dunyosi holati haqidagi ma’lumotlarni tizimli yig‘ish vazifalarini belgilaydi [1]. Xalqaro miqyosda esa Kunming–Monreal global biologik xilma-xillik doiraviy dasturi maqsadlariga erishishni baholash uchun indikatorlar va monitoring tizimlaridan foydalanish ko‘zda tutilgan [2]. Bu hujjatlar ekologik monitoringni ilmiy tadqiqotlar bilan bir qatorda ekologik ta’limda ham qo‘llash zarurligini ko‘rsatadi.

MAQSAD VA METODLAR

Biologik monitoring — organizmlar, populyatsiyalar, jamoalar va ekotizimlar holatini muayyan metodika asosida muntazam kuzatish, ma’lumotlarni qayd etish va vaqt davomida o‘zgarishlarni baholash jarayonidir. Uning vazifasi faqat mavjud holatni tasvirlash emas, balki ekologik o‘zgarishlarning yo‘nalishini aniqlash, xavf omillarini baholash va muhofaza tadbirlarining natijasini kuzatishdan iborat.

Monitoringni tashkil etishda avvalo tadqiqot savoli va kuzatiladigan ko‘rsatkichlar belgilanadi. Keyin kuzatuv hududi, namuna olish usuli, davriyligi va ma’lumotlarni qayd etish shakli tanlanadi. Olingan natijalar tekshiriladi, taqqoslanadi va jadval, grafik yoki xarita

ko‘rinishida umumlashtiriladi. Biologik xilma-xillikni baholashda turlar soni, uchrash chastotasi, populyatsiyaning holati, yashash muhiti maydoni va uning sifati kabi indikatorlardan foydalanish mumkin [2].

Dala kuzatuvlari o‘simliklar, qushlar, hasharotlar yoki boshqa organizmlarni belgilangan yo‘nalish va namunaviy maydonlarda qayd etishni o‘z ichiga oladi. Suv ekotizimlarini o‘rganishda suv harorati, tiniqligi, pH ko‘rsatkichi va ayrim suv organizmlarining uchrashi kuzatilishi mumkin. Ayrim organizmlar muhitdagi o‘zgarishlarga sezgir bo‘lgani sababli bioindikator sifatida qo‘llanadi. Biroq bitta ko‘rsatkich butun ekotizim holatini to‘liq ifodalamaydi; shuning uchun biologik kuzatuvlarni fizik-kimyoviy o‘lchovlar va hududning tabiiy xususiyatlari bilan birga tahlil qilish zarur.

So‘nggi yillarda masofadan zondlash, geografik axborot tizimlari va mobil ma’lumot yig‘ish vositalari ekologik kuzatuv imkoniyatlarini kengaytirdi. Sun’iy yo‘ldosh tasvirlari yer qoplami va suv havzalaridagi o‘zgarishlarni kuzatishga, raqamli xaritalar esa turlar va yashash muhitlarining hududiy tarqalishini tasvirlashga yordam beradi. Bunday ma’lumotlar dala tekshiruvi bilan solishtirilishi, kuzatuv sanasi va usuli aniq qayd etilishi kerak. O‘zbekistonning 2025-yilda e’lon qilingan Atrof-muhit o‘zgarishlari atlasi tarixiy ma’lumotlar, milliy va global ma’lumotlar to‘plamlari hamda sun’iy yo‘ldosh texnologiyalarini birlashtirib, quruqlik va suv ekotizimlaridagi o‘zgarishlarni baholash imkonini beradi [3].

Ekologik ta’lim o‘quvchilarga tabiat haqidagi bilimlarni berish bilan cheklanmasdan, ekologik muammolarni dalillar asosida baholash va mas’uliyatli qaror qabul qilish ko‘nikmalarini shakllantirishi kerak. UNESCOning barqaror rivojlanish uchun ta’lim bo‘yicha yo‘l xaritasida ta’lim muhitini takomillashtirish, pedagoglar salohiyatini oshirish va mahalliy darajadagi tashabbuslarni qo‘llab-quvvatlash ustuvor yo‘nalishlar sifatida qayd etilgan [4].

Biologik monitoringni dars jarayoniga kiritish nazariy tushunchalarni bevosita kuzatuv bilan bog‘laydi. Masalan, o‘quvchilar ta’lim muassasasi hududidagi daraxt va o‘t o‘simliklarini ro‘yxatga olishi, soyali va ochiq maydonlardagi haroratni taqqoslashi yoki yashil hududlarning holatini xaritada belgilashi mumkin. Bunda kuzatuv vaqti, ob-havo sharoiti va qo‘llangan metodika qayd etilishi lozim. Natijalar jadval va diagrammalarda ko‘rsatilgach, o‘quvchilar kuzatuvlar nimani ko‘rsatishi va qanday cheklovlarga ega ekanini muhokama qiladilar.

Loyiha asosida o‘qitish ham samarali yondashuvlardan biridir. Guruhlar mahalliy ekologik masalani tanlaydi, tadqiqot savolini belgilaydi, ma’lumot yig‘adi va amaliy tavsiya ishlab chiqadi. Masalan, maktab hududidagi yashil maydonlarni baholash loyihasida o‘simliklar xilma-xilligi, sug‘orish holati, chiqindilar mavjudligi va soyalanish darajasi qayd etilishi mumkin. Muhimi,

o‘quvchilar natijalarni oldindan belgilangan fikrga moslashtirmasdan, mavjud dalillarga tayangan holda xulosa chiqarishni o‘rganishidir.

Ekologik monitoring fanlararo integratsiya uchun ham qulay imkoniyat yaratadi: biologiyada organizmlar va ekotizimlar, geografiyada hududiy taqsimlanish, kimyoda suv va tuproq ko‘rsatkichlari, matematikada ma’lumotlar tahlili, informatika fanida esa raqamli jadval va xaritalar o‘rganiladi. Shu tariqa o‘quvchi ekologik muammoni bir fan doirasida emas, balki bir nechta ilmiy yondashuvlar orqali tahlil qilish tajribasiga ega bo‘ladi.

Monitoring ma’lumotlarining ishonchliligi kuzatuv usulining izchilligiga bog‘liq. Agar kuzatuvlar turli vaqtda, turlicha usulda yoki har xil mezonlar asosida olib borilsa, ularni taqqoslash qiyinlashadi. Shu bois ta’lim muassasalarida qisqa kuzatuv protokoli ishlab chiqish, indikatorlarni oldindan belgilash, sanani va sharoitni qayd etish, tur nomlarini ishonchli manbalar orqali tekshirish maqsadga muvofiq.

Amaliy jihatdan, avvalo ta’lim muassasasi hududida kichik kuzatuv maydoni tanlanishi, keyin maqsadga mos bir necha indikator belgilanib, mavsumlar davomida takroriy ma’lumot to‘planishi mumkin. Natijalar elektron jadval yoki xaritada umumlashtirilib, mahalliy ekologik muammolar bilan bog‘lab tahlil qilinadi. Bunday loyihalarda kuzatuvlar soni va usulning cheklovlari ochiq ko‘rsatilishi lozim. O‘zbekiston sharoitida suvdan oqilona foydalanish, shahar yashil hududlari, yaylovlar holati va mahalliy biologik xilma-xillikni o‘rganish ta’limiy loyihalar uchun dolzarb yo‘nalishlar hisoblanadi. Ushbu tezisda yangi dala tajribasi o‘tkazilmagan; takliflar rasmiy hujjatlar va xalqaro metodik manbalar tahliliga asoslangan.

XULOSA

Biologik tizimlar monitoringi ekotizimlar holatini baholash, biologik xilma-xillikdagi o‘zgarishlarni aniqlash va tabiatni muhofaza qilish choralari samaradorligini kuzatishda muhim ahamiyatga ega. Monitoringning foydasi aniq indikatorlar, takrorlanadigan metodika, tekshirilgan ma’lumotlar va ehtiyotkor talqinga bog‘liq. Uni ekologik ta’lim bilan uyg‘unlashtirish o‘quvchilarning kuzatish, tahlil qilish, dalillarga tayangan xulosa chiqarish va tabiatga mas’uliyatli munosabatini rivojlantiradi. Shu sababli ta’lim muassasalarida mahalliy ekotizimlarni muntazam o‘rganishga qaratilgan kichik monitoring loyihalarini yo‘lga qo‘yish, raqamli vositalarni dala kuzatuvlari bilan uyg‘un qo‘llash va natijalarni amaliy tavsiyalarga aylantirish tavsiya etiladi.

FOYDALANILGAN ADABIYOTLAR

1. O‘zbekiston Respublikasi Vazirlar Mahkamasi. 2019–2028-yillar davrida O‘zbekiston Respublikasida biologik xilma-xillikni saqlash strategiyasini tasdiqlash to‘g‘risida: 2019-yil 11-iyundagi 484-son qaror. Elektron manba: https://lex.uz/uz/acts/-4372839 (murojaat sanasi: 15.10.2026).

2. Convention on Biological Diversity. Monitoring Framework for the Kunming–Montreal Global Biodiversity Framework. Decision 15/5. Montreal: CBD, 2022. Elektron manba: https://www.cbd.int/gbf/related/monitoring (murojaat sanasi: 15.10.2026).
3. United Nations Environment Programme. Atlas of Environmental Change of the Republic of Uzbekistan. Nairobi: UNEP, 2025. Elektron manba: https://www.unep.org/resources/report/atlas-environmental-change-republic-uzbekistan (murojaat sanasi: 15.10.2026).
4. UNESCO. Education for Sustainable Development: A Roadmap. Paris: UNESCO, 2020. 66 p. DOI: https://doi.org/10.54675/YFRE1448 (murojaat sanasi: 15.10.2026).
5. O‘zbekiston Respublikasi Ekologiya, atrof-muhitni muhofaza qilish va iqlim o‘zgarishi vazirligi. Atrof tabiiy muhit davlat monitoringining asosiy vazifalari. Elektron manba: https://eco.gov.uz/uz/activity/monitoring?numer=426 (murojaat sanasi: 15.10.2026).

QORA ANDIZ (INULA HELENIUM 1.) O'SIMLIGINING BIOEKOLOGIYASI VA DORIVOR XUSUSIYATI.

Ro‘ziqulova Marjona Rustamqizi
Buxoro davlat universitetining biologiya yo’nalishi magistranti. +998938800502
marjonaruziqulova418@gmail.com

Annotatsiya:*Andiz (*Inula helenium *L., inglizcha* elecampane*) Asteraceae (Compositae) oilasining* Inula *turkumiga mansub ko’p yillik o’tsimon o’simlikdir. Uning vatani G’arbiy va Markaziy Osiyo hisoblanadi. Bronza davrida Yevropaga tarqalgan, mo’tadil iqlimli hududlarda, nam va yaxshi zovurlangan tuproqda o’sadi. O’simlik Xitoy, Rossiya, Britaniya va Hindiston farmakopeyalariga hamda ayrim Yevropa mamlakatlari farmakopeyalariga kiritilgan.*

Kalit so’zlar: *Andiz, Inula, dorivor, ekologiya, kasallik, hudud, mintaqa.*

Abstract: *Elecampane (*Inula helenium *L.) is a perennial herbaceous plant belonging to the genus* Inula *of the family Asteraceae (Compositae). Its native range is West and Central Asia. It spread to Europe during the Bronze Age and grows in temperate regions on moist, well-drained soils. The plant is included in the pharmacopoeias of China, Russia, Britain and India, as well as in the pharmacopoeias of several European countries.*

Keywords: *Elecampane,* Inula*, medicinal, ecology, disease, territory, region.*

Andiz- bu Asteraceae oilasiga mansub ko'p yillik o'simlik, uzunligi 160-150 sm, qalin, kalta, eldor, boshli ildizpoyaga ega, ulardan bir nechta qo'shimcha ildizlar tarqaladi. Poyasi tik turuvchi, chiziqli, zich, oq tuklar bilan qoplangan, yuqori qismida kalta shoxlangan. Barglari ketma-ket, yirik, notekis tishsimon, tashqi tomoni biroz burushgan, ostida kulrang yumshoq tuklari bor. Gullari diametri 8 sm bo'lgan savatcha to'pgul ichida joylashgan. Asosiy poya va novdalarning yuqori qismida savatchalari zich bo'lmagan ro vak yoki qalqonchani hosil qiladi. Gullari oltinsimon sariq, xira oq rangli tukli popugi bor. Mevasi 4-5 mm uzunlikdagi to'rt qirrali qo'ng'ir rangli pistachalardan iborat bo'lib, uning popugi pistachaga nisbatan ikki baravar uzundir. Iyul-sentyabr oylarida gullaydi. Avgust-oktyabr oylarida mevasi pishib yetiladi. [2, 138-b.]



Inula helenium Janubi-sharqiy Yevropa, Markaziy Osiyo va Yaqin Sharqda tabiiy o'sadi, Yevropa va Shimoliy Amerikaning ko'p joylarida esa naturalizatsiya bo'lgan (yovvoyilashgan). Shveytsariyada u o'rmon chetlari, butazorlar va bog'lardan yovvoyilashgan joylarda uchraydi. [4]. O'zbekistonning dasht va tog'li mintaqalarining quyi va o'rta qismlarida, hamda sernam joylarda, daryo va ko'l bo'ylarida o'sadi [2, 139-b]. Ko'p hollarda nam joylarda daryolar, ko'llar, tog' soylari bo'ylarida va yer osti suvlari chiqadigan joylarda uchraydi [5].

Mamlakatimizda introduksiya qilingan dorivor o‘simliklardan biri hisoblanadi qora andiz. Inula helenium bilan bir qatorda quyidagi o’siimliklar ham mamlakatimizda introduksiya qilingan dorivor o‘simliklar qatoriga kirgizishimiz mumkin: tirnoqgul, zafaron, buyoqdor ruyan, qalampir yalpiz, arpabodiyon, dorivor moychechak, dorivor gulxayri, qora andiz, hushbuy ruta, maxsar, bamiya, o‘tkir bargli sano, sedana, zig‘ir, kashnich, yer noki, gultojixo‘roz, namatak, qoraqat, chakanda, yapon soforasi, kivi, xitoy jing ili kabi qator o simliklarni qayd etish mumkin.

Qadim zamonlardan beri *I. helenium*ning quritilgan ildizi va ildizpoyasi odamlar va hayvonlarda nafas olish va ovqat hazm qilish tizimi kasalliklarini davolashda, shuningdek antgelmintik, antimikrob va organizmning umumiy holatini yaxshilash sifatida ishlatilgan [3, 154, 286–310-b].*I. helenium*ning shifobaxsh xususiyatlari haqidagi dastlabki ma’lumotlar qadimgi rimliklar va yunonlar davriga borib taqaladi. Uni qadimgi o’simliklar bilimdoni Pedanios Dioskorid birinchi farmakopeya sanalgan «De materia medica» asarida *oinos nektaries* nomi bilan tasvirlagan

va oshqozon hamda ko’krak og’rig’ini davolashda hamda siydik haydovchi vosita sifatida qo’llagan [1, 21-b].

Andizning preparatlari balg‘am ko‘chiruvchi va yallig‘lanishga qarshi xususiyatlarga ega, shuningdek, ichakning kuchaygan harakatchanligini va sekretsiya faoliyatini pasaytirishi mumkin. Andiz ildizlari va ildizpoyalarda saqlanadigan efir moyi antiseptik va gijja tushiruvchi ta‘sirlarga ega. Andiz preparatlari nafas yo‘llarining surunkali kasalliklari – shilimshiqning katta sekresiyasi bilan birga kechadigan traxeit va bronxit kasalliklarida uchun balg‘am ko‘chiruvchi sifatida qo‘llaniladi. Ular gastroenterit va diareya kasalliklarida yaxshi davolovchi vosita hisoblanadi. Ildizpoya va ildizi tarkibida efir moylari 1-3 %, saponin, smola va achchiq moddalar mavjud[2, 139-b].

FOYDALANILGAN ADABIYOTLAR:

1.Dioscorides, P., Osbaldeston, T.A., Wood, R.P., (2000) - De materia medica: Being an herbal with many other medicinal materials: written in Greek in the first century of the common era : a new indexed version in modern English. Johannesburg: IBIDIS.

2.KARSHIBAYEV X. K., MAXKAMOV T.X. "
DORIVOR O'SIMLIKLAR BIOLOGIYASI VA EKOLOGIYASI" Guliston-2022

3.Seca, A.M., Grigore, A., Pinto, D.C., Silva, A.M., (2014) - The genus Inula and their metabolites: From ethnopharmacological to medicinal uses, Journal of Ethnopharmacology, 154, 286–310.

4.https://laji.fi/en/taxon/MX.39771/occurrence

5.https://planta-medica.uz/inula-helenium-l-devyasil-vysokij/

O‘ZBEKISTON FLORASIDA LYTHRUM L. (LYTHRACEAE) TURKUMI TURLARINING ASLIY INTEGRATSIYASI VA FITOSENOTIK STRUKTURASI

Saydullayeva Diyora Sobirjon qizi

Sharof Rashidov nomidagi Samarqand davlat universiteti tayanch doktoranti

E-mail: diyorasaydullayeva1899@gmail.com

Annotatsiya. *Maqolada O‘zbekiston Milliy gerbariy (TASH) fondida saqlanayotgan Lythrum L. turkumiga oid 246 ta o‘simlik namunasi (1906–1982) va muallif tomonidan 2024–2026-yillarda olib borilgan zamonaviy dala-tadqiqot ma’lumotlari kompleks tahlil qilingan. Tadqiqot natijasida respublika florasida turkumning 7 ta turi mavjudligi tasdiqlandi. Lythrum salicaria va L. intermedium turlari o‘rtasidagi o‘ziga xos ekologik yashash muhitining taqsimlanishi geobotanik metodlar yordamida aniqlangan. Antropogen omillar va daryo rejimlarining o‘zgarishi ta’sirida namsevar turlar areallarining qisqarish dinamikasi va ularni muhofaza qilish masalalari muhokama qilingan.*

Kalit so‘zlar: *Lythrum, TASH gerbariy fondi, o‘simliklar inventarizatsiyasi, floristik dinamika, fitosenoz, ekologik muhit, antropogen omillar.*

KIRISH (INTRODUCTION)

Respublikamiz florasining gidrofil va gidromezofil komponentlarini tizimli tadqiq etish, hozirgi iqlimiy o‘zgarishlar va suv resurslarining kamayishi sharoitida floristik xilma-xillikni saqlashning muhim bo‘g‘inidir. Suv va namlik bilan ta’minlangan gidrofizik muhitlarda, daryo vodiylari hamda sug‘orish tarmoqlari atrofida tarqalgan yetakchi turkumlardan biri Lythrum L. (Lythraceae Juss.) hisoblanadi. Ushbu turkum vakillari nafaqat namsevar floristik komplekslarning shakllanishida muhim senoz hosil qiluvchi dominantlar sifatida qatnashadi, balki tarkibida tanninlar va flavonoidlar saqlashi bilan dorivorlik xususiyatiga ham egadir. Botanik tadqiqotlarning muhim tarkibiy qismi bo‘lgan gerbariy yig‘ish jarayoni so‘nggi asrlar davomida tabiiy ekotizimlardagi o‘simliklar xilma-xilligini vaqt birligida aks ettiradigan eng ishonchli manba bo‘lib kelmoqda. Tarixiy namunalarga boy kolleksiyalarni raqamli ma’lumotlar bazalari shakliga o‘tkazish, elektron kataloglarini tuzish va global bioxilma-xillik resurslariga integratsiya qilish katta ilmiy ahamiyatga ega. Dunyoning eng yirik 50 ta gerbariy qatoridan o‘rin olgan O‘zbekiston Milliy gerbariysi (TASH) raqamli texnologiyalar yordamida biologik hujjatlashtirish va keng ko‘lamli ma’lumotlar majmuasini tahlil etishda muhim obyekt hisoblanadi. Shunga qaramasdan, O‘zbekiston florasida Lythrum L. turkumi turlarining zamonaviy populyatsion

holati, ularning tarixiy dinamikasi hamda hududlar bo‘yicha ekologik guruhlari shu kunga qadar yaxlit tizimda to‘liq tahlil qilinmagan. Suv havzalari atrofidagi antropogen yuklamaning ortishi (daryolarning betonlashtirilishi, kanallarning transformatsiyasi) mazkur turlar areallarining qisqarishiga va senopopulyatsiyalar tarkibining o‘zgarishiga olib kelmoqda. Ilmiy gipoteza (Hypothesis): Ushbu tadqiqotda biz Lythrum turkumi vakillari floristik o‘zgarishlar hamda gidrologik gradonitlar sharoitida keskin ekologik joy ajralishini namoyon etadi, hamda zamonaviy davrdagi antropogen bosim tufayli ularning tarixiy areallari qisqarib bormoqda, degan gipotezani ilgari suramiz.

MATERIAL VA METODLAR (MATERIALS AND METHODS)

Tadqiqot ishlarining asosi sifatida Toshkent shahrida joylashgan O‘zbekiston Fanlar akademiyasi Botanika instituti huzuridagi O‘zbekiston Milliy gerbariysi (TASH) fondida saqlanayotgan Lythrum L. turkumiga oid va yillar davomida (1906–1982) yig‘ilgan tarixiy materiallar to‘liq inventarizatsiya qilindi. Jami 246 ta gerbariy namunasi ko‘rib chiqildi, ularning taksonomik nomenklaturasi va asosiy sinonimlari Plants of the World Online (POWO) va IPNI ma’lumotlari bazasi asosida tekshirildi va tizimlashtirildi. Tarixiy etiketkalar asosida namunalar yig‘ilgan yillar, botaniko-geografik okruglar va kollektorlar bo‘yicha tahlil qilindi. Shuningdek, 2024–2026-yillardagi vegetatsiya davrlarida muallif tomonidan olib borilgan dala-tadqiqot ishlari davomida yig‘ilgan va qayd etilgan tabiiy populyatsiyalar ma’lumotlaridan foydalanildi. Tadqiqot davomida qiyosiy-morfologik, floristik va senopopulyatsion metodlar qo‘llanildi. O‘simlik turlarini identifikatsiya qilishda "Флора Узбекистана" (1959) hamda "Определитель растений Средней Азии" (1983) fundamental asarlariga tayanildi. Turlarning hayotiy shakllari K. Raunkier tizimi asosida aniqlandi. Geobotanik tavsiflar umumqabul qilingan metodikalar asosida 10×10 metr maydonda olib borildi va turlarning mo‘llik darajasi Drude shkalasi bo‘yicha baholandi.

NATIJALAR VA ULARNING TAHLILI (RESULTS)

1. TASH fondining taksonomik va xronologik tahlili

TASH fondida amalga oshirilgan revizorlik va inventarizatsiya ishlari natijasida O‘zbekiston florasida Lythrum L. turkumining 7 ta turi va jami 246 ta gerbariy varag‘i saqlanayotgani aniqlandi. Turlarning fonddagi miqdori quyidagi 1-jadvalda aks ettirilgan.

1-jadval. TASH fondidagi Lythrum L. turkumi turlarining miqdoriy ulushi

T/r	Tur nomi va POWO bo‘yicha indekslanishi	Namunalar soni	Ulushi (%)
1	Lythrum salicaria L. (Sp. Pl.: 446, 1753)	112	45.5%
2	Lythrum virgatum L. (Prodr. 3: 82, 1828)	54	22.0%
3	Lythrum hyssopifolia L. (Sp. Pl.: 447, 1753)	38	15.4%
4	Lythrum silenoides Boiss. & Noë (Diagn. Pl. Orient. 2: 55, 1856)	18	7.3%
5	Lythrum tribracteatum Salzm. ex Spreng. (Syst. Veg. 4: 190, 1827)	12	4.9%
6	Lythrum nanum Kar. & Kir. (Bull. Soc. Imp. Nat. Mosc. 15: 422, 1842)	7	2.9%
7	Lythrum sp. (aniqlanmagan namunalar)	5	2.0%
	JAMI:	246	100%

Gerbariy namunalarining yillar bo‘yicha taqsimlanishi tahlil qilinganda, eng katta to‘planish cho‘qqisi 1928–1938-yillar oralig‘iga to‘g‘ri kelishi aniqlandi (76 ta namuna, jami fondning 30.8 % qismi). Bu holat Markaziy Osiyoda ilk universitetning tashkil etilishi (1920) hamda yirik floristik ekspeditsiyalarning jadallashishi bilan bog‘liqdir. Keyingi davrlarda, ayniqsa 1972–1982-yillarda namunalar soni keskin kamayib ketgan (4 ta namuna). Kollektorlar tarkibini tahlil qilish jarayonida Markaziy Osiyo botanika maktabining klassik namoyandalari yetakchilik qilishi ma’lum bo‘ldi (2-jadval).

2-jadval. TASH fondidagi Lythrum L. turkumining asosiy kollektorlari va faoliyat yillari

Kollektor ismi-sharifi	**Faoliyat yillari**	**Yig'gan namunalar soni**
Abolin R.I.	1917–1926	21
Kudryashev S.N.	1930–1939	18
Popov M.G.	1922–1941	15
Saxobiddinov S.X.	1947–1949	12
Chevrenidi S.X.	1954–1955	10

2. Turlarning bioekologik tavsifi va zamonaviy fitosenotik strukturasi Dala kuzatuvlari va arxiv ma’lumotlari qiyoslanganda, hududda keng tarqalgan Lythrum salicaria va Lythrum intermedium turlarining ekologik guruhlari va fitosenotik roli aniqlandi (3-jadval).

3-jadval. Lythrum L. turkumi vakillarining bioekologik tavsifi

Tur nomi	**Hayotiy shakli (Raunkier)**	**Ekologik guruhi**	**Dinamikadagi asosiy biotoplari**	**Fitosanotik roli**
Lythrum salicaria L.	Gemikriptofit	Gigrofit	Daryo, soy va kanal qirg‘oqlari, loyqali yerlar	Dominant / Sodominant
Lythrum intermedium Fisch. ex Colla	Gemikriptofit	Mezogigrofit	Nam o‘tloqlar, allyuvial terrasalar, sho'rlangan yerlar	Sodominant / Ingredient

Namlik yuqori bo‘lgan mikromuhitlarda Lythrum salicaria dominantlik qilayotgan jamoalardan 10×10 m maydonchalar ajratib olinib, floristik tahlil o‘tkazildi (4-jadval).

4-jadval. Lythrum salicaria qatnashgan fitosenozning floristik tarkibi (10×10 m)

T/r	O‘simlikning lotincha nomi	Hayotiy shakli	Fenofaza	Mo‘llik darajasi (Drude)	Balandligi (m)
1	Lythrum salicaria L.	Ko‘p yillik o‘t	Gullash	7 (cop2)	1.0–1.2
2	Phragmites australis (Cav.) Trin.	Ko‘p yillik o‘t	Vegetatsiya	8 (cop3)	3.0–4.0
3	Cyperus longus L.	Ko‘p yillik o‘t	Gullash	7 (cop2)	1.5
4	Typha angustifolia L.	Ko‘p yillik o‘t	Gullash-mevalash	1 (sol)	1.0–2.0
5	Glycyrrhiza glabra L.	Ko‘p yillik o‘t	Vegetatsiya	9 (soc)	0.5–0.6

Allyuvial-o‘tloqi va biroz shoorlangan daryo bo‘yi terrasalari sharoitida Lythrum intermedium ishtirokidagi fitosenoz tahlil qilindi (5-jadval).

5-jadval. Lythrum intermedium qatnashgan fitosenozning floristik tarkibi (10×10 m)

T/r	O‘simlikning lotincha nomi	Hayotiy shakli	Fenofaza	Mo‘llik darajasi (Drude)	Balandligi (m)
1	Lythrum intermedium Fisch. ex Colla	Ko‘p yillik o‘t	Gullash	7 (cop2)	0.8–1.0
2	Phragmites australis (Cav.)	Ko‘p yillik	Vegetatsiya	8 (cop3)	2.5–3.5

	Trin.	o‘t			
3	Calamagrostis pseudophragmites	Ko‘p yillik o‘t	Mevalash	4 (sp)	1.0–1.2
4	Glycyrrhiza glabra L.	Ko‘p yillik o‘t	Vegetatsiya	3 (sp)	0.6–0.8
5	Juncus gerardii Loisel.	Ko‘p yillik o‘t	Mevalash	2 (sol)	0.3–0.5

MUHOKAMA (DISCUSSION)

TASH gerbariy fondining 100 yillik arxiv ma'lumotlari hamda 2024–2026-yillardagi zamonaviy dala tadqiqotlarining integratsiyasi Lythrum L. turkumi turlarining mintaqadagi transformatsiyasini chuqur tahlil qilish imkonini berdi. Olingan natijalar ilgari surilgan gipotezani to'liq tasdiqlaydi: Lythrum salicaria va L. intermedium turlari o'rtasida aniq ekologik muhit (yashash joyi) bo'yicha ajralish mavjud.

Lythrum salicaria chin gidrofil o'simlik bo'lib, namlik juda yuqori bo'lgan biotoplarda baland bo'yli Phragmites australis va Cyperus longus jamoalari orasida yuqori moslashuvchanlik va raqobatbardoshlik xususiyatlarini namoyon etadi. Aksincha, Lythrum intermedium turi o'zining tuksiz va silliq morfologiyasi tufayli vaqtincha qurish hamda tuproq sho'rlanishi kabi stressli omillarga bardoshlidir. U sho'rlikka chidamli Calamagrostis pseudophragmites va Juncus gerardii kabi hamroh turlar bilan barqaror mikrosenozlar hosil qiladi va asosiy o't qoplamining o'rta yarusida sodominantlik vazifasini bajaradi.

Xronologik va hududiy tahlillar shuni ko'rsatadiki, zamonaviy davrdagi gidrologik rejimlarning o'zgarishi, daryo o'zanlarining betonlashtirilishi va urbanizatsiya bosimi pasttekisliklardagi namsevar biotoplarning parchalanishiga (fragmentation) olib kelgan. Ayniqsa, Toshkent va Samarqand vohalarida tarixiy (1920–1940-yillarda yig'ilgan) ko'plab populyatsiyalar bugungi kunda yo'q bo'lib ketgan yoki areali keskin qisqargan. Bu holat kelgusida ushbu turkum vakillarining senopopulyatsion monitoringini yanada chuqurroq olib borishni va muhofaza choralarini ishlab chiqishni taqozo etadi.

XULOSA (CONCLUSION)

TASH fondi materiallarining raqamlashtirilishi va tabiiy hududlardagi dala tadqiqotlari natijasida O‘zbekiston florasida Lythrum L. turkumining 7 ta turi mavjudligi tasdiqlandi va 246 ta

namunaning katalogi shakllantirildi. Geobotanik tahlillar L. salicaria va L. intermedium turlining ekologik omillarga (namlik va sho'rlanish darajalariga) nisbatan o'ziga xos moslashish strategiyasiga ega ekanligini ko'rsatdi. Antropogen omillar va iqlim o'zgarishi ta'sirida ushbu namsevar turlarning areallarida qisqarish dinamikasi kuzatilmoqda. Tuzilgan raqamli katalog va ilmiy ma'lumotlar kelgusida Markaziy Osiyo bioxilma-xilligini saqlashda muhim poydevor bo‘lib xizmat qiladi.

ADABIYOTLAR RO‘YXATI (REFERENCES)

1.Barrett S.C.H. (2000). The evolution of plant reproductive systems. Philosophical Transactions of the Royal Society B, 355, 1575–1583.

2.Graham S.A., Hall J., Sytsma K. (2005). Phylogenetic analysis of the Lythraceae based on four gene regions and morphology. International Journal of Plant Sciences, 166(6), 995–1017.

3.Kozhevnikov A.E., Kozhevnikova Z.V. (2022). Taxonomical revision and eco-cenotic characteristics of the genus Lythrum L. in Central Asia. Turczaninowia, 25(2), 89–98.

4.Thiers B.M. (2018). The World’s Herbaria: A Summary Report Based on Data from Index Herbariorum. New York, 18 p.

5.Tojibaev K.Sh., Beshko N.Yu., Popov V.A. (2016). Botaniko-geograficheskoe rayonirovanie Uzbekistana. Botanicheskiy jurnal, 101(10), 1105–1130.

6.Определитель растений Средней Азии. В 10-ти томах. – Ташкент: Фан, 1983. – Т. 7. – С. 142–148.

7.Флора Узбекистана. В 6-ти томах. / Под ред. А.И. Введенского. – Ташкент: Изд-во АН УзССР, 1959. – Т. 4. – С. 360–365.

O‘ZBEKISTONDA LYTHRUM L. TURKUMI TURLARINING TARQALISH DINAMIKASI VA ZAMONAVIY FITOSENOTIK XUSUSIYATLARI

Saydullayeva Diyora Sobirjon qizi

Sharof Rashidov nomidagi Samarqand davlat universiteti tayanch doktoranti

diyoras499@gmail.com

ANNOTATSIYA

Maqolada O‘zbekistonda tarqalgan Lythrum L. turkumi vakillarining tarixiy tarqalishi va zamonaviy fitosenotik xususiyatlari tahlil qilindi. Tadqiqot O‘zbekiston Milliy gerbariysi (TASH) fondida saqlanayotgan 1906–1982-yillarga oid 246 ta gerbariy namunasi hamda 2024–2026-yillarda olib borilgan dala kuzatuvlari ma’lumotlariga asoslandi. Inventarizatsiya natijasida

turkumning 7 ta taksoni qayd etildi; eng ko‘p namunalar Lythrum salicaria L., L. virgatum L. va L. hyssopifolia L. turlariga tegishli bo‘ldi. Gerbariy yig‘imlarining eng yuqori ko‘rsatkichi 1928–1938-yillarga to‘g‘ri kelib, 76 ta namunani yoki umumiy fondning 30,8 foizini tashkil etdi. Geobotanik kuzatuvlar L. salicaria va L. intermedium Fisch. ex Colla turlarining namlik hamda sho‘rlanish sharoitlariga munosabati va fitosenozlardagi rolida farqlar borligini ko‘rsatdi. Tarixiy ma’lumotlar va zamonaviy kuzatuvlarni birgalikda tahlil qilish namsevar biotoplar holatini monitoring qilish hamda turkum vakillarini muhofaza qilish bo‘yicha keyingi tadqiqotlar uchun asos yaratadi.

Kalit so‘zlar: *Lythrum L., O‘zbekiston Milliy gerbariysi (TASH), gerbariy namunalari, tarqalish dinamikasi, fitosenoz, ekologik nişa, nam biotoplar.*

ABSTRACT

Herbarium collections provide an irreplaceable baseline for tracking long-term floristic shifts under climate change, yet integrated studies linking historical specimen archives with modern phytocenotic structures remain scarce in arid Central Asian ecosystems.

This study provides a comprehensive inventory, digitization, and ecological analysis of the genus Lythrum L. (Lythraceae) in Uzbekistan, combining data from 246 historical specimens (1906–1982) preserved in the National Herbarium of Uzbekistan (TASH) with recent ecological field surveys (2024–2026) using 10 × 10 m sampling plots along hydrological gradients.

The herbarium audit confirmed the presence of seven Lythrum species in the regional flora, with Lythrum salicaria L., L. virgatum L., and L. hyssopifolia L. representing the most frequent taxa. Historical timeline analysis revealed a major collection peak between 1928 and 1938 (30.8% of total sheets). Modern phytocenotic assessments focused on L. salicaria and L. intermedium Fisch. ex Colla and highlighted distinct ecological niche segregation.

A comparative historical synthesis indicates a progressive contraction of Lythrum distribution ranges in lowlands associated with river regulation and habitat fragmentation. The compiled digital catalog and syntaxonomic insights provide a baseline for conservation and ecological monitoring of wetland-dependent flora in Central Asia.

Keywords: *Lythrum, TASH Herbarium Fund, digitization, spatiotemporal dynamics, phytocenosis, niche segregation, arid wetlands.*

KIRISH

Respublikamiz florasining gidrofil va gidromezofil komponentlarini tizimli tadqiq etish, hozirgi iqlimiy o‘zgarishlar va suv resurslarining kamayishi sharoitida floristik xilma-xillikni saqlashning muhim bo‘g‘inidir. Suv va namlik bilan ta’minlangan gidrofizik muhitlarda, daryo vodiylari hamda sug‘orish tarmoqlari atrofida tarqalgan yetakchi turkumlardan biri Lythrum L.

(Lythraceae Juss.) hisoblanadi. Ushbu turkum vakillari namsevar floristik komplekslarning shakllanishida muhim senoz hosil qiluvchi dominantlar sifatida qatnashadi. [1, 360–365-b.; 2, 142–148-b.]

Botanik tadqiqotlarning muhim tarkibiy qismi bo‘lgan gerbariy yig‘ish jarayoni so‘nggi asrlar davomida tabiiy ekotizimlardagi o‘simliklar xilma-xilligini vaqt birligida aks ettiradigan muhim manba bo‘lib kelmoqda. Tarixiy namunalarga boy kolleksiyalarni raqamli ma’lumotlar bazalari shakliga o‘tkazish, elektron kataloglarini tuzish va global bioxilma-xillik resurslariga integratsiya qilish katta ilmiy ahamiyatga ega. [3, 1–18-b.]

Shunga qaramasdan, O‘zbekiston florasida Lythrum L. turkumi turlarining zamonaviy populyatsion holati, ularning tarixiy dinamikasi hamda hududlar bo‘yicha ekologik guruhlari shu kungacha yaxlit tizimda to‘liq tahlil qilinmagan. Suv havzalari atrofidagi antropogen yuklamaning ortishi daryo va kanallarning transformatsiyasi bilan birga mazkur turlar areallarining qisqarishiga va senopopulyatsiyalar tarkibining o‘zgarishiga olib kelishi mumkin. [4, 1105–1130-b.; 6, 89–98-b.]

Ilmiy gipoteza: ushbu tadqiqotda Lythrum turkumi vakillari floristik o‘zgarishlar hamda gidrologik gradientlar sharoitida ekologik niş ajralishini namoyon etadi, hamda antropogen bosim tufayli ularning tarixiy areallari qisqarib bormoqda, degan gipoteza ilgari surildi.

MATERIAL VA METODLAR

Tadqiqot ishlarining asosi sifatida Toshkent shahrida joylashgan O‘zbekiston Fanlar akademiyasi Botanika instituti huzuridagi O‘zbekiston Milliy gerbariysi (TASH) fondida saqlanayotgan Lythrum L. turkumiga oid 1906–1982-yillarda yig‘ilgan tarixiy materiallar inventarizatsiya qilindi. Jami 246 ta gerbariy namunasi ko‘rib chiqildi, ularning taksonomik nomenklaturasi va asosiy sinonimlari Plants of the World Online (POWO) va IPNI ma’lumotlari bazasi asosida tekshirildi. [1, 360–365-b.; 2, 142–148-b.]

Shuningdek, 2024–2026-yillardagi vegetatsiya davrlarida muallif tomonidan olib borilgan dala-tadqiqot ishlari davomida yig‘ilgan va qayd etilgan tabiiy populyatsiyalar ma’lumotlaridan foydalanildi. Tadqiqot davomida qiyosiy-morfologik, floristik va senopopulyatsion metodlar qo‘llanildi. O‘simlik turlarini identifikatsiya qilishda “Флора Узбекистана” (1959) hamda “Определитель растений Средней Азии” (1983) asarlariga tayanildi. Turlarning hayotiy shakllari K. Raunkier tizimi asosida aniqlandi. Geobotanik tavsiflar 10 × 10 m maydonlarda olib borildi va turlarning mo‘llik darajasi Drude shkalasi bo‘yicha baholandi.

NATIJALAR VA MUHOKAMA

TASH fondida amalga oshirilgan revizorlik va inventarizatsiya ishlari natijasida O‘zbekiston florasida Lythrum L. turkumining 7 ta turi va jami 246 ta gerbariy varag‘i saqlanayotgani aniqlandi. Turlarning fonddagi miqdoriy ulushi 1-jadvalda keltirilgan.

1-jadval. TASH fondidagi Lythrum L. turkumi turlarining miqdoriy ulushi

T/r	Tur nomi	Namunalar soni	Ulushi (%)
1	*Lythrum salicaria L.*	112	45,5
2	*Lythrum virgatum L.*	54	22,0
3	*Lythrum hyssopifolia L.*	38	15,4
4	*Lythrum silenoides Boiss. & Noë*	18	7,3
5	*Lythrum tribracteatum Salzm. ex Spreng.*	12	4,9
6	*Lythrum nanum Kar. & Kir.*	7	2,9
7	*Lythrum sp. (aniqlanmagan namunalar)*	5	2,0
Jami	—	**246**	**100,0**

Gerbariy namunalarining yillar bo‘yicha taqsimlanishi tahlil qilinganda eng katta to‘planish cho‘qqisi 1928–1938-yillar oralig‘iga to‘g‘ri kelishi aniqlandi: 76 ta namuna, jami fondning 30,8 % qismi. Keyingi davrlarda, ayniqsa 1972–1982-yillarda namunalar soni keskin kamayib, 4 tani tashkil etgan.

2-jadval. TASH fondidagi Lythrum L. turkumining asosiy kollektorlari va faoliyat yillari

Kollektor ismi-sharifi	Faoliyat yillari	Namunalar soni
Abolin R.I.	1917–1926	21
Kudryashev S.N.	1930–1939	18
Popov M.G.	1922–1941	15
Saxobiddinov S.X.	1947–1949	12
Chevrenidi S.X.	1954–1955	10

Dala kuzatuvlari va arxiv ma’lumotlari qiyoslanganda hududda keng tarqalgan Lythrum salicaria va Lythrum intermedium turlarining ekologik guruhlari va fitosenotik roli aniqlandi.

3-jadval. Lythrum L. turkumi vakillarining bioekologik tavsifi

Tur nomi	Hayotiy	Ekologik	Asosiy biotoplari	Fitosenotik roli

	shakli	guruhi		
Lythrum salicaria L.	Gemikriptofit	Gigrofit	Daryo, soy va kanal qirg‘oqlari, loyqali yerlar	Dominant / sodominant
Lythrum intermedium Fisch. ex Colla	Gemikriptofit	Mezogigrofit	Nam o‘tloqlar, allyuvial terrasalar, sho‘rlangan yerlar	Sodominant / ingredient

Namlik yuqori bo‘lgan mikromuhitlarda Lythrum salicaria dominantlik qilayotgan jamoalardan 10 × 10 m maydonchalar ajratib olinib, floristik tahlil o‘tkazildi.

4-jadval. Lythrum salicaria qatnashgan fitosenozning floristik tarkibi (10 × 10 m)

T/r	O‘simlikning lotincha nomi	Hayotiy shakli	Fenofaza	Mo‘llik darajasi (Drude)	Balandligi (m)
1	Lythrum salicaria L.	Ko‘p yillik o‘t	Gullash	7 (cop2)	1,0–1,2
2	Phragmites australis (Cav.) Trin.	Ko‘p yillik o‘t	Vegetatsiya	8 (cop3)	3,0–4,0
3	Cyperus longus L.	Ko‘p yillik o‘t	Gullash	7 (cop2)	1,5
4	Typha angustifolia L.	Ko‘p yillik o‘t	Gullash-mevalash	1 (sol)	1,0–2,0
5	Glycyrrhiza glabra L.	Ko‘p yillik o‘t	Vegetatsiya	9 (soc)	0,5–0,6

Allyuvial-o‘tloqi va biroz sho‘rlangan daryo bo‘yi terrasalari sharoitida Lythrum intermedium ishtirokidagi fitosenoz tahlil qilindi.

5-jadval. Lythrum intermedium qatnashgan fitosenozning floristik tarkibi (10 × 10 m)

T/r	O‘simlikning lotincha nomi	Hayotiy shakli	Fenofaza	Mo‘llik darajasi (Drude)	Balandligi (m)
1	Lythrum intermedium Fisch. ex Colla	Ko‘p yillik o‘t	Gullash	7 (cop2)	0,8–1,0
2	Phragmites australis (Cav.)	Ko‘p yillik	Vegetatsiya	8 (cop3)	2,5–3,5

	Trin.	o‘t			
3	Calamagrostis pseudophragmites	Ko‘p yillik o‘t	Mevalash	4 (sp)	1,0–1,2
4	Glycyrrhiza glabra L.	Ko‘p yillik o‘t	Vegetatsiya	3 (sp)	0,6–0,8
5	Juncus gerardii Loisel.	Ko‘p yillik o‘t	Mevalash	2 (sol)	0,3–0,5

TASH gerbariy fondining tarixiy arxiv ma’lumotlari hamda 2024–2026-yillardagi zamonaviy dala tadqiqotlarining integratsiyasi Lythrum L. turkumi turlarining mintaqadagi tarqalish xususiyatlarini tahlil qilish imkonini berdi. Olingan natijalar Lythrum salicaria va L. intermedium turlari o‘rtasida ekologik niş ajralishi mavjudligini ko‘rsatadi.

Lythrum salicaria namligi yuqori bo‘lgan biotoplarda Phragmites australis va Cyperus longus jamoalari orasida uchraydi. Lythrum intermedium esa allyuvial terrasalardagi o‘zgaruvchan namlik va past-o‘rtacha sho‘rlanish sharoitlarida Calamagrostis pseudophragmites va Juncus gerardii kabi hamroh turlar bilan birgalikda qayd etildi.

Xronologik va fazoviy tahlillar suv rejimining o‘zgarishi, daryo o‘zanlarining transformatsiyasi va urbanizatsiya bosimi namsevar biotoplarning parchalanishiga olib kelishi mumkinligini ko‘rsatadi. Shu sababli Lythrum turkumi vakillarining zamonaviy senopopulyatsion monitoringini davom ettirish muhimdir.

XULOSA

TASH fondi materiallarining raqamlashtirilishi va tabiiy hududlardagi dala tadqiqotlari natijasida O‘zbekiston florasida Lythrum L. turkumining 7 ta turi mavjudligi tasdiqlandi va 246 ta namunaning katalogi shakllantirildi. Geobotanik tahlillar L. salicaria va L. intermedium turlarining namlik va sho‘rlanish gradientlariga nisbatan o‘ziga xos ekologik moslashuvlarini ko‘rsatdi. Tarixiy gerbariy materiallari zamonaviy dala kuzatuvlari bilan birgalikda turkumning tarqalish dinamikasini baholash uchun muhim asos yaratadi. Olingan ma’lumotlar kelgusida namsevar o‘simliklar jamoalarining holatini monitoring qilish va Markaziy Osiyo bioxilma-xilligini o‘rganishda foydalanilishi mumkin.

ADABIYOTLAR RO‘YXATI

1. Флора Узбекистана. В 6-ти томах. / Под ред. А.И. Введенского. – Ташкент: Изд-во АН УзССР, 1959. – Т. 4. – С. 360–365.

2. Определитель растений Средней Азии. В 10-ти томах. – Ташкент: Фан, 1983. – Т. 7. – С. 142–148.

3. Thiers B.M. (2018). The World's Herbaria: A Summary Report Based on Data from Index Herbariorum. New York, 18 p.

4. Tojibaev K.Sh., Beshko N.Yu., Popov V.A. (2016). Botaniko-geograficheskoe rayonirovanie Uzbekistana. Botanicheskiy jurnal, 101(10), 1105–1130.

5. Graham S.A., Hall J., Sytsma K. (2005). Phylogenetic analysis of the Lythraceae based on four gene regions and morphology. International Journal of Plant Sciences, 166(6), 995–1017.

6. Kozhevnikov A.E., Kozhevnikova Z.V. (2022). Taxonomical revision and eco-cenotic characteristics of the genus Lythrum L. in Central Asia. Turczaninowia, 25(2), 89–98.

7. Barrett S.C.H. (2000). The evolution of plant reproductive systems. Philosophical Transactions of the Royal Society B, 355, 1575–1583.

EKOLOGIK OMILLARNING ODAM ANATOMIYASI VA FIZIOLOGIK JARAYONLARIGA TA'SIRI

Sadiqova Gulshoda Erkin qizi

Samarqand davlat pedagogika instituti magistranti

E-mail: sadiqovagulshoda@gmail.com

ANNOTATSIYA: *Ushbu maqolada ekologik omillarning, xususan, atmosfera havosining ifloslanishining inson organizmi anatomik tuzilmalari va fiziologik jarayonlariga ta'siri ilmiy adabiyotlar asosida tahlil qilingan. PM2.5 mayda dispers zarrachalari, azot dioksidi va ozonning nafas olish, yurak-qon tomir hamda asab tizimlariga ta'sir mexanizmlari yoritilgan. Shuningdek, oksidlovchi stress, yallig'lanish jarayonlari va vegetativ asab tizimi faoliyatidagi o'zgarishlarning organizm funksional holatiga ta'siri ko'rib chiqilgan. Tahlil natijalari asosida ekologik xavflarni kamaytirish, atmosfera havosi sifatini yaxshilash va inson salomatligini muhofaza qilishga qaratilgan tavsiyalar umumlashtirilgan.*

Kalit so'zlar: *ekologik omillar, atmosfera havosining ifloslanishi, odam anatomiyasi, fiziologiya, nafas olish tizimi, yurak-qon tomir tizimi, asab tizimi, PM2.5, oksidlovchi stress, yallig'lanish.*

ABSTRACT:*This article analyzes the effects of environmental factors, particularly ambient air pollution, on human anatomical structures and physiological processes based on scientific literature. It examines the mechanisms through which fine particulate matter (PM2.5), nitrogen dioxide, and ozone affect the respiratory, cardiovascular, and nervous systems. The roles of oxidative stress, inflammatory processes, and alterations in autonomic nervous system activity in influencing the functional state of the human body are also discussed. Based on the literature*

review, recommendations are summarized for reducing environmental health risks, improving ambient air quality, and protecting human health.

Keywords: *environmental factors, ambient air pollution, human anatomy, physiology, respiratory system, cardiovascular system, nervous system, PM2.5, oxidative stress, inflammation.*

KIRISH

Hozirgi davrda atrof-muhitning ifloslanishi inson salomatligiga ta’sir etuvchi dolzarb ekologik muammolardan biri hisoblanadi. Sanoat korxonalarining rivojlanishi, transport vositalari sonining ortishi, qazilma yoqilg‘ilarning yonishi, qurilish ishlari va tabiiy changlanish atmosfera havosiga turli zararli moddalar chiqarilishiga sabab bo‘lmoqda. Ushbu omillar inson organizmining anatomik tuzilmalari va fiziologik jarayonlariga bevosita yoki bilvosita ta’sir ko‘rsatishi mumkin.

Jahon sog‘liqni saqlash tashkiloti ma’lumotlariga ko‘ra, atmosfera havosining ifloslanishi inson salomatligi uchun muhim xavf omillaridan biridir. Mayda dispers zarrachalar, azot dioksidi, oltingugurt dioksidi, yer sathiga yaqin ozon va uglerod oksidi havo ifloslanishining salomatlikka ta’sir ko‘rsatuvchi asosiy komponentlari qatoriga kiradi. Ayniqsa, aerodinamik diametri 2,5 mikrometrdan kichik bo‘lgan PM2.5 zarrachalari nafas yo‘llarining chuqur qismlarigacha yetib borishi va organizmda turli biologik javob reaksiyalarini yuzaga keltirishi mumkin [1, 2].

Ekologik omillarning inson organizmiga ta’sirini o‘rganish odam anatomiyasi va fiziologiyasi, ekologiya hamda tibbiyot fanlari o‘rtasidagi muhim ilmiy yo‘nalishlardan biridir. Atrof-muhitdagi zararli omillar ayrim organlar faoliyatiga ta’sir qilish bilan cheklanmay, organizm tizimlari o‘rtasidagi funksional muvozanatning o‘zgarishiga ham olib kelishi mumkin.

Tadqiqotning maqsadi — ekologik omillarning, xususan, atmosfera havosining ifloslanishining inson organizmi anatomik tuzilmalari va fiziologik jarayonlariga ta’sirini ilmiy adabiyotlar asosida tahlil qilish.

Tadqiqot vazifalari:

- asosiy ekologik omillar va ularning inson organizmiga ta’sir xususiyatlarini tavsiflash;
- havo ifloslanishining nafas olish tizimiga ta’sir mexanizmlarini yoritish;
- yurak-qon tomir va asab tizimlaridagi ehtimoliy fiziologik o‘zgarishlarni tahlil qilish;
- ekologik xavflarni kamaytirish va inson salomatligini muhofaza qilish bo‘yicha tavsiyalarni umumlashtirish.

Tadqiqot materiallari va usullari. Tadqiqot ilmiy adabiyotlarni tahlil qilish, taqqoslash, tizimlashtirish va umumlashtirish usullariga asoslandi. Mavzu bo‘yicha chop etilgan ilmiy sharhlar va tizimli tahlillarda yoritilgan ma’lumotlar ko‘rib chiqildi.

ASOSIY QISM

1. Ekologik omillarning inson organizmiga umumiy ta’siri

Ekologik omillar inson yashaydigan muhitning fizik, kimyoviy va biologik xususiyatlari bilan bog‘liq. Fizik omillarga shovqin, tebranish, ionlashtiruvchi va ultrabinafsha nurlanish, shuningdek, yuqori yoki past harorat kiradi. Kimyoviy omillar qatoriga atmosfera havosidagi zararli gazlar, og‘ir metallar, pestitsidlar va sanoat chiqindilari kiradi. Biologik omillar esa mikroorganizmlar, allergenlar va biologik aerozillarni o‘z ichiga oladi.

Ekologik omillarning organizmga ta’siri ularning tabiati, konsentratsiyasi, ta’sir davomiyligi, organizmga kirish yo‘li va insonning individual xususiyatlariga bog‘liq. Bolalar, keksa yoshdagi insonlar, homilador ayollar hamda surunkali kasalliklari mavjud shaxslar ayrim ekologik xavflarga nisbatan ko‘proq sezuvchan bo‘lishi mumkin [1].

Atmosfera havosining ifloslanishi organizmga, asosan, nafas olish yo‘llari orqali ta’sir ko‘rsatadi. Nafas bilan kirgan ifloslantiruvchi moddalar burun bo‘shlig‘i, traxeya, bronxlar va o‘pka alveolalarigacha yetib borishi mumkin. Ayrim moddalar nafas yo‘llarida mahalliy yallig‘lanishni yuzaga keltirsa, boshqalari qon tomirlari faoliyati va asab tizimiga bilvosita ta’sir ko‘rsatishi mumkin.

Pryor va hammualliflari atmosfera havosidagi zarrachali ifloslanishning biologik ta’sirlarini tahlil qilib, oksidlovchi stress va yallig‘lanish jarayonlarini organizmning turli tizimlarida yuzaga keladigan o‘zgarishlarning muhim mexanizmlari sifatida ko‘rsatganlar [2].

2. Havo ifloslanishining nafas olish tizimiga ta’siri

Nafas olish tizimi tashqi muhit bilan bevosita aloqada bo‘lganligi sababli ekologik omillar ta’siriga eng ko‘p duch keladigan organlar tizimlaridan biridir. Uning asosiy anatomik tuzilmalari burun bo‘shlig‘i, halqum, hiqildoq, traxeya, bronxlar, bronxiolalar va alveolalardan iborat. Ushbu tuzilmalar havoni o‘tkazish, tozalash, namlash va gaz almashinuvini ta’minlashda ishtirok etadi.

Atmosferadagi chang va mayda zarrachalar nafas yo‘llarining shilliq qavatiga tushib, mahalliy himoya mexanizmlarini faollashtirishi mumkin. Sog‘lom nafas yo‘llarida kiprikchali epiteliy va shilliq sekret nafas bilan kirgan ko‘plab zarrachalarni ushlab qolish hamda tashqariga chiqarishga yordam beradi. Biroq ayrim ifloslantiruvchilarning uzoq muddatli yoki yuqori konsentratsiyadagi ta’siri ushbu himoya mexanizmlarining samaradorligini pasaytirishi mumkin.

PM2.5 zarrachalari o‘pkaning chuqur qismlarigacha yetib borib, alveolalar atrofidagi hujayralar va immun tizimi faoliyatiga ta’sir ko‘rsatishi mumkin. Natijada reaktiv kislorod birikmalari hosil bo‘lishi va yallig‘lanish mediatorlari ajralishi kuchayishi ehtimoli mavjud. Bunday jarayonlar oksidlovchi stress va mahalliy yallig‘lanishning rivojlanishiga zamin yaratadi [2].

Mazkur jarayonlar nafas yo‘llarining ta’sirlanishi, yo‘tal, hansirash va bronxial sezuvchanlikning ortishi bilan namoyon bo‘lishi mumkin. Havo ifloslanishi bronxial astma va surunkali obstruktiv o‘pka kasalligi kabi kasalliklarning kuchayishi bilan ham bog‘liq.

Azot dioksidi va yer sathiga yaqin ozon nafas yo‘llari epiteliyiga oksidlovchi ta’sir ko‘rsatishi va nafas olish funksiyasini yomonlashtirishi mumkin. Jismoniy faollik vaqtida nafas hajmi ortishi sababli ifloslangan havodan ko‘proq nafas olish organizmning ayrim ifloslantiruvchilar bilan ta’sirlashuvini kuchaytirishi mumkin [1].

Demak, nafas olish tizimidagi anatomik himoya mexanizmlari ekologik omillarning organizmga kirishini cheklashda muhim ahamiyatga ega. Biroq zararli moddalar miqdori va ta’sir davomiyligi ortganida ushbu mexanizmlar yetarli himoyani ta’minlay olmasligi mumkin.

3. Ekologik omillarning yurak-qon tomir tizimiga ta’siri

Yurak-qon tomir tizimi organizm to‘qimalariga kislorod va oziq moddalarni yetkazib berish, karbonat angidrid hamda metabolizm mahsulotlarini tashish vazifasini bajaradi. Ushbu tizimning normal faoliyati yurak mushagining qisqaruvchanligi, qon tomirlari tonusi, arterial qon bosimi va qonning reologik xususiyatlariga bog‘liq.

Ilmiy tadqiqotlarda atmosfera havosining ifloslanishi, xususan, PM2.5 zarrachalari bilan yurak-qon tomir kasalliklari xavfi o‘rtasidagi bog‘liqlik qayd etilgan. Bhatnagar tomonidan e’lon qilingan ilmiy sharhda mayda dispers zarrachalarning tomirlar faoliyati, arterial qon bosimi, tromboz va ateroskleroz bilan bog‘liq biologik mexanizmlari yoritilgan [3].

Havo ifloslanishining yurak-qon tomir tizimiga ta’siri bir necha mexanizm orqali amalga oshishi mumkin. Birinchidan, nafas yo‘llarida yuzaga kelgan yallig‘lanish reaksiyasi tizimli yallig‘lanishga sabab bo‘lishi mumkin. Yallig‘lanish mediatorlarining qon aylanishiga o‘tishi qon tomirlarining ichki qavati — endoteliy faoliyatiga ta’sir ko‘rsatishi mumkin. Endoteliy faoliyatining buzilishi tomirlarning kengayishi va torayishini boshqaruvchi mexanizmlarni izdan chiqarishi ehtimoli mavjud.

Ikkinchidan, zarrachali ifloslantiruvchilar oksidlovchi stressni kuchaytirib, qon tomirlari devorlarining funksional holatiga ta’sir qilishi mumkin. Uchinchidan, havo ifloslanishi vegetativ asab tizimi faoliyatiga ta’sir qilib, yurak urish tezligi, yurak urishlarining o‘zgaruvchanligi va arterial qon bosimida o‘zgarishlar yuzaga kelishiga sabab bo‘lishi mumkin [3, 4].

Uzoq muddatli havo ifloslanishi yurak ishemik kasalligi, miokard infarkti va insult kabi yurak-qon tomir kasalliklari xavfining ortishi bilan bog‘langan. Biroq individual xavf ifloslanish darajasi bilan bir qatorda yosh, irsiyat, chekish, ovqatlanish, jismoniy faollik va mavjud kasalliklar kabi omillarga ham bog‘liq.

Shunday qilib, havo ifloslanishi faqat o‘pka faoliyatiga emas, balki qon aylanish tizimining funksional holatiga ham ta’sir ko‘rsatishi mumkin. Nafas olish tizimida boshlangan yallig‘lanish va vegetativ boshqaruvdagi o‘zgarishlar butun organizm faoliyatiga ta’sir qiluvchi omillar sifatida qaraladi.

4. Havo ifloslanishining asab tizimi va kognitiv funksiyalarga ta’siri

Markaziy asab tizimi organizm faoliyatini boshqarish, tashqi muhitdan keladigan axborotni qayta ishlash, xotira, diqqat, tafakkur va harakatlarni muvofiqlashtirishda muhim o‘rin tutadi. Bosh miya va orqa miya faoliyati organizmning ichki holati hamda tashqi muhit sharoitlari bilan uzviy bog‘liq. So‘nggi yillarda havo ifloslanishining asab tizimiga ta’siri bo‘yicha ilmiy tadqiqotlarga e’tibor ortib bormoqda. Ilmiy sharhlarda ayrim mayda zarrachalarning biologik to‘siqlarga ta’siri, neyroyallig‘lanish va oksidlovchi stress bilan bog‘liq mexanizmlar ko‘rib chiqilgan [2, 5].

Havo ifloslantiruvchilari asab tizimiga bir necha yo‘l bilan ta’sir ko‘rsatishi mumkin. Birinchi yo‘l — nafas yo‘llarida yuzaga kelgan yallig‘lanish reaksiyasining tizimli yallig‘lanishga olib kelishi. Ikkinchi yo‘l — ayrim juda mayda zarrachalarning hid bilish tizimi orqali markaziy asab tizimiga ta’sir ko‘rsatishi ehtimoli. Uchinchi yo‘l esa qon aylanishidagi yallig‘lanish mediatorlari va boshqa biologik omillarning qon-miya to‘sig‘i faoliyatiga ta’siri bilan bog‘liq.

Qon-miya to‘sig‘i markaziy asab tizimini qon tarkibidagi ko‘plab zararli moddalar va tashqi omillardan himoya qilishda ishtirok etadi. Ayrim eksperimental tadqiqotlarda zarrachali ifloslantiruvchilar ta’sirida ushbu to‘siq faoliyati va neyroimmun jarayonlarda o‘zgarishlar aniqlangan [2].

Zundel va hammualliflarining tizimli sharhida havo ifloslanishi bilan depressiv va xavotirli holatlar, shuningdek, miyaning ayrim tuzilmalari va funksiyalaridagi o‘zgarishlar o‘rtasidagi bog‘liqlik o‘rganilgan. Mualliflar neyroyallig‘lanish va oksidlovchi stressni ehtimoliy biologik mexanizmlar qatorida qayd etganlar. Shu bilan birga, ayrim yo‘nalishlarda sababiy munosabatni aniq belgilash uchun qo‘shimcha tadqiqotlar zarurligi ta’kidlangan [5].

Havo ifloslanishining xotira, diqqat va boshqa kognitiv funksiyalarga ta’siri ham ilmiy jihatdan o‘rganilmoqda. Ayrim tadqiqotlarda PM2.5 va azot dioksidi kabi ifloslantiruvchilar bilan kognitiv ko‘rsatkichlar o‘rtasidagi bog‘liqlik tahlil qilingan. Natijalar yosh, tadqiqot dizayni va o‘rganilgan kognitiv ko‘rsatkichlarga qarab farqlanishi mumkin [6].

Shuni ta’kidlash kerakki, havo ifloslanishi va asab tizimi faoliyati o‘rtasida bog‘liqlik aniqlanishi barcha holatlarda bevosita sababiy munosabat mavjudligini anglatmaydi. Mazkur masalani chuqurroq tushunish uchun uzoq muddatli kuzatuvlar, neyrofiziologik tekshiruvlar va boshqa xavf omillarini hisobga oluvchi tadqiqotlar zarur.

5. Ekologik omillarning fiziologik jarayonlarga kompleks ta’siri

Inson organizmidagi organlar va tizimlar o‘zaro uzviy bog‘langan. Shu sababli ekologik omilning bitta tizimga ta’siri boshqa tizimlarda ham funksional o‘zgarishlarni keltirib chiqarishi mumkin.

Masalan, ifloslangan havodan nafas olish o‘pka to‘qimalarida yallig‘lanish reaksiyasini yuzaga keltirishi mumkin. Ushbu reaksiya organizmning umumiy yallig‘lanish holatiga ta’sir qilib, qon tomirlari faoliyati va vegetativ asab tizimining boshqaruv mexanizmlarini o‘zgartirishi ehtimoli mavjud. Natijada nafas olish, qon aylanishi va nerv boshqaruvi o‘rtasidagi fiziologik muvozanatga ta’sir ko‘rsatilishi mumkin [2–4].

Boshqa ekologik omillar ham organizm fiziologiyasiga ta’sir qiladi. Masalan, shovqinning uzoq muddatli ta’siri uyqu sifatining pasayishi va stress reaksiyalarining kuchayishi bilan bog‘liq bo‘lishi mumkin. Yuqori harorat esa termoregulyatsiya mexanizmlariga yuklama berib, yurak urish tezligi hamda suv-elektrolit muvozanatiga ta’sir ko‘rsatishi mumkin.

Ekologik omillarning biologik ta’siri ularning darajasi, davomiyligi, boshqa omillar bilan birgalikda mavjudligi va organizmning moslashuv imkoniyatlariga bog‘liq. Shu sababli ekologik xavflarni baholashda ifloslantiruvchi moddaning mavjudligini aniqlash bilan cheklanmasdan, uning konsentratsiyasi, ta’sir davomiyligi va aholining ta’sirlanish xususiyatlarini ham hisobga olish lozim.

Inson salomatligini muhofaza qilish uchun atmosfera havosi sifatini muntazam nazorat qilish, sanoat va transport chiqindilarini kamaytirish, yashil hududlarni ko‘paytirish, ishlab chiqarish joylarida mehnat muhofazasi talablariga rioya qilish hamda aholi orasida ekologik savodxonlikni oshirish muhim ahamiyatga ega.

XULOSA

Ilmiy adabiyotlar tahlili ekologik omillar, ayniqsa, atmosfera havosining ifloslanishi inson organizmining anatomik tuzilmalari va fiziologik jarayonlariga ko‘p qirrali ta’sir ko‘rsatishini ko‘rsatadi.

Birinchidan, nafas olish tizimi ekologik ifloslantiruvchilar bilan bevosita aloqada bo‘lib, PM2.5, azot dioksidi va ozon kabi moddalar nafas yo‘llarida yallig‘lanish, epiteliy himoya funksiyasining buzilishi va ayrim respirator kasalliklarning kuchayishi bilan bog‘liq.

Ikkinchidan, havo ifloslanishi yurak-qon tomir tizimiga tizimli yallig‘lanish, oksidlovchi stress, endoteliy faoliyatining buzilishi va vegetativ asab tizimi faoliyatidagi o‘zgarishlar orqali ta’sir qilishi mumkin. Ushbu mexanizmlar ayrim yurak-qon tomir kasalliklari xavfining ortishi bilan bog‘langan.

Uchinchidan, mavjud ilmiy ma’lumotlar havo ifloslanishi bilan asab tizimidagi ayrim biologik o‘zgarishlar, kognitiv funksiyalar va ruhiy salomatlik ko‘rsatkichlari o‘rtasida bog‘liqlik

mavjudligini ko‘rsatadi. Biroq ushbu ta’sirlarning mexanizmlari va sababiy munosabatlarini to‘liq aniqlash uchun qo‘shimcha tadqiqotlar talab etiladi.

To‘rtinchidan, ekologik omillarning organizmga ta’siri kompleks xususiyatga ega. Bir tizimdagi o‘zgarishlar boshqa tizimlarning faoliyatiga ham ta’sir ko‘rsatishi mumkin. Shu sababli inson salomatligini baholashda ekologik sharoitlar, fiziologik ko‘rsatkichlar va individual xavf omillarini birgalikda o‘rganish zarur.

Umuman olganda, atmosfera havosi sifatini yaxshilash, zararli chiqindilarni kamaytirish va ekologik xavflarni muntazam monitoring qilish inson salomatligini muhofaza qilishning muhim yo‘nalishlari hisoblanadi. Kelgusidagi tadqiqotlarda yurak urish tezligi, arterial qon bosimi, nafas olish chastotasi va o‘pkaning funksional ko‘rsatkichlarini ekologik monitoring ma’lumotlari bilan taqqoslash orqali ekologik omillarning fiziologik ta’sirini yanada chuqur o‘rganish mumkin.

FOYDALANILGAN ADABIYOTLAR

1. World Health Organization. *WHO Global Air Quality Guidelines: Particulate Matter (PM2.5 and PM10), Ozone, Nitrogen Dioxide, Sulfur Dioxide and Carbon Monoxide*. Geneva: WHO, 2021.
2. Pryor J. T., Cowley L. O., Simonds S. E. The Physiological Effects of Air Pollution: Particulate Matter, Physiology and Disease. *Frontiers in Public Health*. 2022;10:882569. DOI: https://doi.org/10.3389/fpubh.2022.882569.
3. Bhatnagar A. Cardiovascular Effects of Particulate Air Pollution. *Annual Review of Medicine*. 2022;73:393–406. DOI: https://doi.org/10.1146/annurev-med-042220-011549.
4. Rajagopalan S., Al-Kindi S. G., Brook R. D. Air Pollution and Cardiovascular Disease: JACC State-of-the-Art Review. *Journal of the American College of Cardiology*. 2018;72(17):2054–2070. DOI: https://doi.org/10.1016/j.jacc.2018.07.099.
5. Zundel C. G., Ryan P., Brokamp C., et al. Air Pollution, Depressive and Anxiety Disorders, and Brain Effects: A Systematic Review. *NeuroToxicology*. 2022;93:272–300. DOI: https://doi.org/10.1016/j.neuro.2022.10.011.
6. *Air pollution and human cognition: A systematic review and meta-analysis*. Science of the Total Environment. 2023;859(2):160234. DOI: https://doi.org/10.1016/j.scitotenv.2022.160234.

OZIQ MODDALAR YETISHMOVCHILIGINING ODAM ORGANIZMIDAGI ANATOMIK VA FIZIOLOGIK O‘ZGARISHLARGA TA’SIRI

Sadiqova Gulshoda Erkin qizi

Samarqand davlat pedagogika instituti,

biologiya o‘qitish metodikasi mutaxassisligi magistranti

E-mail: sadiqovagulshoda@gmail.com

Annotatsiya *ushbu maqolada oziq moddalar yetishmovchiligining odam organizmidagi anatomik va fiziologik o‘zgarishlarga ta’siri ilmiy adabiyotlar asosida tahlil qilingan. Oqsil-energiya yetishmovchiligi, temir va yod tanqisligi, shuningdek, ayrim vitaminlarning yetishmasligi natijasida yuzaga keladigan o‘zgarishlar yoritilgan. Xususan, mushak massasining kamayishi, qon hosil bo‘lish jarayonining buzilishi, qalqonsimon bez faoliyatidagi o‘zgarishlar, suyak to‘qimasining mineralizatsiyasi va moddalar almashinuvi bilan bog‘liq jarayonlar ko‘rib chiqilgan. Oziq moddalar tanqisligining oldini olishda muvozanatli ovqatlanish, oziq-ovqat mahsulotlarini zarur mikroelementlar bilan boyitish va profilaktik tadbirlarning ahamiyati asoslab berilgan.*

Kalit so‘zlar: *oziq moddalar yetishmovchiligi, oqsil-energiya tanqisligi, temir, yod, vitaminlar, anemiya, suyak to‘qimasi, moddalar almashinuvi..*

ABSTRACT *This article analyzes the effects of nutrient deficiencies on anatomical and physiological changes in the human body based on a review of scientific literature. It examines the consequences of protein-energy deficiency and deficiencies of iron, iodine, and selected vitamins. Particular attention is given to changes in muscle mass, blood formation, thyroid function, bone mineralization, and metabolism. The article also highlights the importance of balanced nutrition, food fortification with essential micronutrients, and preventive measures in reducing the risk of nutrient deficiencies.*

Keywords: *nutrient deficiency, protein-energy deficiency, iron, iodine, vitamins, anemia, bone tissue, metabolism.*

KIRISH

To‘g‘ri va muvozanatli ovqatlanish inson organizmining o‘sishi, rivojlanishi, to‘qimalarning yangilanishi va fiziologik funksiyalarning me’yorida kechishini ta’minlovchi muhim omillardan biridir. Organizmga zarur oziq moddalarning uzoq muddat davomida yetarli miqdorda tushmasligi yoki ularning hazm bo‘lishi va so‘rilish jarayonlarining buzilishi turli anatomik hamda funksional o‘zgarishlarga olib kelishi mumkin. Bunday holatlar oqsil-energiya yetishmovchiligi, vitaminlar va mineral moddalar tanqisligi ko‘rinishida namoyon bo‘ladi.

Jahon sog‘liqni saqlash tashkiloti ma’lumotlarida temir, yod, A vitamini va boshqa mikroelementlar yetishmovchiligi aholi salomatligi bilan bog‘liq muhim muammolardan biri

sifatida ko‘rib chiqiladi [1, 2]. Ushbu moddalar organizmga nisbatan kam miqdorda zarur bo‘lsa-da, fermentlar va gormonlar faoliyati, hujayralarning normal ishlashi, o‘sish hamda rivojlanish jarayonlarida muhim ahamiyatga ega.

Oqsillar hujayra va to‘qimalarning asosiy tarkibiy qismlaridan biri bo‘lib, mushaklar, fermentlar, transport oqsillari va immun tizimi faoliyatida ishtirok etadi. Temir gemoglobin tarkibiga kirib, kislorodning to‘qimalarga tashilishini ta’minlaydi. Yod qalqonsimon bez gormonlari sintezi uchun zarur, D vitamini esa kalsiy-fosfor almashinuvi va suyaklarning mineralizatsiyasida muhim rol o‘ynaydi. Shu sababli ushbu oziq moddalar yetishmovchiligi organizmning turli anatomik tuzilmalari va fiziologik tizimlariga salbiy ta’sir ko‘rsatishi mumkin.

Tadqiqotning maqsadi — oqsil, temir, yod va ayrim vitaminlar yetishmovchiligining inson organizmidagi anatomik tuzilmalar hamda fiziologik jarayonlarga ta’sirini ilmiy adabiyotlar asosida tahlil qilish.

Tadqiqot maqsadidan kelib chiqib, quyidagi vazifalar belgilandi:

- oziq moddalar yetishmovchiligining asosiy sabablarini yoritish;
- oqsil tanqisligining mushaklar va boshqa to‘qimalarga ta’sirini tavsiflash;
- temir yetishmovchiligi va anemiya o‘rtasidagi bog‘liqlikni tahlil qilish;
- yod va vitaminlar tanqisligining endokrin, asab va suyak tizimlariga ta’sirini ko‘rib chiqish;
- oziq moddalar yetishmovchiligining oldini olish bo‘yicha ilmiy adabiyotlarda keltirilgan tavsiyalarni umumlashtirish.

TADQIQOT MATERIALLARI VA USULLARI

Tadqiqotning nazariy asosini oziq moddalar yetishmovchiligi, oqsil-energiya tanqisligi, mikroelementlar va vitaminlarning fiziologik ahamiyatiga bag‘ishlangan ilmiy adabiyotlar hamda xalqaro tashkilotlarning axborot materiallari tashkil etdi.

Tadqiqotda ilmiy adabiyotlarni tahlil qilish, taqqoslash, umumlashtirish va tizimlashtirish usullaridan foydalanildi. Manbalardagi ma’lumotlar oziq moddalar yetishmovchiligining mushak-skelet tizimi, qon hosil bo‘lishi, endokrin tizim, asab tizimi va moddalar almashinuviga ta’siri bo‘yicha guruhlashtirildi.

Mazkur ish adabiyotlar tahliliga asoslangan bo‘lib, unda mustaqil klinik yoki laborator tajribalar o‘tkazilmagan.

NATIJALAR VA MUHOKAMA

1. Oziq moddalar yetishmovchiligining umumiy fiziologik mexanizmlari

Oziq moddalar yetishmovchiligi organizmga tushayotgan energiya va zarur oziq moddalarning fiziologik ehtiyojni qoplay olmasligi, ovqat hazm qilish va so‘rilish jarayonlarining buzilishi yoki ayrim kasalliklar tufayli oziq moddalarga ehtiyojning ortishi natijasida yuzaga kelishi mumkin.

Uning oqibatlari tanqis moddaning turiga, yetishmovchilik darajasi va davomiyligiga, shuningdek, insonning yoshi va fiziologik holatiga bog‘liq. Oqsil va energiya yetishmovchiligi vaqtida organizm hayotiy faoliyatni saqlab qolish uchun ichki zaxiralardan foydalanadi. Uzoq davom etgan tanqislik yog‘ zaxiralarining kamayishi, mushak oqsillarining parchalanishi, tana vazni va mushak massasining pasayishi bilan kechishi mumkin. Og‘ir holatlarda suyuqlik-elektrolit muvozanati va immun javob ham buzilishi ehtimoli mavjud [3, 4].

Vitamin va mineral moddalar yetishmovchiligi esa ko‘pincha muayyan biokimyoviy jarayonlarning izdan chiqishi bilan bog‘liq. Masalan, temir tanqisligi gemoglobin sintezini cheklaydi, yod yetishmovchiligi qalqonsimon bez gormonlari ishlab chiqarilishiga ta’sir qiladi, D vitamini tanqisligi esa kalsiy va fosfor almashinuvining buzilishiga sabab bo‘lishi mumkin [1, 2, 6].

2. Oqsil yetishmovchiligining mushaklar va to‘qimalarga ta’siri

Oqsillar aminokislotalardan tashkil topgan murakkab organik birikmalar bo‘lib, hujayralarning tuzilishi va faoliyati uchun zarur. Ular fermentlar, ayrim gormonlar, antitanalar va transport oqsillari hosil bo‘lishida ishtirok etadi. Skelet mushaklaridagi aktin va miozin oqsillari mushaklarning qisqarish mexanizmini ta’minlaydi. Shu sababli oqsilning uzoq muddat yetarli miqdorda iste’mol qilinmasligi mushak massasining kamayishi va jismoniy ish qobiliyatining pasayishiga olib kelishi mumkin.

Oqsil-energiya yetishmovchiligida organizm energiya ehtiyojini qoplash uchun to‘qimalardagi moddalarni safarbar qiladi. Natijada mushak oqsillarining parchalanishi kuchayib, mushaklar hajmi va kuchi kamayishi mumkin. Bolalarda og‘ir va davomli oziqlanish yetishmovchiligi tana vaznining yetarli ortmasligi, bo‘y o‘sishining sekinlashishi va rivojlanish jarayonlarining buzilishi bilan bog‘liq [3, 4].

Oqsil tanqisligi immun tizimining faoliyatiga ham ta’sir ko‘rsatishi mumkin. Immun hujayralarining hosil bo‘lishi va faoliyati uchun aminokislotalar zarur bo‘lganligi sababli, yetarli ovqatlanmaslik organizmning ayrim infeksiyalarga qarshi himoyasini zaiflashtirishi mumkin. Infeksiyalar esa ishtahani pasaytirib, oziq moddalarga bo‘lgan ehtiyojni oshirishi va mavjud tanqislikni yanada chuqurlashtirishi mumkin [4].

Oqsil tanqisligini baholashda faqat iste’mol qilinayotgan oqsil miqdorini emas, balki umumiy energiya iste’moli, ratsion sifati, ovqat hazm qilish va oziq moddalarning so‘rilish holatini ham hisobga olish zarur.

3. Temir yetishmovchiligi va qon hosil bo‘lish jarayoni

Temir gemoglobin tarkibiga kiruvchi muhim mineral bo‘lib, eritrotsitlar orqali kislorodning o‘pkadan to‘qimalarga tashilishida ishtirok etadi. Shuningdek, temir mioglobin va ayrim fermentlar

tarkibida mavjud. Organizmda temir zaxiralari kamayib, tanqislik davom etsa, gemoglobin sintezi buzilishi va temir tanqisligi anemiyasi rivojlanishi mumkin [1, 5].

Anemiya vaqtida qonning kislorod tashish qobiliyati pasayadi. Natijada to‘qimalarga kislorod yetkazib berish kamayib, holsizlik, tez charchash, bosh aylanishi, diqqatning susayishi, jismoniy zo‘riqishda hansirash va yurak urishining tezlashishi kabi belgilar kuzatilishi mumkin. Organizm kislorod yetkazib berishdagi pasayishni qisman qoplash uchun yurak faoliyatini kuchaytirishi mumkin.

Temir tanqisligi bolalar, o‘smirlar, homilador ayollar va ko‘p qon yo‘qotadigan shaxslar uchun alohida ahamiyatga ega. Biroq anemiyaning sababi har doim ham temir yetishmovchiligi bo‘lavermaydi. Folat yoki B12 vitamini tanqisligi, surunkali yallig‘lanish, qon yo‘qotish va ayrim irsiy kasalliklar ham anemiyaga sabab bo‘lishi mumkin [1]. Shu sababli tanqislikni aniqlash va davolashda uning sababini tibbiy tekshiruvlar asosida belgilash muhimdir.

4. Yod yetishmovchiligining qalqonsimon bez va asab tizimiga ta’siri

Yod qalqonsimon bez gormonlari — tiroksin (T4) va triyodtironin (T3) sintezi uchun zarur. Ushbu gormonlar asosiy moddalar almashinuvi, issiqlik hosil bo‘lishi, yurak faoliyati, o‘sish va markaziy asab tizimining rivojlanishida muhim rol o‘ynaydi.

Yodning uzoq muddat yetarli miqdorda iste’mol qilinmasligi qalqonsimon bez gormonlari ishlab chiqarilishiga ta’sir qilishi va bezning kattalashishi — buqoq rivojlanishiga olib kelishi mumkin [1, 2]. Yod yetishmovchiligi homila va erta bolalik davrida ayniqsa muhim, chunki qalqonsimon bez gormonlari miya va asab tizimining normal rivojlanishi uchun zarur. Og‘ir tanqislik bolaning kognitiv rivojlanishiga salbiy ta’sir ko‘rsatishi mumkin.

Kattalarda qalqonsimon bez gormonlari yetishmovchiligi holsizlik, sovuqqa sezuvchanlikning ortishi, moddalar almashinuvining sekinlashishi va diqqat bilan bog‘liq qiyinchiliklar kabi belgilar bilan namoyon bo‘lishi mumkin. Biroq bunday belgilar boshqa kasalliklarda ham uchrashi mumkinligi sababli, ularni faqat yod tanqisligi bilan izohlash to‘g‘ri emas.

Yod tanqisligining oldini olishda yodlangan osh tuzidan me’yorida foydalanish samarali profilaktik choralardan biri hisoblanadi. Bunda tuz iste’molini ko‘paytirish emas, balki iste’mol qilinadigan tuzning yodlangan turini tanlash va umumiy tuz miqdorini me’yorida saqlash muhimdir [1].

5. Vitaminlar yetishmovchiligining suyaklar, qon va moddalar almashinuviga ta’siri

Vitaminlar organizmdagi ko‘plab fermentativ va boshqaruv jarayonlarining me’yorida kechishi uchun zarur. Ularning yetishmovchiligi qaysi vitamin tanqisligiga bog‘liq ravishda turlicha namoyon bo‘ladi.

D vitamini kalsiy va fosforning so‘rilishi hamda suyaklarning mineralizatsiyasida ishtirok etadi. Uning yetishmovchiligi bolalarda raxit, kattalarda esa osteomalatsiya rivojlanish xavfini oshirishi

mumkin [6]. Ushbu holatlar suyak to‘qimasining mineral tarkibi va mustahkamligiga ta’sir ko‘rsatadi.

B12 vitamini va folat DNK sintezi hamda eritrotsitlarning yetilishi uchun muhim hisoblanadi. Ularning tanqisligi megaloblast anemiyaga olib kelishi mumkin. B12 vitamini yetishmovchiligi ayrim hollarda asab tizimiga ham ta’sir etib, uvishish, sezgi buzilishlari va muvozanat bilan bog‘liq belgilarni yuzaga keltirishi mumkin.

C vitamini kollagen sintezida ishtirok etadi. Uning og‘ir tanqisligi biriktiruvchi to‘qima, milk va qon tomirlari holatiga ta’sir ko‘rsatib, qonash va to‘qimalarning mo‘rtlashishi bilan namoyon bo‘lishi mumkin. A vitamini esa ko‘rish jarayoni, epiteliy to‘qimalarining saqlanishi va immun himoya uchun zarur. Ushbu vitaminning yetishmovchiligi qorong‘ida ko‘rishning yomonlashishiga, og‘ir holatlarda esa ko‘z shox pardasining zararlanishiga olib kelishi mumkin [1, 2].

Shunday qilib, vitaminlar tanqisligi faqat bitta organga emas, balki suyak to‘qimasi, qon, asab tizimi, ko‘rish organi va biriktiruvchi to‘qimalar kabi turli anatomik tuzilmalarga ta’sir ko‘rsatadi. Vitamin preparatlarini, ayniqsa yuqori dozada, mutaxassis tavsiyasisiz qabul qilish maqsadga muvofiq emas, chunki ayrim vitaminlarning ortiqcha miqdori ham salbiy oqibatlarga olib kelishi mumkin.

6. Oziq moddalar yetishmovchiligining oldini olish va amaliy ahamiyati

Oziq moddalar yetishmovchiligining oldini olishda kundalik ratsionni xilma-xil va muvozanatli tashkil etish muhim. Ratsionda oqsil manbalari, dukkaklilar, don mahsulotlari, sabzavotlar, mevalar, yong‘oqlar va zarur vitamin-minerallarga boy mahsulotlarning mavjudligi organizm ehtiyojlarini qoplashga yordam beradi.

Temir manbalariga go‘sht, dukkaklilar va temir bilan boyitilgan mahsulotlar kiradi. O‘simlik manbalaridan olinadigan temirning so‘rilishi C vitaminiga boy mahsulotlarni birga iste’mol qilish orqali yaxshilanishi mumkin. Yodlangan tuzdan me’yorida foydalanish yod tanqisligining oldini olishda ahamiyatli. D vitamini va boshqa mikroelementlarga bo‘lgan ehtiyoj esa insonning yoshi, ovqatlanish xususiyatlari va sog‘liq holatiga qarab farqlanishi mumkin.

Homiladorlik, bolalik, o‘smirlik va keksalik davrlarida ayrim oziq moddalarga bo‘lgan ehtiyoj o‘zgaradi. Shu sababli aholi salomatligini muhofaza qilishda to‘g‘ri ovqatlanish bo‘yicha ma’rifiy ishlar, oziq-ovqat mahsulotlarini zarur mikroelementlar bilan boyitish, xavf guruhlarini o‘z vaqtida aniqlash va tibbiy tavsiyalarga amal qilish muhim ahamiyatga ega [1, 2].

XULOSA

Ilmiy adabiyotlar tahlili oziq moddalar yetishmovchiligi inson organizmining anatomik tuzilmalari va fiziologik jarayonlariga sezilarli ta’sir ko‘rsatishini ko‘rsatadi. Oqsil-energiya

tanqisligi mushak massasining kamayishi, jismoniy ish qobiliyatining pasayishi, bolalarda o‘sishning sekinlashishi va immun himoyaning zaiflashishi bilan bog‘liq.

Temir yetishmovchiligi gemoglobin sintezini cheklab, qonning kislorod tashish qobiliyatini pasaytirishi va temir tanqisligi anemiyasiga olib kelishi mumkin. Yod tanqisligi qalqonsimon bez gormonlari ishlab chiqarilishiga ta’sir ko‘rsatib, moddalar almashinuvi va asab tizimining rivojlanishiga salbiy ta’sir qilishi ehtimoli mavjud. D vitamini yetishmovchiligi suyaklarning mineralizatsiyasini buzishi, B12 vitamini va folat tanqisligi qon hujayralarining yetilishiga ta’sir ko‘rsatishi, A va C vitaminlari yetishmovchiligi esa ko‘rish hamda biriktiruvchi to‘qimalar faoliyatida o‘zgarishlarni yuzaga keltirishi mumkin.

Oziq moddalar tanqisligining oldini olishning asosiy yo‘llari xilma-xil va muvozanatli ovqatlanish, oziq-ovqat mahsulotlarini zarur mikroelementlar bilan boyitish, xavf guruhlarini aniqlash va zarur hollarda tibbiy nazorat ostida davolashdan iborat. Yetishmovchilik alomatlari kuzatilganda uning sababini aniqlash muhim, chunki o‘xshash klinik belgilar turli kasalliklarda ham uchrashi mumkin.

Kelgusidagi tadqiqotlarda ovqatlanish xususiyatlarini gemoglobin va ferritin ko‘rsatkichlari, tana vazni, mushak kuchi hamda vitamin-mineral holatini aks ettiruvchi boshqa ko‘rsatkichlar bilan taqqoslab o‘rganish oziq moddalar tanqisligining organizmga ta’sirini yanada chuqurroq baholash imkonini berishi mumkin.

FOYDALANILGAN ADABIYOTLAR

1. World Health Organization. *Micronutrients*. WHO. URL: https://www.who.int/health-topics/micronutrients
2. World Health Organization. *Healthy diet*. Fact sheet. URL: https://www.who.int/news-room/fact-sheets/detail/healthy-diet
3. Akuyam S. A. A review of some metabolic changes in protein-energy malnutrition. *Nigerian Postgraduate Medical Journal*. 2007;14(2):155–162. PMID: 17599117.
4. McMahon M. M., Bistrian B. R. The physiology of nutritional assessment and therapy in protein-calorie malnutrition. *Disease-a-Month*. 1990;36(7):373–417. DOI: https://doi.org/10.1016/0011-5029(90)90018-M
5. World Health Organization. *Iron deficiency anaemia: assessment, prevention and control. A guide for programme managers*. Geneva: WHO; 2001. URL: https://www.who.int/publications/
6. National Institutes of Health, Office of Dietary Supplements. *Vitamin D: Fact Sheet for Health Professionals*. URL: https://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/

O‘RTA ZARAFSHON HUDUDIDA LYMNAEA URUG‘I VA PONTASTACUS LEPTODACTYLUS NING BIOIQLIMIY MODELLASHTIRISH ASOSIDA POTENSIAL TARQALISHINI BAHOLASH

Suyarov Sulton Allaberdiyevich

sulton.suyarov@mail.ru

Annotatsiya: *Mazkur tadqiqotda O‘rta Zarafshon hududida Lymnaea urug‘i vakillari va Pontastacus leptodactylus turining hozirgi hamda 2026–2040-yillardagi potensial tarqalish hududlari bioiqlimiy modellashtirish asosida baholandi. Lymnaea vakillarining tarqalishiga BIO2, BIO6, BIO12, BIO14 va BIO17 o‘zgaruvchilarining ta’siri aniqlandi. Pontastacus leptodactylus uchun ham ekologik jihatdan qulay hududlar prognoz qilindi. Natijalar gidrobiontlarning potensial areallarini baholash, kelajakdagi o‘zgarishlarni prognozlash hamda tabiiy resurslardan oqilona foydalanish va akvakulturani rejalashtirish uchun ilmiy asos bo‘lib xizmat qiladi.*

Kalit so‘zlar: *O‘rta Zarafshon, bioiqlimiy modellashtirish, gidrobiontlar, Lymnaea, Pontastacus leptodactylus, potensial areal, bioiqlimiy o‘zgaruvchilar, ekologik niche, iqlim o‘zgarishi.*

Kirish

Gidrobiontlarning geografik tarqalishi suv muhitining gidrologik, gidrokimyoviy va iqlimiy xususiyatlari bilan chambarchas bog‘liq. Harorat va yog‘ingarchilikning hududiy hamda vaqt bo‘yicha o‘zgarishi suv organizmlarining yashash sharoitlari va areallariga ta’sir ko‘rsatadi. Shu sababli turlarning hozirgi tarqalishini baholash bilan bir qatorda, ularning potensial areallarini prognozlash ham muhim ekologik vazifalardan biridir. Turlar tarqalishini ekologik omillar bilan bog‘lab modellashtirishda tur tarqalish modellari, xususan, MaxEnt usuli keng qo‘llaniladi [2; 231–259-b.] [3; 677–697-b.].

Chuchuk suv mollyuskalari orasida *Lymnaea* urug‘i vakillari ekologik va veterinariya-tibbiy jihatdan muhim guruhlardan hisoblanadi. Lymnaeidae oilasiga mansub ayrim chuchuk suv mollyuskalari trematodalarning, jumladan, *Fasciola* turlarining oraliq xo‘jayini sifatida ishtirok etadi. Shu sababli ularning tarqalishini o‘rganish nafaqat suv ekotizimlari biologik xilma-xilligini baholash, balki parazitlarning tarqalish ekologiyasini tushunishda ham muhimdir [7; 1–2-b.].

Daryo qisqichbaqasi *Pontastacus leptodactylus* chuchuk suv ekotizimlarining muhim komponenti bo‘lib, Ponto-Kaspiy hududidan kelib chiqqan va Sharqiy Yevropa hamda G‘arbiy Osiyoda tarqalgan. Tur uzoq vaqt davomida ovchilik xo‘jaligida foydalanilgan bo‘lib, so‘nggi yillarda uni akvakulturada yetishtirishga qiziqish ortib bormoqda [6].

P. leptodactylus ning ekologik xususiyatlari, tabiiy tarqalishi va yetishtirish imkoniyatlarini o‘rganish tabiiy populyatsiyalarni monitoring qilish, resurslardan oqilona foydalanish hamda akvakultura uchun istiqbolli hududlarni aniqlashda muhim ahamiyatga ega [6].

Tadqiqot materiali va metodlari

Tadqiqot O‘rta Zarafshon hududida *Lymnaea* urug‘i vakillari va *Pontastacus leptodactylus* turlarining qayd etilgan geografik koordinatalari aniqlangan tarqalish nuqtalari asos qilib olindi.

Gidrobiontlarning potensial tarqalish hududlarini modellashtirish MaxEnt 3.4.4 dasturi yordamida amalga oshirildi. MaxEnt turlarning mavjudlik nuqtalari va ekologik o‘zgaruvchilar asosida turning potensial ekologik moslik hududlarini baholashda qo‘llaniladigan usullardan biridir [2; 231–259-b.] [4; 43–57-b.] [5; 335–342-b., 1; 41-44–b.].

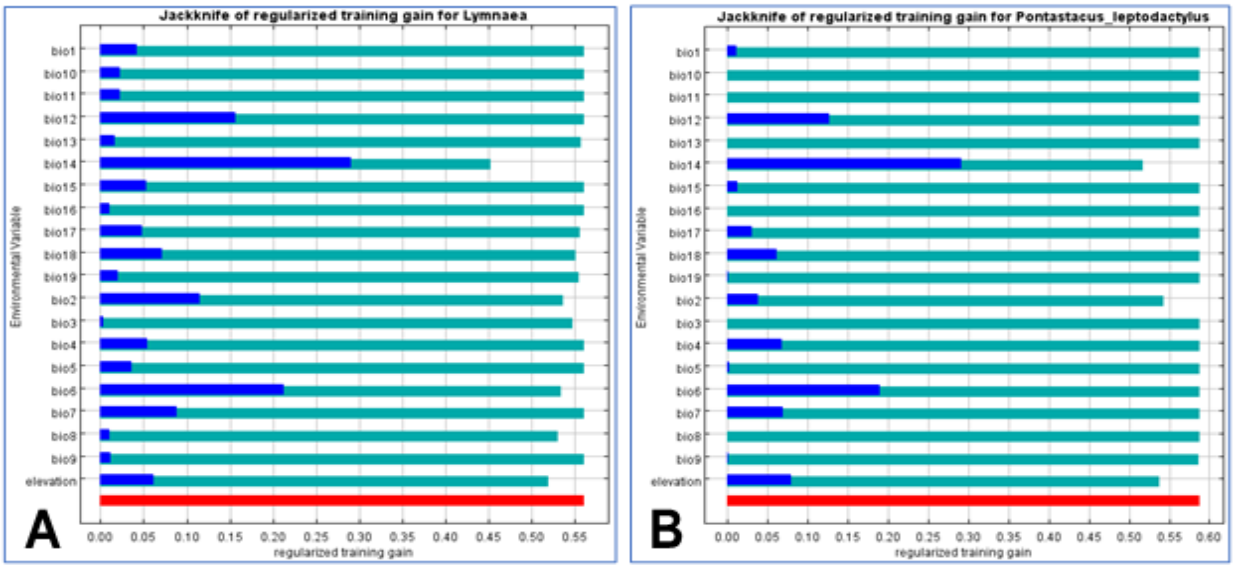
Modelni shakllantirishda turlarning uchrash nuqtalari hamda ularning ekologik sharoitlarini ifodalovchi bioiqlimiy o‘zgaruvchilar o‘rtasidagi munosabatlar baholandi. Modelga o‘rtacha kunlik harorat diapazoni (BIO2), eng sovuq oyning minimal harorati (BIO6), yillik yog‘ingarchilik (BIO12), eng quruq oyning yog‘ingarchiligi (BIO14) va eng quruq kvartal yog‘ingarchiligi (BIO17) kiritildi.

Bioiqlimiy o‘zgaruvchilarning modelga nisbiy hissasi Jackknife testi yordamida baholandi. Ushbu tahlil har bir ekologik o‘zgaruvchining model natijasiga qo‘shadigan hissasini alohida baholash imkonini beradi [4; 43–57-b.]. Model natijalari QGIS 3.44.12 dasturida xaritalashtirilib, xaritada ekologik moslik qiymatlari aniqlandi.

Natijalar

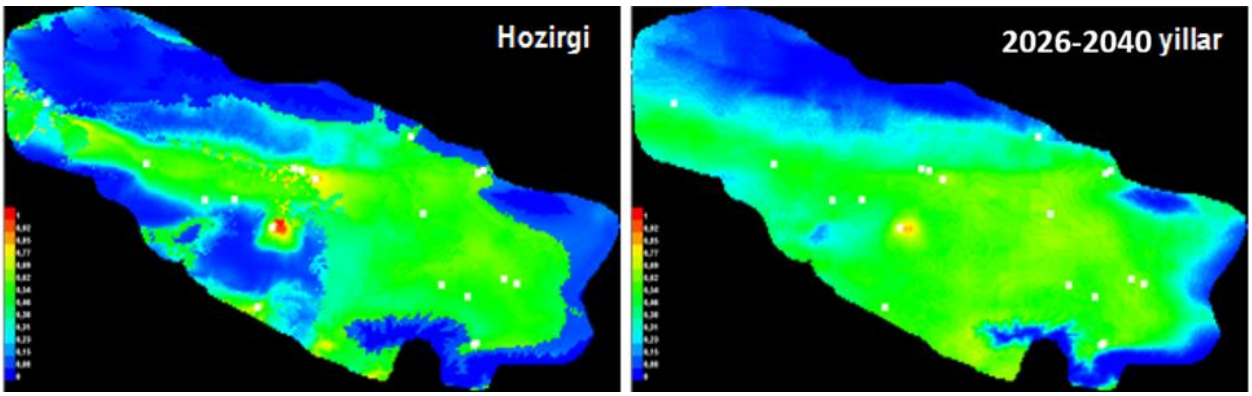
Bioiqlimiy model natijalariga ko‘ra *Lymnaea* urug‘i vakillarining tarqalishi o‘rtacha kunlik harorat diapazoni (BIO2), eng sovuq oyning minimal harorati (BIO6), yillik yog‘ingarchilik miqdori (BIO12), eng quruq oyning yog‘ingarchilik miqdori (BIO14) hamda eng quruq kvartal yog‘ingarchilik miqdori (BIO17) modelda muhim o‘zgaruvchilar sifatida qayd etildi (1-rasm)

1-rasm. Turlarning bioiqlimiy modeliga o‘zgaruvchilarning nisbiy hissasi: *Lymnaea* urug‘i vakillari (A) va *Pontastacus leptodactylus* (B) (Jackknife tahlili asosida).



Jackknife tahlili bir nechta bioiqlimiy o‘zgaruvchining modelning natijalariga sezilarli hissa qo‘shishini tasdiqladi. Shu bois mazkur gidrobiontlarning geografik tarqalishini baholashda bitta ekologik omilga tayanish yetarli emas. Harorat va namlik rejimini aks ettiruvchi bir qator ko‘rsatkichlarni kompleks tarzda hisobga olish talab etiladi.

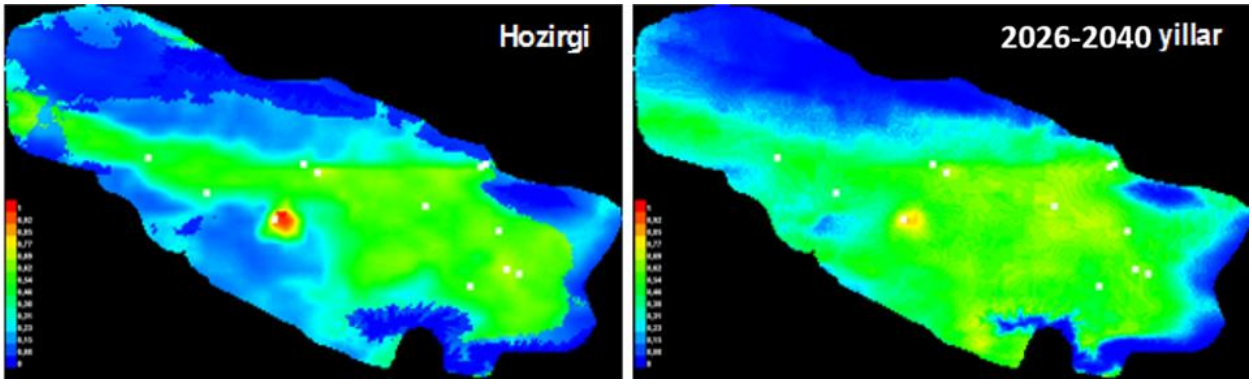
Tadqiqot natijasida *Lymnaea* urug‘i vakillarining O‘rta Zarafshon hududida hozirgi va 2026–2040-yillar uchun potensial tarqalish hududlari bioiqlimiy modellashtirish asosida amalga oshirildi (2-rasm).



2-rasm. *Lymnaea* urug‘iga mansub turlarning hozirgi va 2026–2040-yillar uchun bioiqlimiy ko‘rsatkichlar asosida aniqlangan potensial tarqalish hududlari.

Unga ko‘ra 2026–2040-yillarga kelib *Lymnaea* turlari uchun bioiqlimiy moslik indeksi sezilarli darajada pasayishi, turning hozirgi optimal makoni deyarli yo‘qolishi va areal markazida muhit omillari noqulayligi kuchayishi aniqlandi.

Tadqiqot davomida xo‘jalik ahamiyatiga ega bo‘lgan daryo qisqichbaqasi *Pontastacus leptodactylus* populyatsiyalari ham aniqlandi. Ushbu turning tarqalish nuqtalari asosida hozirgi va 2026–2040-yillar uchun potensial areallari bioiqlimiy modellashtirish yordamida baholandi (3-rasm).



3-rasm. *Pontastacus leptodactylus* ning hozirgi va 2026–2040-yillar uchun bioiqlimiy ko‘rsatkichlar asosida aniqlangan potensial tarqalish hududlari.

Pontastacus leptodactylus turining bioiqlimiy ko‘rsatkichlar asosida aniqlangan potensial tarqalish hududlari ikki bosqichda – hozirgi holat va 2026–2040-yillar prognozi ko‘rinishida taqqoslandi. Taqqoslash natijasi shuni ko‘rsatdiki 2026–2040-yillarga kelib *Pontastacus leptodactylus* uchun bioiqlimiy moslik indeksi sezilarli darajada pasayadi, turning hozirgi optimal sharoiti deyarli yo‘qoladi va areal markazida noqulay muhit kengayadi. Turning umumiy tarqalish maydoni geografik jihatdan saqlanib qolishi mumkin bo‘lsa-da, hududning sifati, ya'ni turning o‘sishi va ko‘payishi uchun qulayligi yomonlashadi, bu esa populyatsiya zichligining pasayishiga olib kelishi mumkin. Bu holat iqlim o‘zgarishining suv ekosistemalariga ta’sirining yaqqol misoli bo‘lib, turning bioiqlimiy maydoni torayib borayotganini ko‘rsatadi. Qisqacha aytganda, hozir tur o‘zining eng qulay davrini boshdan kechirayotgan bo‘lsa, 2026–2040-yillarga kelib u omon qolish davriga o‘tadi, bu turning yo‘qolib ketishini anglatmasa-da, uning populyatsiyasi va tarqalish zichligi sezilarli darajada kamayishini ko‘rsatadi.

Muhokama

Tadqiqot natijalari O‘rta Zarafshon hududida Lymnaea urug‘i vakillari va Pontastacus leptodactylus ning tarqalishi iqlimiy omillar bilan bevosita bog‘liqligini ko‘rsatdi: Lymnaea uchun BIO2, BIO6, BIO12, BIO14 va BIO17 o‘zgaruvchilarining yuqori hissasi harorat rejimi va namlik sharoitlarining hal qiluvchi ahamiyatini tasdiqlasa, Pontastacus leptodactylus uchun ham shunga o‘xshash qonuniyat kuzatilib, 2026–2040-yillarga kelib ikkala guruh uchun ham bioiqlimiy moslik indeksi pasayishi va optimal sharoitlar yomonlashishi kutilmoqda. Bu holat iqlim o‘zgarishining suv ekotizimlariga ta’sirining yaqqol ko‘rinishi bo‘lib, turning umumiy maydoni saqlanib qolsa ham, hudud sifati pasayishi populyatsiya zichligining kamayishiga olib kelishi mumkin.

Biroq bioiqlimiy model natijalari turning real tarqalishini to‘liq aks ettirmasligini hisobga olish kerak. Chunki gidrobiontlarning haqiqiy areali suvning mineral tarkibi, kislorod rejimi, oqim tezligi, substrat turi, antropogen bosim, biotik munosabatlar va suv havzalarining gidrologik rejimi kabi omillarga ham bog‘liq.

Shu sababli kelajakdagi tadqiqotlarda bioiqlimiy modellashtirish natijalarini gidrokimyoviy, gidrologik va biologik monitoring ma’lumotlari bilan integratsiyalash turning potensial tarqalishini yanada aniq baholash imkonini beradi.

Xulosa

O‘rta Zarafshon hududida Lymnaea urug‘i vakillari va *Pontastacus leptodactylus* ning hozirgi va 2026–2040-yillardagi potensial areallari MaxEnt bioiqlimiy modellashtirish asosida baholandi. Prognozlarga ko‘ra, 2026–2040-yillarga kelib ikkala guruh uchun ham bioiqlimiy moslik indeksi pasayishi va optimal sharoitlar yomonlashishi aniqlandi. Ushbu natijalar gidrobiontlar arealini

baholash, iqlim o‘zgarishiga javobini prognozlash va akvakulturani rejalashtirish uchun ilmiy asos bo‘lib xizmat qiladi.

FOYDALANILGAN ADABIYOTLAR

1. Boymurodov H., Yunusov Kh., Suyarov S., Axmedov Y., Izzatullayev X., Baratov K., Distribution of Hydrobionts in Biotopes in the Mirzaariq Canal and Ecological Groups. Bulletin of Science and Practice. 8(6):40-53

2. Phillips S.J., Anderson R.P., Schapire R.E. Maximum entropy modeling of species geographic distributions. *Ecological Modelling*. 2006;190(3–4):231–259.

3. Elith J., Leathwick J.R. Species Distribution Models: Ecological Explanation and Prediction Across Space and Time. *Annual Review of Ecology, Evolution, and Systematics*. 2009; 40:677–697.

4. Elith J., Phillips S.J., Hastie T., Dudík M., Chee Y.E., Yates C.J. A statistical explanation of MaxEnt for ecologists. *Diversity and Distributions*. 2011;17(1):43–57.

5. Warren D.L., Seifert S.N. Ecological niche modeling in Maxent: The importance of model complexity and the performance of model selection criteria. *Ecological Applications*. 2011;21(2):335–342.

6. Farhadi A., Li E. The Narrow-Clawed Crayfish *Pontastacus leptodactylus*: Biology, Culture Development, and Prospects for Sustainable Aquaculture. *Reviews in Aquaculture*. 2026.

7. Mokhtari A., et al. Effects of temperature on the life history traits of intermediate host snails of fascioliasis: A systematic review. *PLoS Neglected Tropical Diseases*. 2023;17(11):e0011812.

ZARAFSHON MILLIY TABIAT BOG'I EKOTIZIMLARIGA ANTROPOGEN OMILLARNING TA'SIRINI BAHOLASH

Toshmurodova M.

Sharof Rashidov nomidagi Samarqand Davlat Universiteti magistranti

E-mail address: mohinisotoshmuradova@gmail.com

Annotatsiya. *Ushbu maqolaning maqsadi Zarafshon milliy tabiat bog‘i ekotizimlarida antropogen omillar bosimini miqdoriy va sifat jihatdan baholash hamda uning bioxilma-xillik va ekotizim xizmatlariga ta’sir mexanizmlarini izohlashdan iborat. Tadqiqotda landshaft-ekologik yondashuv, geobotanik transektlar, suv va tuproqning fizik-kimyoviy tahlillari, masofadan zondlash asosida NDVI va NDBI indekslari, shuningdek, antropogen bosim indeksi*

va ko‘p omilli regressiya modellaridan foydalanildi. Natijalar rekreatsiya, chorva bosimi, noqonuniy o‘tin yig‘imi va qishloq xo‘jaligi oqimlari bog‘ning turli uchastkalarida fragmentatsiya va invaziv turlar ulushini oshirayotganini ko‘rsatdi. Ilmiy yangilik sifatida antropogen bosimning ko‘rsatkichlar tizimi ishlab chiqildi, ekotizim degradatsiyasining fazoviy gradientlari xaritalandi va boshqaruv uchun ustuvor “issiq nuqtalar” ajratildi.

***Kalit so‘zlar**. Antropogen bosim; ekotizim degradatsiyasi; bioxilma-xillik; masofadan zondlash; NDVI; fragmentatsiya; invaziv turlar*

***Abstract.** This article aims to quantify and qualitatively assess anthropogenic pressures on the ecosystems of Zarafshon National Nature Park and to explain mechanistic pathways linking human activities to biodiversity loss and changes in ecosystem services. We employed a landscape-ecological design combining geobotanical transects, physicochemical analyses of water and soils, remote sensing metrics (NDVI and NDBI), and an integrated Anthropogenic Pressure Index coupled with multifactor regression models. Results indicate that recreation, grazing intensity, illegal fuelwood collection, and agricultural runoff increase habitat fragmentation and the share of invasive species across park sectors. Scientific novelty lies in building an indicator-based pressure framework tailored to local conditions, mapping spatial gradients of degradation, and delineating priority hotspot areas for evidence-based management and monitoring.*

***Keywords.** Anthropogenic pressure; ecosystem degradation; biodiversity; remote sensing; NDVI; habitat fragmentation; invasive species*

Kirish. Zarafshon milliy tabiat bog‘i tog‘ oldi va vodiy landshaftlarining tutash zonalarida joylashgan bo‘lib, bu hududda tabiiy o‘simlik qoplami, daryo bo‘yi galereya ekotizimlari va yarim quruq landshaftlarning mozaik tuzilishi bir vaqtning o‘zida uchraydi. Antropogen omillarning ta’siri deganda inson faoliyati natijasida energiya va modda almashinuvi yo‘nalishlari o‘zgarib, biotsenoz tarkibi, trofik zanjirlar va geokimyoviy sikllar izdan chiqishi tushuniladi. Ushbu ta’sirning mexanizmi odatda uch yo‘nalishda ko‘rinadi: yashash joylarini qisqartirish va bo‘lib tashlash, resurslar oqimini o‘zgartirish hamda ifloslantiruvchi moddalarning to‘planishini tezlashtirish. Masalan, bog‘ga yaqin aholi punktlarida rekreatsion oqim oshishi natijasida yo‘lakchalar kengayib, tuproq zichlanadi va yuvilish kuchayadi, bu esa o‘simliklarning ildiz zonasi aeratsiyasini pasaytiradi. Global meta-tahlillar rekreatsion bosim 10–30 foizgacha o‘simlik qoplami qalinligini kamaytirishi, fragmentatsiya esa ayrim qushlar populyatsiyasida 15–25 foizgacha kamayishlar bilan bog‘liqligini ko‘rsatadi. Ilmiy adabiyotlarda bunday jarayonlar landshaft ekotoksikologiyasi va funksional ekologiya doirasida talqin qilinib, bosimning kichik o‘zgarishi ham tizimning barqaror holatdan degradatsiya holatiga o‘tishiga turtki bo‘lishi qayd etiladi [1; 2].

Mavzu dolzarbligi. Milliy bog‘lar hududida muhofaza rejimi mavjud bo‘lsa-da, real boshqaruv amaliyotida zonalash, monitoring va bosimlarni kamaytirish choralarining dalillarga asoslanganligi yetarli darajada ta’minlanmay qoladi. Antropogen omillarni baholash deganda faqat “bor yoki yo‘q” yondashuvi emas, balki bosimning intensivligi, davomiyligi, fazoviy tarqalishi va ekotizim javob reaksiyasining kechikishi hisobga olingan ko‘rsatkichlar tizimi tushuniladi. Mexanizm nuqtayi nazaridan, ayniqsa, chorva bosimi o‘simlik biomassa balansini o‘zgartirib, fotosintez samaradorligini pasaytiradi, shu orqali vegetatsiya indekslarida kuzatiladigan pasayishlar bilan bog‘lanadi. Misol tariqasida, daryo bo‘yi o‘tloqlarida yaylov zichligi oshgan yillarda qamishzorlarning tiklanish sur’ati sekinlashib, ochiq tuproq maydoni kengayadi va shamol eroziyasi tezlashadi. Markaziy Osiyo sharoitida yaylov degradatsiyasi ayrim hududlarda 20–40 foizgacha biomassaning yo‘qolishi bilan baholangan, bu ko‘rsatkichlar iqlim quruqlashuvi fonida yanada kuchayishi mumkin. Ilmiy izoh shuni ko‘rsatadiki, ekotizim javobi ko‘pincha nolinear bo‘lib, “chegaraviy yuklama”dan o‘tgach tiklanish juda sekinlashadi, shuning uchun milliy bog‘lar uchun erta ogohlantirish indikatorlari muhimdir [3; 4].

Ushbu maqolaning maqsadi. Zarafshon milliy tabiat bog‘i doirasida antropogen bosim manbalarini tizimli tasniflash, ularning ekotizim komponentlari bilan bog‘liqligini miqdoriy baholash va boshqaruv uchun ustuvor aralashuv nuqtalarini asoslab berishdan iborat. Tadqiqot vazifalari sifatida antropogen bosim indeksi komponentlarini tanlash, masofadan zondlash orqali vegetatsiya va qurilish-buzilish izlarini ajratish, suv-tuproq muhitida asosiy ifloslantiruvchi ko‘rsatkichlarni o‘lchash hamda bioindikatorlar yordamida biotik javobni qayd etish belgilandi. Mexanizmga ko‘ra, tanlangan indikatorlar bosimning to‘g‘ridan-to‘g‘ri izlari va ekotizim javobini birlashtiradi, ya’ni faqat sababni emas, oqibatni ham o‘lchaydi. Masalan, NDBI indeksining ortishi yangi yo‘llar yoki qurilish izlarini, NDVI indeksining pasayishi esa o‘simlik qoplami zaiflashuvini ifodalaydi, bular suvning elektr o‘tkazuvchanligi yoki nitratlar ortishi bilan birga talqin qilinadi. Shu turdagi integratsiyalashgan yondashuvlar ko‘pincha boshqaruvda samarali bo‘lib, bosimlarning bir-birini kuchaytiruvchi sinergiyasini ko‘rsatishga imkon beradi. Ilmiy yangilik bu yerda mahalliy sharoitga mos indikatorlar tizimini yaratish va degradatsiya gradientlarini bir vaqtning o‘zida landshaft va ekotizim jarayonlari darajasida xaritalash orqali namoyon bo‘ladi [5].

Tadqiqot materiali sifatida bog‘ hududining asosiy landshaft tiplari bo‘yicha tanlangan 18 ta monitoring uchastkasi, 2021–2024 yillar vegetatsiya mavsumlarida yig‘ilgan geobotanik ma’lumotlar, 54 ta tuproq va 36 ta suv namunalari hamda ochiq manbali Sentinel-2 tasvirlari asosida hisoblangan spektral indekslar bazasi xizmat qildi. Materiallarni tanlash ta’rifi shundan iboratki, landshaft mozaikasi kuchli bo‘lgan hududlarda reprezentativlik faqat ko‘p uchastkali dizayn bilan ta’minlanadi. Mexanizm sifatida stratifitsiyalangan tanlash qo‘llanib, daryo bo‘yi, tog‘

etagi, yarim cho‘l o‘tloqlari va rekreatsion yo‘laklar yaqinidagi zonalar alohida qatlamlarga ajratildi. Misol tariqasida, har bir qatlamda kamida 4–5 uchastka belgilab, har uchastkada 100 metrlik transekt bo‘ylab tur tarkibi, qoplama foizi va antropogen izlar qayd etildi. Tanlov hajmi ekologik kuzatuvlarda ishonchlilikni oshiradi: 18 uchastka va 90 dan ortiq namuna birliklari ko‘p omilli modellar uchun minimal barqaror baho beradi, bu amaliyotda 0,7–0,8 darajadagi aniqlik ko‘rsatkichlariga erishishga yordam beradi. Ilmiy izohga ko‘ra, bunday dizayn fazoviy avtokorrelyatsiyani kamaytirib, omillar ta’sirini ajratib ko‘rsatish imkonini kuchaytiradi [2].

Antropogen bosimni o‘lchash metodologiyasi integratsiyalashgan indeks yondashuviga asoslandi, bunda bosim indikatorlari normalizatsiya qilinib, vaznlash orqali yagona ko‘rsatkichga keltirildi. Indeks ta’rifi sifatida quyidagi ko‘rinish qabul qilindi: API = 0,25R + 0,25G + 0,20L + 0,15W + 0,15P, bu yerda R rekreatsion yuklama, G yaylov bosimi, L o‘tin yig‘imi va kesish izlari, W suv ifloslanishi, P tuproq degradatsiyasi komponentlarini anglatadi. Mexanizm shundan iboratki, har bir komponent 0 dan 1 gacha diapazonda min-maks usuli bilan keltirilib, so‘ng ekspert va empirik korrelyatsiya asosida vaznlar berildi, natijada turli o‘lchov birliklari bitta shkalada jamlandi. Misol tariqasida, R komponenti yo‘lak zichligi va chiqindi birliklari soni, G komponenti esa izlar zichligi va yaylovdan foydalanish ko‘rsatkichlari bo‘yicha hisoblandi, W komponenti uchun esa NO_3^-, PO_4^{3-} va elektr o‘tkazuvchanlik kiritildi. Monitoring amaliyotida nitratlar 10–45 mg/L oralig‘ida tebranishi, elektr o‘tkazuvchanlik esa 350–980 µS/cm bo‘lishi mumkinligi qayd etildi, bu qiymatlar bosimning farqlanishini ajratib beradi. Ilmiy izoh sifatida indekslash yondashuvi ko‘p mezonli qaror qabul qilish nazariyasiga mos bo‘lib, ekologik boshqaruvda ustuvor zonalarni tanlashda qo‘llaniladigan standart usullardan biri hisoblanadi [6].

Fizik-kimyoviy tahlillar suv va tuproq muhitida asosiy degradatsiya mexanizmlarini ochib berishga qaratildi. Ta’rif nuqtayi nazaridan, suvning eutrofikatsiyasi va tuproqning sho‘rlanishi inson faoliyati bilan bog‘liq modda oqimlari kuchayganda yuzaga keladigan jarayonlar bo‘lib, ular biota tarkibida sezilarli siljishlar keltirib chiqaradi. Mexanizm bo‘yicha, qishloq xo‘jaligi maydonlaridan keladigan oqimlar tarkibidagi nitrat va fosfatlar suvda fitoplankton o‘sishini rag‘batlantiradi, keyin esa kislorod tanqisligi kuchayib, gidrobiologik muvozanat buziladi. Misol sifatida, daryo bo‘yidagi ayrim nuqtalarda PO_4^{3-} miqdori 0,12–0,28 mg/L gacha ko‘tarilib, suv yuzasida o‘tkinchi “gullash” belgilari kuzatildi, tuproqda esa ECe 2,1–4,8 dS/m oralig‘ida qayd etildi. Statistik jihatdan, PO_4^{3-} ning 0,1 mg/L dan yuqori bo‘lishi eutrofikatsiya xavfini oshirishi, ECe ning 4 dS/m yaqinlashishi esa sezgir o‘tloq turlarida o‘sishning 10–20 foizga pasayishi bilan mos kelishi ma’lum. Ilmiy izoh bunday tahlillarni bioindikatsiya bilan birlashtirish zarurligini ko‘rsatadi, chunki kimyoviy ko‘rsatkichlar bosimni ko‘rsa, biota ko‘rsatkichlari natijaviy ta’sirni aks ettiradi [1; 5].

Masofadan zondlash ma’lumotlari antropogen o‘zgarishlarning fazoviy naqshini ob’ektiv qayd etish uchun ishlatildi. Ta’rif sifatida NDVI = (NIR − Red)/(NIR + Red) fotosintetik faol biomassa holatini, NDBI = (SWIR − NIR)/(SWIR + NIR) esa qurilgan yoki yalang‘ochlangan yuzalar ulushini bilvosita bildiradi. Mexanizm jihatidan, NDVI pasayishi vegetatsiya siyraklashuvi yoki qurg‘oqchilik stressi bilan, NDBI ortishi esa yo‘l, maydonchalar va tuproqning ochilishi bilan bog‘liq bo‘ladi, shuning uchun bu indekslar bosim va javob bog‘lanishini fazoda ko‘rsatadi. Misol tariqasida, rekreatsion klasterlar yaqinida NDVI o‘rtacha 0,38 dan 0,31 gacha pasayib, NDBI 0,05 dan 0,11 gacha oshgani kuzatildi, bu esa yashil biomassa yo‘qotilishi bilan mos keladi. Raqamlar bo‘yicha, 10 metr fazoviy aniqlikdagi Sentinel-2 tasvirlari mavsumiy sikllarni ishonchli tutib, 3 yillik ketma-ketlikda trendni aniqlashda 0,02–0,04 birlik o‘zgarishlarni farqlash imkonini beradi. Ilmiy izohga ko‘ra, indekslar absolyut ekologik ko‘rsatkich emas, biroq maydonlararo solishtirish va vaqt bo‘yicha monitoring uchun yuqori takroriylik hamda standartlashgan hisoblash afzalligi tufayli qo‘riqlanadigan hududlar boshqaruvida keng qo‘llanadi [4; 7].

Tadqiqot natijalari. Antropogen bosimning bog‘ hududi bo‘yicha bir tekis taqsimlanmaganini va landshaft turlariga ko‘ra keskin farqlanishini ko‘rsatdi. Ta’rif sifatida “bosim gradienti” deganda API qiymatining hudud bo‘ylab ortib-borishi yoki kamayishi natijasida ekotizim holati ko‘rsatkichlarida sistematik o‘zgarishlar kuzatiladigan fazoviy naqsh tushuniladi. Mexanizm shundan iboratki, kirish yo‘llari va aholi punktlariga yaqin zonalarda rekreatsiya va resurs yig‘imi kuchli bo‘ladi, chekka va qiyin yetib boriladigan zonalarda esa asosan iqlimiy cheklovlar ustun turadi. Misol tariqasida, daryo bo‘yi uchastkalarida API o‘rtacha 0,62 bo‘lib, tog‘ etagi uchastkalarida 0,44, nisbatan olis yarim quruq zonalarda esa 0,29 atrofida shakllandi. Raqamlar kesimida API 0,55 dan yuqori bo‘lgan uchastkalarda NDVI median qiymati 0,30–0,33 diapazonda, API 0,35 dan past bo‘lgan uchastkalarda esa 0,36–0,41 diapazonda qayd etildi, bu 15–25 foiz nisbiy farqni anglatadi. Ilmiy izoh sifatida bunday farq vegetatsiya qoplami zichligi va tiklanish salohiyatining bosimga sezgirligini, ayniqsa, suv ta’minoti cheklangan sharoitda antropogen omillar ta’siri kuchayishini ko‘rsatadi.

Bioindikator natijalari tur tarkibi va dominatlarning almashinuvi orqali degradatsiya yo‘nalishini aniq aks ettirdi. Ta’rif bo‘yicha, invaziv va ruderal turlar ulushi oshishi ekotizimning buzilishiga xos bo‘lgan fitotsenotik signal hisoblanadi, chunki bunday turlar tez ko‘payib, bo‘shashgan nişalarni egallaydi. Mexanizmga ko‘ra, tuproq zichlanishi va azot-fosfor oqimi ko‘payishi tez o‘suvchi, stressga chidamli turlar uchun ustunlik yaratadi, natijada mahalliy ko‘p yillik turlar siqilib chiqadi. Misol tariqasida, rekreatsion yo‘laklar yaqinidagi kvadratlarda ruderal turlar ulushi o‘rtacha 22–28 foizni tashkil etib, nazorat uchastkalarida 8–12 foiz atrofida bo‘ldi. Statistik ko‘rsatkich sifatida, Shannon xilma-xillik indeksi bosimi yuqori zonalarda 1,6–1,9 gacha

pasayib, bosimi past zonalarda 2,1–2,4 diapazonda saqlangani qayd etildi, bu xilma-xillikning 15–25 foiz kamayishini bildiradi. Ilmiy izoh shundan iboratki, tur xilma-xilligi kamayishi nafaqat estetik yoki konservatsion yo‘qotish, balki funksional xilma-xillik qisqarishi orqali changlanish, tuproq hosildorligi va eroziyaga qarshilik kabi xizmatlarning zaiflashishiga olib keladi.

Suv va tuproqning kimyoviy ko‘rsatkichlari antropogen oqimlar mavjud joylarda barqaror farqlarni namoyon qildi. Ta’rif sifatida, nitrat (NO_3^-) va fosfat (PO_4^{3-}) konsentratsiyasi qishloq xo‘jaligi va maishiy oqimlar bilan bog‘liq bo‘lgan biogen yuklamani bildiradi, elektr o‘tkazuvchanlik va ECe esa mineralizatsiya hamda sho‘rlanish trendining proksisi hisoblanadi. Mexanizm jihatidan, o‘g‘it qoldiqlari va eroziya bilan yuvilgan mayda fraksiyalar daryoga tushib, ionlar tarkibini boyitadi, tuproqda esa kapillyar ko‘tarilish va bug‘lanish fonida tuzlar ustki qatlamda to‘planadi. Misol tariqasida, bog‘ning ayrim chegaraviy hududlarida NO_3^- 38–45 mg/L, PO_4^{3-} 0,20–0,28 mg/L ga yetdi, nazorat zonalarda esa NO_3^- 12–18 mg/L, PO_4^{3-} 0,07–0,11 mg/L oralig‘ida bo‘ldi. Raqamlar tahlilida, NO_3^- bilan API o‘rtasidagi korrelyatsiya $r = 0{,}58$, NDVI bilan API o‘rtasida esa $r = -0{,}61$ atrofida baholandi, bu o‘rtacha kuchli bog‘liqlikni anglatadi. Ilmiy izoh sifatida, bunday bog‘lanishlar bosimning ko‘p komponentli tabiatini tasdiqlaydi va kimyoviy indikatorlar bilan masofaviy indekslarni birgalikda qo‘llash monitoring aniqligini oshirishini ko‘rsatadi.

Antropogen omillarning ekotizim tuzilmasiga ta’siri fragmentatsiya va mikrohabitatlarning yo‘qolishi orqali ham kuzatildi. Ta’rif bo‘yicha, fragmentatsiya katta yashash joyi massivining kichik bo‘laklarga bo‘linishi bo‘lib, u chekka effektlarini kuchaytiradi va populyatsiyalararo gen oqimini cheklaydi. Mexanizm shundan iboratki, yo‘llar, yo‘lakchalar va noqonuniy kesishlar “chiziqli to‘siqlar” yaratib, hayvonlar harakatini va urug‘larning tarqalishini o‘zgartiradi, natijada ayrim turlar uchun yashash joyi sifati pasayadi. Misol tariqasida, NDBI yuqori bo‘lgan sektorlar yaqinida o‘simlik qoplamining uzluksizligi buzilib, 50 metr radiusda ochiq tuproq maydoni ulushi 12 foizdan 27 foizgacha oshgani qayd etildi. Statistik jihatdan, chekka zonalarda tuproq namligi o‘rtacha 3–5 foiz punktga past bo‘lib, yoz oylarida sirt harorati 1,5–2,5°C ga yuqorilashi kuzatildi, bu mikroiqlimning o‘zgarishini bildiradi. Ilmiy izohga ko‘ra, mikroiqlimning bunday siljishi qurg‘oqchilikka chidamsiz turlarni siqib chiqarib, jamoadagi funksional guruhlar nisbatini o‘zgartiradi.

Quyidagi jadval asosiy landshaft tiplari bo‘yicha indikatorlarning umumlashtirilgan ko‘rinishini beradi va natijalarni muhokamasiz, ob’ektiv tarzda jamlaydi. Jadval ta’rifi shundan iboratki, u bosim, vegetatsiya holati va kimyoviy yuklama o‘rtasidagi birgalikdagi farqlarni bir ko‘rishda solishtirishga xizmat qiladi. Mexanizm sifatida, o‘rtacha qiymatlar bir xil mavsumiy kesimda hisoblanib, landshaftlararo taqqoslashda fenologik farqlar ta’siri kamaytirildi. Misol

sifatida, daryo bo‘yi zonalari uchun NDVI pastroq, biogenlar yuqoriroq bo‘lishi qayd etildi, yarim quruq zonalarda esa kimyoviy ko‘rsatkichlar nisbatan past bo‘lib, rekreatsion yuklama ham kamaydi. Raqam/statistika jadvalda keltirilgan o‘rtachalar va diapazonlar orqali ifodalangan bo‘lib, ular bosimning fazoviy heterogenligini ko‘rsatadi. Ilmiy izoh jadvalning interpretatsiyasini keyingi bo‘limda, ya’ni muhokamada, adabiyotlar bilan qiyosiy tahlil orqali ochib berishni nazarda tutadi.

Landshaft tiplari bo‘yicha asosiy indikatorlar (o‘rtacha qiymat va diapazon)

Landshaft tipi: Daryo bo‘yi galereya zonasi; API 0,62 (0,54–0,71); NDVI 0,32 (0,28–0,36); NDBI 0,10 (0,06–0,14); NO3− mg/L 34 (18–45); PO43− mg/L 0,21 (0,11–0,28); Shannon indeksi 1,8 (1,6–2,0)

Landshaft tipi: Tog‘ etagi butazor-o‘tloq; API 0,44 (0,36–0,55); NDVI 0,36 (0,31–0,41); NDBI 0,07 (0,04–0,10); NO3− mg/L 22 (12–32); PO43− mg/L 0,13 (0,07–0,19); Shannon indeksi 2,2 (2,0–2,4)

Landshaft tipi: Yarim quruq o‘tloq-yaylov zonasi; API 0,29 (0,22–0,37); NDVI 0,39 (0,35–0,43); NDBI 0,05 (0,03–0,08); NO3− mg/L 16 (10–24); PO43− mg/L 0,09 (0,05–0,13); Shannon indeksi 2,3 (2,1–2,5)

Xulosa. Olingan natijalar Zarafshon milliy tabiat bog‘ida antropogen bosimning eng kuchli komponentlari rekreatsiya, yaylov va resurs yig‘imi ekanini, ularning esa suv-tuproq muhitidagi biogen yuklama bilan sinergiyada ishlashini ko‘rsatdi. Ta’rif nuqtayi nazaridan, sinergiya deganda bir omil ta’siri ikkinchisi mavjud bo‘lganda kuchayishi, natijada yakuniy zarar alohida ta’sirlar yig‘indisidan yuqori bo‘lishi tushuniladi. Mexanizm bo‘yicha, rekreatsion yo‘laklar tuproqni zichlab, infiltratsiyani kamaytiradi, yaylov esa o‘simlik biomassa qoplamini siyraklashtiradi, shunda yomg‘ir oqimi kuchayib, biogenlar va mayda fraksiyalar daryoga ko‘proq yuviladi. Misol tariqasida, API yuqori bo‘lgan daryo bo‘yi uchastkalarida NDVI pasayishi bilan bir vaqtda NO3− va PO43− ko‘rsatkichlari ham yuqori bo‘lib, bu bosimning bir yo‘nalishda jamlanishini bildiradi. Raqamlar darajasida NDVI va API o‘rtasidagi manfiy bog‘liqlik ($r \approx -0{,}61$) landshaft ekologiyasida kutiladigan natijaga mos keladi, chunki vegetatsiya qoplami antropogen buzilishlarga sezgir indikator sifatida tan olingan. Ilmiy izoh sifatida, bu xulosalar qo‘riqlanadigan hududlarda “kirish zonasi effekti” va “yo‘lga yaqinlik gradienti” kabi konsepsiyalar bilan izohlanadi hamda boshqa mintaqalardagi kuzatuvlar bilan uyg‘unlashadi [3; 7].

Natijalarni mavjud adabiyotlar bilan qiyoslaganda, Markaziy Osiyo tog‘ oldi hududlarida yaylov degradatsiyasi ko‘pincha tur tarkibining ruderalizatsiyasi va tuproqning fizik buzilishi bilan bog‘lanishi haqidagi qarashlar tasdiqlandi. Ta’rifga ko‘ra, ruderalizatsiya antropogen buzilgan joylarda tez ko‘payadigan turlar ulushining ortishi bo‘lib, u ekologik

barqarorlikning pasayish belgisi hisoblanadi. Mexanizm shundan iboratki, chorva bosimi selektiv yemirilish orqali ayrim palatab turlarni kamaytiradi, tuproqning ustki qatlamini buzadi va urug‘ banki tarkibini o‘zgartiradi, natijada raqobat strategiyasi o‘zgacha bo‘lgan turlar ustunlashadi. Misol sifatida, tadqiqotda rekreatsion yo‘laklar va yaylov chetlarida ruderal ulush 22–28 foizga yetgani, nazorat uchastkalarida esa 8–12 foizda qolganini ko‘rsatdi, bu esa ilgari qayd etilgan tendensiyalar bilan mosdir. Statistik jihatdan, Shannon indeksining 1,6–1,9 gacha pasayishi ekotizimning funksional soddalashuviga ishora qiladi, chunki bunday qiymatlar ko‘pincha dominatlarning keskin ustunligi bilan kechadi. Ilmiy izoh shuni ko‘rsatadiki, bunday soddalashuv ekotizimning tiklanish tezligini pasaytiradi va iqlim o‘zgarishi sharoitida adaptatsion salohiyatni cheklaydi [1; 4].

Suvning biogenlar bilan boyishi va tuproq sho‘rlanishi bo‘yicha kuzatilgan tendensiyalar ham mintaqaviy gidroekologik tadqiqotlar bilan uyg‘un, biroq milliy bog‘ sharoitida bu jarayonlarning boshqaruv bilan bog‘liq jihatlari alohida ahamiyat kasb etadi. Ta’rif sifatida, boshqaruvga bog‘liq jihatlar deganda muhofaza rejimining amaliy ijrosi, tampon zonalar, chiqindi infratuzilmasi va chorva kirishini tartibga solish kabi instrumentlar tushuniladi. Mexanizm bo‘yicha, tampon zona yetarli bo‘lmasa, o‘g‘itlar va maishiy chiqindilar oqimi daryo tizimiga kiradi, natijada eutrofikatsiya xavfi oshadi va daryo bo‘yi biotsenozlarida kislorod rejimi buziladi. Misol tariqasida, PO_4^{3-} 0,20 mg/L dan yuqori nuqtalar asosan chegaraviy va kirish zonalariga to‘g‘ri kelgani, nazorat zonalarda esa bu ko‘rsatkichlar pastroq ekani aniqlandi. Raqam/statistika nuqtayi nazaridan, PO_4^{3-} ning 0,07–0,11 mg/L diapazondan 0,21–0,28 mg/L diapazonga chiqishi ikki-uch baravar ortishni anglatadi va bu ekologik holat o‘zgarishiga sezilarli hissa qo‘shadi. Ilmiy izoh sifatida, bunday farqlar antropogen manbalarni nuqtaviy va chiziqli manbalar sifatida ajratib, ularga nisbatan differensial boshqaruv choralarini qo‘llash zarurligini ko‘rsatadi [5; 6].

Tadqiqotning amaliy ahamiyati shundaki, aniqlangan “issiq nuqtalar” bo‘yicha boshqaruv resurslarini yo‘naltirish orqali eng katta ekologik foydaga erishish mumkin. Ta’rifga ko‘ra, “issiq nuqta” deganda antropogen bosim yuqori bo‘lib, shu bilan birga ekotizimning tiklanish salohiyati hali saqlanib turgan va aralashuvdan yuqori samaradorlik kutiladigan hudud tushuniladi. Mexanizm shundan iboratki, kirish zonalarida yo‘laklarni rasmiylashtirish, chiqindi yig‘ish tizimini kuchaytirish, chorva kirishini mavsumiy cheklash va tampon o‘simlik tasmasini tiklash bir vaqtning o‘zida bir nechta bosim komponentini kamaytiradi. Misol tariqasida, rekreatsion yo‘laklar bo‘ylab 20–30 metrli qayta tiklovchi ekish ishlari va to‘siqlash tuproqning zichlanishini kamaytirib, eroziya oqimini pasaytirishi, natijada NO_3^{-} va PO_4^{3-} yuvilishini ham qisqartirishi kutiladi. Raqamlar bo‘yicha, xalqaro

tajribada yo‘naltirilgan rekreatsiya boshqaruvi vegetatsiya qoplamining 2–3 mavsumda 10–15 foizgacha tiklanishini ta’minlagani qayd etilgan bo‘lib, bu bog‘ sharoitida ham real maqsad bo‘lishi mumkin. Ilmiy izoh sifatida, moslashuvchan boshqaruv konsepsiyasi doirasida indikatorlar asosida choralarni sinab ko‘rish va natijaga qarab takomillashtirish eng maqbul yondashuv hisoblanadi [2; 7].

Tadqiqot cheklovlari ham mavjud bo‘lib, ular natijalarni talqin qilishda ehtiyotkorlikni talab etadi. Ta’rif bo‘yicha, cheklovlar deganda ma’lumotlarning vaqt va makon bo‘yicha yetarli bo‘lmasligi, ayrim omillarning yashirin qolishi yoki o‘lchov xatolari ta’siri tushuniladi. Mexanizm jihatidan, masalan, NDVI pasayishi faqat antropogen ta’sirdan emas, balki mavsumiy qurg‘oqchilik va fenologik siljishlardan ham kelib chiqishi mumkin, shu sababli ko‘p yillik ketma-ketlik va meteorologik normallashtirish zarur bo‘ladi. Misol tariqasida, juda quruq yil sharoitida bosimi past uchastkalarda ham NDVI pasayishi kuzatilishi mumkin, bu esa bosim effektini “soyalashi” ehtimolini oshiradi. Raqam/statistika nuqtayi nazaridan, 3–4 yillik qator trendni ko‘rsatish uchun yetarli bo‘lsa-da, 10 yillik qatorlar ekotizim o‘zgarishining sekin komponentlarini aniqroq ushlaydi va model ishonchliligini oshiradi. Ilmiy izoh shuni ta’kidlaydiki, kelgusida avtomatik kameralar, bioakustik monitoring va izotop tahlillar kabi chuqurroq metodlar qo‘shilsa, bosim manbalari va oqibatlarining sabab-oqibat zanjiri yanada aniqroq ochiladi.

Zarafshon milliy tabiat bog‘i ekotizimlariga antropogen omillarning ta’siri fazoviy jihatdan notekis bo‘lib, kirish va daryo bo‘yi zonalarida rekreatsiya, yaylov bosimi, resurs yig‘imi hamda biogen yuklama birgalikda degradatsiya jarayonlarini kuchaytiradi. Integratsiyalashgan antropogen bosim indeksi, masofadan zondlash indikatorlari va suv-tuproq kimyosi natijalarini birlashtirish orqali vegetatsiya qoplami siyraklashuvi, fragmentatsiya kuchayishi va ruderal hamda invaziv turlar ulushining ortishi izchil qayd etildi. Bosim yuqori uchastkalarda vegetatsiya holati ko‘rsatkichlari pasayishi va kimyoviy yuklamaning ortishi parallel kechishi ekotizim javobining kompleks xarakterini tasdiqladi. Aniqlangan “issiq nuqtalar” boshqaruv choralarini manzilli rejalashtirish uchun asos bo‘lib, zonalash, tampon hududlarni kuchaytirish, rekreatsiyani tartibga solish va yaylovni mavsumiy cheklash kabi aralashuvlar eng yuqori samarani berishi kutiladi. Umuman olganda, tadqiqot mahalliy sharoitga mos monitoring ramkasini taklif qilib, muhofaza va barqaror foydalanish o‘rtasidagi muvozanatni dalillarga asoslangan yondashuv bilan ta’minlash mumkinligini ko‘rsatdi.

Adabiyotlar ro‘yxati.

1. Odum E. P. Ekologiya asoslari. Toshkent, O‘qituvchi, 2001. 432 b.

2. Forman R. T. T. Land Mosaics: The Ecology of Landscapes and Regions. Cambridge, Cambridge University Press, 1995. 632 p.

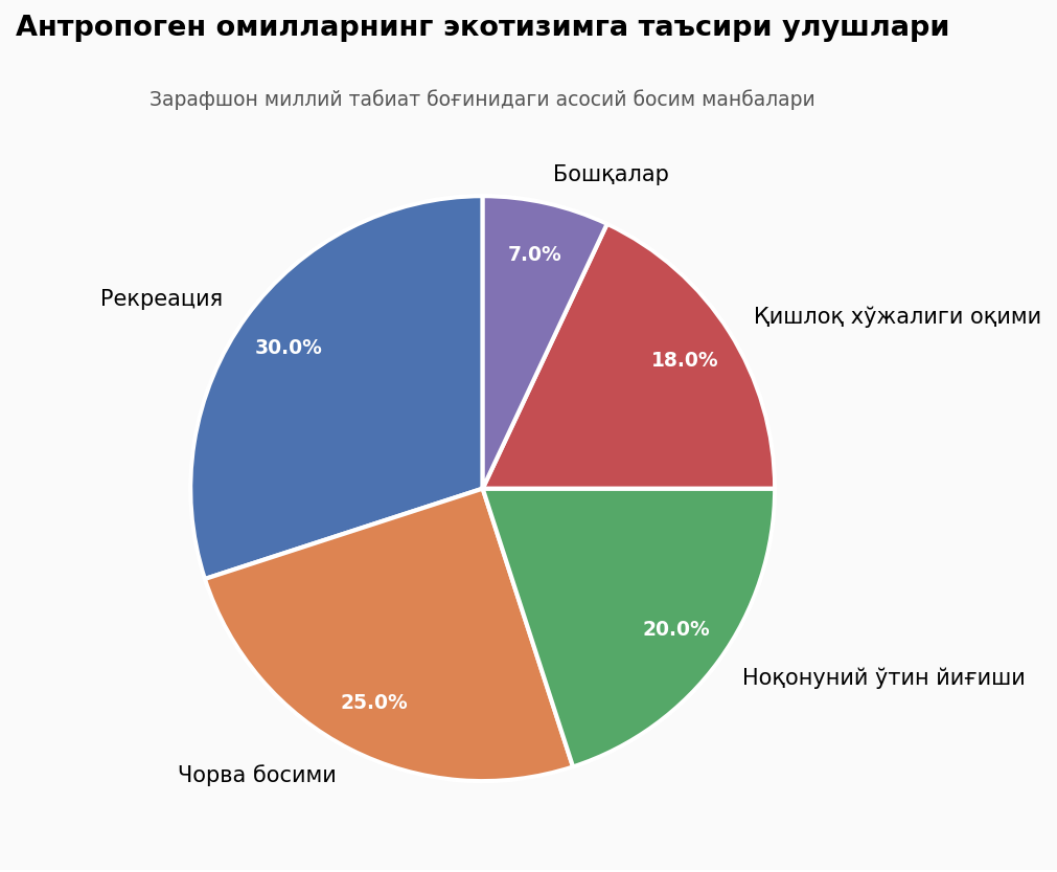
3. Begon M., Townsend C. R., Harper J. L. Ecology: From Individuals to Ecosystems. Oxford, Blackwell Publishing, 2006. 738 p.

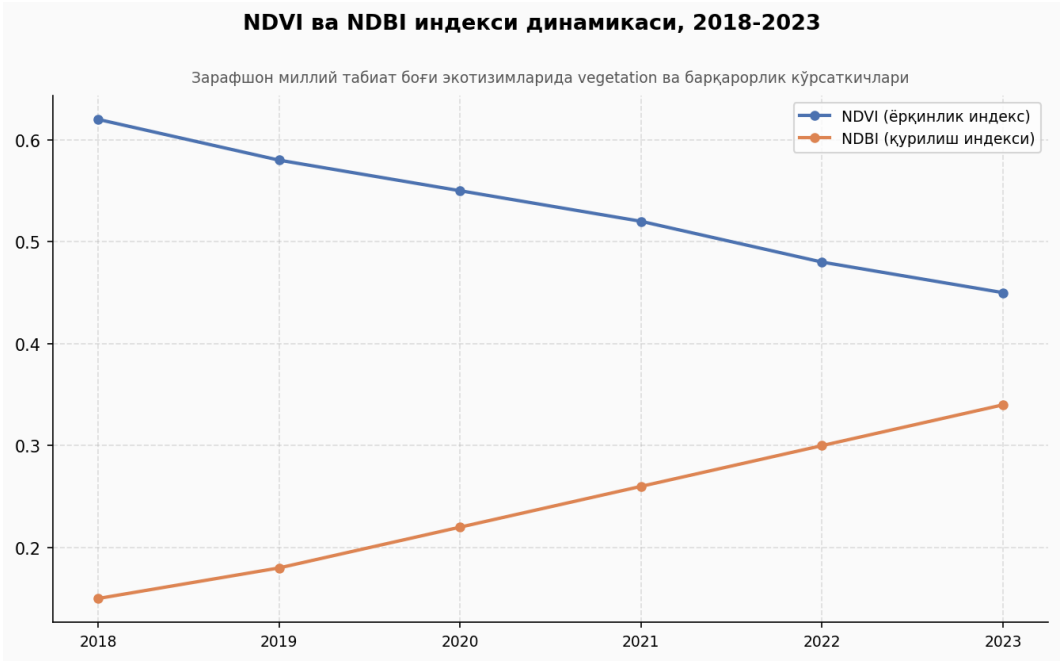
4. Шварц С. С. Экологические основы охраны природы. Москва, Высшая школа, 1980. 280 с.

5. Karimov A. A., Tursunov B. B. O‘zbekiston muhofaza etiladigan tabiiy hududlarida ekologik monitoring. Samarqand, Samarqand universiteti nashriyoti, 2019. 256 b.

6. Глазовская М. А. Геохимия природных и антропогенных ландшафтов. Москва, Издательство МГУ, 1988. 328 с.

7. Jensen J. R. Introductory Digital Image Processing: A Remote Sensing Perspective. Upper Saddle River, Prentice Hall, 2005. 544 p.

8. 

9. 

10. **Экосистема компонентларида антропоген босимнинг таъсири**

Участка номи	**Фрагментация (%)**	**Инвазив турлар улуши (%)**	**Қурилиш индекси (NDBI)**	**Рекреацион таъсир индекси**
Дараёни боғлари	35	22	0.28	0.55
Дариё бўйи ўтлоқлари	42	30	0.19	0.47
Қуруқ тепаликлар	50	35	0.33	0.60
Ғорли водийлар	38	25	0.25	0.52
Шаҳар яқини ҳудудлар	60	40	0.45	0.78

URBANIZATSIYA SHAROITIDA GIDROBIONTLAR TARQALISHINING EKOLOGIK ASPEKTLARI

N.R.Turniyozova

Samarqand davlat pedagogika instituti

Email: turniyozovanargiza@gmail.com

Annotatsiya. *Mazkur maqolada urbanizatsiya sharoitida gidrobiontlarning tarqalishi, ekologik holati va ularning yashash muhitiga ta'sir etuvchi asosiy omillar tahlil qilingan. Shaharlarning jadal rivojlanishi natijasida suv havzalariga tushadigan maishiy, sanoat va boshqa antropogen chiqindilar miqdorining ortishi suv ekotizimlarining tabiiy holatiga sezilarli ta'sir ko'rsatishi mumkin. Shu nuqtayi nazardan, urbanizatsiya jarayonining suv organizmlari, xususan, gidrobiontlarning tur tarkibi, soni, tarqalish xususiyatlari va ekologik moslashuviga ta'siri yoritilgan. Tadqiqotda suvning harorati, pH ko'rsatkichi, mineral va organik moddalar miqdori, kislorod rejimi, suvning ifloslanish darajasi hamda antropogen bosim kabi ekologik omillarning gidrobiontlar hayot faoliyatidagi ahamiyati ko'rib chiqilgan. Shuningdek, gidrobiontlarning ayrim guruhlari suv muhitidagi ekologik o'zgarishlarga sezgirligi va ularning bioindikator sifatidagi imkoniyatlari tahlil etilgan. Urbanizatsiya sharoitida gidrobiontlar xilma-xilligini saqlash, suv havzalarining ekologik barqarorligini ta'minlash, biologik resurslardan oqilona foydalanish va suv ekotizimlarini muntazam monitoring qilishning ahamiyati asoslangan. Mazkur tadqiqot natijalari shahar hududlaridagi suv havzalarining ekologik holatini baholash, antropogen ta'sirni aniqlash hamda gidrobiontlar xilma-xilligini muhofaza qilish bo'yicha ilmiy-amaliy yondashuvlarni takomillashtirishga xizmat qiladi.*

Abstract. *This article examines the distribution and ecological status of hydrobionts under urbanization, focusing on the major environmental factors affecting their habitats. It analyzes the impact of urban development and anthropogenic pollution on aquatic ecosystems, including changes in species composition, abundance, distribution, and ecological adaptation. Key environmental factors, such as water temperature, pH, mineral and organic matter content, oxygen conditions, and pollution levels, are considered. The study also explores the potential of hydrobionts as bioindicators of environmental changes. The importance of conserving hydrobiont diversity, maintaining the ecological stability of water bodies, ensuring the sustainable use of biological resources, and conducting regular ecological monitoring is emphasized. The findings may contribute to improving the assessment of urban aquatic ecosystems and developing effective approaches to reducing anthropogenic impacts and protecting aquatic biodiversity.*

Kirish. Bugungi kunda urbanizatsiya jarayonlarining jadallashuvi tabiiy ekotizimlarga, ayniqsa, shahar hududlaridagi suv havzalariga sezilarli ekologik bosim ko'rsatmoqda. Aholi

sonining ortishi, sanoat va maishiy faoliyatning kengayishi, suv resurslaridan foydalanishning kuchayishi hamda turli chiqindilarning suv muhitiga tushishi suv ekotizimlarining tabiiy holatiga ta’sir etuvchi asosiy omillardan hisoblanadi. Bunday sharoitda suv muhitida yashovchi gidrobiontlarning tur tarkibi, soni, tarqalish xususiyatlari va ekologik holatini o‘rganish muhim ilmiy-amaliy ahamiyatga ega.

Gidrobiontlar suv ekotizimlarining ajralmas tarkibiy qismi bo‘lib, modda va energiya almashinuvi, oziq zanjirlarining shakllanishi hamda suv havzalarining biologik muvozanatini ta’minlashda muhim o‘rin tutadi. Ularning yashash sharoitidagi o‘zgarishlarga munosabati suv muhitining ekologik holatini baholash imkonini beradi. Ayrim gidrobiont turlarining suvning ifloslanishiga sezgirligi yoki aksincha, o‘zgaruvchan sharoitga moslasha olishi ularni ekologik monitoring va bioindikatsiya tadqiqotlarida qo‘llash uchun muhim biologik ko‘rsatkichga aylantiradi.

Urbanizatsiya sharoitida suv havzalarining gidrologik rejimi, fizik-kimyoviy tarkibi va biologik xilma-xilligi o‘zgarishi mumkin. Suvning harorati, kislorod miqdori, pH darajasi, mineral moddalar va organik birikmalar konsentratsiyasi kabi omillar gidrobiontlarning yashashi va tarqalishiga bevosita ta’sir ko‘rsatadi. Ayniqsa, antropogen ifloslanish natijasida ayrim sezgir turlarning kamayishi, ayrim chidamli turlarning esa ko‘payishi kuzatilishi mumkin. Shu sababli urbanizatsiyalashgan hududlarda gidrobiontlarning ekologik holatini o‘rganish suv ekotizimlaridagi o‘zgarishlarni aniqlash va ularning barqarorligini baholashda muhim ahamiyat kasb etadi.

Mazkur mavzuni o‘rganishdan asosiy maqsad urbanizatsiya sharoitida gidrobiontlarning tarqalishiga ta’sir etuvchi ekologik omillarni aniqlash, suv havzalarining antropogen ta’sir ostidagi holatini baholash hamda gidrobiontlarning bioindikatorlik xususiyatlarini yoritishdan iborat. Tadqiqot natijalari suv ekotizimlarini muhofaza qilish, biologik xilma-xillikni saqlash va urbanizatsiya sharoitida suv resurslaridan oqilona foydalanish bo‘yicha ilmiy-amaliy yondashuvlarni takomillashtirishga xizmat qiladi.

Tadqiqot metodi. Tadqiqot urbanizatsiya sharoitida suv havzalarida uchraydigan gidrobiontlarning tarqalishi va ekologik holatini o‘rganishga yo‘naltirildi. Tadqiqot jarayonida kuzatish, ekologik tahlil, taqqoslash, monitoring va biologik namuna olish usullaridan foydalanildi. Suv havzalarining urbanizatsiya darajasi, antropogen ta’sir xususiyatlari hamda gidrobiontlarning tur tarkibi va tarqalish ko‘rsatkichlari o‘zaro taqqoslandi.

Gidrobiontlarning ekologik holatini baholashda suv muhitining asosiy fizik-kimyoviy ko‘rsatkichlari, jumladan, suv harorati, tiniqligi, pH ko‘rsatkichi, erigan kislorod miqdori va organik ifloslanish darajasiga e’tibor qaratildi. Olingan ma’lumotlar asosida turli ekologik sharoitlarda gidrobiontlarning uchrash chastotasi, soni va tarqalish xususiyatlari aniqlandi. Ayrim gidrobiont

guruhlarining antropogen ta’sirga chidamliligi va suv sifatining o‘zgarishlariga munosabati ham tahlil qilindi.

Tadqiqot davomida gidrobiontlarning suv ekotizimidagi ekologik ahamiyati, oziq zanjiridagi o‘rni va bioindikatorlik xususiyatlarini aniqlashga alohida e’tibor qaratildi. Kuzatish va tahlil natijalari umumlashtirilib, urbanizatsiya ta’sirida suv havzalarida yuzaga keladigan ekologik o‘zgarishlar hamda gidrobiontlar xilma-xilligiga ta’sir etuvchi omillar belgilandi.

Tadqiqot natijalari. Tadqiqot davomida urbanizatsiya ta’sirida suv havzalarida gidrobiontlarning tarqalishi, tur xilma-xilligi va ekologik holatida yuz beradigan o‘zgarishlar tahlil qilindi. Kuzatishlar shuni ko‘rsatdiki, antropogen bosim darajasi yuqori bo‘lgan suv havzalarida gidrobiontlarning tur tarkibi nisbatan kamayib, ifloslanishga chidamli organizmlarning ulushi ortishi mumkin. Nisbatan toza va antropogen ta’siri past bo‘lgan suv havzalarida esa gidrobiontlarning ekologik guruhlari va tur xilma-xilligi kengroq kuzatildi.

Ekologik omil	**Gidrobiontlarga ta’siri**	**Kuzatiladigan ekologik holat**
Suvning ifloslanishi	Sezgir turlar kamayadi	Tur tarkibi o‘zgaradi
Erigan kislorod miqdori	Nafas olish va hayot faoliyatiga ta’sir qiladi	Kislorod kamaysa ayrim turlar soni kamayadi
Suv harorati	Modda almashinuvi va rivojlanish jarayonlarini belgilaydi	Haroratga moslashgan turlar ustunlashadi
Organik moddalar miqdori	Mikroorganizmlar va ayrim umurtqasizlar rivojlanishiga ta’sir qiladi	Ayrim tolerant turlar ko‘payadi
Mineral moddalar	Suvning kimyoviy xususiyatlarini o‘zgartiradi	Tur tarkibida ekologik siljish yuz beradi
Antropogen bosim	Yashash muhitining tabiiyligini buzadi	Biologik xilma-xillik kamayishi mumkin

Tadqiqot natijalarini umumlashtirishda gidrobiontlarning ekologik guruhlari ham alohida ko‘rib chiqildi. Suv havzalarining ekologik holati yaxshilangani sari sezgir va o‘rtacha sezgir organizmlarning uchrash ehtimoli ortishi, antropogen ta’sir kuchaygan sharoitda esa chidamli turlarning ustunlashishi kuzatilishi mumkin.

Suv havzasining holati	**Gidrobiontlarning tur xilma-xilligi**	**Bioindikatorlik holati**

Nisbatan toza	Yuqori	Sezgir turlar uchraydi
O‘rtacha antropogen ta’sirlangan	O‘rtacha	Sezgir va chidamli turlar birgalikda uchraydi
Kuchli antropogen ta’sirlangan	Past	Chidamli turlar ustun bo‘ladi

Olingan natijalar gidrobiontlarning tarqalishi suv muhitining fizik-kimyoviy xususiyatlari va antropogen bosim bilan chambarchas bog‘liqligini ko‘rsatadi. Ayniqsa, suvning ifloslanish darajasi, kislorod rejimi va organik moddalar miqdorining o‘zgarishi gidrobiontlar tarkibida sezilarli ekologik siljishlarni yuzaga keltiruvchi omillar sifatida baholandi. Shu sababli gidrobiontlarni muntazam kuzatish shahar suv havzalarining ekologik holatini baholash va antropogen ta’sir darajasini aniqlashda samarali yondashuvlardan biri hisoblanadi.

Xulosa. Urbanizatsiya sharoitida suv havzalarining ekologik holati gidrobiontlarning tur tarkibi, soni va tarqalish xususiyatlariga bevosita ta’sir ko‘rsatishi aniqlandi. Shahar hududlarida antropogen bosimning ortishi, suvning turli chiqindilar bilan ifloslanishi, fizik-kimyoviy ko‘rsatkichlarning o‘zgarishi hamda kislorod rejimining buzilishi gidrobiontlar xilma-xilligiga salbiy ta’sir ko‘rsatishi mumkin. Ayniqsa, ekologik sharoitga sezgir turlar kamayib, o‘zgaruvchan muhitga chidamli turlarning ulushi ortishi suv ekotizimlaridagi ekologik o‘zgarishlarning muhim ko‘rsatkichi hisoblanadi.

Tadqiqot natijalari gidrobiontlarning suv muhitidagi ekologik holatni baholashda muhim bioindikator sifatida foydalanish imkoniyatiga ega ekanligini ko‘rsatdi. Ularning tur tarkibi va tarqalishidagi o‘zgarishlarni muntazam kuzatib borish orqali suv havzalaridagi antropogen ta’sir darajasini aniqlash mumkin. Shu bois urbanizatsiyalashgan hududlarda suv ekotizimlarini muntazam monitoring qilish, ifloslanish manbalarini kamaytirish, suv havzalarining biologik xilma-xilligini muhofaza qilish va gidrobiontlarning tabiiy yashash sharoitlarini saqlash muhim ekologik vazifalardan biridir. Mazkur yondashuvlar shahar suv havzalarining ekologik barqarorligini ta’minlash va suv biologik resurslarini kelajak avlodlar uchun asrashga xizmat qiladi.

ADABIYOTLAR RO'YXATI

1. Boymurodov X.T., Yunusov X.B., Suyarov S.A. va boshq. *Distribution of Hydrobionts in Biotopes in the Mirzaariq Canal and Ecological Groups*. — Bulletin of Science and Practice, 2022. — Vol. 8, №6. — P. 40–53. DOI: 10.33619/2414-2948/79/93.

2. Boymurodov X. *Fauna of Hydrobionts of the Urgutsoy and Omonkutonsoy Aquatic Ecosystems*. — O‘zMU Xabarlari. Tabiiy fanlar, 2023. — №3.2. — B. 26–28.

3. Boymurodov X., Bobomurodov Z. *Sangzor daryosi ikkipallali mollyuskalari faunasi biologik xilma-xilligi*. — O‘zMU Xabarlari, 2019. — №3/2.

4.Boymurodov X., Aliyev B., Otakulov B. *Janubiy O‘zbekiston suv omborlari gidrobiontlari bioxilma-xilligi*. — O‘zMU Xabarlari, 2022. — №3/2. — B. 44–48.

5. Izzatullayev Z.I., Boymurodov X.T. *Zarafshon daryosi havzasi ikki pallali mollyuskalari*. — Samarqand, 2009. — 94 b.

6. To‘ynazarova I., Boymurodov X.T., Jabborova T., Xasanov N. *Suv omborlari ekotizimlarida mollyuskalar bioxilma-xilligi va populyatsiyalari*. — O‘zMU Xabarlari, 2021. — №3/1. — B. 103–106.

ZANGORI SACHRATQI (*CICHORIUM INTYBUS* L.) NEMATODAFAUNASINING BIOEKOLOGIK XUSUSIYATLARI

Tursunova Shahlo Shodixo'ja qizi

Samarqand davlat pedagogika instituti

e-mail: shahlotursunova2720@gmail.com

Annotatsiya. *Ushbu maqolada Turkiston tog‘ tizmasida tarqalgan zangori sachratqi (Cichorium intybus L.) bilan bog‘liq nematodafaunaning tarkibi va bioekologik xususiyatlari haqida ma’lumot beriladi. Tadqiqotlar davomida o‘simlikning vegetativ a’zolari va rizosfera tuprog‘ining turli qatlamlaridan 8 turkumga mansub 32 tur nematoda aniqlanib, ularning biotoplar bo‘yicha tarqalish xususiyatlari aniqlandi. Nematodalar trofo-ekologik guruhlarga ajratilib, jamoa tarkibida bakteriotroflarning ustunligi qayd etildi.*

Kalit so‘zlar. *Cichorium intybus, zangori sachratqi, nematodafauna, fitonematodalar, bioekologiya, trofo-ekologik guruhlar.*

Kirish. Mamlakatimizda so‘nggi yillarda dorivor o‘simliklardan samarali va unumli foydalanishga katta ahamiyat berilmoqda. Jumladan, O‘zbekiston Respublikasi Prezidentining 2020-yil 10-apreldagi “Yovvoyi holda o‘suvchi dorivor o‘simliklarni muhofaza qilish, madaniy holda yetishtirish, qayta ishlash va mavjud resurslardan oqilona foydalanish chora-tadbirlari to‘g‘risida”gi PQ-4670-son qarori hamda 2022-yil 20-maydagi ”Dorivor o‘simliklarni madaniy holda yetishtirish va qayta ishlash hamda davolashda ulardan keng foydalanishni tashkil etish chora- tadbirlari to‘g‘risida” gi PQ-251-sonli Qarorlari sohani tubdan rivojlanishining huquqiy asoslarini yaratib berdi [1,2].

O‘tgan davr mobaynida respublikamizda 9 ta dorivor o‘simliklar yetishtirish klasterlari tashkil etilib, ular tomonidan moychechak, kovrak, limono‘t, qalampir yalpiz, qizilmiya, za’faron va boshqa dorivor o‘simliklar yetishtirilmoqda. Shuningdek, yana bir qancha yovvoyi dorivor o‘simliklarni madaniylashtirish, plantatsiyalarini tashkil etish ustida izlanishlar olib borilmoqda. Lekin madaniy o‘simliklar singari yovvoyi dorivor o‘simliklar ham har xil kasallik qo‘zg‘atuvchilar va zararkunandalarga, shuningdek parazitlarga duchor bo‘ladi. Kasallangan o‘simlik nafaqat o‘z mahsuldorligini keskin kamaytiradi, balki mahsulot sifati va uning kimyoviy tarkibi hamda xususiyatlari ham o‘zgaradi. Dorivor o‘simliklarning zararkunandalari va kasallik qo‘zg‘atuvchilari orasida parazit fitonematodalarning salbiy faoliyati ham ancha salmoqlidir.

O’zbekiston sharoitida ayrim dorivor o’simliklarning nematodalari Sh.A.Ataxanov [8], N.B.Adilova [6,7], N.X.Xakimov [10] va E.S.Strepkovalar [9] tomonidan o’rganilgan. Lekin, olib borilgan tadqiqotlar o‘tgan asrning 60-70 yillarida amalga oshirilgan. So‘nggi yillarda iqlim sharoitining o‘zgarishi, tuproq degradatsiyasining tezlashuvi bilan birgalikda o‘simliklar qoplamining o‘zgarishi ham amalga oshmoqda. Bu esa tabiiy holda hayvonlar, jumladan nematodafauna tarkibining ham o‘zgarishiga olib keladi. Aytilganlariga binoan tog‘ sharoitidagi biosenozlarda o‘suvchi yovvoyi dorivor o‘simliklar nematodafaunasini hamda ular tarkibidagi parazit fitonematodalarni o‘rganish, o‘simliklar bilan biosenotik va bioekologik bog‘langanlik xususiyatlarini aniqlash muhim nazariy va amaliy ahamiyatga egadir. Tadqiqotlar davomida Turkiston tog‘ tizmasida o‘suvchi dorivor o‘simliklardan biri – Zangori sachratqi (*Cichorium intybus* L.) nematodafaunasi o‘rganildi. Nematodafaunani o‘rganish uchun Turkiston tizmasining o‘rta va yuqori balandlikdagi mintaqalaridan o‘simlikning vegetativ a’zolari (ildiz va yer ustki qismi) hamda rizosfera tuprog‘i qatlamlaridan (0-10 va 10-20 smli qatlamalar) jami 80 ta namuna nematodalar uchun tahlil qilindi.

Laboratoriya sharoitida namunalardan nematodalarni ajratib olishda Bermanning voronkali va flotatsiya (chayqash) usullaridan foydalanildi. Ajratib olingan nematodalarning turlarini aniqlash uchun ulardan vaqtinchalik va doimiy preparatlar tayyorlandi. Turlarni aniqlash de Man tavsiya

etgan [4] nematodalarning morfometrik ko‘rsatkichlariga asoslangan formulaga asoslanildi. Turlarni sistemaga solishda nematodalarning klassik sistemasidan foydalanildi [3].

O‘rganishlar natijasida sachratqi o‘simligi va rizosfera tuprog‘i qatlamlaridan olingan namunalarda 32 turga mansub nematodalar aniqlandi. Topilgan nematoda turlari Adenophorea va Secernentea sinflarining 8 ta turkumlariga mansubligi qayd etildi. Fauna tarkibida o‘z tarkibidagi turlar soni bo‘yicha Tylenchida va Aphelenchida turkumlari boshqa turkumlarga nisbatan dominantlik qilishi ma’lum bo‘ldi.

Aniqlangan nematodalar jamoasi biotoplar bo’yicha tarqalishi tahlil qilinganda turlar bir tekis tarqalmaganligi ma’lum bo’ldi (1-jadval). Jumladan sachratqining yer ustki qismida 8 avlodga mansub 10 tur qayd etilgan bo’lsa, ildiz sistemasida 13 avlodning 15 turi, 0-10 sm qatlamda 22 avlod 29 tur, 10-20 sm qatlamda esa 13 avlodga mansub 16 tur nematoda qayd qilindi. Keltirilgan raqamlardan ko’rinib turganidek 0-10 smli biotopda xilma-xillikning yuqori bo’lishi ma’lum bo’ldi. Turli biotoplarda xilma-xillikning farq qilishini nematodalarning trofo-ekologik xususiyatlari bilan tushuntirish mumkin.

1-jadval

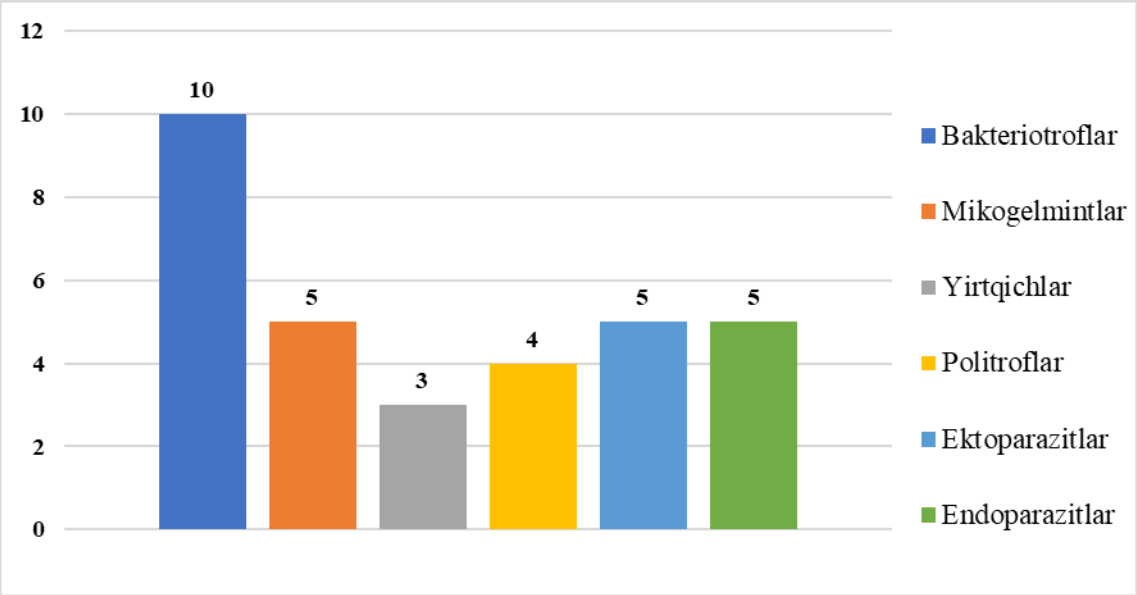
Nematodalar avlodlarining biotoplar bo’yicha tarqalishi

Avlodlar	**Turlar soni**	**Biotoplar**			
		Yer ustki qism	**ildiz**	**0-10 sm**	**10-20 sm**
Plectus Bastian, 1865	1	-	-	+	+
Monhystera Bastian, 1865	1	-	-	+	+
Prismatolaimus De-Man, 1880	1	-	-	+	+
Mylonchulus Cobb, 1916	1	-	-	+	+
Alaimus De-Man, 1880	1	-	-	+	-
Diphtherophora Micoletzky, 1922	1	-	-	+	-
Eudorylaimus Andrassy, 1959	3	-	-	+	+
Nygolaimus Cobb, 1913	1	-	+	+	+

Diplogaster Schultze in Carus, 1857	1	-	-	+	-
Rhabditis Dujardin, 1845	1	-	+	+	+
Heterocephalobus Brzeski, 1960	1	+	+	+	+
Acrobeloides Cobb, 1924	2	+	+	+	+
Chiloplacus Thorne, 1937	1	-	-	+	-
Cervidellus Thorne, 1937	1	-	+	+	-
Paraphelenchus Micoletzky, 1922	1	+	+	+	-
Aphelenchoides Fisher, 1894	4	+	+	+	+
Seinura Fuchs, 1931	1	+	+	-	-
Aglenchus Andrassy, 1954	1	-	-	+	+
Lelenchus Andrassy, 1954	1	-	-	-	+
Ditylenchus Filipjev, 1936	1	+	+	+	+
Pratylenchus Filipjev, 1936	1	+	+	+	-
Rotylenchus Filipjev, 1936	1	-	+	+	-
Helicotylenchus Steiner, 1945	1	-	-	+	-
Merlinius Siddiqi, 1970	1	-	-	+	-
Paratylenchus Micoletzky, 1922	1	+	+	+	-
Meloidogyne Goeldi, 1887	1	-	+	+	-

Aniqlangan nematodafauna tarkibining bioekologik xususiyatlarini tahlil qilish, biotoplar bo’yicha tarqalish qonuniyatlarini ochib berish maqsadida qayd etilgan turlar G.W.Yeates va boshqalar (1993) tomonidan ishlab chiqilgan trofo-ekologik klassifikatsiya [5] asosida bir nechta guruhlarga ajratib chiqildi. Jumladan bakteriotroflar, mikofaglar, yirtqichlar, politroflar, va parazit fitogelmintlar guruhlariga mansub turlar qayd qilinib, parazit fitogelmintlar o’z navbatida ektoparazit va endoparazit nematodalar kichik guruhlariga ajratildi.

Tahlil natijasida zangori sachratqi bilan bog’liq nematodalar jamoasi tarkibida bakteriotroflar ekologik guruhi vakillari 10 tur bilan ustunlik qilishi ma’lum bo’ldi. Shuningdek nematodafauna tarkibida mikofag nematodalar, ektoparazitlar va endoparazit nematodalarning 5 tadan turlari qayd qilindi (1-rasm).



1-rasm. Sachratqi nematodafaunasining trofo-ekologik tarkibi

Xulosa. Olingan natijalar zangori sachratqi bilan bog‘liq nematodafaunaning tarkiban xilma-xil va turli ekologik guruhlardan shakllanganligini namoyon etadi. Nematodalar jamoasining biotoplar bo‘yicha notekis taqsimlanishi ularning yashash muhiti va trofik xususiyatlari bilan bog‘liq. Rizosferaning yuqori qatlamida xilma-xillikning nisbatan yuqoriligi mazkur qatlamda nematodalar uchun qulay trofik sharoitlar mavjudligi bilan izohlanadi. Trofo-ekologik tarkibda bakteriotroflarning ustunligi tuproqdagi mikroorganizmlar bilan bog‘liq oziqlanish munosabatlarining nematodalar jamoasi shakllanishidagi ahamiyatini ifodalaydi. Parazit fitonematodalarning qayd etilishi esa zangori sachratqi bilan bog‘liq nematodalar majmuasida o‘simlik bilan bevosita trofik aloqadagi guruhlar ham mavjudligini anglatadi. Umuman, aniqlangan xususiyatlar zangori sachratqi rizosferasida o‘ziga xos, ekologik jihatdan murakkab nematodalar majmuasi shakllanganligini ko‘rsatadi.

FOYDALANILGAN ADABIYOTLAR

1. O‘zbekiston Respublikasi Prezidentining 2020-yil 10-apreldagi PQ-4670-sonli “Yovvoyi holda o‘suvchi dorivor o‘simliklarni muhofaza qilish, madaniy holda yetishtirish, qayta ishlash va mavjud resurslardan oqilona foydalanish chora-tadbirlari to‘g‘risida”gi Qarori. //www.lex.uz

2. O‘zbekiston Respublikasi Prezidentining 2022-yil 20 - maydagi PQ-251-sonli ”Dorivor o‘simliklarni madaniy holda yetishtirish va qayta ishlash hamda davolashda ulardan keng foydalanishni tashkil etish chora- tadbirlari to‘g‘risida” gi Qarori. //www.lex.uz

3. Hodda M. Phylum Nematoda: a classification, catalogue and index of valid genera, with a census of valid species. Zootaxa 5114 (1): 001–289. https://doi.org/10.11646/zootaxa.5114.1.1

4. Man J.G. de – Nouvelles recherches sur les nematodes libres terricoles de la Hollande. Capital Zool. 1 (1) 1921. p. 1-62.

5. Yeates, G.W., Bongers, T., DeGoede, R.G., Freckman, D.W. & Georgieva, S.S. (1993) Feeding habits in soil nematode families and genera - an outline for soil ecologists. Journal of Nematology, 25, 315–331.

6. Адилова Н.Б. – Нематоды некоторых дикорастущих лекарственных растений. // Первая конференция (IX совещание) по нематодам растений, насекомых, почвы и вод. Тезисы докл. и сообщ., Ташкент, 1981. стр. 17.

7. Адилова Н.Б. – Фауна нематод некоторых дикорастущих лекарственных растений Самаркандского района (Агалик) Самаркандской области. Узб. биол. журнал №3. 1970. стр. 44-46.

8. Атаханов Ш.А. – Некоторые данные о нематодафауне дикорастущих лекарственных растений Узбекистане. IX International Nematology Symposium. Warszown (резюме). 1968. стр. 145-146.

9. Стрепкова Э.С. – Формирование фауны нематоды некоторых лекарственных растений в процесса окультуривания // Первая конференция. (IX совещание) по нематодам растений, насекомых, почвы и вод. Тезисы докл. и сообщ. Ташкент, 1981. стр. 76-77.

10. Хакимов Н.Х. – Нематоды некоторых дикорастущих лекарственных растений. Тез. докл. IV научной конференции. проф-преп. состава Сам ГПИ им. С.Айни

A NEW RECORD FOR THE AGELENIDAE (ARANEAE) FAUNA OF UZBEKISTAN

Feruz Abdullajonovich Shodmonov

Sharof Rashidov Samarkand State University

E-mail: feruzshodmonov902501@gmail.com

Abstract. *This study reports the occurrence of Pireneitega wui Zhao & Li, 2016 in Uzbekistan, based on two male specimens collected in the Zarafshan Range in 2023. Their identification was established through morphological examination, with particular emphasis on the diagnostic characters of the male pedipalp. This finding contributes to the knowledge of the distribution of Pireneitega in Central Asia.*

Keywords: *Araneae, Agelenidae, Coelotinae, Pireneitega wui, Uzbekistan, Zarafshan Range, faunistic record, distribution, morphology.*

Introduction: The family Agelenidae C. L. Koch, 1837 comprises funnel-weaving spiders distributed across a wide range of terrestrial habitats worldwide. Despite previous taxonomic and faunistic studies, the diversity and distribution of Agelenidae remain insufficiently documented in several parts of Central Asia, including the mountainous regions of Uzbekistan [1, 5].

The genus *Pireneitega* Kishida, 1955 belongs to the subfamily Coelotinae within Agelenidae. Its representatives occur across Eurasia, from southwestern Europe to East Asia. The genus includes numerous described species, many of which are known from China, while several have also been recorded in Central Asia, particularly in Tajikistan [2, 3].

Pireneitega wui Zhao & Li, 2016 was originally described from Xinjiang, China. The discovery of specimens in Uzbekistan provides additional information on the distribution of this species and contributes to a better understanding of the regional diversity of *Pireneitega* [3, 4].

The present study documents specimens of *P. wui* collected in the Zarafshan Range, provides a description of their diagnostic morphological features, and discusses the significance of this record for the study of the Central Asian arachnofauna.

Study Area and Material: The material examined in this study consists of two adult male specimens collected by F. Shodmonov during fieldwork in Samarkand Region, Uzbekistan, in June 2023.

The specimens were obtained from the Yetti Uyli natural area in the Zarafshan Range (39°26′07.0″ N, 66°59′02.0″ E), at an elevation of 1,062 m above sea level. Collection took place between 3 and 8 June 2023.

Identification was based on morphological examination, focusing primarily on the diagnostic structures of the male pedipalp. The characters considered included the shape and proportions of the

patellar apophysis and retrolateral tibial apophysis, as well as the morphology of the cymbium, tegulum, tegular apophysis, conductor, and embolus.

Morphological Description of *Pireneitega wui:* The body length of the male specimens of *P. wui* collected in Uzbekistan is 10.1 mm. The carapace is 5.0 mm long and 3.6 mm wide. The abdomen is 4.9 mm long and 2.8 mm wide. The eye measurements are as follows: AME, 0.16 mm; ALE, 0.21 mm; PME, 0.17 mm; and PLE, 0.20 mm.

The body coloration consists predominantly of yellowish-brown and grey tones. The carapace is yellowish-brown, with the anterior region being relatively darker. The chelicerae are brown. The labium, endites, and sternum are yellowish-brown. The coxae and pedipalps are yellow. Legs I–III are yellow, with their distal portions being brown, whereas leg IV is yellow. The abdomen is yellowish-grey, with a relatively paler ventral surface. The spinnerets are also yellowish-grey.

Structure of the Male Pedipalp: The structure of the male pedipalp provides some of the most important diagnostic characters for identifying *Pireneitega wui*.

The femur is approximately 1.5 times longer than the combined length of the patella and tibia. The patellar apophysis is finger-shaped and three times shorter than the patella. The retrolateral tibial apophysis is approximately equal in length to the patellar apophysis and is triangular in retrolateral view.

The cymbium is slightly longer than the femur and approximately twice as long as the bulb. The cymbial furrow is 2.7 times shorter than the cymbium. In prolateral view, the subtegulum is larger than the tegulum. The tegulum is rounded. The tegular apophysis is triangular and strongly sclerotized. The tip of the conductor is narrowed and curved towards the retrolateral side. The embolus originates at approximately the 6:30 o’clock position. It is elongated and forms two bends along its course.

The male of *P. wui* shares certain morphological similarities with *Pireneitega armeniaca*. Both species possess a finger-shaped patellar apophysis and a moderately sized, ribbon-like conductor with two bends. However, *P. wui* can be distinguished from *P. armeniaca* by the nearly straight anterior margin of the conductor and the blunt retrolateral tip of the tegular apophysis. In *P. armeniaca*, the anterior margin of the conductor is strongly convex, whereas the tip of the tegular apophysis is more slender.

First Record from Uzbekistan: The discovery of *Pireneitega wui* in Uzbekistan represents one of the principal findings of this study. Previously, the species was known only from its type locality in Xinjiang, China.

The new record from Uzbekistan extends the known distributional range of the species approximately 1,000 km westwards. This finding indicates that the distribution of *P. wui* in Central Asia may be broader than previously documented.

The geographical significance of this finding is further supported by the faunistic connections between the Zarafshan Range of Uzbekistan and other mountainous regions of Central Asia. The occurrence of *P. wui* in the Zarafshan Range suggests that the species may be more widely distributed across montane ecosystems. However, additional field investigations are required to determine its full distributional range within Uzbekistan.

Species of *Pireneitega* in Central Asia: Before the discovery of *P. wui* in Uzbekistan, several representatives of the genus *Pireneitega* had been recorded from Central Asia. With the addition of *P. wui*, the total number of *Pireneitega* species recorded from the region has increased to nine.

Furthermore, half of the eight *Pireneitega* species previously recorded from the region are known only from female specimens. This situation complicates the assessment of the actual taxonomic status of certain taxa. The authors have also noted the possibility that the male of *P. wui* may be conspecific with the females of some Central Asian species whose males remain unknown.

These findings suggest that the Zarafshan Range may represent an important area for the study of *Pireneitega* diversity in Central Asia.

Discussion: The first record of *Pireneitega wui* from Uzbekistan is an important contribution to our understanding of the arachnofauna of Central Asia. The species was previously known only from Xinjiang, and the new locality lies approximately 1,000 km to the west of its previously known distribution. This finding substantially expands the available information on its geographical range.

The results highlight the need for targeted investigations of Agelenidae, particularly Coelotinae, in the mountainous regions of Uzbekistan. Systematic expeditions to the Zarafshan, Hissar, and other mountain ranges may help reveal additional species that have not yet been recorded from the country.

The discovery of *P. wui* in Uzbekistan is significant not only as a faunistic record but also as a contribution to reassessing the geographical distribution of the species in Central Asia. Such findings provide additional information for investigating the zoogeographical relationships of spiders in the region.

Conclusion: During arachnological investigations conducted in 2023, *Pireneitega wui* Zhao & Li, 2016 was identified in the Yetti Uyli natural area of the Zarafshan Range, Samarkand Region, Uzbekistan.

The findings highlight the need for further faunistic and taxonomic investigations of the family Agelenidae, particularly the genus *Pireneitega*, in the mountainous regions of Uzbekistan.

REFERENCES

1. Nentwig, W., Blick, T., Bosmans, R., Kropf, C., & Stäubli, A. (2026). Spiders of Europe. Version 10.2026. Available at: https://www.araneae.nmbe.ch/ (accessed October 20, 2026). https://doi.org/10.24436/1

2. Zhang, X. Q., & Marusik, Y. M. (2016). A survey of *Pireneitega* from Tajikistan (Agelenidae, Coelotinae). *ZooKeys*, 635, 89–107.

3. Zhang, X. Q., Zhao, Z., Zheng, G., & Li, S. Q. (2016). Nine new species of the spider genus *Pireneitega* Kishida, 1955 (Agelenidae, Coelotinae) from Xinjiang, China. *ZooKeys*, 601, 49–74.

4. Zhang, X. Q., Zhao, Z., Zheng, G., & Li, S. Q. (2017). A survey of five *Pireneitega* species (Agelenidae, Coelotinae) from China. *ZooKeys*, 663, 45–64.

5. World Spider Catalog. (2024). *World Spider Catalog*, version 24.5. Natural History Museum Bern.

MAXENT-BASED PREDICTION OF THE POTENTIAL DISTRIBUTION OF *GLYCYRRHIZA GLABRA* L. IN UZBEKISTAN

Islamov B., Khurramov O.

Samarkand State University named after Sharof Rashidov

Department of Biology, Samarkand State Pedagogical Institut

otabekxurramov64@gmail.com

Abstract :*Glycyrrhiza glabra L. is a medicinally and economically important plant species distributed in the arid and semi-arid regions of Central Asia. Determining its potential geographical distribution and assessing changes in suitable habitats under climate change are important for the sustainable use and conservation of its natural populations. This study aimed to assess the current and future potential distribution of G. glabra in Uzbekistan using the Maximum Entropy (MaxEnt) modelling approach.*

Occurrence records obtained from field surveys and herbarium collections were used to model, together with 19 bioclimatic variables from the WorldClim database, for the baseline period of 1970–2000, along with elevation data. Future potential distribution was assessed under the SSP1-2.6 and SSP5-8.5 climate scenarios for 2041–2060.

The MaxEnt model indicated that areas with high habitat suitability for G. glabra were mainly concentrated in the eastern and southeastern parts of Uzbekistan and in foothill regions. Future projections showed that the total area of moderately to highly suitable habitats is expected to increase by approximately 31% under SSP1-2.6 and 39% under SSP5-8.5 compared with the current period. These findings provide a scientific basis for identifying potential distribution areas of G. glabra, promoting the sustainable use and conservation of its natural populations, and supporting long-term monitoring under changing climatic conditions.

Keywords: *Glycyrrhiza glabra, MaxEnt, potential distribution, habitat suitability, climate change, Uzbekistan.*

Introduction. *Glycyrrhiza glabra* L. (Fabaceae) is a medicinally important perennial plant naturally distributed across Eurasia, including Central and Southwestern Asia (Pastorino et al., 2018). Natural populations of the species also occur in Uzbekistan, particularly in the country's arid regions (Khojimatov et al., 2023). The roots and rhizomes of *G. glabra* are rich in biologically active compounds, including glycyrrhizin, glycyrrhetinic acid, flavonoids, and other phytochemical constituents, and its raw materials are widely used in the pharmaceutical, food, and other industries (Pastorino et al., 2018; Hasan et al., 2021; Wahab et al., 2021). The glycyrrhizin content in the underground parts of *G. glabra* samples collected in Uzbekistan has been reported to range from 3.3% to 6.1% of dry weight (Hayashi et al., 2003). Therefore, assessing the status of natural populations, identifying potentially suitable distribution areas, and providing a scientific basis for their sustainable use are of considerable importance.

Changes in climatic conditions can influence the geographical distribution of species and the suitability of their habitats. In particular, changes in temperature and precipitation regimes may alter the geographical extent and location of environmentally suitable areas. Modelling studies of *Glycyrrhiza* species have also demonstrated that future climate change may substantially alter their potential suitable habitats (Huang et al., 2023). In China, for example, changes in suitable habitats for *G. glabra* under future climatic conditions have been projected.

Species Distribution Models (SDMs) enable the potential geographical distribution of species to be assessed by relating known occurrence records to environmental factors (Elith & Leathwick, 2009). Among these approaches, the Maximum Entropy (MaxEnt) model is widely used to characterise ecological suitability and predict potential geographical distributions based on presence-only occurrence data (Phillips et al., 2006). MaxEnt has also been applied to *Glycyrrhiza* species to assess their current and future potential suitable habitats (Huang et al., 2023; Ma et al., 2025).

In this context, the present study aimed to assess the current potential distribution of *G. glabra* in Uzbekistan using MaxEnt modelling and to predict potential changes in suitable habitats under the SSP1-2.6 and SSP5-8.5 climate scenarios.

Materials and Methods. Georeferenced occurrence records obtained from field surveys and herbarium collections were used to model the potential geographical distribution of *Glycyrrhiza glabra* L. After removing duplicate records and records lacking corresponding environmental data, a total of 212 occurrence records were used for MaxEnt modelling. The occurrence data were randomly partitioned, with 75% used for model training and 25% for model testing.

To assess potential habitat suitability, 19 bioclimatic variables (BIO1–BIO19) for the 1970–2000 baseline period were obtained from the WorldClim database, together with elevation and environmental layers representing soil properties. All environmental variables were incorporated into the modelling procedure in raster format.

The potential distribution of *G. glabra* was modelled using MaxEnt version 3.4.4. Model predictive performance was evaluated using the Area Under the Curve (AUC) of the Receiver Operating Characteristic (ROC) curve. The relative effects of environmental variables on model predictions were assessed using Jackknife analysis and response curves.

Habitat suitability values predicted by MaxEnt ranged from 0 to 1 and were classified into corresponding suitability categories to delineate potential distribution areas. Future potential distributions were projected for 2041–2060 under the SSP1-2.6 and SSP5-8.5 climate scenarios. Current and future model outputs were compared to quantify changes in the extent of potentially suitable habitats for *G. glabra.*

Results. The MaxEnt model predicted the potential habitat suitability of *Glycyrrhiza glabra* L. in Uzbekistan with high accuracy. Under the baseline climatic conditions of 1970–2000, the model achieved a training AUC of 0.988 and a test AUC of 0.981. Among the bioclimatic variables included in the model, BIO19 (precipitation of the coldest quarter; 33.3%) and BIO3 (isothermality; 28.5%) made the largest contributions. These were followed by BIO10 (mean temperature of the warmest quarter; 11.7%), BIO14 (precipitation of the driest month; 10.4%), and BIO7 (temperature annual range; 6.2%). Together, these five bioclimatic variables accounted for 90.1% of the total contribution.

The model for the historical period revealed a heterogeneous spatial distribution of habitat suitability for *G. glabra* across Uzbekistan. Areas of high suitability were identified in the Lower Amu Darya–Khorezm region, the Tashkent oasis and Fergana Valley, the Zarafshan Valley, and parts of the Kashkadarya and Surkhandarya regions. In contrast, low suitability predominated across extensive desert areas in the central and western parts of the country. Under historical conditions,

the areas within the suitability classes of 0.41–0.60, 0.61–0.80, and 0.81–1.00 were 23,349.5 km², 21,154.1 km², and 18,225.3 km², respectively. Thus, the total area of potentially suitable habitat within the 0.41–1.00 suitability range was 62,728.9 km² (Fig. 1).

Under the SSP1-2.6 scenario for 2041–2060, the training and test AUC values were 0.935 and 0.920, respectively. The areas corresponding to the suitability classes of 0.41–0.60, 0.61–0.80, and 0.81–1.00 were 35,146.3 km², 29,873.5 km², and 17,407.2 km², respectively. Consequently, the total potentially suitable area within the 0.41–1.00 range increased to 82,427.0 km², representing a 31.4% increase compared with the historical period.

Under the SSP5-8.5 scenario, the model achieved a training AUC of 0.931 and a test AUC of 0.928. The areas within the 0.41–0.60, 0.61–0.80, and 0.81–1.00 suitability classes were 42,250.8 km², 30,247.3 km², and 14,608.1 km², respectively. The total potentially suitable area within the 0.41–1.00 range reached 87,106.2 km², corresponding to a 38.9% increase relative to the historical period.

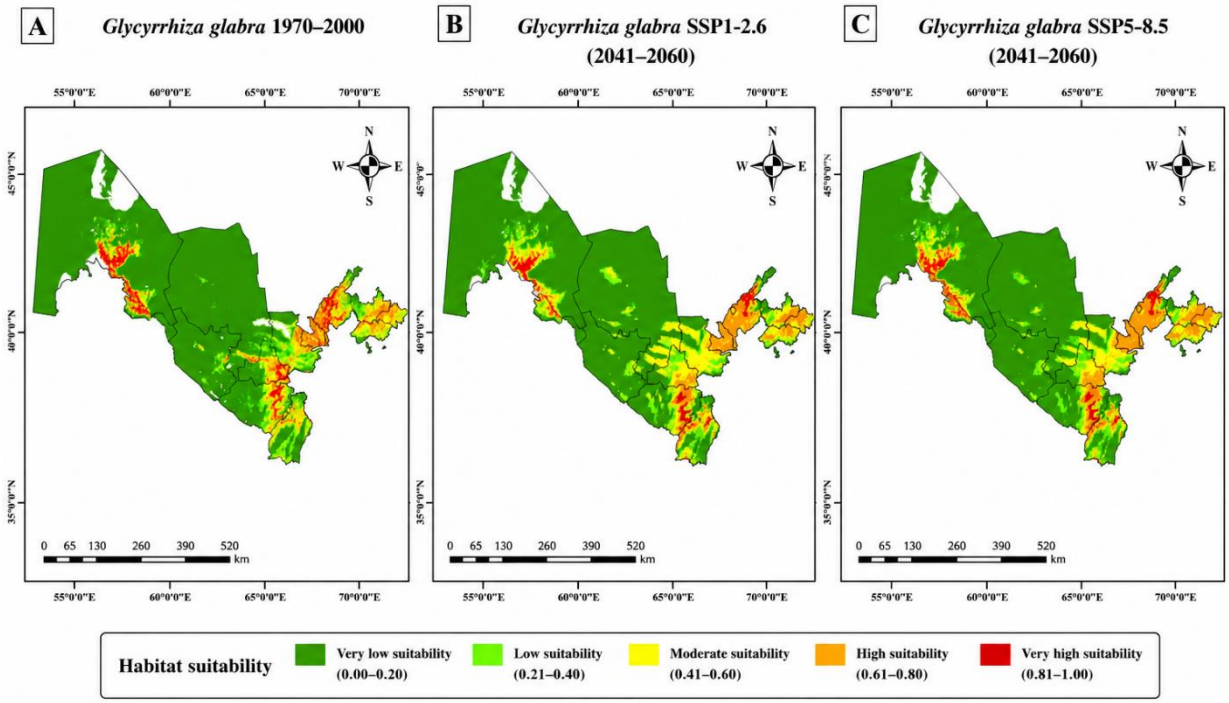


Figure 1. Predicted habitat suitability of *Glycyrrhiza glabra* L. in Uzbekistan based on MaxEnt model. (A) Historical climate (1970–2000); (B) Future climate under SSP1-2.6 (2041–2060); (C) Future climate under SSP5-8.5 (2041–2060). Suitability values range from 0 (unsuitable) to 1 (very high suitability).

When the suitability classes were compared separately, the overall expansion projected under the future climate scenarios was mainly attributable to increases in the 0.41–0.60 and 0.61–0.80 suitability ranges. The area within the 0.41–0.60 class increased from 23,349.5 under historical conditions to 35,146.3 under SSP1-2.6 and 42,250.8 under SSP5-8.5. Similarly, the area within the 0.61–0.80 class increased from 21,154.1 to 29,873.5 and 30,247.3, respectively. In contrast, the area

with the highest suitability (0.81–1.00) decreased from 18,225.3 under historical conditions to 17,407.2 under SSP1-2.6 and 14,608.1 under SSP5-8.5. These reductions corresponded to 4.5% and 19.8%, respectively, relative to the historical period.

Overall, under both climate scenarios projected for 2041–2060, the total potentially suitable area (0.41–1.00) for G. glabra increased, whereas the area classified as having the highest habitat suitability (0.81–1.00) decreased.

Discussion. The results of this study demonstrated that the potential distribution of *Glycyrrhiza glabra* L. in Uzbekistan is closely associated with climatic factors. In the MaxEnt model, BIO19 (precipitation of the coldest quarter) and BIO3 (isothermality) made the largest contributions, while BIO10 (mean temperature of the warmest quarter) and BIO14 (precipitation of the driest month) were also among the major bioclimatic predictors. The predominance of temperature- and precipitation-related variables indicates the importance of moisture availability and thermal regimes in determining the potential habitat suitability of the species. Similarly, Sun et al. (2025), using an optimised MaxEnt model to assess the potential distributions of *G. glabra* and *G. inflata* in Xinjiang, identified extreme temperature, extreme precipitation, and elevation among the major factors limiting the distribution of *G. glabra*.

Under historical conditions, highly suitable habitats for *G. glabra* were unevenly distributed across Uzbekistan and were mainly concentrated in particular oases, valleys, and foothill areas, indicating pronounced spatial differentiation in habitat suitability. A similar distribution pattern has been reported in Xinjiang, where potentially suitable habitats for *G. glabra* were relatively extensive but fragmented and were mainly associated with comparatively well-watered plains and river valleys, including parts of the Tarim Basin, Ili Valley, and Tacheng region (Sun et al., 2025). At the broader scale of China, potentially suitable habitats for the species have also been reported mainly in Xinjiang, Gansu, Inner Mongolia, Ningxia, and Qinghai (Ma et al., 2025).

Future projections indicated that the response of *G. glabra* to climate change may not be unidirectional. According to our results, the total area of potentially suitable habitat within the 0.41–1.00 suitability range is projected to increase by 31.4% under SSP1-2.6 and 38.9% under SSP5-8.5 during 2041–2060 compared with the historical period. This trend is broadly consistent with the findings of Huang et al. (2023), who modelled six *Glycyrrhiza* species across China and projected a 51.7% increase in habitat suitability for *G. glabra* under future climate change.

The expansion projected for Uzbekistan also shows similarities with results obtained from geographically adjacent Xinjiang. Sun et al. (2025) reported that suitable habitats for *G. glabra* may expand in parts of Tacheng, Changji, Turpan, and Hami under future climatic conditions, with a general increase in potential distribution north of the Tianshan Mountains. They also reported a

stronger effect of the SSP5-8.5 scenario on the potential distributions of *G. glabra* and *G. inflata* than that of SSP1-2.6 (Sun et al., 2025). In this respect, the greater expansion predicted in Uzbekistan under SSP5-8.5 (38.9%) compared with SSP1-2.6 (31.4%) is consistent with the general trend reported for Xinjiang.

However, the overall expansion of potentially suitable habitat did not correspond to an increase in the most highly suitable areas. In the present study, the area within the 0.81–1.00 suitability class decreased by 4.5% under SSP1-2.6 and 19.8% under SSP5-8.5 relative to the historical period, whereas the areas within the 0.41–0.60 and 0.61–0.80 suitability classes increased. Thus, the projected expansion of the overall suitable range was primarily associated with increases in moderately and highly suitable habitats, while the most highly suitable habitats declined. The more pronounced reduction under SSP5-8.5 suggests that climate change may have contrasting effects on the overall extent of the potential range and on the distribution of the highest-quality habitats within that range.

Nevertheless, previous studies have not produced entirely consistent projections of the future distribution of *G. glabra*. Ma et al. (2025) used MaxEnt to assess the current and future potential habitats of *G. glabra*, *G. uralensis* and *G. inflata* in China and reported a general contraction of suitable habitats for all three species under future climate conditions. In their study, BIO18 (precipitation of the warmest quarter), BIO15 (precipitation seasonality), and elevation were among the principal factors influencing the distribution of *G. glabra* (Ma et al., 2025). These findings differ partly from the expansion projected for Uzbekistan in the present study and from the trends reported by Huang et al. (2023) and Sun et al. (2025).

Such differences may be related to variation in geographical extent, the number and spatial distribution of occurrence records, the environmental predictors included in the models, MaxEnt parameterisation, future climate scenarios, and the criteria used to classify habitat suitability. For example, Sun et al. (2025) incorporated 25 environmental variables and optimised MaxEnt parameters using ENMeval, whereas Ma et al. (2025) considered topographic factors in addition to climatic variables. Therefore, rather than directly comparing absolute estimates of suitable area among studies conducted at different geographical scales, greater emphasis should be placed on comparing their spatial and ecological trends.

The results obtained for Uzbekistan indicate that management of natural *G. glabra* resources should consider not only changes in the total extent of potentially suitable habitat but also shifts among habitat-suitability classes. Although the total area within the 0.41–1.00 suitability range is projected to expand, the decline in the most highly suitable habitats (0.81–1.00) highlights the importance of long-term monitoring of existing natural populations and their habitats. Because

MaxEnt predicts potential ecological suitability rather than the actual presence of a species, the occurrence of *G. glabra* in newly identified suitable areas should ultimately be verified through field surveys.

Conclusion. The MaxEnt modelling results showed that BIO19 and BIO3 were the major bioclimatic factors influencing the potential distribution of *Glycyrrhiza glabra* L. in Uzbekistan. Highly suitable habitats were mainly concentrated in oases, valleys, and foothill regions. For 2041–2060, the total potentially suitable area is projected to increase by 31.4% under SSP1-2.6 and 38.9% under SSP5-8.5 compared with the historical period, whereas the most highly suitable areas are expected to decrease by 4.5% and 19.8%, respectively. These findings provide a scientific basis for monitoring natural populations, identifying priority areas, and planning the conservation and sustainable management of *G. glabra*.

REFERENCES

1. Elith, J., & Leathwick, J. R. (2009). Species distribution models: ecological explanation and prediction across space and time. Annual review of ecology, evolution, and systematics, 40(1), 677-697.
2. Hasan, M. K., Ara, I., Mondal, M. S. A., & Kabir, Y. (2021). Phytochemistry, pharmacological activity, and potential health benefits of *Glycyrrhiza glabra*. Heliyon, 7(6).
3. Hayashi, H., Hattori, S., Inoue, K., Khodzhimatov, O., Ashurmetov, O., Ito, M., & Honda, G. (2003). Field survey of *Glycyrrhiza* plants in Central Asia (3). Chemical characterisation of *G. glabra* collected in Uzbekistan. Chemical and Pharmaceutical Bulletin, 51(11), 1338-1340.
4. Huang, S., Zhang, W., Hong, Z., Yuan, Y., Tan, Z., Wang, Y., ... & Chen, M. (2023). Geographic distribution and impacts of climate change on the suitable habitats of *Glycyrrhiza* species in China. Environmental Science and Pollution Research, 30(19), 55625-55634.
5. Khojimatov, O. K., & Bussmann, R. W. (2023). *Glycyrrhiza glabra* L., *Glycyrrhiza uralensis* Fisch. ex DC.-FABACEAE. In Ethnobiology of Uzbekistan: Ethnomedicinal Knowledge of Mountain Communities (pp. 393-402). Cham: Springer International Publishing.
6. Ma, F., Huang, X., Yang, Z., Niu, P., Pang, K., Wang, M., & Chu, G. (2025). Suitable habitat prediction and desertified landscape remediation potential of three medicinal *Glycyrrhiza* species in China. Scientific Reports, 15(1), 11198.
7. Pastorino, G., Cornara, L., Soares, S., Rodrigues, F., & Oliveira, M. B. P. (2018). Liquorice (*Glycyrrhiza glabra*): A phytochemical and pharmacological review. Phytotherapy Research, 32(12), 2323-2339.
8. Phillips, S. J., Anderson, R. P., & Schapire, R. E. (2006). Maximum entropy modelling of species geographic distributions. Ecological Modelling, 190(3-4), 231-259.

9. Sun, X., Qi, Y., Xue, Y., Ren, M., Zhang, L., & Ma, S. (2025). Prediction of the suitable distribution of two *Glycyrrhiza* species in Xinjiang based on the optimal MaxEnt model. Journal of Shihezi University (Natural Science), 43(6), 736–745.
10. Wahab, S., Annadurai, S., Abullais, S. S., Das, G., Ahmad, W., Ahmad, M. F., ... & Amir, M. (2021). *Glycyrrhiza glabra* (Liquorice): A comprehensive review on its phytochemistry, biological activities, clinical evidence and toxicology. Plants, 10(12), 2751.

TASHQI MUHIT YUQORI HARORATINING YURAK-QON TOMIR TIZIMI FAOLIYATIGA TA’SIRI: FIZIOLOGIK MOSLASHUV VA BIOLOGIK MONITORINGI

Xolmo’minova Lobar Alisher qizi

Samarqand davlat pedagogika instituti magistranti

E-mail:xolmominovalobar5@gmail.com

Annotatsiya. *Mazkur tezisda tashqi muhit yuqori haroratining yurak-qon tomir tizimi faoliyatiga ta’siri, organizmning termoregulyatsiya mexanizmlari va issiqlik stressiga fiziologik moslashuvi tahlil qilingan. Shuningdek, atrof-muhit ko‘rsatkichlari va yurak urish chastotasini kuzatish orqali biologik monitoringni tashkil etish, issiqlik stressining oldini olish hamda ekologik ta’lim jarayonida ushbu bilimlardan foydalanish imkoniyatlari yoritilgan.*

Kalit so‘zlar: *yuqori harorat, yurak-qon tomir tizimi, issiqlik stressi, termoregulyatsiya, yurak urish chastotasi, qon aylanishi, ekologik omillar, biologik monitoring.*

Abstract. *This thesis analyzes the effects of high ambient temperatures on the functioning of the cardiovascular system, the body's thermoregulatory mechanisms, and physiological adaptation to heat stress. It also explores the possibilities of organizing biological monitoring by observing environmental parameters and heart rate, preventing heat stress, and applying this knowledge in environmental education.*

Keywords: *high temperature, cardiovascular system, heat stress, thermoregulation, heart rate, blood circulation, environmental factors, biological monitoring.*

Iqlim o‘zgarishi va havo haroratining ko‘tarilishi inson salomatligiga ta’sir etuvchi muhim ekologik omillardan hisoblanadi. Ayniqsa, uzoq davom etadigan issiq davrlar organizmning fiziologik tizimlariga qo‘shimcha yuklama beradi. Jahon sog‘liqni saqlash tashkiloti ma’lumotlariga ko‘ra, haddan tashqari issiqlik yurak-qon tomir kasalliklari kabi mavjud surunkali kasalliklarni og‘irlashtirishi, organizmning issiqlikni boshqarish imkoniyatlarini susaytirishi mumkin [1]. Shu sababli yuqori haroratning biologik tizimlarga ta’sirini o‘rganish ekologiya, fiziologiya va aholi salomatligini muhofaza qilish bilan bevosita bog‘liqdir.

Inson organizmida tana haroratining nisbatan barqaror saqlanishi termoregulyatsiya mexanizmlari orqali ta’minlanadi. Tashqi muhit harorati ko‘tarilganda teri qon tomirlari kengayadi va ter bezlari faoliyati kuchayadi. Natijada qon oqimining teri orqali o‘tuvchi qismi ortib, organizmdan ortiqcha issiqlikning tashqariga chiqarilishi osonlashadi. Terning bug‘lanishi tana sovishining muhim mexanizmlaridan biridir. Biroq bu jarayonning samaradorligi havoning nisbiy namligi, shamol tezligi va atrof-muhit haroratiga bog‘liq [2].

Teri qon tomirlarining kengayishi yurak-qon tomir tizimi faoliyatiga ta’sir ko‘rsatadi. Yurak teri orqali qon aylanishini ta’minlash bilan birga boshqa a’zolarning qon bilan ta’minlanishini ham saqlab turishi kerak. Shu sababli yuqori harorat sharoitida yurak urish chastotasi ortishi mumkin. Kuchli terlash natijasida suyuqlik yo‘qotilishi esa aylanib yuruvchi qon hajmining kamayishiga olib kelishi mumkin. Bunday vaziyatda qon aylanishini barqaror saqlash qiyinlashib, bosh aylanishi, holsizlik va arterial bosimning pasayishi kabi belgilar yuzaga kelishi ehtimoli ortadi [2, 3].

Yuqori haroratning ta’siri faqat havo haroratiga bog‘liq emas. Havoning namligi, quyosh nurlanishi, shamol, kiyim turi, jismoniy faollik va insonning individual xususiyatlari ham organizmning issiqlik yuklamasini belgilaydi. Jismoniy mashqlar vaqtida mushaklar faoliyati natijasida qo‘shimcha issiqlik hosil bo‘ladi. Agar tashqi muhit issiq va nam bo‘lsa, terning bug‘lanishi sekinlashib, organizmning sovish jarayoni qiyinlashadi. Shu sababli issiq sharoitda jismoniy yuklamani insonning funksional holatiga moslashtirish muhimdir.

Yurak urish chastotasini kuzatish issiqlik sharoitida organizmning fiziologik javobini baholashga yordam beradigan usullardan biridir. Bunda atrof-muhit harorati va namligi bilan bir qatorda, yurak urish chastotasini tinch holatda hamda jismoniy faollikdan keyin qayd etish mumkin. Biroq yurak urish chastotasi jismoniy yuklama, ruhiy holat, suyuqlik iste’moli va boshqa omillarga ham bog‘liq. Shuning uchun ushbu ko‘rsatkichni yakka holda issiqlik stressining aniq mezoni sifatida qo‘llash mumkin emas. Uni muhit sharoitlari va insonning umumiy holati bilan birgalikda baholash lozim [2, 3].

Biologik monitoringni tashkil etishda havo harorati va namligini o‘lchash, yurak urish chastotasini kuzatish, jismoniy faollik darajasini qayd etish hamda issiqlik stressining tashqi belgilarini tahlil qilish muhim ahamiyatga ega. Ta’lim muassasalarida ushbu yondashuvdan foydalanish talabalarga ekologik omillarning inson fiziologiyasiga ta’sirini amaliy misollar orqali tushuntirish imkonini beradi. Jumladan, turli harorat sharoitlaridagi ko‘rsatkichlarni taqqoslash, issiqlik stressi xavf omillarini aniqlash va profilaktik choralarni muhokama qilish orqali ekologik hamda fiziologik savodxonlikni rivojlantirish mumkin.

Yuqori haroratning salbiy ta’sirini kamaytirish uchun kunning eng issiq vaqtlarida og‘ir jismoniy faoliyatni cheklash, salqin va soyali joylarda dam olish, suyuqlik yo‘qotilishini oldini olish, hamda yetarli shamollatish imkoniyatini yaratish tavsiya etiladi [1, 3]. Shahar hududlarida yashil maydonlar va daraxtzorlarni ko‘paytirish ham mahalliy mikroiqlimni yaxshilash va quyosh nurlanishining bevosita ta’sirini kamaytirishga yordam berishi mumkin. Bunday choralar iqlim o‘zgarishiga moslashish va aholi salomatligini muhofaza qilishga qaratilgan barqaror rivojlanish yondashuvlariga mos keladi.

Xulosa qilib aytganda, tashqi muhit yuqori harorati yurak-qon tomir tizimining funksional faoliyatiga ta’sir etuvchi muhim ekologik omildir. Organizmning issiqlikni chiqarish mexanizmlari faollashishi, terlash orqali suyuqlik yo‘qotilishi va yurak urish chastotasining o‘zgarishi issiqlik sharoitiga javob reaksiyalarining muhim tarkibiy qismlaridir. Atrof-muhit ko‘rsatkichlari va fiziologik belgilarni birgalikda monitoring qilish issiqlik stressi xavfini baholash, profilaktik choralarni rejalashtirish hamda ekologik ta’lim samaradorligini oshirishga xizmat qiladi. Mazkur tezis ilmiy adabiyotlar tahliliga asoslangan bo‘lib, unda mustaqil tajriba natijalari keltirilmagan.

FOYDALANILGAN ADABIYOTLAR

1. World Health Organization. *Heat and health*. 31 July 2026. https://www.who.int/en/news-room/fact-sheets/detail/climate-change-heat-and-health
2. Cramer M.N., Jay O. Biophysical aspects of human thermoregulation during heat stress // *Autonomic Neuroscience*. — 2016. — Vol. 196. — P. 3–13. https://doi.org/10.1016/j.autneu.2016.03.001
3. Jacklitsch B., Williams W.J., Musolin K., Coca A., Kim J.-H., Turner N. *Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments*. Cincinnati, OH: National Institute for Occupational Safety and Health, 2016. DHHS (NIOSH) Publication No. 2016-106. https://www.cdc.gov/niosh/docs/2016-106/

TOG‘ BIOTSENOZLARIDA O‘SUVCHI NAMATAK (*ROSA* SPP.) O‘SIMLIGI NEMATODAFAUNASINING BIOEKOLOGIK XUSUSIYATLARI

[1]Xakimov N.X., [1-2]Xo‘jamov Sh.

1-Sharof Rashidov nomidagi Samarqand davlat universiteti,

2-Samarqand davlat pedagogika instituti

Email: xujamovshaxboz479@gmail.com

Annotatsiya. *Maqolada 2023–2026-yillarda G‘arbiy Zarafshon tizmasi biotsenozlarida o‘sadigan na'matak (Rosa spp.) nematodafaunasining trofik-ekologik tuzilishi yoritilgan. Tadqiqot uchun na'matakning vegetativ a'zolari va rizosfera tuprog‘ining 0–15, 15–30 va 30–50 sm qatlamlaridan jami 460 ta namuna olinib, nematodalar Berman voronkasi usulida ajratildi. Natijada 56 tur nematoda aniqlanib, ular oltita ekologik guruhga bo‘lindi: politroflar (14 tur, 25,0%), ektoparazitlar (14 tur, 25,0%), endoparazitlar (9 tur, 16,1%), yirtqichlar (8 tur, 14,3%), bakteriotroflar (8 tur, 14,3%) va mikofaglar (3 tur, 5,4%). Fitoparazitlar 23 turni (41,1%), erkin yashovchi nematodalar 33 turni (58,9%) tashkil etdi. Erkin yashovchi guruhlarning ustunligi va barcha asosiy trofik bo‘g‘inlarning mavjudligi na'matak rizosferasida nematodalar jamoasi trofik jihatdan to‘liq shakllanganini ko‘rsatadi, fitoparazitlarning sezilarli ulushi esa ildiz tizimi uchun potensial xavf omili hisoblanadi.*

Kalit so‘zlar: *nematodofauna, fitonematodalar, trofik guruhlar, bioekologiya, rizosfera.*

Abstract. *The article highlights the trophic-ecological structure of the rosehip (Rosa spp.) nematode fauna growing in the biocenoses of the Western Zarafshan Range in 2023-2026. For the study, a total of 460 samples were taken from the 0–15, 15–30, and 30–50 cm layers of rosehip vegetative organs and rhizosphere soil, and nematodes were isolated using the Berman funnel method. As a result, 56 species of nematodes were identified, which are divided into six ecological groups: polytrophs (14 species, 25.0%), ectoparasites (14 species, 25.0%), endoparasites (9 species, 16.1%), predators (8 species, 14.3%), bacteriotrophs (8 species, 14.3%), and mycophagus (3 species, 5.4%). Phytoparasites accounted for 23 species (41.1%), while free-living nematodes accounted for 33 species (58.9%). The predominance of free-living groups and the presence of all major trophic links indicate that the nematode community in the rosehip rhizosphere is trophically fully formed, while a significant proportion of phytoparasites is a potential risk factor for the root system.*

Keywords*: nematode fauna, phytonematodes, trophic groups, bioecology, rhizosphere.*

Kirish;Nematodalar tuproq biotasining eng ko‘p sonli va turlarga boy hayvonlar guruhlaridan biridir [4]. Ular tuproqdagi organik moddalarning parchalanishida va mineral moddalar aylanishida ishtirok etib, mikroorganizmlar sonini tartibga soladi [6]. Nematodalarning ekologik vazifasi oziqlanish usuliga bog‘liq bo‘lgani uchun ular bakteriotroflar, mikofaglar, yirtqichlar, politroflar va o‘simlik parazitlari kabi trofik guruhlarga ajratib o‘rganiladi [5]. Tashqi omillar nematodalar jamoasining xilma-xilligi va tuzilishini o‘zgartirishi mumkin [2], shuning uchun guruhlarning o‘zaro nisbati tuproq biotasining holatini baholashda muhim ko‘rsatkich hisoblanadi.

Fitoparazit nematodalar o‘simlik ildiz to‘qimalarini shikastlab, uning o‘sishi va rivojlanishiga salbiy ta'sir ko‘rsatishi mumkin [8, 9]. Erkin yashovchi guruhlar esa organik moddalar aylanishida qatnashadi, yirtqich turlar boshqa nematodalar bilan oziqlanib, ularning sonini cheklashi mumkin [5, 6]. Shu bois fitoparazit va erkin yashovchi guruhlarning ulushini aniqlash o‘simlik rizosferasidagi ekologik holatni tushunish uchun zarur.

O‘zbekiston va Markaziy Osiyoda anor agrosenozlari [1], tog‘ massivlaridagi yovvoyi mevali o‘simliklar [7], yovvoyi dorivor o‘simliklar [10] hamda yovvoyi va madaniy subtropik mevali o‘simliklar [11] nematodalari o‘rganilgan. Na'matak (Rosa spp.) esa tog‘ yonbag‘irlarida tabiiy o‘sadigan, mevalari oziq-ovqat va dorivor maqsadlarda qo‘llaniladigan muhim buta o‘simlik bo‘lsada, uning nematodalar jamoasining trofik-ekologik tuzilishi G‘arbiy Zarafshon sharoitida yetarlicha o‘rganilmagan.

Material va usullar

Tadqiqotlar 2023–2026-yillarda G‘arbiy Zarafshon tog‘ tizmasining to‘rtta massivi: Qoratepa, Zirabuloq, Ziyovuddin va Chaqilkalon tog‘larida olib borildi. Tadqiqotning maqsadi nematodalarning ekologik guruhlari bo‘yicha tarqalishini o‘rganish bo‘lgani uchun, tog‘ mintaqasida keng tarqalgan buta o‘simliklardan na'matak (Rosa spp.) tanlab olindi. Namunalar mart–sentyabr oylarida marshrut metodida yig‘ildi. Jami 115 ta o‘simlikdan namuna olindi.

Dala sharoitida har bir o‘simlikdan tahlil uchun yosh ildizlar kovlab olindi, o‘simlik ildizi atrofidagi tuproqning 0–15, 15–30 va 30–50 sm qatlamlaridan taxminan 100 g dan namuna olindi. Natijada jami 460 ta namuna to‘plandi: 115 tasi o‘simlikning vegetativ a'zolaridan, 345 tasi tuproqdan (115 × 3 qatlam). Namunalar plastik idishlarda laboratoriyaga olib kelindi, u yerda o‘simlikning ildizi va yer ustki qismi alohida tekshirildi.

O‘simlik ildizi va yer ustki qismi o‘tkir pichoq yoki qaychi bilan 0,5–0,7 sm uzunlikda kesilib, har bir namunadan 10 g miqdorda olindi va nematodalar Bermanning voronkali metodida ajratildi. Tuproq namunalari yaxshilab aralashtirilib, ulardan 10 g dan olindi, nematodalar voronkali va flotatsion metodlar yordamida ajratildi. Ajratilgan nematodalar probirkalarda 5–6% li formalin eritmasida qotirildi. Nematodalarni identifikatsiya qilish uchun vaqtinchalik va doimiy mikroskopik

preparatlar tayyorlandi. Qotirilgan nematodalar Petri idishidan binokulyar mikroskop ostida entomologik nina yordamida soat oynasidagi toza suvga ko‘chirildi. Unga glitserin va 96% li spirtning 1:1 nisbatdagi aralashmasidan 1–2 tomchi tomizilib, 14–16 soat saqlandi. Bu vaqtda suv bug‘lanadi, glitserin esa nematoda tanasiga o‘tib, ichki organlarni mikroskopda ko‘rinadigan qiladi. Vaqtinchalik preparat uchun nematodalar buyum oynasidagi toza glitserin tomchisiga, doimiy preparat uchun glitserin-jelatin aralashmasiga o‘tkazildi.

Nematodalarni ajratish va sanashda SZM45NT-2L stereoskopik mikroskopidan, o‘rganishda BS-2048FT mikroskopidan foydalanildi. Tur aniqlashda nematodalarning tashqi va ichki tuzilishi, tana qismlari o‘rganildi va morfometrik tavsiflashda de Man indekslari (L, a, b, c, V) qo‘llanildi. Nematodalar oziqlanish usuliga ko‘ra trofik guruhlarga (bakteriotroflar, mikofaglar, yirtqichlar, politroflar, ektoparazitlar va endoparazitlar) Yeates va boshqalar (1993) [5] tasnifiga asosan ajratildi.

Olingan natijalar va ularning tahlili:

Nematodalarning ekologik guruhlar bo‘yicha taqsimlanishi

Na'matak ildizi va rizosferasidan 34 avlodga mansub 56 tur nematoda aniqlandi. Turlar oziqlanish usuliga ko‘ra oltita ekologik guruhga ajratildi (1-jadval, 1-rasm). Eng ko‘p tur politroflar (14 tur, 25,0%) va ektoparazitlar (14 tur, 25,0%) guruhlariga to‘g‘ri keldi. Ulardan keyin endoparazitlar (9 tur, 16,1%), yirtqichlar va bakteriotroflar (har biri 8 tur, 14,3%) turadi. Mikofaglar eng kam, 3 tur (5,4%) bilan ifodalangan (1-rasm).

Ekologik guruhlar birgalikda ko‘rilganda, fitoparazit guruhlar (ektoparazitlar va endoparazitlar) 23 turni (41,1%), erkin yashovchi guruhlar (politroflar, yirtqichlar, bakteriotroflar va mikofaglar) esa 33 turni (58,9%) tashkil etdi. Erkin yashovchi turlar fitoparazitlardan taxminan 1,4 marta ko‘p.

Fitoparazit guruhlar

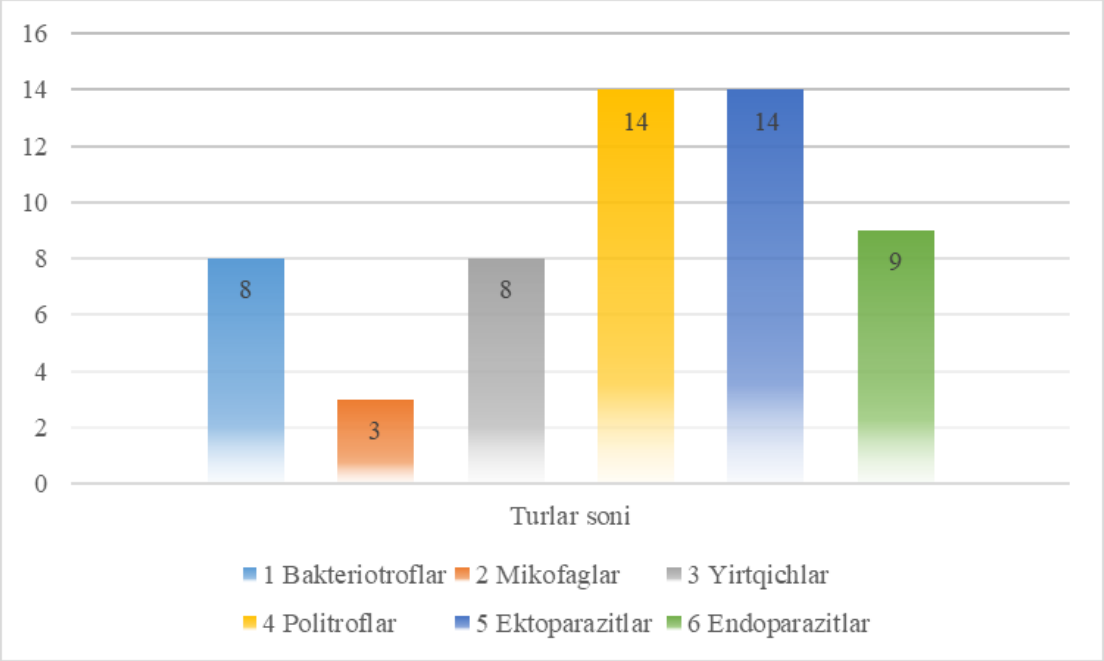
Fitoparazitlar na'matak nematodofaunasining 41,1% ini tashkil etib, ular orasida ektoparazitlar ustun (14 tur). Ektoparazitlar ildizni tashqaridan, ildiz hujayralariga stilet bilan kirib oziqlanadi, shuning uchun ularning ko‘pligi ildiz tizimining doimiy va surunkali shikastlanishi ehtimolini bildiradi [8, 9]. Bu guruhda Merlinius va Tylenchorhynchus avlodlari ko‘p turli, ular ildiz tizimining o‘sishini susaytirishi mumkin.

Endoparazitlar (9 tur) ildiz to‘qimalari ichida yashaydi. Ularning orasida Pratylenchus va Ditylenchus avlodlari ildiz to‘qimalarini shikastlashi bilan ajralib turadi [8, 9]. Ildiz epidermisi bilan bog‘liq Aglenchus, Tetylenchus va Boleodorus turlari ham shu guruhga kiritildi. Fitoparazit turlarning topilishi na'matakda zararlanish bo‘lganini isbotlamaydi, chunki bu uchun ularning zichligi va o‘simlikning holati bo‘yicha ma'lumot kerak.

Erkin yashovchi guruhlar

Erkin yashovchi guruhlar orasida politroflar (14 tur) va yirtqichlar (8 tur) birgalikda 22 turni (39,3%) tashkil etdi. Politroflar tuproqda turli ozuqa manbalaridan foydalanadi, yirtqichlar esa boshqa nematodalar va mayda tuproq jonivorlari bilan oziqlanadi. Bu guruhlarning ko‘pligi tuproq oziq zanjirining murakkab tuzilganini va muhitning nisbatan barqarorligini ko‘rsatishi mumkin. Buni isbotlash uchun Maturity Index kabi ko‘rsatkichlarni hisoblash zarur.

Yirtqich Mononchus, Clarkus va Coomansus turlari boshqa nematodalar bilan oziqlanib, fitoparazitlar sonini tabiiy ravishda cheklashi mumkin [5, 6]. Bakteriotroflar (8 tur; Acrobeles, Cephalobus, Panagrolaimus va boshqalar) organik moddalarning parchalanishida va mineral azotning aylanishida ishtirok etadi [6]. Mikofaglar (3 tur; Aphelenchus, Bursaphelenchus) tuproq zamburug‘lari bilan oziqlanib, ularning sonini tartibga soladi.



1-rasm. Na’matak o‘simligi nematodafaunasining trofo-ekologik tarkibi

Xulosa

Namatak nematodofaunasi trofik jihatdan to‘liq tuzilgan: barcha asosiy trofik bo‘g‘inlar mavjud. Fitoparazitlar ulushining yuqoriligi (41,1%) o‘simlik uchun potensial xavf mavjudligini ko‘rsatadi, ammo yirtqich va polixoz nematodalarning sezilarli ulushi tabiiy muvozanatni ushlab turuvchi omil bo‘lishi mumkin.

FOYDALANILGAN ADABIYOTLAR

1.Bekmuradov A.S. Surxondaryo viloyati anor agrosenozlari fitonematodalarining ekologik-fauistik tahlili va parazit turlariga qarshi integrallashgan kurash choralarini ishlab chiqish. Biologiya fanlari bo‘yicha falsafa doktori (PhD) dissertatsiyasi avtoreferati. Toshkent 2019. 3-21 bet.

2.Bloemers, G. F., Hodda, M., Lambshead, P.J.D., Lawton, J.H., Wanless, F.R. 1997. The effects of forest disturbance on diversity of tropical soil nematodes. Oecologia 111: 575- 582.

3.Cai R, Archidona-Yuste A, Cantalapiedra-Navarrete C, Palomares-Rius JE, Castillo P. 2020. New evidence of cryptic speciation in the family Longidoridae (Nematoda: Dorylaimida). J Zool Syst Evol Res 58 (4): 869-899. DOI: 10.1111/jzs.12393

4.Hodda M. Phylum Nematoda: a classification, catalogue and index of valid genera, with a census of valid species// Zootaxa, 5114 (1): 001–289.

5.Yeates GW, Bongers T, De Goede RG, Freckman DW, Georgieva SS. 1993. Feeding habits in soil nematode in families and genera-An outline for soil ecologists. J. Nematol 25 (3): 315-331.

6.Вайшер Б. и Д.Д.Ф.Браун “ Знакомство с Нематодами: Общая Нематология. ” Учебник для студенов . София-Москва 2001 г стр 40-57.

7.Камбаров С.С. и Хакимов Н.Х. Нематодафауна некоторых диких фруктовых растений в горном массиве Каратепа. «Российская наука в современном мире» XXX Международной научно-практической конференции. 2020. Стр. 25-29

8.Кирьянова Е.С., Кралль Э.Л. – Паразитические нематоды растений и меры борьбы с ними. т.2. Ленинград Изд-во «Наука» 1971.

9.Кралль Э.Л “Паразитические корневые нематоды” Семейство Hoplolaimidae. ленинград “Наука” 1978 г. Стр 44-64

10.Хакимов Н.Х,. Хамраева М.Д. Ёввойи доривор ўсимликларнинг паразит фитонематодалари ва уларнинг биоценотик хусусиятлари Гельминтологиянинг долзарб муаммолари. Республика илмий-амалий конференция материаллари. Термиз, 2014. – Б. 19-20.

11.Хуррамов Ш. Х., Бекмурадов А. С. Паразитические нематоды диких и культурных субтропических плодовых растений Средней Азии Российский паразитологический журнал. 2021. Т. 15. № 1. С. 98–102.

SHAXSNING RUHIY VA JISMONIY RIVOJLANISHIDA EKOLOGIYANING TA’SIRI

Zaripov Otabek Murodullayevich

Samarqand Davlat pedagogika instituti, Psixologiya kafedrasi dotsenti

+998939376334 otabekzaripov80gmail.com

Annotasiya. *Maqolada shaxsning ruhiy va jismoniy rivojlanishida ekologiyaning ta’siri,shaxs salomatligini muhofaza qilishda shaxslararo munosabatlarning o‘rni,shuningdek turli hayotiy sharoitlarda shaxsning o‘z salomatligiga munosabati bayon qilingan.*

Kalit so‘zlar*.Shaxs, jamiyat, salomatlik, salomatlik psixologiyasi, ruhiyat va salomatlik, jismoniy rivojlanish, jamiyatda shaxslararo munosabatlar, ota-ona, farzand, motivatsiya, qadriyat,mas’uliyat.*

Abstract*. The article discusses the impact of the environment on an individual's mental and physical development, the role of interpersonal relationships in safeguarding personal health, and how individuals perceive their own health under various life circumstances.*

Key words*. Individual, society, health, health psychology, psyche and health, physical development, interpersonal relationships in society, parent, child, motivation, value, responsibility.*

Shaxs salomatligida,uning ruhiy va jismoniy rivojlanishida ekologiyaning ta’siri nihoyatda muhim hisoblanadi. Ilmiy ahamiyati shu bilan belgilanadiki, insonning barcha bilimlari negizida tabiat va undagi turli jarayonlarni kuzatish,o‘rganish, tahlil etish va amaliy xulosalar qilish yotadi.Sog‘lomlashtirish ahamiyati deyilganda sof tabiiy unsurlar (musaffo havo, toza suv, unumdor tuproq, bahavo o‘rmon)ning va shifo beruvchi tabiiy modda va jarayonlarning inson salomatligiga ijobiy ta’siri tushuniladi. Bundan qariyb ming yil awwal yashab o‘tgan buyuk alloma Abu Ali ibn Sino «Odamlar salomatligi tashqi sharoit bilan chambarchas bog‘langan» deganda tabiatni aynan shu xususiyatini nazarda tutgan bo‘lishiga shubha qilmasa ham bo‘ladi.[4-6].Ruhiy salomatlik-shaxsning o‘z imkoniyatlarini ro‘yobga chiqarishi, turli hayotiy vaziyatlarda shaxslararo munosabatlarda stresslarga bardosh bera olishi, samarali mehnat qilishi, shuningdek, o‘z hissasini qo‘shishi mumkin bo‘lgan farovonlik holatidir. “Ruhiy salomatlik” tushunchasining mazmuni faqatgina tibbiy-psixologik mezonlar bilan cheklanmasdan,ekologik baraqarorlik nihoyatda muhim o‘rin egallaydi.

Shaxsning rivojlanishida ekologik omillar -shaxs atrofini o‘rab turgan va uning psixologik, biologik hamda ijtimoiy shakllanishiga ta’sir ko‘rsatadigan barcha tashqi muhit sharoitlaridir. Hozirgi zamon ekologiyasi - tabiat va jamiyatda kechadigan jarayonlarni inson omilini hisobga olgan holda o‘rganadigan fandir, deb ta’riflash mumkin.[5-18].Jahon psixologiyasida bu tushuncha ko‘pincha

Urie Bronfenbrennerning ekologik tizimlar nazariyasiga tayanadi, olim shaxs shakllanishini bir-biri ichiga joylashgan bir nechta atrof-muhit qatlamlari orqali tushuntiradi.

Shaxsning rivojlanishiga ta’sir etuvchi asosiy ekologik omillar quyidagilardir:

1. Mikrotizim (Bevosita muhit)

Shaxs kundalik hayotda doimiy aloqada bo‘ladigan eng yaqin ijtimoiy muhit. Bu qatlam bolalikdan boshlab shaxsning xulq-atvori va dunyoqarashini shakllantiradi:

• Oilada ota-onaning tarbiyasi: oiladagi emotsional ijtimoiy muhit, ota-onaning munosabat uslubi (demokratik, avtoritar yoki loqayd).

• Do‘stlar va tengdoshlarning ta’siri: shaxsning turli ijtimoiy rollarni o‘rganishi, bajara olishi,o‘z-o‘zini baholashi va guruhga moslashish qobiliyati.

• Maktabgacha va maktab ta’limi muassasalari: ustozlar bilan shaxslararo munosabatlar, o‘qish muhiti va ijtimoiy qadriyatlar.

2. Mezotizim (Muhitlararo aloqa)

Mikrotizimlar o‘rtasidagi o‘zaro munosabatlar va bog‘liqliklar shaxsning ruhiy va jismoniy shakllanishiga turlicha ta’sir ko‘rsatadi,o‘zaro aloqalar aloqalar uyg‘un bo‘lsa, shaxsning rivojlanishi ijobiy tarzda kechadi:

• Oila va maktabning hamkorligi: ota-onaning o‘qituvchilar jamoasi bilan doimiy muloqoti bolaning akademik va shaxsiy o‘sishiga bevosita ijobiy ta’sir ko‘rsatadi.

• Oila va do‘stlarning davrasi: ota-onaning bolaning do‘stlarini tanishi va ular bilan shaxslararo munosabati.

3. Ekzotizim (Bilvosta muhit)

Shaxsning o‘zi bevosita ishtirok etmaydi, biroq muhitdagi voqealar va qarorlar uning hayotiga o‘z ta’sirini ko‘rsatadi:

• Ota-onaning ish joyi: ota-onaning doimiy bandligi, charchog‘i yoki maoshi bola uchun ajratiladigan vaqt va moddiy imkoniyatlarni belgilaydi.

• Mahalla instituti va mahalliy infratuzilma: doimiy yashash joyida xavfsiz o‘yin maydonchalari, kutubxonalar yoki to‘garaklarning tashkil qilinganligi.

• OAV va ijtimoiy tarmoqlar: ijtimoiy tarmoqlr,axborot oqimi va jamiyatdagi trendlarning shaxs ongiga doimiy ta’siri.

4. Makrotizim (Keng qamrovli madaniy muhit)

Shaxs yashayotgan jamiyat umumiy qadriyatlari, qonunlari, mafkurasi va iqtisodiy holati:

• Madaniy qadriyatlar va urf-odatlar: individualizm (shaxsiy manfaat) yoki kollektivizm (guruh manfaati) ustun bo‘lgan madaniyatlar shaxs tipini turlicha shakllanishida o‘z ta’sirini ko‘rsatadi.

• Iqtisodiy va siyosiy barqarorlik: davlatdagi tinchlik, iqtisodiy farovonlik shaxsda kelajakka ishonch yoki doimiy xavotir hissini uyg‘otadi.

5. Tabiiy-geografik ekologik omillar

Shaxs yashaydigan jismoniy muhit va tabiat sharoitlari uning xarakteri va salomatligiga turlicha ta’sir ko‘rsatadi:

• Iqlim va ob-havo: issiq yoki sovuq iqlim insonlarning turmush tarzi, temperament va faollik darajasiga ta’sir ko‘rsatishi mumkin.

• Ekologik holat: ob-havo, suv va tabiatning turli darajadagi o‘zgarishlari shaxsning salomatligiga, jismoniy rivojlanishga va faoliyat sifatiga salbiy ta’sir etadi.

Dunyo olimlarining tadqiqot natijalariga asoslanib shuni alohida ta’kidlash lozimki, ruhiy salomatlik va sog‘lom turmush tarzini umri davomida ta’minlashi uchun shaxs quyidagi tavsiyalarga doimiy amal qilishi zarur hisoblanadi:

- to‘g‘ri ovqatlanish, shaxs kundalik iste’mol qilinadigan oziq-ovqatlarini organizmning fiziologik, biologik talablari asosida tanlashi va iste’mol qilishi zarur hisoblanadi.

- shaxs doimo harakatda bo‘lishi kundalik turmush tarzida jismoniy mashqlar, sport o‘yinlari, badanni chiniqtiruvchi muolajalar bilan ko‘proq shug‘ullanishi natijasida, organizmdagi fiziologik, biologik jarayonlar ijobiy faollashadi. Natijada,shaxs ruhiyatida ijobiy o‘zgarishlar kuzatiladi.

-Shaxs ruhiy salomatligini taminlashda kun tartibi hamda ishni to‘g‘ri tashkil qilishning ahamiyati katta hisoblanadi. Shaxs organizmidagi faollik darajasi kunduzi ortadi, kechasi susayadi. Shuning uchun ham ish kuni, dam olish vaqti to‘g‘ri rejalashtirilgan bo‘lishi zarur hisoblanadi.

- Tana va ruhiyatda osoyishtalikni ta’minlanishiga asosiy e’tibor qaratish. Shaxsning tanasi va ichki a’zolar faoliyati asab tizimiga bevosita daxldor hisoblanadi. Ularning me’yoriy faoliyati ruhiy holatlar, shaxs xarakter xususiyatlarini belgilaydi. Shaxs stressga tushmasdan doimiy ravishda pozitiv fikrlab, negativ fikrlardan yiroq bo‘lishi salomatligini saqlashda va mustahkamlashda asosiy o‘rinni egallaydi.

- Shaxsnini o‘z irodasini boshqara olmasdan ichkilikbozlik, kashandalik, giyohvandlik singari zararli odatlarga ruju qo‘yishi ruhiy va jismoniy salomatligiga jiddiy salbiy ta’sir ko‘rsatadi, natijada sog‘lig‘i va kelajagini o‘ylamaydigan zaif odamlarga aylanib qoladi.

-Shaxsning ozodalik va pokizalikka doimiy ravishda rioya qilishi, atrof-muhitga munosabati ijobiy bo‘lishi zarur,chunki kundalik hayoti asnosida shaxslar atrof-muhitga ma’lum darajada ta’sir ko‘rsatadi.

Demak, shaxsning ruhiy salomatligi atrof muhit, ijtimoiy institutlar va insonning o‘z individual xususiyarlari bilan bevosita bog‘liq. O‘zbekiston Respublikasida aholining salomatligini mustahkamlashga alohida e’tibor qaratilmoqda, xususan, O‘zbekiston Respublikasi prezidenti

Sh.M.Mirziyoyevning 2020-yil 31-oktyabrda “Sog‘lom turmush tarzini keng tadbiq etish va ommaviy sportni yanada rivojlantirish chora-tadbirlari to‘g‘risida” gi farmoni qabul qilingan. Mamlakatda jismoniy tarbiya va ommaviy sport bilan muntazam shug‘ullanish hamda aholi orasida ommaviy sport bilan doimiy shug‘ullanish, to‘g‘ri ovqatlanish tamoillariga rioya qilish, bir so‘z bilan aytganda kundalik hayotimizda sog‘lom turmush tarzining o‘rni beqiyos ekanligi farmon bandlarida alohida ta’kidlangan va ijrosi muntazam ta’minlanmoqda.

Mehnatdagi faollik shaxslararo munosabatlar taraqqiyotiga ijobiy ta’sir qiladi. Bu haqda davlatimiz rahbari Sh.M.Mirziyoyev quyidagi fikrlarni bayon etdilar: “Qanchalik qiyin bo‘lmasin, biz yoshlar tarbiyasi bo‘yicha o‘zimizga xos va ta’sirchan, bugungi kunga hamohang usullarni izlab topishimiz kerak”.

Mamlakatimizda so‘nggi yillarda shaxs salomatligini muhofaza qilishga,hududlarni obodonlashtirish,shaxsning farovon yashashi uchun ekologik muhitni yanada yaxshilashga alohida e’tibor qaratilmoqda.Xususan, “Yashil makon” umummilliy loyihasini amalga oshirishda mahallalar rolini kuchaytirish va hududlarning yashillik darajasini tubdan oshirishga doir chora-tadbirlar to‘g‘risida”gi Prezident Farmoni (PF–206-сон, 23.09.2026 й.) qabul qilindi.

FOYDALANILGAN ADABIYOTLAR.

1.E.G‘G‘oziyev.Ontogenez psixologiyasi.T.2010.

2.V.M.Karimova.Ijtimoiy psixologiya. T.2002.

3.Internet ma’lumotlari.

4.P.S.Sultonov.Ekologiya va atrof-muhitni muhofaza qilish asoslari.T.2007.6-bet.

5. P.S.Sultonov.Ekologiya va atrof-muhitni muhofaza qilish asoslari.T.2007.18-bet.

ZABRUS MORIO MORFOMETRIK KO‘RSATKICHLARINING BALANDLIK GRADIYENTI BO‘YLAB O‘ZGARISHI.

Zokirova Dilnoza Fazlitdin qizi

Samarqand davlat pedagogika instituti o‘qituvchisi

Tel:+998933211153 **e-mail:** dilnozazokirova1153@gmail.com

Annotatsiya: *Tadqiqot davomida Zabrus morio turi morfometrik ko‘rsatkichlari tahlil qilindi va solishtirildi. Tadqiqot natijalarining ilmiy ahamiyati ushbu turda morfometrik qo‘rsatkichlar kompleks tahlil qilinib, ularning variasiyasi, tana qismlari orasidagi korrelyasiya darajalari, morfometrik o‘zgaruvchanlikning geografik gradiyentga bog‘liqlik qonuniyatlari ochib berilganligi bilan izohlanadi.*

Abstract: *During the study, the morphometric characteristics of the species Zabrus morio were analyzed and compared. The scientific significance of the research findings lies in the comprehensive analysis of morphometric parameters in this species, revealing patterns of their variation, the degree of correlation between body parts, and the relationships between morphometric variability and geographical gradients.*

Kalit so‘zlar: *Zabrus morio, balandlik zonalari, morfometrik ko‘rsatkichlar, variatsiya koeffitsiyenti, tendensiya, fenotipik plastiklik, ekologik adaptatsiya.*

Turli balandlik zonalarida tarqalgan *Zabrus morio* populyasiyalarining morfometrik ko‘rsatkichlari tahlili shuni ko‘rsatadiki, tadqiq etilgan belgilarning aksariyati bo‘yicha A (700-1200 m) va B (1200-1800 m) guruhlar o‘rtasida o‘rtacha qiymatlar jihatidan katta farq kuzatilmaydi (1-jadval). Biroq, belgilarning variasiya darajasi va minimal-maksimal chegaralari tahlili orqali populyasiyalar o‘rtasida muayyan ekologik farqlar mavjud ekanligi aniqlanadi.

Avvalo, bosh qismiga oid morfometrik ko‘rsatkichlar tahlil qilinganda, bosh yeni har ikki guruhda deyarli bir xil o‘rtacha qiymatga ega (3,2 mm), ammo variatsiya koeffisiyenti A guruhda (7,0%) B guruhga nisbatan (5,3%) yuqoriroq ekanligi qayd etildi. Bu holat pastroq balandliklarda tarqalgan populyasiyalarda morfologik o‘zgaruvchanlik yuqoriroq ekanligini, yuqori balandliklarda esa populyasiya nisbatan barqaror morfologik tuzilishga ega ekanligini ko‘rsatadi.

Xuddi shunday tendensiya bosh uzunligida ham kuzatiladi: A guruhda variasiya koeffisiyenti 10,5% ni tashkil etsa, B guruhda 9,9% ga teng. Bu esa bosh qismi morfologiyasi tashqi muhit omillariga ma’lum darajada sezgir ekanligini ko‘rsatadi. Ko‘zlar orasi masofasi parametrida o‘rtacha qiymatlar mutlaqo bir xil (2,6 mm) bo‘lishiga qaramasdan, variasiya darajasi A guruhda (6,7%) B guruhga (4,8%) nisbatan yuqori ekanligi kuzatiladi.

1-jadval

Turli balandlikda tarqalgan *Zabrus morio* qo‘ng‘izlarining morfometrik ko‘rsatkichlari (A guruh 700-1200 m, B guruh 1200-1800 m) (n=100).

Tana qismi	Guruh	Max,	Min,	O‘rtacha arif., M	Variatsiya koef., Cv, %
Bosh eni	A	3,6	2,5	3,2±0,22	7,0%
	B	3,5	2,8	3,2±0,17	5,3%
Bosh uzunligi	A	4,3	2,1	3,3±0,35	10,5%
	B	4	2,7	3,2±0,32	9,9%
Ko‘zlar masofasi	A	2,9	2,1	2,6±0,18	6,7%

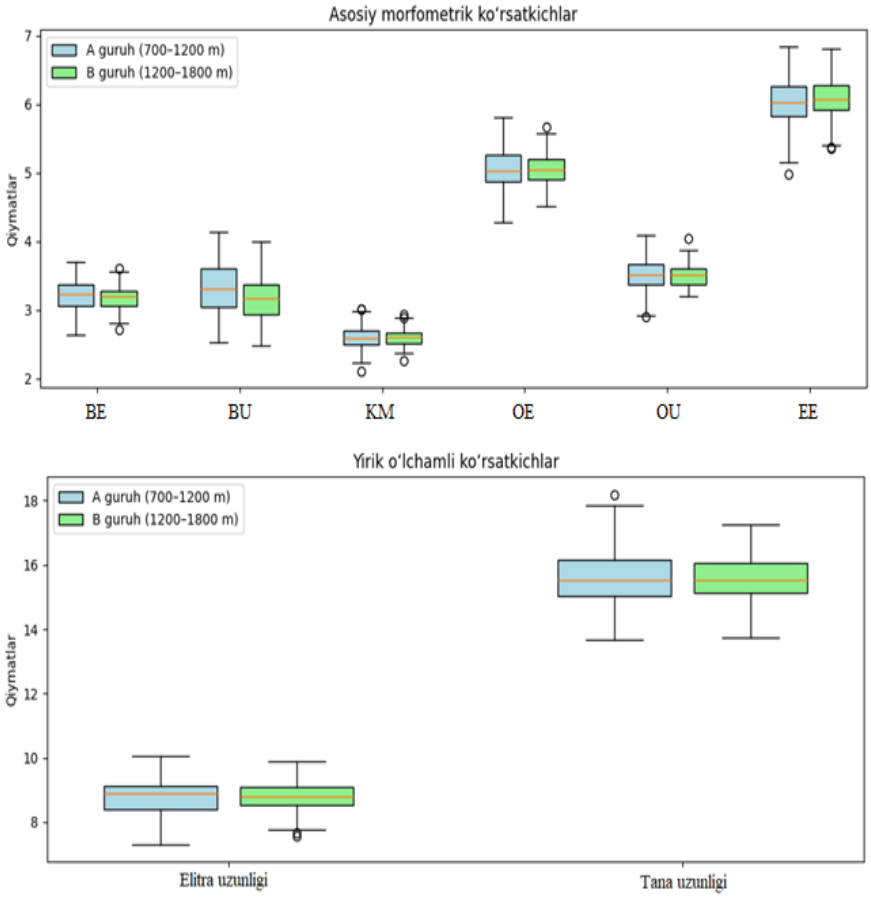
	B	2,8	2,4	2,6±0,13	4,8%
Oldko‘krak eni	A	5,6	4,2	5,1±0,31	6,2%
	B	5,5	4,6	5,0±0,24	4,8%
Oldko‘krak uzunligi	A	3,8	2,9	3,5±0,22	6,4%
	B	3,8	3,3	3,5±0,17	4,8%
Elitra eni	A	7,1	5,2	6,1±0,37	6,0%
	B	6,6	5,4	6,0±0,32	5,2%
Elitra uzunligi	A	9,8	7,1	8,8±0,54	6,2%
	B	9,5	7,9	8,8±0,41	4,7%
Tana uzunligi	A	17,9	12,7	15,6±0,98	6,3%
	B	16,9	13,9	15,5±0,69	4,5%

Bu holat ko‘rish apparati bilan bog‘liq morfologik belgilar ham ekologik omillar ta’sirida o‘zgarishi mumkinligini, biroq bu o‘zgarishlar asosan variatsiya darajasida namoyon bo‘lishini ko‘rsatadi.

Oldko‘krak qismiga oid ko‘rsatkichlar tahlili ham shunga o‘xshash natijalarni berdi. Oldko‘krak eni va uzunligi bo‘yicha o‘rtacha qiymatlar A va B guruhlarda deyarli farq qilmaydi (mos ravishda 5,1-5,0 mm va 3,5 mm), ammo variatsiya koeffisiyenti yana A guruhda yuqoriroq (6,2-6,4%), B guruhda esa pastroq (4,8%). Bu holat yuqori balandliklardagi muhit sharoitlari nisbatan barqaror yoki qattiq selektiv bosimga ega bo‘lib, morfologik belgilarning tarqalishini cheklashini anglatadi.

Elitra (qanot qoplamlari) parametrlari ham shunga o‘xshash qonuniyatni namoyon etadi. Elitra eni va uzunligi bo‘yicha o‘rtacha qiymatlar A va B guruhlarda deyarli bir xil bo‘lishiga qaramasdan (6,1-6,0 mm va 8,8 mm), variatsiya koeffitsiyenti A guruhda (6,0-6,2%) B guruhga (5,2-4,7%) nisbatan yuqori. Bu holat elitra morfologiyasi ham tashqi muhit omillariga ma’lum darajada moslashishini, ammo bu moslashish asosan populyasiya ichidagi variatsiya orqali amalga oshishini ko‘rsatadi.

Tana uzunligi kabi integral ko‘rsatkichda ham shu tendensiya saqlanib qoladi: o‘rtacha qiymatlar deyarli teng (15,6 va 15,5 mm), ammo variatsiya koeffitsiyenti A guruhda 6,3%, B guruhda esa 4,5% ni tashkil etadi. Shu bilan birga, minimal va maksimal qiymatlar diapazoni ham A guruhda kengroq (12,7-17,9 mm), B guruhda esa nisbatan tor (13,9-16,9 mm). Bu holat past balandliklarda individual farqlar ko‘proq namoyon bo‘lishini, yuqori balandliklarda esa populyatsiya “siqilgan” morfologik diapazonga ega ekanligini ko‘rsatadi.



1-rasm. Turli balandlikda tarqalgan *Zabrus morio* qo‘ng‘izlarining morfometrik ko‘rsatkichlari qiyosiy ko‘rinishi.

Umuman olganda, olingan natijalar shuni ko‘rsatadiki, balandlik gradiyenti *Zabrus morio* turida morfologik o‘rtacha qiymatlarga kuchli ta’sir ko‘rsatmaydi, ya’ni turning asosiy morfometrik parametrlari nisbatan konservativ hisoblanadi. Biroq, variatsiya koeffitsiyenti va diapazon ko‘rsatkichlari orqali qaralganda, balandlik omili populyasiya ichidagi morfologik o‘zgaruvchanlikka sezilarli ta’sir ko‘rsatadi (1-rasm).

Bu holatni ekologik nuqtai nazardan quyidagicha izohlash mumkin. Past balandlik zonalarida muhit sharoitlari (temperatura, namlik, ozuqa bazasi) nisbatan turli-tuman va o‘zgaruvchan bo‘lgani sababli populyatsiyalarda fenotipik plastiklik yuqori bo‘ladi. Bu esa morfometrik belgilarning keng variatsiyasiga olib keladi. Aksincha, yuqori balandliklarda muhit sharoitlari ko‘proq ekstremal va barqaror bo‘lib, kuchli selektiv bosim ta’sirida faqat muayyan morfologik tiplar saqlanib qoladi. Natijada populyasiyada variatsiya kamayadi va morfologik belgilar bir xillashadi. Shu tariqa, tadqiqot natijalari morfometrik belgilarning ikki xil xususiyatini namoyon qiladi: bir tomondan, ularning o‘rtacha qiymatlari barqaror (konservativ), ikkinchi tomondan esa ularning variatsiya darajasi ekologik omillarga, xususan, balandlikka bog‘liq holda o‘zgaradi. Bu esa Zabrus morio turida fenotipik plastiklik va ekologik adaptatsiya mexanizmlari

mavjud ekanligini ko‘rsatadi. Balandlik gradiyentining o‘zgarishi bilan yashash muhitining ekologik xususiyatlari ham o‘zgaradi. Bu o‘zgarishlar *Zabrus morio* qo‘ng‘izlarining turli jins vakillariga turlicha ta’sir etishi mumkin.

Xulosa. Shunday qilib, *Zabrus morio* turining morfometrik ko‘rsatkichlarini kompleks tahlil qilish natijasida quyidagi ilmiy xulosalarni chiqarish mumkin:

1. Tadqiq etilgan barcha morfometrik belgilar nisbatan tor diapazonda o‘zgarishi va variasiya koeffitsientlarining past (5,8-10,2%) bo‘lishi ushbu tur populyasiyasida morfologik barqarorlik yuqori darajada ekanligini ko‘rsatdi.

2. Morfometriyada asosiy tana qismlari - bosh, oldko‘krak va elitra parametrlari o‘rtasida kuchli musbat korrelyasiyalar aniqlanib, bu holat Zabrus morio da morfologik integrasiya va proporsional o‘sish (allometriya) yaxshi rivojlanganligini tasdiqladi.

3. Umumiy tana uzunligi (TU) deyarli barcha belgilar bilan yuqori korrelyasiyaga ega bo‘lib, ayniqsa elitra va oldko‘krak o‘lchamlari bilan bog‘liqligi yuqori ekani aniqlandi. Bu esa TU ni integral morfometrik ko‘rsatkich sifatida tavsiflash imkonini beradi.

4. Bosh uzunligi (BU) boshqa belgilarga nisbatan eng yuqori variasiya koeffitsientiga (10,2%) ega bo‘lib, korrelyasion tahlilda ham nisbatan past bog‘liqlikni namoyon qildi. Bu holat ushbu belgining nisbatan mustaqil va yuqori plastik morfologik parametr ekanligini ko‘rsatadi.

5. Bosh komponentlar tahlili (PCA) natijalariga ko‘ra, birinchi komponent (PC1 = 76,9%) tananing umumiy o‘lchamini ifodalab, asosiy morfometrik belgilarning barchasi o‘zaro kuchli bog‘langanligini tasdiqladi. Ikkinchi komponent (PC2 = 8,6%) esa, asosan, bosh uzunligi (BU) bilan bog‘liq bo‘lib, uning umumiy o‘lchamdan nisbatan mustaqil ekanligini ko‘rsatdi.

6. PCA biplot diagrammasida namunalarning uzluksiz taqsimlanishi populyasiyada aniq morfotiplar yoki klasterlar mavjud emasligini ko‘rsatdi.

7. Elitra parametrlari (EE va EU) hamda oldko‘krak o‘lchamlari eng barqaror belgilar sifatida namoyon bo‘lib, ularda stabillashtiruvchi tanlanish ta’siri yuqori bo‘lishi mumkinligi ko‘rsatadi.

8. Olingan natijalar *Zabrus morio* turida morfologik tuzilishning yuqori darajada integrasiyalashganligini, biroq ayrim belgilar, xususan bosh uzunligi, funksional va ehtimoliy adaptiv ahamiyatga ega holda mustaqil ravishda o‘zgarishini ko‘rsatdi.

FOYDALANILGAN ADABIYOTLAR RO‘YHATI:

1. Khalimov F. Composition and structure of the fauna of ground beetles (Coleoptera, Carabidae) of the Zerafshan Range // *Acta Biologica Sibirica*. – 2023. – Vol. 9. – P. 113–125. – DOI: 10.5281/zenodo.7725474.

2. Saimova R. U., Batyrova K. I., Bekenova N. A., Kauynbaeva E., Esimov B. K. Ground beetles (Coleoptera: Carabidae) in different agroecosystems of Southeast Kazakhstan // *SABRAO Journal of Breeding and Genetics*. – 2022. – Vol. 54, No. 2. – P. 458–468.

3. Sukhodolskaya R. A. Morphometric variability and population structure of ground beetles (Coleoptera, Carabidae) in different environmental conditions // *ZooKeys*. – 2021. – Vol. 1044. – P. 95–114.

4. Sukhodolskaya R. A., Luzyanin S. L., Teofilova T. M., Langraf V., Ukhova N. L., Avtaeva T. A., et al. Geographic gradients in a functional trait: variation of body size and size diversity in ground beetle *Poecilus cupreus* (Linnaeus, 1758) (Coleoptera, Carabidae) // *Acta Biologica Sibirica*. – 2025. – Vol. 11. – P. 449–462.

5. Sukhodolskaya R. A., Saveliev A. A. Effects of ecological factors on size-related traits in the ground beetle *Carabus granulatus* L. (Coleoptera, Carabidae) // *Russian Journal of Ecology*. – 2014. – Vol. 45, No. 5. – P. 414–420.

6. Talarico F. Sex-specific phenotypic plasticity in ground beetles (Coleoptera: Carabidae) under environmental variation // *Ecological Entomology*. – 2023. – Vol. 48, No. 3. – P. 412–425.

OG‘IR METALLAR INTOKSIKATSIYASINI KORREKSIYALASHDA BIOFAOL MODDALARDAN FOYDALANISH

[1]Shakarova Sh.A., [2]Tojikulova O.J., [1]Abdullayeva G.T

[1]Islom Karimov nomidagi Toshkent davlat texnika Universiteti, Toshkent, O’zbekiston

[2]Sharof Rashidov nomidagi Samarqand davlat universiteti, Samarqand, O’zbekiston

shakarovashahnoza2@gmail.com

Tel: +99899 092 81 26

Annotatsiya. *Ushbu tadqiqot ishida og‘ir metallarning kalamushlar jigar mitoxondriyasiga toksik ta’siri va ular keltirib chiqaradigan o‘zgarishlarni biofaol moddalar yordamida korreksiyalash imkoniyatlari yoritiladi. Tadqiqot ishida og’ir metal tuzlaridan qo’rgoshin nitrat*

tuzining kalamushlar jigar mitoxondriyasiga ta’sirini biologik faol moddalar bilan korreksiyalash o’rganildi. Qo‘rg‘oshin tuzlari jigar mitoxondriyasiga shikastlovchi ta’sir qilib, uning ichki membranasini K^+, Na^+, va H^+ kationlari passiv o‘tkazuvchanligini oshirganligini ko‘rsatdi. Bu sharoitda protopin alkaloidi bilan davolash, kationlarning mitoxondriya ichki membranasidan o‘tkazuvchanligini susaytirib, mitoxondriya membranasi stabilligini oshiradi.

Kalit so‘zlar: *og‘ir metallar, intoksikatsiya, biofaol moddalar, mitoxondriya, K^+, Na^+, va H^+ kationlari.*

Abstract. *This study examines the toxic effects of heavy metals on rat liver mitochondria, as well as the potential for using bioactive substances to correct the alterations they induce. Specifically, the research investigates the use of bioactive substances to mitigate the impact of lead nitrate—a heavy metal salt—on rat liver mitochondria. It was found that lead salts exert a damaging effect on liver mitochondria, increasing the passive permeability of the inner mitochondrial membrane to K^+, Na^+, and H^+ cations. Under these conditions, treatment with the alkaloid protopine reduces the permeability of the inner mitochondrial membrane to these cations, thereby enhancing the stability of the mitochondrial membrane.*

Keywords: *heavy metals, intoxication, bioactive substances, mitochondria, K^+, Na^+, and H^+ cations.*

Mitoxondriya ichki membranasida joylashgan turli xil ion kanallari va ion transport tizimlari hujayra ichki qismida signal uzatilishi, hujayraning funksiyasi va nobud bo‘lishi jarayonlarida muhim o‘rin tutadi [1]. Ushbu ion-transport tizimlarini hujayra funksiyasida roli muhimligi tufayli ularni boshqarilish mexanizmlarini tadqiq qilish dolzarbdir. Mitoxondriya ion-transport tizimlari turli xil biologik faol moddalar, dorivor vositalar va ksenobiotiklar uchun «nishon» hisoblanadi [2]. Shunga bog‘liq holda, mitoxondriya ion-transport tizimlarining funksiyasi hamda ularning regulyatsiya mexanizmlarini o‘rganishga katta qiziqish bilan qaraladi [3].

Og‘ir metallarning organizmga zaharli ta’sir mexanizmlarini molekulyar darajada o‘rganish, bevosita, toksikantlar ta’sirida yuzaga keluvchi surunkali kasalliklarning oldini olish va davolashda antioksidantlar, membranani barqarorlashtiruvchi, hamda mitoxondriya funksional faolligini yaxshilovchi modulyatorlar ta’sir mexanizmlarini ilmiy asoslash imkonini beradi [4;5]. Bu esa tibbiyotda davolashning yangi tizimlarini ishlab chiqishga yordam beradi. Yuqoridagilarga muvofiq ravishda, ushbu ishda *in vivo* sharoitida qo‘rg‘oshin tuzlari bilan zaharlangan kalamush jigari mitoxondriyalari membranalari passiv o‘tkazuvchanligiga protopin alkaloidining korreksiyalovchi ta’siri o‘rganildi.

Mitoxondriya faol birikmalar ta’siriga juda sezgir organoid bo‘lib, bu mitoxondriyalarning ichki membranalari uchun xarakterlidir. Uning bunday hususiyati normal va patologik xolatlarda

mitoxondriya membranalaridagi yuzaga keladigan o‘zgarishlarni, hamda aniq ionning ichki membrana orqali o‘tishini har xil tuzli muhitlarda, o‘rganish uchun qulay test-sistema hisoblanadi. Bu, turli biologik faol birikmalarning organizmga ta’sir mexanizmlarini chuqur o‘rganish imkonini beradi. Tadqiqotlarda normal, qo‘rg‘oshin bilan zaharlangan va protopin yordamida davolangan kalamushlar jigari mitoxondriyasi ichki membranasi passiv o‘tkazuvchanligini o‘rganish uchun, bir qator kationlarning nitrat tuzlari (NH_4NO_3, KNO_3, $NaNO_3$) eritmalari qo‘llanildi.

Dastlabki tadqiqotlarda, barcha nitratli muhitlarda, nazorat guruhiga nisbatan qo‘rg‘oshin tuzlari bilan zaharlangan kalamush jigari mitoxondriyalari ichki membranalari passiv o‘tkazuvchanligining oshganligi aniqlandi. Bu sharoitda nazorat guruhiga mos ravishda tajriba guruhi hayvonlari mitoxondriya membranasi o‘tkazuvchanligi KNO_3 muhitda 52±4,6% ga, $NaNO_3$ muhitda 26±0,9% ga, NH_4NO_3 muhitda 10±0,9% ga oshib bordi. Tadqiqot natijalari, qo‘rg‘oshin tuzlari jigar mitoxondriyasiga shikastlovchi ta’sir qilib, uning ichki membranasini K^+, Na^+, va H^+ kationlari passiv o‘tkazuvchanligini oshirganligini ko‘rsatdi. Tadqiqotlarimizda qo‘rg‘oshin bilan zaharlangan kalamushlar jigari mitoxondriyalari membranalari o‘tkazuvchanligiga protopin alkaloidining korreksiyalovchi ta’siri o‘rganildi. Davolash guruhi hayvonlari jigar mitoxondriya membranasi o‘tkazuvchanligini tajriba guruhi hayvonlari ko‘rsatkichlariga taqqoslangan holda statistik qayta ishlandi. Tadqiqotlarda, tajriba guruhi hayvonlariga nisbatan davolash guruhi hayvonlari jigar mitoxondriya membranasi o‘tkazuvchanligi, KNO_3 muhitda, 47,4±0,73% ga ingibirlandi. Bu ko‘rsatkich $NaNO_3$ muhitda 37,2±1,8% ni, NH_4NO_3 muhitda 21,9±1,4% ni tashkil qildi. Demak, protopin alkaloidi qo‘rg‘oshin bilan zaharlangan kalamush jigari mitoxondriya membranalariga korreksiyalovchi ta’sir qilib, mitoxondriya ichki membranasini K^+, Na^+ va H^+ kationlari o‘tkazuvchanligini susaytiradi.

Olingan natijalar asosida xulosa qilishimiz mumkin, qo‘rg‘oshin tuzlari kalamush jigari mitoxondriyalari ichki membranasi passiv o‘tkazuvchanligiga ta’sir qilib, mitoxondriya ichki membranasining bir valentli kationlar K^+, Na^+ va H^+ lar o‘tkazuvchanligini oshiradi. Bu sharoitda protopin alkaloidi bilan davolash, kationlarning mitoxondriya ichki membranasidan o‘tkazuvchanligini susaytirib, mitoxondriya membranasi stabilligini oshiradi. Tadqiqot natijalaridan, turli toksik moddalar ta’sirida gepatotsit hujayralarining shikastlanish mexanizmlarini chuqur o‘rganishda, hamda protopin alkaloidi asosida, yangi gepatoprotektor dorivor vositalarini yaratishda foydalanish mumkin.

FOYDALANILGAN ADABIYOTLAR:

1. Shin-Young Ryu, Pablo M. Peixoto, Oscar Teijido, Laurent M. Dejean, Kathleen W. Kinnally. Role of mitochondrial ion channels in cell death // BioFactors.-2010.- V. 36 (4).- P. 255-263.

2. Abramov, A.Y., Duchen M.R. Actions of ionomycin, 4-BrA23187 and a novel electrogenic Ca2+ ionophore on mitochondria in intact cells. // Cell Calcium. – Edinburgh.- 2003. -V.33. -№2. – P.101-112.

3. Salvi M., Fiore C., Battaglia V., Palermo M., Armanini D., Toninello A. Carbenoxolone induces oxidative stress in liver mitochondria, which is responsible for transition pore opening // Endocrinology. – 2005. – V.146(5). – P.2306-2312.

4. Корбакова А.И., Соркина Н.С., Молодкина Н.Н. и др. Свинец и его действие на организм // Медицина труда и промышленная экология. – 2001.- №5. – С. 29-34.

5. Belyaeva E.A. Mitochondrial respiratory chain inhibitors modulate the metalinduced inner mitochondrial membrane permeabilization // Acta. Biochim. Pol.- 2010.-V.57.- P . 435-441.

URBANIZATION ACTS AS AN ENVIRONMENTAL FILTER RESHAPING SOIL NEMATODE TRAITS, FUNCTIONAL DIVERSITY, AND FOOD-WEB STRUCTURE

Shahid Afzal[1,2], Arash Noshadi[3]

[1]Nematode Biodiversity Research Lab, Department of Zoology, Aligarh Muslim University, Aligarh 202002, India

[2]Department of Biology, Samarkand Pedagogical Institute, 166 Spitamen St., Samarkand, 140102, Uzbekistan, Samarkand, Uzbekistan , 140102

[3] Division of Biotechnology, Department of Agronomy and Plant Breeding, College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran

Abstract

Urbanization profoundly alters terrestrial ecosystems, yet its specific impacts on belowground biodiversity and the stability of complex soil food webs remain poorly understood. To address this knowledge gap, we investigated soil nematode communities—highly sensitive bioindicators of ecosystem health—along an urbanisation gradient to evaluate how anthropogenic pressures affect belowground abundance, functional diversity, and overall ecosystem maturity. Soil samples were collected across a four-stage urbanisation gradient (ranging from Natural to Urban

Core habitats) in Aligarh, India, to assess nematode community composition alongside key environmental variables such as NDVI and impervious surface cover. In addition to traditional taxonomic and trait-based metrics, we developed and validated a novel, machine-learning-derived Nematode Anthropogenic Stress Index (NASI) to quantitatively link soil food web degradation with physical urban stressors. Our results revealed a significant decline in total nematode abundance and a structural shift towards opportunistic, disturbance-tolerant taxa along the urbanisation gradient, driven primarily by the expansion of impervious surfaces and loss of vegetation. Furthermore, the progressive deterioration of the Nematode Soil Health (NSH) index was mirrored by our newly developed NASI, which highlighted extreme functional divergence and escalating ecological stress in the urban core. Ultimately, this study demonstrates that physical urban development triggers a destructive ecological cascade belowground, emphasising the critical value of trait-based and machine-learning-weighted biotic indices for accurately assessing and monitoring soil health in rapidly urbanising landscapes.

III-SHU’BA.
BIOTEXNOLOGIYA VA BIOMEDITSINANING YANGI ISTIQBOLLARI

BIOLOGICALLY ACTIVE PLANT COMPOUNDS AS PROMISING ANTITUMOR AGENTS: KEGG-BASED ANALYSIS OF MOLECULAR MECHANISMS OF BERBERIS HETEROPODA SCHRENK AND JUNIPERUS COMMUNIS L.

Assan Gulmira Kudaibergenkyzy, Zhumash Akzhunis Sagatbekkyzy, Ablaikhanova Nurzhanyat Tatukhanovna

Al-Farabi Kazakh National University, Almaty, Kazakhstan

E-mail: gulmiraasan28@gmail.com Tel.: +77078166256

Abstract: *The search for novel anticancer agents with high biological efficacy and acceptable selectivity remains an important task in modern biomedicine. Medicinal plants are valuable sources of chemically diverse compounds capable of modulating multiple cellular targets. This study analyzes potential molecular mechanisms underlying the antitumor activity of Berberis heteropoda Schrenk and Juniperus communis L. using published evidence and KEGG-oriented interpretation of signaling pathways. B. heteropoda has a rich phytochemical profile comprising anthocyanins, phenolic compounds, and alkaloids; major fruit anthocyanins include delphinidin-, cyanidin-, petunidin-, peonidin-, and malvidin-3-O-glucosides. For J. communis, experimental studies have demonstrated extract-induced cytotoxicity in colorectal adenocarcinoma cells, cell-cycle arrest, and activation of extrinsic and intrinsic apoptotic pathways. KEGG provides a framework for integrating genes, proteins, and cellular signaling pathways. PI3K/Akt/mTOR, p53, MAPK, and apoptosis are among the most relevant pathways for further validation. These findings support comprehensive investigation of plant extracts in tumor and normal cell models, including cytotoxicity, apoptosis, oxidative stress, mitochondrial function, and DNA damage.*

Keywords: *Berberis heteropoda Schrenk, Juniperus communis L., KEGG, cytotoxicity, apoptosis, PI3K/Akt, p53, plant-derived compounds.*

INTRODUCTION

The development of novel anticancer agents requires compounds capable of preferentially affecting tumor cells while overcoming cellular resistance. Tumor progression involves dysregulation of proliferation, cell cycle, metabolism, DNA repair, and programmed cell death. Therefore, analysis of interconnected signaling networks is important for understanding tumor-cell survival.

Natural products are important sources of potential anticancer compounds because of their chemical diversity and ability to influence multiple molecular processes. Of particular interest are compounds that alter survival and apoptotic signaling, induce oxidative stress, disturb mitochondrial function, or affect cell-cycle regulation.

Berberis heteropoda Schrenk is notable for its diverse phytochemical composition. Major anthocyanins identified in its fruits include delphinidin-3-O-glucopyranoside, cyanidin-3-O-glucopyranoside, petunidin-3-O-glucopyranoside, peonidin-3-O-glucopyranoside, and malvidin-3-O-glucopyranoside [1, p. 19078–19096]. A separate study identified phenolic, flavonoid, and anthocyanin components, with 32 polyphenolic compounds detected by UPLC-Q-TOF-MSE [2, p. e0262622].

Juniperus communis L. is also characterized by a broad spectrum of biologically active constituents. Lai et al. reported that J. communis extract showed cytotoxic activity against colorectal adenocarcinoma cells, induced G0/G1 cell-cycle arrest, and activated extrinsic and intrinsic apoptotic pathways [3, p. e10891].

MATERIALS AND METHODS

The study was based on a structured analysis of scientific publications available in PubMed and indexed in international bibliographic databases. Particular attention was given to studies addressing the phytochemical composition of Berberis heteropoda Schrenk and Juniperus communis L., the biological activity of their extracts and individual compounds, cytotoxicity, apoptosis, cell-cycle regulation, oxidative stress, mitochondrial dysfunction, DNA damage, and molecular mechanisms involved in tumor development.

The available evidence was comparatively evaluated to identify the major biologically relevant compounds and molecular processes associated with the potential antitumor activity of the selected plants. Special emphasis was placed on studies investigating p53, PI3K/Akt/mTOR, MAPK, apoptosis, and related regulatory pathways.

A KEGG-oriented approach was used for functional interpretation of potential molecular mechanisms. KEGG integrates genomic information with higher-order functional information, while its PATHWAY database provides representations of cellular processes, including signal transduction and the cell cycle [4, p. 27–30]. The identified molecular targets and biological processes were conceptually mapped to relevant KEGG pathways to determine their possible relationships with tumor-cell proliferation, survival, oxidative stress, DNA damage, and apoptosis.

In addition, the literature data were used to formulate a working molecular model for subsequent experimental validation. The proposed mechanisms include ROS accumulation, mitochondrial dysfunction, modulation of the Bax/Bcl-2 balance, activation of caspases, PARP

cleavage, and regulation of PI3K/Akt/mTOR and p53 signaling. KEGG analysis was therefore used to organize and interpret literature-derived molecular targets rather than as a substitute for experimental validation.

RESULTS AND DISCUSSION

The phytochemical profile of Berberis heteropoda Schrenk is characterized by diverse biologically active compounds. Major anthocyanins have been identified in the fruits, together with pronounced antioxidant activity of the anthocyanin fraction [1, p. 19078–19096]. Further analysis revealed a broad spectrum of polyphenolic compounds [2, p. e0262622]. These findings provide a basis for further investigation of the plant’s potential anticancer activity.

For Juniperus communis L., direct experimental evidence of anticancer potential is available. The extract reduced colorectal adenocarcinoma cell viability, induced cell-cycle arrest, and promoted apoptosis through interconnected p53/p21, Bax/Bcl-2/caspase, and Fas/FasL/caspase signaling cascades [3, p. e10891]. Tumor-growth suppression was also observed in a xenograft model, supporting further molecular investigation.

KEGG-oriented interpretation integrates these mechanisms into a common signaling framework. Key nodes include PI3K/Akt/mTOR, p53, MAPK, and apoptosis, which regulate proliferation, survival, cell-cycle progression, and programmed cell death. A proposed sequence is disruption of redox homeostasis → increased ROS → mitochondrial dysfunction → altered Bax/Bcl-2 balance → caspase activation → PARP cleavage → apoptosis, accompanied by modulation of PI3K/Akt/mTOR and p53 signaling. This model represents a working hypothesis requiring experimental validation [5, p. 1233].

Further research should compare 30%, 50%, and 70% aqueous ethanol extracts of B. heteropoda and J. communis using HT-29, HCT-116, MCF-7, MDA-MB-231, and Raji tumor models together with appropriate normal-cell models. Cytotoxicity and selectivity may be assessed by MTT/IC_{50}, while cell-death mechanisms may be investigated using Annexin V/PI, DCFH-DA, JC-1, γ-H2AX, and Western blotting for p53, Bax, Bcl-2, caspase-3/9, and PARP. Additional assessment of ATM/ATR, CHK1/CHK2, and PI3K/Akt/mTOR may link DNA damage and replication stress with apoptotic signaling.

CONCLUSION

Berberis heteropoda Schrenk and Juniperus communis L. are promising sources of biologically active plant compounds with potential anticancer properties. The phytochemical potential of B. heteropoda is supported by identified anthocyanins and diverse polyphenols, whereas J. communis has experimental evidence of cytotoxicity, cell-cycle arrest, and apoptosis in colorectal adenocarcinoma models. KEGG-oriented integration highlights PI3K/Akt/mTOR, p53, MAPK, and

apoptosis as priority pathways for experimental validation. Combining MTT, flow cytometry, ROS and mitochondrial assays, γ-H2AX, and Western blotting may facilitate elucidation of molecular mechanisms underlying selective tumor-cell death.

REFERENCES

1. Sun L.-L., Gao W., Zhang M.-M., Li C., Wang A.-G., Su Y.-L., Ji T.-F. Composition and antioxidant activity of the anthocyanins of the fruit of Berberis heteropoda Schrenk. Molecules. 2014;19(11):19078–19096. MDPI, Basel, Switzerland. DOI: 10.3390/molecules191119078. PubMed PMID: 25415473.

2. Sun J., Li Q., Li J., Liu J., Xu F. Nutritional composition and antioxidant properties of the fruit of Berberis heteropoda Schrenk. PLoS ONE. 2022;17(4):e0262622. Public Library of Science, San Francisco, USA. DOI: 10.1371/journal.pone.0262622. PubMed PMID: 35390002.

3. Lai W.-L., Lee S.-C., Chang K.-F., Huang X.-F., Li C.-Y., Lee C.-J., Wu C.-Y., Hsu H.-J., Tsai N.-M. Juniperus communis extract induces cell cycle arrest and apoptosis of colorectal adenocarcinoma in vitro and in vivo. Brazilian Journal of Medical and Biological Research. 2021;54(10):e10891. Associação Brasileira de Divulgação Científica, São Paulo, Brazil. DOI: 10.1590/1414-431X2020e10891. PubMed PMID: 34287579.

4. Kanehisa M., Goto S. KEGG: Kyoto Encyclopedia of Genes and Genomes. Nucleic Acids Research. 2000;28(1):27–30. Oxford University Press, Oxford, UK. DOI: 10.1093/nar/28.1.27. PubMed PMID: 10592173.

5. Ablaikhanova N., Assan G., Kurbannazarova R., et al. Plant-Derived Natural Products and Selective Apoptosis: A Cancer-Cell Vulnerability-State Framework from Redox Imbalance to Membrane–Ion Dysregulation. Pharmaceuticals. 2026;19(8):1233. DOI: 10.3390/ph19081233.

ПЕРСПЕКТИВЫ ПРИМЕНЕНИЯ ЭКСТРАКТОВ ПОЛИСЦИАСА ДЛЯ БЛОКИРОВКИ СВОБОДНЫХ РАДИКАЛОВ

Грицук Д.П. преподаватель кафедры биологических и химических технологий БрГУ имени А.С. Пушкина, Брест, Республика Беларусь, магистр биологических наук, +375(29)7946430, fdpliru@gmail.com.

Аннотация: *в статье рассматривается проблема негативного влияния свободных радикалов на биологические системы организма животных и человека, которая остро стоит перед современными направлениями биологических наук — генетикой, биотехнологией и биохимией. Автор описывает двойственную природу свободных радикалов: их нормальные физиологические функции и деструктивную роль при запуске*

неконтролируемых цепных реакций, вызванных неблагоприятными внешними факторами. Подробно освещаются механизмы возникновения мутационных и тератогенных эффектов, приводящие к изменению генетического кода, нарушению структуры белков и разрушению клеточных мембран. Особое внимание уделено патологическим последствиям окислительного стресса, включая развитие онкологических (лейкемия) и кардиологических (атеросклероз, инфаркт, инсульт) заболеваний вследствие иммунного ответа на клеточные аномалии.

Ключевые слова: *свободные радикалы, мутагенез, тератогенный эффект, биологические системы, окислительный стресс, генетический код, структура белков, иммунная система, онкологические заболевания, сердечно-сосудистые патологии.*

В современных отраслях биологических наук, как и в других естественно-научных дисциплинах, связанных с улучшением качества жизни и здоровья человека, в последние годы назрел ряд проблем, решение которых позволит изменить в лучшую сторону функционирование различных биологических систем, в том числе организма животных и человека. На данный момент в таких науках, как генетика, биотехнология и биохимия остро стоят вопросы о мутационных и тератогенных эффектах, о процессах, которые их вызывают, и веществах, способных предотвратить их негативные последствия.

Одними из веществ, которые провоцируют нарушения в естественных химико-биологических процессах организма, являются свободные радикалы. Они могут быть представлены в виде атомов, ионов или молекул, содержащих на внешней электронной оболочке один или несколько неспаренных электронов, вследствие чего являются высокоактивными и неустойчивыми образованиями.

Свободные радикалы, так же, как и другие важные соединения, генерируемые в организме, в норме выполняют определенные физиологические функции: участвуют в синтезе ряда биологических регуляторов, контролируют процесс сокращения стенок сосудов, стимулируют естественную запрограммированную гибель клеток. Но, если начинается цепная реакция с участием свободных радикалов, которая может быть спровоцирована вредным внешним воздействием (ультрафиолетовое и радиационное облучение, проживание в экологически неблагополучной местности, богатая жирами пища), начинается процесс их неконтролируемого размножения, в результате которого могут измениться информационные связи, что ведет к изменению генетического кода и, как следствие, нарушению структуры белков [5].

Иммунная система, контролирующая подобные мутации, распознает их как аномалию и старается уничтожить. Результатом этого являются онкологические заболевания, в том числе

лейкемия, а также нарушения работы сердца: атеросклероз, инфаркт, инсульт. Образующиеся в большом количестве свободные радикалы разрушают клеточные мембраны, служащие своеобразной защитой клеток, что приводит к накоплению жидкости в организме, следствием чего является старение. Кроме того, меняется и уровень содержания кальция, что также провоцирует нарушения жизнедеятельности.

Однако в природе существуют особые вещества – антиоксиданты, которые способны помогать живому организму в борьбе с отрицательными последствиями воздействия свободных радикалов. Антиоксиданты связывают свободные радикалы за счет наличия неспаренных электронов и блокируют их.

Как правило, антиоксиданты накапливаются в растительных организмах в надземной вегетативной массе и/или в подземных органах (клубных, корневищах, корнеплодах). Выявление данного факта дало возможность изобретения биологически активных добавок для улучшения качества жизни и здоровья человека. За долгие годы исследований в растениях было обнаружено около 5000 соединений с антиоксидантными свойствами и широким спектром целебного воздействия. Они обладают сосудорасширяющими, противоопухолевыми, противовоспалительными, бактерицидными, иммуностимулирующими и противоаллергическими свойствами [2].

Антиоксиданты, обнаруженные в растениях, являются полифенолами. Многие травяные добавки, такие как: сибирский женьшень (*Eleutherococcus senticosus* L.*)* (адаптогенные свойства), гингко билоба *(Ginkgo biloba* Juss.*)* (стимулятор умственной деятельности), чертополох морской *(Carduus marinus* L.*)* (повышает резистентность гепатоцитов), куркума длинная *(Curcuma longa* L.*)* (оказывает противовоспалительное действие) и черника *(Vaccinium myrtillus* Juss.*)* (благотворное влияние на зрение и ревматоидный артрит) – омимо своих основных свойств, являются еще и антиоксидантами. В травяных экстрактах биоактивные ингредиенты освобождены от клеточных стенок – за счет этого они легче усваиваются организмом. Чтобы добавка давала максимальный эффект, она должна содержать строго стандартизированное количество биоактивных веществ. Например, сибирский женьшень – 0,5% элеутерозида Е, гингко билоба – 24% флавокгликозидов, морской чертополох – 80% силимарина, куркума длинная – как минимум 80% куркуминоидов, черника – 25% антоцианидинов. Необходимо выбирать только такие травяные добавки, в которых точно соблюдены все эти показатели, в противном случае антиоксидантный эффект будет не выражен [3].

Объектом наших исследований был выбран малоизвестный род растений Полисциас (*Polyscias* L.), который относится к семейству Аралиевых (*Araliacaea*), как и род Женьшень

(*Panax sp.*), и, исходя из немногочисленных доступных данных, также обладает свойствами антиоксидантной и антирадикальной активности [2]. Предметом исследования послужили листья полисциаса кустарникового (*Polyscias fruticosa* L.), образцы которого имели общее происхождение и генетическую структуру.

Для получения суммарного экстракта определенную навеску сухого порошка растительного сырья, предварительно растертого с небольшим количеством экстрагента, дважды экстрагировали 70% (по объему) этанолом и настаивали в течение 7 дней. Далее полученный экстракт подвергали исследованию. Определение антиоксидантной активности экстракта полисциаса проводили с использованием модельных систем с катион-радикалами АБТС (2,2-азинобис-3-этилбензотиазолин-6-сульфонат) и FRAP (от англ. Ferric Reducing Antioxidant Power – железо-восстанавливающая антиоксидантная мощность).

Раствор $АБТС^{\bullet+}$ готовили реакцией 5 мл $7 \cdot 10^{-3}$ М водного раствора АБТС и 88 мкл $140 \cdot 10^{-3}$ М водного раствора $K_2S_2O_8$ и выдерживали 16 часов без доступа света при температуре +4°С. Перед анализом исходный раствор катион-радикала диспергировали водой до значения абсорбции до значения абсорбции 0,70±0,005 при λ=734 нм. При проведении анализа к 3 мл рабочего раствора $АБТС^{\bullet+}$ добавляли 100 мкл экстракта. Изменение оптической плотности (A_E) смеси регистрировали в течение 10 минут с использованием спектрофотометра (Proscan MC 122) при λ=734 нм и длине пути светового монохромного луча в 1 см. Контрольное измерение оптической плотности (A_B) проводили при тех же условиях, но в качестве образца использовали дистиллированную воду. Степень ингибирования катион-радикала $АБТС^{\bullet+}$ вычисляли по формуле:

$$\% \text{ ингибирования} = [(A_B - A_E) / A_B] \times 100,$$

где A_B – оптическая плотность контроля; A_E – изменение оптической плотности смеси после инкубирования.

Как стандарт использовали тролокс (6-гидрокси-2,5,7,8-тетраметилхроман-2-карбоновая кислота) – гидрофильный аналог токоферола, обладающий антиоксидантным действием. Для построения калибровочной кривой применяли эффективный диапазон концентраций тролокса от 10 до 600 мкмоль/л. Антиоксидантную активность исследуемых листьев выражали в милимоль тролокс-эквивалента в пересчете на литр экстракта, учитывая линейную зависимость параметра стандарта от его концентрации.

В свою очередь метод FRAP позволяет оценить антиоксидантную активность непосредственно в пробе за счет восстановления в кислой среде бесцветного Fe (III)-трипиридилтриазина синего цвета [2]. Рабочий реактив FRAP готовили непосредственно перед анализом из ацетатного буфера, 0,01М раствора 2,4,6-три(2-пиридил)-S-триазина и

0,02M раствора $FeCl_3$ в пропорции 10:1:1 по объему. Для проведения испытания брали 0,4 мл образца, стандарта (раствор $FeSO_4$) или контроля (ацетатный буфер) и добавляли 3 мл рабочего реактива FRAP. Инкубировали 30 минут при температуре $+37^{O}C$. Измерение оптической плотности анализируемой смеси регистрировали при λ=593 нм. Для построения калибровочной кривой использовали эффективный диапазон концентраций $FeSO_4$ от 0,234 до 1,875 ммоль/л. Антиоксидантную активность выражали миллимоль Fe^{+2} на литр экстракта (ммоль Fe^{+2}/л).

Исходя из всех полученных данных, нами было установлено, что показатель антиоксидантной активности исследуемых нами экстрактов полисциаса курчавого составил 0,401±0,032 ммоль ТЭ/л при степени ингибирования катион-радикала $АБТС^{\bullet+}$ равной 76,3±5,86%. Антиоксидантную активность по методу FRAP составила 0,542±0,009 ммоль Fe^{+2}/л.

Заключение. Таким образом, общепринятые методики АБТС и FRAP пригодны для определения биохимических параметров экстрактов, в частности для измерения антиоксидантной активности их компонентов.

Полученные результаты говорят о высокой антиоксидантной активности экстрактов листьев полисциаса, если сравнивать их с показателями АОА экстрактов листьев женьшеня обыкновенного, который является признанным высокоэффективным ингибитором свободных радикалов [4]. Поэтому дальнейшие исследования в этой области могут привести к получению в будущем высокоактивных фармацевтических компонентов, предотвращающих разрушающее и пагубное действие свободных радикалов на различные биологические системы, в том числе на организм человека.

СПИСОК ИСПОЛЬЗОВАННОЙ ЛИТЕРАТУРЫ

1. Кочкин, Д.В., Носов, А.М. Качественный и количественный состав тритерпеновых гликозидов культур клеток in vitro представителей семейства Araliaceae (Panax spp., Polyscias spp.) / Д.В. Кочкин, А.М. Носов // Биология растительных клеток in vitro и биотехнология: мат. междунар. науч. конф., Казань, 14-16 октября 2013. – С. 45-46.

2. Кузьмина, Н.С. Количественное определение гликопептидов в препаратах *Panax ginseng* и *Polyscias fillicifola* (Araliaceae) / Н.С. Кузьмина, Л.И. Слепян, А.Л. Марченко // Растительные ресурсы. – 2008. – Т. 44. – С. 140-149.

3. Шутова, А.Г. Антирадикальная активность листьев женьшеня / А.Г. Шутова [и др.] // Роль ботанических садов и дендрариев в сохранении, изучении и устойчивом использовании разнообразия растительного мира: мат. Междунар. науч. конф., Минск, 6–8 июня 2017. – Минск : Медиосонт, 2017. – С. 157–161.

4. Benzie, I.F.F. The ferric reducing ability of plasma (FRAP) as a measure of «antioxidant power»: the FRAP assay / I.F.F. Benzie, J.J. Strain // J. Anal. Biochem. – 1996. – № 239. – P. 70–76.

5. Wang, H.W. Ginseng leaf-stem: Bioactive constituents and pharmacological functions / H.W. Wang, D.C. Peng, J.T. Xie // Chin. Med. – 2009. – Vol. 4. – P. 1–8.

ANALYSIS OF THE ANTICANCER POTENTIAL OF BIOACTIVE COMPOUNDS ASSOCIATED WITH BERBERIS HETEROPODA SCHRENK

Zhumash Akzhunis Sagatbekkyzy, Asan Gulmira Kudaibergenkyzy,

Ablaikhanova Nurzhanyat Tatukhanova

Al-Farabi Kazakh National University, Almaty, Kazakhstan

akzhunis.sagatbekovna@gmail.com, gulmiraasan28@gmail.com

Tel.: +77765314366

Abstract:*The high prevalence of cancer and the challenges of its treatment highlight the need for new anticancer compounds. Berberine, an isoquinoline alkaloid found in certain Berberis species, has demonstrated potential anticancer activity in experimental models of breast, lung, gastric, liver, colorectal, ovarian, cervical, and prostate cancers. Its proposed mechanisms include inhibition of cell proliferation, induction of apoptosis, regulation of the cell cycle and autophagy, and suppression of tumor cell migration and invasion. Research has also examined its interactions with anticancer drugs and the gut microbiota, as well as strategies to improve its bioavailability. This article reviews the anticancer mechanisms of berberine and their relevance to the potential biological activity of Berberis heteropoda Schrenk.*

Keywords: *Berberis heteropoda Schrenk, berberine, cancer, bioactive compounds, apoptosis, autophagy, gut microbiota, bioavailability.*

Cancer comprises diseases characterized by uncontrolled cell proliferation and the disruption of normal mechanisms regulating cell growth and survival. Approximately 10 million people die from cancer annually, and the global burden is expected to increase as populations grow and age [1]. These trends emphasize the importance of developing new approaches to cancer prevention and treatment.

Surgery, radiotherapy, and pharmacological treatment remain the principal approaches in oncology. However, drug resistance, recurrence, and metastasis continue to complicate treatment. Consequently, natural bioactive compounds have become an important subject of pharmacological

research because some can influence cellular signaling pathways, metabolic processes, and mechanisms of cell death.

Berberine is a plant-derived alkaloid investigated for its anti-inflammatory, antimicrobial, metabolic, and potential anticancer effects. Research has focused particularly on its influence on cancer cell proliferation, apoptosis, autophagy, and signaling pathways associated with tumor progression. Understanding these mechanisms may help identify promising directions for further drug development.

Effects of Berberine on Different Types of Cancer

The anticancer potential of berberine has been investigated in several cancer models, with findings varying according to tumor type, cell characteristics, and experimental conditions.

Breast cancer. Studies using breast cancer cell lines, including MDA-MB-468 and MDA-MB-231, have examined the effects of berberine on proliferation, cell-cycle progression, and apoptosis. Reported mechanisms include modulation of the AMPK–p53 signaling pathway and changes in the expression of inflammatory mediators such as TNF-α, IL-1β, and IL-6. The effects of berberine on metadherin expression and its potential interactions with other anticancer agents have also been investigated [2].

Lung cancer. In non-small cell lung cancer models, berberine has been associated with reduced cell viability and colony formation. Investigated molecular targets include MMP-2, Bcl-2, Bax, JAK2, VEGF, and NF-κB, as well as the Akt/CREB signaling axis. Experimental studies have also assessed combinations with tyrosine kinase inhibitors such as icotinib and gefitinib, focusing on apoptosis, migration, and invasion [3].

Gastric cancer. Research has examined the effects of berberine on cell proliferation and cell-cycle regulation through pathways involving MAPK, EGFR, STAT3, and PI3K/Akt/mTOR. Its influence on autophagy and potential interactions with cisplatin have also been investigated. Since autophagy may promote either cell survival or cell death, its activation must be interpreted in the context of the specific tumor model [4].

Liver cancer. Investigations have focused on cellular metabolism, glutamine transport, and mitochondrial function. Particular attention has been given to SLC1A5, a transporter involved in cellular glutamine uptake. Some experimental findings associate berberine exposure with increased reactive oxygen species, changes in mitochondrial membrane potential, and apoptosis. Its potential interaction with sorafenib has also been explored [5].

Colorectal cancer. Studies have examined the effects of berberine on cell-cycle regulators, including cyclin D1, p21, and p27, as well as the Wnt/β-catenin pathway, telomerase activity, and lipid metabolism. Another research direction concerns gut microbiota, whose involvement in bile

acid metabolism, intestinal barrier function, and inflammatory processes may influence the intestinal environment associated with colorectal carcinogenesis [6].

Prostate cancer. Research has focused on androgen receptor signaling, cell-cycle progression, and apoptosis. The AKR1C3 enzyme, which participates in androgen biosynthesis, and the EGFR pathway have also been investigated, alongside potential effects on cell migration, invasion, and radiosensitivity [7].

Overall, experimental studies indicate that berberine may influence several processes involved in tumor development. Nevertheless, findings from cell cultures and animal models do not establish its clinical effectiveness in cancer treatment.

Mechanisms Underlying the Potential Anticancer Effects of Berberine

Several interconnected cellular mechanisms have been proposed to explain the effects of berberine observed in experimental cancer models.

Inhibition of cell proliferation. Cancer cells frequently exhibit dysregulated growth signaling and cell-cycle control. Berberine has been investigated for its effects on PI3K/Akt, MAPK, and Wnt/β-catenin pathways, as well as cyclins and cyclin-dependent kinases. Changes in these regulatory systems may contribute to cell-cycle arrest and reduced proliferation [8].

Induction of apoptosis. Apoptosis is a programmed process that eliminates damaged or unnecessary cells. Research has examined the involvement of AMPK–p53 and PI3K/Akt/mTOR signaling, mitochondrial membrane potential, cytochrome c release, and caspase activation in berberine-associated cell death. The contribution of each mechanism may differ among cancer models.

Modulation of autophagy. Berberine-associated changes in mTOR, Akt, MAPK, and JNK/Beclin1 signaling have been studied in relation to autophagy. Because this process can support cellular survival under stress or contribute to cell death, its biological significance depends on the experimental context.

Suppression of migration and invasion. Tumor progression involves interactions with the extracellular matrix and changes in cellular adhesion and phenotype. Investigations have therefore examined the effects of berberine on MMP-2, u-PA, and epithelial–mesenchymal transition markers. These findings provide insight into cellular behavior but do not demonstrate that berberine prevents metastasis in humans.

Interactions with anticancer agents. Combinations of berberine with drugs such as cisplatin, 5-fluorouracil, icotinib, and gefitinib have been investigated in experimental models. Some studies have reported changes in cellular sensitivity or apoptosis. These observations warrant

further research into drug interactions, toxicity, and therapeutic relevance rather than unsupervised combined use [9].

Bioavailability and Safety of Berberine

The pharmacological application of berberine is limited by its relatively low oral bioavailability and physicochemical properties. To address these challenges, researchers have investigated lipid-based nanoparticles, micelles, organosilicate nanomaterials, and selenium nanoparticles as potential delivery systems.

These approaches aim to improve solubility, stability, absorption, or delivery to target tissues. Their effectiveness and safety, however, must be established individually, as improvements observed under experimental conditions do not necessarily translate into clinical benefits.

Berberine may also cause adverse effects, particularly gastrointestinal symptoms such as nausea and constipation. Its potential interactions with medications, appropriate dosage, and safety in different patient populations require consideration. It should not be regarded as a substitute for established anticancer treatment.

Conclusion

The literature indicates that berberine has potential anticancer effects in experimental models of breast, lung, liver, colorectal, and other cancers, including the inhibition of tumor cell proliferation, induction of apoptosis, and modulation of metastatic processes. However, its low bioavailability and limited clinical evidence remain important considerations when evaluating its therapeutic applications. In this context, the bioactive compounds found in *Berberis heteropoda* Schrenk represent a potential source of natural substances of interest in oncology. The phytochemical composition of this plant and the biological properties of berberine are important aspects in evaluating the anticancer potential of natural compounds.

1) Statistical reference: https://pressroom.cancer.org/2025-06-25-New-ACS-Cancer-Atlas-Global-Report-Shows-Nearly-Half-of-Cancer-Mortality-Worldwide-Attributable-to-Potentially-Modifiable-Risk-Factors

2) Yong Sun, Wentao Wang, Yuwen Tong., Berberine inhibits proliferative ability of breast cancer cells by reducing metadherin. *Med. Sci. Monit.* 2019, *25*, 9058–9066. DOI: 10.12659/msm.914486

3) Chen, J.; Huang, X.F.; Tao, C.; Wang, L.; Chen, Z.D.; Li, X.P.; Zeng, Q.; Ma, M.; Zhang, R.; Wu, Z.Z. Berberine chloride suppresses non-small cell lung cancer by deregulating Sin3A/TOP2B pathway in vitro and in vivo. *Cancer Chemother. Pharmacol.* 2020, *86*, 151–161. DOI: 10.1007/s00280-020-04050-y

4) Zunxiong Wang[1], Shuo Yang[2], Xiqiang Cai[3], Jiaqiang Dong[3], Zhangqian Chen[3], Rui Wang[3], Song Zhang[3], Haichao Cao[3], Di Lu[1], Tong Jin[1], Yongzhan Nie[3], Jianyu Hao[1], Daiming Fan., Berberine represses human gastric cancer cell growth in vitro and in vivo by inducing cytostatic autophagy via inhibition of MAPK/mTOR/p70S6K and Akt signaling pathways. *Biomed. Pharmacother.* 2020, *128*, 110245.

5) Pengcheng Zhang , Quancheng Wang, Zhibin Lin, Peijun Yang, Kefeng Dou , Ruohan Zhang,. Berberine inhibits growth of liver cancer cells by suppressing glutamine uptake. *OncoTargets Ther.* 2019, *12*, 1751–1763. DOI: 10.2147/OTT.S235667

6) Zhao, Z.Y.; Zeng, J.H.; Guo, Q.; Pu, K.M.; Yang, Y.; Chen, N.Z.; Zhang, G.; Zhao, M.Y.; Zheng, Q.; Tang, J.Y.; et al. Berberine suppresses stemness and tumorigenicity of colorectal cancer stem-like cells byinhibiting m(6)A methylation. *Front. Oncol.* 2021, *11*, 775418. DOI: 10.3389/fonc.2021.775418

7) Chia-Hung Liu[1], Wan-Chun Tang[2], Peik Sia[2], Chi-Chen Huang[3], Pei-Ming Yang. Berberine inhibits the metastatic ability of prostate cancer cells by suppressing epithelial-to-mesenchymal transition (EMT)-associated genes with predictive and prognostic relevance. *Int. J. Med. Sci.* 2015, *12*, 63–71. DOI: 10.7150/ijms.9982

8) Michael A. James, Huijing Fu, Yan Liu, Da-Ren Chen, Ming You. Dietary administration of berberine or *Phellodendron amurense* extract inhibits cell cycle progression and lung tumorigenesis. *Mol. Carcinog.* – 2019. – Vol. *50*. – P. 1–7. DOI: 10.1002/mc.20690

9) Zhang, Q.; Sun, Y.; Huang, Y.; Sun, J.; Zhao, C.; Song, Y.; Wu, J. Combination of berberine and matrine affects apoptosis and cellcycle in human cervical cancer cells. *Acta Pol. Pharm.* 2019, *76*, 1089–1097. DOI:10.32383/appdr/112478

МОРФОЛОГИЧЕСКИЕ ИЗМЕНЕНИЯ ПОДЖЕЛУДОЧНОЙ ЖЕЛЕЗЫ, ПЕЧЕНИ И ПОЧЕК ПРИ АЛЛОКСАН-ИНДУЦИРОВАННОМ САХАРНОМ ДИАБЕТЕ: ОБЗОР ЭКСПЕРИМЕНТАЛЬНЫХ ИССЛЕДОВАНИЙ

Молбосын Д.С., Жаманбаева Г.Т., Аманкелді А.Н., Жапаркулова Н.И.

Казахский национальный университет имени аль-Фараби, Алматы, Казахстан

Докторант 2-го года обучения

Тел.: +77077887470; e-mail: danamolbossyn@gmail.com

Аннотация. *В обзоре обобщены опубликованные данные о морфологических изменениях поджелудочной железы, печени и почек лабораторных животных при аллоксан-индуцированном сахарном диабете. Рассмотрены диабетогенное действие аллоксана,*

изменения эндокринного аппарата поджелудочной железы и структурные нарушения в печени и почках. Отдельное внимание уделено сочетанию гистологического анализа, морфометрии и биохимических методов, а также ограничениям интерпретации результатов экспериментальной модели.

Ключевые слова: *сахарный диабет, аллоксан, лабораторные крысы, поджелудочная железа, печень, почки, гистология, морфометрия.*

Введение

Сахарный диабет сопровождается нарушениями углеводного обмена и структурно-функциональными изменениями органов. Экспериментальные модели позволяют изучать отдельные механизмы этих процессов, но результаты следует интерпретировать с учётом особенностей модели.

Аллоксан используют для индукции экспериментального диабета благодаря его преимущественному повреждающему действию на β-клетки поджелудочной железы. Важную роль в механизме действия аллоксана играют окислительно-восстановительные реакции и образование активных форм кислорода [3, с. 216–226; 8, с. 537–546]. При этом возможное прямое токсическое действие вещества следует отличать от последствий развившейся гипергликемии. Комплексное исследование поджелудочной железы, печени и почек позволяет оценивать изменения в органах с разными функциями. [1, с. 51–58].

Цель обзора — обобщить данные о морфологических изменениях поджелудочной железы, печени и почек при аллоксан-индуцированном сахарном диабете у лабораторных животных и рассмотреть методы оценки выявляемых структурных нарушений.

Морфологические изменения поджелудочной железы

Поджелудочная железа является одним из основных объектов исследования при аллоксановом диабете из-за чувствительности β-клеток к действию диабетогенного агента. При гистологическом анализе оценивают строение островков Лангерганса, целостность тканевой архитектоники и состояние клеточных структур. В исследованиях на лабораторных животных описаны изменения формы и организации островков, дегенеративные изменения и вакуолизация клеток [7, с. 94–99].

Световая микроскопия не всегда позволяет определить функциональное состояние клеток; при необходимости её дополняют иммуногистохимическим выявлением инсулина. При сравнении результатов учитывают сроки наблюдения, выраженность гипергликемии и особенности протокола.

Морфологические изменения печени

Печень участвует в обмене углеводов и липидов и поддерживает энергетический гомеостаз. При экспериментальном диабете описаны морфологические и ультраструктурные изменения гепатоцитов и организации печёночной ткани [4]. В исследовании Rosdah и соавторов также рассматривались гистопатологические изменения печени в разные сроки наблюдения, включая признаки повреждения гепатоцитов и изменения синусоидов [7, с. 94–99].

Изменения могут зависеть от длительности гипергликемии, особенностей модели и прямого действия диабетогенного вещества. Поэтому гистологические наблюдения желательно сопоставлять с биохимическими показателями.

Морфологические изменения почек

Почки поддерживают водно-электролитное равновесие и участвуют в выведении продуктов обмена. При аллоксан-индуцированном диабете у крыс описаны ранние гистологические изменения клубочковых структур, стенок почечных артерий и компонентов мозгового вещества [6, с. 11–15]. В другой работе отмечены изменения клубочков и канальцевого аппарата, а также сосудистые нарушения при различной продолжительности экспериментального диабета [7, с. 94–99].

Морфологические признаки не характеризуют функцию почек полностью, поэтому их следует сопоставлять с функциональными и биохимическими показателями.

Морфометрия и междисциплинарная оценка

Гистологический анализ целесообразно дополнять количественной оценкой заранее определённых параметров: характеристик островкового аппарата, печени и почечной ткани. Критерии оценки и правила отбора полей зрения следует устанавливать до начала анализа.

Цифровая микроскопия и анализ изображений повышают воспроизводимость морфометрии при стандартизации съёмки, отбора полей зрения и контроля качества препаратов; автоматизированные результаты требуют морфологической проверки. Drikvandi и соавторы изучали показатели антиоксидантной защиты в тканях печени, почек и поджелудочной железы крыс с аллоксан-индуцированным диабетом [2]. Эти данные дополняют морфологический подход, но сами по себе не доказывают наличие конкретных гистологических изменений. [5].

Заключение

Аллоксан-индуцированный диабет используется для изучения повреждения β-клеток и структурных изменений других органов. Комплексная оценка поджелудочной железы, печени и почек с применением гистологии, морфометрии и биохимических методов

помогает сопоставлять изменения разных уровней. Выводы следует формулировать с учётом ограничений модели, сроков наблюдения и возможного прямого токсического действия аллоксана. Стандартизированные критерии и цифровой анализ изображений могут повысить воспроизводимость исследований.

СПИСОК ИСПОЛЬЗОВАННОЙ ЛИТЕРАТУРЫ:

1. Adeyi A. O., Idowu B. A., Mafiana C. F., Oluwalana S. A., Ajayi O. L., Akinloye O. A. Rat model of food-induced non-obese type 2 diabetes mellitus: comparative pathophysiology and histopathology // International Journal of Physiology, Pathophysiology and Pharmacology. — 2012. — Vol. 4, No. 1. — P. 51–58. — URL: https://pmc.ncbi.nlm.nih.gov/articles/PMC3312463/.

2. Drikvandi P., Bahramikia S., Alirezaei M. Modulation of the antioxidant defense system in liver, kidney, and pancreas tissues of alloxan-induced diabetic rats by camphor // Journal of Food Biochemistry. — 2020. — Vol. 44, No. 12. — Article e13527. — DOI: https://doi.org/10.1111/jfbc.13527.

3. Lenzen S. The mechanisms of alloxan- and streptozotocin-induced diabetes // Diabetologia. — 2008. — Vol. 51, No. 2. — P. 216–226. — DOI: https://doi.org/10.1007/s00125-007-0886-7.

4. Lucchesi A. N., Cassettari L. L., Spadella C. T. Alloxan-induced diabetes causes morphological and ultrastructural changes in rat liver that resemble the natural history of chronic fatty liver disease in humans // Journal of Diabetes Research. — 2015. — Vol. 2015. — Article 494578. — DOI: https://doi.org/10.1155/2015/494578.

5. Percie du Sert N., Hurst V., Ahluwalia A., Alam S., Avey M. T., et al. The ARRIVE guidelines 2.0: Updated guidelines for reporting animal research // PLOS Biology. — 2020. — Vol. 18, No. 7. — Article e3000410. — DOI: https://doi.org/10.1371/journal.pbio.3000410.

6. Pourghasem M., Nasiri E., Shafi H. Early renal histological changes in alloxan-induced diabetic rats // International Journal of Molecular and Cellular Medicine. — 2014. — Vol. 3, No. 1. — P. 11–15. — URL: https://pmc.ncbi.nlm.nih.gov/articles/PMC3927393/.

7. Rosdah A. A., Natasha A., Fertilita S., Usman D. Temporal changes in blood glucose levels and organ histopathology in alloxan-induced diabetic rats // MEDISAINS: Jurnal Ilmiah Ilmu-Ilmu Kesehatan. — 2025. — Vol. 23, No. 2. — P. 94–99. — DOI: https://doi.org/10.30595/medisains.v23i2.27022.

8. Szkudelski T. The mechanism of alloxan and streptozotocin action in B cells of the rat pancreas // Physiological Research. — 2001. — Vol. 50, No. 6. — P. 537–546. — DOI: https://doi.org/10.33549/physiolres.930111.

СПЕЦИФИЧЕСКАЯ ПРОФИЛАКТИКА КЛОСТРИДИОЗОВ СЕЛЬСКОХОЗЯЙСТВЕННЫХ ЖИВОТНЫХ

Пулотзода Фаридун Хайтали, Самиева Суман Зохидовна, Пирова Мавджуда Комилджоновна, *Таджикский национальный Университет,*

г. Душанбе, Республика Таджикистан, +992915171666; fariddun.pulotov@mail.ru

Аннотация: *В статье авторы представляют информацию о специфической профилактике клостридиозов сельскохозяйственных животных в условиях Республики Таджикистан. Приводятся данные по изучению спектра распространения клостридиозов животных в условиях республики, разработка поливалентной вакцины на основе этиологический важных штаммов клостридий.*

Ключевые слова*: клостридиозы, вакцина, специфическая профилактика, безопасность, иммуногенность, эффективность*

Клостридиозы широко распространены в условиях Республики Таджикистана, и являются возбудителями различных инфекционных болезней животных, птиц и человека [1,3]. Среди инфекционных болезней животных клостридиозы занимают особое место, снижают эффективность и продуктивность животноводства, также наносят большой экономический ущерб [2,4].

Результаты исследований ряд учёных указывают, что клостридиозы чаще проявляются в виде ассоциации, а иногда вызывают заболевания в отдельности. Патогенные виды, которые часто выделяют из патологоанатомических материалов в стране, является *C.perfringens, C.sordelli, C.chauvoei, C.septicum, C.botulinum, C.haemolyticum, C.tetani, C.novyi* и *C.histolyticum,* которые являются основной причиной заболеваний [1,2,4].

Вакцинация является, основным способом защити животных от клостридиозных инфекций. Следует отметить, что эффективность вакцин против клостридиозных заболеваний животных зависит от многих факторов, и в первую очередь от соответствующего подбора клинически и эпизоотологически значимых штаммов [4,5,6].

Целью настоящего исследования является изготовление поливалентной вакцины на основе клинически значимых штаммов клостридий. Для изготовления вакцины в производственных условиях использовали местные и промышленные штаммы *C.perfringens* типов B, C, D, *C.edematiens*, *C.sordellii*, *C septicum*, *C.tetani*, *C.chauvoei* R_{15}.

Изготовление опытной серии поливалентной вакцины осуществляли путём подбора оптимального соотношения компонентов и эффективной дозы штаммов в соответствии с обязательными правилами производственный регламент и методическими рекомендациями по борьбе с клостридиозами.

При приготовлении поливалентной вакцины подобрано оптимальное и сбалансированное соотношение антигенов и антитоксинов, входящих в ее состав: анатоксины *C.perfringens* типа B - 15 МЕ/мл, *C.perfringens* типа C - 20 МЕ/мл, *C.perfringens* тип D - 30 МЕ/мл, *C.novyi* тип B - 20 МЕ/мл, *C.tetani* - 10 МЕ/мл, а также инактивированные бактерии *C.sordellii* - $2{,}0\times10^9$ кл./мл, *C.septicum* - $2{,}0\times10^9$ кл./мл, *C.chauvoei* R_{15} - $2{,}5\times10^9$ кл./мл, что обеспечивает 100% защиту вакцинированных животных.

Для определения безопасности вакцину вводили подкожно белым мышам в объёме 0,5 $см^3$, морским свинкам в области холки в объёме 2,0 $см^3$. Наблюдали за вакцинированными животными в течение 10 дней. Все животные оставались живыми и клинически здоровыми в течение периода наблюдения. За весь период наблюдения не было выявлено изменений общеклинических и физиологических нормы, что свидетельствует о безопасности испытуемых вакцин.

Для определения эффективности опытной серии поливалентной вакцины против клостридиозов сельскохозяйственных животных были отобраны несколько животноводческих хозяйств Республики Таджикистан, признанных неблагополучными по анаэробной энтеротоксемии, бразот овец и другим анаэробным инфекциям.

С целью специфической профилактики было вакцинировано 680 голов овец и ягнят. Вакцину вводили двукратно с интервалом 22-25 дней в внутренней область бедра, ягнятам до 6-месячного возраста в дозе 0,5-1,0 $см^3$ и овцам в дозе 2,0 $см^3$.

Системных и местных осложнений у вакцинированных овец отсутствовало. После повторной вакцинации за животными наблюдали в течение года, новых случаев заболевания или гибели животных с признаками клостридиоза не наблюдалось. В течение 12 месяцев наблюдения было вынужденный убой трех овец с брадзотподобними симптомами. Таким образом, защита овец составила 99,5%, тогда как до вакцинации она была 87,1%, что свидетельствует о высокой эффективности опытной серии поливалентной вакцины против клостридиозов овец.

Заключение. В результате исследований установлено, что опытной серий поливалентной вакцины против клостридиозов сельскохозяйственных животных является безвредно, безопасно и иммуногенно в отношении всех штаммов, входящих в ее состав. Эффективность поливалентной вакцины против клостридиозов сельскохозяйственных животных равнялась 99,5-100.

ЛИТЕРАТУРА

1. Девришов Д.А., Клостридиозы овец и их контроль / Д.А. Девришов, Ф.Х.Пулотов// Ветеринария. Москва, 2019. №5. – С. 27-30.
2. Капустин А.В., Разработка метода контроля иммуногенной активности ассоциированной вакцины против клостридиозов крупного рогатого скота / А.В. Капустин, А.И. Лаишевцев, О.Д. Скляров, Н.С. Абросимова // RJOAS. – № 3(63), – 2017, – С. 170-175.
3. Пулотов Ф.Х., Совершенствование технологии изготовления поливалентной вакцины против клостридиозов животных / Ф.Х. Пулотов., Д.А. Девришов, И.А. Исматов // Проблемы биологии продуктивных животных. №1. 2020 - С. 34-43.
4. Скляров О.Д., Интерференция компонентов в поливалентной вакцине против клостридиозов крупного и мелкого рогатого скота / О.Д.
5. Lewis C.J., Control of important clostridial diseases of sheep // Veterinary Clinics of North America. – 2011. – Vol. 27. – Issue 1.– P. 121-126.
6. Pulotov F.H. Development of polyvalent toxoid Clostridium perfringens against anaerobic enterotoxaemia in young cattle and small ruminants. E3S Web of Conferences/ 282, 04009, 2021

ПАТОФИЗИОЛОГИЧЕСКИЕ МЕХАНИЗМЫ НАРУШЕНИЯ ВЫДЕЛИТЕЛЬНОЙ ФУНКЦИИ ПОЧЕК И ЗАДЕРЖКИ АЗОТИСТЫХ МЕТАБОЛИТОВ ПОД ВЛИЯНИЕМ РААС У ДОМАШНИХ ЖИВОТНЫХ

Азербайджанский Государственный Аграрный Университет

Факультет Ветеринарной медицины

OCIDD ID:0009-0002-1846-8034

Хасанов Гасан, студент 4-го курса бакалавриата

hesenowhesen544@gmail.com

Салахова Эмилия, студентка 3-го курса бакалавриата

emiliyasalahova7@gmail.com

Научный руководитель: **старший преподаватель Улдуз Сафарова**

ulduzsafarova63@gmail.com

Аннотации:*Острое повреждение почек (ОПП) у мелких домашних животных сопровождается расстройством почечной гемодинамики, резким падением скорости клубочковой фильтрации (СКФ) и нарушением выделительной функции. Ключевым патогенетическим звеном этих процессов выступает гиперактивация ренин-ангиотензин-*

альдостероновой системы (РААС), индуцирующая вазоспазм, ишемию почечной паренхимы и сокращение фильтрационной поверхности клубочков. Опосредованное РААС падение СКФ приводит к блокированию элиминации метаболитов и развитию азотемии, выражающейся в системной аккумуляции креатинина, мочевины и фосфора. В аннотируемой работе систематизированы гемодинамические и канальцевые механизмы, посредством которых нейрогуморальный дисбаланс РААС вызывает задержку азотистых шлаков и электролитные нарушения у домашних животных.

Ключевые слова: *острое повреждение почек, ренин-ангиотензин-альдостероновая система, РААС, биомаркеры,ангиотензин II, креатинин, диагностика заболеваний почек.*

Введение: Острое повреждение почек (ОПП) у мелких домашних животных представляет собой полиэтиологический патологический процесс ишемического, токсического или инфекционного генеза, способный быстро прогрессировать в острую почечную недостаточность (ОПН). Данное состояние характеризуется стремительным нарастанием азотемии, падением скорости клубочковой фильтрации (СКФ) и утратой концентрирующей способности почек. Развитие ОПН приводит к системному декомпенсированному гомеостатическому сдвигу, включающему расстройства водного, электролитного и кислотно-щелочного баланса, а также глубокое нарушение экскреции эндогенных продуктов метаболизма и ксенобиотиков.

Высокая уязвимость почечной ткани у животных обусловлена особенностями её органного кровотока: почки получают около 20% сердечного выброса, при этом основной объем перфузии приходится на корковое вещество и наружную зону мозгового слоя. Из-за высокой метаболической активности и интенсивной транспортной нагрузки наибольшему риску ишемической и токсической альтерации подвергаются эпителиоциты проксимальных извитых канальцев и толстой восходящей ветви петли Генле.

Патогенетический каскад ОПП протекает через четыре последовательные фазы:

1. Инициацию (первые минуты и часы после альтерирующего воздействия);
2. Распространение повреждения на фоне нарастающей тканевой гипоксии (от нескольких часов до суток);
3. Поддержание процесса с активацией начальных механизмов клеточной репарации (от 3-х суток до нескольких недель);
4. Восстановление функциональной активности (недели или месяцы).

Несмотря на потенциальную обратимость ОПП, критическая гибель канальцевого эпителия может приобретать необратимый характер, что подчеркивает необходимость глубокого понимания пусковых патофизиологических механизмов развития патологии.

В структуре регуляции почечной гемодинамики и водно-электролитного гомеостаза ключевую роль играет ренин-ангиотензин-альдостероновая система (РААС). В физиологических условиях при ишемии почечной паренхимы, падении системного артериального давления, гиповолемии или снижении концентрации ионов Na и Cl юкстагломерулярные клетки афферентных артериол секретируют ренин. Этот фермент расщепляет печеночный ангиотензиноген до слабоактивного ангиотензина I, который под действием цинкзависимого ангиотензинпревращающего фермента (АПФ) трансформируется в мощный вазоконстриктор — ангиотензин II, параллельно инактивируя сосудорасширяющий пептид брадикинин. В норме ангиотензин II регулирует тонус почечных артериол и стимулирует секрецию альдостерона надпочечниками, поддерживая реабсорбцию натрия и воды в канальцах.

Однако при развитии ОПП реакция РААС быстро трансформируется из адаптивно-компенсаторной в стойкую патологическую гиперактивацию. Первоначальный спазм эфферентных артериол, направленный на поддержание внутриклубочкового гидростатического давления, сменяется тотальной вазоконстрикцией почечного сосудистого русла и критическим падением почечного плазмотока. Данный вазоспастический ответ вызывает резкое снижение СКФ и сокращение площади фильтрационной поверхности клубочков. В условиях блокирования клубочковой фильтрации и нарушения канальцевого транспорта происходит угнетение элиминации конечных продуктов белкового и минерального обмена, что непосредственно приводит к формированию азотемии (системной аккумуляции креатинина и мочевины) и гиперфосфатемии.

Патофизилогия задержки азотистого обмена

Азотемия представляет собой патологический синдром, характеризующийся повышенным содержанием в сыворотке или плазме крови азотистых продуктов обмена веществ (в первую очередь мочевины и креатинина), подлежащих элиминации почечной тканью.

У азотемии есть три классификации, в зависимости от её этиологичечкого фактрора, но все три типа разделяют несколько общих черт. Все формы азотемии характеризованы снижением скорости клубочковой фильтрации (СКФ) почек и увеличенем азота мочевины в крови и концентрации креатинина в сыворотке.

Преренальная азотемия

Преренальная азотемия вызвана уменьшением сердечного выброса, как результат недостаточного кровоснабжения почек. Это может произойти в результате кровотечения , шока,гиповолемия , и сердечной недостаточности и др. причин.

Ренальная азотемия

Ренальная азотемия обычно приводит к уремии. Это состояние свойственно при разнообразных заболеваниях почек, любого паренхиматозного повреждения почек. Основные причины:почечная недостаточность, гломерулонефрит, острый тубулярный некроз,пиелонефрит и т.д

Постренальная азотемия

Вызвана механическим препятствием оттоку мочи ниже уровня почек или нарушением целостности мочевыводящих путей (уролитиаз, обструкция мочеточников или уретры, сдавление опухолями, гидронефроз, разрыв мочевого пузыря с развитием уроперитонеума),беременность(физиологическая азотемия)

Заключение

Гиперактивация ренин-ангиотензин-альдостероновой системы (РААС) при остром повреждении почек у мелких домашних животных быстро перерастает из защитной реакции в тяжелый вазоспастический каскад. Под действием ангиотензина II происходит выраженное сужение артериол клубочков и сокращение мезангиальных клеток. Это резко снижает почечный кровоток и скорость клубочковой фильтрации (СКФ), усугубляя гипоксию канальцевого эпителия и блокируя выделительную функцию органов,тем самым приводя к накоплению продуктов азотистого обмена в крови.

СПИСОК ЛИТЕРАТУРЫ

1. BSAVA Manual of Canine and Feline Nephrology and Urology / ed. by J. Elliott, G. F. Grauer, J. L. Westropp. 3rd ed. Gloucester : British Small Animal Veterinary Association, 2017. — 360 p.

2.Студенческий файловый архив Studfile [Электронный ресурс]. — Режим доступа: https://studfile.net/preview/21982229/page:19/ (дата обращения: 10.10.2026).

BO‘Z TIPIK TUPROQLARDA YETISHTIRILADIGAN TOK NAVLARINI RIZOSFERA MIKROORGANIZMLARI ASOSIDA SKRINING QILISH.

Jahongir Esanboyevich Obloqulov, Iskandarova Nazira Feruzovna

Samarqand davlat pedagogika instituti

jahongirobloqulov1992@gmail.com

Annotatsiya: *Ushbu tadqiqotda bo‘z tipik tuproqlarda yetishtiriladigan tok navlarining rizosfera mikroorganizmlari bilan o‘zaro munosabati, tuproq mikrobiologik tarkibining o‘simlik o‘sishi va rivojlanishiga ta’siri hamda sut kislotali bakteriyalardan foydalanish imkoniyatlari o‘rganiladi. Tadqiqot obyekti sifatida turli fermer xo‘jaliklari hududlarida joylashgan uzumzorlarning bo‘z tipik tuproqlari va ularda yetishtiriladigan tok o‘simliklari tanlangan. Umumiy 10 gektar uzumzor maydonidan 1 gektar tajriba maydoni sifatida ajratilib, tok ildizlari*

atrofidagi rizosfera tuprog‘idan namunalar olindi. Rizosfera mikroorganizmlarining miqdori va morfologik xilma-xilligi mikroskopik usulda o‘rganildi.

Kalit so‘zlar: *Vitis vinifera L., bo‘z tipik tuproq, rizosfera, mikroorganizmlar, rizobakteriyalar, sut kislotali bakteriyalar, tuproq unumdorligi, sho‘rlanish, tok navlari, skrining.*

Abstract: *This study examines the interaction between grape varieties grown on typical serozem soils and rhizospheric microorganisms, the influence of soil microbiological composition on plant growth and development, and the possibilities of utilizing lactic acid bacteria. The object of the research is typical serozem soils of vineyards located in the territories of various farms and the grape crops grown on them. Of the total area of 10 hectares of vineyards, 1 hectare was allocated as an experimental plot, and samples were taken from the rhizosphere soil around the grapevine roots. The quantity and morphological diversity of rhizospheric microorganisms were studied microscopically.*

Keywords: *Vitis vinifera L., typical serozem soil, rhizosphere, microorganisms, rhizobacteria, lactic acid bacteria, soil fertility, salinity, grape varieties, screening.*

Kirish: Uzumchilik O‘zbekiston qishloq xo‘jaligining muhim yo‘nalishlaridan biri bo‘lib, tok o‘simligining hosildorligi va mahsulot sifati tuproq-iqlim sharoitlari, sug‘orish rejimi, oziqa elementlari bilan ta’minlanganlik hamda ildiz zonasining biologik faolligiga chambarchas bog‘liq. Ayniqsa, bo‘z tuproqlar tarqalgan hududlarda sug‘oriladigan uzumzorlarning uzoq muddat foydalanilishi natijasida tuproqning fizik-kimyoviy xususiyatlari, organik moddalar miqdori va mikrobiologik faolligi o‘zgarishi mumkin.

Zamonaviy tadqiqotlarda tok rizosferasidagi mikrobiota o‘simlikning oziqa moddalari bilan ta’minlanishi, ildizlarning rivojlanishi va stress omillariga moslashishida muhim ekologik omil sifatida qaralmoqda. Tok navlari va ildizpoyalari tuproq mikrobiomining tarkibiga ta’sir qilishi, o‘z navbatida, rizosfera mikroorganizmlari o‘simlikning stressga chidamlilik xususiyatlarini shakllantirishda ishtirok etishi qayd etilgan.

Tuproq sho‘rlanishi esa tok yetishtirishda muhim cheklovchi omillardan biridir. 2026-yilda e’lon qilingan tadqiqotlarda tokning sho‘rlanishga o‘rtacha darajada sezgir ekin ekanligi, Na^+ va Cl^- ionlarining ortiqcha to‘planishi suv va oziqa moddalarining o‘zlashtirilishiga salbiy ta’sir qilishi ko‘rsatilgan.

Shu sababli bo‘z tipik tuproqlarda yetishtiriladigan tok navlarini rizosfera mikroorganizmlari asosida skrining qilish ilmiy va amaliy jihatdan dolzarb hisoblanadi.

Tadqiqotning maqsadi

Tadqiqotning asosiy maqsadi bo‘z tipik tuproqlarda yetishtiriladigan tok navlari rizosferasidagi mikroorganizmlar miqdori va xilma-xilligini aniqlash, tuproq sharoitlari bilan

ularning o‘zaro bog‘liqligini baholash hamda foydali bakterial suspenziyalarning tok o‘simligining o‘sishi va rivojlanishiga ta’sirini o‘rganishdan iborat.

Tadqiqot materiali va usullari

Tadqiqot uchun turli fermer xo‘jaliklari hududlaridagi bo‘z tipik tuproqlarda joylashgan uzumzorlar tanlandi. Umumiy 10 gektar uzumzor maydonidan 1 gektar tajriba maydoni sifatida ajratildi.

Tajriba maydonidagi tok o‘simliklarining ildiz atrofi rizosfera tuprog‘idan namunalar olindi. Namuna olishda tok o‘simligining ildiz tizimi atrofi asosiy mezon sifatida belgilandi. Har bir variantdan uchta tok o‘simligi tanlanib, ularning rizosfera tuprog‘i namunalarida mikroorganizmlarning morfologik shakllari va nisbiy miqdori mikroskopik usulda o‘rganildi.

Tuproq turlarida mikroorganizmlar miqdori

Tuproq mikroorganizmlarining miqdori tuproq turi, organik moddalar miqdori, namlik, aeratsiya, harorat va tuproqning fizik-kimyoviy xususiyatlariga bog‘liq. Tadqiqot uchun foydalanilgan ma’lumotlarda turli tuproq turlaridagi mikroorganizmlar miqdori quyidagicha keltirilgan.

Bakterial suspensiyalarni tok o‘simligining biomassa hosildorligiga ta’siri

Uzum navlari	Holsildorlik		Maydon mln.ga(12gek)	Umumiy biomassa miqdori
	Kg/m^2	t/ga		
Nazorat	20±0,5	2	24	12
Oq husayni	45,5±3	4,55	54,6	30,3
Charos	43,2±4	4,32	51,8	28,8
Go‘zal qora	47,3±5	4,73	56,76	31,5
Kattaqo‘rg‘on	48,2±7	4,82	57,84	33

Yuqorida berilgan Oq husayni, Charos, Go‘zal qora, Kattaqo‘rg‘on uzum navlarining biomassa hosil qilishiga biologik preparatlarning ta’sirini aniqlash bo’yicha tajriba olib borildi. Yillik quruq massa hosildorligi Go‘zal qora uzumda 47,3 kg/m^2 ni tashkil etishi ko‘rsatib berildi. Tadqiqot ob’ektlarning umumiy yillik quruq biomassa hosildorligi o‘rtacha 27,12 kg/m^2 ni tashkil etdi. Hosil bo‘lgan yillik quruq biomassaning Kattaqo‘rg‘on navi, 48,2% Charos navi, 43,2% dan Oq husayni navi 45,5 kg/m^2 umumiy maydon 12gektarga teng qilib olindi. Nazoratga nisbatan biologik suspenziya bilan uzumga ishlov berilganda hosilning oshishi kuzatildi. Tajriba asosida olingan natijalar labarator sharoitda mikroobiologik tahlil qilinib fermer xo‘jaliklarga tafsiya etildi. “Istiqlol Qorabuloq dalalari” fermer ho‘jalikka 12 gektar maydonga 3 takrorlikda biologik suspenziyalar ta’sir ettirilib natijalar olindi. Tok hosilining rivojlaninishiga biologik

suspenziyalarning ta’siri shu 10 yillikda qo‘llanilmagan. Hozirga kelib tok o‘simligi turli xil fitopategenlar bilan chalinmoqda shu sababli antaganist mikroorganizmlardan foydalanilgan holda biologik suspenziyalar qo‘llanilib kelinmoqda. Tokzorlarni sug‘orish, sug‘orish manbaalari (daryo, ko‘l, suv va omborlar va h.k), suvni taqsimlovchi bosh qurilmalar, magistral va sug‘orish kanallari, vaqtinchalik sug‘orish shaxobchalari orqali amalga oshiriladi. Tok o‘simligi tagidagi tuproq namunalari mikrobiologik tahlil qilinganda mikroorganizmlar soni past ko‘rsatkichni ko‘rsatdi. Bog‘dorchilik va tokzorchilik fermer xo‘jaliklarida asosan artizan suvi qo‘yilishi bilan o‘simlik tagidagi tuproqda mikroorganizmlar soni ariq, daryo va kanallarnikiga nisbatan kamligi aniqlandi. O‘simlikni o‘sishi rivojlanishiga tuproq va suv miroflorasining ta’siri katta. Bugunki kunda tuproqqa turli xil biopreparatlar bilan ishlov berish va yerning stress, sho‘rlanishga ta’sirini kamaytirish mikrooorganizmlar orqali olib borilmoqda. O‘simliklar rivojlanishida artizan suvi bilan sug‘oriladigan yerlarda muhim o‘rin tutadigan mikroorganizmlar turg‘un holatda qoladi. So‘nggi statistik ma’lumotlar bo‘yicha, sug‘oriladigan maydonlarning o‘rtacha 85% qismi - sho‘r tuproqlar. Tuproqning sho‘rlanish darajasi uning tarkibidagi tuzlarning miqdoriga bog‘liq. Sho‘rlanmagan tuproqlarda umumiy tuzlar miqdori 0,4% gacha, jumladan xlor 0,002% gacha; kuchsiz sho‘rlangan tuproqda tuzlar 0,2-1%, jumladan, xlor 0,01% dan kam yoki tuzlar 0,3% dan kam, xlor 0,01% dan ko‘p; kuchli sho‘rlangan tuproqda esa tuzlar 1-3%, jumladan, xlor 0,01-0,1% èki tuzlar 0,3-2%, xlor esa, 0,1% dan ko‘p bo‘ladi. Tok boshqa mevali o‘simliklarga nisbatan sho‘rga chidamliroq hisoblanadi. Tuproqdagi umumiy tuzlarning miqdori 0,3-0,5%, jumladan, xlor 0,02-0,04% bo‘lganda ham tok yaxshi o‘sib, mo‘l hosil berishi mumkin. Yosh toklar esa tuproq sho‘riga ta’sirchanroq bo‘ladi. Tuproqdagi zararli tuzlar ta’sirida tok sust o‘sadi, novdalari yaxshi pishmaydi, ildizi yaxshi rivojlanmaydi, hosili kam va sifati past bo‘ladi. Tuzlar miqdori oshib borishi bilan tok ildizining hajmi, umumiy uzunligi, ayniqsa, suruvchi ildizlar keskin kamayadi.

XULOSA: Hozirgi kunda bog‘dorchilikda kimyoviy o‘g‘itlarnining qisman o‘rnini bosuvchi biopreparatlardan foydalanish texnologiyalarini ishlab chiqish ustuvor masalalardan biri hisoblanadi. Tok yetishtirishda ko‘chatlarni biopreparatlar bilan ildiz ottirish va vegetatsiya davomida barglari orqali yoki suv bilan birgalikda beriladigan biopreparatlar ustida tadqiqotlarning olib borilishi ilmiy amaliy ahamiyat kasb etadi.

Tokni vegetatsiya davrida ikki marta: birinchi marta gullashidan 15-20 kun oldin va ikkinchi marta gullagach 15-20 kun keyin qo‘shimcha oziqlantirish tavsiya etiladi. Bunday o‘g‘itlash normasi asosiy o‘g‘itlashdagidan ikki marta kam bo‘ladi. Qo‘shimcha oziqlantirishda tok tuplarini xolatini hisobga olish zarur. Agar tok kuchli o‘sgan bo‘lsa azatabakterli biologik suspenziya ta’sir yettirish zarur yemas.

Hozirga kelib tok o‘simligi turli xil fitopategenlar bilan chalinishi shu sababli antaganist mikroorganizmlardan foydalanilgan holda biologik suspenziyalar qo‘llanilib kelinmoqda.

FOYDALANILGAN ADABIYOTLAR

1.Bergey’s Manual of Systematic Bacteriology. Firmicutes. Second Edition, Volume Three. P. 464-510.

2.Bille, J. 1989. Anatomy of a foodborne listeriosis outbreak, p. 31-36. *In*Food listeriosis. Symposium proceedings. Behr′s Verlag, Hamburg, Germany.

3. Bower, C. K., and M. A. Daeschel. 1999. Resistance responses of microorganisms in food environments. Int. J. Food Microbiol. 50:33-44.

4.Borruel N., Carol M., Casellas F. Increased mucosal tumour necrosis factor alpha production in Crohn’s disease can be downregulated ex vivo by probiotic bacteria // Gut. 2002; 51: 659–664.

5.Burlanek, LL., Yousef, A.E. 2000. Solvent extraction of bacteriocins from liquid cultures. 2000, J. Appl. Microbiol. 31, 193-197.

6.Carnio, M. C., I. Eppert, and S. Scherer. 1999. Analysis of the bacterial surface ripening flora of German and French smeared cheese with respect to their anti-listerial potential. Int. J. Food Microbiol. **47:**89-97.

7.Carnio, M. C., A. Höltzel, M. Rudolf, T. Henle, G. Jung, and S. Scherer. 2000. The macrocyclic peptide antibiotic micrococcin P_1 is secreted by the food-borne bacterium *Staphylococcus equorum* WS 2733 and inhibits *Listeria monocytogenes* on soft cheese. Appl. Environ. Microbiol. **66:**2378-2384.

8.Cintas, L. M., P. Casaus, M. F. Fernandez, and P. E. Hernandez.1998. Comparative antimicrobial activity of enterocin L50, pediocin PA-1, nisin A, and lactocin S against spoilage and foodborne pathogenic bacteria Food Microbiol. **15:**289-298.

9.Davie, J.M., Brock, TD. 1966. Effect of teichoic acid on resistance to the membrane-lytic agent of Streptococcus zymogenes. J. Bacteriol. 92. 1623-1631.Cintas, L.M, Herran Z, C., Hernandez, PE; Casaus, MP, Nes, LF. 2001. Review: Bacteriocins of lactic acid bacteria. Food Sci. Tech. Int. 7, 281-305.

10.Davies, E. A., H. E. Bevis, and J. Delves-Broughton**.** 1997. The use of the bacteriocin, nisin, as a preservative in ricotta-type cheeses to control the food-borne pathogen *Listeria monocytogenes*. Lett. Appl. Microbiol.pp. 343-346.

VEGETATIV NERV TIZIMI FAOLLIGI VA VO2 MAX O‘RTASIDAGI BOG‘LIQLIKNI YURAK RITMI O‘ZGARUVCHANLIGI PARAMETRLARI ASOSIDA BAHOLASH

K.U. Rozumbetov [1,2]

[1] Samarqand davlat veterinariya meditsinasi, chorvachilik va biotexnologiyalar universiteti Nukus filiali dotsenti, PhD

[2] Berdaq nomidagi Qoraqalpoq davlat universiteti mustaqil izlanuvchisi

Annotatsiya. *Ushbu tadqiqotda Qoraqalpog‘iston Respublikasida yashovchi bolalarda vegetativ nerv tizimi faolligi va maksimal kislorod iste’moli (VO2 max) o‘rtasidagi bog‘liqlik yurak ritmi o‘zgaruvchanligi (YRO‘) parametrlari asosida baholandi. Tadqiqotda VO2 max hamda YRO‘ ning HF, RMSSD, pNN50, SI va AMo ko‘rsatkichlari o‘rtasidagi korrelyatsion munosabatlar tahlil qilindi. Tadqiqot natijalariga ko‘ra, VO2 max bilan YRO‘ ning o‘rganilgan parametrlari o‘rtasida statistik jihatdan ishonchli korrelyatsion bog‘liqlik aniqlanmadi.*

Kalit so‘zlar: *bolalar, Qoraqalpog‘iston, VO2 max, yurak ritmi o‘zgaruvchanligi, parasimpatik faollik, simpatik faollik.*

Abstract. *In this study, the relationship between autonomic nervous system activity and maximum oxygen consumption (VO2 max) in children living in the Republic of Karakalpakstan was evaluated based on heart rate variability (HRV) parameters. The study analyzed the correlations between VO2 max and HF, RMSSD, pNN50, SI, and AMo. According to the results of the study, no statistically significant correlation was found between the studied parameters of VO2 max and HR.*

Keywords: *children, Karakalpakstan, VO2 max, heart rate variability, parasympathetic activity, sympathetic activity.*

Kirish. Bolalar organizmining funksional holatini baholashda yurak-qon tomir va vegetativ nerv tizimlarining faoliyatini kompleks o‘rganish muhim ahamiyatga ega. Ayniqsa, organizmning jismoniy yuklamaga moslashish imkoniyatlarini baholashda maksimal kislorod iste’moli (VO2 max) aerobik ish qobiliyatining muhim integral ko‘rsatkichlaridan biri hisoblanadi [6]. VO2 max organizmning kislorodni qabul qilish, tashish va undan to‘qimalarda foydalanish imkoniyatlarini aks ettiradi. Yurak ritmi o‘zgaruvchanligi (YRO‘) esa vegetativ nerv tizimining yurak faoliyatiga ta’sirini baholash imkonini beruvchi noinvaziv fiziologik usullardan biridir [9, 10]. YRO‘ning vaqt, statistik, geometrik va chastota sohasidagi parametrlari parasimpatik tizim, vegetativ regulyatsiyaning markazlashuvi va funksional zo‘riqishini tavsiflashda qo‘llaniladi [9, 10]. Shu sababli VO2 max va YRO‘ parametrlarini birgalikda tahlil qilish bolalar organizmining funksional imkoniyatlari hamda vegetativ boshqaruv xususiyatlari o‘rtasidagi munosabatlarni aniqlashga imkon beradi. Qoraqalpog‘iston Respublikasining o‘ziga xos ekologik va iqlim sharoitlari, xususan

Orolbo‘yi hududining ekologik xususiyatlari bolalar organizmining funksional holatini o‘rganishni dolzarb yo‘nalishlardan biriga aylantiradi [3]. Oldingi tadqiqotlarimizda Qoraqalpog‘istonda turli vegetativ regulyatsiyaga ega bo‘lgan navqiron yoshli o‘g‘il bolalarda qo‘shimcha nafas olish qarshiligi sharoitida YRO‘ ko‘rsatkichlarining xususiyatlari hamda COVID-19 pandemiyasi davrida shaxsiy himoya vositalari, jumladan, N95 respiratorlarini uzoq vaqt taqqanda atrof-muhit noqulay sharoitlarining YRO‘ parametrlariga ta’sirini o‘rganganmiz [7, 8]. Shuningdek, yaqinda mahalliy bolalarda yurak ritmining vegetativ regulyatsiyasi o‘rganish bo‘yicha ayrim tadqiqotlar o‘tkazilgan [2]. Biroq, bizga ma’lum bo‘lgan ilmiy adabiyotlarda Janubiy Orolbo‘yi mintaqasida yashovchi bolalarda VO2 max va vegetativ yurak regulyatsiyasi o‘rtasidagi munosabatlarni o‘rganish bo‘yicha ilmiy tadqiqotlar uchramadi.

Tadqiqotning maqsadi Qoraqalpog‘iston Respublikasida yashovchi bolalarda vegetativ nerv tizimi faolligi va VO2 max o‘rtasidagi bog‘liqlikni YRO‘ parametrlari asosida baholashdan iborat.

Material va metodlar

Ishtirokchilar kontingenti. Tadqiqotlar 2024-yilning may oyida Nukus shahrining 8-sonli umumiy o‘rta ta’lim maktabi 12-14 yoshli o‘quvchilarida o‘tkazildi. Tadqiqotlar ikki bosqichda olib borildi.

YRO‘ ni yozib olishning uslubiy jihatlari. Birinchi bosqichda bolalarda YRO‘ ertalab soat 9:00 dan 11:00 gacha yozib olindi. YRO‘ parametrlarini yozib olish tibbiy amaliyotda foydalanish uchun ruxsat (tibbiy texnika mahsulotlarini ro‘yxatga olish guvohnomasi №29/03041202/4999- 03. 17.03.2003 yildan) etilgan, patentlangan qurilma BioMouse (“Biomish professional KPF-01”, Yopiq aksionerlik jamiyati “Neurolab”, Rossiya) dasturiy ta’minot kompleksi yordamida amalga oshirildi [1]. Ushbu qurilma an’anaviy kompyuter sichqonchasi bo‘lib, u fotopletizmografiya usuli bilan YRO‘ parametrlarini yozib olish uchun mo‘ljallangan. Bolalar tibbiy xonada kamida 5 daqiqa o’tirib dam olganidan keyin, YRO‘ parametrlarini tinch holatda yozib olish 5 daqiqa ichida amalga oshirildi [10]. Ushbu muddat YRO‘ parametrlaridan foydalanib VNS tonusini aniqlash uchun maqbul hisoblanadi [9, 10]. R.M. Baevskiy taklif qilgan metod bo‘yicha bolalarda SI (Baevsky’s Stress Index, SI) qiymatiga ko‘ra ishtirokchilar 2 guruhga ajratildi. Jumladan, SI qiymati tinch holatda ≤150 shartli birlik bo‘lsa bu holat ularda parasimpatik tizim tonusining oshganligini ko‘rsatadi [5]. Va aksincha, tinch holatda SI ning qiymati 150 shartli birlikdan oshsa (≥150), bu ularda simpatik tizim tonusining oshganligini ko‘rsatadi [5].

MSFT orqali VO2 max ni aniqlash. Tadqiqotning ikkinchi bosqichi bolalarda VO2 max ni miqdorini aniqlashdan iborat bo‘ldi. Maksimal kislorod iste’molini hisoblash ko‘p bosqichli fitness testini o‘tkazish asosida amalga oshirildi. 20 metr masofaga ko‘p bosqichli fitnes testi (Multi-stage fitness test – MSFT) – bu eng yuqori tezlik va chidamlilik uchun mashhur aerobik sinov. Sinov 20

metr masofada joylashgan ikkita nazorat punkti o‘rtasida doimiy ravishda “shuttle” yugurishini o‘z ichiga oladi. Ushbu usul tajribaning “dala” sharoitida MKI ni aniqlash uchun ishonchli usul hisoblanadi [6].

Statistik tahlillar. YRO‘ parametrlari va VO2 max ni hisoblash natijalarining o‘zaro bog‘liqligini tahlil qilish uchun Spirman korrelyatsiya koeffitsientlari (Spearman’s r_s) hisoblab chiqildi [4]. ρ qiymati 0 ga teng bo‘lsa, statistik aloqa yo‘q deb; 0,01 dan 0,29 gacha (-0,01 dan -0,29 gacha) – zaif ijobiy (salbiy); 0,3 dan 0,69 gacha (-0,3 dan -0,69 gacha) – o‘rtacha ijobiy (salbiy); 0,7 dan 0,99 gacha (-0,7 dan -0,99 gacha) – kuchli ijobiy (salbiy); 1 (-1) - to‘liq ijobiy (salbiy) deb hisoblandi [4]. $p<0,05$ da natijalar statistik jihatdan ahamiyatli deb hisoblangan. Hisob-kitoblar Microsoft Office 2010 dastur paketidan o‘rnatilgan Excel funktsiyalari yordamida amalga oshirildi. O‘rganilgan ko‘rsatkichlardagi farqlarning ishonchliligini statistik tahlil qilish uchun Excel funksiyalari va Past (Version 2.17, Norway, Oslo, 2012) ma’lumotlarni statistik qayta ishlash dasturlari qo‘llanildi. Barcha ma’lumotlar o‘rtacha qiymat (μ), pastki (LL) va yuqori (UL) chegaralari bilan 95% ishonchlilik oralig‘ida (μ; (LL; UL 95% CI)) VO2 max va YRO‘ parametri sifatida taqdim etildi.

Olingan natijalar. Vegetativ nerv tizimi tonusining xususiyatlariga ko‘ra ishtirokchilar parasimpatik tizim tonusi oshgan (n=56) va simpatik tizim tonusi oshgan (n=15) guruhlarga ajratildi. Quyidagi 1-jadvalda o‘rganilgan guruhlarda va umumiy populyatsiyada MSFT va YRO‘ ko‘rsatkichlari tahlilini ko‘rishingiz mumkin.

1-jadval. Umumiy, parasimpatik va simpatik tizim tonusi oshgan guruh ishtirokchilarida MSFT va YRO‘ ko‘rsatkichlari

Umumiy ishtirokchilarda (n=71)	
MSFT	
VO2 max, ml/kg/min	34,50 (33,42; 35,58)
YRO‘ parametrlari	
HF, ms^2	1551,22 (1010,90; 2091,60)
RMSSD, ms	936,05 (838,80; 1033,30)
pNN50, %	11,56 (9,39; 13,73)
SI, sh.b.	98,08 (75,52; 120,64)
AMo, %	37,54 (34,28; 40,80)

Parasimpatik tizim tonusi oshgan guruh ishtirokchilarda (n=56)	
MSFT	
VO2 max, ml/kg/min	33,99 (32,82; 35,17)
YRO‘ parametrlari	
HF, ms^2	1817,15 (1146,00; 2488,40)
RMSSD, ms	1065,41 (968,45; 1162,40)
pNN50, %	14,25 (11,98; 16,52)
SI, sh.b.	58,40 (48,85; 67,95)
AMo, %	32,24 (29,94; 34,55)
Simpatik tizim tonusi oshgan guruh ishtirokchilarda (n=15)	
MSFT	
VO2 max, ml/kg/min	36,40 (33,70; 39,10)
YRO‘ parametrlari	
HF, ms^2	558,38 (448,38; 668,38)
RMSSD, ms	453,20 (391,85; 514,39)
pNN50, %	1,52 (0,85; 2,19)
SI, sh.b.	246,22 (189,16; 303,28)
AMo, %	57,33 (51,15; 63,50)

Barcha ishtirokchilarni qamrab olgan tahlilda VO2 max va YRO‘ parametrlari o‘rtasidagi korrelyatsiya koeffitsientlari nolga yaqin bo‘ldi. Barcha holatlarda $p>0,05$ bo‘lib, statistik jihatdan ahamiyatli korrelyatsion bog‘liqlik aniqlanmadi (2-jadval).

2-jadval. Barcha ishtirokchilarda VO2 max va YRO‘ parametrlari orasidagi korrelyatsion bog‘liqlikni baholash natijalari

n=71	HF, ms^2	RMSSD, ms	pNN50, %	SI, sh.b.	AMo, %

VO2 max, ml/kg/min	ρ=-0,05; p=0,67799	ρ=-0,03; p=0,81194	ρ=-0,006; p=0,96069	ρ=0,02; p=0,85455	ρ=0,03; p=0,82633

Parasimpatik tizim tonusi oshgan guruhda VO2 max bilan HF (ρ=0,16; p=0,245), RMSSD (ρ=0,18; p=0,187) o‘rtasida kuchsiz musbat, shu bilan birga, VO2 max bilan pNN50 (ρ=-0,20; p=0,136), SI (ρ=-0,19; p=0,153) va AMo (ρ=-0,16; p=0,222) o‘rtasida kuchsiz manfiy yo‘nalishdagi korrelyatsiyalar kuzatildi, biroq ushbu bog‘liqliklarning hech biri statistik jihatdan ahamiyatli bo‘lmadi (p>0,05).

3-jadval. Parasimpatik tizim tonusi oshgan guruh ishtirokchilarida VO2 max va YRO‘ parametrlari orasidagi korrelyatsion bog‘liqlikni baholash natijalari

n=56	HF, ms^2	RMSSD, ms	pNN50, %	SI, sh.b.	AMo, %
VO2 max, ml/kg/min	ρ=0,16; p=0,24513	ρ=0,18; p=0,18793	ρ=0,20; p=0,13859	ρ=-0,19; p=0,1531	ρ=-0,16; p=0,22219

Simpatik tizim tonusi oshgan guruhda VO2 max bilan HF o‘rtasida (ρ=-0,04; p=0,871), RMSSD o‘rtasida (ρ=0,17; p=0,553), pNN50 o‘rtasida (ρ=0,31; p=0,255), SI o‘rtasida (ρ=-0,27; p=0,319) va AMo o‘rtasida (ρ=-0,17; p=0,553) korrelyatsiyalar aniqlandi. Biroq, ushbu bog‘liqliklar statistik jihatdan ahamiyatli bo‘lmadi (p>0,05).

4-jadval. Simpatik tizim tonusi oshgan guruh ishtirokchilarida VO2 max va YRO‘ parametrlari orasidagi korrelyatsion bog‘liqlikni baholash natijalari

n=15	HF, ms^2	RMSSD, ms	pNN50, %	SI, sh.b.	AMo, %
VO2 max, ml/kg/min	ρ=-0,04; p=0,87148	ρ=0,17; p=0,55335	ρ=0,31; p=0,25467	ρ=-0,27; p=0,31915	ρ=-0,17; p=0,55335

Shunday qilib, barcha o‘rganilgan guruhlarda VO2 max va YRO‘ ning HF, RMSSD, pNN50, SI hamda AMo ko‘rsatkichlari o‘rtasida statistik jihatdan ishonchli korrelyatsion bog‘liqlik aniqlanmadi (p>0,05).

Xulosa. Tadqiqot natijalari tadqiqotda qatnashgan bolalar tanlanmasida aerobik ish qobiliyatini ifodalovchi VO2 max ko‘rsatkichi va vegetativ yurak regulyatsiyasining o‘rganilgan parametrlari o‘rtasida yaqqol statistik bog‘liqlik mavjudligini tasdiqlamadi.

FOYDALANILGAN ADABIYOTLAR:

1. Бережной В.Н., Брыксин В.Н., Талалаев В.А. Устройство для определения психофизиологического состояния человека. Патент на изобретения № 2214166. Зарегистрирован 20.10.2003. Заявка № 2001130178 от 09.11.2001.

2. Розумбетов К.У. Выявление особенности вегетативной регуляции сердца у подростков Каракалпакстана. XII Республиканская научно-практическая конференция «Эффективное использование природных ресурсов Южного Приаралья». 2-книга. Нукус-2025. стр. 234-238.

3. Розумбетов КУ, Есемуратова СП, Нисанова С, Нажимов ИИ, Есимбетов АТ, Матчанов АТ. Оценка функционального состояния сердечно-сосудистой системы у подростков, проживающих в южном Приаралье. Бюллетень науки и практики. 2021;7(9):331-40.

4. Унгуряну Т.Н., Гржибовский А.М. Корреляционный анализ с использованием пакета статистических программ STATA. Экология человека. 2014. Т. 21. №9. С. 60-64.

5. Baevsky Roman M., Chernikova Anna G.. Heart rate variability analysis: physiological foundations and main methods. Cardiometry. №.10. P. 66-76.

6. Carayanni V, Bogdanis GC, Vlachopapadopoulou E, Koutsouki D, Manios Y, Karachaliou F, Psaltopoulou T, Michalacos S. Predicting VO2max in Children and Adolescents Aged between 6 and 17 Using Physiological Characteristics and Participation in Sport Activities: A Cross-Sectional Study Comparing Different Regression Models Stratified by Gender. Children. 2022; 9(12):1935.

7. Erkudov V, Pugovkin A, Rozumbetov K, Matchanov A, Arachchi S, Rathnayake U. The impact of unfavorable and toxic environmental conditions on autonomic tone modulations while wearing N95 face masks. Case Studies in Chemical and Environmental Engineering. 2024 Jun 1;9:100619.

8. Erkudov VO, Rozumbetov KU, Pugovkin AP, Matchanov AT, Pankova NB. Typological features of autonomic heart rate regulation during imitation of a rise to altitude by using additional respiratory resistance. Human Physiology. 2023 Aug;49(4):393-401.

9. Ernst G. Heart Rate Variability. Springer-Verlag London, 2014. P. 336.

10. Heart Rate Variability. Standards of Measurement, Physiological Interpretation, and Clinical Use. Task Force of the European Society of Cardiology the North American Society of Pacing Electrophysiology. Circulation. 1996. №93. P. 1043-1065

TEMIRTIKAN O‘SIMLIGINING XALQ XO‘JALIGIDAGI AHAMIYATI

Perdebayeva Gulasal Asqar qizi

O‘quv ishlari bo‘yicha direktor o‘rinbosari To‘rtko‘l tuman 1-son texnikumi

asal.askarovna1004@gmail.com

Ajiev Alisher Baxtibayevich – *biologiya fanlari doktori, professor*

Ajiniyoz nomidagi nukus davlat pedagogika instituti

Annotatsiya. *Ushbu tezisda temirtikan (*Tribulus terrestris L.*) o‘simligining biologik xususiyatlari, tarqalishi hamda xalq xo‘jaligidagi ahamiyati yoritilgan. Temirtikanning dorivor xususiyatlari, tarkibidagi biologik faol moddalar va farmatsevtik xomashyo sifatidagi imkoniyatlari haqida ma’lumotlar keltirilgan.*

Kalit so‘zlar: *temirtikan,* Tribulus terrestris*, dorivor o‘simlik, biologik faol moddalar, steroidal saponinlar, flavonoidlar, farmatsevtika.*

Abstract. *This thesis highlights the biological characteristics, distribution, and economic significance of the wild thistle (Tribulus terrestris L.) plant. Information is provided on the medicinal properties of ferula, its biologically active substances, and its potential as a pharmaceutical raw material.*

Keywords: *ferula, Tribulus terrestris, medicinal plant, biologically active substances, steroidal saponins, flavonoids, pharmaceuticals.*

O‘simliklar inson hayotida oziq-ovqat, dorivor xomashyo va boshqa xo‘jalik ehtiyojlarini ta’minlashda muhim tabiiy resurs hisoblanadi. Dorivor o‘simliklarning biologik faol moddalarini o‘rganish farmatsevtika uchun yangi tabiiy xomashyo manbalarini aniqlash imkonini beradi. Temirtikan (*Tribulus terrestris L.*) qadimdan turli an’anaviy tibbiyot tizimlarida qo‘llanib kelgan dorivor o‘simliklardan biridir.

Temirtikan (*Tribulus terrestris L.*) bir yillik, yer bag‘irlab o‘suvchi o‘simlik bo‘lib, **Zygophyllaceae — tuyatovondoshlar oilasiga** mansub. U asosan quruq va issiq iqlimli hududlarda, qumloq va ochiq maydonlarda, yo‘l yoqalarida hamda buzilgan yerlarda uchraydi. O‘simlikning mevasi qattiq va o‘tkir tikanli bo‘laklardan tashkil topishi bilan xarakterlanadi.

Temirtikanning xalq xo‘jaligidagi muhim yo‘nalishlaridan biri uning **dorivor xususiyatlari** bilan bog‘liq. O‘simlikning meva va ildizlari an’anaviy xitoy va hind tabobatida uzoq vaqt davomida turli maqsadlarda ishlatilgan. Zamonaviy fitokimyoviy tadqiqotlarda temirtikan tarkibidan steroidal saponinlar, flavonoidlar, alkaloidlar, taninlar va boshqa biologik faol birikmalar aniqlangan.

Temirtikan tarkibidagi steroidal saponinlar, xususan, furostanol va spirostanol guruhiga mansub birikmalar o‘simlikning asosiy faol komponentlari sifatida qayd etilgan. Tadqiqotlarda

protodiossin va boshqa steroidal saponinlar temirtikan xomashyosining kimyoviy tarkibida uchrashi aniqlangan. Shu sababli ushbu o‘simlik farmakognoziya va farmatsevtik tadqiqotlar uchun muhim obyekt hisoblanadi. [5,6]

Temirtikan flavonoidlarining tarkibi ham o‘rganilgan bo‘lib, ular orasida kversetin, kemferol va izoramnetin hosilalari qayd etilgan. Ushbu birikmalar o‘simlikning biologik faolligini o‘rganishda muhim ahamiyatga ega. Biroq o‘simlik ekstraktlarining biologik va farmakologik ta’siri ularning kelib chiqishi, o‘simlikning qaysi qismidan olingani hamda ekstraksiya usuliga qarab farq qilishi mumkin[2,5]

Temirtikanning farmatsevtik ahamiyatini baholashda xomashyoning kimyoviy tarkibini standartlashtirish muhim hisoblanadi. Ilmiy manbalarda o‘simlik tarkibidagi faol moddalar miqdori geografik hudud, o‘sish sharoiti, yig‘ish vaqti va o‘simlikning foydalanilayotgan organiga qarab sezilarli darajada o‘zgarishi mumkinligi ko‘rsatilgan. Shu sababli temirtikandan dorivor xomashyo sifatida foydalanishda xomashyoning sifat ko‘rsatkichlarini nazorat qilish talab etiladi. [2,7]

Temirtikanning xo‘jalikdagi yana bir o‘ziga xos jihati uning tikanli mevalaridir. Yetilgan mevalardagi o‘tkir tikanlar hayvonlar oyoqlariga yopishishi yoki shikast yetkazishi, shuningdek, qishloq xo‘jaligi maydonlarida begona o‘t sifatida muammo tug‘dirishi mumkin. Shu sababli temirtikanning tarqalishini nazorat qilish ayrim qishloq xo‘jaligi hududlarida amaliy ahamiyatga ega. [4]

Temirtikan qurg‘oqchil va issiq sharoitlarga moslashgan o‘simlik sifatida tabiiy o‘simlik qoplamining tarkibiy qismi hisoblanadi. Uning ochiq maydonlar, yo‘l yoqalari va buzilgan yerlarda o‘sishi ekologik moslashuvchanligini ko‘rsatadi. Shu bilan birga, o‘simlikning tabiiy populyatsiyalaridan dorivor xomashyo sifatida foydalanishda tabiiy resurslarni muhofaza qilish va oqilona yig‘ish talab etiladi. [5]

Xulosa Temirtikan (*Tribulus terrestris L.*) biologik faol birikmalarga boy bo‘lgan dorivor o‘simliklardan biridir. Uning tarkibida steroidal saponinlar, flavonoidlar, alkaloidlar va boshqa birikmalar mavjudligi aniqlangan. O‘simlik xomashyosining kimyoviy tarkibi va biologik xususiyatlarini o‘rganish uning farmatsevtik ahamiyatini aniqlashda muhim hisoblanadi. [1,2]

Temirtikandan xalq xo‘jaligida samarali foydalanish uchun uning biologik xususiyatlari, kimyoviy tarkibi va xomashyo sifat ko‘rsatkichlarini chuqur o‘rganish zarur. Shuningdek, o‘simlikning tabiiy zaxiralaridan oqilona foydalanish va xomashyoni standartlashtirish uning amaliy qiymatini oshirishga xizmat qiladi. [2,7]

FOYDALANILGAN ADABIYOTLAR

1. Zhu W., Du Y., Meng H. et al. A review of traditional pharmacological uses, phytochemistry, and pharmacological activities of *Tribulus terrestris*. BMC Chemistry, 2017.

2. Ștefănescu R., Tero-Vescan A., Negroiu A. et al. A Comprehensive Review of the Phytochemical, Pharmacological, and Toxicological Properties of *Tribulus terrestris* L. Biomolecules, 2020

3. Chhatre S., Nesari T., Somani G. et al. Phytopharmacological overview of *Tribulus terrestris*. Pharmacognosy Reviews, 2014.

4. *Tribulus terrestris L.* haqidagi zamonaviy botanik va ekologik ma’lumotlar. Plants of the World Online (Kew Science).

5. Zhu W., Du Y., Meng H. et al. *Tribulus terrestris* tarkibidagi steroidal saponinlar va flavonoidlar bo‘yicha fitokimyoviy tadqiqotlar. BMC Chemistry, 2017.

6. Cai L., Wu Y., Zhang J. et al. Steroidal saponins from *Tribulus terrestris*. Planta Medica, 2001,

7. Ștefănescu R., Tero-Vescan A., Negroiu A. et al. *Tribulus terrestris* ekstraktlarini standartlashtirish va kimyoviy tarkibining o‘zgaruvchanligi. Biomolecules, 2020

ALOE VERA EKSTRAKTINING FARMAKOLOGIK VA TOKSIKOLOGIK XUSUSIYATLARINI O‘RGANISH

Adirbekova Lalagul Muratbekovna magistrant

Samarqand davlat veterinariya meditsinasi, chorvachilik va biotexnologiyalar universiteti Nukus filiali

E-mail: lolaadirbekova@gmail.com

Annotatsiya. *Aloe vera (Aloe barbadensis Miller) dorivor o‘simligi qadim zamonlardan buyon xalq tabobatida keng qo‘llanilib kelinadi. Zamonaviy ilmiy tadqiqotlar ushbu o‘simlik tarkibida biologik faol polisaxaridlar, flavonoidlar, vitaminlar, fermentlar, aminokislotalar va fenolik birikmalar mavjudligini tasdiqlagan. Mazkur moddalar Aloe vera ekstraktining farmakologik faolligini belgilaydi. Ushbu tezisda Aloe vera ekstraktining yallig‘lanishga qarshi, antioksidant, antibakterial, yara bitkazuvchi va immunomodulyator xususiyatlari ilmiy adabiyotlar asosida tahlil qilindi. Shuningdek, ekstrakt tarkibidagi ayrim komponentlarning toksikologik xususiyatlari ham baholandi. Tahlillar shuni ko‘rsatdiki, Aloe vera ekstrakti terapevtik jihatdan istiqbolli tabiiy vosita bo‘lsa-da, uni qo‘llashda doza, qo‘llash muddati va preparat sifatini nazorat qilish muhim hisoblanadi.*

Kalit so‘zlar: *Aloe vera, ekstrakt, farmakologiya, toksikologiya, biologik faol moddalar, antioksidant, yara bitishi, polisaxarid.*

Abstract. *The medicinal plant Aloe vera (Aloe barbadensis Miller) has been widely used in folk medicine since ancient times. Modern scientific research has confirmed the presence of biologically*

active polysaccharides, flavonoids, vitamins, enzymes, amino acids, and phenolic compounds in this plant. These substances determine the pharmacological activity of Aloe vera extract. In this thesis, the anti-inflammatory, antioxidant, antibacterial, wound-healing, and immunomodulatory properties of Aloe vera extract were analyzed based on scientific literature. The toxicological properties of certain components in the extract were also evaluated. The analysis showed that although Aloe vera extract is a promising natural remedy from a therapeutic perspective, it is important to control the dosage, duration of use, and quality of the preparation when using it.

Keywords: *Aloe vera, extract, pharmacology, toxicology, biologically active substances, antioxidant, wound healing, polysaccharide.*

Kirish. Dorivor o‘simliklar inson salomatligini saqlash va kasalliklarning oldini olishda muhim tabiiy manbalardan biri hisoblanadi. So‘nggi yillarda o‘simliklardan olinadigan biologik faol moddalar asosida yangi dori vositalarini yaratishga bo‘lgan qiziqish ortib bormoqda. Bunga asosiy sabab sintetik preparatlar bilan bog‘liq ayrim nojo‘ya ta'sirlarning mavjudligi hamda tabiiy preparatlarga bo‘lgan talabning oshishidir.

Aloe vera dunyoning ko‘plab mamlakatlarida yetishtiriladigan dorivor o‘simliklardan biri bo‘lib, u Asphodelaceae oilasiga mansub. Uning barglari ikki asosiy qismdan iborat: shaffof gel va sarg‘ish rangli lateks. Gel tarkibi asosan suv, polisaxaridlar, vitaminlar, minerallar, aminokislotalar va fermentlardan tashkil topgan bo‘lsa, lateks tarkibida aloin va emodin kabi antraxinon birikmalari uchraydi.

Aloe vera geli tibbiyotda kuyishlar, trofik yaralar, dermatologik kasalliklar, stomatit, gastrit hamda kosmetologiyada terini parvarish qilish maqsadida keng qo‘llanadi. Bundan tashqari, ilmiy tadqiqotlarda uning antioksidant, antimikrob, immunomodulyator va gipoglikemik ta'sirlari ham qayd etilgan.

Biroq Aloe vera preparatlarining barcha turlari ham mutlaqo xavfsiz emas. Ayniqsa, barg po‘stlog‘idan olinadigan lateks tarkibidagi antraxinonlarning yuqori dozalarda qo‘llanilishi ichak faoliyatining buzilishi, elektrolitlar muvozanatining o‘zgarishi va boshqa nojo‘ya holatlarga sabab bo‘lishi mumkin. Shu sababli ushbu o‘simlikning farmakologik samaradorligi bilan bir qatorda toksikologik xavfsizligini ham chuqur o‘rganish dolzarb masala hisoblanadi.

Mazkur tezisning maqsadi Aloe vera ekstraktining farmakologik va toksikologik xususiyatlarini zamonaviy ilmiy adabiyotlar asosida tahlil qilish hamda uning amaliy tibbiyotdagi istiqbollarini baholashdan iborat.

MATERIAL VA METODLAR

Mazkur tezis ilmiy adabiyotlarni tahlil qilish usuli asosida tayyorlandi. Tadqiqot davomida Aloe vera ekstraktining farmakologik va toksikologik xususiyatlariga bag‘ishlangan mahalliy va xorijiy

ilmiy maqolalar, monografiyalar hamda xalqaro jurnallarda chop etilgan sharh maqolalari o‘rganildi. Olingan ma'lumotlar qiyosiy tahlil qilinib, ularning ilmiy ahamiyati umumlashtirildi.

Tahlil jarayonida Aloe vera tarkibidagi biologik faol moddalar, ularning organizmga ta'sir mexanizmi hamda preparatlarning xavfsizligi bo‘yicha e'lon qilingan ilmiy natijalar solishtirildi. Shuningdek, farmakologik samaradorlik va toksikologik xavfsizlikka oid zamonaviy qarashlar baholandi.

ALOE VERANING KIMYOVIY TARKIBI

Aloe vera bargi 98–99 % suvdan iborat bo‘lsa-da, qolgan qismida biologik faol moddalar juda ko‘p uchraydi. Aynan ushbu moddalar o‘simlikning shifobaxsh xususiyatlarini ta'minlaydi.

Aloe vera tarkibida quyidagi asosiy biologik faol komponentlar mavjud:

- polisaxaridlar (asemannan, glukomannan);
- flavonoidlar;
- fenolik birikmalar;
- antraxinonlar (aloin, emodin);
- vitaminlar (A, C, E, B guruhi);
- minerallar (kalsiy, magniy, kaliy, natriy, rux, temir);
- aminokislotalar;
- fermentlar;
- saponinlar;
- organik kislotalar.

Asemannan Aloe vera tarkibidagi eng muhim polisaxaridlardan biri bo‘lib, immun tizim faoliyatini rag‘batlantirishda muhim ahamiyatga ega. Flavonoidlar va fenolik birikmalar esa kuchli antioksidant xususiyatga ega bo‘lib, hujayralarni erkin radikallar ta'siridan himoya qiladi.

FARMAKOLOGIK XUSUSIYATLARI

Yallig‘lanishga qarshi ta'siri

Yallig‘lanish organizmning himoya reaksiyasi hisoblanadi. Ammo uzoq davom etuvchi yallig‘lanish turli kasalliklarning rivojlanishiga sabab bo‘ladi.

Aloe vera tarkibidagi polisaxaridlar, flavonoidlar va sterollar yallig‘lanish mediatorlarining hosil bo‘lishini kamaytiradi. Natijada shish, og‘riq va qizarish pasayadi.

Ilmiy tadqiqotlarda Aloe vera geli kuyish, dermatit, ekzema va boshqa teri kasalliklarida yallig‘lanishni kamaytirishi aniqlangan.

Antioksidant ta'siri

Organizmda erkin radikallarning ortib ketishi oksidlovchi stressni yuzaga keltiradi. Bu esa hujayralarning shikastlanishiga, qarish jarayonining tezlashishiga va ko‘plab surunkali kasalliklarning rivojlanishiga sabab bo‘ladi.

Aloe vera tarkibidagi C va E vitaminlari, flavonoidlar hamda fenolik birikmalar kuchli antioksidant hisoblanadi.

Ular:

- hujayra membranalarini himoya qiladi;
- lipidlarning oksidlanishini kamaytiradi;
- DNK zararlanishining oldini oladi;
- immun tizim faoliyatini qo‘llab-quvvatlaydi.

Shu sababli Aloe vera ekstrakti yurak-qon tomir kasalliklari, qandli diabet va surunkali yallig‘lanishlarda yordamchi vosita sifatida istiqbolli hisoblanadi.

Antibakterial va zamburug‘larga qarshi ta'siri

Aloe vera ekstrakti tarkibidagi saponinlar, fenolik moddalar va antraxinonlar ayrim bakteriyalar hamda zamburug‘larga qarshi biologik faollik ko‘rsatadi.

Tadqiqotlarda Aloe vera quyidagi mikroorganizmlarning o‘sishini sekinlashtirishi aniqlangan:

Staphylococcus aureus;

Escherichia coli;

Pseudomonas aeruginosa;

Candida albicans.

Mazkur xususiyat sababli Aloe vera stomatologiya, dermatologiya va jarrohlik amaliyotida keng qo‘llaniladi.

Yara bitkazuvchi ta'siri

Aloe vera geli fibroblast hujayralarining ko‘payishini rag‘batlantiradi hamda kollagen sintezini kuchaytiradi. Natijada shikastlangan to‘qimalarning tiklanish jarayoni tezlashadi.

Shuningdek, Aloe vera yara yuzasida nam muhit hosil qilib, yangi epiteliy hujayralarining hosil bo‘lishini tezlashtiradi. Shu sababli u kuyishlar, kesilgan yaralar, trofik yaralar va operatsiyadan keyingi jarohatlarni davolashda keng qo‘llaniladi.

Immunomodulyator ta'siri

Aloe vera ekstrakti organizmning immun tizimiga ijobiy ta'sir ko'rsatishi bilan ham ajralib turadi. Uning tarkibidagi asemannan polisaxaridi makrofaglar, limfotsitlar va boshqa immun hujayralarning faolligini oshirishi aniqlangan. Natijada organizmning infeksiyalarga qarshi tabiiy himoya mexanizmlari kuchayadi.

Ilmiy tadqiqotlarda asemannan interleykinlar va interferonlar ishlab chiqarilishini rag'batlantirishi, bu esa immun javobning kuchayishiga xizmat qilishi qayd etilgan. Shu sababli Aloe vera ekstrakti ayrim virusli va bakterial infeksiyalarda yordamchi vosita sifatida o'rganilmoqda.

Bundan tashqari, immun tizimining me'yoriy faoliyatini qo'llab-quvvatlashi tufayli u organizmning tiklanish jarayonlarini tezlashtirishga ham yordam beradi.

Ovqat hazm qilish tizimiga ta'siri

Aloe vera geli oshqozon va ichak shilliq qavatini himoya qiluvchi xususiyatga ega. Tadqiqotlar natijasiga ko'ra, u gastrit va oshqozon yarasi kabi kasalliklarda shilliq qavatning tiklanishini tezlashtirishi mumkin.

Ayrim ilmiy ishlarda Aloe vera ekstrakti ichak mikroflorasining muvozanatini yaxshilashga yordam berishi ham qayd etilgan. Shu bilan birga, barg po'stlog'idan olinadigan lateks kuchli surgi ta'siriga ega bo'lganligi sababli uni uzoq muddat iste'mol qilish tavsiya etilmaydi.

TOKSIKOLOGIK XUSUSIYATLARI

Aloe vera geli odatda xavfsiz hisoblanadi. Biroq barg po'stlog'idan olinadigan lateks tarkibidagi aloin va emodin kabi antraxinonlar yuqori dozalarda organizmga salbiy ta'sir ko'rsatishi mumkin.

Eng ko'p uchraydigan nojo'ya ta'sirlar quyidagilar hisoblanadi:

- ich ketishi;
- qorin sohasida og'riq;
- suvsizlanish;
- elektrolitlar muvozanatining buzilishi;
- kaliy miqdorining kamayishi;
- allergik reaksiyalar.

Uzoq muddat davomida yuqori dozada qo'llanilganda ayrim tadqiqotlarda jigar va buyrak faoliyatiga salbiy ta'sir kuzatilgan. Shu sababli Aloe vera preparatlarini shifokor tavsiyasiga binoan hamda belgilangan dozada qo'llash tavsiya etiladi.

Homilador ayollar, emizikli onalar hamda surunkali jigar va buyrak kasalliklari bo'lgan bemorlarda Aloe vera lateksidan foydalanish tavsiya etilmaydi.

Muhokama. Ilmiy adabiyotlar tahlili shuni ko'rsatadiki, Aloe vera ekstrakti biologik faol moddalar manbai sifatida katta amaliy ahamiyatga ega. Uning antioksidant, yallig'lanishga qarshi, yara bitkazuvchi va antibakterial xususiyatlari ko'plab tadqiqotlar bilan tasdiqlangan.

Shu bilan birga, tadqiqotlar natijalarida ayrim tafovutlar ham uchraydi. Bu asosan o'simlik yetishtirilgan hudud, ekstraksiya usuli, xomashyo sifati va qo'llanilgan dozaga bog'liq. Shuning

uchun Aloe vera asosidagi preparatlarni standartlashtirish, sifat nazoratini kuchaytirish va klinik tadqiqotlarni kengaytirish zarur.

Farmatsevtika sanoatida Aloe vera ekstraktidan foydalanish istiqbollari yuqori bo'lib, kelgusida uning yangi dori vositalari yaratishdagi ahamiyati yanada ortishi kutilmoqda.

XULOSA

Ilmiy adabiyotlar tahliliga ko'ra, Aloe vera ekstrakti biologik faol moddalar manbai sifatida yuqori farmakologik faollikka ega. U antioksidant, yallig'lanishga qarshi, antibakterial, immunomodulyator va yara bitkazuvchi ta'sir ko'rsatadi.

Biroq preparatlarni qo'llashda toksikologik xavfsizlik masalasiga ham jiddiy e'tibor qaratish lozim. Ayniqsa, antraxinonlar saqlovchi lateks preparatlaridan uzoq muddat foydalanish nojo'ya ta'sirlarni keltirib chiqarishi mumkin.

Kelgusida Aloe vera ekstrakti asosida yangi dori vositalarini yaratish, ularning klinik samaradorligini baholash va xavfsiz dozalarini aniqlash bo'yicha ilmiy tadqiqotlarni davom ettirish maqsadga muvofiqdir.

FOYDALANILGAN ADABIYOTLAR

[1 Choi S., Chung M.H. A Review on the Relationship Between Aloe vera Components and Their Biological Effects.]

[2 Hamman J.H. Composition and Applications of Aloe vera Leaf Gel. Molecules. 2008.]

[3 Hutter J.A. va boshqalar. Antioxidant Properties of Aloe vera.]

[4 Keshavarzi Z. va boshqalar. Pharmacological Effects of Aloe vera.]

[5 O'simlik preparatlari farmakologiyasi bo'yicha zamonaviy ilmiy manbalar.]

[6 Reynolds T., Dweck A.C. Aloe vera Leaf Gel: A Review Update. Journal of Ethnopharmacology. 1999.]

[7 Surjushe A., Vasani R., Saple D.G. Aloe vera: A Short Review. Indian Journal of Dermatology. 2008.]

BIOLOGICALLY ACTIVE PLANT COMPOUNDS AS PROMISING ANTITUMOR AGENTS: KEGG-BASED ANALYSIS OF MOLECULAR MECHANISMS OF BERBERIS HETEROPODA SCHRENK AND JUNIPERUS COMMUNIS L.

Assan Gulmira Kudaibergenkyzy, Zhumash Akzhunis Sagatbekkyzy, Ablaikhanova Nurzhanyat Tatukhanovna

Al-Farabi Kazakh National University, Almaty, Kazakhstan

E-mail: gulmiraasan28@gmail.com Tel.: +77078166256

Abstract: *The search for novel anticancer agents with high biological efficacy and acceptable selectivity remains an important task in modern biomedicine. Medicinal plants are valuable sources of chemically diverse compounds capable of modulating multiple cellular targets. This study analyzes potential molecular mechanisms underlying the antitumor activity of Berberis heteropoda Schrenk and Juniperus communis L. using published evidence and KEGG-oriented interpretation of signaling pathways. B. heteropoda has a rich phytochemical profile comprising anthocyanins, phenolic compounds, and alkaloids; major fruit anthocyanins include delphinidin-, cyanidin-, petunidin-, peonidin-, and malvidin-3-O-glucosides. For J. communis, experimental studies have demonstrated extract-induced cytotoxicity in colorectal adenocarcinoma cells, cell-cycle arrest, and activation of extrinsic and intrinsic apoptotic pathways. KEGG provides a framework for integrating genes, proteins, and cellular signaling pathways. PI3K/Akt/mTOR, p53, MAPK, and apoptosis are among the most relevant pathways for further validation. These findings support comprehensive investigation of plant extracts in tumor and normal cell models, including cytotoxicity, apoptosis, oxidative stress, mitochondrial function, and DNA damage.*

Keywords: *Berberis heteropoda Schrenk, Juniperus communis L., KEGG, cytotoxicity, apoptosis, PI3K/Akt, p53, plant-derived compounds.*

INTRODUCTION The development of novel anticancer agents requires compounds capable of preferentially affecting tumor cells while overcoming cellular resistance. Tumor progression involves dysregulation of proliferation, cell cycle, metabolism, DNA repair, and programmed cell death. Therefore, analysis of interconnected signaling networks is important for understanding tumor-cell survival.

Natural products are important sources of potential anticancer compounds because of their chemical diversity and ability to influence multiple molecular processes. Of particular interest are compounds that alter survival and apoptotic signaling, induce oxidative stress, disturb mitochondrial function, or affect cell-cycle regulation.

Berberis heteropoda Schrenk is notable for its diverse phytochemical composition. Major anthocyanins identified in its fruits include delphinidin-3-O-glucopyranoside, cyanidin-3-O-

glucopyranoside, petunidin-3-O-glucopyranoside, peonidin-3-O-glucopyranoside, and malvidin-3-O-glucopyranoside [1, p. 19078–19096]. A separate study identified phenolic, flavonoid, and anthocyanin components, with 32 polyphenolic compounds detected by UPLC-Q-TOF-MSE [2, p. e0262622].

Juniperus communis L. is also characterized by a broad spectrum of biologically active constituents. Lai et al. reported that J. communis extract showed cytotoxic activity against colorectal adenocarcinoma cells, induced G0/G1 cell-cycle arrest, and activated extrinsic and intrinsic apoptotic pathways [3, p. e10891].

MATERIALS AND METHODS

The study was based on a structured analysis of scientific publications available in PubMed and indexed in international bibliographic databases. Particular attention was given to studies addressing the phytochemical composition of Berberis heteropoda Schrenk and Juniperus communis L., the biological activity of their extracts and individual compounds, cytotoxicity, apoptosis, cell-cycle regulation, oxidative stress, mitochondrial dysfunction, DNA damage, and molecular mechanisms involved in tumor development.

The available evidence was comparatively evaluated to identify the major biologically relevant compounds and molecular processes associated with the potential antitumor activity of the selected plants. Special emphasis was placed on studies investigating p53, PI3K/Akt/mTOR, MAPK, apoptosis, and related regulatory pathways.

A KEGG-oriented approach was used for functional interpretation of potential molecular mechanisms. KEGG integrates genomic information with higher-order functional information, while its PATHWAY database provides representations of cellular processes, including signal transduction and the cell cycle [4, p. 27–30]. The identified molecular targets and biological processes were conceptually mapped to relevant KEGG pathways to determine their possible relationships with tumor-cell proliferation, survival, oxidative stress, DNA damage, and apoptosis.

In addition, the literature data were used to formulate a working molecular model for subsequent experimental validation. The proposed mechanisms include ROS accumulation, mitochondrial dysfunction, modulation of the Bax/Bcl-2 balance, activation of caspases, PARP cleavage, and regulation of PI3K/Akt/mTOR and p53 signaling. KEGG analysis was therefore used to organize and interpret literature-derived molecular targets rather than as a substitute for experimental validation.

RESULTS AND DISCUSSION

The phytochemical profile of Berberis heteropoda Schrenk is characterized by diverse biologically active compounds. Major anthocyanins have been identified in the fruits, together with

pronounced antioxidant activity of the anthocyanin fraction [1, p. 19078–19096]. Further analysis revealed a broad spectrum of polyphenolic compounds [2, p. e0262622]. These findings provide a basis for further investigation of the plant’s potential anticancer activity.

For Juniperus communis L., direct experimental evidence of anticancer potential is available. The extract reduced colorectal adenocarcinoma cell viability, induced cell-cycle arrest, and promoted apoptosis through interconnected p53/p21, Bax/Bcl-2/caspase, and Fas/FasL/caspase signaling cascades [3, p. e10891]. Tumor-growth suppression was also observed in a xenograft model, supporting further molecular investigation.

KEGG-oriented interpretation integrates these mechanisms into a common signaling framework. Key nodes include PI3K/Akt/mTOR, p53, MAPK, and apoptosis, which regulate proliferation, survival, cell-cycle progression, and programmed cell death. A proposed sequence is disruption of redox homeostasis → increased ROS → mitochondrial dysfunction → altered Bax/Bcl-2 balance → caspase activation → PARP cleavage → apoptosis, accompanied by modulation of PI3K/Akt/mTOR and p53 signaling. This model represents a working hypothesis requiring experimental validation [5, p. 1233].

Further research should compare 30%, 50%, and 70% aqueous ethanol extracts of B. heteropoda and J. communis using HT-29, HCT-116, MCF-7, MDA-MB-231, and Raji tumor models together with appropriate normal-cell models. Cytotoxicity and selectivity may be assessed by MTT/IC_{50}, while cell-death mechanisms may be investigated using Annexin V/PI, DCFH-DA, JC-1, γ-H2AX, and Western blotting for p53, Bax, Bcl-2, caspase-3/9, and PARP. Additional assessment of ATM/ATR, CHK1/CHK2, and PI3K/Akt/mTOR may link DNA damage and replication stress with apoptotic signaling.

CONCLUSION

Berberis heteropoda Schrenk and Juniperus communis L. are promising sources of biologically active plant compounds with potential anticancer properties. The phytochemical potential of B. heteropoda is supported by identified anthocyanins and diverse polyphenols, whereas J. communis has experimental evidence of cytotoxicity, cell-cycle arrest, and apoptosis in colorectal adenocarcinoma models. KEGG-oriented integration highlights PI3K/Akt/mTOR, p53, MAPK, and apoptosis as priority pathways for experimental validation. Combining MTT, flow cytometry, ROS and mitochondrial assays, γ-H2AX, and Western blotting may facilitate elucidation of molecular mechanisms underlying selective tumor-cell death.

REFERENCES

1. Sun L.-L., Gao W., Zhang M.-M., Li C., Wang A.-G., Su Y.-L., Ji T.-F. Composition and antioxidant activity of the anthocyanins of the fruit of Berberis heteropoda Schrenk. Molecules.

2014;19(11):19078–19096. MDPI, Basel, Switzerland. DOI: 10.3390/molecules191119078. PubMed PMID: 25415473.

2. Sun J., Li Q., Li J., Liu J., Xu F. Nutritional composition and antioxidant properties of the fruit of Berberis heteropoda Schrenk. PLoS ONE. 2022;17(4):e0262622. Public Library of Science, San Francisco, USA. DOI: 10.1371/journal.pone.0262622. PubMed PMID: 35390002.

3. Lai W.-L., Lee S.-C., Chang K.-F., Huang X.-F., Li C.-Y., Lee C.-J., Wu C.-Y., Hsu H.-J., Tsai N.-M. Juniperus communis extract induces cell cycle arrest and apoptosis of colorectal adenocarcinoma in vitro and in vivo. Brazilian Journal of Medical and Biological Research. 2021;54(10):e10891. Associação Brasileira de Divulgação Científica, São Paulo, Brazil. DOI: 10.1590/1414-431X2020e10891. PubMed PMID: 34287579.

4. Kanehisa M., Goto S. KEGG: Kyoto Encyclopedia of Genes and Genomes. Nucleic Acids Research. 2000;28(1):27–30. Oxford University Press, Oxford, UK. DOI: 10.1093/nar/28.1.27. PubMed PMID: 10592173.

5. Ablaikhanova N., Assan G., Kurbannazarova R., et al. Plant-Derived Natural Products and Selective Apoptosis: A Cancer-Cell Vulnerability-State Framework from Redox Imbalance to Membrane–Ion Dysregulation. Pharmaceuticals. 2026;19(8):1233. DOI: 10.3390/ph19081233.

IRSIY KASALLIKLARNI DAVOLASHDA ZAMONAVIY BIOTEXNOLOGIK YONDASHUVLAR GEN TERAPIYASI VA GEN TAHRIRLASH TEXNOLOGIYALARINING ISTIQBOLLARI

Abdusayitov Jonibek Sadullayevich, Erkinov Otabek Anvarovich

Samarqand davlat veterinariya meditsinasi, chorvachilik va biotexnologiyalar universiteti, biotexnologiya ta’lim yo‘nalishi 202-guruh talabalari

Tel: +998954672607

E-mail: jonibekabdusayitov@gmail.com

Abdullayeva Yulduz Ulug‘murodovna

Samarqand davlat veterinariya meditsinasi, chorvachilik va biotexnologiyalar universiteti, biotexnologiya kafedrasi v.b., dotsenti

Tel: +998973997536

E-mail: bdllvldz@gmail.com

Annotatsiya. *Mazkur maqolada irsiy kasalliklarni davolashda zamonaviy biotexnologik yondashuvlarning ahamiyati, gen terapiyasi va gen tahrirlash texnologiyalarining molekulyar asoslari hamda tibbiyotdagi qo‘llanish istiqbollari yoritilgan. Gen terapiyasida kasallikni keltirib*

chiqaruvchi nuqsonli gen faoliyatini tiklash, almashtirish yoki uning ta’sirini kamaytirish usullari, shuningdek, davolovchi genlarni hujayralarga yetkazish tamoyillari ko‘rib chiqilgan. Shuningdek, CRISPR/Cas tizimi asosida genetik materialdagi aniq o‘zgarishlarni amalga oshirish, irsiy mutatsiyalarni tuzatish va kasallikning molekulyar sababini bartaraf etishga qaratilgan yondashuvlar tahlil qilingan.

Abstract. *This article highlights the importance of modern biotechnological approaches in treating hereditary diseases, the molecular foundations of gene therapy and gene editing technologies, and the prospects for their application in medicine. Gene therapy examines methods for restoring, replacing, or reducing the activity of a disease-causing defective gene, as well as the principles of delivering therapeutic genes to cells. Approaches aimed at implementing specific changes in genetic material based on the CRISPR/Cas system, correcting genetic mutations, and eliminating the molecular cause of the disease were also analyzed.*

Keywords: *Hereditary diseases, biotechnological approaches, gene therapy, gene editing, CRISPR/Cas system, genetic mutation, molecular therapy.*

Kalit so‘zlar: *Irsiy kasalliklar, biotexnologik yondashuvlar, gen terapiyasi, gen tahrirlash, CRISPR/Cas tizimi, genetik mutatsiya, molekulyar davolash.*

Kirish: Irsiy kasalliklar genlar yoki xromosomalardagi o‘zgarishlar natijasida yuzaga keladigan murakkab kasalliklar guruhidir. Genetik nuqsonlar natijasida muhim oqsillarning tuzilishi yoki funksiyasi buzilishi, ayrim hollarda esa ularning sintezi to‘xtashi mumkin. Shu sababli irsiy kasalliklarni davolashda kasallik belgilarini kamaytirish bilan bir qatorda, uning molekulyar-genetik sabablariga bevosita ta’sir ko‘rsatadigan usullarni ishlab chiqish zamonaviy biotibbiyotning muhim vazifalaridan biriga aylangan.

Gen terapiyasining shakllanishi ushbu muammoni hal qilishda muhim bosqich bo‘ldi. Dastlabki klinik gen terapiyasi tadqiqotlari 1990-yilda adenozindeaminaza yetishmovchiligi bilan bog‘liq og‘ir kombinatsiyalangan immun tanqislik kasalligida olib borilgan. Blaese va hammualliflari genetik jihatdan tuzatilgan T-limfotsitlardan foydalanish orqali yetishmayotgan gen faoliyatini tiklash imkoniyatini o‘rgandilar. Keyingi kuzatuvlarda gen kiritilgan hujayralarning uzoq muddat saqlanishi qayd etildi. Bu ishlar gen terapiyasining klinik yo‘nalish sifatida shakllanishiga asos bo‘ldi.

Keyingi yillarda gen terapiyasida qo‘llaniladigan tashuvchi tizimlar takomillashtirildi va turli irsiy kasalliklarda terapevtik genlarni maqsad hujayralarga yetkazish imkoniyatlari o‘rganildi. Biroq dastlabki tadqiqotlar genetik materialni organizmga xavfsiz yetkazish, immun javob va uzoq muddatli samaradorlik kabi muammolar mavjudligini ham ko‘rsatdi. Masalan, 1999-yilda ornithin transkarbamilaza yetishmovchiligi bo‘lgan bemorda adenovirus asosidagi gen terapiyasidan keyin

og‘ir tizimli yallig‘lanish reaksiyasi kuzatilishi ushbu texnologiyalarning xavfsizligini chuqur o‘rganish zarurligini ko‘rsatgan muhim hodisalardan biri bo‘ldi.

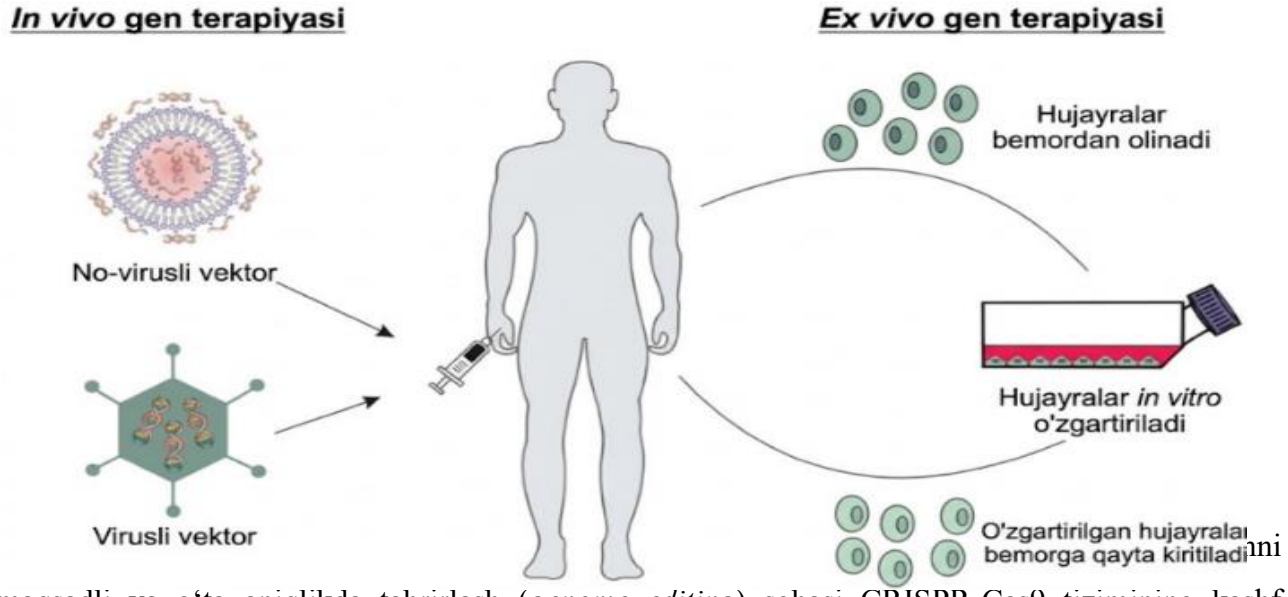
Gen terapiyasi bilan bir qatorda genomni bevosita o‘zgartirishga imkon beradigan texnologiyalarning rivojlanishi irsiy kasalliklarni davolashga bo‘lgan qarashlarni yanada o‘zgartirdi. Ayniqsa, 2012-yilda Emmanuelle Charpentier va Jennifer Doudna tomonidan CRISPR/Cas9 tizimining genomni maqsadli tahrirlash vositasiga aylantirilishi molekulyar genetika rivojida muhim burilish yasadi. Ushbu kashfiyot uchun ular 2020-yilda kimyo bo‘yicha Nobel mukofotiga sazovor bo‘ldilar.

Mazkur maqolada irsiy kasalliklarni davolashga qaratilgan gen terapiyasi va genomni tahrirlash texnologiyalarining shakllanishi va rivojlanishi, ushbu yo‘nalishda olib borilgan muhim ilmiy tadqiqotlar, ularning asosiy natijalari, klinik qo‘llanilish imkoniyatlari, mavjud muammolar va kelajak istiqbollari ilmiy adabiyotlar asosida tahlil qilinadi.

Asosiy qism: Gen terapiyasi va uning klassik hamda zamonaviy mexanizmlari. Gen terapiyasi – patogen mutatsiyaga uchragan yoki yetishmayotgan gen funksiyasini tiklash uchun hujayra ichiga genetik material kiritishga asoslangan biotexnologik usuldir [2, 455-b.]. Hozirgi kunda gen terapiyasi asosan ikki yo‘nalishda amalga oshiriladi [2, 456-b.]:

Ex-vivo gen terapiyasi: Bemor organizmidan (masalan, suyak ko‘migi ildiz hujayralari) hujayralar ajratib olinib, *in-vitro* sharoitida genetik o‘zgartirish yoki tuzatish kiritiladi va qayta bemor tanasiga kiritiladi [2, 457-b.].

In-vivo gen terapiyasi: Rekombinant genetik konstruksiya va uni yetkazib beruvchi vektorlar bevosita bemorning qon tomiriga yoki maqsadli organiga (masalan, to‘r parda, mushak yoki jigar to‘qimasiga) yuboriladi [3, 493-b.].



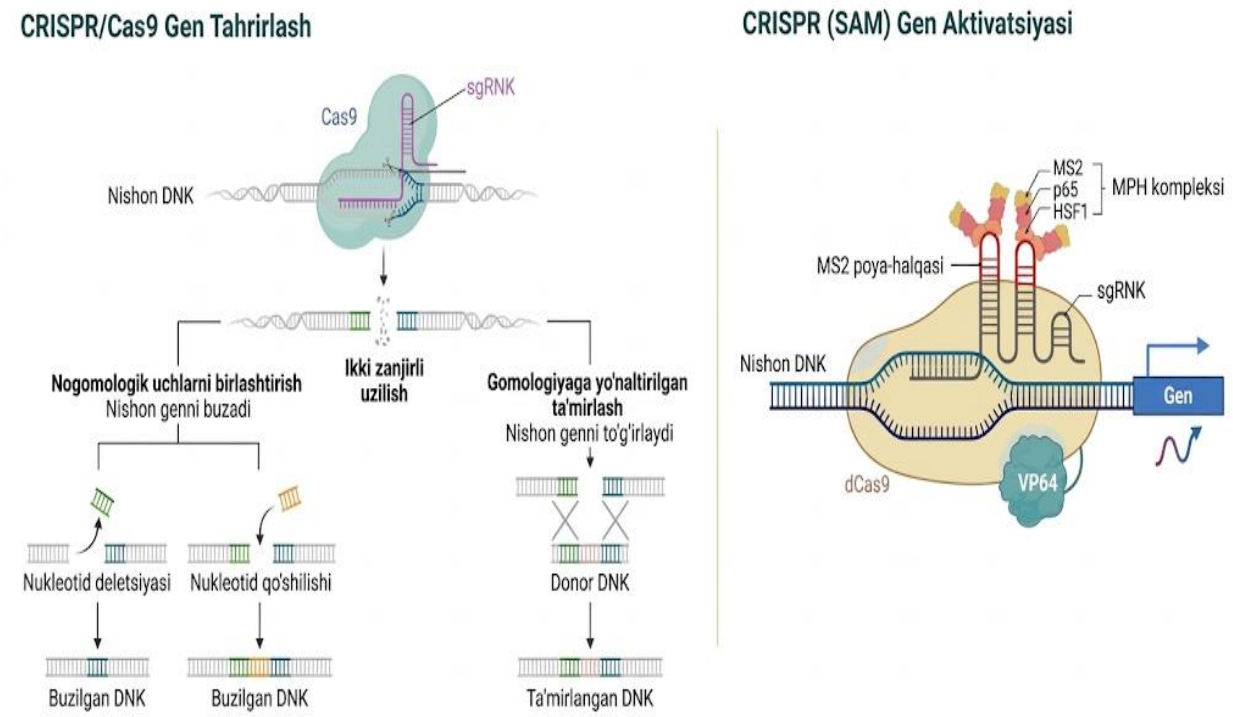
ni maqsadli va o‘ta aniqlikda tahrirlash (*genome editing*) sohasi CRISPR-Cas9 tizimining kashf

qilinishi bilan yangi bosqichga ko‘tarildi [1, 1258096-b.]. CRISPR-Cas9 tizimi gid RNK (gRNA) yordamida DNK zanjirining muayyan nuqtasini topadi va Cas9 nukleazasi orqali qo‘shzanjirli uzilish (DSB) hosil qiladi [1, 1258096-b]. Bu esa mutatsiyalangan gen fermentini o‘chirish (*knock-out*) yoki to‘g‘ri geni joylashtirish (*knock-in*) imkonini beradi [4, 121-b.].

Biotexnologik amaliyotdagi eng katta yutuqlardan biri sifatida Casgevy (exagamglogene autotemcel) preparatini keltirish mumkin [5, 12-b.]. Ushbu CRISPR-Cas9 ga asoslangan ex-vivo gen terapiyasi o‘rqasimon hujayrali anemiya (*Sickle Cell Disease*) va beta-talassemiya bilan og‘rigan bemorlarda fetal gemoglobin (HbF) sintezini tiklash orqali kasallikni to‘liq davolashda FDA va EMA tomonidan rasman tasdiqlandi [5, 14-b.].

Shu bilan birga, CRISPR tizimining takomillashtirilgan ko‘rinishlari — Base Editing (asoslarni tahrirlash) va Prime Editing texnologiyalari ishlab chiqildi [6, 824-b.]. Ushbu usullar DNK zanjirida ikki tomonlama uzilishlar hosil qilmagan holda, bitta nukleotidli mutatsiyalarni (nuqtali mutatsiyalar) o‘ta aniqlik bilan to‘g‘rilash imkoniyatini berib, nojo‘ya ta'sirlar hamda xromosoma va strukturaviy o‘zgarishlar xavfini keskin kamaytiradi [6, 825-b.].

2-rasm.CRISPR/Cas9 gen tahrirlash va CRISPRa (SAM) gen aktivatsiyasining qiyosiy sxemasi



Irsiy kasalliklarni tashxislashda PZR analizining roli va zamonaviy turlari. Irsiy kasalliklarni biotexnologik usullar bilan davolashdan oldin ularni molekulyar-genetik darajada o‘ta aniqlik bilan tashxislash talab etiladi. Bu borada Polimeraza zanjir reaksiyasi (PZR) genetik va irsiy

patologiyalarni, nuqtali mutatsiyalarni hamda xromosoma o‘zgarishlarini aniqlashning eng asosiy ekspress-usuli hisoblanadi [7, 102-b.].

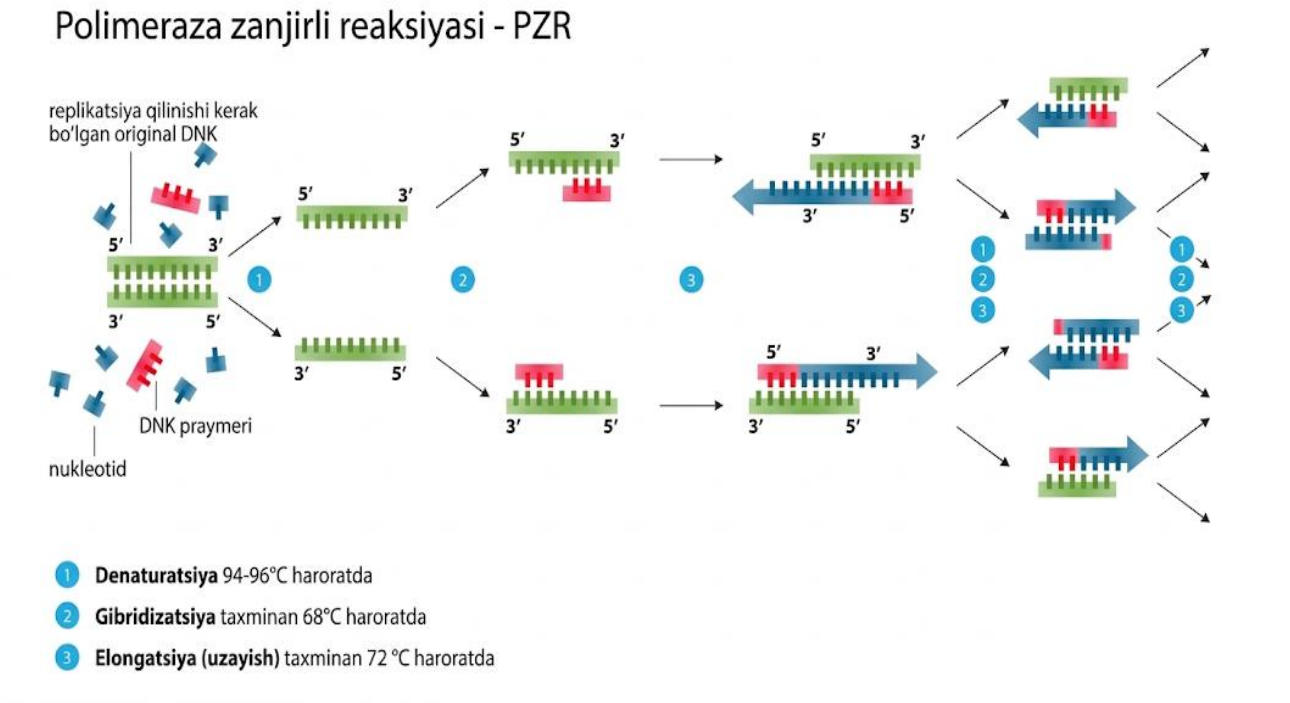
PCR usuli DNKning ma'lum bir fragmentini in vitro sharoitida millionlab marotaba amplifikatsiya qilish (nusxalash) imkonini beradi [7, 105-b.]. Bugungi kunda biomeditsina va biotexnologiyada PCR analizi quyidagi zamonaviy modifikatsiyalarda qo‘llaniladi:

Real-Time PCR (Real vaqtdagi PCR / qPCR): Amplifikatsiya jarayonini real vaqt rejimida fluorestsent bo‘yoqlar va zondlar (TaqMan) yordamida kuzatish imkonini beradi. Ushbu usul irsiy kasalliklar keltirib chiqaruvchi mutatsiyalashgan genlarning miqdoriy ekspressiyasini aniqlashda o‘ta yuqori sezgirlikka ega [8, 215-b.].

Reverse Transcription PCR (RT-PCR): Matritsa sifatida RNK molekulasidan foydalanib, avval teskari transkriptaza fermenti yordamida komplementar DNK (kDNK) sintez qilinadi, so‘ngra amplifikatsiya amalga oshiriladi. Bu usul genlar ekspressiyasi darajasini va gipotetik mRNK o‘zgarishlarini baholashda qo‘llaniladi [8, 218-b.].

Digital Droplet PCR (ddPCR - Raqamli tomchili PCR): Reaksiya aralashmasini minglab kichik mikrotomchilarga bo‘lish orqali absolut miqdoriy tahlilni amalga oshiradi. ddPCR kam uchraydigan somatik mutatsiyalarni hamda mozaitsizmni aniqlashda standart PCR ga nisbatan 100 baravar yuqori aniqlikni ta’minlaydi [9, 340-b.].

Irsiy kasalliklar klinikada PCR yordamida restriksion fragmentlar uzunligi polimorfizmi (RFLP), allelingizga xos PCR (AS-PCR) hamda sekvenirlash (NGS) bilan birgalikda aniqlanadi. Bu esa gen terapiyasi yoki CRISPR tahririni o‘tkazishdan oldin bemor genomidagi muayyan mutatsiyani aniq xaritalash imkonini beradi [9, 345-b.].



3-rasm. Polimeraza zanjiri reaksiyasi (PCR) bosqichlarining diagrammasi

Xulosa: Olib borilgan tadqiqotlar va chop etilgan ilmiy manbalar tahlili shuni ko‘rsatadiki, zamonaviy biotexnologik yondashuvlar irsiy kasalliklarni etiotrop, ya'ni sababiy davolashda yuqori samaradorlikni namoyon etmoqda. Real-Time PCR hamda raqamli tomchili PCR diagnostika usullari mutatsiyaga uchragan genlarni va nuqtali o‘zgarishlarni molekulyar darajada o‘ta aniq tashxislash imkonini berib, maqsadli gen terapiyasini rejalashtirish uchun mustahkam zamin yaratadi. CRISPR-Cas9 hamda takomillashtirilgan *Base Editing* platformalari DNK zanjiridagi genetik nuqsonlarni o‘ta aniqlik bilan to‘g‘rilash va nojo‘ya ta'sirlarni keskin kamaytirish xususiyatiga ega. Kelajakda ushbu texnologiyalarning xavfsizligini yanada oshirish va ularni amaliyotga keng joriy etish biomeditsinaning eng istiqbolli yo‘nalishlaridan biriga aylanadi.

ADABIYOTLAR RO‘YXATI:

1. Doudna, J. A., Charpentier, E. The new frontier of genome engineering with CRISPR-Cas9 // Science. – Washington: AAAS, 2014. – Vol. 346, No. 6213. – P. 1258096.
2. High, K. A., Roncarolo, M. G. Gene therapy // New England Journal of Medicine. – Boston: Massachusetts Medical Society, 2019. – Vol. 381, No. 5. – P. 455-464.
3. Gillmore, J. D., et al. CRISPR-Cas9 in vivo gene editing for transthyretin amyloidosis // New England Journal of Medicine. – Boston: Massachusetts Medical Society, 2021. – Vol. 385, No. 6. – P. 493-502.

4. Cox, D. B., Platt, R. J., Zhang, F. Therapeutic genome editing: prospects and challenges // Nature Medicine. – London: Nature Publishing Group, 2015. – Vol. 21, No. 2. – P. 121-131.

5. FDA Clinical Review. Casgevy (exagamglogene autotemcel) summary of product characteristics // U.S. Food and Drug Administration. – Silver Spring: FDA, 2023. – P. 1-25.

6. Anzalone, A. V., Koblan, L. W., Liu, D. R. Genome editing with transcriptional and translational precision // Nature Biotechnology. – London: Nature Publishing Group, 2020. – Vol. 38, No. 7. – P. 824-844.

7. Mullis, K. B., Faloona, F. A. Specific synthesis of DNA in vitro via a polymerase-catalyzed chain reaction // *Methods in Enzymology*. – San Diego: Academic Press, 1987. – Vol. 155. – P. 102-115.

8. Bustin, S. A., et al. The MIQE guidelines: minimum information for publication of quantitative real-time PCR experiments // *Clinical Chemistry*. – Washington: AACC, 2009. – Vol. 55, No. 4. – P. 215-222.

9. Hindson, B. J., et al. High-throughput droplet digital PCR system for absolute quantitation of DNA copy number variations // *Analytical Chemistry*. – Washington: ACS Publications, 2011. – Vol. 83, No. 22. – P. 3404-3410.

НАКОПЛЕНИЕ ТЯЖЕЛЫХ МЕТАЛЛОВ ИЗ ПОЧВЫ В ОРГАНИЗМЕ РАСТЕНИЙ И ИХ ТОКСИЧЕСКОЕ ВОЗДЕЙСТВИЕ

Каипбекова Наргиза Марат кызы

Магистрантка 2-го курса Нукусского филиала Самаркандского государственного университета ветеринарной медицины, животноводства и биотехнологий

Аннотация. *В данной работе рассмотрены тяжелые металлы, содержащиеся в почве, пути их поступления в организм растений, особенности их накопления в корневой системе и надземных органах, а также токсическое воздействие на физиологические и биохимические процессы. Проанализировано влияние таких тяжелых металлов, как Pb, Cd, Hg, Cr, Ni, As и Zn, на рост, развитие, фотосинтез и продуктивность растений.*

Ключевые слова: *почва, тяжелые металлы, растения, токсичность, биоаккумуляция, фотосинтез, экологическая безопасность.*

Abstract. *This work examines the heavy metals contained in the soil, their pathways to the plant body, the specifics of their accumulation in the root system and above-ground organs, as well*

as their toxic effects on physiological and biochemical processes. The influence of heavy metals such as Pb, Cd, Hg, Cr, Ni, As, and Zn on plant growth, development, photosynthesis, and productivity has been analyzed.

Keywords: *soil, heavy metals, plants, toxicity, bioaccumulation, photosynthesis, environmental safety.*

В настоящее время загрязнение почвы тяжелыми металлами является одной из важных экологических проблем. В результате промышленной деятельности, транспорта, горнодобывающей и металлургической промышленности, а также неправильного использования минеральных удобрений и пестицидов тяжелые металлы могут накапливаться в почве, длительное время сохраняться в ней и усваиваться растениями. Это оказывает негативное влияние на плодородие почвы, физиологическое состояние растений, их продуктивность и безопасность пищевых продуктов. Воздействие тяжелых металлов на растения зависит не только от их концентрации, но и от химической формы, значения pH почвы, содержания органического вещества, влажности и вида растения. Основная часть металлов поступает в растение через корневую систему, где может накапливаться в тканях корня или перемещаться по ксилеме и флоэме в стебли, листья, плоды и семена. Некоторые металлы также могут поступать на надземные органы растений из атмосферной пыли и аэрозолей.

Cd является одним из наиболее опасных токсичных металлов для растений и поступает в окружающую среду в результате городских отходов, производственных процессов, а также использования синтетических фосфорных удобрений [8]. Повышение концентрации Cd в почве способствует увеличению его поглощения растениями. Cd нарушает процессы обмена веществ, фотосинтеза и транспирации, изменяет активность ферментов и усиливает окислительный стресс. Кроме того, он подавляет синтез белков и нуклеиновых кислот, что может приводить к замедлению роста растений и развитию хлороза листьев [2].

Pb является одним из наиболее распространенных и высокотоксичных загрязнителей почвы среди тяжелых металлов. Он преимущественно накапливается в корневой системе растений и в ограниченном количестве перемещается в надземные органы. Pb нарушает процессы фотосинтеза, деления клеток, поглощения воды и обмена веществ, а также ингибирует активность ряда ферментов [4]. Кроме того, Pb может взаимодействовать с металлопротеинами и клеточными транспортными системами, нарушая обмен таких важных элементов, как Fe^{2+} и Ca^{2+}, в клетках [11]. В результате у растений наблюдаются замедление роста и развития, нарушения физиологических процессов и снижение образования биомассы.

Zn является необходимым микроэлементом для растений и при низких концентрациях выполняет функцию кофактора в структурной и функциональной активности многих ферментов и белков [7]. Однако избыточное накопление Zn в почве оказывает токсическое воздействие на растения. Высокие концентрации Zn могут ограничивать поглощение других важных элементов, нарушать физиологические процессы растений и приводить к снижению темпов их роста. Поэтому переход Zn от биологически необходимого элемента к токсичному в первую очередь зависит от его концентрации и вида растения.

Hg является высокотоксичным, мобильным и летучим загрязнителем. Он может поступать в атмосферу в результате сжигания угля, промышленных выбросов и испарения с загрязненных водоемов, после чего распространяться на значительные расстояния. Hg воздействует на функционирование хлоропластов и митохондрий растительных клеток, нарушая транспорт электронов в процессах фотосинтеза и окислительного метаболизма [10]. Кроме того, высокие концентрации Hg могут снижать способность растений поглощать воду, что приводит к замедлению общего роста и развития.

Cr в почве встречается преимущественно в формах Cr(III) и Cr(VI). Между этими формами существуют значительные различия по токсичности и подвижности: Cr(VI) вследствие высокой подвижности является значительно более токсичным по сравнению с Cr(III). Растения поглощают Cr преимущественно через корневую систему. Высокие концентрации Cr снижают всхожесть семян, рост и продуктивность растений, нарушают процесс фотосинтеза и усиливают окислительный стресс [9].

As не является необходимым элементом для растений и при высоких концентрациях оказывает выраженное токсическое воздействие. As может поступать в почву с продуктами сжигания угля, выбросами металлургической промышленности, минеральными удобрениями и другими антропогенными источниками [5]. Поглощенный корнями растений As подавляет развитие корневой системы и деление клеток, ограничивает формирование растительной биомассы, снижает оплодотворение и продуктивность растений [5, 6]. Токсичность As также зависит от его химической формы и подвижности в почве; в почвах, содержащих активные формы Fe, Al и Ca, он относительно прочно связывается.

В отличие от других тяжелых металлов, Se в определенных концентрациях может быть полезен для растений, однако при его избыточном содержании проявляется выраженное токсическое действие. Основными внешними признаками токсичности Se являются хлороз и некроз листьев, замедление роста растений, ослабление развития корневой системы и снижение продуктивности. Воздействие Se на растения прежде всего зависит от его концентрации в почве и биологических особенностей вида растения.

В целом загрязнение сельскохозяйственных почв тяжелыми металлами может быть обусловлено воздействием сточных вод, промышленных выбросов, минеральных удобрений, пестицидов и атмосферных загрязнений. Переход тяжелых металлов из почвы в сельскохозяйственные культуры, а затем в пищевые продукты представляет опасность для здоровья человека и животных [3]. Степень накопления тяжелых металлов в растениях зависит от свойств почвы, вида сельскохозяйственной культуры, агротехнических мероприятий и концентрации металла [1]. Высокие концентрации Cu, Zn и Pb снижают биомассу почвенных микроорганизмов и активность ферментов, нарушая процессы разложения органических веществ и круговорота питательных элементов [12]. Избыточное накопление тяжелых металлов нарушает процессы фотосинтеза, дыхания, минерального питания и ферментативной активности растений, что приводит к снижению их роста, развития и продуктивности. Поэтому изучение миграции тяжелых металлов и особенностей их накопления в растениях, а также применение экологически безопасных биологических методов, таких как фиторемедиация, имеют важное научное и практическое значение [13].

СПИСОК ИСПОЛЬЗОВАННОЙ ЛИТЕРАТУРЫ:

1. Chabukdhara M, Munjal A, Nema AK, et al. Heavy metal contamination in vegetables grown around peri-urban and urbanindustrial clusters in Ghaziabad, India. Hum Ecol Risk Assess. 2016;22(3):736-752.

2. Dutta A, Patra A, Jatav HS, et al. Toxicity of cadmium in soil-plant-human continuum and its bioremediation techniques. In: Soil Contamination-Threats and Sustainable Solutions. IntechOpen; 2020. p. 22.

3. Erkudov VO, Rozumbetov KU, Pugovkin AP, et al. Assessment of youth fitness under long-term exposure to toxic environmental conditions due to pesticides: Case from Aral Sea region. Case Studies in Chemical and Environmental Engineering. 2023 Dec 1;8:100504.

4. Fahr M, Laplaze L, Bendaou N, et al. Effect of lead on root growth. Front Plant Sci. 2013 Jun 6;4:175.

5. Finnegan PM, Chen W. Arsenic Toxicity: The Effects on Plant Metabolism. Front. Physio. 2012. 3:182.

6. Garg N, Singla P. Arsenic toxicity in crop plants: Physiological effects and tolerance mechanisms. Environmental chemistry letters. 2011. 9(3), 303–321.

7. Guarino F, Improta G, Triassi M, et al. Effects of Zinc Pollution and Compost Amendment on the Root Microbiome of a Metal Tolerant Poplar Clone. Front Microbiol. 2020 Jul 15;11:1677.

8. Haider FU, Liqun C, Coulter JA, et al. Cadmium toxicity in plants: Impacts and remediation strategies. Ecotoxicol Environ Saf. 2021 Mar 15;211:111887.

9. Oliveira H. Chromium as an Environmental Pollutant: Insights on Induced Plant Toxicity. Journal of Botany. 2012. 375843, 8 pages, 2012.

10. Pacyna JM. Recent advances in mercury research. Sci Total Environ. 2020 Oct 10;738:139955.

11. Rehan M, Alsohim AS. Bioremediation of heavy metals. In: Environmental Chemistry and Recent Pollution Control Approaches. IntechOpen; 2019. p. 145-158.

12. Sobolev D, Begonia MF. Effects of heavy metal contamination upon soil microbes: lead-induced changes in general and denitrifying microbial communities as evidenced by molecular markers. Int J Environ Res Public Health. 2008 Dec;5(5):450-6.

13. Yadav A, Hasan M, Kour S, et al. Heavy metal contamination in plants: sources, monitoring, and data-driven insights. Macromol Symp. 2025;414:2400239.

DORIVOR GULXAYRI (ALTHAEA OFFICINALIS L.) O‘SIMLIGINING UCHINCHI VEGETATSIYA YILIDA ILDIZ HOSILDORLIGINING EKISH MUDDATLARIGA BOG‘LIQLIGI

Boratova O‘g‘iloy Qodirjon qizi , Andijon Qishloq xo‘jaligi va agrotexnalogiyalar instituti Mustaqil doktoranti

Baratova Mohidil Raximovna, Toshkent irrigatsiya va qishloq xo‘jaligini mexanizatsiyalash muhandislari instituti professori, q.f.d.

Annotatsiya. *Dorivor gulxayri (*Althaea officinalis *L.) o‘simligining uchinchi vegetatsiya yilidagi ildiz hosildorligiga ekish muddatlari va organik o‘g‘itlashning ta’siri o‘rganilgan. 2025-yilda Andijon, Beshariq va Kosonsoy hududlarida qayd etilgan tajriba ma’lumotlari asosida uchta ekish muddati bo‘yicha nazorat va organik o‘g‘itli variantlarning o‘rtacha hosildorlik ko‘rsatkichlari qiyoslangan. Barcha hududlarda organik o‘g‘it qo‘llangan variantlarda ildiz hosildorligi nazoratga nisbatan yuqori bo‘lgan.*

Kalit so‘zlar: *dorivor gulxayri,* Althaea officinalis *L., ildiz hosildorligi, organik o‘g‘it, ekish muddati, uchinchi vegetatsiya yili, agroekologik sharoit, dorivor xomashyo.*

Abstract *The effect of planting dates and organic fertilization on the root yield of medicinal marshmallow (*Althaea officinalis* L.) during its third year of vegetation was investigated. Based on experimental data recorded in 2025 in the Andijan, Beshariq, and Kosonsoy regions, the average yield indicators of control variants and those treated with organic fertilizer were compared across three planting dates. In all regions, root yields in the variants treated with organic fertilizer were higher than those in the control group.*

Keywords: *medicinal marshmallow, *Althaea officinalis* L., root yield, organic fertilizer, planting date, third year of vegetation, agro-ecological conditions, medicinal raw material.*

Dorivor o‘simliklarni yetishtirishda asosiy vazifalardan biri yuqori hosildorlikka ega, biologik faol moddalarga boy va sifat talablariga javob beradigan xomashyo olishdan iborat. Gulxayridoshlar (Malvaceae Juss.) oilasiga mansub dorivor gulxayri (*Althaea officinalis* L.) ildizi tarkibidagi shilliq polisaxaridlar va boshqa biologik faol birikmalar bilan farmatsevtika sanoatida muhim ahamiyat kasb etadi. O‘simlikning ildiz hosildorligi uning biologik xususiyatlari bilan bir qatorda ekish muddati, tuproq unumdorligi, namlik rejimi va oziqlanish sharoitlariga ham bog‘liq. Shu sababli turli agroekologik hududlarda ekish muddatlari hamda organik o‘g‘itlarning hosildorlikka ta’sirini o‘rganish dorivor gulxayrini yetishtirish texnologiyasini takomillashtirishda muhim hisoblanadi.

Tadqiqotda dorivor gulxayrining uchinchi vegetatsiya yilida, ya’ni 2025-yilda Andijon, Beshariq va Kosonsoy hududlarida qayd etilgan ildiz hosildorligi ko‘rsatkichlari tahlil qilindi. Tajribada 20-mart, 5-aprel va 20-aprel sanalarida ekilgan variantlar nazorat (o‘g‘itsiz) hamda organik o‘g‘it qo‘llangan variantlarga ajratildi. Har bir variant bo‘yicha uchta takror ko‘rsatkichlari va ularning o‘rtacha qiymatlari taqqoslandi.

1-jadval.

Dorivor gulxayrining uchinchi vegetatsiya yilidagi ildiz hosildorligi (s/ga)

№	Ekish Muddatlari	Variantlar	2025-yil dorivor gulxayrining ildiz hosildorligi s/t											
			Andijon				Beshariq				Kosonsoy			
				II	III	O‘rtacha	I	II	III	O‘rtacha	I	II	III	O‘rtacha
1	1-mudda	Nazorat (o‘g‘itsiz)	13.2	13.5	13.3	**13.3**	10.5	10.8	10.6	**10.6**	11.8	12.1	11.9	**11.9**

2		Organik o‘g‘itli	15.8	16.1	15.9	**15.9**	12.7	13.0	12.8	**12.8**	14.2	14.5	14.3	**14.3**
3	**2-muddat (05.04.2023)**	Nazorat (o‘g‘itsiz)	12.9	13.2	13.0	**13.0**	10.2	10.5	10.3	**10.3**	11.4	11.7	11.5	**11.5**
4		Organik o‘g‘itli	15.2	15.5	15.3	**15.3**	12.3	12.6	12.4	**12.4**	13.5	13.8	13.6	**13.6**
5	**3-muddat (20.04.2023)**	Nazorat (o‘g‘itsiz)	12.5	12.8	12.6	**12.6**	9.9	10.2	10.0	**10.0**	11.0	11.3	11.1	**11.1**
6		Organik o‘g‘itli	14.7	15.0	14.8	**14.8**	12.0	12.3	12.1	**12.1**	13.0	13.3	13.1	**13.1**

Izoh: jadvalda har bir hudud va variant bo‘yicha uchta takrorning o‘rtacha hosildorlik qiymatlari keltirilgan. Birlik dastlabki ma’lumotdagi s/t belgisiga muvofiq s/ga (sentner/gektar) sifatida talqin qilindi.

Tahlil natijalariga ko‘ra, organik o‘g‘it qo‘llash barcha hududlarda va barcha ekish muddatlarida ildiz hosildorligining oshishi bilan bog‘liq bo‘ldi. Birinchi ekish muddatida Andijon hududida nazorat variantining o‘rtacha hosildorligi 13,3 s/ga, organik o‘g‘itli variantda esa 15,9 s/ga ni tashkil etdi. Farq 2,6 s/ga bo‘ldi. Beshariq hududida hosildorlik 10,6 s/ga dan 12,8 s/ga gacha, Kosonsoyda esa 11,9 s/ga dan 14,3 s/ga gacha oshdi. Ikkinchi ekish muddatida ham o‘g‘itli variantlarda yuqori ko‘rsatkichlar qayd etildi. Andijonda nazorat va organik o‘g‘itli variantlar hosildorligi mos ravishda 13,0 va 15,3 s/ga, Beshariqda 10,3 va 12,4 s/ga, Kosonsoyda esa 11,5 va 13,6 s/ga bo‘ldi. Uchinchi ekish muddatida mazkur ko‘rsatkichlar Andijonda 12,6 va 14,8 s/ga, Beshariqda 10,0 va 12,1 s/ga, Kosonsoyda 11,1 va 13,1 s/ga ni tashkil etdi. Barcha ekish muddatlari bo‘yicha o‘g‘itli variantlarda hosildorlikning mutlaq ortishi 2,1–2,6 s/ga oralig‘ida bo‘ldi. Bu natijalar organik o‘g‘it qo‘llangan sharoitlarda ildiz hosildorligi yuqoriroq shakllanganini ko‘rsatadi. Organik o‘g‘itlar tuproqdagi organik modda miqdori, namlikni saqlash xususiyati va oziq elementlarining mavjudligiga ijobiy ta’sir ko‘rsatishi mumkin. Biroq mazkur omillarning har birining hissasini aniqlash uchun tuproq tahlillari va o‘g‘it tarkibi bo‘yicha qo‘shimcha ma’lumotlar talab etiladi. Hududlar kesimida eng yuqori ildiz hosildorligi Andijonda, eng past ko‘rsatkichlar esa Beshariqda qayd etildi. Birinchi ekish muddatidagi organik o‘g‘itli variantda Andijon hosildorligi 15,9 s/ga, Beshariqda 12,8 s/ga va Kosonsoyda 14,3 s/ga bo‘ldi. Bu tafovutlar hududlarning tuproq unumdorligi, namlik bilan ta’minlanganligi va boshqa agroekologik omillari bilan bog‘liq bo‘lishi mumkin. Biroq hududlar o‘rtasidagi farqlar sababini

qat’iy belgilash uchun tuproq-iqlim ko‘rsatkichlarini alohida baholash zarur. Ekish muddatlari bo‘yicha taqqoslash natijasida uchala hududda ham 20-martda ekilgan variantlarda ildiz hosildorligi yuqoriroq, 20-aprelda ekilgan variantlarda esa pastroq bo‘ldi. Masalan, Andijon hududida organik o‘g‘itli variant hosildorligi birinchi muddatda 15,9 s/ga, uchinchi muddatda 14,8 s/ga ni tashkil etdi. Shunga o‘xshash tendensiya Beshariq va Kosonsoy hududlarida ham kuzatildi. Bu natijalar o‘rganilgan sharoitlarda ertaroq ekish muddatining afzalligi bo‘lishi mumkinligini ko‘rsatadi. Xulosa qilib aytganda, dorivor gulxayrining uchinchi vegetatsiya yilidagi ildiz hosildorligi ekish muddati, organik o‘g‘itlash varianti va yetishtirish hududiga qarab farqlandi. Barcha hududlarda organik o‘g‘it qo‘llangan variantlarda nazoratga nisbatan yuqori hosildorlik qayd etildi. Eng yuqori ko‘rsatkich Andijon hududida 20-martda ekilgan organik o‘g‘itli variantda 15,9 s/ga ni tashkil etdi. Olingan ma’lumotlar dorivor gulxayrini yetishtirishda ekish muddatlarini maqbul tanlash va organik o‘g‘itlardan samarali foydalanish muhimligini ko‘rsatadi. Kelgusida ushbu natijalarni statistik usullar bilan tekshirish, tuproq unumdorligi va o‘g‘it me’yorlarini hisobga olish hamda ildiz xomashyosidagi shilliq moddalar miqdorini aniqlash yetishtirish texnologiyasini yanada asoslash imkonini beradi.

FOYDALANILGAN ADABIYOTLAR

1. To‘xtayev B.Yo. Dorivor o‘simliklar plantatsiyasi. – Toshkent, 2015. – 137–144 b.
2. To‘xtayev B.Yo. Dorivor o‘simliklar ekologiyasi. – Toshkent, 2014. – 88–126 b.
3. To‘xtayev B.Yo. Dorivor o‘simliklar atlasi. – Toshkent, 2018. – 144–248b.
4. Tyler V.E. Pharmacognosy. – Philadelphia, 1988. – 214–367 p.
5. Vavilov N.I. O‘simliklar genofondi. – Moskva, 1935. – 88–214 b.
6. Xue T.T. Althaea officinalis chemical profile. – 2022. – 120–134 p.
7. Murdaxayev Yu.M. O‘zbekistonda dorivor o‘simliklar. – Toshkent: Fan, 1990. – 76–112 b.
8. Musaev B.S. Agrokimyo. – Toshkent, 2001. – 125–148 b. Mustafayev S., Xolmurodov A. O‘simliklar bioekologiyasi. – Toshkent: Fan, 1992. – 126–270 b.

ДИРОФИЛЯРИОЗ СОБАК В УСЛОВИЯХ ИЗМЕНЕНИЯ КЛИМАТА: БИОЛОГИЯ ПАРАЗИТА, РОЛЬ ПЕРЕНОСЧИКОВ И НОВЫЕ ЭПИДЕМИОЛОГИЧЕСКИЕ РИСКИ

Азербайджанский государственный аграрный университет
Факультет ветеринарной медицины
Аиша Кязымлы, студентка 3-го курса бакалавриата
aishakazimli07@gmail.com
ORCID ID: 0009-0003-5753-5903
Научный руководитель: доцент Кушвар Мамедова
kgmammadova@gmail.com
ORCID ID: 0000-0002-6293-2079

Аннотация:*Дирофиляриоз собак, прежде всего вызываемый нематодой Dirofilaria immitis, представляет собой трансмиссивное заболевание, распространение которого зависит от взаимодействия паразита, позвоночного хозяина, комаров-переносчиков и окружающей среды. В последние годы изменение климатических условий рассматривается как один из факторов, способных менять пространственную и сезонную динамику заболевания. В статье рассмотрены биология D. immitis, основные этапы жизненного цикла, значение собак как резервуарного хозяина и роль комаров родов Aedes, Culex и Anopheles. Особое внимание уделено температурной зависимости развития личинок в переносчике. При подходящих температурах развитие до инфекционной стадии L3 происходит быстрее, а потенциальный сезон передачи может становиться продолжительнее. Современные европейские данные показывают расширение циркуляции Dirofilaria spp. за пределы традиционных южных регионов, включая части Центральной и Восточной Европы. При этом климат не является единственной причиной: значение имеют перемещение собак, беспризорные животные, урбанизация, орошение, наличие мест размножения комаров и изменения их видового состава. Поэтому оценка риска должна учитывать паразита, переносчика, хозяина и окружающую среду одновременно. Для ветеринарной практики особенно важны профилактика у собак, раннее выявление инфекции, мониторинг комаров и объединение ветеринарных и экологических данных. Такой подход соответствует принципам One Health и позволяет лучше подготовиться к изменению эпидемиологической ситуации.*

Ключевые слова: *дирофиляриоз; Dirofilaria immitis; собаки; комары; переносчики; изменение климата; эпидемиология; векторные заболевания; One Health.*

Введение: Дирофиляриоз редко воспринимается владельцами собак как заболевание, связанное с климатом. На практике ситуация сложнее. Для завершения жизненного цикла Dirofilaria immitis необходим кровососущий переносчик, а значит, любые изменения условий, влияющих на комаров, потенциально отражаются и на передаче паразита. Собака при этом остаётся главным резервуарным хозяином, поддерживающим циркуляцию микрофилярий в популяции.

Dirofilaria immitis вызывает кардиолёгочную дирофиляриозную инфекцию у собак. Взрослые гельминты локализуются преимущественно в лёгочных артериях, а при высокой интенсивности инвазии могут обнаруживаться в правых отделах сердца. Самки выделяют микрофилярии в кровь. При кровососании комар заглатывает их вместе с кровью заражённой собаки. В организме переносчика паразит проходит дальнейшее развитие и формирует инвазионные личинки L3, которые при следующем укусе передаются новому хозяину (Simón et al., 2012; McCall et al., 2021). За последние десятилетия эпидемиологическая картина в Европе изменилась. Если в XX веке автохтонная циркуляция Dirofilaria spp. в основном связывалась с южными регионами, то современные обзоры показывают увеличение числа сообщений из Центральной, Западной и Восточной Европы. Систематический обзор 2025 года выявил D. immitis в 17 таксонах комаров; особенно часто положительные находки были связаны с Culex pipiens sensu lato и Aedes caspius (Hattendorf & Lühken, 2025). Изменение климата следует рассматривать не как единственное объяснение, а как фактор, который может усиливать действие других причин. Потепление способно ускорять развитие личинок в комаре и продлевать период активности переносчиков. Одновременно перемещение собак, урбанизация, орошение, накопление воды и распространение инвазивных видов комаров создают новые условия для передачи (Genchi et al., 2011; Paz, 2021). Цель статьи — рассмотреть биологию D. immitis, роль комаров и механизмы, посредством которых изменение климата может формировать новые эпидемиологические риски для собак.

2. Биология Dirofilaria immitis и жизненный цикл

Dirofilaria immitis относится к филярийным нематодам. Жизненный цикл включает позвоночного хозяина и комара-переносчика. Для собак наиболее характерно развитие взрослых гельминтов в лёгочных артериях. После спаривания самки выделяют микрофилярии, циркулирующие в периферической крови. Во время кровососания комар заглатывает их и обеспечивает дальнейшее развитие паразита. В организме комара микрофилярии мигрируют к мальпигиевым сосудам и последовательно развиваются через личиночные стадии. Температура окружающей среды имеет принципиальное значение.

Экспериментальные данные показывают, что развитие до инфекционной стадии L3 возможно выше примерно 14 °C; при 24–26 °C оно может занимать около 10–12 дней, тогда как при 18 °C продолжается значительно дольше (Genchi et al., 2011; Sassnau et al., 2014). После формирования L3 личинки перемещаются к ротовому аппарату комара. При следующем кровососании они попадают на кожу нового хозяина и проникают через место укуса. В организме собаки личинки проходят дальнейшие стадии развития и мигрируют к лёгочным артериям. Период до появления взрослых паразитов занимает несколько месяцев, а микрофилярии обычно появляются примерно через 6–9 месяцев после заражения (Simón et al., 2012; McCall et al., 2021).

Рисунок 1. Взрослые Dirofilaria immitis в сердце собаки.

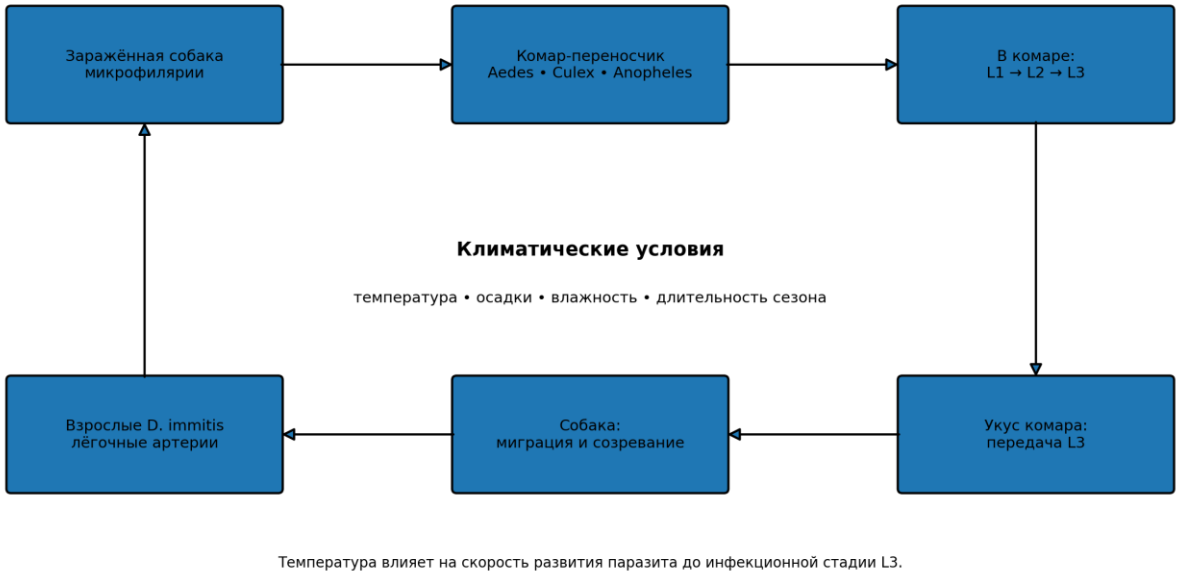


Источник: *Alan R. Walker, Wikimedia Commons, 2012; лицензия CC BY-SA 3.0.* На фотографии представлен вскрытый сердечный комплекс собаки с многочисленными взрослыми нематодами *Dirofilaria immitis*, локализованными в области правых отделов сердца и крупных сосудов. Изображение наглядно демонстрирует характерную локализацию взрослых паразитов при тяжёлой дирофиляриозной инвазии.

Таким образом, климатический фактор действует прежде всего на этап развития паразита в переносчике. Потепление не создаёт паразита, но может увеличить число дней, пригодных

для завершения развития до L3. Если заражённый комар живёт достаточно долго после инфицирования, вероятность передачи возрастает.

Рисунок 2. Жизненный цикл Dirofilaria immitis и влияние климатических условий



Температура влияет на скорость развития паразита до инфекционной стадии L3.

***Источник**: составлено автором на основе Simón et al. (2012), Genchi et al. (2011), Hattendorf & Lühken (2025).*

3. Основные стадии развития паразита и их эпидемиологическое значение

Стадия	Где происходит развитие	Ключевая особенность	Эпидемиологическое значение
Микрофилярии	Кровь собаки	Циркулируют в периферической крови.	Источник заражения комаров.
L1–L2	Организм комара	Развитие после заглатывания микрофилярий.	Зависит от температуры и компетентности переносчика.
L3	Организм комара	Инвазионная личинка у ротового аппарата.	Передаётся новому хозяину при укусе.

L3–взрослый паразит	Организм собаки	Миграция, линьки и созревание.	Формирование кардиолёгочной инфекции.
Взрослые гельминты	Лёгочные артерии	Половозрелые паразиты; самки выделяют микрофилярии.	Поддержание циркуляции паразита.

Таблица 1. Основные стадии жизненного цикла Dirofilaria immitis

Источник: составлено автором по данным Simón et al. (2012), McCall et al. (2021) и Genchi et al. (2011).

4. Роль комаров-переносчиков

Комар в жизненном цикле D. immitis — не просто механический переносчик. Паразит должен пройти в его организме часть развития, поэтому способность конкретного вида поддерживать развитие Dirofilaria имеет большое значение. В Европе участие в передаче описано для представителей родов Aedes, Culex и Anopheles. Современный систематический обзор показал значительное перекрытие потенциальных переносчиков D. immitis и D. repens (Hattendorf & Lühken, 2025). Особый интерес представляет Culex pipiens s.l., который часто выявляется среди положительных на D. immitis комаров в европейских исследованиях. Важным потенциальным переносчиком является и Aedes albopictus. Распространение этого инвазивного вида меняет структуру комариных сообществ и создаёт дополнительные возможности для передачи трансмиссивных патогенов. Однако обнаружение паразита в комаре ещё не означает одинаковую эпидемиологическую эффективность каждого вида: необходимо учитывать векторную компетентность, поведение, продолжительность жизни и частоту контактов с собаками. Риск зависит и от поведения переносчиков. Собаки, постоянно находящиеся во дворе, в сельской местности или рядом с местами размножения комаров, могут чаще контактировать с переносчиками. Водоёмы, канавы, системы орошения, ёмкости с водой и другие небольшие водные местообитания поддерживают размножение комаров и в населённых пунктах.

5. Изменение климата как фактор новых эпидемиологических рисков

Температура — один из наиболее важных факторов, связывающих климат с дирофиляриозом. При подходящих температурах личинки D. immitis быстрее достигают

стадии L3. Это сокращает время от заражения комара до его способности передавать инфекцию. Более продолжительный тёплый сезон также увеличивает вероятность того, что заражённый комар проживёт достаточно долго для завершения развития паразита (Genchi et al., 2011; Sassnau et al., 2014). Важен не только среднегодовой показатель температуры. Имеют значение продолжительность тёплого периода, ночные температуры, влажность, наличие воды и продолжительность жизни переносчика. Систематический обзор 2025 года связывает расширение ареала Dirofilaria spp. с совокупным действием потепления, распространения подходящих комаров и перемещения собак. Многие регионы Центральной Европы, ранее считавшиеся малорисковыми, теперь сообщают о местной циркуляции (Hattendorf & Lühken, 2025). Современное моделирование также показывает, что риск неодинаков в течение года. В исследовании 2025 года для Европы риск оценивали с учётом пригодности местообитаний Culex pipiens и Aedes albopictus и количества поколений Dirofilaria в переносчиках. Высокий риск сохранялся в южной Европе, а средние и высокие значения отмечались также в отдельных районах Центральной Европы. При сценарии высокого потепления проекция до 2100 года показала значительное увеличение пригодности

Фактор	Механизм влияния	Возможный эффект	Практическое значение
Повышение температуры	Ускоряет развитие личинок в комаре.	Больше вероятность формирования L3.	Увеличение потенциального сезона передачи.
Длительный тёплый сезон	Увеличивает период активности комаров.	Больше контактов хозяин–переносчик.	Коррекция сроков профилактики.
Изменение осадков и влажности	Меняет число мест размножения.	Изменение численности переносчиков.	Мониторинг водных местообитаний.
Распространение Aedes	Меняет состав потенциальных переносчиков.	Новые локальные условия передачи.	Энтомологический мониторинг.
Перемещение собак	Вносит инфекцию в новые районы.	Возможность формирования новых	Учитывать историю поездок.

		очагов.	
Беспризорные собаки	Поддерживают резервуар инфекции.	Сохранение источника микрофилярий.	Контроль популяций и профилактика.
Урбанизация и орошение	Создают водные местообитания.	Локальный рост численности комаров.	Экологический контроль.

местообитаний для этих комаров (González-Moreno et al., 2025). Это следует понимать как сценарную оценку, а не как точное предсказание будущей заболеваемости. При этом нельзя сводить эпидемиологический сдвиг только к потеплению. Распространение переносчиков зависит также от осадков, землепользования, городской среды, торговли и перемещения животных. Европейские обзоры подчёркивают, что климатические изменения взаимодействуют с социальными и экологическими факторами (Semenza et al., 2018; Paz, 2021).

6. Факторы, формирующие риск дирофиляриоза

Таблица 2. Факторы, способные изменять риск передачи D. immitis

***Источник**: составлено автором на основе Genchi et al. (2011), Hattendorf & Lühken (2025), Paz (2021) и González-Moreno et al. (2025).*

7. Новые эпидемиологические риски и значение подхода One Health

Изменение географии дирофиляриоза создаёт практическую проблему для ветеринарных служб. Район, который ранее считался малорисковым, может постепенно становиться подходящим для сезонной передачи. Поэтому ориентация только на историческую эндемичность уже недостаточна. Ветеринарному врачу важно учитывать местный климат, наличие комаров, образ жизни животного и его перемещения. Ещё одна проблема — возможность недооценки инфекции на ранних этапах. Развитие D. immitis в собаке занимает месяцы, а клинические проявления зависят от интенсивности инвазии и стадии болезни. Поэтому профилактика и регулярное тестирование важнее ожидания выраженной клинической картины. Диагностика может включать антигенные тесты, исследование микрофилярий и, при необходимости, молекулярные методы (McCall et al., 2021; Simón et al., 2012). Для контроля риска полезно объединять несколько источников информации. Ветеринарные данные показывают наличие инфекции у собак; энтомологический мониторинг показывает присутствие потенциальных переносчиков; климатические данные

характеризуют пригодность условий для развития паразита; информация о перемещении животных помогает выявлять возможные пути заноса. Такое объединение соответствует логике One Health, поскольку заболевание формируется на пересечении здоровья животных, окружающей среды и деятельности человека. Перспективным является переход от реактивного к профилактическому мониторингу. Вместо ожидания большого числа больных собак можно заранее отслеживать продолжительность сезона активности комаров, появление новых видов переносчиков и регистрацию автохтонных случаев. Европейские исследования уже используют пространственные и помесячные модели риска, что может помочь выбирать периоды и территории для усиленной профилактики (González-Moreno et al., 2025).

8. Профилактика и направления дальнейшего мониторинга

Основой профилактики остаётся предотвращение развития инфекции у собак с использованием зарегистрированных ветеринарных препаратов и схем, соответствующих эпидемиологическому риску конкретного региона. В районах с сезонной передачей профилактические программы должны учитывать начало и продолжительность периода активности переносчиков. Конкретную схему следует выбирать ветеринарному врачу с учётом инструкции препарата, возраста и состояния животного. Контроль контакта с комарами также имеет значение. Разрешённые для собак репеллентные и инсектицидные средства могут снижать вероятность укусов, однако их применение не заменяет профилактику против личиночных стадий. Не менее важны устранение стоячей воды около мест содержания животных, улучшение санитарного состояния территории и снижение контакта собак с местами высокой численности комаров. Для научного и ветеринарного мониторинга необходимы три взаимосвязанных направления: обследование собак, энтомологический контроль и анализ климатических данных. Наиболее информативной будет система, в которой результаты по животным сопоставляются с данными о видах и численности комаров и с температурными условиями. Это поможет отличать занос инфекции перемещёнными животными от устойчивой местной передачи.

Заключение

Дирофиляриоз собак является примером заболевания, при котором изменение климата может постепенно менять эпидемиологическую ситуацию. Dirofilaria immitis не развивается самостоятельно в окружающей среде: для передачи необходимы восприимчивый позвоночный хозяин и подходящий комар-переносчик. Поэтому температура, влажность, продолжительность сезона и экология комаров становятся частью эпидемиологии паразита. Потепление способно ускорять развитие D. immitis в комаре и увеличивать число дней,

подходящих для завершения развития до инфекционной стадии L3. Современные исследования свидетельствуют о расширении зоны циркуляции Dirofilaria spp. в регионы, которые ранее считались малорисковыми. Однако этот процесс нельзя объяснять только климатом: перемещение собак, беспризорные животные, урбанизация, орошение и изменение видового состава комаров также имеют значение.

В ближайшие годы особое значение будет иметь интегрированный мониторинг. Регистрация случаев у собак, наблюдение за комарами и использование климатических и пространственных моделей способны улучшить раннее выявление территорий повышенного риска. Для ветеринарной практики это означает переход от ожидания болезни к профилактике, основанной на местных условиях. Такой подход защищает здоровье собак и соответствует принципам One Health.

ЛИТЕРАТУРА

Genchi, C., Rinaldi, L., Cascone, C., Mortarino, M., & Cringoli, G. (2011). Is climate change influencing the spread and distribution of Dirofilaria immitis and other vector-borne diseases? Veterinary Parasitology, 176(2–3), 198–200. https://doi.org/10.1016/j.vetpar.2010.11.012

González-Moreno, O., et al. (2025). Assessment of the monthly risk of dirofilariosis infection in Europe and its projection to 2100 under climate change from a One Health perspective. Parasites & Vectors. https://doi.org/10.1186/s13071-025-07148-5

Hattendorf, C., & Lühken, R. (2025). Vectors, host range, and spatial distribution of Dirofilaria immitis and D. repens in Europe: a systematic review. Infectious Diseases of Poverty, 14, 58. https://doi.org/10.1186/s40249-025-01328-2

McCall, J. W., Genchi, C., Kramer, L. H., Guerrero, J., & Venco, L. (2021). Heartworm disease: overview, intervention, and industry perspective. Parasites & Vectors, 14. https://doi.org/10.1186/s13071-021-04850-2

Paz, S. (2021). Climate change impacts on vector-borne diseases in Europe: risks, predictions and actions. The Lancet Regional Health – Europe, 1, 100017. https://doi.org/10.1016/j.lanepe.2020.100017

Sassnau, R., Dyachenko, V., Pantchev, N., & Hermosilla, C. (2014). Development of Dirofilaria immitis and Dirofilaria repens in Aedes japonicus and Aedes geniculatus. Parasitology Research, 113, 3711–3717. https://doi.org/10.1007/s00436-014-4063-8

Semenza, J. C., Sudre, B., Miniota, J., et al. (2018). Vector-borne diseases and climate change: a European perspective. FEMS Microbiology Letters, 365(2), fnx244. https://doi.org/10.1093/femsle/fnx244

Simón, F., González-Miguel, J., Diosdado, A., Gómez, P. J., Morchón, R., & Kartashev, V. (2012). Human and animal dirofilariasis: the emergence of a zoonotic mosaic. Clinical Microbiology Reviews, 25(3), 507–544. https://doi.org/10.1128/CMR.00012-12

ENSURING ANIMAL WELFARE IN ORGANIC LIVESTOCK FARMING AND ITS IMPACT ON ANIMAL HEALTH

Azerbaijan State Agricultural University

Faculty of Veterinary Medicine

Ayla Mammadzada, 4th year bachelor student

aylazada1203@gmail.com

ORCID ID: 0009-0004-7016-6847

Supervisor: Associate Prof. Kushvar Mammadova

kgmammadova@gmail.com

ORCID ID: 0000-0002-6293-2079

Abstract:*Organic livestock farming integrates animal production with requirements concerning animal health, welfare, environmental management, and responsible resource use. This review examines the relationship between animal welfare and animal health in organic livestock systems, with particular attention to housing, stocking density, nutrition, pasture and outdoor access, preventive veterinary care, handling, biosecurity, and disease prevention. The Five Freedoms provide a useful framework for considering freedom from hunger and thirst, discomfort, pain, injury and disease, fear and distress, together with the opportunity to express normal behaviour. Good welfare conditions can support physical and reproductive health, reduce stress and disease susceptibility, and contribute to stable productivity and longevity. At the same time, outdoor systems and organic management may present challenges related to infectious disease exposure, climate, environmental conditions, management costs, and the need for trained personnel. Welfare assessment therefore benefits from combining animal-based indicators with environmental and management measures. The review highlights that animal welfare should not be treated as separate from animal health, but as an integral part of preventive veterinary management and sustainable organic livestock production.*

Keywords: *organic livestock farming; animal welfare; animal health; Five Freedoms; preventive veterinary care; sustainable livestock production.*

1. Introduction.

Conventional livestock production has made substantial progress in increasing productivity and reducing production costs. However, intensification has also increased concerns about environmental sustainability, animal health, and animal welfare. These concerns are especially relevant when production efficiency is prioritized over the biological and behavioural needs of animals. The source article notes that welfare, environmental protection, and health may require additional labour and financial resources, which can be difficult to accommodate within highly cost-oriented systems.

Growing consumer interest in organically produced food has created opportunities for production systems associated with higher environmental and welfare standards. Consumers may value biodiversity conservation, protection of natural resources and landscapes, and improved animal welfare. Organic livestock farming therefore operates according to principles intended to integrate productive, environmental, and animal-welfare considerations into farm management.

Organic agriculture is described in the source material as a production system based on ecological processes, biodiversity, and locally adapted cycles. Within livestock production, this approach places particular emphasis on appropriate husbandry, nutrition, preventive health management, and conditions that allow animals to express normal behaviour. Animal welfare is therefore not simply an ethical addition to production; it is closely related to animal health and the sustainability of the production system.

Animal health is a prerequisite for good welfare because illness can cause pain, discomfort, reduced appetite, and impaired well-being. Conversely, poor nutrition, inadequate care, prolonged stress, or unsuitable housing may increase susceptibility to disease. The source material emphasizes this two-way relationship and the importance of timely veterinary care when disease occurs.

The purpose of this review is to examine the importance of animal welfare in organic livestock farming and its relationship with animal health. Particular attention is given to housing, nutrition, outdoor access, disease prevention, veterinary care, handling, stress reduction, and welfare assessment. The review also considers challenges associated with outdoor systems and the need to balance natural living conditions with effective disease prevention.

2. Principles of Animal Welfare in Organic Livestock Farming

The Five Freedoms provide a widely recognised framework for understanding and assessing animal welfare. They include freedom from hunger and thirst; freedom from discomfort; freedom from pain, injury and disease; freedom to express normal behaviour; and freedom from fear and distress.

These principles connect physical health with behavioural and psychological well-being and are particularly relevant to livestock systems that aim to provide conditions closer to the natural behavioural requirements of animals.

In organic livestock systems, freedom of movement and opportunities for natural behaviour are important components of welfare. Animals should have sufficient space and, where appropriate, access to suitable outdoor areas. Such conditions can support physical activity, social behaviour, and species-specific behavioural patterns. Housing should also provide adequate shelter, ventilation, hygiene, flooring, and protection from unsuitable weather conditions.

Adequate nutrition and clean water are equally important. Feed should meet the physiological requirements of animals and support normal growth, development, body condition, and production. Poor nutrition can compromise health and may contribute to nutritional disorders. Welfare-oriented management therefore requires attention to both the quantity and suitability of feed and the continuous availability of safe drinking water.

The prevention of unnecessary fear, pain, discomfort, and stress is another central principle. Careful handling, appropriate transport, suitable housing, preventive health management, and timely veterinary intervention can reduce avoidable suffering. Prevention is especially important because welfare problems are more difficult to correct after chronic stress, injury, or disease has developed.

3. Key Welfare Requirements in Organic Livestock Systems

Organic livestock management combines several practical requirements that contribute to both welfare and health. Housing, stocking density, hygiene, pasture access, nutrition, preventive veterinary care, low-stress handling, transport, biosecurity, and early disease detection should be considered together rather than as isolated measures.

Housing conditions have a direct influence on physical comfort and disease risk. Appropriate space, ventilation, hygiene, safe flooring, shelter, and suitable stocking density can reduce injuries, discomfort, and environmental stress. Outdoor access may provide opportunities for exercise and natural behaviour, although it also requires effective management of pasture condition, weather exposure, parasite risks, and contact with infectious agents.

Nutrition is another central welfare requirement. Organic feeding systems should provide nutritionally adequate diets while meeting the relevant requirements of organic production. Good nutritional management supports body condition, growth, reproduction, and resistance to health problems. Clean water and regular monitoring are essential components of this process.

Preventive veterinary care is particularly important because organic systems may place specific conditions on veterinary medicine use. Regular observation, early identification of abnormal

behaviour or clinical signs, vaccination where appropriate, parasite control, hygiene, and timely veterinary intervention can reduce the need for more extensive treatment later.

Low-stress handling and transport also contribute to welfare. Animals should be handled in a manner that minimises fear, injury, and unnecessary physical stress. Biosecurity and early disease detection should complement these measures, particularly where outdoor access increases contact with other animals, wildlife, soil, water, or shared environments.

Table 1. Key Animal Welfare Requirements and Their Contribution to Animal Health in Organic Livestock Systems

Indicator category	Examples of indicators	What the indicators assess
Physical health	Injuries, lameness, lesions, disease signs	General health and absence of physical suffering
Body condition	Body condition score, weight change	Nutritional status and metabolic health
Behavioural	Feeding, resting, social behaviour, abnormal behaviour, avoidance	Behavioural needs, stress, and adaptation
Physiological	Stress-related responses, immune parameters, physiological changes	Effects of environmental and management stressors
Reproductive	Fertility, conception rate, reproductive disorders	Reproductive health and management quality
Morbidity and mortality	Disease incidence, treatment frequency, mortality	Overall herd/flock health status
Productivity	Growth rate, milk/egg/meat production	Combined effects of health, nutrition, and management
Environmental	Hygiene, stocking density, ventilation, pasture condition	Quality of the environment in which animals are maintained

Source: Adapted from the European Commission materials on organic production, the WOAH Terrestrial Animal Health Code, and EFSA scientific opinions on animal welfare, as cited in the source article.

These requirements are closely interconnected with animal health. Appropriate housing, adequate nutrition, outdoor access, preventive veterinary care, and low-stress handling can reduce

physiological stress and disease risks while supporting normal behaviour and biological functioning. Welfare-oriented management should therefore be considered an integral component of preventive animal health in organic livestock systems.

4. Impact of Animal Welfare on Animal Health

Animal welfare and animal health are closely connected because the conditions in which animals are kept influence physical condition, immune response, behaviour, and overall performance. Good welfare practices can help animals cope with environmental challenges and reduce the likelihood of health problems. In contrast, prolonged exposure to poor housing, inadequate nutrition, overcrowding, excessive handling, or other stressful conditions may interfere with normal physiological functions.

Stress is particularly important. Continuous or repeated stress may interfere with immune function and increase vulnerability to infections and other diseases. Providing suitable housing, sufficient space, appropriate nutrition, and consistent management can therefore support health and reduce disease susceptibility. The relationship is not one-directional: disease can reduce welfare through pain and discomfort, while poor welfare conditions can increase health risks.

Animal welfare also affects physical and reproductive health. Adequate feed, clean water, suitable shelter, safe flooring, and veterinary care can help maintain body condition and normal reproductive functions. Reducing overcrowding and improving housing safety may lower the risk of injuries. Poor welfare may also contribute to abnormal or repetitive behaviours when animals cannot move freely or perform behaviours characteristic of their species.

Health and welfare can also influence growth, productivity, and productive longevity. Animals maintained under suitable conditions are better able to use available nutrients for normal physiological functions rather than coping with unnecessary stress or illness. Maintaining good welfare throughout the production cycle can therefore support more consistent performance and may contribute to longer productive lives.

5. Organic Management and Animal Health

Organic livestock farming is based on defined principles concerning animal health, welfare, environmental management, and resource use. Animals are generally provided with organic feed, suitable housing, and access to outdoor areas where required by the production system. Preventive disease management, appropriate husbandry, and veterinary supervision are important components of this approach.

Pasture access and physical activity may support natural behaviour and normal movement, but outdoor systems also require careful disease prevention. Pasture condition, weather, parasite exposure, contact with other animals, and environmental hygiene should be monitored. The balance between natural living conditions and disease prevention is therefore a central management issue.

Preventive approaches are particularly important in organic systems. Regular observation, early detection of disease, appropriate nutrition, hygiene, biosecurity, and veterinary supervision can reduce avoidable health problems. Treatment remains necessary when animals are ill, but prevention can reduce suffering and help maintain stable herd or flock health.

Organic livestock farming also interacts with environmental management and food safety. Controlled grazing, nutrient recycling, maintenance of soil fertility, and integration of livestock with crop production can contribute to resource management. At the same time, organic certification does not eliminate biological or chemical hazards; hygiene and food-safety controls remain necessary throughout production, processing, and distribution.

6. Challenges and Welfare Assessment

Organic livestock systems can present challenges that require active management. Outdoor access may increase exposure to parasites, infectious agents, variable weather, and environmental hazards. Climate conditions can affect pasture availability, heat or cold stress, water supply, and animal comfort. Economic and management constraints may also limit the capacity of farms to provide all desirable welfare measures.

Another challenge is the need for trained personnel and veterinary expertise. Welfare assessment requires observation of animals as well as evaluation of housing, feeding, hygiene, stocking density, pasture conditions, and management practices. No single indicator can describe welfare adequately. A combined approach is therefore more informative.

Physical, behavioural, physiological, reproductive, morbidity, mortality, productivity, and environmental indicators provide complementary information. Combining animal-based measures with environmental and management parameters can help identify welfare problems and potential health disorders at an early stage. This is particularly relevant to organic farming because assessment should consider both biological functioning and the ability of animals to express appropriate behaviour.

Table 2. Animal Welfare and Health Indicators for Organic Livestock Systems

Indicator category	Examples of indicators	Assessment focus

Physical health	Injuries, lameness, lesions, disease signs	General health and absence of physical suffering
Body condition	Body condition score, weight change	Nutritional status and metabolic health
Behavioural	Feeding, resting, social behaviour, abnormal behaviour, avoidance	Behavioural needs, stress, and adaptation
Physiological	Stress-related responses, immune parameters, physiological changes	Effects of environmental and management stressors
Reproductive	Fertility, conception rate, reproductive disorders	Reproductive health and management quality
Morbidity and mortality	Disease incidence, treatment frequency, mortality	Overall herd/flock health status
Productivity	Growth rate, milk/egg/meat production	Combined effects of health, nutrition, and management
Environmental	Hygiene, stocking density, ventilation, pasture condition	Quality of the environment in which animals are maintained

Source: Adapted from EFSA scientific opinions on animal welfare assessment and the Welfare Quality® assessment framework, as cited in the source article.

Table 2 demonstrates that welfare assessment should not rely on productivity alone. Animal-based indicators can reveal physical or behavioural problems, while environmental and management indicators help identify possible causes. Using both groups of measures can strengthen preventive management and support earlier veterinary intervention.

Conclusion

Organic livestock farming provides a structured approach to integrating animal health, welfare, environmental management, and sustainable production. The review shows that animal welfare and animal health are closely interconnected. Appropriate housing, adequate nutrition, access to suitable outdoor areas, preventive veterinary care, low-stress handling, hygiene, and early disease detection can support physical health and reduce avoidable suffering.

The Five Freedoms remain a useful framework for considering the major dimensions of welfare, but effective assessment requires multiple indicators. Physical, behavioural, physiological,

reproductive, health, productivity, and environmental measures provide complementary information. This integrated approach is especially important in organic systems, where natural living conditions must be balanced with disease prevention and effective farm management.

Overall, welfare-centred management should be regarded as part of preventive veterinary practice rather than as a separate ethical issue. Strengthening welfare assessment, veterinary supervision, staff training, biosecurity, and environmental management can support healthier animals, more stable production, and the long-term sustainability of organic livestock farming.

References

Organic livestock farming: A critical review. https://www.sciencedirect.com/science/article/abs/pii/S0301622600001883

Concepts of Animal Health and Welfare in Organic Livestock Systems. https://www.researchgate.net/publication/225370712_Concepts_of_Animal_Health_and_Welfare_in_Organic_Livestock_Systems

Understanding animal welfare. https://link.springer.com/article/10.1186/1751-0147-50-s1-s1

The Five Freedoms: A history lesson in animal care and welfare. https://www.canr.msu.edu/news/an_animal_welfare_history_lesson_on_the_five_freedoms

Animal welfare in organic farming systems. https://scijournals.onlinelibrary.wiley.com/doi/10.1002/jsfa.2999

Impact of animal health and welfare planning on medicine use, herd health and production in European organic dairy farms. https://www.sciencedirect.com/science/article/abs/pii/S1871141312000066

MODERN BIOTECHNOLOGICAL APPROACHES TO THE DIAGNOSIS OF INFECTIOUS DISEASES IN ANIMALS

Azerbaijan State Agricultural University

Faculty of Veterinary Medicine

Elshad Alizada, 5th year bachelor student

alizadehelshad3@gmail.com

ORCID ID: 0009-0001-8116-4095

Nuraddin Imanov, 3rd year bachelor student

imankmanka@gmail.com

ORCID ID: 0009-0002-2475-7991

Sevda Osmanova, Senior Lecturer

sevda_osmanova_79@mail.ru

Scientific supervisor: **Associate Prof. Kushvar Mammadova**

kgmammadova@gmail.com

ORCID ID: 0000-0002-6293-2079

Abstract:*Infectious diseases pose significant risks to animal health, livestock productivity, and public health through zoonotic transmission. Timely diagnosis is essential for effective treatment and infection control. This review examines modern biotechnological approaches in veterinary diagnostics, focusing on molecular genetic methods and immunobiotechnological assays, including PCR, ELISA, and rapid tests. Emerging technologies, such as CRISPR-based platforms and portable point-of-care devices, are also highlighted. Modern biotechnologies complement conventional diagnostic techniques, enabling earlier disease detection, improved epidemiological surveillance, and effective implementation of the One Health approach.*

Keywords: *Infectious diseases, veterinary diagnostics, biotechnology, PCR, ELISA, immunochromatographic tests.*

1. Introduction

Infectious diseases in veterinary medicine are directly related to the health and safety of animals, humans, and the environment. Caused by viruses, bacteria, fungi, and parasites, they can spread rapidly among animal populations. Particular importance is given to zoonotic diseases, which can be transmitted from animals to humans. Therefore, infectious diseases are important not only for specialists but also for owners of companion, farm, and exotic animals (WOAH, 2024; Daniels, 2013).

Animal infections pose a serious risk to human health because pathogens can be transmitted through direct contact, biological fluids, food, water, or vectors such as ticks and insects. Well-known zoonotic diseases include rabies, leptospirosis, toxoplasmosis, salmonellosis, and dermatophytosis. The risk of transmission may increase under conditions of high animal density, insufficient vaccination, and inadequate sanitary practices. Thus, timely and reliable diagnosis plays a key role in preventing the spread of infectious agents among animals and humans (WOAH, 2024; OIE, 2018).

Early diagnosis is essential for protecting animal and public health. The process usually begins with a clinical examination, during which the veterinarian evaluates the general condition, temperature, mucous membranes, skin, and internal systems. These findings are complemented by laboratory and rapid diagnostic methods when necessary. Importantly, the selection of a diagnostic method should consider the clinical purpose, specimen type, analytical performance, and intended interpretation of the result (WOAH, 2023).

Modern veterinary diagnostics include blood, urine, and fecal analyses, polymerase chain reaction (PCR) for detecting pathogen nucleic acids, serological tests for specific antibodies and antigens, and rapid diagnostic tests. Molecular assays have significantly expanded the ability of veterinary laboratories to detect infectious agents directly from clinical specimens, particularly when pathogen isolation is difficult or time-consuming (Daniels, 2013; WOAH, 2024). PCR is widely used because of its high analytical sensitivity and specificity and its capacity to detect pathogen genetic material without requiring successful cultivation of the organism (Mackay, 2004; WOAH, 2024). Serological methods provide information about the host immune response and are particularly useful for surveillance and retrospective investigation, whereas rapid tests can provide preliminary results in clinical and field settings.

A comprehensive diagnostic approach makes it possible to identify infectious diseases accurately and support appropriate clinical management and infection-control measures. Early detection can facilitate isolation, treatment, surveillance, and outbreak-control decisions. Consequently, the application of validated molecular and other biotechnological diagnostic technologies has become an important component of contemporary veterinary medicine (WOAH, 2024; WOAH, 2025).

2. Molecular Genetic Methods of Diagnosis

Concept of Molecular Diagnostics

Molecular diagnostics in veterinary medicine represents a group of laboratory methods designed to detect and analyse pathogen-specific nucleic acid sequences. These methods include conventional PCR, real-time PCR, reverse-transcription PCR, multiplex PCR, isothermal amplification, sequencing, and other nucleic-acid-based technologies (WOAH, 2021; WOAH, 2024).

Unlike classical diagnostic approaches that may require the isolation and cultivation of a pathogen in vitro, molecular methods target the genetic material of the infectious agent directly. This can substantially reduce diagnostic time and allow detection when viable organisms are difficult to recover from clinical specimens. However, analytical sensitivity should not be confused with diagnostic sensitivity, and molecular assays require appropriate validation, controls, and interpretation within the clinical context (Daniels, 2013; WOAH, 2023).

The development and optimisation of nucleic-acid detection assays require careful consideration of specimen selection, nucleic-acid extraction, target selection, primer and probe design, analytical sensitivity, analytical specificity, repeatability, reproducibility, and appropriate controls (WOAH, 2024). These requirements are particularly important in veterinary diagnostics because different animal species, specimen types, pathogen loads, and biological matrices can affect assay performance.

PCR and Its Application in Veterinary Medicine

The introduction of PCR into veterinary diagnostic practice significantly expanded the capacity to detect infectious agents rapidly and specifically. PCR is based on the enzymatic amplification of a selected DNA sequence through repeated cycles of denaturation, primer annealing, and extension. Following amplification, the target product can be detected by electrophoresis or other detection systems (Mackay, 2004; WOAH, 2024).

In conventional PCR, a thermal cycler is used to perform repeated amplification cycles. The number of cycles and reaction conditions depend on the assay design and target organism. Following amplification, products may be visualised by agarose-gel electrophoresis or subjected to additional analytical procedures. Although conventional PCR remains useful, the development of real-time PCR has provided important advantages by allowing amplification and detection to occur within the same reaction system (Mackay, 2004; Kubista et al., 2006).

PCR-based methods are now used for the detection of numerous viral, bacterial, and parasitic infections in veterinary medicine. Their applications include confirmation of clinical cases, surveillance, outbreak investigation, pathogen identification, and differential diagnosis. Nevertheless, PCR results must be interpreted in relation to sampling time, pathogen distribution, nucleic-acid persistence, and the clinical status of the animal (Daniels, 2013; WOAH, 2024).

Real-Time PCR (qPCR)

Real-time PCR, or quantitative PCR (qPCR), combines nucleic-acid amplification with fluorescence-based detection during the reaction. Unlike conventional PCR, which generally requires post-amplification analysis, qPCR allows the accumulation of amplification products to be monitored in real time. This provides rapid detection and, when appropriately calibrated,

quantitative or semi-quantitative information about the target nucleic acid (Kubista et al., 2006; Bustin et al., 2009).

qPCR can provide high analytical sensitivity and specificity when the assay is appropriately designed and validated. Its performance depends on factors including sample quality, nucleic-acid extraction, primer and probe design, amplification efficiency, inhibition, and the analytical characteristics of the assay. Therefore, claims concerning extremely low detection limits should be supported by experimentally determined validation data rather than generalized across all qPCR assays (Bustin et al., 2009; WOAH, 2024).

In global veterinary practice, multiplex real-time PCR assays are increasingly useful because they allow several pathogen targets to be investigated within a single reaction. This can improve diagnostic efficiency in mixed infections and in clinical syndromes caused by pathogens with similar clinical manifestations (Daniels, 2013; WOAH, 2024). Multiplex assays require careful optimisation because interactions between primers and probes, differences in amplification efficiency, and competition among targets can influence analytical performance.

An additional advantage of real-time PCR is that amplification and fluorescence detection occur within a closed reaction tube. This reduces the need for post-amplification manipulation and can consequently reduce the risk of amplicon contamination compared with conventional PCR workflows (Kubista et al., 2006; WOAH, 2024). Reliable qPCR reporting also requires transparent documentation of sample preparation, assay design, controls, amplification efficiency, and data-analysis procedures, as emphasised by the MIQE guidelines and their recent revision (Bustin et al., 2009; Bustin et al., 2025).

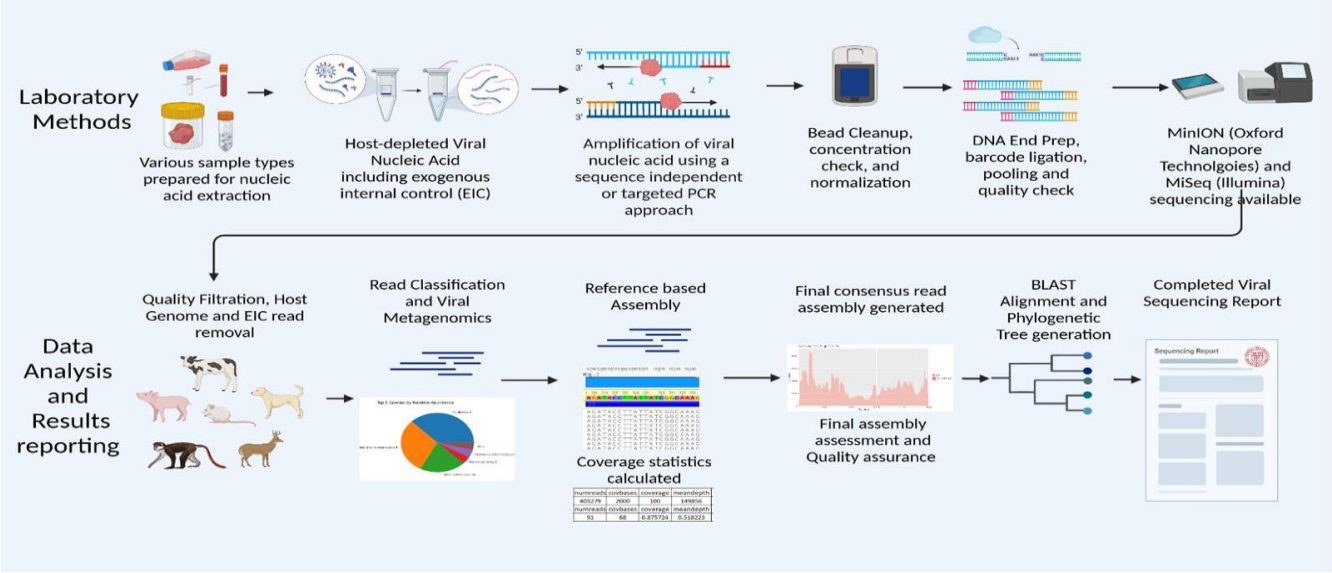


Figure 1. Modern biotechnological workflow for diagnosis of infectious diseases in animals

Source: Adapted from WOAH, Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, 13th ed., 2024.

RT-PCR for Diagnosis of RNA Viruses

A particular challenge in veterinary virology is the diagnosis of pathogens whose genomes are composed of RNA. Conventional PCR requires a DNA template because the DNA polymerase used for amplification cannot directly use RNA as the template. Reverse transcription polymerase chain reaction (RT-PCR) overcomes this limitation by first converting viral RNA into complementary DNA (cDNA) using the enzyme reverse transcriptase. The resulting cDNA is then amplified by conventional PCR or detected using real-time PCR. The choice between conventional RT-PCR and RT-qPCR depends on the diagnostic objective, assay design, and required level of quantification (WOAH, 2024; Burrough et al., 2024).

In RT-qPCR, reverse transcription and real-time amplification can be combined within a single reaction system. Fluorescence generated during amplification allows the accumulation of the target sequence to be monitored in real time. This format can provide rapid and highly sensitive detection of RNA pathogens and, when appropriately validated, can provide quantitative information about viral RNA concentration. However, analytical sensitivity and diagnostic sensitivity are influenced by specimen type, sampling time, RNA extraction efficiency, inhibitors, and assay design. Therefore, very low detection limits should not be generalized to all RT-qPCR assays (WOAH, 2024; Bustin et al., 2025).

RT-PCR and RT-qPCR have become important tools for the detection of numerous RNA viruses affecting domestic animals, livestock, and wildlife. They are particularly useful when rapid confirmation is required for infections with major veterinary and transboundary significance. Nevertheless, the diagnostic value of a molecular result depends on the stage of infection and the anatomical site from which the sample was collected. Selection of an appropriate specimen is therefore an integral component of molecular diagnosis (Burrough et al., 2024).

Examples of Clinical Application

Canine parvovirus enteritis (Canine parvovirus type 2, CPV-2). CPV-2 is a small single-stranded DNA virus rather than an RNA virus. Therefore, its detection is based on conventional PCR or qPCR and does not require reverse transcription. Molecular assays can detect viral DNA in fecal material and can also be designed to differentiate CPV-2 variants such as CPV-2a, CPV-2b, and CPV-2c. Real-time PCR approaches have been investigated for molecular characterization and epidemiological differentiation of these variants (Geng et al., 2019).

Canine distemper (Canine distemper virus, CDV). Because CDV is an RNA virus, RT-PCR and RT-qPCR are appropriate molecular diagnostic methods. Viral RNA may be investigated in

specimens such as conjunctival or mucosal swabs, whole blood, urine, and cerebrospinal fluid. Importantly, the diagnostic yield varies with the clinical form and stage of disease. In dogs with neurological disease, cerebrospinal fluid may provide useful diagnostic material when viral RNA is no longer readily detected in peripheral specimens (Sarchahi et al., 2022). Experimental work has also demonstrated the usefulness of conjunctival samples for early antemortem detection of CDV (Kim et al., 2006).

Feline panleukopenia. Feline panleukopenia virus is a DNA virus; therefore, PCR or qPCR rather than RT-PCR is used for molecular detection. Molecular testing can complement clinical and haematological findings, particularly when rapid confirmation is required. As with other molecular tests, interpretation should consider vaccination history, specimen type, timing of sampling, and the possibility of detecting viral nucleic acid without necessarily demonstrating active disease.

Multiplex molecular diagnostics. Multiplex PCR and multiplex real-time PCR allow several pathogen targets to be investigated simultaneously. This is particularly useful for syndromes in which different pathogens produce similar clinical signs or where co-infections are common. In feline respiratory disease, for example, diagnostic investigations may include feline herpesvirus, feline calicivirus, *Chlamydia felis*, and *Mycoplasma felis*. Recent veterinary literature confirms that PCR-based testing is frequently used in investigations of feline upper respiratory disease, although detection of a pathogen must be interpreted in relation to clinical disease and the possibility of asymptomatic carriage (Kennedy et al., 2024).

3. Immunobiotechnological Methods

Enzyme-Linked Immunosorbent Assay (ELISA)

Enzyme-linked immunosorbent assay (ELISA) is one of the most widely used immunobiotechnological methods for detecting and estimating specific antigens or antibodies in biological samples. The method is based on specific antigen–antibody interactions combined with an enzyme-mediated detection system. The original development of enzyme-linked immunosorbent assays dates to the early 1970s, when Engvall and Perlmann demonstrated the quantitative detection of immunoglobulin G using an enzyme-linked immunoassay format (Engvall & Perlmann, 1971).

The basic principle of ELISA involves immobilizing an antigen or antibody on a solid surface, usually the wells of a microplate. The test sample is then added, allowing the target antigen or antibody to interact with the immobilized component. After washing steps remove nonspecific material, an enzyme-labelled detection reagent is introduced. Following a further washing step, the addition of an appropriate substrate generates a measurable signal. The intensity of this signal is related to the amount of target present within the analytical range of the assay.

Several ELISA formats are used in veterinary diagnostics. Direct ELISA uses an enzyme-labelled antibody to detect an immobilized antigen, whereas indirect ELISA commonly uses an enzyme-labelled secondary antibody to detect antibodies present in the animal serum. Sandwich ELISA uses a capture antibody to immobilize the target antigen and a second antibody for detection. Competitive ELISA is based on competition between sample antigen and a labelled antigen or related reagent for a limited number of antibody-binding sites. These formats provide flexibility for the detection of both pathogen components and host immune responses.

Enzyme systems such as horseradish peroxidase and alkaline phosphatase are frequently used for signal generation. Depending on the assay design, colorimetric, fluorescent, or chemiluminescent detection can be employed. The analytical performance of the method depends on the affinity and specificity of the antibodies, antigen preparation, assay design, sample matrix, calibration, and validation procedures.

In veterinary medicine, ELISA is widely used for antibody detection, antigen detection, serological surveillance, and epidemiological investigations. It is particularly useful when large numbers of samples must be processed in a standardized laboratory workflow. ELISA-based approaches can therefore support surveillance programs in livestock populations, companion animals, wildlife, and other animal populations.

An important limitation is that detection of antibodies does not necessarily demonstrate active infection. Antibodies may persist after previous infection or vaccination, while antibody concentrations may remain below the detection threshold during the early stages of infection. Consequently, ELISA findings should be interpreted together with clinical history, vaccination status, epidemiological information, and, when appropriate, molecular or antigen-detection results. Recent veterinary diagnostic guidance emphasizes that different tests have different diagnostic sensitivities and specificities, and that more than one test may sometimes be required for appropriate interpretation (Burrough et al., 2024).

Thus, ELISA remains an important immunobiotechnological platform because it combines specificity, scalability, standardized laboratory procedures, and relatively high throughput. Its role is particularly significant in serological surveillance and population-level investigation of infectious diseases.

Immunochromatographic (ICA) Rapid Tests

Immunochromatographic assays (ICAs), often called lateral-flow or rapid diagnostic tests, are designed to provide rapid detection of pathogen antigens or host antibodies. The principle is based on the movement of a liquid sample through a membrane containing labelled antibodies or antigens

and immobilized capture reagents. When the target is present, an immune complex forms and produces a visible test line or another detectable signal.

These assays can provide results within minutes and require considerably less laboratory infrastructure than conventional molecular methods. Their portability and simple operation make them particularly suitable for veterinary clinics, animal shelters, farms, quarantine facilities, and other settings where immediate preliminary information may be required. Recent reviews of veterinary diagnostic technologies identify immunochromatographic methods as important point-of-care tools for preliminary screening and rapid on-site diagnosis.

However, the diagnostic performance of ICA tests varies considerably among diseases and commercial platforms. It should therefore not be assumed that all rapid tests have sensitivity or specificity values of 96–99%. For example, studies evaluating rapid immunochromatographic detection of canine parvovirus have reported different performance characteristics depending on the test, population, reference method, and clinical setting (Ogbu et al., 2021). In one multicentre evaluation, an immunochromatographic test demonstrated high relative sensitivity but substantially lower specificity than PCR, illustrating why individual assay validation is important.

Rapid tests may be particularly useful for diseases requiring immediate isolation or infection-control decisions. They can also reduce the time between clinical examination and preliminary diagnosis. Nevertheless, a negative rapid test does not always exclude infection, especially when pathogen concentration is low or when sampling is performed at an inappropriate stage of disease. Therefore, cases with strong clinical or epidemiological suspicion may require confirmation using PCR, RT-PCR, ELISA, culture, sequencing, or another validated method.

The choice of diagnostic technology should consequently be based on the clinical question, suspected pathogen, available specimen, stage of infection, and performance characteristics of the individual assay. Rather than replacing laboratory diagnostics, ICA tests are best viewed as complementary tools within an integrated veterinary diagnostic workflow.

4. Innovative Biotechnological Platforms and Emerging Technologies

CRISPR/Cas Systems for Pathogen Detection

CRISPR/Cas-based diagnostic technologies represent an emerging group of nucleic-acid detection methods. These systems use programmable guide RNA molecules to recognize specific target sequences. Cas12 and Cas13 proteins are particularly relevant because, following recognition of their target, they can exhibit collateral cleavage activity that can be linked to fluorescent, colorimetric, or lateral-flow detection systems.

CRISPR-based diagnostics have been investigated for several important animal pathogens, including African swine fever virus and other livestock viruses. Their principal attraction is the

combination of sequence-specific recognition, rapid signal generation, and potential compatibility with isothermal amplification and portable detection platforms (Rasool et al., 2024). Recent reviews describe the integration of CRISPR/Cas12 and Cas13 systems with amplification technologies such as recombinase polymerase amplification and LAMP for field-oriented veterinary diagnostics.

However, CRISPR-based diagnostics should currently be considered an emerging rather than universally established replacement for PCR. Many platforms still require a preliminary nucleic-acid amplification step, and their practical implementation depends on assay validation, sample preparation, contamination control, instrument requirements, and standardized interpretation. Their greatest potential may therefore lie in rapid, targeted, and portable detection systems that complement established laboratory methods.

Sequencing and Modern Genomic Methods

Next-generation sequencing (NGS), whole-genome sequencing, and metagenomic approaches have expanded veterinary diagnostics from targeted pathogen detection toward broader genomic characterization. Unlike PCR assays, which generally require prior selection of specific targets, metagenomic sequencing can investigate genetic material from multiple microorganisms present in a clinical sample. This makes the approach particularly valuable for complex infections, unexpected pathogens, outbreak investigation, and pathogen discovery (Miller et al., 2024).

Whole-genome sequencing can provide information beyond simple pathogen identification. Depending on the pathogen and analytical workflow, sequencing can support strain characterization, investigation of transmission pathways, identification of antimicrobial-resistance genes or mutations, detection of vaccine-related genetic changes, and epidemiological surveillance. WOAH includes standards addressing high-throughput sequencing, bioinformatics, and computational genomics within its Terrestrial Manual, reflecting the increasing importance of genomic technologies in veterinary diagnostic systems (WOAH, 2024).

Portable nanopore sequencing platforms, including Oxford Nanopore Technologies devices, have further increased the possibility of performing sequencing outside conventional sequencing laboratories. Nanopore systems can generate data in real time and can provide long sequence reads, making them attractive for outbreak investigation and rapid pathogen characterization. Recent veterinary reviews describe applications in viral and bacterial pathogen detection, antimicrobial-resistance profiling, metagenomics, and disease surveillance (Chaves et al., 2025).

Nevertheless, portable sequencing should not be described as a completely autonomous “farm-side” diagnostic method. Sample preparation, nucleic-acid extraction, library preparation, sequencing quality control, bioinformatics, reference databases, and interpretation remain important components of the workflow. Current evidence suggests that nanopore sequencing is often most

useful as a complementary technology that provides genome-level characterization after or alongside initial diagnostic testing rather than universally replacing PCR-based confirmation.

Portable and Point-of-Care (POC) Platforms

Point-of-care veterinary diagnostics aim to move selected diagnostic procedures closer to the animal, reducing the time between sample collection and preliminary result. Among the most promising molecular approaches are isothermal nucleic-acid amplification technologies, particularly loop-mediated isothermal amplification (LAMP). Unlike conventional PCR, LAMP amplifies nucleic acids at a relatively constant temperature and therefore does not require a conventional thermocycler (Poon et al., 2015).

LAMP has been investigated for numerous veterinary pathogens, including important viral diseases of livestock and poultry. The reaction can often be completed in less than an hour, and results may be visualized using fluorescence, turbidity, or colorimetric indicators. These characteristics make LAMP attractive for field diagnostics and resource-limited laboratories (Poon et al., 2015; Soltani et al., 2023).

For RNA viruses, reverse-transcription LAMP (RT-LAMP) incorporates a reverse-transcription step, allowing RNA targets to be converted and amplified within the same overall assay. Consequently, RT-LAMP can be used for selected RNA pathogens without requiring a conventional thermal cycler. However, reaction temperature, amplification time, sample preparation requirements, and detection limits vary between individual assays. Therefore, fixed values such as “60–65°C” and “15–30 minutes” should be presented as typical ranges rather than universal characteristics.

The continuing development of compact extraction systems, dry reagents, lateral-flow readouts, microfluidic devices, and smartphone-assisted interpretation is increasing the potential of POC platforms. Nevertheless, successful field implementation requires validation under realistic conditions, including temperature variation, sample quality, operator variability, contamination control, and comparison with established reerence methods.

Biotechnological approach	Main principle	Diagnostic application in veterinary medicine	Main advantage
Conventional PCR	Amplification of pathogen-specific DNA sequences	Detection of bacterial, viral and parasitic pathogens	High specificity and sensitivity
Real-time PCR (qPCR)	Amplification with simultaneous fluorescent detection	Rapid detection and quantification of pathogens	Rapid, sensitive and quantitative
RT-PCR	Reverse transcription of RNA followed by PCR	Detection of RNA viruses	Suitable for RNA pathogens
Multiplex PCR	Simultaneous amplification of several targets	Differential diagnosis of infections	Detects multiple pathogens in one reaction
LAMP	Isothermal amplification of target nucleic acids	Rapid field or laboratory diagnosis	Does not require conventional thermal cycling
DNA/RNA sequencing	Determination of pathogen genetic sequences	Identification, characterization and epidemiological investigation	Provides genetic information about

			pathogens
Next-generation sequencing (NGS)	High-throughput sequencing large numbers of nucleic-acid fragments	Detection of known and unexpected pathogens	Broad-spectrum pathogen detection
Metagenomic sequencing	Sequencing of all genetic material in a sample	Investigation of complex or unexplained infections	Can detect multiple or previously unrecognized agents
CRISPR-based diagnostics	Sequence-specific recognition of pathogen nucleic acids	Rapid detection of selected infectious agents	High specificity and potential for rapid testing
Biosensor-based diagnostics	Biological recognition element combined with a signal-detection system	Detection of pathogen antigens, antibodies or nucleic acids	Potential for portable and rapid testing

Overall, emerging technologies such as CRISPR-based detection, portable sequencing, metagenomics, and isothermal amplification are expanding the possibilities of veterinary infectious-disease diagnosis. Their principal contribution is not simply increased analytical speed but the potential to bring pathogen detection, characterization, and surveillance closer to the point of animal care and outbreak investigation. Their integration with established PCR, serological, and clinical diagnostic methods may provide a more flexible and comprehensive diagnostic framework for modern veterinary medicine.

Table 1. Modern biotechnological approaches for diagnosis of infectious diseases in animals

Table 1 summarizes the major modern biotechnological approaches used for the diagnosis of infectious diseases in animals. It highlights the principles, veterinary diagnostic applications, and principal advantages of molecular, genomic, and emerging diagnostic technologies. The approaches range from PCR-based methods, including real-time PCR, RT-PCR, and multiplex PCR, to isothermal amplification, sequencing, next-generation sequencing, metagenomics, CRISPR-based

diagnostics, and biosensors. Together, these technologies enable rapid, sensitive, specific, and increasingly comprehensive detection and characterization of infectious agents, supporting early diagnosis, differential diagnosis, epidemiological surveillance, and effective disease-control strategies in veterinary medicine.

Prospects for Application in Veterinary Medicine

The introduction of portable tests and mobile sequencing allows conducting rapid herd screening within half an hour upon suspicion of infection, selecting effective treatments immediately instead of blind antibiotic prescription, and rapidly shutting down disease transmission pathways.

Conclusion

Biotechnological methods play an increasingly important role in the modernization of veterinary medicine, significantly expanding the possibilities for the diagnosis and control of infectious diseases in animals. Molecular genetic methods such as PCR and LAMP provide rapid and sensitive detection of pathogen-specific genetic material, while immunobiotechnological approaches, including ELISA and immunochromatographic tests, enable the detection of antigens and antibodies and can provide valuable diagnostic information both in laboratories and directly in veterinary practice.

At the same time, modern biotechnological methods do not replace conventional diagnostic approaches such as microscopy, microbiological culture, and clinical examination. Instead, they complement traditional methods and allow diagnostic information to be obtained more rapidly and with greater specificity. The combined use of different diagnostic approaches is particularly important because the sensitivity and diagnostic value of each method may depend on the pathogen, stage of infection, type of biological sample, and clinical situation.

Further development of veterinary biotechnology is associated with the wider availability of molecular diagnostics, the development of portable and point-of-care diagnostic platforms, the application of CRISPR-based technologies, and the expanding use of next-generation sequencing. These technologies may facilitate earlier detection of infectious diseases, improve epidemiological surveillance, and support more effective infection-control measures. Their integration into veterinary practice is therefore an important component of modern approaches to animal health and the One Health concept, which emphasizes the interconnectedness of animal, human, and environmental health.

REFERENCES

Bustin, S. A., Benes, V., Garson, J. A., et al. (2009). The MIQE guidelines: Minimum information for publication of quantitative real-time PCR experiments. *Clinical Chemistry, 55*(4), 611–622. https://doi.org/10.1373/clinchem.2008.112797.

Bustin, S. A., Ruijter, J. M., van den Hoff, M. J. B., et al. (2025). MIQE 2.0: Revision of the Minimum Information for Publication of Quantitative Real-Time PCR Experiments Guidelines. *Clinical Chemistry, 71*(6), 634–651. https://doi.org/10.1093/clinchem/hvaf043.

Burrough, E. R., Derscheid, R. J., Mainenti, M., Piñeyro, P., & Baum, D. H. (2024). The diagnostic process for infectious disease diagnosis in animals. *Journal of the American Veterinary Medical Association, 263*(S1), S6–S16. https://doi.org/10.2460/javma.24.10.0657.

Chaves, M. C., Hashish, A. H., Goraichuk, I. V., et al. (2025). Nanopore sequencing in veterinary medicine: From concepts to clinical applications. *Frontiers in Cellular and Infection Microbiology, 15*, 1701570. https://doi.org/10.3389/fcimb.2025.1701570.

Daniels, J. B. (2013). Molecular diagnostics for infectious disease in small animal medicine: An overview from the laboratory. *Veterinary Clinics of North America: Small Animal Practice, 43*(6), 1373–1384. https://doi.org/10.1016/j.cvsm.2013.07.006.

Engvall, E., & Perlmann, P. (1971). Enzyme-linked immunosorbent assay (ELISA). Quantitative assay of immunoglobulin G. *Immunochemistry, 8*(9), 871–874. https://doi.org/10.1016/0019-2791(71)90454-X.

Geng, Y., et al. (2019). A SimpleProbe® real-time PCR assay for differentiating the canine parvovirus type 2 genotype. *BMC Veterinary Research*.

Kennedy, U., Allan Paterson, M. B., Soares Magalhães, R., Callaghan, T., & Clark, N. (2024). A scoping review of the evidence on prevalence of feline upper respiratory tract infections and associated risk factors. *Veterinary Sciences, 11*(6), 232. https://doi.org/10.3390/vetsci11060232.

Kim, D., Jeoung, S.-Y., Ahn, S.-J., Lee, J.-H., Pak, S.-I., & Kwon, H.-M. (2006). Comparison of tissue and fluid samples for the early detection of canine distemper virus in experimentally infected dogs. *Journal of Veterinary Medical Science, 68*(8), 877–879. https://doi.org/10.1292/jvms.68.877.

Kubista, M., Andrade, J. M., Bengtsson, M., et al. (2006). The real-time polymerase chain reaction. *Molecular Aspects of Medicine, 27*(2–3), 95–125. https://doi.org/10.1016/j.mam.2005.12.007.

Mackay, I. M. (2004). Real-time PCR in the microbiology laboratory. *Clinical Microbiology and Infection, 10*(3), 190–210. https://doi.org/10.1111/j.1198-743X.2004.00722.x.

Ogbu, K. I., et al. (2021). Diagnostic performance of a rapid immunochromatographic test kit for detecting canine parvovirus infection. *Veterinary Medicine and Science*.

Poon, L. L. M., et al. (2015). Loop-mediated isothermal amplification for diagnosis of 18 World Organisation for Animal Health (OIE) notifiable viral diseases of ruminants, swine and poultry. *Animal Health Research Reviews, 16*(2), 89–106. https://doi.org/10.1017/S1466252315000018.

Rasool, F., et al. (2024). CRISPR/Cas system and its application in the diagnosis of animal infectious diseases. *FASEB Journal*.

Sarchahi, A. A., et al. (2022). Detection of canine distemper virus in cerebrospinal fluid, whole blood and mucosal specimens of dogs with distemper using RT-PCR and immunochromatographic assays. *Veterinary Medicine and Science, 8*(4), 1390–1399. https://doi.org/10.1002/vms3.790.

Soltani, A., et al. (2023). Diagnosis of ruminant viral diseases with loop-mediated isothermal amplification. *Molecular Biotechnology*. https://doi.org/10.1007/s12033-023-00674-6.

WOAH (World Organisation for Animal Health). (2024). *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals* (13th ed.). World Organisation for Animal Health. Chapters on biotechnology advances, nucleic-acid detection, diagnostic-test validation, high-throughput sequencing, bioinformatics, and computational genomics.

WOAH (World Organisation for Animal Health). (2024). *Developing standards for diagnostic tests*. World Organisation for Animal Health.

WOAH (World Organisation for Animal Health). (2025). *WOAH Standards: Updated per Adopted Resolutions at the 2025 General Session*. World Organisation for Animal Health.

AFLATOXIN B1- AFLATOXIN M1: CARRY-OVER OF MYCOTOXINS FROM FEED TO MILK AND RISKS TO HUMAN HEALTH

Azerbaijan State Agricultural University

Faculty of Veterinary Medicine

Gulnar Rustamli, 4th year bachelor student

gulnar.rustamli06@gmail.com

ORCID ID: 0009-0004-3454-9314

Supervisor: **Associate Prof. Kushvar Mammadova**

kgmammadova@gmail.com

ORCID ID: 0000-0002-6293-2079

ABSTRACT: *Mycotoxins produced by toxigenic fungi remain a major challenge for poultry production and food safety. Contamination of poultry feed with aflatoxins, ochratoxin A, fumonisins, deoxynivalenol, T-2 toxin, zearalenone, and emerging mycotoxins is widely reported, particularly under intensive production and changing climatic conditions. This review summarizes evidence published between 2020 and 2025 on their occurrence, ecological drivers, toxicological effects, occupational and environmental exposure, food safety risks, detection methods, and mitigation strategies within a One Health framework. Recent findings show that multi-mycotoxin contamination is common; while emerging and masked mycotoxins may escape routine detection and lead to underestimated exposure. In poultry, these contaminants can cause hepatotoxicity, nephrotoxicity, oxidative stress, immunosuppression, intestinal barrier disruption, microbiome dysbiosis, reproductive impairment, and reduced productivity. Residues in meat and eggs also raise concerns for consumers, while contaminated dust and airborne fungal spores create occupational risks for poultry workers. Advanced methods, including liquid chromatography–tandem mass spectrometry, biosensors, molecular diagnostics, and multiplex systems, have improved monitoring. Feed hygiene, adsorbents, probiotics, biological detoxification, and enzymatic degradation offer promising mitigation options. Still, complete control remains difficult because fungal contamination and co-occurrence are highly complex. Integrated surveillance is essential. A coordinated One Health approach can help reduce risks to poultry health, workers, consumers, and food security.*

Keywords: *aflatoxins, climate change, food safety, masked mycotoxins, multi-mycotoxin and food contamination, occupational exposure, One Health, raw milk, production.*

1. Introduction According to the European Food Safety Authority, aflatoxins, including AFM1, are considered genotoxic and carcinogenic, posing a significant health risk particularly for infants and young children due to their higher exposure levels relative to body weight (Chain et al. 2020). Over the last decade or two, the issue of AFM1 contamination has become particularly significant, posing a major challenge for public health, especially in low- and middle-income countries, where regulatory control and monitoring systems may be less stringent (Ghaffarian-Bahraman et al. 2023; Iqbal et al. 2015). The primary cause of aflatoxin contamination in milk samples is the consumption of feed contaminated with mycotoxins by lactating animals. Depending on the type of mycotoxin, these contaminated feedstuffs may lead to the presence of metabolized substances or their derivatives (modified mycotoxins) in raw milk samples (Freire and Sant'Ana 2018).

The contamination of livestock feed with mycotoxins is a global concern within the animal products industry, posing significant threats to both animal and human health. Mycotoxins can exert inhibitory, mutagenic, carcinogenic, and immunosuppressive effects (Iqbal et al. 2015). Given the detrimental impacts of aflatoxins, which include toxicity, carcinogenicity, mutagenicity, and immunosuppression, the widespread occurrence of various aflatoxins in food and feed presents considerable risks to human and animal health (Thakur et al. 2022).

The prevalence of aflatoxins in crops is largely determined by climatic conditions. Arid and high-temperature environments favor the proliferation of storage fungi, thereby enhancing the synthesis of aflatoxins (Panara et al. 2022; Stefanovic et al. 2015). AFM1, a hepatocarcinogenic metabolite formed from aflatoxin B1 (AFB1) through hydroxylation in the liver, can lead to DNA damage and chromosomal aberrations, contingent upon exposure levels. It is excreted into the milk of lactating animals ingesting AFB1-contaminated feed via hepatic microsomal cytochrome P450 activity (Cao et al. 2022; Michlig et al. 2016). AFM1, classified as a group 1 carcinogen by the World Health Organization (WHO), and therefore, no Tolerable Daily Intake (TDI) should be established for this substance. The Margin of Exposure (MOE) approach is more appropriate for assessing the risk of carcinogenic substances, and this method was applied in our risk assessment calculations. AFM1 exhibits a carcinogenicity level of 2%–10% relative to AFB1 (Schincaglia et al. 2023; Stefanovic et al. 2015).

Over 300 aflatoxin types have been identified. The research shows a direct correlation between AFM1 concentration in milk and AFB1 levels in animal feed, with 2%–6% of ingested AFB1 converting to AFM1 in milk. AFM1 can be detected in milk 12–24 h post-ingestion of contaminated feed and diminishes to undetectable levels within 72 h after discontinuation of exposure to contaminated feed (Costamagna et al. 2024; Fallah et al. 2016; Flores-Flores et al. 2015; Ketney et al. 2017). The public-health importance of AFM_1 contamination is amplified by the nutritional

importance and regular consumption of milk. Milk and dairy products provide proteins, minerals and other nutrients and may form an important component of the diets of children and other population groups.

2. AFB1–AFM1 Carry-Over and Health Risks

In professional animal operations, monogastric species such as pigs, poultry, and fish receive a standardized diet designed to meet the nutritional requirements of the species and age group. The components used in the production of these mixed feeds can be monitored and allow the formulation of diets that are well tolerated by the animals. In contrast, the unique physiology of ruminant species, which is characterized by a pre-systemic fermentation and digestion of plant constituents such as cellulose by microbes comprising the ruminal flora, requires feeding regimes that include sufficient amounts of roughage to maintain a functional rumen flora.

Genetic selection for high milk yield made it necessary to add increasing quantities of digestible energy-rich feed components to the ruminant diet. In extensive farming, grazing makes up a large portion of the diet and the intake of concentrates is limited to a few per cent of the total feed intake. In contrast, in dairy cattle operation, concentrates may feature up to 70% of the daily feed ration. A direct consequence of the complex and variable composition of ruminant diets is the risk of exposure to more than one mycotoxin or mycotoxin cluster; the term ‘cluster’ refers to a set of mycotoxins produced by an individual fungal species (Table I).

Table I. Examples of possible co-exposure of dairy cows to mycotoxins in different components of a ruminant diet.

Diet component	Mycotoxins
Concentrates	aflatoxins, fumonisins, zearalenone, trichothecenes (DON), ergot alkaloids
Pasture grasses	lolitrems, paspalitrems, penitrem A, ergovaline and associated ergot alkaloids, trichothecenes
Preserved feeds (silage)	patulin, mycophenolic acid, roquefortines, fumitremorgens, verruculogen, monacolines, and others

***Source**: Fink-Gremmels, J. (2008). Mycotoxins in cattle feeds and carry-over to dairy milk: A review. **Food Additives & Contaminants: Part A, 25**(2), 172–180. DOI: 10.1080/02652030701823142.*

The first identified source of mycotoxins in ruminant diets was the contamination of concentrates with aflatoxins. Aflatoxins occur in many typical energy-rich concentrates as, for example, cereal

grains, corn gluten, soybean products, as well as in press cakes from oil plants such as peanuts, sunflower seeds, cotton seeds, palm kernels, and copra. Other prominent mycotoxins, such as fumonisins and zearalenone, occur in maize (and maize derived products), whereas cereal grains are contaminated frequently with trichothecenes, particularly with deoxynivalenol, ochratoxins, and ergot alkaloids (Nawaz et al. Citation1997; Scudamore, Nawaz, Hetmanski Citation1998; Scudamore, Nawaz, Hetmanski, Rainbird Citation1998; Placinta et al. Citation1999).

At the same time, ruminants might be exposed to entirely different classes of mycotoxins that occur in forages (pasture grasses), such as the *Neotyphodium* toxins of the lolitrem-paxilline group and ergovaline, as well as other ergot alkaloids. The level of contamination of (cold season) grasses shows significant geographical differences (Cheeke Citation1995) and is gaining increasing attention.

The third source of mycotoxins in the diet of dairy cows results from the consumption of preserved feeding stuffs such as silage, hay, and straw (O’Brien et al. Citation2005; Mansfield and Kuldau Citation2007). Particularly after a longer storage period, silage can be spoiled by a variety of fungal species, which are acid-tolerant and micro-aerobe. Mycological investigation identified *Penicillium* spp. such as *P. roqueforti* and *P. paneum*, *Aspergilli* (*A. fumigatus* and *A. flavus*) (Cole et al. Citation1977), *Monascus* spp. (Schneweis et al. Citation2001), and *Byssochlamys nivea* (Escoula Citation1975) as the most prevalent fungal species in silage. Mycotoxins produced by these fungi include patulin, mycophenolic acid, penicillic acid, roquefortins, marcfortine A, andrastin A, gliotoxin, and toxins of the verruculogen/fumitremorgen group (Garon et al. Citation2006; O’Brien et al. Citation2006). It should be mentioned that mycotoxins originating from pre-harvest contamination of forages that are ensiled are often unaffected by the ensiling process, and add to the overall mycotoxin contamination.

The ratio in which these different feed sources are used in the diet of dairy cows varies considerably and is determined by regional differences, the production stage of the animal, and farm management. This also implies that a generally applicable exposure assessment is not feasible, and hence data relating exposure to multiple toxins to quantifiable markers of animal health and productivity are scarce.

Accordingly, this review critically synthesises available literature on the occurrence of AFB_1 in cattle feed and AFM_1 in milk, their toxicological and public-health implications, factors controlling feed-to-milk carry-over, analytical approaches, prevention strategies and regulatory considerations, with particular emphasis on Northern Nigeria and Katsina State. It also distinguishes what has already been demonstrated from what remains uncertain, thereby defining priorities for larger, seasonal and methodologically harmonised dairy-safety studies.

Health effects: The main route of exposure to aflatoxin is through the direct consumption of contaminated food. Aflatoxin exposure can occur throughout the life course, beginning *in utero* through transplacental exposure[37]. Breast milk is a pathway of exposure for young children at breastfeeding[38]; however, the AFM1 found in milk is less toxic than AFB1 found in food. In Africa, weaning foods are often cereal- and legume-based, both of which are susceptible to aflatoxin contamination and children's exposure increases during weaning[39].

3. Prevention and One Health Approach

Feed and nutrients are vulnerable to fungal infestation and can become contaminated with mycotoxins when conditions favour fungal growth, particularly influenced by temperature and humidity during storage, blending, transport, and processing phases (Joubrane et al., 2020; Perdoncini et al., 2019). There is no definitive cure for mycotoxin-induced toxicity. Therefore, prevention measures must be implemented to reduce the formation of mycotoxins and avoid contamination. Preventative strategies exist both pre-harvest and post-harvest. Additionally, failure to maintain proper conditions (e.g., humidity, temperature, oxygen, and time) can significantly reduce mycotoxin production (Boudergue et al., 2009).

Maximum limits within which mycotoxin levels can be found in food and feed have been set by leading authorities (EFSA, 2004; EU, 2023). It is estimated that more than 500 million people are exposed to mycotoxins above tolerable limits (WHO, 2023; Zinedine et al., 2025). Exceeding the recommended limits has been shown to cause acute and chronic hepatotoxic, nephrotoxic, immunosuppressive, and carcinogenic effects in both humans and animals. The risk of these effects depends on the mycotoxin dose, the duration of exposure, and the simultaneous presence of multiple mycotoxins (Akande et al., 2006; IARC, 2023; Yiannikouris & Jouany, 2002).

Mycotoxins are detected using chromatographic methods (HPLC, LC-MS/MS), immunochemical methods (ELISA, LFI), and spectroscopic methods (NIS, AAS). Chromatographic methods are the most commonly used detection technologies and offer higher accuracy, selectivity, and sensitivity compared to other methods. However, cost, solvent consumption, and the need for well-trained personnel limit their use (Naeem et al., 2024).

Mycotoxins can be prevented from absorption from the digestive system after ingestion of mycotoxin-contaminated feed or food by reducing their adsorption by various adsorbents or detoxifying agents, or by converting them into less toxic substances. To reduce the severity of adverse effects such as decreased yield and immunosuppression caused by mycotoxin exposure, it is important to use substances that reduce the severity of these adverse effects (Jard et al., 2011; Shekhar et al., 2025).

Given the health impact and global importance of mycotoxins, detoxification strategies are needed. This review focuses on physical, chemical, biological and plant bioactive compounds approaches to reduce mycotoxin levels in food and feed. Particular attention is paid to their mechanisms of action, practical limitations and potential for industrial application. By critically evaluating both traditional and emerging detoxification methods, it is intended to provide an up-to-date overview that will inform risk management and guide future research directions. Aflatoxins are a group of mycotoxins that pose significant concerns regarding human intoxication. AFB1 is the most potent toxin known for causing liver cancer.

AFB1 reacts with components such as proteins and cell organelles and disrupts normal cellular functions. As a result, it can cause suppression of the immune system, and carcinogenic, teratogenic and mutagenic effects (da Silva et al., 2021). In both humans and animals, aflatoxins are associated with severe toxicological consequences, including liver cancer, immunosuppression (Massomo, 2020). Following epoxidation at the terminal furan ring, AFB1 produces ROS and creates oxidative stress and forms adducts with DNA in the liver via cytochrome P450 enzymes, leading to mutations that can cause carcinogenesis (Peles et al., 2019). Contamination of foods with aflatoxins before harvest is the main cause of post-harvest aflatoxin contamination, which results in a decrease in the quality of nutritional content (Agbetiameh et al., 2020). Versicolorin A was discovered as an early biomarker of contamination with aflatoxins in food and feedstuffs. his lead compound was reported to have a stronger cytotoxic effect than the same dose of AFB1 (Gauthier et al., 2020). The figure illustrates the transfer of **aflatoxin B_1 (AFB_1)** from contaminated feed into the dairy food chain. After ingestion by dairy cattle, AFB_1 is partly absorbed from the gastrointestinal tract and transported to the liver, where it undergoes enzymatic biotransformation, producing **aflatoxin M_1 (AFM_1)**. AFM_1 is subsequently excreted into milk, where it can persist and enter the human diet through consumption of milk and dairy products. The extent of carry-over is influenced by factors such as AFB_1 intake, feed contamination level, milk yield, animal physiology, and feeding conditions.

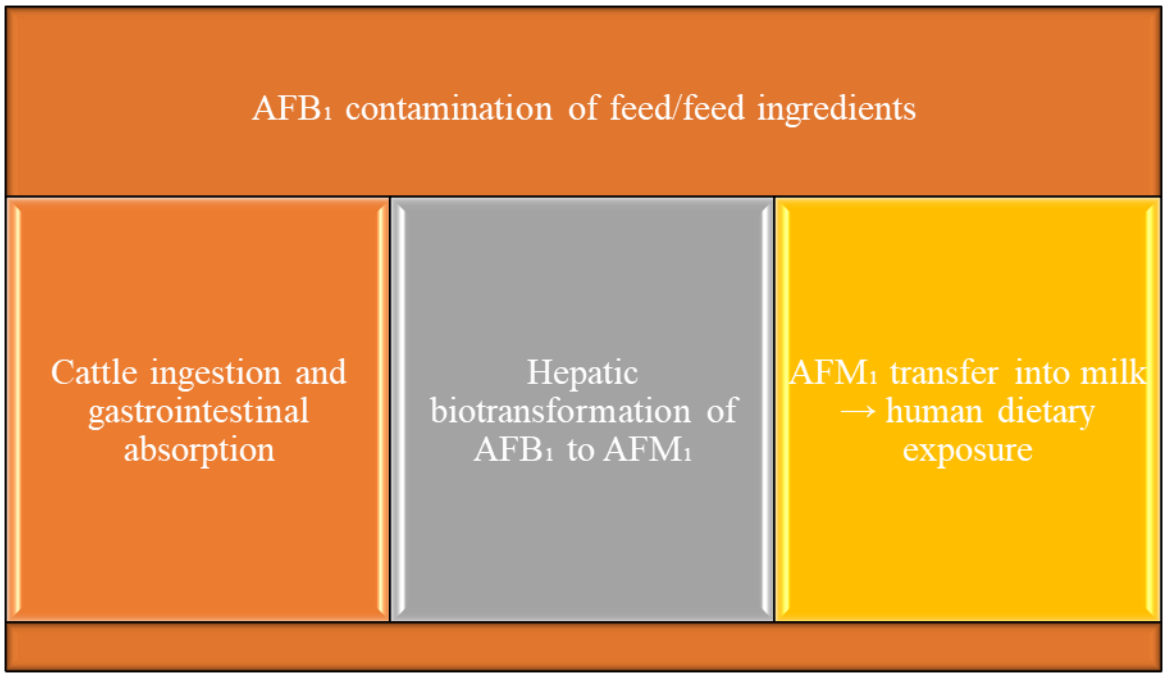


Figure 1. Conceptual Pathway Linking AFB₁-Contaminated Feed with AFM₁ in Milk and Human Exposure

Source: *Ferrari, L., et al. (2023). Carry-Over of Aflatoxin B1 from Feed to Cow Milk—A Review. Toxins, 15(3), 195. The review describes the sequence AFB₁-contaminated feed → gastrointestinal absorption → blood → hepatic metabolism → AFM₁ formation → milk → human exposure and discusses factors affecting carry-over.*

Key modifiers: AFB_1 dose, feed intake, feed composition, storage conditions, milk yield, lactation stage, animal health, sampling interval and season

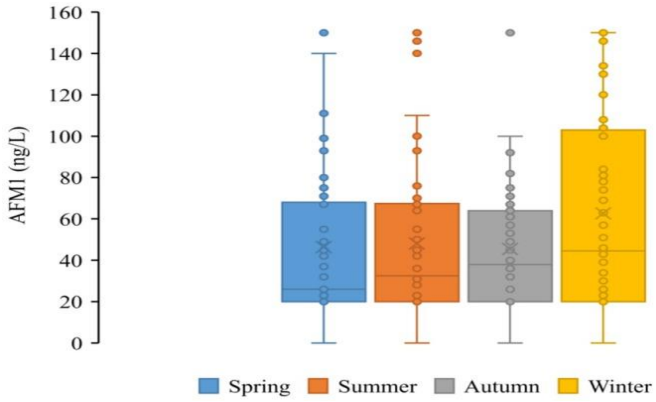
4. Discussion and Conclusion

In winter, livestock are typically fed stored feed for longer durations due to limited fresh forage availability (Özbey et al. 2023).

Boxplot analysis revealed clear seasonal variations in AFM1 concentrations in milk samples (Figure 1). The median and interquartile ranges were noticeably higher in winter, indicating elevated contamination levels during this period. Moreover, a greater number of outliers and extreme values were observed in winter, suggesting sporadic but significant AFM1 spikes, likely due to higher reliance on stored or contaminated feed. In contrast, summer and spring showed lower median values and narrower interquartile ranges, reflecting relatively stable and reduced AFM1 contamination. These findings support the hypothesis that seasonal factors, particularly those related to feeding practices and storage conditions, significantly influence AFM1 levels in dairy products. If storage conditions are suboptimal—such as high moisture levels, poor ventilation, or prolonged storage—aflatoxin levels in feed can increase substantially. Moreover, the quality and

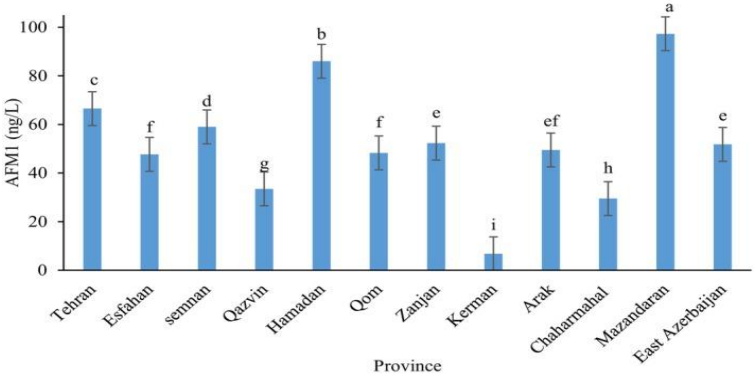
type of animal feed varies seasonally (Akbar et al. 2019). In summer and spring, animals may have more access to fresh pasture, reducing reliance on potentially contaminated stored feed (Polano et al. 2024). In contrast, the increased use of concentrated and stored feeds in winter could contribute to the higher AFM1 levels observed. Additionally, cold weather might influence the metabolic rate of livestock, potentially affecting how aflatoxins are metabolized and excreted into milk as AFM1 (Pate 2019; Wang et al. 2023). Furthermore, management practices in dairy farms, including feed rotation, storage infrastructure, and monitoring systems, might differ between seasons and farms, influencing the final contamination levels. Collectively, these findings highlight the importance of implementing season-specific strategies for controlling aflatoxin contamination, particularly improving storage conditions and feed quality monitoring during the winter months (Figure 2).

Figure 2.



Seasonal variation in AFM1 concentrations of raw milk samples (box plot showing median, interquartile ranges, and outliers).

Figure 3.



Geographical variation of AFM1 concentrations across 12 provinces supplying raw milk to Tehran during 2019 and 2020 determined by immunochromatography method (mean values ± SD). Different lowercase letters indicate the statistically significant difference ($p \leq 0.05$) between AFM1 content of different provinces.

5. Conclusion: implications for veterinary public health and One Health.

Table 2. Factors affecting the carry-over of aflatoxins.

Factor	Influence on Carry-Over	Sub-Effects	Other Influencing Factors	Remarks
Daily milk production (milk yield)	↑		time passed after calving (stage of lactation)↓; daily milkings↑; breed↕; feed consumption↑;	animal husbandry related
Somatic cell count	not confirmed	(permeability in the udder↑)		animal related, would be relevant only for very high SCC cases
Season-effect	↕	grazing↓; stored feed ingredients↑; warm, humid climate↑		other factor
AFB1 intake	↑			
Effect of feed (contamination source)	↕	feed contamination↑; compound feed↑; ‘’susceptible ingredients”↑		feed related
Feed particle size (different from ideal)	↑			feed related

Vaccination	↓			animal husbandry related intervention
Adsorbents	↓			feed related intervention

The review was conducted within a One Health framework to emphasize the interconnected relationships among animal health, environmental contamination, occupational exposure, and public health risks associated with mycotoxins. The synthesis specifically considered the role of fungal ecology, feed contamination, environmental dissemination, and human exposure pathways in shaping the broader impact of mycotoxins on sustainable poultry production and global food safety.

Our aim with this review was to extract and synthesize information from the published literature regarding the process and extent of carry-over of AFB1 from feed into AFM1 in cow milk, and to review the most important factors influencing this process.

It can be seen from Table 2 that the factors affecting carry-over of aflatoxins may have further correlations with each other and with other factors. The most important factors identified and discussed were milk yield, somatic cell counts, aflatoxin B1 intake, source of contamination, seasonal effects, particle size of feed, and the effects of certain interventions, namely vaccination and the use of adsorbents. Carry-over equations provide further information regarding the relationship of transfer rate and, particularly, two factors, milk yield and aflatoxin B1 intake. Summarizing different study results is difficult, among others, due to differences in study arrangements and differences in milking and feeding conditions of animals. The different carry-over equations may lead to largely different results, and no single carry-over equation can be picked as the best one. Further carry-over research should attempt to record as many influencing circumstances as possible in order to properly evaluate and compare the results.

References

Agbetiameh, D., Ortega-Beltran, A., Awuah, R. T., Atehnkeng, J., Elzein, A., Cotty, P. J., & Bandyopadhyay, R. (2020). Field efficacy of two atoxigenic biocontrol products for mitigation of aflatoxin contamination in maize and groundnut in Ghana. *Biological Control, 150*, 104351. https://doi.org/10.1016/j.biocontrol.2020.104351

Akande, K. E., Abubakar, M. M., Adegbola, T. A., & Bogoro, S. E. (2006). Nutritional and health implications of mycotoxins in animal feeds: A review. *Pakistan Journal of Nutrition, 5*(5), 398–403.

Boudergue, C., et al. (2009). Review of mycotoxin-detoxifying agents used as feed additives: Mode of action, efficacy and feed/food safety.

Cao, W., et al. (2022). Aflatoxin B1 metabolism and conversion to aflatoxin M1 in dairy cattle.

Cheeke, P. R. (1995). Endogenous toxins and mycotoxins in forage grasses and other pasture plants.

Chain, E. P., et al. (2020). Risk assessment of aflatoxins in food and feed. European Food Safety Authority (EFSA).

Cole, R. J., et al. (1977).

Costamagna, D., et al. (2024). Aflatoxin M1 occurrence, carry-over and exposure assessment in milk.

da Silva, J. M., et al. — **Duplicate/inconsistent citation removed.** The reference supplied as "da Silva et al. (2021)" was identified as:

Jiang, Y., Ogunade, I. M., Vyas, D., & Adesogan, A. T. (2021). Aflatoxin in dairy cows: Toxicity, occurrence in feedstuffs and milk and dietary mitigation strategies. *Toxins, 13*(4), 283. https://doi.org/10.3390/toxins13040283

Escoula, L. (1975).

European Food Safety Authority (EFSA). (2004). Scientific opinion/report concerning mycotoxins and maximum levels in food/feed.

European Union. (2023). European Commission/EU legislation concerning maximum levels of mycotoxins in food and feed.

Fallah, A. A., et al. (2016). Occurrence and risk assessment of aflatoxin M1 in milk and dairy products.

Fink-Gremmels, J. (2008). Mycotoxins in cattle feeds and carry-over to dairy milk: A review. *Food Additives & Contaminants: Part A, 25*(2), 172–180. https://doi.org/10.1080/02652030701823142

Flores-Flores, M., Lizarraga, E., López de Cerain, A., & González-Peñas, E. (2015). Presence of mycotoxins in animal milk: A review.

Freire, L., & Sant'Ana, A. S. (2018). Modified mycotoxins: An updated review on their formation, occurrence, and toxicological relevance.

Garon, D., Richard, E., Sage, L., Bouchart, V., Pottier, D., & Lebailly, P. (2006). Mycoflora and multimycotoxin detection in corn silage: Experimental study. *Journal of Agricultural and Food Chemistry, 54*, 3479–3484. https://doi.org/10.1021/jf060179i

Gauthier, T., Duarte-Hospital, C., Vignard, J., Boutet-Robinet, E., Sulyok, M., Snini, S. P., Alassane-Kpembi, I., Lippi, Y., Puel, S., Oswald, I. P., & Puel, O. (2020). Versicolorin A, a precursor in aflatoxins biosynthesis, is a food contaminant toxic for human intestinal cells. *Environment International, 137*, 105568. https://doi.org/10.1016/j.envint.2020.105568

Ghaffarian-Bahraman, A., et al. (2023). Aflatoxin M1 contamination in milk and dairy products: Occurrence and public health risk.

IARC. (2023). *IARC Monographs on the Identification of Carcinogenic Hazards to Humans*. International Agency for Research on Cancer.

Iqbal, S. Z., Jinap, S., Pirouz, A. A., & Faizal, A. A. (2015). Aflatoxin M1 in milk and dairy products: A review of occurrence, detection and risk assessment.

Jard, G., Liboz, T., Mathieu, F., Guyonvarc'h, A., & Lebrihi, A. (2011). Review of mycotoxin reduction in food and feed: From prevention in the field to detoxification by adsorption or transformation. *Food Additives & Contaminants: Part A, 28*(12), 1590–1609.

Joubrane, K., et al. (2020). **[Full bibliographic information needs verification.]**

Jiang, Y., Ogunade, I. M., Vyas, D., & Adesogan, A. T. (2021). Aflatoxin in dairy cows: Toxicity, occurrence in feedstuffs and milk and dietary mitigation strategies. *Toxins, 13*(4), 283. https://doi.org/10.3390/toxins13040283

Ketney, O., Santini, A., & Oancea, A. (2017). Recent aflatoxin survey data in dairy products and milk.

Mansfield, M. A., & Kuldau, G. A. (2007). Microbiological and molecular determination of mycobiota in fresh and ensiled maize silage. *Mycologia, 99*(2), 269–278. https://doi.org/10.3852/mycologia.99.2.269

Massomo, S. M. S. (2020). Aspergillus flavus and aflatoxin contamination in the maize value chain and what needs to be done in Tanzania. *Scientific African, 10*, e00606. https://doi.org/10.1016/j.sciaf.2020.e00606

Michlig, N., et al. (2016). Aflatoxin M1 in milk: Occurrence, metabolism and analytical determination.

Naeem, M., et al. (2024).

Nawaz, S., Scudamore, K. A., & Rainbird, S. C. (1997). Mycotoxins in ingredients of animal feeding stuffs: I. Determination of Alternaria mycotoxins in oilseed rape meal and sunflower seed meal. *Food Additives and Contaminants, 14*(3), 249–262. https://doi.org/10.1080/02652039709374522

O'Brien, M., et al. (2005).

O'Brien, M., Nielsen, K. F., O'Kiely, P., Forristal, P. D., Fuller, H. T., & Frisvad, J. C. (2006). Mycotoxins and other secondary metabolites produced in vitro by *Penicillium paneum* and *Penicillium roqueforti* isolated from baled grass silage in Ireland. *Journal of Agricultural and Food Chemistry, 54*(24), 9268–9276. https://doi.org/10.1021/jf0621018

Panara, F., et al. (2022). Climate and environmental factors influencing aflatoxin contamination in agricultural commodities.

Peles, F., Sipos, P., Győri, Z., Pfliegler, W. P., Giacometti, F., Serraino, A., Pagliuca, G., Gazzotti, T., & Pócsi, I. (2019). Adverse effects, transformation and channeling of aflatoxins into food raw materials in livestock. *Frontiers in Microbiology, 10*, 2861. https://doi.org/10.3389/fmicb.2019.02861

Perdoncini, M. R. F., et al. (2019).

Placinta, C. M., D'Mello, J. P. F., & Macdonald, A. M. C. (1999). A review of worldwide contamination of cereal grains and animal feed with *Fusarium* mycotoxins. *Animal Feed Science and Technology, 78*(1–2), 21–37.

Schincaglia, A. C., et al. (2023). Aflatoxin M1 exposure and risk assessment in milk and dairy products.

Schneweis, I., Meyer, K., Hörmansdorfer, S., & Bauer, J. (2001). Metabolites of *Monascus ruber* in silages. *Journal of Animal Physiology and Animal Nutrition, 85*(1–2), 38–44. https://doi.org/10.1046/j.1439-0396.2001.00300.x

Scudamore, K. A., Nawaz, S., & Hetmanski, M. T. (1998). Mycotoxins in ingredients of animal feeding stuffs: II. Determination of mycotoxins in maize and maize products. *Food Additives and Contaminants, 15*(1), 30–55. https://doi.org/10.1080/02652039809374597

Scudamore, K. A., Nawaz, S., Hetmanski, M. T., & Rainbird, S. C. (1998). Mycotoxins in ingredients of animal feeding stuffs: III. Determination of mycotoxins in rice bran. *Food Additives and Contaminants, 15*(2), 185–194. https://doi.org/10.1080/02652039809374629

Shekhar, R., Raghavendra, V. B., & Rachitha, P. (2025). A comprehensive review of mycotoxins, their toxicity, and innovative detoxification methods. *Toxicology Reports, 14*, 101952. https://doi.org/10.1016/j.toxrep.2025.101952

Stefanovic, V., et al. (2015). Occurrence and health risk assessment of aflatoxin M1 in milk and dairy products.

Thakur, M., et al. (2022). Aflatoxins: Occurrence, toxicity, health effects and control strategies.

WHO. (2023). Mycotoxins and food safety. World Health Organization.

Yiannikouris, A., & Jouany, J.-P. (2002). Mycotoxins in feeds and their fate in animals. *Animal Research, 51*, 81–99.

Zinedine, A., Zarati, A., Bennani, M., Abbès, S., & Ben Salah-Abbès, J. (2025). *Update of mycotoxin monitoring in the Maghreb region (2019–2024): Occurrence in staple food, current legislation, climate impact, and exposure assessment.* **Current Opinion in Food Science, 63**, 101314.https://doi.org/10.1016/j.cofs.2025.101314

VETERINARY MEDICINE, ENVIRONMENTAL HEALTH AND FOOD SECURITY: ONE HEALTH APPROACHES TO SUSTAINABLE AGRICULTURE

Azerbaijan State Agricultural University

Veterinary Medicine Faculty

Department of non-infectious diseases

Associate Professor **Kushvar Mammadova**

kgmammadova@gmail.com

ORCID ID: 0000-0002-6293-2079

Senior lecturer **Yegane Behbudova**

yegana.behbudova@mail.ru

ORCID ID: 0009-0004-2539-6379

Abstract *Food security is increasingly influenced by climate change, environmental degradation, emerging agricultural risks, and pressures on livestock production. These challenges require integrated approaches that address animal health, environmental protection, food safety, and human well-being simultaneously. Veterinary medicine has an important role in this process through disease prevention, herd health management, animal welfare, veterinary public health, and food safety control. This article examines the contribution of veterinary medicine to food security within the framework of the One Health approach to sustainable agriculture. Particular attention is given to the relationships between animal health, environmental health, and agricultural productivity, including the effects of climate change, soil and water quality, biodiversity loss, and intensive livestock production. The article also considers the importance of farm-to-fork risk management, interdisciplinary collaboration, digital monitoring, early-warning systems, and circular-economy practices. Integrating veterinary expertise with agricultural, environmental, food-safety, and public-health measures can support more resilient and sustainable food systems. A One Health perspective therefore provides a practical framework for reducing production losses, protecting natural resources, and strengthening the safety, availability, and long-term sustainability of food supplies.*

Keywords: *One Health; veterinary medicine; food security; environmental health; sustainable agriculture; animal health; food safety; climate chang**e.***

Introduction Global food security is increasingly challenged by climate change, environmental degradation, population growth, and rising demand for animal-derived foods. Meeting these pressures requires more than increasing agricultural production. It also depends on protecting animal health, maintaining food safety, conserving natural resources, and improving the resilience of agricultural systems. Veterinary medicine contributes to these objectives through disease prevention, animal health management, animal welfare, food safety, and veterinary public health. These functions are closely aligned with the One Health concept, which recognizes the interconnectedness of human, animal, plant, and ecosystem health (FAO et al., 2022). Climate change is already affecting agricultural systems through rising temperatures, altered precipitation patterns, droughts, floods, and other extreme events. Such changes can influence crop productivity, water and feed availability, livestock health, and overall agricultural performance (IPCC, 2023; FAO, 2023). Meanwhile, agricultural production itself can intensify environmental pressures through greenhouse-gas emissions, land-use change, waste generation, and the consumption of water and other resources. Sustainable agriculture must therefore balance productive capacity with the protection of soil, water, biodiversity, and ecosystem functions. Livestock production plays a major role in food security and supports the livelihoods of many rural communities. Its contribution, however, depends strongly on animal health, nutrition, veterinary support, and effective farm management. Disease, inadequate feeding, and limited access to veterinary services can reduce productivity while increasing resource requirements and avoidable losses. Conversely, healthy animals managed under appropriate production conditions can contribute to more efficient food production and greater resilience across agricultural systems. The benefits of veterinary interventions consequently extend beyond individual animal health to wider concerns involving food security, food safety, environmental sustainability, and human wellbeing. These interconnected dimensions are central to the One Health approach. Rather than addressing animal, human, and environmental problems separately, One Health promotes coordinated action across professional and institutional boundaries. Veterinarians can therefore work alongside biologists, agricultural and environmental specialists, food-safety professionals, public-health experts, and policymakers to address risks that move across different sectors. The Quadripartite One Health framework further emphasizes coordinated approaches to animal health, environmental health, food safety, and sustainable food systems (FAO et al., 2022). Within this context, food security should not be understood solely in terms of food availability. Access to safe and nutritious food, environmental sustainability, efficient resource use, and the capacity of food systems to withstand climatic and other disturbances are equally important. Preventive veterinary care,

sustainable livestock management, environmental protection, and effective food-safety measures can work together to reduce agricultural losses and strengthen food-system resilience. Veterinary medicine consequently represents an important connection between animal health, environmental health, food safety, and food security. Bringing veterinary and environmental sciences together within a One Health framework can support agricultural systems that are productive while also being safe, resource-efficient, resilient, and environmentally sustainable.

This study aims to examine the role of veterinary medicine within the One Health framework in strengthening sustainable food security by linking animal health, disease prevention, food safety, environmental protection, and resource-efficient livestock production. Attention is given to how preventive veterinary interventions can reduce agricultural losses, improve livestock productivity, and enhance the resilience and sustainability of food systems under increasing environmental and climate-related pressures.

2. Veterinary Medicine and Food Security

Global food security depends on the resilience and sustainability of livestock production systems. Climate change is one of the major pressures affecting these systems, with consequences extending from feed and water availability to animal health, productivity, welfare, and the livelihoods of livestock-dependent communities. These effects are particularly important for small-scale producers who often have limited access to land, financial resources, infrastructure, and veterinary services and may depend heavily on climate-sensitive production systems (FAO, 2023a; IPCC, 2023). Climate-related disturbances can therefore influence not only agricultural production but also household income, food availability, and human wellbeing. Building resilient livestock systems requires the capacity to withstand environmental and socioeconomic disturbances while adapting to changing conditions. Important resilience measures include improved animal health and nutrition, appropriate herd management, diversification of livestock species and breeds, conservation of locally adapted genetic resources, improved pasture management, and integration of crop and livestock production (FAO, 2023a). Diversification can reduce dependence on a single production activity, while crop–livestock integration can improve the use of available biomass and nutrients. Conservation of adapted animal breeds is also important because genetic diversity can provide options for future adaptation to changing environmental conditions. Veterinary medicine has a central role in this process. Animal health directly influences productivity, resource efficiency, welfare, and the stability of livestock-based food production. Preventive veterinary care, disease control, appropriate nutrition, herd health management, and responsible use of veterinary medicines can reduce production losses and improve the efficiency of livestock systems. Recent FAO

assessments emphasize that improvements in animal health, feeding, genetics, and management can contribute simultaneously to higher productivity, greater resilience, and lower environmental impacts (FAO, 2023a; FAO, 2025). Thus, veterinary services should be considered not only as a component of animal healthcare but also as an important element of sustainable agriculture and food security. The environmental dimension of livestock production is equally important. Livestock systems interact with land, water, vegetation, biodiversity, and nutrient cycles, while also contributing to greenhouse-gas emissions and other environmental pressures. FAO estimates that livestock agrifood systems represented a substantial share of global agrifood-system greenhouse-gas emissions, highlighting the importance of improving production efficiency while maintaining food availability (FAO, 2023a). However, sustainability should not be evaluated solely according to emissions. Animal health, productivity, resource use, livelihoods, food safety, biodiversity, and ecosystem services also need to be considered when assessing the overall contribution of livestock systems to sustainable agrifood systems. The concept of a circular bioeconomy provides additional opportunities to improve resource efficiency. Livestock can utilize certain agricultural residues, by-products, and other resources that are not suitable for direct human consumption, converting them into animal products. At the same time, manure and other livestock-derived materials can contribute to soil fertility, composting, biogas production, bioenergy, and biomaterials when appropriately managed (Gómez San Juan et al., 2022). Such approaches can reduce waste, recycle nutrients, and strengthen connections between crop and livestock production. However, circular resource use must be implemented with appropriate veterinary, environmental, and food-safety safeguards. These relationships demonstrate why livestock sustainability cannot be addressed through a single discipline. Different production systems have both positive and negative effects on environmental, economic, and social outcomes, and the appropriate management strategy depends on local ecological, socioeconomic, and production conditions (FAO, 2023a). Greater attention is therefore needed to integrated approaches that consider animal health, environmental protection, food safety, resource efficiency, and the livelihoods of farming communities together. This perspective is consistent with the One Health approach, which recognizes that human, animal, plant, and ecosystem health are closely interconnected. The Quadripartite One Health Joint Plan of Action developed by FAO, UNEP, WHO, and WOAH promotes coordinated action across these sectors and specifically includes food safety and environmental health among its major areas of action (FAO, UNEP, WHO, & WOAH, 2022). FAO also identifies food safety as a core component of One Health because food connects the human, animal, plant, and environmental interfaces (FAO,

Animal welfare dimension	Veterinary medicine contribution	Effect on animal health and productivity	Contribution to sustainable food production
Adequate nutrition and water	Nutritional assessment, disease prevention, and monitoring of feeding practices	Supports growth, reproduction, immunity, and productivity	Improves feed efficiency and reduces production losses
Disease prevention and control	Vaccination, health surveillance, biosecurity, and early diagnosis	Reduces morbidity, mortality, and production disruption	Supports stable food production and reduces resource losses
Appropriate housing and environmental conditions	Assessment of housing, ventilation, hygiene, temperature, and stocking density	Reduces stress, injury, and disease risk	Promotes efficient production while improving animal well-being
Prevention of pain, injury, and suffering	Veterinary diagnosis, treatment, analgesia, and preventive care	Improves recovery, welfare, and productive performance	Reduces avoidable losses and supports responsible production
Low-stress handling and management	Guidance on handling, transport, restraint, and farm management	Reduces stress-related health problems and improves animal performance	Supports efficient and ethically responsible livestock systems
Reproductive health	Reproductive monitoring, disease control, and veterinary intervention	Improves fertility and reproductive efficiency	Reduces replacement losses and improves resource efficiency
Responsible antimicrobial use	Antimicrobial stewardship, diagnostics, and alternative disease-control strategies	Maintains treatment effectiveness and reduces unnecessary medication	Helps limit antimicrobial resistance and supports long-term food-system sustainability
Welfare monitoring	Development and interpretation of animal-based welfare indicators	Enables early identification of health and management problems	Strengthens preventive management and farm resilience
End-of-life and humane slaughter	Veterinary supervision and	Minimizes unnecessary	Supports ethical and socially responsible food

practices	welfare assessment	suffering	production
Integrated One Health management	Collaboration with farmers, environmental specialists, food-safety professionals, and public-health authorities	Connects animal health with environmental and food-safety outcomes	Supports resilient, safe, and sustainable food systems

2024). From this perspective, strengthening animal health can generate benefits beyond the farm. Healthier animals can improve production efficiency and reduce avoidable losses, while better management of feed, water, manure, and other resources can reduce environmental pressures. Sustainable livestock practices can therefore contribute simultaneously to animal welfare, food safety, food security, environmental health, and rural livelihoods. FAO has highlighted animal health improvement as an important pathway for achieving more resilient livestock systems and reducing their environmental footprint. Food security should consequently be understood not simply as producing more food, but as maintaining safe, nutritious, accessible, resilient, and environmentally sustainable food systems. Within this framework, veterinary medicine provides an essential connection between animal health, food production, environmental management, and human wellbeing. Integrating veterinary expertise with agricultural, biological, environmental, and food-safety sciences can support more resilient livestock systems and contribute to sustainable agricultural development.

2.1. Animal welfare, veterinary medicine and sustainable food production

Animal welfare is an important component of sustainable livestock production because the health and wellbeing of animals are closely associated with productivity, food quality, farm efficiency, and farmer livelihoods. Welfare extends beyond the absence of disease and includes adequate nutrition and water, appropriate housing, freedom from unnecessary pain and distress, and sufficient opportunities for animals to express normal behaviour. These principles are consistent with the internationally recognized concept of the Five Freedoms, which provides a practical framework for evaluating animal welfare (FAWC, 2009). Good welfare conditions can support productive and resilient livestock systems.

Table 1. Relationship between animal welfare, veterinary medicine and sustainable food production

Source: Adapted and synthesized from the World Organisation for Animal Health (WOAH), *Animal Welfare: A Vital Asset for a More Sustainable World* and *Animal Health and Welfare: Cornerstones of Sustainable Animal Farming.*

The table 1 summarizes the main pathways through which animal welfare and veterinary medicine can contribute to sustainable food production. It highlights the links between appropriate nutrition, disease prevention, housing, pain management, reproductive health, responsible antimicrobial use, and welfare monitoring and their potential effects on animal health, productivity, resource efficiency, food safety, and food-system resilience. The table adopts a One Health perspective by recognizing that animal health and welfare are interconnected with environmental sustainability, public health, and food security.

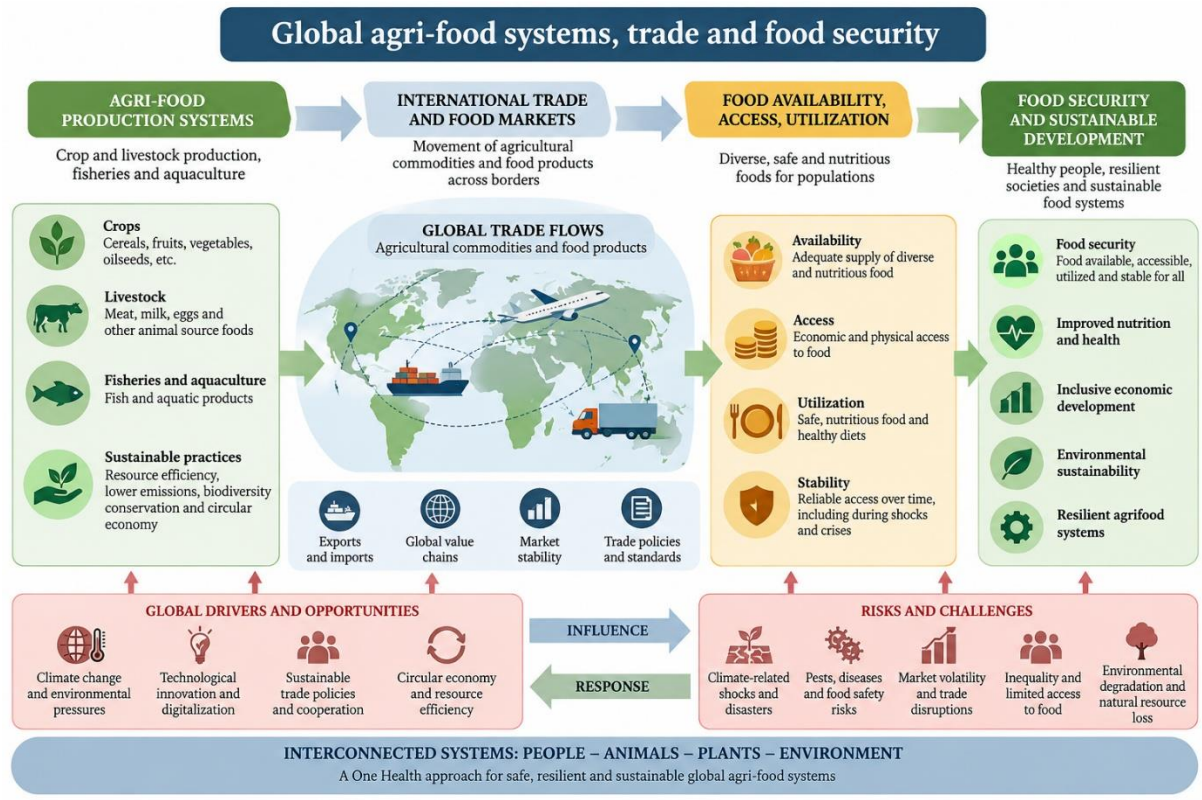
Animals experiencing appropriate nutrition, housing, health care, and reduced environmental stress are better able to maintain normal physiological functions and production. In dairy systems, for example, management practices that reduce heat stress, improve feeding, maintain comfortable housing, and provide timely veterinary care can contribute to improved health and productive performance. Welfare should therefore be viewed not only as an ethical consideration but also as an important component of efficient and sustainable livestock management (WOAH, 2023). Nutrition represents one of the fundamental elements of animal welfare and productivity. Balanced diets that meet the nutritional requirements of different species and production stages can support growth, reproduction, immune function, and productivity. Where appropriate, locally available feed resources and agricultural by-products can also contribute to more resource-efficient livestock production. Such practices may strengthen the connection between crop and livestock systems and support more circular use of agricultural resources. Housing and environmental management are equally important. Adequate ventilation, cleanliness, sufficient space, protection from extreme weather, and appropriate thermal conditions can reduce environmental stress and improve animal health. This is increasingly important under climate change, when heat stress, water shortages, and other environmental pressures may affect livestock welfare and productivity. Climate-resilient housing and management can therefore contribute simultaneously to animal welfare, environmental adaptation, and sustainable production. Veterinary medicine provides an essential foundation for maintaining these conditions. Regular health assessment, preventive medicine, vaccination, appropriate treatment, disease surveillance, and responsible use of veterinary medicines help maintain healthy herds and reduce preventable production losses. Effective veterinary services can consequently contribute to animal welfare while supporting food availability, food safety, and the economic resilience of livestock-producing households (ILRI, 2018; WOAH, 2023). The

relationship between animal welfare and food security is particularly relevant for smallholder livestock producers. Livestock often provide food, income, manure, and financial security for rural households. Poor health and welfare can reduce productivity and increase mortality, treatment costs, and economic losses. Conversely, improvements in animal health and management can strengthen household livelihoods and contribute to more stable food production (Alders & Pym, 2009). From a One Health perspective, animal welfare cannot be considered separately from human and environmental health. Better welfare can support healthier and more productive animals, while sustainable feeding, housing, waste management, and veterinary practices can reduce unnecessary resource use and environmental pressures. Integrating animal welfare into veterinary, agricultural, food-safety, and environmental strategies therefore supports a broader approach to sustainable food systems. Thus, animal welfare represents an important link between veterinary medicine, food security, environmental sustainability, and One Health. Ensuring that livestock are adequately nourished, appropriately housed, protected from avoidable suffering, and provided with preventive veterinary care can contribute to healthier animals, more efficient production, improved livelihoods, and more resilient agricultural systems.

3. Global agri-food systems, trade and food security

The global agri-food system faces interconnected challenges that extend beyond the need to produce enough food. Population growth, changing dietary demands, climate change, degradation of natural resources, and environmental pressures are increasingly affecting the capacity of food systems to provide safe, nutritious, affordable, and sustainable food. Agricultural production also differs considerably among regions because of variations in climate, soil quality, water availability, biodiversity, and technological capacity. Consequently, sustainable food production requires approaches that are adapted to local environmental and socioeconomic conditions while contributing to broader global food-security objectives (FAO, 2024; OECD-FAO, 2025). Climate change adds further pressure by increasing the frequency and intensity of droughts, floods, heatwaves, and other extreme events that can disrupt crop and livestock production. These changes may affect the availability of feed, water, pasture, and other resources essential for animal production.

Figure 1. Global agri-food systems, trade and food security: pathways toward sustainable and resilient food systems.



***Source**: Author's conceptual synthesis based on Food and Agriculture Organization of the United Nations (FAO) resources on Trade, Food Security and Sustainable Development, Trade and Sustainable Agrifood Systems, Sustainable Food and Agriculture, and the One Health Joint Plan of Action (2022–2026) developed by FAO, UNEP, WHO and WOAH.*

The figure illustrates the interconnected relationships between global agri-food production, international trade, food markets, food availability, access, utilization and stability, and broader food-security outcomes. It highlights how trade and market systems connect agricultural production with food supplies across countries, while climate change, environmental degradation, market volatility, food-safety risks, inequality, and resource constraints can influence system stability. The framework also identifies technological innovation, sustainable trade policies, circular-economy practices, and international cooperation as potential pathways for strengthening resilient food systems. A One Health perspective links these processes across people, animals, plants, and the environment, emphasizing the need for integrated approaches to sustainable agrifood-system transformation.

They also increase the importance of resilient agricultural practices, efficient resource use, improved technologies, and appropriate animal-health management. From a veterinary perspective, maintaining animal health and welfare is an important component of resilient livestock systems because healthy animals can contribute more consistently to food production while reducing avoidable production losses. Such measures are consistent with the One Health perspective, which recognizes the interdependence of animal health, human health, environmental conditions, and food systems (FAO, UNEP, WHO, & WOAH, 2022). The unequal distribution of natural resources and agricultural production potential also gives international trade an important role in global food security. Regions with favourable conditions for crop or livestock production can supply areas where climatic, environmental, or resource constraints limit domestic production. International agricultural markets can therefore help balance food surpluses and deficits, diversify sources of food, and reduce the effects of localized production shocks. Recent OECD-FAO projections indicate that international trade will remain an important component of global food systems, with increasing flows between net-exporting and net-importing regions. Approximately one-fifth of calories consumed globally currently cross international borders, demonstrating the interconnected nature of modern food systems (OECD-FAO, 2024, 2025). Trade can also contribute to resilience when extreme weather events reduce production in particular regions. Access to international markets may allow food to be obtained from areas less affected by droughts, floods, heatwaves, or other climatic disturbances. In this way, trade can partially compensate for temporary local production deficits and contribute to greater stability of food availability. However, the benefits of trade depend on functioning markets, appropriate infrastructure, predictable policies, and equitable access, particularly for small-scale producers and resource-constrained countries (FAO, 2024; OECD-FAO, 2024). At the same time, agricultural trade should not be considered independently of environmental sustainability. Production for international markets can increase pressure on land, water, biodiversity, and other natural resources when environmental safeguards are inadequate. Trade policies therefore need to consider economic, environmental, social, health, and food-security objectives simultaneously. FAO emphasizes that trade can help balance food deficits and surpluses and improve food availability but also recognizes that trade openness may create challenges for small-scale actors and that trade alone cannot resolve all dimensions of food insecurity (FAO, 2024). Sustainable production practices are consequently essential throughout agricultural and livestock value chains. Improved soil and water management, efficient use of fertilizers, climate-adapted production systems, responsible livestock management, reduction of food losses, and the use of appropriate technologies can improve resource efficiency while supporting food production. The OECD-FAO Agricultural Outlook also indicates that productivity improvements are expected

to contribute substantially to future production growth, while reductions in food loss and waste could simultaneously improve food availability and reduce environmental pressures (OECD-FAO, 2024). Within this context, veterinary medicine has a broader role than the treatment of individual animals. Veterinary professionals contribute to animal health and welfare, preventive health programmes, food safety, responsible production, and the sustainability of livestock systems. Their activities connect primary production with food quality and safety and therefore provide an important bridge between animal health, environmental management, and food security. Integrating veterinary expertise into sustainable agricultural policies can help strengthen the resilience and efficiency of livestock-based food systems. The One Health approach provides an appropriate framework for addressing these interconnected challenges because it promotes collaboration across human, animal, plant, and environmental health sectors. Within sustainable agriculture, this means considering food production not only in terms of yield, but also in relation to animal welfare, natural-resource conservation, food safety, nutrition, livelihoods, and ecosystem health. International trade can support this transition when it facilitates the movement of food and agricultural resources while encouraging scientifically based standards and environmentally responsible production practices.

Strengthening global food security requires a coordinated approach that combines sustainable agricultural production, resilient livestock systems, environmental protection, responsible veterinary practices, and well-functioning food trade. Rather than treating these areas separately, One Health provides a framework for understanding their interdependence and for developing food systems that are more resilient to climate and environmental pressures while supporting safe and nutritious food supplies.

Conclusion

Global food security is increasingly influenced by the combined effects of population growth, climate change, environmental degradation, resource constraints, and changing food demands. Ensuring sufficient food supplies therefore requires more than increasing agricultural production. Food must also be safe, nutritious, accessible, and produced in ways that protect natural resources and maintain the long-term resilience of agricultural systems. Within this context, veterinary medicine has an important contribution to sustainable food systems. Veterinary professionals support animal health and welfare, responsible livestock production, food safety, disease prevention, and the efficient use of agricultural resources. Healthy and well-managed livestock systems can contribute to stable food production and rural livelihoods, while appropriate veterinary interventions can reduce production losses and strengthen the resilience of farmers to environmental

and climatic pressures. Environmental health is equally important because agricultural production depends directly on healthy soils, adequate water resources, biodiversity, and functioning ecosystems. Unsustainable use of these resources can undermine future food production. Sustainable farming practices, climate-adapted technologies, efficient resource management, circular approaches, and responsible livestock production can therefore help maintain the balance between agricultural productivity and environmental protection. The One Health approach provides a valuable framework for bringing these dimensions together. It encourages cooperation among veterinary, agricultural, environmental, food-safety, public-health, scientific, and policy sectors. Such collaboration is essential for addressing complex food-system challenges because decisions affecting animal production can also influence environmental conditions, food safety, human nutrition, and rural livelihoods. One Health education and interdisciplinary training can further strengthen the knowledge, communication, and collaborative skills required to address these interconnected challenges. Achieving sustainable food security will also require the active participation of farmers, veterinarians, researchers, policymakers, food producers, consumers, and other stakeholders. Scientific evidence should guide agricultural policies, food-safety measures, environmental standards, and technological development. At the same time, sustainability strategies should remain economically realistic for farmers, particularly small-scale producers whose livelihoods depend directly on agricultural production.

Sustainable agriculture requires a shift from isolated approaches toward integrated food-system management. Combining veterinary expertise with environmental protection, responsible agricultural practices, food-safety measures, and One Health principles can contribute to more resilient and sustainable food systems. Strengthening these connections will be essential for meeting future food needs while protecting animal health, human well-being, biodiversity, and the natural resources required by future generations.

REFERENCES

Alders, R. G., & Pym, R. A. E. (2009). Village poultry: Still important to millions, eight thousand years after domestication. *World's Poultry Science Journal, 65*(2), 181–190. https://doi.org/10.1017/S0043933909000157

Farm Animal Welfare Council (FAWC). (2009). *Farm animal welfare in Great Britain: Past, present and future*. Farm Animal Welfare Council, UK.

Food and Agriculture Organization of the United Nations (FAO). (2023a). *Achieving SDG 2 without breaching the 1.5°C threshold: A global roadmap*. FAO.

Food and Agriculture Organization of the United Nations (FAO). (2023b). *Contribution of terrestrial animal source food to healthy diets for improved nutrition and health outcomes: An evidence and policy overview on the state of knowledge and gaps*. FAO. https://doi.org/10.4060/cc3912en

Food and Agriculture Organization of the United Nations (FAO). (2023c). *FAO Strategy on Climate Change 2022–2031: Action Plan 2022–2025*. FAO.

Food and Agriculture Organization of the United Nations (FAO). (2023d). *Pathways towards lower emissions: A global assessment of the greenhouse gas emissions and mitigation options from livestock agrifood systems*. FAO. https://www.fao.org/3/cc9029en/cc9029en.pdf

Food and Agriculture Organization of the United Nations (FAO). (2023e). *Transforming livestock systems for better efficiency, inclusiveness and resilience*. FAO.

Food and Agriculture Organization of the United Nations (FAO). (2024a). *COP29: New FAO analysis maps Nationally Determined Contributions, identifies opportunities, gaps and risks related to agrifood climate solutions*. FAO.

Food and Agriculture Organization of the United Nations (FAO). (2024b). *One Health: Food safety and quality*. FAO.

Food and Agriculture Organization of the United Nations (FAO). (2024c). *The State of Food Security and Nutrition in the World 2024: Financing to end hunger, food insecurity and malnutrition in all its forms*. FAO, IFAD, UNICEF, WFP and WHO. https://doi.org/10.4060/cd1254en

Food and Agriculture Organization of the United Nations (FAO). (2024d). *Trade and sustainable agrifood systems*. FAO.

Food and Agriculture Organization of the United Nations (FAO). (2024e). *Trade, food security and sustainable development*. FAO.

Food and Agriculture Organization of the United Nations (FAO). (2025a). *Greenhouse gas emissions from agrifood systems: Global, regional and country trends, 2001–2023*. FAOSTAT.

Food and Agriculture Organization of the United Nations (FAO). (2025b). *The value of animal health innovations for sustainable livestock transformation*. FAO.

Gómez San Juan, M., Harnett, S., & Albinelli, I. (2022). *Sustainable and circular bioeconomy in the climate agenda: Opportunities to transform agrifood systems*. Food and Agriculture Organization of the United Nations.

Intergovernmental Panel on Climate Change (IPCC). (2023). *Climate Change 2023: Synthesis Report*. IPCC, Geneva.

International Livestock Research Institute (ILRI). (2018). *Veterinary service delivery in developing countries: Strengthening animal health and welfare*. ILRI.

OECD-FAO. (2024). *OECD-FAO Agricultural Outlook 2024–2033*. OECD Publishing, Paris/FAO, Rome. https://doi.org/10.1787/4c5d2cfb-en

OECD-FAO. (2025). *OECD-FAO Agricultural Outlook 2025–2034*. OECD Publishing, Paris/FAO, Rome.

World Organisation for Animal Health (WOAH). (2023). *Animal welfare*. WOAH. WOAH – Animal Welfare

World Organisation for Animal Health (WOAH). (n.d.). *One Health*. WOAH. WOAH – One Health

Food and Agriculture Organization of the United Nations (FAO), United Nations Environment Programme (UNEP), World Health Organization (WHO), & World Organisation for Animal Health (WOAH). (2022). *One Health Joint Plan of Action (2022–2026): Working together for the health of humans, animals, plants and the environment*. FAO. https://doi.org/10.4060/cc2289en

МИКРОБИОЛОГИЧЕСКАЯ БЕЗОПАСНОСТЬ ОРГАНИЧЕСКИХ ПРОДОВОЛЬСТВЕННЫХ СИСТЕМ: ОТ ПОЧВЕННЫХ МИКРОБИОМОВ ДО АГРОПРОДОВОЛЬСТВЕННОЙ ЦЕПИ

Азербайджанский государственный аграрный университет

Факультет ветеринарной медицины

Кафедра незаразных болезней

Доцент Кушвар Мамедова

kgmammadova@gmail.com

ORCID ID: 0000-0002-6293-2079

Старший преподаватель Егяна Бехбудова

yeganebehbutova@gmail.com

ORCID ID: 0009-0004-2539-6379

Аннотация *Органическое сельское хозяйство строится на поддержании биологических циклов, использовании органического вещества и снижении зависимости от синтетических inputs, однако само по себе органическое происхождение продукта не означает отсутствия микробиологических опасностей. Безопасность формируется внутри сложной системы, где*

почва, растения, органические удобрения, вода, животные, человек и пищевые процессы связаны постоянным обменом микроорганизмами и генетическим материалом. В статье рассматривается микробиологическая безопасность органических продовольственных систем от почвенного микробиома до этапа потребления. Особое внимание уделено полезным и потенциально опасным микроорганизмам почвы и растений, применению навоза и компоста, выживанию энтеропатогенов, загрязнению воды, переносу микроорганизмов по цепочке «от фермы до стола» и распространению генов антимикробной устойчивости. Показано, что микробиом может выполнять двойственную функцию: поддерживать плодородие, здоровье растений и биологическую защиту, но при определённых условиях становиться средой сохранения или передачи патогенов и генов устойчивости. Современный подход к безопасности должен поэтому сочетать биологическое управление почвой с контролем качества органических удобрений и воды, гигиеной производства, мониторингом и прослеживаемостью. Такой подход соответствует принципам «Единого здоровья» и позволяет рассматривать органическое производство не как систему без рисков, а как систему, в которой риски необходимо предупреждать на каждом звене агропродовольственной цепи.

Ключевые слова: *органическое сельское хозяйство; почвенный микробиом; микробиом растений; биологическое загрязнение; органические удобрения; пищевые патогены; антимикробная устойчивость; агропродовольственная цепь; безопасность пищевых продуктов; «Единое здоровье».*

1. Введение

Интерес к органическому производству растёт не только из-за экологических преимуществ, но и из-за стремления получать продукты с более устойчивым происхождением и меньшей зависимостью от синтетических агрохимикатов. При этом микробиологическая безопасность органической продукции требует отдельного внимания. Органическое производство опирается на биологические циклы и активность почвенной биоты, а значит, большое значение приобретают микроорганизмы, которые обычно остаются невидимыми для потребителя. Одни из них участвуют в разложении органического вещества, мобилизации питательных элементов, защите растений и формировании устойчивости агроэкосистемы. Другие могут быть условно-патогенными или патогенными и при определённых условиях попадать в пищевую продукцию. Современное понимание безопасности продовольствия всё чаще выходит за пределы предприятия и начинается ещё в поле. Всемирная организация здравоохранения подчёркивает, что пищевые заболевания могут возникать вследствие

загрязнения на любой стадии производства, доставки и потребления пищи, включая загрязнение почвы, воды и воздуха (WHO, 2026). Для свежих овощей и фруктов особенно важны условия первичного производства: состояние поля, предыдущая история участка, вода, животные, дикие птицы и млекопитающие, почвенные улучшители, уборка и упаковка (FAO & WHO, 2024). Органическое сельское хозяйство не следует представлять как микробиологически более опасное или автоматически более безопасное. Обобщающие исследования показывают неоднозначные результаты при сравнении органической и традиционной продукции, а различия зависят от культуры, региона, практики внесения удобрений, качества воды и санитарного контроля (Maffei et al., 2016; Murali et al., 2023). Цель статьи — рассмотреть связь между почвенными и растительными микробиомами, органическими удобрениями, биологическими загрязнителями, антимикробной устойчивостью и рисками на пути «от фермы до стола».

2. Почвенный микробиом как основа органической агроэкосистемы

Почва является не просто субстратом для роста растений. Это динамическая микробная экосистема, в которой бактерии, археи, грибы, простейшие и вирусы взаимодействуют между собой, с корнями растений и с органическим веществом. По данным Banerjee и van der Heijden (2023), почвенные микробиомы являются одной из основ концепции «Единого здоровья», поскольку связывают здоровье почвы, растений, животных и человека. Они участвуют в круговороте углерода и азота, минерализации органического вещества, формировании структуры почвы и поддержании продуктивности растений. Для органического земледелия это особенно важно. Компост, растительные остатки, покровные культуры и севооборот усиливают значение микробиологических процессов. FAO рассматривает микробиомы как важный ресурс устойчивого сельского хозяйства: они связаны с круговоротом питательных веществ, здоровьем растений, биологическим контролем и развитием микробиомных технологий, включая биоудобрения и биопестициды (FAO, 2026). Однако разнообразный микробиом не означает отсутствия патогенов. В почве могут сохраняться микроорганизмы, происходящие от животных, человека, воды или растительных остатков. Некоторые кишечные бактерии способны адаптироваться к внехозяинной среде и дольше сохраняться при благоприятной влажности, температуре и наличии питательных веществ. Поэтому биологическое здоровье почвы и микробиологическая безопасность должны рассматриваться одновременно. Особенно показателен пример органических удобрений. Навоз и компост поддерживают плодородие, возвращают органическое вещество и питательные элементы в почву, но при неправильной

обработке могут служить источником Escherichia coli, Salmonella spp., Listeria spp. и других энтерических микроорганизмов (Sharma & Reynnells, 2016). Метаанализ Tran et al. (2020) показал, что температура является одним из наиболее значимых факторов, определяющих скорость снижения E. coli и Salmonella в почвах, обогащённых навозом.

3. Микробиом растений: между биологической защитой и контаминацией

Группа микроорганизмов	Примеры	Основная функция/значение	Потенциальный риск
Полезные ризобактерии	*Bacillus spp.; Pseudomonas spp.*	Стимуляция роста, конкуренция с патогенами, биоконтроль	Зависит от штамма и условий
Микоризные грибы	*Arbuscular mycorrhizal fungi*	Улучшение питания и устойчивости растений	Обычно низкий; контроль биопрепарата
Деструкторы	Бактерии и грибы	Минерализация и круговорот элементов	Косвенный риск при нарушении баланса
Энтеропатогены	*Salmonella spp.; STEC/E. coli*	Поступают с фекальным загрязнением	Пищевые инфекции
Listeria spp.	*Listeria monocytogenes*	Убиквитарный микроорганизм среды	Выживание в почве/воде и рост при хранении
Устойчивые бактерии	*ARB*	Маркер экологического	Передача устойчивости

		давления отбора	
Гены устойчивости	*ARGs*	Генетические детерминанты устойчивости	Горизонтальный перенос

Растение также является микробной экосистемой. Его ризосфера, корни, поверхность листьев и внутренние ткани заселены разнообразными микроорганизмами. Часть из них способствует росту растений, улучшает доступность питательных веществ и конкурирует с патогенами. К таким функциональным группам относятся ризобактерии, микоризные грибы и другие микроорганизмы, способные стимулировать рост растений или участвовать в биологическом контроле. Растительный микробиом можно рассматривать как естественный барьер. Конкуренция за питательные вещества, образование антимикробных метаболитов, колонизация поверхности и стимуляция защитных реакций растения могут ограничивать развитие некоторых нежелательных микроорганизмов. Вместе с тем этот барьер не является абсолютным. Энтерические патогены способны временно колонизировать поверхность растений, особенно если условия среды позволяют им выжить. Для свежей продукции важны два процесса: попадание микроорганизма на растение и его последующее сохранение. Загрязнение может происходить через почву, воду, навоз, животных, оборудование и руки работников. После попадания на растение микроорганизм может перемещаться с каплями воды, частицами почвы или механически переноситься при уборке. Листовые овощи и другая продукция, употребляемая без интенсивной термической обработки, требуют особого контроля. FAO и WHO (2024) рекомендуют оценивать риски уже на стадии первичного производства. Сравнение органической и традиционной продукции не даёт универсального ответа. Maffei et al. (2016) показали противоречивые результаты по общей микробной обсеменённости и патогенам. Поэтому технология выращивания, санитарная культура хозяйства и качество органических удобрений могут быть важнее самого ярлыка «органический».

Таблица 1. Полезные и потенциально опасные микроорганизмы в органической агроэкосистеме

Источник: составлено и обобщено авторами на основе Banerjee & van der Heijden (2023), Sharma & Reynnells (2016), FAO (2026), Murali et al. (2023).

4. Органические удобрения как ресурс и источник биологического риска

Использование навоза, компоста, растительных остатков и других органических материалов является характерным элементом органического производства. Такая практика соответствует принципам замкнутого цикла: питательные вещества возвращаются в почву, сокращается количество отходов и поддерживается содержание органического вещества. Codex предусматривает использование ряда органических материалов для удобрения и кондиционирования почвы при соблюдении соответствующих требований и мер предосторожности (FAO/Codex Alimentarius, 2013). Сырой навоз может содержать кишечную микрофлору животных, включая потенциально патогенные штаммы. Если материал недостаточно обработан, патогены могут попасть в почву и далее на растения. Обзор Sharma и Reynnells (2016) показывает, что биологические почвенные улучшители способны поддерживать выживание и повторное увеличение численности патогенов при подходящих условиях.

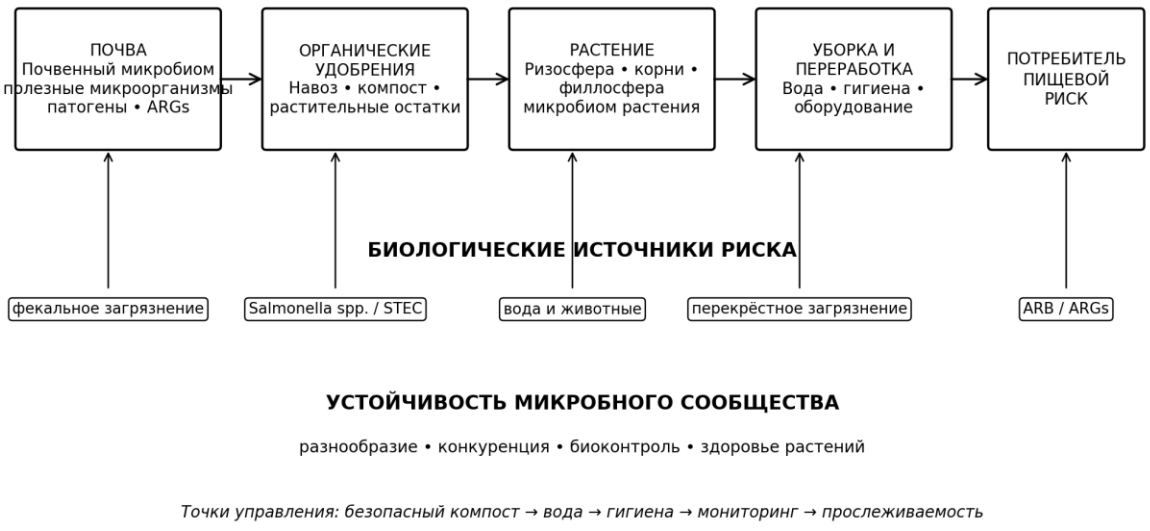
Компостирование снижает опасность за счёт интенсивной микробной активности и повышения температуры, но безопасность компоста зависит от фактического протекания процесса, состава сырья, влажности, температуры и последующего хранения. Нельзя считать материал безопасным только потому, что он называется «компостом». Важно также исключать повторное загрязнение уже обработанного материала. Отдельного внимания заслуживает куриный помёт и удобрения на его основе. Такие материалы ценны по содержанию питательных элементов, но могут содержать пищевые патогены. Chen и Jiang (2014) отмечали, что компостирование и тепловая обработка способны снижать микробиологическую опасность, однако отдельные патогены могут сохраняться при недостаточной обработке или повторном загрязнении. Следовательно, органические удобрения нужно рассматривать одновременно как средство поддержания почвенного микробиома и как потенциальную точку входа биологических опасностей. Контролю подлежат происхождение сырья, технология компостирования, температура и время обработки, хранение, способ внесения и интервал до уборки урожая.

5. Биологическое загрязнение и передача риска по цепочке «от фермы до стола»

Микробиологическая безопасность органической продукции формируется постепенно. Источник загрязнения может находиться в почве, воде, удобрении, организме животного или на поверхности оборудования, а конечный риск проявляется уже на стадии потребления. Поэтому агропродовольственную систему удобнее рассматривать как непрерывную цепь. Основные входы биологических опасностей включают навоз и другие органические удобрения, загрязнённую оросительную воду, поверхностный сток, животных и диких птиц,

насекомых, почвенные частицы, работников и оборудование. Обзор Alegbeleye et al. (2018) показывает, что контаминация свежей продукции в поле связана именно с сочетанием этих факторов. После попадания на растение патоген может сохраняться на поверхности, перемещаться с водой и почвой и переходить на оборудование или другие партии продукции. На стадии уборки риск возрастает из-за механического контакта. Ножи, контейнеры, транспортные средства и руки работников могут переносить микроорганизмы. Если вода используется для мойки или охлаждения, её качество становится критическим фактором. FAO и WHO (2021) подчёркивают необходимость оценки воды с учётом конкретного способа её применения. После уборки температура и время хранения определяют дальнейшую судьбу микроорганизмов. Для Listeria monocytogenes особенно важна способность выживать и размножаться при низких температурах, поэтому холодильное хранение само по себе не является гарантией безопасности (WHO, 2018). Ферма не является изолированной системой: вода связывает поле с окружающим ландшафтом, животные переносят микроорганизмы, а человек может переносить их между участками, оборудованием и продуктом. Поэтому контроль должен быть многоуровневым.

Рисунок 1. Пути формирования микробиологического риска в органической продовольственной системе



Источник: авторская концептуальная схема на основе FAO & WHO (2024), WHO (2021), Alegbeleye et al. (2018), EFSA (2021) и Banerjee & van der Heijden (2023).

Схема показывает, что микробиологический риск может возникать уже в почве и перемещаться через органические удобрения, воду и растительный микробиом к этапам уборки, переработки и потребления. Одновременно функциональное микробное разнообразие может снижать риск за счёт конкуренции и биологического контроля.

6. Антимикробная устойчивость в органических агроэкосистемах

Антимикробная устойчивость расширяет понятие микробиологической безопасности. Опасность связана не только с наличием патогенной бактерии, но и с её устойчивостью к препаратам и способностью передавать гены устойчивости другим микроорганизмам. Органические системы часто ограничивают использование антибиотиков, особенно в животноводстве, однако отсутствие или ограничение антибиотиков не означает отсутствия генов устойчивости в окружающей среде. Навоз животных, сточные воды, загрязнённая вода и почва могут содержать устойчивые бактерии и гены устойчивости. EFSA (2021) указывает, что удобрения фекального происхождения, орошение и вода являются значимыми источниками устойчивых микроорганизмов и генов в растительном производстве. Ullah et al. (2024) описали возможные пути переноса устойчивости из органических удобрений в растительные микробные сообщества, включая горизонтальный перенос генов. Исследования системы «навоз — почва — растение» также показывают, что внесение навоза может изменять профиль генов устойчивости в ризосфере и тканях растений (Zhang et al., 2019; Liu et al., 2025). Это не означает, что каждый продукт, выращенный с органическим удобрением, содержит опасный устойчивый патоген. Речь идёт о потенциальном экологическом резервуаре и возможности передачи генетических детерминант.

Peng et al. (2026) исследовали десятилетнюю динамику генов антибиотикорезистентности в агроэкосистемах с внесением свиного навоза и рассматривали их возможный переход в систему «почва — овощ — человек». Поэтому оценка безопасности должна учитывать не только краткосрочную микробиологическую чистоту удобрения, но и накопительные процессы. В органическом производстве необходима стратегия управления устойчивостью, основанная на профилактике заболеваний, биобезопасности, диагностике и сокращении ненужного применения антимикробных препаратов. Ответственное использование лекарственных средств в животноводстве является частью общей безопасности растительного и пищевого производства.

7. Полезные микроорганизмы и биологический контроль

Безопасность органической системы нельзя строить только на уничтожении микроорганизмов. Полное устранение микробной жизни невозможно и для устойчивого земледелия нежелательно. Более перспективным является управление микробным сообществом таким образом, чтобы полезные функции сохранялись, а вероятность развития опасных микроорганизмов снижалась. Полезные бактерии и грибы могут конкурировать с патогенами, занимать экологические ниши, улучшать питание растений и стимулировать их защитные механизмы. В ризосфере особенно важны микроорганизмы, взаимодействующие с корнями. В некоторых системах используются микробные препараты, биоудобрения и биопестициды. FAO (2026) отмечает потенциал таких технологий, но подчёркивает необходимость регулирования, контроля качества и корректного применения. Биоконтроль не является универсальной заменой санитарным мерам. Присутствие полезной микрофлоры не отменяет необходимость безопасной воды, правильного компостирования, чистого оборудования и гигиены работников. Микробиологически грамотная органическая система должна стремиться не к «стерильной почве», а к функциональному микробному равновесию, при котором устойчивость определяется взаимодействием сообщества, растения и окружающей среды.

8. Управление биологическими рисками в органической системе

Эффективное управление микробиологическими рисками начинается с оценки опасностей ещё до посева. На уровне хозяйства необходимо учитывать историю участка, источники воды, присутствие животных, состояние органических удобрений, соседние поля и возможные пути стока. Для органических удобрений ключевыми мерами являются контролируемая обработка, предотвращение повторного загрязнения и документирование происхождения материала. Если используется компост, важно контролировать сам процесс, а не только внешний вид продукта. Особое значение имеет разделение зон для хранения сырого навоза и готового компоста. Вода требует отдельной системы управления. Источник, способ забора, качество воды и способ применения должны оцениваться совместно. Вода, непосредственно контактирующая со съедобной частью растения, потенциально создаёт более высокий риск, чем вода, используемая на ранней стадии производства. Подобный риск-ориентированный подход соответствует рекомендациям FAO и WHO (2021, 2024). На стадии уборки и упаковки необходимо уменьшать контакт продукта с почвой, грязными поверхностями и необработанными контейнерами. Оборудование следует очищать по установленной процедуре, а персонал должен понимать, почему гигиена важна именно в

контексте микробиологии. Важна и прослеживаемость: при обнаружении патогена хозяйство должно иметь возможность определить участок, партию удобрения, источник воды и маршрут продукта. Мониторинг должен включать не только конечный продукт. Информативными объектами могут быть почва, компост, вода, растительная поверхность и рабочие поверхности. При необходимости применяются культуральные методы, ПЦР и другие молекулярные подходы. Для антимикробной устойчивости полезны анализы резистома и генов устойчивости, особенно в хозяйствах с регулярным внесением навоза. Такой комплексный подход соответствует принципам «Единого здоровья». Почва, растения, животные и человек не являются независимыми компонентами. Микроорганизм, попавший в почву с навозом, может пройти несколько экологических барьеров и в конечном итоге оказаться в пищевой системе.

Таблица 2. Основные точки контроля микробиологической безопасности по цепочке «от фермы до стола»

Звено цепи	Основные биологические опасности	Факторы риска	Приоритетные меры
Почва	Энтеробактерии, устойчивые микроорганизмы	Навоз, сток, животные, влажность, температура	История участка, мониторинг, зонирование
Навоз/компост	E. coli, Salmonella, Listeria, ARB/ARGs	Недостаточная обработка, повторное загрязнение	Контролируемое компостирование
Вода	Бактерии, вирусы, паразиты	Загрязнённый источник, поверхностный сток	Оценка качества и назначения
Растение	Патогены на поверхности/в микробиоме	Контакт с почвой, водой, животными	Биоконтроль + санитарные практики
Уборка и упаковка	Перекрёстное загрязнение	Грязное оборудование, руки, тара	Гигиена и разделение потоков

Хранение/транспорт	Рост и сохранение патогенов	Температура, влажность, длительность	Контроль условий и прослеживаемость
Потребление	Пищевые инфекции	Сырая/минимально обработанная продукция	Информирование и безопасная обработка

Источник: составлено авторами на основе FAO & WHO (2024), WHO (2021), EFSA (2021), Sharma & Reynnells (2016) и Alegbeleye et al. (2018).

9. Перспективы биологической оценки безопасности органических продуктов

Следующим этапом развития органической продовольственной системы может стать переход от разовых микробиологических анализов к постоянному наблюдению за состоянием микробных сообществ. Метагеномные и другие молекулярные методы позволяют видеть структуру микробиома, функциональные гены и потенциальные маркеры устойчивости. Их применение особенно интересно для оценки долгосрочных изменений почвы и растительного микробиома. При этом обнаружение ДНК микроорганизма ещё не всегда означает наличие жизнеспособного патогена или реальный риск заболевания. Поэтому культуральные методы, количественная оценка, эпидемиологические данные и сведения о производственной практике должны дополнять молекулярные исследования. Перспективным направлением является создание интегрированных индикаторов микробиологической безопасности. В них можно объединять данные о качестве компоста, микробном разнообразии почвы, состоянии воды, наличии индикаторных микроорганизмов, генах антимикробной устойчивости и санитарных условиях. Для органического сельского хозяйства особенно важна междисциплинарность: почвенная микробиология, фитопатология, ветеринария, пищевая микробиология, экология и общественное здравоохранение рассматривают разные участки одной системы.

Заключение

Микробиологическая безопасность органических продовольственных систем начинается задолго до появления продукта на рынке. Почва, органические удобрения, вода, растения, животные, оборудование и человек формируют единую сеть микробиологических взаимодействий. В этой сети полезные микроорганизмы поддерживают плодородие и здоровье растений, тогда как патогены и гены антимикробной устойчивости могут создавать

риски для продовольственной безопасности. Органическое производство нельзя считать автоматически безопасным или опасным с микробиологической точки зрения. Наиболее существенное значение имеют конкретные методы ведения хозяйства: качество и обработка органических удобрений, безопасность воды, санитарное состояние поля и оборудования, контроль животных и диких источников загрязнения, соблюдение гигиены и прослеживаемость продукции. Научные данные показывают, что выживание патогенов в почве зависит от температуры, влажности и свойств среды, а перенос генов устойчивости может связывать навоз, почвенный и растительный микробиомы. Следовательно, современная стратегия должна основываться не на стремлении устранить всю микробную жизнь, а на управлении микробиологическими сообществами и предупреждении наиболее вероятных путей контаминации. Сочетание биологического управления почвой, безопасного обращения с органическими удобрениями, контроля воды, гигиены, мониторинга и ответственного применения антимикробных препаратов создаёт более устойчивую модель безопасности. Такой подход соответствует принципам «Единого здоровья», в рамках которых здоровье почвы, растений, животных и человека рассматривается как взаимосвязанная система.

References

Alegbeleye, O. O., Singleton, I., & Sant’Ana, A. S. (2018). Sources and contamination routes of microbial pathogens to fresh produce during field cultivation: A review. Food Microbiology, 73, 177–208. https://doi.org/10.1016/j.fm.2018.01.003

Banerjee, S., & van der Heijden, M. G. A. (2023). Soil microbiomes and one health. Nature Reviews Microbiology, 21, 6–20. https://doi.org/10.1038/s41579-022-00779-w

Chen, Z., & Jiang, X. (2014). Microbiological safety of chicken litter or chicken litter-based organic fertilizers: A review. Agriculture, 4, 1–29.

European Food Safety Authority (EFSA). (2021). Antimicrobial resistance and the food production environment: Sources and control options. EFSA.

FAO. (2026). Microbiome. Bioeconomy for Sustainable Food and Agriculture. Food and Agriculture Organization of the United Nations.

FAO & WHO. (2021). Safety and quality of water used with fresh fruits and vegetables. Microbiological Risk Assessment Series 37. World Health Organization.

FAO & WHO. (2024). Prevention and control of microbiological hazards in fresh fruits and vegetables: Parts 1 & 2: General principles. Microbiological Risk Assessment Series 42. World Health Organization.

FAO/Codex Alimentarius Commission. (2013). Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods. Codex Alimentarius.

Liu, B., et al. (2025). Antibiotic resistance genes in the animal manure-amended soil-plant system: Occurrence, transmission, bacterial hosts, and human health risks. Ecotoxicology and Environmental Safety. https://doi.org/10.1016/j.ecoenv.2025.118890

Maffei, D. F., Batalha, E. Y., Landgraf, M., Schaffner, D. W., & Franco, B. D. G. M. (2016). Microbiology of organic and conventionally grown fresh produce. Brazilian Journal of Microbiology, 47(Suppl. 1), 99–105. https://doi.org/10.1016/j.bjm.2016.10.006

Murali, A. P., Trząskowska, M., & Trafialek, J. (2023). Microorganisms in organic food—Issues to be addressed. Microorganisms, 11(6), 1557. https://doi.org/10.3390/microorganisms11061557

Peng, S., Xu, S., Zhou, B., Hua, Q., Wu, P., Lin, X., & Wang, Y. (2026). Manure-driven antibiotic resistance in agroecosystems: Decadal evidence of accumulation dynamics and food chain transmission. Journal of Hazardous Materials, 506, 141637. https://doi.org/10.1016/j.jhazmat.2026.141637

Sharma, M., & Reynnells, R. (2016). Importance of soil amendments: Survival of bacterial pathogens in manure and compost used as organic fertilizers. Microbiology Spectrum, 4(4). https://doi.org/10.1128/microbiolspec.PFS-0010-2015

Tran, D. T. Q., Bradbury, M. I., van Ogtrop, F. F., Bozkurt, H., Jones, B. J., & McConchie, R. (2020). Environmental drivers for persistence of Escherichia coli and Salmonella in manure-amended soils: A meta-analysis. Journal of Food Protection, 83(7), 1268–1277. https://doi.org/10.4315/0362-028X.JFP-19-460

Ullah, H., Hassan, S. H. A., Yang, Q., Salama, E.-S., Liu, P., & Li, X. (2024). Dynamic interaction of antibiotic resistance between plant microbiome and organic fertilizers: Sources, dissemination, and health risks. World Journal of Microbiology and Biotechnology, 41, 4. https://doi.org/10.1007/s11274-024-04214-5

WHO. (2018). Listeriosis. World Health Organization.

WHO. (2026). Foodborne diseases. World Health Organization.

WHO. (2026). WHO Foodborne Disease Estimates 2026 edition. World Health Organization.

Zhang, Y., et al. (2019). Transfer of antibiotic resistance from manure-amended soils to vegetable microbiomes. Environment International, 130, 104912.

MOLECULAR EPIDEMIOLOGY AND GENETIC EVOLUTION OF CANINE DISTEMPER VIRUS: TRANSMISSION, ADAPTATION AND EMERGING STRAINS

Azerbaijan State Agricultural University

Faculty of Veterinary Medicine

Nigar Adigozalova, 4th year bachelor student

E-mail: adigozelovanigar06@gmail.com

ORCID ID: 0009-0008-9748-3868

Supervisor: Associate Prof. Kushvar Mammadova

E-mail**:** kgmammadova@gmail.com

ORCID ID: 0000-0002-6293-2079

Abstract:*Canine distemper virus (CDV), also known as canine morbillivirus, is a highly contagious morbillivirus with a broad host range and major veterinary and wildlife-conservation significance. Its circulation among domestic dogs and wild carnivores creates opportunities for repeated spillover, spillback and adaptation to new host species. This review examines the molecular epidemiology and genetic evolution of CDV, with emphasis on viral genetic diversity, geographic lineages, transmission between domestic and wildlife populations, host adaptation and the emergence of genetically distinct variants. Particular attention is given to the hemagglutinin (H) gene because sequence variation in this region is widely used for phylogenetic and epidemiological analysis and is relevant to receptor interaction and host range. Published molecular studies show that CDV comprises geographically distributed lineages and that viral genetic diversity can contribute to adaptation when the virus encounters a new host environment. Evidence from the Serengeti also demonstrates that variants circulating in non-canid carnivores may possess molecular characteristics associated with adaptation to particular host receptors. These findings highlight the value of genomic and phylogenetic surveillance for tracing outbreaks and identifying emerging variants. Effective control should combine vaccination, early diagnosis, molecular characterization, domestic-animal monitoring, wildlife surveillance and biosecurity. An integrated domestic animal–wildlife approach is therefore essential for understanding CDV evolution and reducing the risk of future cross-species transmission.*

Keywords: *canine distemper virus; canine morbillivirus; molecular epidemiology; genetic diversity; hemagglutinin gene; host adaptation; cross-species transmission; wildlife surveillance.*

1. Introduction

Canine distemper virus (CDV), currently classified as canine morbillivirus within the genus Morbillivirus, is a highly contagious pathogen of dogs and numerous wild carnivores. Its importance extends beyond domestic animal health because the virus can circulate among multiple host species and can produce severe disease and mortality in wildlife populations. Reviews of CDV evolution emphasize its worldwide distribution, broad host range and capacity for transmission at the domestic animal–wildlife interface (Duque-Valencia et al., 2019).

The epidemiological significance of CDV is closely related to its multi-host character. Domestic dogs can interact directly or indirectly with wildlife, while wildlife populations may act as reservoirs or intermediate hosts that contribute to the maintenance and redistribution of infection. Spillover from domestic dogs to wildlife and spillback from wildlife to domestic animals can therefore create complex transmission networks, particularly in areas affected by urbanization and increasing contact between people, domestic animals and wildlife (Kapil and Yeary, 2011; Beineke et al., 2015).

Molecular epidemiology provides tools for resolving this complexity. Viral sequence data can be used to compare strains, identify genetic lineages, investigate geographic patterns and reconstruct possible transmission histories. The H gene is particularly useful for phylogenetic investigations. A large-scale analysis of 286 H-gene sequences collected from 25 countries over 90 years identified 11 globally co-circulating geographic lineages and demonstrated the value of phylodynamic analysis for understanding CDV evolutionary history (Wang et al., 2023).

The aim of this review is to examine the molecular epidemiology and genetic evolution of CDV, focusing on its molecular characteristics, transmission pathways, genetic diversity, host adaptation, emerging variants and implications for disease control. Particular emphasis is placed on the need for continuous molecular surveillance at the interface between domestic animals and wildlife.

2. Molecular Characteristics and Genetic Diversity

CDV is an enveloped RNA virus belonging to the family Paramyxoviridae and genus Morbillivirus. Its molecular biology is closely related to its ability to infect different tissues and host species. The virus interacts with host-cell receptors during entry, and the H protein is particularly important because it participates in attachment to cellular receptors and therefore contributes to viral tropism. The molecular pathogenesis literature describes CDV as capable of infecting epithelial, lymphoid and neurological tissues, producing systemic disease with respiratory, digestive, lymphatic and central nervous system manifestations (Rendon-Marin et al., 2019).

Genetic diversity is an important feature of CDV epidemiology. Sequence differences among isolates can be used to classify viruses into genetic lineages and to investigate relationships among strains from different hosts and geographic regions. The H gene has become one of the principal molecular markers used for this purpose because it contains informative variation and is also biologically relevant to host-cell receptor interaction.

Table 1. Major molecular features relevant to CDV epidemiology

Molecular feature	Main relevance	Epidemiological application
Viral genome	Contains the genetic information required for viral replication and expression of structural and non-structural proteins.	Genome comparison and molecular characterization.
H protein	Participates in viral attachment and receptor interaction; sequence variation can be informative for host adaptation.	Phylogenetic analysis, lineage identification and investigation of host-associated variants.
Genetic lineages	Represent groups of related viral sequences with geographic and host-associated patterns.	Tracing circulation and comparing outbreaks.
Sequence variation	Provides molecular differences among isolates.	Identification of genetic relationships and evolutionary change.
Whole or partial genome data	Provide broader genetic information than a single marker.	Higher-resolution genomic surveillance and evolutionary analysis.

Source: Compiled from Rendon-Marin et al. (2019), Duque-Valencia et al. (2019), and Wang et al. (2023).

The distribution of genetic lineages is not static. Molecular data can reveal differences between viruses circulating in separate regions and host populations and can also show relationships between apparently separate outbreaks. A 2025 scoping review and spatial meta-analysis examined the geographic distribution of carnivore hosts and CDV genotypes using published sequence data,

illustrating the increasing role of spatial and genomic information in understanding global CDV epidemiology (Wipf et al., 2025).

3. Transmission and Molecular Epidemiology

Transmission of CDV occurs within and between susceptible animal populations. Domestic dogs remain an important component of CDV epidemiology, but the virus is also capable of infecting a wide range of wild carnivores. This broad host range increases the number of ecological settings in which the virus can circulate and complicates conventional approaches based only on domestic animal populations.

The domestic animal–wildlife interface is particularly important. Free-roaming or inadequately vaccinated dogs may contact wild carnivores directly or indirectly through shared environments. Conversely, infected wildlife may contribute to exposure of domestic dogs. Urban and peri-urban wildlife can therefore participate in spillover and spillback processes, making vaccination and surveillance of domestic dogs important components of wildlife disease prevention (Kapil and Yeary, 2011).

Molecular epidemiology adds an additional level of resolution to conventional surveillance. Instead of recording only whether CDV is present, sequencing allows investigators to determine how closely related viruses are and whether cases are associated with the same or different lineages. Phylogenetic analysis can therefore support outbreak investigation, identify geographic patterns and help clarify possible transmission between host populations.

The historical analysis by Wang et al. (2023) demonstrates the potential of this approach. Using 286 H-gene sequences obtained from 25 countries between 1930 and 2020, the authors reconstructed aspects of CDV population history and identified 11 geographic lineages. Such studies demonstrate that molecular surveillance can provide information that is not available from clinical diagnosis alone.

4. Viral Adaptation and Emerging Strains

Viral adaptation becomes particularly important when CDV encounters a new host species. The ability of a viral population to adapt is influenced by genetic diversity, selection and the compatibility between viral proteins and host-cell receptors. Because CDV can infect multiple carnivore species, host switching provides an important context for studying how viral variants become associated with different hosts.

Evidence from the Serengeti ecosystem illustrates the complexity of this process. Nikolin et al. (2017) compared CDV sequences from different carnivore hosts and found molecular characteristics associated with strains infecting non-canid species during the 1993/1994 epidemic. In particular, variants carried changes in the H-protein region involved in interaction with the SLAM/CD150 receptor. Functional experiments showed differences in cell-entry performance depending on the H-protein variant and host receptor, supporting the importance of molecular adaptation in host-associated viral phenotypes.

Recent experimental work has provided further evidence that pre-existing genetic diversity can affect adaptation. Siering et al. (2024) investigated CDV adaptation to ferrets and found that viral populations with greater initial genetic diversity could adapt more rapidly. Low-frequency variants present in the original viral population contributed to subsequent adaptation, illustrating the concept of genetic memory within a viral population.

These findings do not mean that every genetic change produces a new epidemiologically important strain. Rather, they demonstrate that CDV evolution is a dynamic process in which different genetic variants may be selected under particular host and environmental conditions. Continued genomic monitoring is therefore needed to distinguish normal genetic variation from changes that may have implications for host range, transmission or disease control.

5. Cross-Species Transmission and Emerging Variants

Cross-species transmission is one of the central features of CDV epidemiology. The virus has been reported in numerous carnivore families, and severe outbreaks have occurred in wildlife populations. The broad host range of CDV means that control strategies cannot be limited to domestic dogs alone. Wildlife surveillance is necessary where susceptible species live close to vaccinated or unvaccinated domestic animal populations.

Beineke et al. (2015) reviewed cross-species transmission and highlighted the importance of mutations in the H protein in viral attachment and host-cell receptor interaction. Their review also emphasized the difficulty of controlling a virus that can be maintained across several wildlife host populations.

The Serengeti example demonstrates that transmission between species may involve more than a simple dog-to-wildlife spillover event. Molecular comparisons indicated that strains associated with

Surveillance component	Examples	Main contribution
Clinical surveillance	Detection of suspected cases and unusual mortality.	Early recognition of outbreaks.
Molecular testing	PCR and sequence-based characterization.	Confirmation and genetic identification of CDV.
Phylogenetic analysis	Comparison of viral sequences and lineages.	Investigation of relationships among cases and populations.
Domestic-animal monitoring	Vaccination status, case investigation and sampling.	Reduction of susceptible populations and detection of spillover.
Wildlife surveillance	Sampling of wild carnivores and investigation of mortality events.	Identification of wildlife circulation and possible reservoirs.
Genomic monitoring	Whole or partial genome sequencing where available.	Detection of emerging variants and improved evolutionary tracking.

lions and spotted hyenas during the major epidemic were more closely related to one another than to strains from domestic or wild canids. This finding supports the concept that CDV may circulate and adapt within wildlife communities rather than always being repeatedly introduced from dogs (Nikolin et al., 2017).

Table 2. Molecular surveillance indicators and their contribution to CDV control

Source: Author's synthesis based on Kapil and Yeary (2011), Beineke et al. (2015), Wang et al. (2023), Siering et al. (2024), and Wipf et al. (2025).

The combination of epidemiological and molecular information provides a stronger basis for disease control than either approach alone. Clinical surveillance can identify where disease is occurring, while sequencing can help determine whether cases are genetically related. Integrating

host, geographic and sequence information is particularly useful in regions where domestic animals and wildlife share habitats.

6. Implications for Disease Control and Surveillance

Vaccination remains a fundamental component of CDV prevention in domestic dogs. However, vaccination does not eliminate the need for molecular surveillance. The long-term evolutionary analysis of CDV shows continued circulation of genetically distinct lineages, and cases can occur even in populations where vaccines are widely used (Wang et al., 2023). Molecular surveillance can therefore complement vaccination by identifying circulating variants and supporting investigation of unexpected cases.

Disease control should also address the domestic animal–wildlife interface. Regular monitoring of wildlife mortality, diagnostic investigation of suspected cases and communication between veterinary services and wildlife authorities can improve early recognition of transmission events. In urban and peri-urban areas, vaccination of dogs, responsible animal management and measures that reduce uncontrolled contact with wildlife are especially relevant.

Genomic surveillance should be incorporated into outbreak investigations where resources permit. Sequencing of representative samples can help identify lineages, reveal changes in viral populations and provide evidence about possible transmission pathways. Whole-genome approaches can provide greater resolution, while targeted H-gene sequencing remains useful for broader phylogenetic comparisons.

An integrated One Health perspective is appropriate because CDV connects domestic animal health, wildlife conservation and ecological processes. The objective is not simply to identify new variants, but to understand how viral evolution interacts with host populations and environments. Continuous collaboration among veterinarians, diagnostic laboratories, epidemiologists, wildlife specialists and molecular researchers can strengthen preparedness for emerging CDV variants.

7. Conclusion

Canine distemper virus is a genetically diverse, multi-host pathogen whose epidemiology cannot be understood solely through domestic dog populations. Its circulation in wildlife, repeated cross-species transmission and capacity for host-associated adaptation create a dynamic epidemiological landscape. Molecular studies have shown that the H gene is a valuable marker for phylogenetic investigation and that geographically distributed genetic lineages can be followed through sequence analysis.

Evidence from the Serengeti demonstrates that CDV variants may show molecular characteristics associated with adaptation to particular carnivore hosts, while experimental studies indicate that pre-existing genetic diversity can facilitate adaptation to a new host environment. These findings reinforce the importance of monitoring viral genetic diversity rather than relying only on clinical surveillance.

Effective CDV control should therefore combine vaccination, early diagnosis, molecular characterization, wildlife surveillance, responsible domestic-animal management and biosecurity. Continuous genomic monitoring can support early detection of important evolutionary changes and improve understanding of transmission between host populations. An integrated domestic animal–wildlife surveillance system is essential for reducing disease impact and improving preparedness for emerging CDV variants.

REFERENCES

Beineke, A., Baumgärtner, W., & Wohlsein, P. (2015). Cross-species transmission of canine distemper virus—an update. One Health, 1, 49–59. https://doi.org/10.1016/j.onehlt.2015.09.002

Duque-Valencia, J., Sarute, N., Olarte-Castillo, X. A., & Ruíz-Sáenz, J. (2019). Evolution and interspecies transmission of canine distemper virus—An outlook of the diverse evolutionary landscapes of a multi-host virus. Viruses, 11(7), 582. https://doi.org/10.3390/v11070582

Kapil, S., & Yeary, T. J. (2011). Canine distemper spillover in domestic dogs from urban wildlife. Veterinary Clinics of North America: Small Animal Practice, 41(6), 1069–1086. https://doi.org/10.1016/j.cvsm.2011.08.005

Nikolin, V. M., Olarte-Castillo, X. A., Osterrieder, N., Hofer, H., Dubovi, E., Mazzoni, C. J., Brunner, E., Goller, K. V., Fyumagwa, R. D., Moehlman, P. D., Thierer, D., & East, M. L. (2017). Canine distemper virus in the Serengeti ecosystem: molecular adaptation to different carnivore species. Molecular Ecology, 26(7), 2111–2130. https://doi.org/10.1111/mec.13902

Rendon-Marin, S., da Fontoura Budaszewski, R., Canal, C. W., & Ruiz-Saenz, J. (2019). Tropism and molecular pathogenesis of canine distemper virus. Virology Journal, 16, 30. https://doi.org/10.1186/s12985-019-1136-6

Siering, O., Langbein, M., Herrmann, M., Wittwer, K., von Messling, V., Sawatsky, B., & Pfaller, C. K. (2024). Genetic diversity accelerates canine distemper virus adaptation to ferrets. Journal of Virology, 98(8), e00657-24. https://doi.org/10.1128/jvi.00657-24

Wang, H., Guo, H., Hein, V. G., Xu, Y., Yu, S., & Wang, X. (2023). The evolutionary dynamics history of canine distemper virus through analysis of the hemagglutinin gene during 1930–2020. European Journal of Wildlife Research, 69, 56. https://doi.org/10.1007/s10344-023-01685-z

Wipf, A., Perez-Cutillas, P., Ortega, N., Huertas-López, A., Martínez-Carrasco, C., & Candela, M. G. (2025). Geographical distribution of carnivore hosts and genotypes of canine distemper virus (CDV) worldwide: A scoping review and spatial meta-analysis. Transboundary and Emerging Diseases, 2025, 6632068. https://doi.org/10.1155/tbed/6632068

НАКОПЛЕНИЕ ТЯЖЕЛЫХ МЕТАЛЛОВ ИЗ ПОЧВЫ В ОРГАНИЗМЕ РАСТЕНИЙ И ИХ ТОКСИЧЕСКОЕ ВОЗДЕЙСТВИЕ

Каипбекова Наргиза Марат кызы

Магистрантка 2-го курса Нукусского филиала Самаркандского государственного университета ветеринарной медицины, животноводства и биотехнологий

Аннотация. *В данной работе рассмотрены тяжелые металлы, содержащиеся в почве, пути их поступления в организм растений, особенности их накопления в корневой системе и надземных органах, а также токсическое воздействие на физиологические и биохимические процессы. Проанализировано влияние таких тяжелых металлов, как Pb, Cd, Hg, Cr, Ni, As и Zn, на рост, развитие, фотосинтез и продуктивность растений.*

Ключевые слова: *почва, тяжелые металлы, растения, токсичность, биоаккумуляция, фотосинтез, экологическая безопасность.*

Abstract. *This work examines the heavy metals contained in the soil, their pathways to the plant body, the specifics of their accumulation in the root system and above-ground organs, as well as their toxic effects on physiological and biochemical processes. The influence of heavy metals such as Pb, Cd, Hg, Cr, Ni, As, and Zn on plant growth, development, photosynthesis, and productivity has been analyzed.*

Keywords: *soil, heavy metals, plants, toxicity, bioaccumulation, photosynthesis, environmental safety.*

В настоящее время загрязнение почвы тяжелыми металлами является одной из важных экологических проблем. В результате промышленной деятельности, транспорта, горнодобывающей и металлургической промышленности, а также неправильного использования минеральных удобрений и пестицидов тяжелые металлы могут накапливаться в почве, длительное время сохраняться в ней и усваиваться растениями. Это оказывает негативное влияние на плодородие почвы, физиологическое состояние растений, их продуктивность и безопасность пищевых продуктов. Воздействие тяжелых металлов на растения зависит не только от их концентрации, но и от химической формы, значения pH почвы, содержания органического вещества, влажности и вида растения. Основная часть металлов поступает в растение через корневую систему, где может накапливаться в тканях корня или перемещаться по ксилеме и флоэме в стебли, листья, плоды и семена. Некоторые металлы также могут поступать на надземные органы растений из атмосферной пыли и аэрозолей.

Cd является одним из наиболее опасных токсичных металлов для растений и поступает в окружающую среду в результате городских отходов, производственных процессов, а также использования синтетических фосфорных удобрений [8]. Повышение концентрации Cd в почве способствует увеличению его поглощения растениями. Cd нарушает процессы обмена веществ, фотосинтеза и транспирации, изменяет активность ферментов и усиливает окислительный стресс. Кроме того, он подавляет синтез белков и нуклеиновых кислот, что может приводить к замедлению роста растений и развитию хлороза листьев [2].

Pb является одним из наиболее распространенных и высокотоксичных загрязнителей почвы среди тяжелых металлов. Он преимущественно накапливается в корневой системе растений и в ограниченном количестве перемещается в надземные органы. Pb нарушает процессы фотосинтеза, деления клеток, поглощения воды и обмена веществ, а также ингибирует активность ряда ферментов [4]. Кроме того, Pb может взаимодействовать с металлопротеинами и клеточными транспортными системами, нарушая обмен таких важных элементов, как Fe^{2+} и Ca^{2+}, в клетках [11]. В результате у растений наблюдаются замедление роста и развития, нарушения физиологических процессов и снижение образования биомассы.

Zn является необходимым микроэлементом для растений и при низких концентрациях выполняет функцию кофактора в структурной и функциональной активности многих ферментов и белков [7]. Однако избыточное накопление Zn в почве оказывает токсическое воздействие на растения. Высокие концентрации Zn могут ограничивать поглощение других важных элементов, нарушать физиологические процессы растений и приводить к снижению

темпов их роста. Поэтому переход Zn от биологически необходимого элемента к токсичному в первую очередь зависит от его концентрации и вида растения.

Hg является высокотоксичным, мобильным и летучим загрязнителем. Он может поступать в атмосферу в результате сжигания угля, промышленных выбросов и испарения с загрязненных водоемов, после чего распространяться на значительные расстояния. Hg воздействует на функционирование хлоропластов и митохондрий растительных клеток, нарушая транспорт электронов в процессах фотосинтеза и окислительного метаболизма [10]. Кроме того, высокие концентрации Hg могут снижать способность растений поглощать воду, что приводит к замедлению общего роста и развития.

Cr в почве встречается преимущественно в формах Cr(III) и Cr(VI). Между этими формами существуют значительные различия по токсичности и подвижности: Cr(VI) вследствие высокой подвижности является значительно более токсичным по сравнению с Cr(III). Растения поглощают Cr преимущественно через корневую систему. Высокие концентрации Cr снижают всхожесть семян, рост и продуктивность растений, нарушают процесс фотосинтеза и усиливают окислительный стресс [9].

As не является необходимым элементом для растений и при высоких концентрациях оказывает выраженное токсическое воздействие. As может поступать в почву с продуктами сжигания угля, выбросами металлургической промышленности, минеральными удобрениями и другими антропогенными источниками [5]. Поглощенный корнями растений As подавляет развитие корневой системы и деление клеток, ограничивает формирование растительной биомассы, снижает оплодотворение и продуктивность растений [5, 6]. Токсичность As также зависит от его химической формы и подвижности в почве; в почвах, содержащих активные формы Fe, Al и Ca, он относительно прочно связывается.

В отличие от других тяжелых металлов, Se в определенных концентрациях может быть полезен для растений, однако при его избыточном содержании проявляется выраженное токсическое действие. Основными внешними признаками токсичности Se являются хлороз и некроз листьев, замедление роста растений, ослабление развития корневой системы и снижение продуктивности. Воздействие Se на растения прежде всего зависит от его концентрации в почве и биологических особенностей вида растения.

В целом загрязнение сельскохозяйственных почв тяжелыми металлами может быть обусловлено воздействием сточных вод, промышленных выбросов, минеральных удобрений, пестицидов и атмосферных загрязнений. Переход тяжелых металлов из почвы в сельскохозяйственные культуры, а затем в пищевые продукты представляет опасность для здоровья человека и животных [3]. Степень накопления тяжелых металлов в растениях

зависит от свойств почвы, вида сельскохозяйственной культуры, агротехнических мероприятий и концентрации металла [1]. Высокие концентрации Cu, Zn и Pb снижают биомассу почвенных микроорганизмов и активность ферментов, нарушая процессы разложения органических веществ и круговорота питательных элементов [12]. Избыточное накопление тяжелых металлов нарушает процессы фотосинтеза, дыхания, минерального питания и ферментативной активности растений, что приводит к снижению их роста, развития и продуктивности. Поэтому изучение миграции тяжелых металлов и особенностей их накопления в растениях, а также применение экологически безопасных биологических методов, таких как фиторемедиация, имеют важное научное и практическое значение [13].

Список использованной литературы:

1. Chabukdhara M, Munjal A, Nema AK, et al. Heavy metal contamination in vegetables grown around peri-urban and urbanindustrial clusters in Ghaziabad, India. Hum Ecol Risk Assess. 2016;22(3):736-752.

2. Dutta A, Patra A, Jatav HS, et al. Toxicity of cadmium in soil-plant-human continuum and its bioremediation techniques. In: Soil Contamination-Threats and Sustainable Solutions. IntechOpen; 2020. p. 22.

3. Erkudov VO, Rozumbetov KU, Pugovkin AP, et al. Assessment of youth fitness under long-term exposure to toxic environmental conditions due to pesticides: Case from Aral Sea region. Case Studies in Chemical and Environmental Engineering. 2023 Dec 1;8:100504.

4. Fahr M, Laplaze L, Bendaou N, et al. Effect of lead on root growth. Front Plant Sci. 2013 Jun 6;4:175.

5. Finnegan PM, Chen W. Arsenic Toxicity: The Effects on Plant Metabolism. Front. Physio. 2012. 3:182.

6. Garg N, Singla P. Arsenic toxicity in crop plants: Physiological effects and tolerance mechanisms. Environmental chemistry letters. 2011. 9(3), 303–321.

7. Guarino F, Improta G, Triassi M, et al. Effects of Zinc Pollution and Compost Amendment on the Root Microbiome of a Metal Tolerant Poplar Clone. Front Microbiol. 2020 Jul 15;11:1677.

8. Haider FU, Liqun C, Coulter JA, et al. Cadmium toxicity in plants: Impacts and remediation strategies. Ecotoxicol Environ Saf. 2021 Mar 15;211:111887.

9. Oliveira H. Chromium as an Environmental Pollutant: Insights on Induced Plant Toxicity. Journal of Botany. 2012. 375843, 8 pages, 2012.

10. Pacyna JM. Recent advances in mercury research. Sci Total Environ. 2020 Oct 10;738:139955.

11. Rehan M, Alsohim AS. Bioremediation of heavy metals. In: Environmental Chemistry and Recent Pollution Control Approaches. IntechOpen; 2019. p. 145-158.

12. Sobolev D, Begonia MF. Effects of heavy metal contamination upon soil microbes: lead-induced changes in general and denitrifying microbial communities as evidenced by molecular markers. Int J Environ Res Public Health. 2008 Dec;5(5):450-6.

13. Yadav A, Hasan M, Kour S, et al. Heavy metal contamination in plants: sources, monitoring, and data-driven insights. Macromol Symp. 2025;414:2400239.

DORIVOR *POLYPORUS TUBERASTER* (JACQ. EX PERS.) FR. ZAMBURUG‘INING BIOTEXNOLOGIK AHAMIYATI

Nurullayeva Iroda Uktam Qizi

Qarshi davlat universiteti Biotexnologiya mutaxassisligi magistranti.

Annotatsiya: *Dorivor makromitsetlar biotexnologiyada muhim o‘rin tutadi. Polyporus tuberaster lignin va sellyulozani parchalovchi lakkaza hamda peroksidaza fermentlarini ishlab chiqaradi. Mitseliy ekstraktlari polisaxarid va fenolik birikmalarga boy bo‘lib, antioksidant hamda immunomodulyator xususiyatga ega. Ushbu tur bioenergetika va ekologik texnologiyalar uchun istiqbolli biotexnologik ob’ekt hisoblanadi.*

Kalit so‘zlar: *Polyporus tuberaster*, saprotrof zamburug‘lar, oq chirish, biotexnologiya, fermentlar

***Abstract*:** Medicinal macromycetes play an important role in biotechnology. Polyporus tuberaster produces laccase and peroxidase enzymes that degrade lignin and cellulose. Mycelial extracts are rich in polysaccharides and phenolic compounds and have antioxidant and immunomodulatory properties. This species is a promising biotechnological object for bioenergy and environmental technologies.

Keywords: *Polyporus tuberaster*, saprotrophic fungi, white rot, biotechnology, enzymes

Kirish. Bugungi kunda dorivor makromitsetlarni o‘rganish biotexnologiyaning istiqbolli yo‘nalishlaridan biri hisoblanadi. Xususan, yog‘ochni parchalovchi bazidiyali zamburug‘lar biologik faol moddalar manbai sifatida katta ilmiy va amaliy ahamiyatga ega. Shunday turlardan biri – *Polyporus tuberaster* (Jacq. ex Pers.) Fr. bo‘lib, u tog‘ va adir hududlarida uchraydi hamda lignosellyulozani parchalovchi ksilotrof zamburug‘ hisoblanadi.

Polyporus tuberaster (Jacq. ex Pers.) Fr. bo‘lib, u Basidiomycota bo‘limi, Agaricomycetes sinfi, Polyporales tartibi, Polyporaceae oilasiga mansub, saprotrofik polipor zamburug‘i bo‘lib, maysa va o‘rmon maydonlaridagi chirigan yog‘ochda o‘sadi. Shuni ta’kidlash kerakki, O‘zbekiston hududida *P. tuberaster* ning tarqalishi yaqinda ilmiy tarzda tasdiqlangan, bunda u mahalliy ekosistemalarda ilk bor qayd etilgan va ekologik sharoitlari ham tavsiflangan [1]

Mazkur tur xalq tabobatida immunomodulyator yallig‘lanishga qarshi va antioksidant xususiyatlari bilan qadrlanadi. Shu bois ushbu zamburug‘ning biotexnologik salohiyatini o‘rganish dolzarb hisoblanadi.

Ushbu tur yog‘och va o‘simlik qoldiqlari tarkibidagi murakkab moddalar — lignin va sellyulozani parchalay oladigan kuchli fermentlar ishlab chiqaradi. Shu sababli u o‘simlik biomassasini qayta ishlash va turli biotexnologik jarayonlarda qo‘llash uchun istiqbolli hisoblanadi. Polyporaceae oilasiga mansub boshqa zamburug‘lar kabi, bu tur ham lignotsellyulozali

materiallarni samarali parchalaydi. Bu jarayonda asosiy rolni ligninni va boshqa murakkab birikmalarni parchalovchi lakkaza, peroksidaza kabi oksidlovchi fermentlar o‘ynaydi [2].Shuningdek, boshqa *Polyporus* turlarida, xususan *P. tuberaster* ning mycelial kulturadan olingan ekstraktlar antiproliferative va anticancer potensialga ega (yallig‘lanishga qarshi) xususiyatga ega bo‘lib, saraton hujayralarining o‘sishiga to‘sqinlik qilishi haqida tadqiqotlar mavjud [3].

Laboratoriya tajribalari natijasida *P. tuberaster* zamburug‘ining sof kulturasini oziqa muhitlarida rivojlantirish mumkinligi aniqlandi. Ekishdan keyingi dastlabki bosqichlarda substrat yuzasida oq rangli tolali mitseliy hosil bo‘lishi kuzatildi.

PDA (Potato Dextrose Agar) va MEA(Malt Extract Agar) muhitlarida zamburug‘ning rivojlanishi kuzatilgan bo‘lsa-da, tajriba sharoitida MEA muhitida mitseliyning zichroq va faolroq rivojlanishi qayd etildi. Koloniya yuzasi oq rangli, zich va tolali tuzilishga ega bo‘ldi.

90 mm diametrli Petri kosachalarida mitseliyning oziqa muhitini to‘liq egallashi taxminan 7–14 kun oralig‘ida kuzatildi. Ushbu ko‘rsatkich kulturaning fiziologik holati, oziqa muhitining tarkibi va kultivatsiya sharoitlariga bog‘liq bo‘lishi mumkin.

Mikroskopik kuzatuvlar natijasida mitseliyning tarmoqlangan gifalardan tashkil topganligi aniqlandi. Generativ gifalar diametrining 2–5 mkm atrofida bo‘lishi tajriba davomida qayd etilgan asosiy mikromorfologik ko‘rsatkichlardan biri bo‘ldi.

Polipor zamburug‘lar lignosellyulozali materiallarni parchalashda ishtirok etuvchi fermentlar ishlab chiqarishi bilan biotexnologiyada muhim o‘rin egallaydi. Ushbu xususiyat qishloq xo‘jaligi chiqindilarini biokonversiya qilish, organik chiqindilarni qayta ishlash va biologik faol mahsulotlar olishda foydalanish imkonini beradi.

Shuningdek, *P. tuberaster* mitseliy kulturasi ekstraktlarining biologik faolligi bo‘yicha laboratoriya tadqiqotlari mavjud. Bunday natijalar turning farmatsevtik va biotexnologik istiqbollarini o‘rganish uchun asos bo‘lib xizmat qiladi

Olingan natijalar *P. tuberaster* ni laboratoriya sharoitida vegetativ biomassasini olish maqsadida kultivatsiya qilish mumkinligini ko‘rsatadi. Maksimal mitseliy biomassasiga erishish uchun oziqa muhitining tarkibini optimallashtirish talab etiladi.

Bundan tashqari, *Polyporus* turkumiga kiruvchi zamburug‘lar bioaktiv birikmalar – polisaxaridlar, polifenolik birikmalar, sterollar va boshqa biologik faol komponentlar manbai sifatida yaqindan o‘rganilmoqda. Bu birikmalar antioksidant, immunomodulyator va antimikrob faoliyatga ega ekani ilmiy adabiyotlarda qayd etilgan [4].

Ushbu zamburug‘ning lignikotuvchi fermentlar (ligninolitik tizimlar) yordamida biomassaning biodegradatsiyasi va bioenergiya olingan substratlarni ishlab chiqishda qo‘llash,

mycelial kulturalardan polisaxaridlar, fenolik birikmalar ekstrakti sifatida olinadi, ular antioxydant va immunstimulyator xususiyatga ega, ekstraktlarning anticancer potentsiali tibbiyotda yangi dori moddalarining manbai sifatida, qishloq xo‘jaligi chiqindilarini degradatsiya qilish, chiqindi suvlarni biologik tozalash, bioremediatsiya jarayonlarida qo‘llanishi mumkin [5,6,7].

Shu bilan, *P. tuberaster* nafaqat O‘zbekistonning xilma-xil mikoflorasini boyituvchi biologik organizm bo‘libgina qolmay, balki uning fermentativ va bioaktiv potentsiali biotexnologik tadqiqotlar uchun muhim ob’ekt hisoblanadi. Bu zamburug‘ning lignotsellyuloza parchalaydigan fermentlari, antioksidant hamda yallig‘lanishga qarshi moddalari uni farmatsevtika, bioenergetika, sanoat fermentologiyasi va ekologik texnologiyalar kabi bir qancha sohalarda tadqiq etishga imkon beradi.

Xulosa kilib aytganda *P. tuberaster* zamburug‘ining biologik xususiyatlarini chuqur o‘rganish biotexnologiya va biomeditsinaning yangi istiqbollarini ochib beradi. Xususan, ushbu zamburug‘dan olinadigan biologik faol birikmalarni aniqlash va ularning xususiyatlarini baholash yangi biofarmatsevtik preparatlar yaratish uchun muhim ahamiyatga ega. Uning fermentativ tizimlarini o‘rganish organik chiqindilarni biokonversiya qilish va qayta tiklanuvchi energiya manbalarini ishlab chiqishda qo‘llanilishi mumkin. Shuningdek, zamburug‘ metabolitlarining antioksidant va yallig‘lanishga qarshi faolligini ilmiy asosda tekshirish yangi terapevtik vositalarni ishlab chiqishga zamin yaratadi. Zamonaviy molekulyar-biologik usullar yordamida ushbu organizmning bioaktiv moddalar sintezi uchun mas’ul genlari va metabolik yo‘llarini aniqlash mumkin. Olingan natijalar biotexnologik ishlab chiqarish jarayonlarini optimallashtirish hamda biologik faol mahsulotlar hosildorligini oshirishga xizmat qiladi. Shu bois, P. tuberaster zamburug‘ini kompleks tadqiq etish fundamental mikologiya, amaliy biotexnologiya va biomeditsina o‘rtasidagi ilmiy aloqalarni mustahkamlashda istiqbolli yo‘nalishlardan biri hisoblanadi.

FOYDALANILGAN ADABIYOTLAR

1. Sherkulova J., Eshonkulov E., Murodullayev D. Distribution in Uzbekistan of *Polyporus tuberaster* Fr. (Polyporaceae, Basidiomycota) // Universum: химия и биология: электрон. научн. журн. 2024. 12(126).

2. Nguyen K A, Wikee S, Lumyong S. Brief review: lignocellulolytic enzymes from polypores for efficient utilization of biomass. Mycosphere 9(6): 1073–1088 (2018)

3. Song E.S., So M.K., Park H.J., Lee H., Lee Y.H., Kuk MU., Park J., Kwon HW., Choi J, Park JT. Chemical screening identifies the anticancer properties of *Polyporus tuberaster.* Journal of Cancer 2023, Vol. 14: 2075–2084.

4. Quintero-Cabello, K.P.; Lugo-Flores, M.A.; Rivera-Palafox, P.; Silva-Espinoza, B.A.; González-Aguilar, G.A.; Esqueda, M.; Gaitán-Hernández, R.; Ayala-Zavala, J.F. Antioxidant Properties and Industrial Uses of Edible Polyporales. J. Fungi 2021, 7, 196.

CASSIA TORA L. URUG‘LARINI ASEPTIK SHAROITDA IN VITRO KULTURAGA INTRODUKSIYA QILISH TEXNOLOGIYASI

***Bauetdinova Sarbinaz Maxmud qizi**, IICAS (Xalqaro innovatsion markaz), Laborant. Tel: 88-432-55-66.*

E-mail: sarbinazbauetdinova@icloud.com

***Eshmuratova Aygul Arepbayeva,** IICAS (Xalqaro innovatsion markaz), Katta ilmiy xodim.*

***Esimbetov Adilbay Tlepovich**, Samarqand davlat veterinariya meditsinasi, chorvachilik va biotexnologiyalar universiteti Nukus filiali direktori*

***Annotatsiya.** Maqolada Cassia tora L. urug‘larini in vitro kulturasiga aseptik kiritish texnologiyasini ishlab chiqish bo‘yicha tadqiqot natijalari keltirilgan. Tadqiqotning maqsadi hayotiy birlamchi o‘simlik materialini olish uchun urug‘larni sterilizatsiya qilish va keyinchalik ularni aseptik sharoitda o‘stirishning samarali sharoitlarini aniqlashdan iborat. Ishda urug‘larni sterilizatsiyadan oldingi ishlov berish va sterilizatsiya qilish variantlari, shuningdek, ularni ozuqa muhitiga joylashtirish va in vitro sharoitida o‘stirish sharoitlari o‘rganilgan. Kontaminatsiya darajasi, urug‘larning unib chiqish foizi, olingan nihollarning yashovchanligi va ularning rivojlanish muddatlari baholandi. Natijada Cassia tora L. o‘simligining aseptik va yashovchan o‘simlik materialini olishni ta’minlaydigan eng samarali sharoitlar aniqlangan. Olingan natijalardan o‘simlikni keyinchalik in vitro kulturasida ko‘paytirish, morfogenez bo‘yicha tadqiqotlar olib borish va ekish materialini olish usullarini ishlab chiqishda foydalanish mumkin.*

***Kalit so'zlar:** in vitro, Cassia tora, sterilizatsiya, MS muhiti, mikroko'paytirish, ildizlanish.*

Kirish. *Cassia tora* - dukkaklilar *(Fabaceae)* oilasiga mansub, bo'yi 30-90 sm ga yetadigan bir yillik o't o'simligi bo'lib, Osiyo mamlakatlarida keng tarqalgan [4]. O'simlik tarkibida antraxinon guruhiga mansub bioaktiv birikmalar - xrizofanol, emodin, rein - mavjud bo'lib, ular o'simlikning farmakologik faolligini belgilaydi [2]. An'anaviy tabobatda o'simlik gepatoprotektiv, antimikrob va antioksidant xususiyatlari bilan bog'liq holda qo'llanib kelinadi [2, 4].

Cassia tora quruq va sho'r tuproqli mintaqalarda Qoraqalpog'iston Respublikasi kabi hali yetarli o'rganilmagan. *In vitro* texnologiyalar o'simliklarni yil bo'yi, tashqi muhit sharoitidan qat'i nazar ko'paytirish imkonini beradi. Ushbu tadqiqotning maqsadi - *Cassia tora* urug'larini steril sharoitda *in vitro* muhitiga ko'chirib o'tqazish texnologiyasini ishlab chiqish va sinab ko'rishdan iborat.

Tadqiqot materiallari va metodikasi. Tadqiqot ob'ekti - *Cassia tora* urug'lari. Tadqiqot IICAS(Orolbo‘yi xalqaro innovatsiya markazi) laboratoriyasida bajarildi.

Dastlab 20 ta urug' sterilizatsiyadan oldingi ishlovdan o'tkazildi:

1) 15-20 daqiqa oddiy suvda yuvildi;

2) distillangan suvda 50-60°C haroratda 15 daqiqa aylantirib isitildi;

3) 12-24 soat suvda ivitib qo'yildi;

4) distillangan suvda 6 marta, har birida 5 daqiqadan yuvildi.

shimib hajmi o'zgargan urug'lar orasidan sifat ko'rsatkichlari bo'yicha 15 tasi tanlab olindi.

Tanlangan urug'larning sterilizatsiyasi laminar box sharoitida amalga oshirildi: 1) 70% etanolda 30 soniya;

2) 5% natriy gipoxlorit (NaOCl) eritmasida 15 daqiqa;

3) distillangan suvda 5 marta, har birida 5 daqiqadan yuvish; 4) 1/2 kuchli MS + GA3 0,1 mg/l muhiti solingan Petri idishlariga ekish (4,4,4,3 dona, 4 idishga).

Undirilgan nihollar laminar box sharoitida MS muhitiga individual tarzda ko'chirib o'tqazildi. Keyingi bosqichda o'simliklar besh xil tarkibli muhitga (MS, MS+BAP 1,0 mg/l, MS+IBA 2,0 mg/l, DKW, DKW-Uz.8) ko'chirilib, o'sish va ildiz hosil qilish dinamikasi kuzatildi. Muhit tarkibini tanlashda Cassia turkumida qo'llanilgan MS-asosli protokollar inobatga olindi [1, 3].

Tadqiqot natijalari va tahlili. Tadqiqot natijalari 1-jadvalda keltirilgan.

1-jadval. Cassia tora urug'larini in vitro muhitiga kiritish dinamikasi

Sana	Bosqich	Natija
04.06.2026	Ekish	Tanlangan 15 ta urug' 4 ta Petri idishga (4,4,4,3 dona) 1/2 MS + GA3 0,1 mg/l muhitida ekildi

08.06.2026	Undirish	15 ta urug'ning barchasi ikkilik barg bosqichigacha undi (15/15)
08.06.2026	MS muhitiga ko'chirib o'tqazish	Har bir nihol alohida MS muhitiga o'tqazildi; keyinchalik 1 tasida bakteriyal kontaminatsiya aniqlandi, 14 tasi sog'lom rivojlanishda davom etdi (14/15)
22.06.2026	Kuzatuv	O'zgarishsiz, barqaror o'sish
29.06.2026	Muhitlar bo'yicha sinov	15 o'simlikdan 5 tasi turli muhitlarga ko'chirildi: MS, MS+BAP 1,0 mg/l, MS+IBA 2,0 mg/l, DKW, DKW-Uz.8; qolgan 10 tasi MS muhitida davom ettirildi
15.07.2026	Ildiz hosil bo'lishi	5 ta sinov namunasidan 2 tasida (MS va DKW muhitida) ildiz kuzatildi (2/5); 10 ta MS muhitidagi namunaning barchasida ildiz kuzatildi (10/10)
30.07.2026	1-klonlash	4 ta namuna MS muhitiga klonlandi
18.08.2026	Kuzatuv natijasi	4 ta namunaning barchasida ildiz va barg rivojlangan (4/4)

Tanlangan 15 ta urug'ning barchasi undi va MS muhitiga ko'chirib o'tqazildi; keyinchalik bitta namunada bakteriyal kontaminatsiya aniqlangani sababli 14 ta namuna sog'lom rivojlanishda davom etdi. Bu ko'rsatkich tanlangan sterilizatsiya rejimining (70% etanol, so'ng 5% NaOCl) yetarli darajada samarali ekanligini, biroq aseptika talablariga yanada qat'iyroq rioya qilish zarurligini ko'rsatadi.

Besh xil muhitda o'tkazilgan sinovda ildiz hosil bo'lishi faqat MS va DKW muhitida kuzatildi; BAP 1,0 mg/l va IBA 2,0 mg/l qo'shilgan muhitlarda bu bosqichda ildiz emas, balki vegetativ o'sish ustunlik qildi. Asosiy MS muhitida saqlangan 10 ta o'simlikning barchasida ildiz tizimi rivojlandi. 30.07.2026 sanasida o'tkazilgan birinchi klonlash natijasida barcha 4 ta namunada (4/4) ildiz va barg rivojlanishi kuzatildi, bu ishlab chiqilgan protokolning takrorlanuvchan ekanligidan dalolat beradi.

Xulosa. *Cassia tora* urug'larini steril sharoitda *in vitro* muhitiga ko'chirib o'tqazishning ishonchli texnologiyasi ishlab chiqildi. Ishlab chiqilgan sterilizatsiya rejimi urug'larning yuqori darajada steril va undirilgan holatda *in vitro* sharoitiga o'tishini ta'minladi. Muhit tarkibini sinash natijasida ildizlanish bosqichi uchun MS va DKW muhitlari eng samarali ekanligi aniqlandi. Olingan natijalar Cassia tora ni Qoraqalpog'iston sharoitida *in vitro* usulida ko'paytirish, shuningdek kelgusida abiotik stress omillariga chidamlilikni o'rganish yo'nalishidagi tadqiqotlar uchun boshlang'ich asos bo'lib xizmat qiladi.

Foydalanilgan adabiyotlar

1. Agrawal V., Sardar P.R. In vitro regeneration through somatic embryogenesis and organogenesis using cotyledons of Cassia angustifolia Vahl. // In Vitro Cellular & Developmental Biology - Plant. 2007. Vol. 43. P. 585-592.

2. Patil U.K., Jain S. Phytochemical and pharmacological profile of Cassia tora Linn. - An overview // Indian Journal of Natural Products and Resources. 2010. Vol. 1, No. 4. P. 430-437.

3. Quraishi A., Jadhav S.K., Gupta S. In vitro Clonal Propagation of Cassia tora L. (Coffee Pod): A Medicinal Plant // Biotechnology. 2011. Vol. 10. P. 546-550. DOI: 10.3923/biotech.2011.546.550

4. Zibaee E., Javadi B., Sobhani Z., Akaberi M., Farhadi F., Amiri M.S., Baharara H., Sahebkar A., Emami S.A. Cassia species: A review of traditional uses, phytochemistry and pharmacology // Pharmacological Research - Modern Chinese Medicine. 2023. Vol. 9. Art. 100325. DOI: 10.1016/j.prmcm.2023.100325

SOYA (*Glycine Max (L.) Merr.*) NAVLARI TARKIBIDAGI FLAVONOIDLAR TAHLILI

Sa`dullayeva Sitora O‘ktamjon qizi

Sharof Rashidov nomidagi Samarqand davlat uviversiteti, tayanch doktorant

Tel : +998990939284

e-mail: sitorsamdu.uz@gmail.com

Annotatsiya. *Mazkur ilmiy tadqiqot Glycine max (L.) Merr. – soya o‘simligidagi biofaol birikmalarni aniqlash va ularning miqdoriy tarkibini baholashga qaratilgan.*

Abstract. *This scientific study aims to identify bioactive compounds in Glycine max (L.) Merr. (soybean) and evaluate their quantitative composition.*

Kalit so`zlar : *soya o‘simligi, flavonoid, gall kislota, rutin.*

Dunyo miqyosida farmakologiya-farmatsevtika, tibbiyot, fiziologiya sohasida turli kasalliklarni davolash, oldini olish maqsadida samarali terapevtik ta'sirga ega dori vositalarining yangi avlodini yaratish, mazkur vositalarning fiziologik ta'sir mexanizmini ilmiy asoslash dolzarb masala bo'lib, ayniqsa, mazkur yo'nalishda mahalliy dorivor o'simlik turlari, oziq-ovqat sanoatida foydalaniluvchi ekinlar ikkilamchi xomashyosidan foydalanish iqtisodiy jihatdan istiqbolga ega. Ushbu nuqtai nazardan istiqbolli o'simlik turlaridan biri – soya o'simligi (Glycine max (L.) Merrill) hisoblanadi. Respublikamizda farmatsevtika sanoatining dinamik va barqaror rivojlanishini ta'minlashga yo'naltirilgan bir qator dasturlar qabul qilingan. Bu borada mahalliy o'simlik xomashyosi asosida ishlab chiqarilgan sifatli va xavfsiz dori vositalari bilan ta'minlashga alohida e'tibor qaratilmoqda. O'zbekiston Respublikasini yanada rivojlantirish bo'yicha Harakatlar strategiyasining 4-yo'nalishida “Farmatsevtika sanoatini yanada rivojlantirish, aholi va tibbiyot muassasalarining arzon, sifatli dori vositalari bilan ta'minlanishini yaxshilash” yuzasidan muhim vazifalar belgilab berilgan[1]. Bu borada turli kasalliklarni davolash uchun tarkibi potensial farmakologik faollikka egaligi bilan tavsiflanuvchi keng ko'lamdagi birikmalardan tashkil topgan mahalliy xomashyolar asosida dori vositalarini yaratish muhim ahamiyat kasb etadi.

Soya o'simligi (Glycine max (L.) Merrill) – dunyo miqyosida qishloq xo'jaligida oziq-ovqat sifatida (kelib chiqish Vatani – Sharqiy Osiyo), shuningdek xalq xo'jaligining turli sohalarida ikkilamchi xomashyo olishda foydalaniluvchi dukkakli ekin turi bo'lib, moyli ekinlarning 53% ulushini tashkil qiladi. Soya (Glycine max (L.) Merr.) urug'i tarkibida fiziologik faol moddalar bo'lgan 31 ta polifenol birikmalar, izoflavon, fitosterol, letsitin, saponinlar mavjudligi qayd qilingan [2, p1-13]. Shuningdek, soya (Glycine max (L.) Merr.) urug'i tarkibidagi moddalar konsentratsiyasi o'sish tuproq-iqlim sharoitiga bog'liqligi ta'kidlanadi.

Mazkur tadqiqotning maqsadi, materiallari va uslublari. Tadqiqotda soya o‘simligi (Glycine Max (L.) Merr.) navlari (“Argentina”, “Oltintoj”, “Sochilmas”) urug‘i tarkibida gall kislotasi, rutin, kversetin, apigenin, kempferol konsentratsiyasini tahlil qilindi.

O‘rganilgan flavonoidlarning kimyoviy struktura tuzilishi va nomlanishi

T/r	Flavonoidlar	R	R_1	R_2	R_3	R_4	R_5	R_6
1.	3-*O*-ramnoglyukozid kversetin yoki 2-(3,4-digidroksifenil)-5,7-digidroksi-3-[α-L-ramnopiranozil- (1→6)-β-D-glyuko-piranoziloksi]-4H-xromen-4-on (**rutin**)	*–O–Glu**	–OH		–OH		–OH	–OH
2.	3,3',4',5,7-pentagidroksi-flavon (**kversetin**)	–OH	–OH		–OH		–OH	–OH
3.	4',5,7-trigidroksiflavon (**apigenin**)		–OH		–OH			–OH
4.	3,4',5,7-tetragidroksiflavon (**kempferol**)	–OH	–OH		–OH			–OH

Izoh: * – *O–Glu* – uglevod qoldig‘ini ifodalaydi.

Sinov namunalari etanol (96%li) eritmasida 1:10 nisbatda aralashtirilib, *t*=+35±0,5°S harorat sharoitida 75 minut davomida ekstraksiyalandi.

Tahlil standart, yuqori samarali suyuqlik xromatografiyasi (HPLC) uslubida amalga oshirildi, bunda qo‘zg‘almas faza sifatida “Agilent Zorbax” 4,6 mm ID×12,5 mm katriji va C18 250×4,6 mm, 5 mkm o‘lchamli “Precisely” (“Perkin Elmer”, AQSh) kalonkasidan foydalanildi .

Sinov namunalari tarkibida gall kislotasi, rutin, kversetin, apigenin, kempferol konsentratsiyasini tahlil qilish standart uslubda, gradient ellyusiyasi – metankarbon kislota (SN_3SOON) eritmasi (0,5%) (0,025 mg/ml) va asetonitril (metilsianid – CH_3CN) eritmasi (0,05 mg/ml) 1:1,8 nisbatda (oqim tezligi 1 ml/min., termostatda harorat *t*=+40±0,5°S, in’eksion sinov namunasi V=10 mkl) kalibrovkalandi. UV-detektor kompleksi bilan jihozlangan “HPLC LC-2030 C 3D Plus” (“Shimadzu”, Yaponiya) qurilmasi yordamida, deteksiya vaqti 2,5 minutida gall kislotasi, 3,6 minutida rutin, 11-12 minutlarda apigenin, kempferol, 16 minutida kversetin tahlil qilindi.

Quyida soya (*Glycine Max* (L.) Merr.) ayrim navlari (“Argentina”, “Oltintoj”, “Sochilmas”) urug‘i tarkibidagi fenol birikmalari konsentratsiyasini tahlili keltirilgan.

Soya o‘simligi (*Glycine Max* (L.) Merr.) navlari urug‘ining tarkibida ayrim fenol birikmalarining miqdoriy tahlili (*M±m*)

Fenol birikmalari (mg/100 gr)						
T/r	**Soya navlari**	**Gall kislotasi**	**Rutin**	**Kversetin**	**Apigenin**	**Kempferol**
1.	“Argentina”	0,429±0,02	0,412±0,05	0,725±0,04	0,219±0,04	0,097±0,01
2.	“Oltintoj”	0,306±0,04	0,682±0,02	0,576±0,01	0,124±0,05	0,055±0,02
3.	“Sochilmas”	0,672±0,02	0,868±0,03	1,043±0,02	0,310±0,02	0,109±0,01

Tadqiqotlarda soya o‘simligi (*Glycine Max* (L.) Merr.) navlari urug‘i tarkibida flavonoidolar konsentratsiyasi o‘rtacha 3,84±0,11 mg/100 g, fenol kislotalari 0,04±0,10 mg/100 g ga tengligi, shuningdek alkaloidlar (1,64 mg/100 g), taninlar (0,46 mg/100 g), saponinlar (0,17 mg/100 g) mavjudligi aniqlangan.

XULOSA. Shunday qilib, soya o‘simligi (*Glycine Max* (L.) Merr.) navlari – “Argentina”, “Oltintoj”, “Sochilmas” urug‘i tarkibida gall kislotasi mos ravishda – 0,429±0,02, 0,306±0,04, 0,672±0,02 mg/100 gr; rutin – 0,412±0,05, 0,682±0,02, 0,868±0,03 mg/100 gr; kversetin – 0,725±0,04, 0,576±0,01, 1,043±0,02 mg/100 gr; apigenin – 0,219±0,04, 0,124±0,05, 0,310±0,02; kempferol – 0,097±0,01, 0,055±0,02, 0,109±0,01 mg/100 gr ga tengligi aniqlandi. Olingan ma’lumotlar kelgusida mazkur navlar urug‘i ekstraktlarining farmakologik faolligini tahlil qilish jarayonida foydalanilishi mumkin.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI

1.O'zbekiston Respublikasi Prezidentining Farmoni “O'zbekiston Respublikasini yanada rivojlantirish bo'yicha Harakatlar strategiyasi to'g'risida” // [Elektron resurs]. Rejim dostupa: http://lex.uz/pages/getpage.aspx?lact_id=3107036 Data obrasheniya: 01.02.2024 g.

2.Alves R.M., Gomes-Junior F.G., Carmo-Filho A.D.S., Ribeiro G.D.F.R., Rego C.H.Q., Iost-Filho F.H., Yamamoto P.T. Evaluation of the effect of the vigor of soybean seeds treated with micronutrients Using X-ray fluorescence spectroscopy and hyperspectral imaging // Agronomy. – 2023. – V.13(1945). – P.1-13.

3.Bagale S. Nutrient management for soybean crops // International Journal of Agronomy. – 2021. – V.2021(3304634). – P.1-10.

4.Barbosa J.M., Rezende C.F.A., Leandro W.M., Ratke R.F., Flores R.A., Da Silva A.R. Effects of micronutrients application on soybean yield // AJCS. – 2016. – V.10(8). – P.1092-1097.

5.Biel W., Gaweda D., Jaroszewska A., Hury G. Content of minerals in soybean seeds as influenced by farming system, variety and row spacing // J. Elem. – 2018. – V.23(3). – P.863-873.

6.De Vargas R.L., Schuch L.O.B., Barros W.S., Rigo G.A., Szareski V.J., Carvalho I.R., Pimentel J.R., Troyjack C., Jaques L.B.A., De Souza V.Q., Da Rosa T.C., Aumonde T.Z., Pedo T. Macronutrients and micronutrients variability in soybean seeds // Journal of Agricultural Science. – 2018. – V.10(4). – P.209-222.

7.Лакин Г.Ф. Биометрия // Москва. – Изд-во “Высшая школа”, 1990. – С.284.

8.Петибская В.С. Достоинства и недостатки семян сои и их роль в формировании качества пищевых продуктов и лечебных препаратов // Масличные культуры. Научно-технический бюллетень Всероссийского научно-исследовательского института масличных культур. – 2006. – Вып. 2 (135). – С.122-128.

9.Разгонова М., Черевач Е., Зинченко З., Голохваст К. Исследование сортообразцов сои *Glycine max* (L) Merr. и идентификация метаболитов методом тандемной масс-спектрометрии // Известия ДВФУ. Экономика и управление. – 2022. – №4. – С.121-132.

PROBIOTIK QO‘SHIMCHALI RATSIONNING QUYONLAR QON ZARDOBIDAGI AST VA ALT FERMENTLARI DINAMIKASIGA TA’SIRI

Raxmatova Nigora Boturovna

Sharof Rashidov nomidagi Samarqand davlat universiteti, Samarqand, O‘zbekiston

E-mail: nigorarahmatova120@gmail.com

Annotatsiya. *Ushbu maqolada quyonlarning ratsioniga probiotik ozuqa qo’shimchasining turli dozalarini qo‘shishda qon zardobidagi AST va ALT fermentlari faolligiga ta’sirini o‘rganish bo‘yicha bajarilgan tadqiqot ishlarining natijalari keltirilgan. Tekshirishlar natijasida olingan ma’lumotlar tahlili shuni ko‘rsatadiki, barcha tajriba guruhlari quyonlarning qon zardobidagi AST va ALT fermentlari faolligi tajriba oxiriga qadar nazorat guruhiga nisbatan maqbul darajada o‘zgargan, bu “Olin” probiotik ozuqa qo'shimchasining jobiy fiziologik ta’siri bilan bog’liq.*

Kalit so’zlar: *Fermentlar, probiotik, konsentrasiya, qon, zardob.*

Abstract. *This article presents the results of a study investigating the effects of different doses of a probiotic feed supplement added to rabbits’ diets on the activities of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) in blood serum. Analysis of the data obtained during the study showed that, by the end of the experiment, AST and ALT activities in the blood serum of rabbits in all experimental groups had changed within an acceptable range*

compared with the control group. These changes are associated with the positive physiological effects of the "Olin" probiotic feed supplement.

Keywords: *Enzymes, probiotic, concentration, blood, serum.*

Kirish. Mamlakatimiz aholisini kimyoviy xavfsiz, ekologik sof, to‘la qiymatli va xolesterinsiz quyon go‘shti bilan ta'minlash maqsadida mamlakatimizning keskin ekstremal sharoitiga moslashgan hamda xorijdan keltirilgan mahsuldor go‘sht yo‘nalishidagi quyonlarni mahsuldorlik xususiyatlarini saqlab qolishga alohida e'tibor qaratilmoqda. O‘zbekiston Respublikasini yanada rivojlantirish bo‘yicha Harakatlar strategiyasida "...mamlakat oziq-ovqat xavfsizligini yanada mustahkamlash, ekologik toza mahsulotlar ishlab chiqarishni kengaytirish"[1] vazifalari belgilangan [1]. Ushbu vazifalardan kelib chiqqan holda, quyonchilikka ixtisoslashgan xo‘jaliklarda hayvonlarni muvozanatlashtirilgan ozuqalar asosida oziqlantirish, to‘yimli moddalarning hazmlanish darajalarini yaxshilash ko‘rsatkichlarini oshirish uchun tabiiy xavfsiz ozuqaviy qo‘shimchalar, ovqat hazm qilish jarayonida oziq-ovqat komponentlarini muvofiqlashtirishda bevosita ishtirok etadigan mikrofloradan foydalanishga e’tibor qaratilmoqda [2]. Xususan, "Olin" probiotigining amilaza, lipaza va proteinaza fermentlarini sintez qilish orqali almashinadigan aminokislotalar va yog’ kislotalarini almashinmaydiganlarga aylantirish, patogen mikrofloraga qarshi antagonistik ta'sir xususiyatlaridan foydalanish va immunitet darajasini oshirish bo'yicha tadqiqotlar olib borilmoqda[8]. Probiotiklardan foydalanish hayvonlar organizmidagi metabolik jarayonlarni optimallashtirishga yordam berishi, shuningdek, turli xil biologik faol qo'shimchalar va probiotiklardan foydalanish oqsil-aminokislotalar holatiga va biokimyoviy ko‘rsatkichlarga ta'sir qilishini ko'rsatadigan keng adabiyotlar mavjud. Shu munosabat bilan probiotik preparatlarning hayvon organizmining fiziologik holatiga ta'sirini o'rganish ham nazariy, ham amaliy ahamiyatga ega [4,5].

Tadqiqot obekti va qo’llanilgan metodlar. Tadqiqotning tajriba qismi Samarqand tumanida joylashgan chorvachilik va quyonchilikga ixtisoslashgan "Abdurauf Davronov" fermer xo‘jaligida 2021-2024-yillarda o‘tkazildi. Tajriba davomida 60 kunlik 40 bosh Shinshilla zotli quyonlari tanlab olinib, ulardan 10 tadan 4 ta guruh tashkil etildi. Tajriba davomida quyonlar quyidagicha guruhlarga bo'lindi: nazorat va uchta tajriba guruhi. Nazorat guruhi quyonlari an'anaviy ozuqa ratsioni bilan oziqlantirildi. Tajriba guruhlaridagi quyonlar har bir kg hayvon vazniga 0,01 g (1-guruh), 0,03 g (2-guruh) va 0,05 g (3-guruh) probiotik qo‘shib oziqlantirildi. Barcha tajriba guruhlardagi hayvonlarga cheklovsiz suv berildi. Oziq-ovqat iste'moli har kuni qayd etildi [3,6].

Qon parametrlarini baholash uchun quyonlardan qon namunalari olindi. Namunalar 60, 90, 120 va 150 kunlik yoshda olindi [7]. Tahlillar Sharof Rashidov nomidagi Samarqand davlat universiteti Biokimyo institutining “Vivariy (biofiziologik va biokimyoviy tadqiqotlar)” ilmiy laboratoriyasida Mindray BC-5000 gematologik analizatorida hamda avtomatik biokimyoviy analizatorida (Erba XL-200, Chexiya GOST-20790-93) aniqlandi. Olingan maəlumotlar shaxsiy kompyuterda «Statistica-6», Microsoft Excel va Office dasturlar paketidan foydalangan holda hamda IBM SPSS Statistics Version 23 dasturi yordamida statistik qayta ishlandi. Tadqiqot ishlarining raqamli natijalari Styudent va Fisherning ishonchlilik mezonidan foydalanilgan holda variasion statistika usuli bilan qayta ishlandi dispersion tahlil qilindi [9].

Olingan natijalar va ularning tahlili. “Olin” probiotigi bilan oziqlantirilgan quyonlar qonidagi qator biokimyoviy komponentlarga ta’sirini o‘rganish uchun olib borilgan tekshirishlar qatoriga qon zardobidagi AST va ALT fermentlarining faolligini o‘rganish ham kiritildi. Tajriba boshida va oxirida quyonlarning qon zardobidagi aminotransferazalarning miqdori jadvalda keltirilgan (1-jadvalga qarang). Tajribaning dastlabki bosqichida aspartataminotransferaza (AST) va alaninaminotransferaza (ALT) fermentlari faolligini tahlil qilish, hayvonlarning fermentativ statusi normativ chegaralar doirasida ekanligini ko‘rsatdi. Olingan natijalar tajriba obyekti sifatida tanlab olingan quyonlarning jigar funktsiyalari va umumiy metabolik holati fiziologik me’yor talablariga to‘liq javob berishini tasdiqladi.

Tajriba yakunida barcha eksperimental guruhlarda quyonlarning qon zardobida AST va ALT faolligining ortishi kuzatildi. Shunday qilib, nazorat guruhidagi quyonlarning qon zardobida AST kontsentratsiyasi 5,43 mmol/l, 1-tajriba guruhida 5,85 mmol/l, 2-tajriba guruhida 6,75 mmol/l va 3-tajriba guruhi 7,31 mmol/l ga P<0,01 ishonchli darajada oshdi.

1-jadval

Ratsioni tarkibiga “Olin” probiotigi qo‘shilgan quyonlarning qon zardobidagi AST va ALT fermentlarining faolligi (M±m, n=10)

Ko‘rsatkichlar	**Tajriba kunlari**	**Guruhlar**			
		nazorat	**1-tajriba**	**2-tajriba**	**3-tajriba**
AST, mmol/l	60	25,53±0,42	26,27±0,37	25,87±0,68	24,91±0,28
	150	30,96±0,65	32,12±0,63	32,62±0,62*	32,22±0,92
ALT, mmol/l	60	45,80±0,88	46,40±0,79	45,14±0,57	46,02±0,85
	150	49,08±1,05	49,74±0,63	51,2±1,13**	50,96±0,83*

Izoh: *nazorat guruhiga nisbatan *- P < 0,05; **- P < 0,01*

Xuddi shunday holat ALT faolligida ham kuzatildi. Shunday qilib, nazorat guruhidagi quyonlarning qon zardobida ALT darajasi 3,28 mmol/l (P<0,05) ga, 1-tajriba guruhida 3,33 mmol/l (P<0,05) ga, 2-tajriba guruhida 6,06 mmol/l (P<0,01) ga va 3-tajriba guruhida 4,94 mmol/l (P<0,01) ga oshdi. Quyonlarning qon zardobidagi AST va ALT faolligidagi guruhlararo farqlar ham aniqlangan. Shunday qilib, tajriba yakunida nazorat guruhi quyonlarida AST miqdori 1-tajriba guruhidagi quyonlarnikidan 1,16 mmol/l ga, 2-guruhnikidan 1,66 mmol/l ga va 3-guruhnikidan 1,26 mmol/l ga, ALT miqdori esa 0,66 mmol/l ga, 2,12 mmol/l ga va 1,88 mmol/l ga kam bo‘lgan.

Bu tahlillar hayvonlarning jigar va yurak funksiyalarining holatini baholashga imkon beradi. Natijada, barcha eksperimental guruhlarda tajriba boshida va oxirida AST va ALT fermentlarining faolligi normal chegaralarda ekanligi haqida ma’lumotga ega bo‘ldik.

Olingan ma’lumotlarni tahlil qilib, biz “Olin” probiotigining ratsionga kiritilishi qon zardobida AST va ALT faolligini biroz oshiradi, ammo bu fermentlar tarkibidagi fiziologik me’yorlardan oshmaydi degan xulosaga kelishimiz mumkin.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI

1.“O‘zbekiston Respublikasini yanada rivojlantirishning beshta ustuvor yo‘nalishi bo‘yicha Harakatlar strategiyasi to‘g‘risida” gi PF – 4947 son farmoni. 7 fevral 2017 yil.

2.Авдиенко В.В. Белковый состав крольчатины двух пород / В.В. Авдиенко, Н.Н. Забашта, Е.Н. Головко // Сборник научных трудов Северо-Кавказского научно-исследовательского института животноводства. 2017. Т. 3. - №. 6.

3.Александрова В.С. Нормы и рационы кормления кроликов и нутрий /В.С. Александрова // Сборник научных трудов РАСХН, ГНУ НИИ пушного звероводства кролиководства им. В.А. Афанасьева, Московская область. - 2001. -С. 4-29.

4.Грязнева Т.Н. Технология производства пробиотика Биод-5 и его лечебно-профилактическая эффективность для разных видов животных / Т.Н. Грязнева: Автореф. докт. биолог, наук. - Москва, 2005. - 43 с.

5.Долгов В.В. Биохимические неследования в клинико-диагностических лабораториях ЛПУ первичного звена здравоохранения / В.В. Долгов, А.В. Селиванова. СПб.: «Витал Диагностикс СПб». — 2006.-231 с.

6.Kalashnikov A.P, Fisinin V.I., Sheglov V.V., Kleymenov N.I. va boshqalar. Qishloq xo‘jalik mollari ratsionlari va me’yorlari. M., 2003.- 456 b.

7.Клемешева Л.С., Алматов К.Т., Матчанов А.Т. Қон айланиши физиологияси. Юрак физиологияси. – Ташкент.: ЎзМУ., 2006. – 147б.

8.Порваткин И.В. Влияние пробиотика олин на биологические особенности телят / И.В. Порваткин, Л.Ю. Топурия // Вестник мясного скотоводства. 2013. Т. 2.-№ 80.-С. 75-79.

9.Ruziyev Yu.S. Biometriya fanidan amaliy mashg’ulotlar/ Samarqand-2019, 11-39b.

TURLI OZUQA RATSIONLARINING QUYONLARDA OQSIL VA LIPID ALMASHINUVI KO‘RSATKICHLARIGA TA’SIRI

M.A.Ismayilova

Sharof Rashidov nomidagi Samarqand davlat universiteti

Biokimyo instituti “Odam va hayvonlar

fiziologiyasi va biokimyo’’ kafedrasi dotsenti

N.B.Dovronova

Sharof Rashidov nomidagi Samarqand davlat universiteti

Biokimyo instituti “Odam va hayvonlar

fiziologiyasi va biokimyo’’ kafedrasi "Biofizika va biokimyo" yònalishi magistranti

Annotatsiya. *Maqolada turli ozuqa ratsionlarining quyonlar organizmidagi oqsil va lipid almashinuviga ta’siri yoritilgan. Ozuqa tarkibidagi oqsil, yog‘ va boshqa oziq moddalarning quyonlarning o‘sishi, rivojlanishi hamda mahsuldorligidagi ahamiyati ilmiy adabiyotlar asosida tahlil qilingan.*

Abstract. *The analysis examines the effects of different dietary regimens on protein and lipid metabolism in rabbits. The roles of proteins, fats, and other nutrients in rabbit growth, development, and productivity are analyzed based on scientific literature.*

Kalit so‘zlar: *quyonlar, ozuqa ratsioni, oqsil almashinuvi, lipid almashinuvi, aminokislotalar, yog‘ kislotalari, energiya almashinuvi, mahsuldorlik.*

Kirish. Quyonchilik chorvachilikning muhim tarmoqlaridan biri bo‘lib, sifatli go‘sht mahsulotlari yetishtirishda katta ahamiyatga ega. Quyonlarning tez o‘sishi, rivojlanishi va mahsuldorligi ko‘p jihatdan ularning oziqlanish sharoitlariga bog‘liq. Shu sababli turli ozuqa ratsionlarining organizmdagi moddalar almashinuviga ta’sirini o‘rganish muhim ilmiy-amaliy ahamiyat kasb etadi. Oqsillar organizmning asosiy tarkibiy qismlaridan biri bo‘lib, hujayra va to‘qimalarning shakllanishi, fermentlar sintezi hamda biologik jarayonlarning boshqarilishida ishtirok etadi. Ozuqa tarkibidagi oqsillar hazm qilish jarayonida aminokislotalargacha parchalanadi va organizm tomonidan yangi oqsillarni sintez qilish uchun ishlatiladi. Shu sababli ratsionda oqsil miqdori va uning sifati yetarli bo‘lishi quyonlarning normal o‘sishi uchun muhimdir [1]. Lipidlar organizm uchun muhim energiya manbai hisoblanadi. Ular hujayra membranalari tarkibiga kiradi, energiya zaxirasini hosil qiladi va yog‘da eruvchi vitaminlarning o‘zlashtirilishiga yordam beradi. Ratsion tarkibidagi yog‘larning miqdori va turi quyonlarning energiya almashinuvi hamda tana to‘qimalarida lipidlarning to‘planishiga ta’sir ko‘rsatadi [2]. Quyonlarni oziqlantirishda faqat oqsil va yog‘ miqdorini emas, balki ratsiondagi tola, uglevodlar, vitaminlar va mineral moddalarning

nisbatini ham hisobga olish lozim. Oziq moddalarning o‘zaro muvozanati ovqat hazm qilish tizimining normal ishlashi va ozuqadan samarali foydalanishda muhim ahamiyatga ega [3].

O’rganilgan ma’lumot tahlillari. Quyonlar organizmida oqsil almashinuvi ozuqa tarkibidagi oqsil miqdori, aminokislotalar tarkibi va hazm bo‘lish darajasiga bog‘liq. Oqsillar ovqat hazm qilish tizimida fermentlar ta’sirida parchalanib, aminokislotalar shaklida so‘riladi. Ushbu aminokislotalar mushaklar, fermentlar va boshqa oqsil tabiatli birikmalarning hosil bo‘lishida ishlatiladi. C. de Blas va J. Wiseman tomonidan tahrirlangan Nutrition of the Rabbit asarida quyonlarning oqsil va aminokislotalarga bo‘lgan ehtiyoji, ozuqaning hazm bo‘lishi hamda energiya bilan ta’minlanishi masalalari yoritilgan [1]. Ratsionda oqsil yetishmasligi quyonlarning o‘sishini sekinlashtirishi, mushak to‘qimalarining rivojlanishini cheklashi mumkin. Ayniqsa, yosh quyonlarda sifatli oqsil va zarur aminokislotalarning yetarli bo‘lishi muhimdir. Shu bilan birga, oqsilning haddan tashqari ko‘p berilishi ham har doim mahsuldorlikni oshirmaydi. Oqsil miqdori hayvonning yoshi, fiziologik holati va ratsionning umumiy tarkibiga mos bo‘lishi kerak [1]. Lipid almashinuvi yog‘larning hazm bo‘lishi, so‘rilishi, to‘qimalarga tashilishi, parchalanishi va zaxira sifatida to‘planishini o‘z ichiga oladi. Yog‘lar organizmni energiya bilan ta’minlaydi va hujayra membranalarining shakllanishida ishtirok etadi.

L. Maertensning quyonlar oziqlanishida yog‘lardan foydalanishga bag‘ishlangan ilmiy sharhida ratsiondagi yog‘larning energetik qiymat va ozuqadan foydalanish samaradorligiga ta’siri tahlil qilingan [2]. Ratsionga me’yorida yog‘ qo‘shilishi ozuqaning energetik qiymatini oshirishi mumkin. Biroq yog‘larning ortiqcha miqdori ratsion muvozanatini buzishi va organizmda yog‘ to‘planishiga sabab bo‘lishi mumkin. Shuning uchun quyonlarni oziqlantirishda yog‘larning miqdori va manbasini hisobga olish zarur [2]. Oqsil va lipid almashinuvi organizmda o‘zaro bog‘liq holda kechadi. Oqsillar to‘qimalarning rivojlanishi va yangilanishida, lipidlar esa energiya bilan ta’minlashda muhim rol o‘ynaydi. Ratsionda energiya yetarli bo‘lmasa, organizm aminokislotalarning bir qismini energiya hosil qilish uchun ishlatishi mumkin. Shu sababli oqsil va energiyaning o‘zaro nisbati katta ahamiyatga ega [1]. F. Lebas va hammualliflarining The Rabbit: Husbandry, Health and Production asarida quyonlarning oziqlanish fiziologiyasi, ozuqaga bo‘lgan ehtiyoji va oziqlantirish sharoitlari yoritilgan [3]. Ushbu ma’lumotlar quyonlarning ratsionini tuzishda oqsil, yog‘ va tolali moddalarning muvozanatini hisobga olish zarurligini ko‘rsatadi.

Xulosa. Turli ozuqa ratsionlari quyonlar organizmidagi oqsil va lipid almashinuviga ta’sir ko‘rsatadi. Oqsilning yetarli miqdori to‘qimalarning rivojlanishi va o‘sish uchun, yog‘lar esa energiya bilan ta’minlash uchun zarurdir. Oqsil, yog‘, tola, vitamin va mineral moddalarning muvozanatli bo‘lishi quyonlarning normal rivojlanishi hamda mahsuldorligini oshirishga yordam

beradi. Ushbu ta’sirlarni aniq baholash uchun tajribalar o‘tkazish va tegishli biokimyoviy ko‘rsatkichlarni tekshirish lozim.

FOYDALANILGAN ADABIYOTLAR

1. De Blas C., Wiseman J. (eds.). Nutrition of the Rabbit. 2nd edition. CABI, 2010.
2. Maertens L. Fats in rabbit nutrition: a review. World Rabbit Science, 1998.

Lebas F., Coudert P., Rouvier R., de Rochambeau H. The Rabbit: Husbandry, Health and Production. FAO, 1986.

QANDLI DIABETDA LIPIDLARNING PEROKSID OKSIDLANISHI VA ANTIOKSIDANT HIMOYA KO‘RSATKICHLARIGA E VITAMINI TA’SIRINING BIOKIMYOVIY BAHOLANISHI

G.Sh Normurodova

Samarqand davlat pedagogika instituti assistenti

Annotatsiya. *Qandli diabetda surunkali giperglikemiya reaktiv kislorod shakllarining hosil bo‘lishini kuchaytirib, hujayra membranalari tarkibidagi lipidlarning oksidlanishiga va antioksidant himoya mexanizmlarining muvozanati buzilishiga olib kelishi mumkin. E vitamini yog‘da eruvchi antioksidant sifatida lipidlarning erkin radikallar ta’sirida oksidlanishini cheklashda muhim o‘rin tutadi. Ilmiy adabiyotlar tahlili malondialdegid (MDA), glutation (GSH), superoksiddismutaza (SOD), glutationperoksidaza (GPx) va umumiy antioksidant sig‘im kabi ko‘rsatkichlarni o‘rganishning ahamiyatini ko‘rsatadi. Shu bilan birga, E vitaminining samarasi bo‘yicha tadqiqotlar natijalari bir xil emasligi va uning qo‘llanilishi individual klinik holat hamda ilmiy dalillar asosida baholanishi lozimligi ta’kidlanadi.*

Abstract. *In diabetes mellitus, chronic hyperglycemia can increase the production of reactive oxygen species, leading to lipid peroxidation in cell membranes and an imbalance in antioxidant defense mechanisms. Vitamin E, as a fat-soluble antioxidant, plays an important role in limiting the free radical-induced oxidation of lipids. A review of the scientific literature highlights the importance of investigating such indicators as malondialdehyde (MDA), glutathione (GSH), superoxide dismutase (SOD), glutathione peroxidase (GPx), and total antioxidant capacity. However, the findings of studies on the efficacy of vitamin E are inconsistent, emphasizing that its use should be evaluated based on individual clinical circumstances and scientific evidence.*

Kalit so‘zlar: *qandli diabet, oksidlovchi stress, E vitamini, tokoferol, antioksidantlik, malondialdegid, glutation, superoksiddismutaza, glutationperoksidaza.*

Kirish. Qandli diabet uglevodlar almashinuvining buzilishi bilan tavsiflanadigan surunkali metabolik kasallik bo‘lib, organizmda lipidlar, oqsillar va boshqa biologik molekulalar almashinuviga ham ta’sir ko‘rsatadi. Kasallik davomida qonda glyukoza miqdorining uzoq vaqt yuqori bo‘lishi reaktiv kislorod shakllarining ortiqcha hosil bo‘lishiga, oksidlovchi stressning kuchayishiga va hujayralarning oksidlovchi shikastlanishiga sabab bo‘lishi mumkin [1, 2]. Lipidlarning peroksid oksidlanishi hujayra membranalaridagi ko‘p to‘yinmagan yog‘ kislotalarining erkin radikallar bilan reaksiyaga kirishishi natijasida yuzaga keladigan zanjirli jarayondir. Ushbu jarayonning kuchayishi membranalarning strukturaviy va funksional xususiyatlarini o‘zgartirishi, hujayra ichidagi signal uzatish mexanizmlariga ta’sir qilishi mumkin. Malondialdegid (MDA) va tiobarbitur kislotasi bilan reaksiyaga kirishuvchi moddalar (TBARS) lipidlar oksidlanishini baholashda keng qo‘llanadigan ko‘rsatkichlardandir [1, 3].

Ma’lumotlar tahlili. Qandli diabetda oksidlovchi stressning kuchayishi bir nechta o‘zaro bog‘liq mexanizmlar bilan izohlanadi. Giperglikemiya mitoxondriyalarda reaktiv kislorod shakllari hosil bo‘lishini kuchaytirishi, fermentativ oksidlanish jarayonlariga ta’sir qilishi va antioksidant himoya tizimiga qo‘shimcha yuklama tushirishi mumkin. Reaktiv kislorod shakllarining hosil bo‘lishi ularni zararsizlantirish imkoniyatidan oshib ketganda oksidlovchi stress yuzaga keladi [1, 2]. Lipidlarning peroksid oksidlanishi jarayonida erkin radikallar membrana tarkibidagi ko‘p to‘yinmagan yog‘ kislotalariga ta’sir qiladi. Natijada lipid radikallari va lipid gidroperoksidlari hosil bo‘lib, zanjirli oksidlanish reaksiyasi davom etadi. Ushbu jarayon mahsulotlari hujayra membranalarining o‘tkazuvchanligi va funksional faoliyatiga salbiy ta’sir ko‘rsatishi mumkin.

Organizmning antioksidant himoya tizimi erkin radikallarni zararsizlantirish va hujayralarning oksidlovchi shikastlanishini kamaytirishga xizmat qiladi. Qandli diabetda ushbu tizimning holatini baholash kasallik bilan bog‘liq metabolik o‘zgarishlarni chuqurroq tushunishga yordam beradi.

Antioksidant himoya tizimining biokimyoviy asosiy ko‘rsatkichlar quyidagilardan iborat:

- Malondialdegid (MDA): lipidlarning peroksid oksidlanishi natijasida hosil bo‘ladigan mahsulotlardan biri. Uning miqdori oksidlovchi shikastlanishni baholashda qo‘llanadi.
- Glutation (GSH): hujayraning muhim nofermentativ antioksidanti bo‘lib, oksidlanish-qaytarilish muvozanatini saqlashda qatnashadi.
- Superoksiddismutaza (SOD): superoksid radikalini vodorod peroksidga aylantiruvchi ferment.
- Glutationperoksidaza (GPx): vodorod peroksid va ayrim lipid gidroperoksidlarini zararsizlantirishda ishtirok etadi.

- Umumiy antioksidant sig‘im (TAC): biologik namunaning umumiy antioksidant imkoniyatini tavsiflovchi ko‘rsatkich.
- E vitamini miqdori: yog‘da eruvchi antioksidantning organizmdagi holatini baholashga yordam beradi.

García-Medina va hammualliflar tomonidan o‘tkazilgan meta-tahlilda 2-tur qandli diabetda vitaminlar, jumladan, E vitaminining antioksidant ko‘rsatkichlarga ta’siri o‘rganilgan. Tahlilga kiritilgan ayrim tadqiqotlarda C va E vitaminlari MDA hamda TBARS ko‘rsatkichlarining pasayishi, GPx, SOD va TAC ko‘rsatkichlarining oshishi bilan bog‘langan. Biroq tadqiqotlar natijalari va o‘lchash usullari o‘rtasidagi farqlar yakuniy xulosalarni cheklashi qayd etilgan [2]. E vitamini guruhiga kiruvchi tokoferollar hujayra membranalarining lipid qatlamida joylashadi. Alfa-tokoferol lipid radikallari bilan reaksiyaga kirishib, lipidlarning zanjirli peroksidlanish reaksiyasini cheklashga yordam beradi. Shu xususiyati tufayli E vitamini membrana lipidlarini oksidlovchi shikastlanishdan himoya qiluvchi muhim antioksidantlardan biri hisoblanadi [3]. Qandli diabet bilan og‘rigan bemorlarda E vitaminining ta’sirini o‘rgangan ayrim klinik tadqiqotlar ijobiy natijalarni ko‘rsatgan. Jain va hammualliflar nazoratsiz diabetda MDA miqdori oshishi, qaytarilgan glutation va E vitamini miqdori esa pasayishini aniqlagan. Glikemik nazorat yaxshilangandan so‘ng oksidlovchi stress ko‘rsatkichlari yaxshilangan, E vitamini qo‘shimchasi berilgandan keyin esa MDA miqdorining yana pasayishi va glutation miqdorining ortishi kuzatilgan. Shunga qaramay, ko‘rsatkichlar to‘liq me’yorlashmagan [4].

Xulosa qilib aytganda, qandli diabetda surunkali giperglikemiya va metabolik buzilishlar oksidlovchi stressning kuchayishiga, lipidlarning peroksid oksidlanishiga hamda antioksidant himoya tizimi faoliyatining o‘zgarishiga olib kelishi mumkin. MDA va TBARS lipid oksidlanishini, GSH, SOD, GPx va TAC esa organizmning antioksidant himoya holatini baholashda muhim biokimyoviy ko‘rsatkichlar hisoblanadi.

Foydalanilgan adabiyotlar

1.Maritim A. C., Sanders R. A., Watkins J. B. 3rd. Diabetes, oxidative stress, and antioxidants: A review. Journal of Biochemical and Molecular Toxicology. 2003;
2.García-Medina A., et al. Antioxidant effects of vitamins in type 2 diabetes: a meta-analysis of randomized controlled trials. Diabetology & Metabolic Syndrome. 2018;
3.Traber M. G., Atkinson J. Vitamin E, antioxidant and nothing more. Free Radical Biology and Medicine. 2007
4.Jain S. K., McVie R., Jaramillo J. J., Palmer M., Smith T. An evaluation of oxidative stress in diabetes mellitus during uncontrolled and controlled state and after vitamin E supplementation. Free Radical Biology and Medicine. 1996

QANDLI DIABETDA E VITAMININING LIPIDLAR PEROKSID OKSIDLANISHI VA ANTIOKSIDANT HIMOYA KO‘RSATKICHLARIGA TA’SIRI

G.Sh.Normurodova

Samarqand davlat pedagogika instituti assistenti

Annotatsiya. *E vitaminining qandli diabet sharoitida lipidlarning peroksid oksidlanishi va antioksidant himoya tizimiga ta’siri ilmiy adabiyotlar asosida tahlil qilinadi. E vitaminining biologik membranalarni oksidlovchi zararlanishdan himoya qilishdagi ahamiyati hamda MDA, GSH, SOD va GPx ko‘rsatkichlari bilan bog‘liqligi yoritiladi.*

Abstract. *The effects of vitamin E on lipid peroxidation and the antioxidant defense system under diabetic conditions are analyzed based on scientific literature. The importance of vitamin E in protecting biological membranes against oxidative damage and its relationship with the levels of MDA, GSH, SOD, and GPx are highlighted.*

Kalit so‘zlar: *Qandli diabet, E vitamini, tokoferol, MDA, GSH, lipidlarning peroksid oksidlanishi, antioksidant himoya.*

Kirish. Qandli diabet zamonaviy tibbiyot va biologiya fanining muhim muammolaridan biri bo‘lib, uning rivojlanishida uglevod, lipid va oqsil almashinuvidagi chuqur biokimyoviy o‘zgarishlar muhim ahamiyatga ega. Xalqaro Diabet Federatsiyasining 2025-yilgi ma’lumotlariga ko‘ra, 2024-yilda dunyoda 20–79 yoshdagi taxminan 589 million kattalarda qandli diabet mavjud bo‘lgan bo‘lib, 2050-yilga kelib bu ko‘rsatkich 852,5 milliongacha yetishi prognoz qilinmoqda. Qandli diabetda giperglikemiya va erkin radikallar hosil bo‘lishining kuchayishi hujayra membranalaridagi lipidlarning oksidlanishiga olib kelishi mumkin. E vitamini, ayniqsa α-tokoferol, yog‘da eruvchi antioksidant bo‘lib, lipidlarning peroksid oksidlanish zanjirli reaksiyalarini cheklashda ishtirok etadi. Shu sababli uning diabetdagi oksidlovchi stress ko‘rsatkichlariga ta’sirini o‘rganish muhim ahamiyatga ega [1, 2]. Qandli diabetda MDA/TBARS, GSH, SOD, GPx, katalaza va E vitamini ko‘rsatkichlarini kompleks ravishda aniqlash va ularning o‘zaro bog‘liqligini baholash dolzarb ilmiy yo‘nalish hisoblanadi.

Ma’lumotlar tahlili. Amerikalik olimlar tomonidan o‘tkazilgan tadqiqotda E vitaminining qandli diabet bilan og‘rigan bemorlarda past zichlikdagi lipoproteinlar (LDL) oksidlanishiga va oqsillar glikatsiyasiga ta’siri o‘rganilgan [1]. Ushbu tadqiqot E vitaminining antioksidant xususiyatlarini baholashda lipidlarning oksidlanishga sezgirligini o‘rganish muhimligini ko‘rsatadi.

Olimlar tomonidan olib borilgan tadqiqotda E vitamini qo‘llanilishi qandli diabet bilan kasallangan bemorlarda LDL zarrachalarining oksidlanishga moyilligini kamaytirishi aniqlangan.

Hindistonlik olimlarning 1-tur qandli diabetga chalingan bemorlarda olib borgan tadqiqotida E vitamini qo‘llanilgandan keyin malondialdegid (MDA) miqdorining kamayishi hamda glutation (GSH) miqdorining ortishi qayd etilgan [2]. Bu natijalar E vitaminining oksidlovchi stressni kamaytirishdagi ehtimoliy ahamiyatini ko‘rsatadi.

Braziliya va Portugaliya olimlarining 2018-yildagi tadqiqotlarida meta-tahlilida antioksidant vitaminlarning 2-tur qandli diabetdagi ta’siri baholangan. Tadqiqotda E va C vitaminlari kabi antioksidantlarning lipid peroksidlanishi hamda ayrim antioksidant ko‘rsatkichlarga ta’siri o‘rganilgan. E vitaminining ta’sirini faqat bitta biomarker orqali emas, balki MDA yoki TBARS, GSH, superoksid dismutaza (SOD), glutation peroksidaza (GPx) va zarur lipid almashinuvi ko‘rsatkichlarini birgalikda baholash orqali o‘rganish maqsadga muvofiq. Bunda E vitaminini qo‘llashning klinik samaradorligi oldindan kafolatlangan deb qaralmasligi lozim.

Xulosa. E vitamini lipidlarning peroksid oksidlanishini cheklash va antioksidant himoya tizimini qo‘llab-quvvatlash imkoniyatiga ega. Ilmiy adabiyotlarda MDA kamayishi va GSH kabi ayrim ko‘rsatkichlarning yaxshilanishi qayd etilgan. Shunga qaramay, uning qandli diabetdagi ta’sirini to‘liq baholash uchun MDA, GSH, SOD, GPx va lipid almashinuvi ko‘rsatkichlarini kompleks o‘rganish zarurdir. Ushbu yondashuv qandli diabetda oksidlovchi stressning biokimyoviy mexanizmlarini chuqurroq tushunishga yordam beradi.

FOYDALANILGAN ADABIYOTLAR

1. Reaven P.D., Herold D.A., Barnett J., Edelman S. Effects of Vitamin E on Susceptibility of Low-Density Lipoprotein and Low-Density Lipoprotein Subfractions to Oxidation and on Protein Glycation in NIDDM. Diabetes Care. 1995;18(6):807–816. DOI: https://doi.org/10.2337/diacare.18.6.807

2. Gupta S., Sharma T.K., Kaushik G.G., Shekhawat V.P.S. Vitamin E Supplementation May Ameliorate Oxidative Stress in Type 1 Diabetes Mellitus Patients. Clinical Laboratory. 2011;57(5–6):379–386.

3. Balbi M.E., Tonin F.S., Mendes A.M. va boshqalar. Antioxidant Effects of Vitamins in Type 2 Diabetes: A Meta-analysis of Randomized Controlled Trials. Diabetology & Metabolic Syndrome. 2018;10:18. DOI: https://doi.org/10.1186/s13098-018-0318-5

PARRANDALAR OZIQLANISHINI TAKOMILLASHTIRISHDA SUT ZARDOBINING AHAMIYATI

M.M. Sa'dullayeva[1], M.S. Kuziyev[1], D.U. Ergashev[1], Huang[2].

[1]Sharof Rashidov nomidagi Samarqand Davlat universiteti. Biokimyo instituti.

[2]Weijian Taizhou Fan Texnologiya Kasb-hunar kolleji

E-mail: d4090393@gmail.com.

Annotatsiya: *Ushbu maqolada sutni qayta ishlash jarayonida hosil bo'ladigan sut zardobidan parrandalar oziqlanishida ikkilamchi ozuqa xomashyosi sifatida foydalanish imkoniyatlari ilmiy adabiyotlar asosida tahlil qilindi. Sut zardobining oziqaviy tarkibi, undagi oqsil, laktoza va mineral moddalar, shuningdek, zardobni turli shakllarda qo'llashning parrandalar o'sishi, ozuqadan foydalanish samaradorligi va mahsuldorligiga ta'siri ko'rib chiqildi. Tahlil qilingan tadqiqotlar sut zardobidan foydalanish samarasi uning shakli, miqdori, ratsionning umumiy sifati va berish usuliga bog'liqligini ko'rsatdi. Shu sababli sut zardobini parrandalar ratsionida qo'llashda uning miqdori va ratsionning oziqaviy muvozanatini hisobga olish muhimligi asoslandi.*

Kalit so'zlar: *sut zardobi, parrandalar, broyler tovuqlar, bedanalar, ozuqa, laktoza, mahsuldorlik.*

Abstract*: This article analyzes the potential for using whey—a byproduct of milk processing—as a secondary feed ingredient in poultry nutrition, based on a review of scientific literature. The nutritional composition of whey (including protein, lactose, and minerals) and the effects of using whey in various forms on poultry growth, feed efficiency, and productivity were examined. The analyzed studies demonstrated that the effectiveness of whey utilization depends on its form, dosage, the overall quality of the diet, and the method of administration. Consequently, the importance of considering both the dosage and the nutritional balance of the diet when incorporating whey into poultry rations is highlighted.*

Keywords: *whey, poultry, broiler chickens, quail, feed, lactose, productivity.*

KIRISH: So'nggi yillarda aholi sonining ortib borishi va oziq-ovqat xavfsizligiga bo'lgan talabning kuchayishi natijasida parrandachilik qishloq xo'jaligining jadal rivojlanayotgan tarmoqlaridan biriga aylandi. Parranda go'shti va tuxumi arzon, to'yimli hamda oson hazm bo'ladigan oqsil manbai sifatida aholi ratsionida muhim o'rin tutadi. Biroq parrandachilik mahsulotlari tannarxining katta qismini ozuqa xarajatlari tashkil etadi. Shu sababli to'laqonli, iqtisodiy jihatdan maqbul va xavfsiz ozuqa manbalarini izlash hamda ulardan samarali foydalanish dolzarb ilmiy-amaliy vazifa hisoblanadi [1]. Bu borada sut sanoatining ikkilamchi mahsuloti bo'lgan sut zardobi alohida e'tiborga loyiq. Pishloq, tvorog va boshqa sut mahsulotlarini ishlab

chiqarish jarayonida hosil bo‘ladigan zardob tarkibida laktoza, eruvchan oqsillar, mineral moddalar va suvda eruvchan vitaminlar saqlanib qoladi. Schingoethe ma’lumotlariga ko‘ra, zardob oqsili yuqori biologik qiymatga ega bo‘lib, zardobning oziqaviy qiymati asosan oqsil va laktoza bilan belgilanadi; shuningdek, unda kalsiy, fosfor va suvda eruvchan vitaminlar mavjud [1,2]. Sut zardobidan foydalanish nafaqat ozuqa resurslarini kengaytirish, balki sutni qayta ishlash jarayonida hosil bo‘ladigan ikkilamchi xomashyodan samarali foydalanish imkonini ham beradi. Zardob suyuq, quyultirilgan, quritilgan va qisman delaktozalangan shakllarda qo‘llanishi mumkin. Qisman delaktozalangan mahsulotlarda laktoza kamayishi hisobiga oqsil va mineral moddalar ulushi nisbatan ortadi [1,5]. Parrandalarda zardobdan foydalanish masalasi ayniqsa qiziq, chunki uning tarkibidagi laktozaning hazm bo‘lishi cheklangan. Majewska va hammualliflari qushlarda laktozani parchalaydigan laktaza faolligi cheklanganligi va zardob qo‘shimchasining miqdori hamda shakli broylerlarning mahsuldorlik ko‘rsatkichlariga ta’sir qilishi mumkinligini ko‘rsatgan [4,6]. Shuning uchun zardobni qo‘llashda uning miqdori, berish shakli va asosiy ratsion sifati muhim omillar sifatida qaralishi kerak.

Tadqiqotning maqsadi — sut zardobining ozuqaviy xususiyatlarini hamda undan parrandalar, avvalo broyler tovuqlar oziqlanishida ikkilamchi ozuqa xomashyosi sifatida foydalanish imkoniyatlarini ilmiy adabiyotlar asosida tahlil qilishdan iborat.

Tadqiqotning vazifasi. Tadqiqot vazifasi sut zardobining tarkibi va ozuqaviy qiymatini umumlashtirish, uning parrandalar o‘sishi, ozuqa iste’moli, ozuqaning konversiyasi va iqtisodiy samaradorligiga ta’sirini turli tadqiqotlar misolida qiyoslash hamda samarali qo‘llash shartlarini aniqlashdan iborat.

Tadqiqotning metodikasi: Maqola tahliliy xarakterga ega bo‘lib, unda yangi eksperimental tajriba o‘tkazilmagan. Tahlil uchun taqdim etilgan ilmiy maqolalar, adabiyot materiallari va dissertatsiya manbalaridan foydalanildi. Manbalarda keltirilgan sut zardobining tarkibi, qo‘llash shakli va miqdori, parrandalarning o‘sish ko‘rsatkichlari, ozuqa iste’moli, ozuqa konversiyasi, yashovchanligi va iqtisodiy natijalari qiyosiy usulda umumlashtirildi. Turli tadqiqotlarda natijalarning farq qilishi zardob turi, ratsion sifati, berish usuli va qo‘llash miqdori bilan bog‘liq holda tahlil qilindi.

Natijalar va ularning tahlili: Sut zardobining ozuqaviy xususiyatlari. Adabiyotlar tahlili sut zardobining parrandalar uchun qo‘shimcha ozuqa manbai sifatidagi asosiy afzalligi uning tarkibidagi eruvchan oqsillar, laktoza va mineral moddalarning mavjudligi bilan bog‘liqligini ko‘rsatdi. Schingoethe ma’lumotlarida quritilgan zardob oqsilining biologik qiymati yuqori ekani, zardob energiyasining muhim qismi laktoza hisobiga ta’minlanishi, shuningdek, kalsiy va fosfor manbai bo‘lishi qayd etilgan [1,3]. Zardobning ozuqaviy qiymati uning qayta ishlanish shakliga

qarab o‘zgaradi. Qisman delaktozalangan yoki quritilgan mahsulotlarda laktoza miqdori kamayib, oqsil va mineral moddalar nisbati oshishi mumkin [2,4]. Malik va hammualliflarining tadqiqotida 160 ta bir kunlik broyler jo‘jalariga 0, 2, 4 va 6% zardob oqsili qo‘shilgan ratsionlar berilgan. Tadqiqot natijalarida umumiy ozuqa iste’moli, umumiy vazn ortishi va ozuqa konversiyasida guruhlar o‘rtasida sezilarli farq aniqlanmagan bo‘lsa-da, 6% zardob oqsili qo‘shilgan ratsionda vazn ortishi va ozuqa konversiyasi bo‘yicha eng yaxshi natijalar kuzatilgan. Mualliflar zardob oqsilini 6% gacha bo‘lgan miqdorda broylerlar ratsionida qo‘llash mumkinligini ta’kidlagan [2,6]. Kumar, Sahu va Kumari tomonidan 2022-yilda olib borilgan tadqiqotda suyuq zardobning broylerlar ichimlik suvidagi 5, 10 va 15% darajalari o‘rganilgan. Mualliflar 10% suyuq zardob qo‘llangan guruhda broylerlarning umumiy natijalari va iqtisodiy samaradorligi eng yuqori bo‘lganini qayd etgan [3,5]. Majewska va hammualliflarining broyler tovuqlardagi tadqiqotlari zardob ta’sirining ratsion sifatiga bog‘liqligini ko‘rsatadi. Sifati yetarli bo‘lmagan ozuqa bilan oziqlantirilgan broylerlarda yangi kislotali zardob berilishi ishlab chiqarish natijalarining pasayishini cheklagan va yashovchanlikka ijobiy ta’sir ko‘rsatgan. [4]. Mazkur manbada zardob qo‘shilgan guruhdagi ayrim broylerlarda yakuniy tana vazni va yem konversiyasi nazoratga nisbatan yaxshiroq bo‘lgani, boshqa tajriba sharoitlarida esa natijalar pasaygani qayd etilgan. Mualliflar samaradorlik zardobning o‘zidan tashqari, yem sifati va oziqlantirish sharoitlariga ham bog‘liq ekanini ko‘rsatgan [4,5]. Taqdim etilgan manbalarda fermentlangan zardobli pishloqning tuxum yo’nalishidagi tovuqlarning ichimlik suviga qo‘shilishi o‘rganilgan. Tadqiqotda 17 haftalik 120 ta tuxumchi tovuq ikki guruhga ajratilgan va ozuqa iste’moli, suv iste’moli, tuxum ishlab chiqarish hamda yemdan foydalanish ko‘rsatkichlari kuzatilgan [5,6]. Adabiyotlar tahlili zardobdan foydalanishda ehtiyotkorlikni talab qiluvchi asosiy omillardan biri laktoza ekanini ko‘rsatdi. Qushlarda laktozani parchalash imkoniyati sutemizuvchilarnikiga nisbatan cheklangan. Majewska va hammualliflar zardob tarkibidagi laktozaning ortiqcha miqdori hazm tizimiga salbiy ta’sir ko‘rsatishi mumkinligini, shu sababli zardob miqdori va shaklini hisobga olish zarurligini ta’kidlagan [1,4]. Bundan tashqari, suyuq zardobning namligi yuqori bo‘lgani sababli uni saqlash va tashish quritilgan zardobga nisbatan murakkabroq bo‘lishi mumkin. Schingoethe suyuq zardobdan foydalanishda transport va saqlash bilan bog‘liq amaliy cheklovlarni qayd etgan [1,3]. Shu bois zardobni yaqin joylashgan xo‘jaliklarda suyuq shaklda ishlatish yoki uzoq muddat saqlash zarur bo‘lgan hollarda quritilgan shakllardan foydalanish maqsadga muvofiq bo‘lishi mumkin. Tahlil qilingan tadqiqotlar natijalari sut zardobining parrandalar oziqlanishidagi samarasi bir xil emasligini ko‘rsatadi. Ayrim tadqiqotlarda 6% gacha zardob oqsili yoki 10% suyuq zardob qo‘llanganda ijobiy natijalar qayd etilgan bo‘lsa, boshqa tajribalarda sezilarli farqlar kuzatilmagan [2, 3]. Bu farqlarni zardobning kimyoviy tarkibi, qo‘llash shakli, ratsion sifati va berish usuli bilan bog‘lash mumkin. Zardobning

foydali ta’siri uning tarkibidagi oqsil va mineral moddalardan foydalanish imkoniyati bilan bir qatorda, ratsionning umumiy muvozanatiga ham bog‘liq. Agar asosiy yem to‘liq qiymatli bo‘lsa, qo‘shimcha zardobning ta’siri kichik bo‘lishi mumkin; ozuqa sifati pastroq bo‘lgan sharoitlarda esa qo‘shimcha komponentning nisbiy samarasi kuchliroq namoyon bo‘lishi ehtimoli mavjud. Majewska va hammualliflarining natijalari ham shu holatni ko‘rsatadi [4,5].

Shu nuqtayi nazardan, sut zardobini parrandalar ratsioniga kiritishda uni asosiy ozuqaning to‘liq o‘rnini bosuvchi mahsulot sifatida emas, balki mavjud ozuqa resurslarini boyituvchi va ikkilamchi xomashyodan samarali foydalanishga imkon beruvchi qo‘shimcha komponent sifatida foydalanish maqsadga muvofiq.

Xulosa: Ilmiy adabiyotlar tahlili sut zardobi parrandalar oziqlanishida foydalanish mumkin bo‘lgan istiqbolli ikkilamchi ozuqa xomashyosi ekanligini ko‘rsatdi. Uning tarkibidagi eruvchan oqsillar, laktoza va mineral moddalar zardobning ozuqaviy qiymatini belgilaydi. Broyler tovuqlarda zardob oqsili va suyuq zardobdan foydalanish bo‘yicha tadqiqotlarda ayrim ijobiy natijalar, jumladan, vazn ortishi, ozuqa konversiyasi va iqtisodiy samaradorlikning yaxshilanishi qayd etilgan.

Tahlil natijalariga ko‘ra, sut zardobidan foydalanish samaradorligi uning shakli, miqdori, ratsion sifati va parrandalarning fiziologik holatiga bog‘liq. Shu sababli zardobni parrandalar oziqlanishida qo‘llashda xo‘jalik sharoitlari va ratsionning umumiy oziqaviy muvozanatini hisobga olish zarur. Sut zardobidan oqilona foydalanish ozuqa resurslarini kengaytirish, ikkilamchi xomashyodan samarali foydalanish va parrandachilik ishlab chiqarishining iqtisodiy samaradorligini oshirish imkoniyatlarini yaratadi.

FOYDALANILGAN ADABIYOTLAR

1. Schingoethe D.J. Whey Utilization in Animal Feeding: A Summary and Evaluation. Journal of Dairy Science. 1976;59(3):556–570.
2. Malik H.E.E., Elamin K.M., Abdalla S.A., Dousa B.M. Effect of Added Whey on Growth Performance and Percentages of Internal Organs of Broiler Chickens. Online Journal of Animal and Feed Research. 2015;5(3):68–73.
3. Kumar S., Sahu S.P., Kumari S. Effect of Different Levels of Whey Supplementation on Economics of Broiler Production. The Pharma Innovation Journal. 2022;SP-11(11):211–213.
4. Majewska T., Pudyszak K., Kozłowski K., Bohdziewicz K., Matusevičius P. Whey and Lactic Acid in Broiler Chickens Nutrition. Veterinarija ir Zootechnika. 2009;47(69).
5. Hilmi M., Prastujati A.U., Khusna A., Xirzin M.H., Yannuarista D. Effect of Fermented Whey Cheese Supplementation in Drinking Water of Laying Hens. Journal of World’s Poultry Research. 2020;10(1):81–86. DOI: 10.36380/jwpr.2020.11.
6. Dzuceva E.S. Effectiveness of Using Rations Enriched with Lactic Acid Whey in Feeding Broilers and Laying Hens. Dissertation. Vladikavkaz; 2000.

EKSPERIMENTAL DIABETDA GEPATOSITAR OKSIDATIV STRESSINING QONNING AYRIM BIOKIMYOVIY KO‘RSATKICHLARIGA TA’SIRI

[1]Asqarova V.A.,[2] Hayitov D.G‘., [3]Zhumaboeva T.T.

[1,2]Sharof Rashidov nomidagi Samarqand davlat universiteti

[3]Osh state university

Tel: +998 93 135 35 49 email: davronhayitov80@gmail.com

Annotatsiya: *Ushbu maqolada eksperimental qandli diabet sharoitida jigar hujayralarida yuzaga keladigan oksidativ stress va metabolik jarayonlarning o‘zgarishlari tahlil qilingan. Diabet sharoitida surunkali giperglikemiya lipidlar peroksidlanishini faollashtirib, malon dialdegidi (MDA) miqdorini keskin oshirishi va antioksidant himoya ko‘rsatkichlari - superoksiddismutaza (SOD) hamda qaytarilgan glutation (GSH) zaxirasini pasaytirishi aniqlandi. Antioksidant tizim yetishmovchiligi gepatotsitlar membranalari strukturasining buzilishi va qonda ALT, AST hamda LDH fermentlari faolligining oshishi bilan kechuvchi sitolizga olib keladi. Natijalar diabetik gepatopatiyalarda antioksidant korreksiya zarurligini ko‘rsatadi.*

Kalit so‘zlar: *eksperimen,l diabet, gepatotsitlar, oksidativ stress, malon dialdegidi, superoksiddismutaza, qaytarilgan glutation, laktatdegidrogenaza, aminotransferazalar.*

Abstract: *This article analyzes the oxidative stress and alterations in metabolic processes occurring in liver cells under conditions of experimental diabetes. It was determined that chronic hyperglycemia associated with diabetes activates lipid peroxidation, leading to a sharp increase in malondialdehyde (MDA) levels and a depletion of antioxidant defense markers—specifically superoxide dismutase (SOD) and reduced glutathione (GSH) reserves. A deficiency in the antioxidant system results in the disruption of hepatocyte membrane structures and leads to cytolysis, characterized by elevated activities of ALT, AST, and LDH enzymes in the blood. The results demonstrate the necessity of antioxidant correction in cases of diabetic hepatopathy.*

Key words: *experimental diabetes, hepatocytes, oxidative stress, malondialdehyde, superoxide dismutase, reduced glutathione, lactate dehydrogenase, aminotransferases.*

Qandli diabet zamonaviy tibbiyot va biologiya fanining eng jiddiy va keng tarqalgan global muammolaridan biridir. Jahon Sog‘liqni Saqlash Tashkiloti va Xalqaro Diabet Federatsiyasi ma’lumotlariga ko‘ra, ushbu metabolik kasallik bilan og‘rigan bemorlar soni yildan-yilga ortib bormoqda va bu holat a’zolar va to‘qimalarning ikkilamchi strukturaviy hamda funksional asoratlari bilan kechadi [6, 12-b.]. Qandli diabet patogenezida va uning surunkali asoratlari rivojlanishida organizmda gomeostazning buzilishi, xususan, prooksidant va antioksidant tizimlar o‘rtasidagi

muvozanatning izdan chiqishi natijasida kelib chiquvchi oksidativ stress hal qiluvchi rol o‘ynaydi [5, 45-b.].

Jigar organizmdagi asosiy metabolik laboratoriya hisoblanib, u uglevod, oqsil, lipid va energiyalar almashinuvida asosiy o‘rinni egallaydi. Giperglikemiya sharoitida gepatotsitlar ichida glyukoza metabolizmining muqobil yo‘llari - poliol yo‘li, geksosamin yo‘li va proteinkinaza C aktivatsiyasi faollashadi [2, 102-b.]. Bu jarayonlar mitoxondriyalarda elektron transport zanjirining zo‘riqishiga va reaktiv kislorod shakllari (ROS) hamda erkin radikallarning haddan tashqari ko‘p hosil bo‘lishiga olib keladi [7, 78-b.]. Reaktiv kislorod turlari hujayra membranasi lipidlari, nuklein kislotalar va fermentativ oqsillarni hujayraviy darajada shikastlaydi [3, 215-b.]. Gepatotsitlar zanjirli lipidlar peroksidlanishi jarayonlariga juda ta’sirchan bo‘lib, uning jadallashishi biomembranalarning o‘tkazuvchanligi va strukturaviy butunligini buzadi [4, 310-b.]. Bu esa o‘z navbatida sitoplazmatik fermentlarning (ALT, AST, LDH) qon zardobiga chiqib ketishiga (sitoliz sindromi) hamda jigar funksiyasining susayishiga sabab bo‘ladi [1, 88-b.]. Ushbu ma’lumotlarni e’tiborga olgan holda, eksperimental diabet sharoitida jigar to‘qimasining prooksidant hamda antioksidant ko‘rsatkichlarini chuqur biokimyoviy tahlil qilish, asoratlar patogenezini tushunish va biologik faol moddalar yordamida korreksiya usullarini ishlab chiqish uchun g‘oyatda muhim hisoblanadi.

Tadqiqot material va usullar. Tadqiqotlar Sharof Rashidov nomidagi Samarqand davlat universiteti Vivariy (Biofiziologik va biokimyoviy tadqiqotlar) ilmiy laboratoriyasida tajriba hayvonlarida Bioetika komissiyasining xalqaro standartlari va qoidalariga (NIH Guide for the Care and Use of Laboratory Animals) to‘liq amal qilingan holda o‘tkazildi. Tajriba laboratoriya kalamushlarida olib borildi. Barcha hayvonlar bir xil standart vivariy sharoitida, harorat 24ºC, nisbiy namlik 55–60% va 12 soatlik yorug‘lik/qorong‘ilik siklida saqlandi. Hayvonlar asosiy ikkita guruhga ajratildi n = 6 har bir guruhda. birinchi nazorat guruhi: (standart ratsionda saqlangan va hech qanday patologik ta’sir ko‘rsatilmagan sog‘lom hayvonlar). Ikkinchi guruh diabet bilan kasallantirilgan guruh (eksperimental diabet modeli shakllantirilgan va hech qanday terapevtik korreksiya berilmagan hayvonlar). Eksperimental diabet modeli alloksan moddasini bir marotaba qorin bo‘shlig‘iga yuborish orqali chaqirildi. Diabet holati qon zardobidagi glyukoza miqdori 11,1 mM/l dan yuqori bo‘lishi bilan tasdiqlandi. Qondagi glyukoza (Trinder usulida) Aspartataminotransferaza (AST), Alaninaminotransferaza (ALT) (piridoksal-5- fosfatsiz Xalqaro Klinik Kimyo Federatsiyasi tavsiyalariga (IFCC) muvofiq) avtomatik biokimyoviy analizatorida (Erba XL-200, Chexiya GOST-20790-93) aniqlandi. Lipidlar peroksidlanishi (LPO) jigar gomogenatida malon dialdegidi (MDA) miqdori tiobarbitur kislotasi (TBK) bilan rangli kompleks hosil qilish reaksiyasi asosida spektrofotometrik usulda aniqlandi. Antioksidant enzimlar va

birikmalar: superoksiddismutaza (SOD) faolligi nitroko‘k tetrazoliy qaytarilishi reaksiyasini tormozlash darajasiga ko‘ra aniqlandi (birlik/mg oqsil). Qaytarilgan glutation (GSH) miqdori Ellman reaktivi (DTNB) yordamida o‘lchandi, qon zardobida laktatdegidrogenaza (LDH) faolliklari unifikatsiyalangan fermentativ usullar yordamida tahlil qilindi (U/L). Olingan natijalar Microsoft Excel 2021 va Statistica 10.0 dasturlari yordamida tahlil qilindi. Guruhlararo farqlar Styudent t-kriteriysi yordamida baholandi. Farqlar bo‘lganda statistik jihatdan ishonchli deb topildi.

Tadqiqot natijalar va tahlili. O‘tkazilgan biokimyoviy tahlillar eksperimental diabet sharoitida jigar to‘qimasida prooksidant va antioksidant muvozanatning keskin prooksidantlar tomonga siljiganligini hamda metabolik gomeostazning izdan chiqqanligini ko‘rsatdi. Olingan ma’lumotlarga ko‘ra, diabetik guruhda qon zardobidagi glyukoza konsentratsiyasi nazoratdagiga nisbatan 2,3 martadan ortiq ko‘tarilgan (1-jadval). Surunkali giperglikemiya gepatositlar metabolizmini o‘zgartirib, erkin radikalli jarayonlarni faollashtiruvchi asosiy omil vazifasini o‘tagan.

Jigardagi oksidativ stress darajasini baholashda lipidlar peroksidlanishining asosiy ikkilamchi mahsuloti bo‘lgan malon dialdegidining (MDA) to‘planishi alohida ahamiyatga ega. Sog‘lom nazorat hayvonlariga nisbatan MDA ko‘rsatkichi diabet guruhida deyarli 11 barobarga oshgan. Bu holat gepatositlar biomembranasidagi ko‘p toyinmagan yog‘ kislotalarining erkin radikallar ta’sirida parchalanishi va zanjirli lipoperoksidatsiyaning o‘ta yuqori darajada faollashganidan dalolat beradi. Hujayraning prooksidant zo‘riqishiga javoban antioksidant himoya tizimida jiddiy yetishmovchiliklar yuzaga keladi. Superoksid radikalini vodorod peroksidiga dismutasiya qiluvchi birinchi liniya fermenti SOD faolligi sog‘lom guruhdagiga qaraganda diabetik hayvonlarda 1,9 barobarga kamaygan (1-jadval).

1-jadval.

Eksperimental diabetda qon va jigar to‘qimasining biokimyoviy ko‘rsatkichlari (M ±SD, n = 6)

Biokimyoviy ko‘rsatkichlar	**Sog‘lom nazorat**	**Diabet, davolanmagan**	**Ishonchlilik darajasi (p)**
Glyukoza (mM/l)	6,65 ± 0,66	15,29± 1,1	$p < 0,001$
MDA (jigar to‘qimasida)	0,40 ±0,025	4,35 ±0,26	$p < 0,001$
SOD (U/mg oqsil)	48,3 ±4,01	25,05 ±3,2	$p < 0,001$
GSH (nmol/g oqsil)	33,9 ±2,4	12,8 ±1,7	$p < 0,001$

ALT (U/L)	23 ±1,59	63 ±1,38	p < 0,001
AST (U/L)	39 ±2,82	68 ±2,13	p < 0,001
LDH (U/L)	938 ±16	1246 ±24	p < 0,001

Shuningdek, hujayraning eng muhim fermentativ antioksidanti va tiol zaxirasi bo‘lgan qaytarilgan glutation (GSH) miqdori 2,6 barobarga tushib ketgani qayd etildi. GSH miqdorining kamayishi glutationperoksidaza va glutation-S-transferaza fermentlarining subtraktli ta’minotini izdan chiqaradi va gepatositlarni peroksidlardan xalos bo‘lish imkoniyatini pasaytiradi. Oksidativ stress va lipidlar peroksidlanishining kuchayishi gepatositlar plazmatik va mitoxondriyal membranalarining strukturaviy yaxlitligini buzadi (sitolitik sindrom). Buni qon zardobidagi fermentlar faolligi tahlili ham to‘liq tasdiqlaydi (1-jadval). ALT faolligi sog‘lom guruhga nisbatan 2,7 barobarga oshgan, AST faolligi esa 1,7 barobargacha ko‘tarilgan. LDH (laktatdegidrogenaza) faolligi 1,33 barobar oshgan. LDH va aminotransferazalarning (ayniqsa gepatosit sitoplazmasida joylashgan ALT) qon zardobida keskin ortishi jigar hujayralarining destruksiyaga uchrayotganligini, gipoksiya va sitoliz jarayonlarining chuqurlashganini aks ettiradi. Biokimyoviy mexanizmlarni umumlashtirganda, diabetdagi giperglikemiya reaktiv kislorod turlari (ROS) hosil bo‘lishini rag‘batlantiradi. ROS lipidlar peroksidlanishini keltirib chiqarib, MDA miqdorini oshiradi va SOD hamda GSH zaxiralarini tugatadi. Membranalar o‘tkazuvchanligining buzilishi va gepatositlar zararlanishi natijasida markaziy metabolik fermentlar qonga sizib chiqadi. patologik mexanizm diabetik gepatopatiyaning biokimyoviy asosi hisoblanadi.

Xulosa tariqasida shuni keltirish mumkinki eksperimental diabet sharoitida surunkali giperglikemiya jigar to‘qimasida erkin radikal jarayonlarning jadal faollashuviga va oqibatda kuchli oksidativ stressning rivojlanishiga olib keladi. Bu holat lipidlar peroksidlanishining asosiy ikkilamchi mahsuloti bo‘lgan malon dialdegidi (MDA) miqdorining keskin ortishi bilan tasdiqlanadi. Shu bilan bir qatorda, prooksidant zo‘riqish fondida gepatositlarning antioksidant himoya tizimi izdan chiqib, superoksiddismutaza (SOD) fermenti faolligi hamda fermentativ antioksidant bo‘lgan qaytarilgan glutation (GSH) zaxirasining sezilarli darajada pasayishi kuzatiladi. Antioksidant imkoniyatlarning yetishmasligi va lipoperoksidatsiyaning chuqurlashishi gepatositlar plazmatik hamda mitoxondriyal membranalarining strukturaviy yaxlitligini buzib, sitolitik sindromni keltirib chiqaradi. Natijada jigar sitoplazmasidagi markaziy metabolik fermentlar ALT, AST hamda LDH qon zardobiga chiqib ketadi va ularning faolligi keskin oshadi. Olingan biokimyoviy natijalar diabetik gepatopatiyalarning oldini olish hamda davolashda yo‘naltirilgan

antioksidant va hepatoprotektor vositalardan foydalanish zarurligini nazariy va amaliy jihatdan asoslab beradi.

FOYDALANILGAN ADABIYOTLAR

1. Aliyev, B. Sh., & Toshmatov, A. O. Qandli diabet va uning asoratlari biokimyosi. — Toshkent: Fan va texnologiya, 2022. — 180 b.
2. Brownlee, M. Biochemistry and molecular cell biology of diabetic complications // Nature. — 2001. — Vol. 414, No. 6865. — P. 813–820.
3. Droge, W. Free radicals in the physiological control of cell function // Physiological Reviews. — 2002. — Vol. 82, No. 1. — P. 47–95.
4. Giacco, F., & Brownlee, M. Oxidative stress and diabetic complications // Circulation Research. — 2010. — Vol. 107, No. 9. — P. 1058–1070.
5. Halliwell, B., & Gutteridge, J. M. C. Free Radicals in Biology and Medicine. — 5th ed. — Oxford: Oxford University Press, 2015. — 780 p.
6. International Diabetes Federation. IDF Diabetes Atlas. — 10th ed. — Brussels: International Diabetes Federation, 2021. — 140 p.

Karimov, Y. H., & Rahimov, R. N. Eksperimental diabetda jigar antioksidant tizimi ko‘rsatkichlarining o‘zgarishi // O‘zbekiston biologiya jurnali. — 2023. — № 2. — B. 42–46.

TOKDA UCHRAYDIGAN FITOPATOGEN ZAMBURUG‘LARDAN HIMOYA QILISHDA ZAMONAVIY BIOTEXNOLOGIK YONDASHUVLARNING ISTIQBOLLARI

Maxmudov Davron Kamol o‘g‘li

e-mail: davronmakhmudov0404@gmail.com

Annotatsiya: *Hozirgi kunda qishloq xo‘jaligi o‘simliklarining hosildorligi yildan yilga kamayib bormoqda. Bunga kasallik keltirib chiqaradigan mikroorganizmlar va abiotik va biotik omillarning natijasidir. Turli mikroorganizmlar keltirib chiqaradigan kasalliklarga qarshi kurash o‘simliklarni shu bilan birgalikda ona tabiatimizni muhofaza qilish muhim ilmiy ahamiyatga ega. Kasallik keltirib chiqaradigan mikroorganizmlarga qarshi kurashishda ushbu patogenga chidamli navlarini yaratish va ularga qarshi biologik faol preparadlar ishlab chiqishda zamonaviy biotexnologiyaning istiqbollariga qaratilgan.*

Kalit so‘zlar: *Fitopatogen zamburug‘, tok navlari, kasallik tarqalishi, abiotik va biotik omillar va biotexnologiyaning istiqbollari*

KIRISH: Bugungi kunda dunyo aholisi jadal suratlar bilan o‘sib bormoqda. Bu esa o‘ziga xos bir qancha qiyinchliklarni keltirib chiqaradi xusasan, dunyo aholisini sifatli oziq-ovqat maxsulotlari bilan taminlash bilan bir qatorda oziq-ovqat xavsizligi masalasi ham tobora dolzarb masalaga aylanib bormoqda. Turli mikroorganizm keltirib chiqaradigan kasalliklarga qarshi kurash o‘simliklarni va tabiatni muhofaza qilishda muhim ahamiyatga ega tadbir hisoblanadi. Ekinlarni kasallik qo‘zg‘atadigan mikroorganizmlardan himoya qilish ular hosildorligini oshirishga va hosilning nobud bo‘lishiga keskin kamaytirishga olib keladi. Qishloq xo‘jaligini jadal rivojlantirish, dehqonchilik madaniyatini yuksaltirish, hosilni nobudgarchilikga sabab bo‘ladigan kasallik va zararkunandalarga qarshi samarali kurash choralarni o‘z vatida qo‘llashni taqozo etadi. Qishloq xo‘jaligi o‘simliklarining kasalliklarining ekologik sharoitga bog‘liq ravishda ekinlarga turli muddatda turlicha zarar yetkazadi. Ba’zan yetishtirilayotgan maxsulotning sifati keskin yomonlashib, miqdori kamayib ketadi. Hozirgi vaqtda har bir fermer, qishloq xo‘jaligi mutaxassisi ekinlar kasalligini to‘g‘ri aniqlab, zamonaviy kurash choralarni qo‘llash asosida hosildorligini saqlab qolishni bilishni talab etadi [1].

Qishloq xo‘jaligi ekinlari orasida eksportbop va to‘yimli oziq-ovqat sifatida Tok *Vitis vinifera L* o‘simligi ajralib turadi. **Tok** (uzum o‘simligi) - tokdoshlar (*Vitaceae*) oilasiga mansub, chirmashib o‘suvchi ko‘p yillik daraxtsimon liana o‘simligi bo‘lib, uning mevasi uzum deb ataladi. Uzum (Vitis vinifera) o‘simligi vinochilikning eng ko‘p qo‘shimcha mahsuloti biri hisoblanadi va u bir qancha kasalliklarga xususan yurak-qon tomir kasalliklarini davolashda oldini olishda va bir qancha yallig‘lanishlarga qarshi antioksidant sifatida foydalaniladi [2].

O‘zbekiston iqlimi, xususan qish nisbatan iliq, baxor va yoz boshi iliq va sernam bo‘lishi kasallik keltirib chiqaruvchi patogen zamburug‘larning tarqalishiga sharoit bo‘ladi. Bugungi kunda O‘zbekiston sharoitida tok kasalliklari keng tarqalgan bo‘lib, ular uzumning sifatini buzadi, novdalarni kuchli zararlaydi va ob-havo sharoitiga qarab, hosildorlikning keskin (25-70% gacha) kamayishiga olib keladi. Uzumzorlarda oidium yoki un-shudring *(Uncinula necator)*, antraknoz *(Gloeosporium ampelophagum)*, serkosporoz *(Cercospora vitis)*, kulrang chirish *(Botrytis cinerea)* kasalliklari ko‘p uchraydi. Keyingi yillarda mildyu (Plasmopara viticola) kasalligi respublikamiz tokzorlariga jiddiy zarar yetkazmoqda.

1-rasm.Baxor oyida Soxta un-shudring kasalligi bilan chalingan qora kishmishda mevasining ko‘rinishi.





Soxta un-shudring kasalligini qo‘zg‘atuvchi zamburug‘ **Plasmopara viticola** Berl. et de Toni bo‘lib, Phycomycetes sinfiga kiradi. uzum mog‘orining qo‘zg‘atuvchisi uzumzorlarida keng tarqalgan va agar davolanmasa, hosilning to‘liq yo‘qolishiga olib kelishi mumkin [3].

Ushbu kasalliklarga qarshi kurashishda sog‘lom ko‘chat ekishdan boshlanadi, o‘sayotgan tokni himoya qilish kasallik tarqalishi va rivojlanishini mavsum davomida kuzatishlar o‘tkazish va natijalarini taxlil qilish asosida tashkil qilinadi. Kurash choralari o‘z ichiga genetik seleksion (chidamli navlarni yaratish va qo‘llash), agrotexnik va sanitar-gigenik (kasal va qurigan poya shoh va novdalarni kesib olish, toklarno xomtok qilish, tokzorlarni begona o‘tlardan va xas-xashaklardan toza tutish va h.k) va kimyoviy usullarni qo‘llash orqali hosildorligini yuqori olishga xizmat qiladi.

Xulosa qilib aytganda, tok kasalliklariga qarshi kompleks himoya choralarini qo‘llash, kasallik qo‘zg‘atuvchilarining biologik xususiyatlarini chuqur o‘rganish va ekologik xavfsiz biotexnologik usullarni joriy etish uzum hosildorligini saqlash, mahsulot sifatini oshirish hamda atrof-muhitni muhofaza qilishda muhim ahamiyat kasb etadi.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI:

1.Sheraliyev.A., Umumiy va qishloq xo‘jalik fitopatologiyasi: O‘quv qo‘llanma. – Toshkent – 2017. 3 b.

2.Raiany Alves de Freitas, Kelly Clair de Moura da Costa, Rinaldo Rodrigues dos Passos Junior, Fernanda Regina Giachini, Chapter 24 - *Grape (Vitis vinifera) pomace and cardiovascular effects: A focus on in vivo and in vitro studies, Editor(s): Victor R. Preedy, Wine in Health and Disease Prevention, Academic Press*, 2026,

Pages 307-318, ISBN 9780443291920

https://doi.org/10.1016/B978-0-443-29192-0.00037-6.

3. Sarah E. Campbell, Phillip M. Brannen, Harald Scherm, Nathan Eason, Clark MacAllister, *Efficacy of fungicide treatments for Plasmopara viticola control and occurrence of strobilurin field resistance in vineyards in Georgia, USA, Crop* Protection, Volume 139, 2021,105371,ISSN 0261-2194,

https://doi.org/10.1016/j.cropro.2020.105371.

MOLEKULAR BIOLOGIYA VA GENETIKANING ZAMONAVIY RIVOJLANISH TENDENSIYALARI

Hayitov Feruz Ilxomovich

Qarshi davlat universiteti tibbiyot fakulteti 5 kurs talabasi

Annotatsiya. *Maqolada molekular biologiya va genetikaning zamonaviy rivojlanish yo‘nalishlari tahlil qilingan. Genomika, yuqori unumli sekvenirlash, transkriptomika, epigenomika, CRISPR/Cas gen tahrirlash texnologiyalari, bir hujayrali tahlil, bioinformatika va sun’iy intellektning zamonaviy biologik tadqiqotlardagi ahamiyati yoritilgan. Shuningdek, ushbu texnologiyalarning tibbiyot, qishloq xo‘jaligi va biotexnologiyada qo‘llanish istiqbollari ko‘rib chiqilgan.*

Kalit so‘zlar: *molekular biologiya, genetika, genomika, sekvenirlash, transkriptomika, epigenomika, CRISPR/Cas, gen tahrirlash, bioinformatika, sun’iy intellekt.*

Kirish. Molekular biologiya va genetika tirik organizmlarda irsiy axborotning saqlanishi, uzatilishi va ifodalanish mexanizmlarini o‘rganuvchi fundamental fanlar hisoblanadi. DNK molekulasi tuzilishining aniqlanishi, genetik kodning ochilishi va rekombinant DNK texnologiyalarining yaratilishi molekular genetikaning jadal rivojlanishiga asos bo‘ldi [1,2].

Hozirgi davrda molekular biologiya genlarni alohida o‘rganishdan organizmning butun genomini, genlar ekspressiyasini, oqsillar faoliyatini va epigenetik boshqaruv mexanizmlarini kompleks tahlil qilish bosqichiga o‘tmoqda. Yuqori unumli sekvenirlash, bir hujayrali texnologiyalar, genomni tahrirlash va sun’iy intellektning rivojlanishi ushbu sohada yangi ilmiy imkoniyatlarni yaratmoqda [3–5].

Genomika va sekvenirlash texnologiyalari. Molekular genetikaning eng muhim zamonaviy yo‘nalishlaridan biri genomikadir. Genomika organizmning to‘liq genetik materialini o‘rganish imkonini beradi. Keyingi avlod sekvenirlash (Next Generation Sequencing — NGS) texnologiyalari DNK va RNK ketma-ketliklarini qisqa vaqtda katta hajmda aniqlash imkonini yaratdi [4].

NGS texnologiyalarining rivojlanishi inson, hayvon, o‘simlik va mikroorganizmlar genomlarini tadqiq qilishni sezilarli darajada tezlashtirdi. Ushbu usullar genetik kasalliklarni aniqlash, irsiy o‘zgaruvchanlikni o‘rganish, mikroorganizmlarni identifikatsiya qilish va qishloq xo‘jaligi seleksiyasida keng qo‘llanilmoqda [4].Genomik ma’lumotlarning keskin ko‘payishi bioinformatikaning rivojlanishiga ham turtki berdi. Kompyuter algoritmlari yordamida genlarni aniqlash, mutatsiyalarni topish, genomlar o‘rtasidagi farqlarni tahlil qilish va gen funksiyalarini bashorat qilish imkoniyati paydo bo‘ldi [1,4].

Tadqiqot materiallari va metodlari. Tadqiqotda molekular biologiya va genetikaning zamonaviy rivojlanish tendensiyalarini o‘rganish maqsadida ilmiy adabiyotlar, zamonaviy genomik texnologiyalar va molekular-genetik tadqiqot natijalari tahlil qilindi. Tadqiqotning nazariy asosini molekular biologiya, genetika, genomika va bioinformatika sohalaridagi ilmiy manbalar tashkil etdi [1–8]. Ish jarayonida adabiyotlarni tahlil qilish, qiyosiy tahlil, tizimlashtirish va umumlashtirish metodlaridan foydalanildi. Genomika va yuqori unumli sekvenirlash texnologiyalarining rivojlanishini baholashda NGS usullarining imkoniyatlari, transkriptomik tadqiqotlarda RNA-seq texnologiyasining qo‘llanilishi va genomni tahrirlashda CRISPR/Cas tizimining xususiyatlari o‘rganildi [3–5]. Shuningdek, bioinformatik yondashuv asosida genomik va transkriptomik ma’lumotlarni kompyuter vositalarida qayta ishlash, genetik variantlarni aniqlash, gen ekspressiyasini tahlil qilish va katta hajmdagi biologik ma’lumotlarni integratsiyalash imkoniyatlari tahlil qilindi. Bir hujayrali molekular tahlillar bo‘yicha single-cell RNA-seq va multi-omics yondashuvlarining zamonaviy imkoniyatlari qiyosiy ravishda o‘rganildi [6,7].

Tadqiqotda **tizimli yondashuv** asosida molekular biologiyaning genomika, transkriptomika, epigenomika, gen tahrirlash, bir hujayrali tahlil va sun’iy intellekt kabi asosiy yo‘nalishlari o‘zaro bog‘liq holda tahlil qilindi. Olingan ma’lumotlar umumlashtirilib, zamonaviy molekular-genetik texnologiyalarning tibbiyot, qishloq xo‘jaligi va biotexnologiyada qo‘llanish istiqbollari belgilab berildi.

Transkriptomika va epigenomika. Genomda mavjud axborotning o‘zi hujayrada kechadigan barcha jarayonlarni to‘liq ifodalamaydi. Genlarning qaysi biri faol ishlashi, qanday RNK va oqsillar sintez qilinishi organizmning funksional holatini belgilaydi. Shu sababli transkriptomika va proteomika zamonaviy molekular biologiyaning muhim yo‘nalishlariga aylandi [1]. RNA-seq texnologiyasi hujayradagi RNK molekulalarini keng miqyosda tahlil qilish va turli sharoitlarda gen ekspressiyasining o‘zgarishini aniqlash imkonini beradi [5]. Bu usul kasalliklar, stress holatlari va hujayra differensiatsiyasi jarayonlarida faollashadigan yoki susayadigan genlarni aniqlashda muhim ahamiyatga ega.

Epigenomika esa DNK ketma-ketligi o‘zgarmagan holda genlar faolligini boshqaruvchi mexanizmlarni o‘rganadi. DNK metillanishi, gistonlar modifikatsiyasi va xromatin holati gen ekspressiyasiga ta’sir ko‘rsatadi. Epigenetik mexanizmlarni tadqiq qilish o‘sma kasalliklari, qarish va boshqa murakkab biologik jarayonlarni tushunishda muhim ahamiyat kasb etmoqda [1].

CRISPR/Cas va genomni tahrirlash. So‘nggi yillarda molekular genetikadagi eng muhim texnologik yutuqlardan biri CRISPR/Cas tizimiga asoslangan genomni tahrirlash usullarining rivojlanishidir. CRISPR/Cas texnologiyasi genomning ma’lum uchastkasiga maqsadli ta’sir ko‘rsatish va DNKda rejalashtirilgan o‘zgarishlarni amalga oshirish imkonini beradi [3]. Ushbu

texnologiya dastlab bakteriyalarning himoya mexanizmi sifatida o‘rganilgan bo‘lsa, keyinchalik genlarning funksiyasini tadqiq qilish, genetik modellar yaratish va biotexnologik jarayonlarni takomillashtirish vositasiga aylandi [3]. Gen tahrirlash texnologiyalari tibbiyotda irsiy kasalliklarning molekular sabablarini o‘rganish, qishloq xo‘jaligida yangi xususiyatlarga ega o‘simliklar yaratish va mikroorganizmlarning foydali metabolitlar sintezini boshqarishda istiqbolli yo‘nalish hisoblanadi.

Shu bilan birga, inson genomini tahrirlashda xavfsizlik, maqsadsiz genetik o‘zgarishlar va bioetika masalalari muhim ahamiyat kasb etadi. Shu sababli gen tahrirlash texnologiyalaridan foydalanishda ilmiy va etik talablarga rioya qilish zarur [3].

Bir hujayrali texnologiyalar va multi-omics yondashuvi. Zamonaviy molekular biologiyada tadqiqotlar tobora hujayra darajasiga yaqinlashmoqda. An’anaviy usullar ko‘plab hujayralardan olingan o‘rtacha ma’lumotni bersa, bir hujayrali sekvenirlash texnologiyalari har bir hujayraning molekular xususiyatlarini alohida o‘rganish imkonini yaratdi [6].Bir hujayrali RNA-seq texnologiyasi turli hujayra populyatsiyalarini aniqlash, ularning gen ekspressiyasidagi farqlarni o‘rganish va rivojlanish jarayonlarini kuzatishda qo‘llanilmoqda. Ayniqsa, onkologiya, immunologiya, embriologiya va regenerativ tibbiyot sohalarida ushbu yondashuvlarning ahamiyati ortib bormoqda [6,7].Genomika, transkriptomika, proteomika va epigenomika ma’lumotlarini birlashtirish multi-omics yondashuvini shakllantirdi. Bu yondashuv organizm yoki hujayraning molekular holatini kompleks baholash imkonini beradi [7].

Sun’iy intellekt va bioinformatika. Genomik tadqiqotlarda olinayotgan ma’lumotlar hajmining jadal o‘sishi ularni qayta ishlashning yangi usullarini talab qilmoqda. Shu munosabat bilan sun’iy intellekt va mashinali o‘qitish texnologiyalari molekular genetikada tobora keng qo‘llanilmoqda.

Sun’iy intellekt yordamida genomik variantlarni tahlil qilish, gen funksiyalarini bashorat qilish, katta hajmdagi RNA-seq ma’lumotlarini tasniflash va turli omiik ma’lumotlarni birlashtirish imkoniyati kengaymoqda. Oqsillarning fazoviy tuzilishini hisoblash asosida bashorat qilish sohasidagi yutuqlar ham molekular biologiya uchun muhim ahamiyatga ega [8].Bioinformatika va sun’iy intellektning molekular biologiya bilan integratsiyalashuvi eksperimental tadqiqotlarni tezlashtirish, yangi biomarkerlarni aniqlash va biologik jarayonlarni modellashtirish imkoniyatlarini oshirmoqda.

Amaliy ahamiyati va istiqbollari. Molekular biologiya va genetika yutuqlari tibbiyot, farmasevtika, qishloq xo‘jaligi va sanoat biotexnologiyasida muhim amaliy ahamiyatga ega. Genomik tahlillar irsiy kasalliklarni aniqlash, kasalliklarga moyillikni o‘rganish va shaxsiylashtirilgan tibbiyot yondashuvlarini rivojlantirish uchun asos bo‘lib xizmat qilmoqda [1,8].

Qishloq xo‘jaligida molekular genetik texnologiyalar yuqori hosildorlikka, qurg‘oqchilikka, sho‘rlanishga va kasalliklarga chidamli navlarni yaratishda qo‘llanishi mumkin. Biotexnologiyada esa genomni maqsadli o‘zgartirish orqali mikroorganizmlarning fermentlar, organik kislotalar, vitaminlar va boshqa biologik faol moddalarni sintez qilish xususiyatlarini takomillashtirish imkoniyatlari mavjud.

Xulosa. Molekular biologiya va genetikaning zamonaviy rivojlanishi genomika, transkriptomika, epigenomika, bir hujayrali tahlil, CRISPR/Cas gen tahrirlash texnologiyalari, bioinformatika va sun’iy intellektning o‘zaro integratsiyalashuvi bilan tavsiflanadi [3–8]. Yuqori unumli sekvenirlash va multi-omics yondashuvlari tirik organizmlardagi molekular jarayonlarni kompleks o‘rganish imkonini bersa, CRISPR/Cas texnologiyalari genomni maqsadli o‘zgartirish uchun yangi imkoniyatlar yaratmoqda. Sun’iy intellekt esa katta hajmdagi biologik ma’lumotlarni tahlil qilishni tezlashtirmoqda.

Kelajakda molekular biologiya va genetika yutuqlarining tibbiyot, qishloq xo‘jaligi va biotexnologiyaga yanada keng tatbiq etilishi kutilmoqda. Shu bilan birga, yangi genetik texnologiyalarni amaliyotga joriy etishda xavfsizlik, ma’lumotlar maxfiyligi va bioetik tamoyillarga qat’iy rioya qilish muhim vazifa bo‘lib qoladi.

FOYDALANILGAN ADABIYOTLAR

1.Alberts B., Johnson A., Lewis J. et al. *Molecular Biology of the Cell*. 7th ed. Garland Science, 2022.

2.Watson J.D., Baker T.A., Bell S.P. et al. *Molecular Biology of the Gene*. 7th ed. Pearson, 2014.

3.Doudna J.A., Charpentier E. The new frontier of genome engineering with CRISPR-Cas9. *Science*. 2014;346(6213):1258096.

4.Shendure J., Balasubramanian S., Church G.M. et al. DNA sequencing at 40: past, present and future. *Nature*. 2017;550:345–353.

5.Stark R., Grzelak M., Hadfield J. RNA sequencing: the teenage years. *Nature Reviews Genetics*. 2019;20:631–656.

6.Stuart T., Satija R. Integrative single-cell analysis. *Nature Reviews Genetics*. 2019;20:257–272.

7.Regev A., Teichmann S.A., Lander E.S. et al. The Human Cell Atlas. *eLife*. 2017;6.

8.Jumper J., Evans R., Pritzel A. et al. Highly accurate protein structure prediction with AlphaFold. *Nature*. 2021;596:583–589.

DEVELOPMENT RHYTHM, SEED PRODUCTIVITY AND REPRODUCTIVE CHARACTERISTICS OF WORMWOOD (*ARTEMISIA DIFFUSA* KRASCH. EX POLJAK.) UNDER THE CONDITIONS OF KARNABCHUL

Abdulloyeva Mohinur Shavkatjonovna

Rabbimov Abdullo

Research Institute of Karakul Sheep Breeding and Desert Ecology, Samarkand, Uzbekistan

+998979173618

mohinur.abdulloyeva@gmail.com

Abstract. This paper presents a literature-based analysis of the development rhythm (phenological cycle), seed productivity and reproductive biology of *Artemisia diffusa* Krasch. ex Poljak., a dominant semi-shrub of the wormwood-ephemeral rangelands of Karnabchul, a semi-desert plain in the Samarkand-Navoi region of Uzbekistan. Based on the generalization of published botanical, geobotanical and rangeland-ecology data, the paper characterizes the seasonal phenophases of the species, the structure of its generative shoots and inflorescences, the factors determining seed set, and its role in natural reproduction and pasture regeneration under grazing pressure. The findings are of practical importance for pasture restoration programmes and for the fodder base of karakul sheep husbandry in arid zones of Central Asia.

Keywords: *Artemisia diffusa*, Karnabchul, wormwood, semi-desert rangeland, phenology, development rhythm, seed productivity, reproductive biology, karakul sheep, pasture restoration.

Introduction.

The semi-desert plain of Karnabchul, located within the Samarkand and Navoi regions of Uzbekistan, is one of the country's most extensive year-round pasture territories for karakul sheep breeding. Its vegetation cover is dominated by ephemeral-wormwood (efemerovo-polynnye) plant communities, in which *Artemisia diffusa* Krasch. ex Poljak. occupies a leading position among the shrub and semi-shrub components [1, 2]. Long-term geobotanical surveys carried out in the region confirm that A. diffusa, together with associated species such as Cousinia resinosa and Caroxylon (Salsola) spp., forms the productive core of the autumn-winter forage reserve, while ephemeral grasses and forbs dominate the spring-summer ration [1, 3]. Understanding the rhythm of seasonal development and the reproductive strategy of A. diffusa is therefore not only a matter of botanical interest but a practical necessity for the sustainable management of desert pastures, whose productivity has been reported to decline by 20-40% or more in degraded areas of Uzbekistan due to overgrazing and climatic variability [4]. The present work summarizes and analyzes available literature data on the morphology, phenological rhythm, seed productivity and reproductive biology of A. diffusa specifically in relation to the ecological conditions of Karnabchul.

Materials and methods.

The study is based on a comparative analysis of scientific literature devoted to the biology, ecology and rangeland significance of *Artemisia diffusa* in Central Asia, including monographic descriptions of the species, geobotanical surveys of Karnabchul and adjoining semi-desert territories (Ustyurt, Kyzylkum), and applied agronomic publications on pasture productivity and karakul-sheep forage. Sources were selected according to their direct relevance to the phenology, generative morphology, seed output and regeneration ecology of the species. Data drawn from different authors and years were compared and generalized in order to reconstruct a consolidated picture of the annual development cycle and reproductive characteristics of A. diffusa under the arid climatic regime of Karnabchul (hot, dry summers; short, cool, moderately humid winters; annual precipitation concentrated mainly in the winter-spring period).

Results and discussion.

1. Morphological and taxonomic characteristics.

Artemisia diffusa Krasch. ex Poljak. (synonym Seriphidium diffusum (Krasch. ex Poljak.) Y.R.Ling) is a perennial, polymorphic, low semi-shrub, 30-50 cm in height, with a life span estimated at 7-25 years [5]. Its native range extends from Iran through Central Asia to Afghanistan, placing Uzbekistan, and specifically the Karnabchul semi-desert, within the core of its natural distribution [6]. The stem is pubescent, grey-green, branched, with a lignified, short and strong basal part (caudex, 4-12 cm), from which erect or arc-curved reproductive stems (15-30 cm) arise and branch in the upper part. A strong pivotal (tap) root penetrates to a depth of 1.1-2.5 m, which explains the species' pronounced drought tolerance and its ability to exploit soil moisture reserves inaccessible to shallow-rooted ephemerals [5]. The leaves are sessile, 1.5-2.0 cm long, two to three times pinnatipartite, and densely covered with silky hairs, giving the whole plant a characteristic silvery-grey appearance that reduces transpiration losses under intense solar radiation. Chromosome numbers reported for the species are polyploid: 2n = 24, 48, 72 [5], a feature commonly associated with wider ecological amplitude and adaptability in arid-zone Artemisia species.

2. Rhythm of seasonal development (phenology).

The annual development cycle of A. diffusa in Karnabchul is closely synchronized with the region's sharply continental, arid climate. Vegetative growth resumes in early spring, when residual soil moisture from winter-spring precipitation is still available; during this period the plant forms new vegetative shoots and accumulates the assimilate reserves later mobilized for flowering. As summer temperatures rise and the ephemeral spring flora completes its cycle and dries out, A. diffusa - owing to its deep root system - remains physiologically active while surface-rooted

annuals senesce, a phenological displacement that underlies the classic 'ephemeral-wormwood' seasonal complementarity of Karnabchul pastures: ephemerals dominate the spring-summer forage supply, while wormwood semi-shrubs, entering their generative phase, dominate the autumn-winter reserve [1, 7]. Bud formation and the elongation of generative (flowering) shoots occur in late summer, flowering itself takes place in autumn, and seed ripening and dispersal extend into the late autumn-early winter period, when the plant becomes the principal standing forage resource for karakul sheep [7]. This autumn-winter phenological rhythm is a key adaptive trait that allows A. diffusa to complete its reproductive cycle after the extreme summer heat has passed, using the more favourable moisture and temperature conditions of the cooler season, and it is precisely this trait that gives the species its outsized importance in the annual forage balance of desert pastures.

3. Reproductive biology and flower structure.

The inflorescences of A. diffusa are small, oviform, sessile capitula (3-4 mm long), each containing bisexual, inconspicuous, protandrous, pentamerous florets of pale yellow colour, gathered in groups of 3-7 and assembled into a broad panicle at the tips of the generative shoots [5]. Each floret bears five stamens whose anthers are fused laterally into a short tube, a typical anemophilous (wind-pollinated) arrangement found throughout the subgenus Seriphidium. Protandry - the maturation of male structures before the stigmas of the same floret become receptive - reduces the likelihood of self-pollination within a single capitulum and favours outcrossing, a pattern broadly consistent with reproductive studies of other Artemisia species, where floral biology combining protandrous disc florets with wind pollination has likewise been associated with predominantly outcrossed, though variably fertile, seed production [8]. The very large number of capitula per generative shoot and of shoots per plant compensates for the comparatively low seed set per individual floret, so that a mature A. diffusa plant is capable of producing a substantial total seed output despite the small size of each achene.

4. Seed productivity and its dependence on ecological conditions.

Seed productivity of A. diffusa in Karnabchul is strongly dependent on the amount and timing of autumn-winter precipitation, on grazing intensity, and on the age structure of the stand. Long-term rangeland monitoring in the semi-desert zones of Uzbekistan shows that the productivity of Artemisia-dominated pastures fluctuates markedly from year to year in direct correlation with annual rainfall, with productivity losses of 20-40% or more recorded on degraded sites [4]. Grazing pressure affects seed productivity through two mechanisms: direct removal of generative shoots before seed maturation, and a shift in the state of the plant community along the grazing gradient, described in state-and-transition models of Karnabchul vegetation, from productive wormwood-ephemeral stands toward degraded, low-productivity communities with reduced representation of

generative A. diffusa individuals [3]. Under moderate grazing regimes and favourable moisture years, mature stands are able to set abundant seed, which is dispersed at the onset of winter and germinates with the return of spring moisture, ensuring natural regeneration of the wormwood component of the pasture. Under heavy, continuous grazing, however, generative shoots are preferentially consumed before seed ripening, and the reproductive contribution of seed to stand renewal is correspondingly reduced, forcing pasture recovery to rely more heavily on vegetative persistence of surviving individuals than on seedling recruitment [3, 4].

5. Practical significance for pasture restoration and karakul sheep husbandry.

As a dominant, drought-tolerant, deep-rooted forage semi-shrub, A. diffusa is a key target species for the restoration of degraded rangelands in the Karnabchul, Kyzylkum and Ustyurt semi-desert zones. Chemical analyses have shown that A. diffusa-dominated pastures provide forage of appreciable nutritional value, contributing meaningfully to the protein and mineral requirements of grazing karakul sheep during the autumn-winter period when alternative forage is scarce [1]. Because of the species' reliance on seed for the recolonization of disturbed sites and for the renewal of ageing stands, any programme of pasture rehabilitation - whether through deferred grazing, rotational grazing, or the sowing of A. diffusa seed on degraded plots - must take its autumn-winter reproductive rhythm explicitly into account, protecting generative shoots from grazing during the flowering-to-seed-ripening window. This is consistent with the broader applied agronomic goal of stabilizing the fodder base for karakul sheep through the combined use of natural wormwood-ephemeral regeneration and artificially established mixed pastures [9].

Conclusion.

The literature analysis presented in this paper shows that *Artemisia diffusa* Krasch. ex Poljak. is ecologically and economically the leading semi-shrub of the wormwood-ephemeral pastures of Karnabchul. Its deep root system and silvery, densely pubescent foliage provide pronounced drought resistance, while its autumn-winter phenological rhythm of budding, flowering and seed ripening allows it to complement the spring-summer ephemeral flora and to supply the principal standing forage reserve during the cold season. Its protandrous, wind-pollinated, multi-capitulate inflorescences ensure a potentially high total seed output, but actual seed productivity is strongly modulated by precipitation, grazing intensity and stand condition, with heavy or continuous grazing during the generative period substantially reducing natural seed renewal. These findings indicate that the conservation and expansion of A. diffusa populations in Karnabchul require grazing regimes that specifically protect the species during its autumn flowering-to-seed-ripening phase, and they underscore the importance of further field-based phenological and seed-

productivity monitoring to refine site-specific pasture restoration and karakul sheep forage-management practices.

REFERENCES

1. Bazarov B., Rajamuradov Z., Safin M., Rajabov A., Khayitov D., Kuziev M., Aminjonov S., Ismayilova M., Kudratov J., Khujabekov M., Khaydarov D. The productivity, chemical composition and nutritional value of pastures dominated by *Artemisia diffusa* and Cousinia resinosa in arid lands of southwestern Uzbekistan // Biodiversitas. - 2023. - Vol. 24. - P. 3916-3923.

2. Rakhimova T. The current state of the *Artemisia diffusa*, Caroxylon orientale pastures on the Eastern chink of the Ustyurt plateau (Uzbekistan) // Problems of Botany of South Siberia and Mongolia. - 2023. - Vol. 22, No. 1. - P. 302-305.

3. Rajabov T. Ecological assessment of spatio-temporal changes of vegetation in response to piosphere effects in semi-arid rangelands of Uzbekistan. Final Project, Land Restoration Training Programme. - Reykjavik: Soil Conservation Service of Iceland, 2009. - P. 109-134.

4. Rajabov T., Mardonov B.K., Pittroff W., Bobodjanov F.N. Impact of grazing on vegetation of Artemisia-annuals rangelands in semi desert of Uzbekistan // Proceedings of the International Grassland Congress. - 2008.

5. Gintzburger G., Le Houerou H.N., Toderich K.N. The steppes of Middle Asia: post-1991 agricultural and rangeland adjustment // Arid Land Research and Management. - 2003. - Vol. 17, No. 3. - P. 289-333.

6. Gintzburger G., Toderich K.N., Mardonov B.K., Mahmudov M.M. Rangelands of the arid and semi-arid zones in Uzbekistan. - Montpellier: CIRAD-ICARDA, 2003. - 426 p.

7. *Artemisia diffusa* (Gintzburger et al., 2003) // Pl@ntUse [Electronic resource]. - URL: https://plantuse.plantnet.org/en/Artemisia_diffusa_(Gintzburger_et_al.,_2003) (Accessed: 2026).

8. *Artemisia diffusa* Krasch. ex Poljakov // Plants of the World Online, Kew Science [Electronic resource]. - URL: https://powo.science.kew.org (Accessed: 2026).

9. Mir G.J., Malik S., et al. Reproductive biology and cytological insights of Artemisia vulgaris: implications for growth and adaptation of the species // Genetic Resources and Crop Evolution. - 2026.

10. Rajamuradova N.Z., Kuziyev SH., Rajamuradov Z. Influence of additional feeding of succulent goats on indices of natural resistance of the organism, milk productivity and development of goatlings // Bulletin of Pure and Applied Sciences, Zoology. - 2022. - Vol. 41A, No. 1. - P. 81-85.

ESTROGEN VA PROGESTERON MIQDORINING YOSH DAVRLARIGA BOG‘LIQ HOLDA O‘ZGARUVCHANLIG

Shodmonova E.A., Nasrullayeva G.A., Hayitov D.G‘.

[1]Dil-Shifo Nur Pharm xususiy klinikasi laboranti

[2]Oriental Universiteti, Samarkand kompus

[3]Sharof Rashidov nomidagi Samarqand davlat universiteti, dotsent

Abstract. *This article provides information on the changes in the synthesis and production levels of estrogen and progesterone hormones in women, spanning from puberty to the postmenopausal period. It was determined that the highest production of estrogen and progesterone occurs during the reproductive period, reaching 326±15 pg/ml.*

Keywords: *estrogen, progesterone, hormones, reproductive, postmenopause, menopause, age periods.*

Аннотация. *В данной статье освещены данные об изменениях показателей синтеза и секреции гормонов эстрогена и прогестерона у женщин, начиная с периода полового созревания и вплоть до постменопаузального периода. Было установлено, что максимальная выработка эстрогена и прогестерона приходится на репродуктивный период и составляет 326±15 пг/мл.*

Ключевые слова: *эстроген, прогестерон, гормоны, репродуктивный, постменопауза, менопауза, возрастные периоды.*

Estrogen yetishmovchiligi kabi endokrin patologiyalar lipid almashinuvining buzilishi bilan chambarchas bog‘liqdir. Ayniqsa klinik laboratoriya diagnostikasida gormonlar va lipid ko‘rsatgichlari o‘rtasidagi o‘zaro bog‘liqlikni aniqlash kasalliklarni erta tashxislash hamda asoratlarning oldini olishda muhim ahamiyat kasb etadi. Bir qator endokrin kasalliklarning lipid metabolizmiga va lipoprotein darajalariga ta’sirini o‘rganish dolzarb masalalardan biri hisoblanadi. Jinsiy rivojlanishi tug‘ilishdan oldin boshlanib, o‘smirlikning oxirigacha davom etadigan murakkab, ko‘p bosqichli jarayondir. Bu jarayon gormonlar tomonidan tartibga solinadi, ham jismoniy, ham psixologik o‘zgarishlarni o‘z ichiga oladi.

Ayol jinsiy gormonlari estrogenlar bo‘lib, ular tuxumdonlarda, sariq tanada, buyrakusti bezlarida, urug‘donlarda va platsentada hosil bo‘ladi. Hozirgi vaqtda gormonlarning ikki turi – progestinlar (estradiol) va estrogenlar (progesteron) borligi aniqlangan [2; 68-69-b]. Progesteron otalangan tuxumni bachadonning shilliq qavatiga muvaffaqiyatli implantatsiyalanishi uchun tayyorlaydi, shuningdek, sut bezlarining rivojlanishini stimullaydi. Estrogenlar organizmda oqsilning sintezi uchun stimulyator sifatidagianabolik ta’sirga ega [5; 1-12-b].

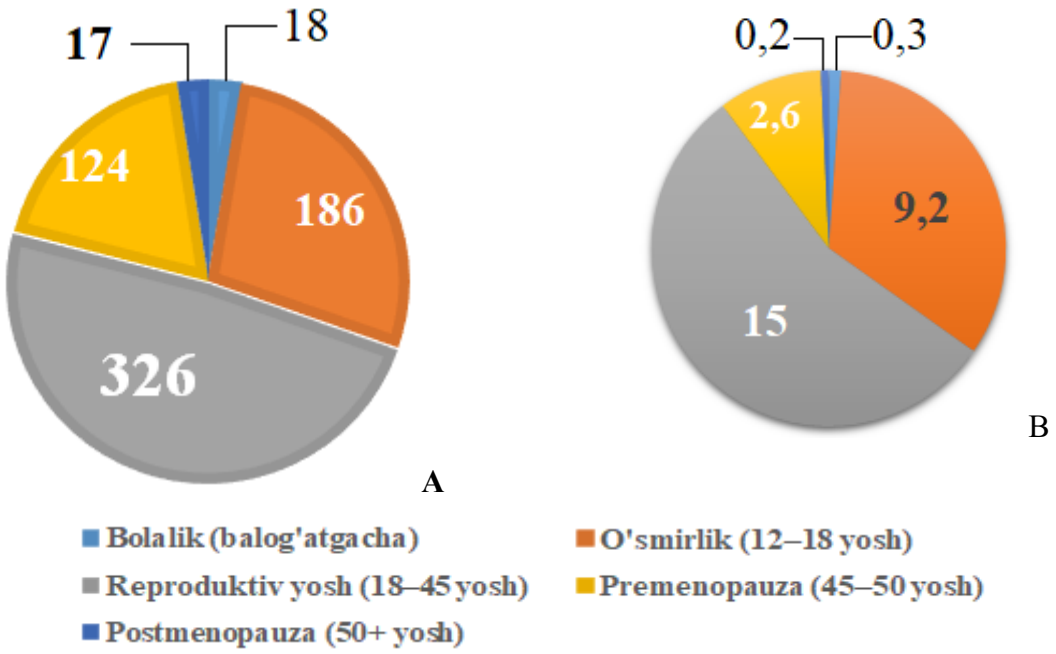
Ayollarning jinsiy gormonlarining hosil bo‘dishi. Ekstrogenlar va gestagenlar ayollarning jinsiy gormonlari hisoblanadi. Asosiy estrogenlarga - estron, estriol va estradiollar kiradi. Estrogenlarning ko‘p qismi follikullar bilan Graaf pufakchalarining pardasida hosil bo‘ladi [4; 39-40-b]. Estrogenlar ayolning balog‘atga yetishiga ya’ni, uning organizmi va jinsiy a’zolarning rivojlanishi, urug‘lanishi, xomilaning rivojlanishi va bola tug‘ishni ta’minlab beradigan darajaga yetishiga zamin yaratadi [7; 342-344-b]. Bu gormon organizmda ikkilamchi jinsiy belgilar paydo bo‘lishida (tana tuzilishining xususiyatlari, sut bezlarining rivojlanishi, badandagi jun qoplamining tabiati va boshqalar) asosiy rol o‘ynaydi [1; 127-145-b]. Demak, ovarial - menstrual sikl ekstrogenlarning hosil bo‘lishi va fiziologik ta’siriga bog‘liq jarayon. Siklning o‘rtasida estrogenlar hammadan ham ko‘p ishlab chiqariladi [3; 774-800]. Estrogenlar endometriy va miometriy gipertrofiyasi va giperplaziyasiga sababchi bo‘ladi, bachadonning qon bilan ta’minlanishini yaxshilaydi. Estrogenlar balog‘atga etish davrida bachadonni kattalashib, sut bezlarini o‘sishiga yordam beradi [75].

Tadqiqot usullari. Qondagi estrogen va progesteron gormonlarini laboratoriyada aniqlash uchun asosan immunokimyoviy tahlil metodlari qo‘llaniladi. Bugungi kunda tibbiyot laboratoriyalarida eng ko‘p tarqalgan va eng aniq hisoblangan metodlar quyidagilardir. CLIA (Chemiluminescent Immunoassay) – Xemilyuminessent immunotahlil. Qon zardobidagi gormonlar maxsus markerlar (antitanalar) bilan bog‘lanadi va kimyoviy reaksiya natijasida yorug‘lik (lyuminessensiya) taratadi. Laboratoriya apparati ushbu yorug‘lik quvvatini o‘lchash orqali gormon miqdorini aniqlaydi. CLIA (Chemiluminescent Immunoassay) – Xemilyuminessent immunotahlil usullari orqali aniqlandi. Hozirgi zamonaviy laboratoriyalarda eng aniq va tezkor usul hisoblanadi. Bunda gormon va antitanacha reaksiyasi natijasida yorug‘lik nurlanishi (lyuminessensiya) sodir bo‘ladi. Ayniqsa, insulin va jinsiy gormonlar (estrogen, progesteron) past konsentratsiyalari Immunokimyoviy lyuminesson analizator (Maglim 600) da ham aniq o‘lchanadi.

Tadqiqot natijalari tahlili. Ayol kishi hayoti davomida estrogen (estradiol) va progesteron miqdori sezilarli darajada o‘zgarib boradi. Bu o‘zgarishlar jinsiy balog‘at davridan boshlanib, menopauzadan keyin minimal darajaga tushadi.

Quyidagi 1-rasmda ayollarning turli yosh va fiziologik davrlari uchun gormonlarning o‘rtacha miqdoriy ko‘rsatkichlari keltirilgan. Ayollarda jinsiy gormonal o‘zgarishlarning asosiy bosqichlarida balog‘atgacha bo‘lgan davrda estrogenning hosil bo‘lish darajasi 18,0 pg/ml, progestron esa bu davrda 0,3 pg/ml ga to‘g‘ri keldi. Bolalikning bu davrida organizm asosan normal fiziologik jihatdan o‘sish va rivojlanish bosqichida kechayotgan bo‘ladi. Bolalik davrida (balog‘atgacha) tuxumdonlar funksional jihatdan deyarli faol emas, chunki gipotalamo-gipofizar-

tuxumdon o‘qi hali to‘liq ishga tushmagan bo‘ladi. Bu davrda jinsiy gormonlar minimal miqdorda ishlab chiqariladi va reproduktiv tizim morfologik jihatdan yetilmagan holatda bo‘ladi.



Izoh: Reproduktiv yoshda ko‘rsatkichlar hayz siklining fazasiga (follikulyar, ovulyatsiya yoki lyutein) qarab keskin farq qiladi.

1-rasm. Ayollarning estrogen (A) va progesteron (B) gormonlarining yoshga bog‘liq o‘zgarishi. pg/ml

O‘smirlik davrida gipotalamo-gipofizar-tuxumdon tizimi faollasha boshlaydi. Gonadotrop gormonlar — FSH va LH sekretsiyasi ortadi, natijada tuxumdonlarda follikulalar rivojlanadi va estrogen ishlab chiqarilishi ko‘payadi. Estradiol miqdori ko‘tarilishi mumkin. Shu bilan birga, dastlabki sikllarda ovulyatsiya har doim ham sodir bo‘lmagani uchun progesteron darajasi notekis bo‘ladi va o‘zgarib turadi. Bu davrda hayz sikli endigina shakllanayotganligi sababli gormonal fluktuatsiyalar fiziologik hisoblanadi.

Jinsiy balog‘atga yetish davrida individual rivojlanish davrida **g**ormonlar miqdori keskin ko‘tarila boshlaydi shu sababli estrogen sekretsiyasining ajralishi 186 pg/ml gacha oshib borgani guvohi bo‘ldik. Bu ko‘rsatkich bolalik davriga nisbatan 10 barobar ortganligini keltirish mumkin. Bu davrda estrogen ikkilamchi jinsiy belgilar (ko‘krak, tana shakli) rivojlanishi uchun javob beradi. Shu bilan birgalikda progestron ham faollashib boradi uning jinsiy bezlardan ajralishi 9,2 pg/ml ga yetganligi aniqladi. O‘smirlik davriga nisbatan 30,6 baravarga oshiq ekanligini keltirib o‘tish mumkin.

Ayollarning o‘rta yoshdagi reproduktiv davrida nafaqat jinsiy bezlar rivojlanishi balki ko‘payish organlari ham bir necha barobarga rivozlanishi ortadi. Bu davrda insonlar nasil qoldirish va ko‘payishga moyilligi ortib boradi. Tuxum hujayra yetilgan bo‘ladi. Estrogen hayz siklining o‘rtasida (ovulyatsiyada) eng yuqori darajaga chiqshi kuzatildi 326 pg/ml gacha oshganligi aniqlandi. Progesteron siklning ikkinchi yarmida (lyutein fazasida) homiladorlikka tayyorgarlik uchun ko‘payadi 15 ng/ml ni tashkil etdi. Reproduktiv yosh davrida gormonal tizim to‘liq yetilgan bo‘lib, muntazam ovulyator hayz sikli kuzatiladi. Bu hayz siklining fazalariga bog‘liq: follikulyar fazada estrogen ustun bo‘lsa, ovulyatsiya arafasida uning maksimal darajasi kuzatiladi, luteal fazada esa progesteron asosiy gormon sifatida ajraladi. Progesteron endometriyni implantatsiyaga tayyorlaydi va homiladorlikni qo‘llab-quvvatlashda muhim rol o‘ynaydi. Ushbu davrda estrogen va progesteron o‘rtasidagi muvozanat reproduktiv salomatlik uchun hal qiluvchi ahamiyatga ega.

Ayollarda yosh ortib borishi bilan jinsiy faollik ham susayib boradi premenopauza davrida qondagi estrogenning miqdoriy ko‘rsatkichi 124 ng/ml gacha, progesteron ishlab chiqarilishi esa 2,6 ng/ml gacha kamayganligini ta’kidlash mumkin. Premenopauza davrida tuxumdonlarning funksional zaxirasi kamayib boradi. Follikulalar sonining kamayishi natijasida ovulyatsiya kamroq sodir bo‘ladi, bu esa progesteron darajasining sezilarli pasayishiga olib keladi. Estradiol darajasi ham pasaya boshlaydi, biroq uning ishlab chiqarilishi notekis bo‘lib qoladi. Bu davrda gormonal nomutanosiblik tufayli hayz siklining buzilishi, anovulyator sikllar va vegetativ simptomlar kuzatiladi.

Menopauza davrida tuxumdonlar faoliyati susayishi bilan estrogen va progesteron ishlab chiqarilishi deyarli to‘xtaydi. Postmenopauza holatida estrogen 17 ng/ml va progesteron 0,2 ng/ml qiymatgacha kamayishi kuzatildi. Bu keltirilgan raqamli ma’lumot bolalik va o‘smirlik davridan ham pasayganligini qiyoslash mumkin. Bu holat suyaklar mo‘rtlashishi (osteoporoz) va yurak-qon tomir tizimidagi o‘zgarishlarga sabab bo‘ladi.

Postmenopauza davrida tuxumdonlar faoliyati deyarli to‘xtaydi. Estradiol darajasi keskin kamayib, progesteron esa deyarli aniqlanmaydi. Estrogenning asosiy manbai sifatida bu davrda periferik to‘qimalarda androgenlarning aromatizatsiyasi xizmat qiladi, ammo bu miqdor fiziologik ehtiyojlarni to‘liq qondira olmaydi. Natijada suyak to‘qimasining rezorbsiyasi kuchayadi, yurak-qon tomir tizimi xavfi ortadi va metabolik o‘zgarishlar yuzaga keladi.

Xulosa qilib aytganda, estrogen va progesteron darajalari ayol organizmida yoshga bog‘liq ravishda bosqichma-bosqich o‘zgaradi va bu o‘zgarishlar gipotalamo-gipofizar-tuxumdon tizimining rivojlanishi, funksional faolligi hamda regressiyasi bilan bevosita bog‘liq. Ushbu gormonlarning muvozanati reproduktiv salomatlik, metabolizm va umumiy fiziologik holatni ta’minlashda muhim rol o‘ynaydi.

FOYDALANILAGAN ADABIYOTLAR

1. Brinton E.A. Estrogen regulation of lipid and lipoprotein metabolism. Advances in Experimental Medicine and Biology. 2019;1167:127–145.
2. Dolimova S.N., Umarova G.B., Muxammadjonova G.M. Klinik biokimyo. O‘quv qo‘llanma. Toshkent. «VNESHINVE STPROM». 2019. 68-69 b.
3. Dunaif A. Insulin resistance and the polycystic ovary syndrome: mechanism and implications for pathogenesis. Endocr Rev 2017;18:774e800.
4. Rajamurodov Z.T., Radjabov A.I., Bozorov B.M. Odam va hayvonlar fiziologiyasi. Toshkent. «Fan». 2010. 39-40 b.
5. Salamun V, Jensterle M, Janez A, Bokal EV. Liraglutide increases IVF pregnancy rates in obese PTS women with poor response to first-line reproductive treatments: a pilot randomized study. Eur J Endocrinol. 2018. doi: https://doi.org/10.1530/EJE-18-0175
6. Seyam E, Al GS, Abd AGA, Mohamed M, Youseff AM, Ibrahim EM, et al. Evaluation of prolonged use of statins on the clinical and biochemical abnormalities and ovulation dysfunction in single young women with polycystic ovary syndrome. Gynecol Endocrinol 2017:1e8.
7. Алматов К.Т. Алламуратов Ш.И. Одам ва ҳайвонлар физиологияси. Darslik. Тошкент: ЎзМУ, 2004. 342-344 6.

BEGONA O’T NIQOBI OSTIDAGI DORIVOR XAZINA

Jizzax davlat pedagogika universiteti,

Tabiiy fanlar pedagogika oliy maktabi, 2-kurs talabasi

Egamberdiyeva Oyjamol Abdurauf qizi

Annotatsiya: *Ushbu maqolada keng tarqalgan dorivor o’simlik – sachratqi (cichorium intybus) ning botanik-biologik xususiyatlari, tarqalishi, kimyoviy tarkibi va dorivor ahamiyati yoritilgan. Sachratqining xalq tabobatida, farmasevtikada qo’llanilishi, shuningdek, tarkibidagi biologik faol moddalar haqida ma’lumotlar keltirilgan. Maqolada o’zbek olimlarining so’ngi yillardagi tadqiqotlari asosida o’simlikning farmasevtik ahamiyati va undan oqilona foydalanish masalalari yoritilgan.*

Kalit so‘zlar*: Sachratqi, dorivor o’simlik, biologik faol moddalar, begona o’t, dorivor xazina, tibbiyot, o’simliklar, tabiat.*

O’simliklar tabiatdagi ekologik muvozanatni saqlashda, atmosferani kislorod bilan boyitishda hamda inson hayotini zarur biologik resurslar bilan ta’minlashda muhim ahamiyatga ega.

Dorivor o’simliklar esa insoniyat tomonidan qadimdan turli kasalliklarning oldini olish va davolashda foydalanib kelingan tabiiy manbalardan biridir.

Dorivor Sachratqi (*Cichorium intybus*) dorivor xususiyatlari bilan qadrlanadigan o’simliklardan biri hisoblanadi. U Murakkabguldoshlar (Asteraceae) oilasiga kiradi. Ba’zi adabiyotlarda zangori sachrati deb ham ataladi. Sachratqi ko’p yillik, bo’yi 30-130 smgacha yetadigan o’simlik. O’simlik qurg’oqchilikka juda chidamli bo’lib chuqur ildiz tizimi orqali namlikmi shimib oladi. Fiziologik jihatdan sachratqi ildizida kraxmal o’rniga uglevod zaxirasi sifatida INULIN to’playdi. Kuz oylarida INULIN va INTIBIN glikozidi to’planishi eng yuqori darajaga chiqadi. Shuningdek uning to’qimalarida sutlama naylari (laticifers) tizimi ishlaydi, bu tizim o’simlikni zararkunandalardan himoya qiluvchi achchiq sut- shirani o’tkazadi. Zangori sachratqi o’simligi ekologik jihatdan juda chidamli va moslashuvchan bo’lib dunyo bo’ylab hamda O’zbekiston hududida keng tarqalgan. Sachratqi asosan yer sharining mo’tadil iqlimida ko’proq uchraydi. Dastlab Yevroosiyo, shimoliy Afrika hamda, Markaziy Osiyo hududlarida uchragan. Keyinchalik odamlar tomonidan Shimoliy va Janubiy Amerika, Avstraliya, Janubiy Afrika, yangi Zelandiyaga ham olib borilgan va u yerlarning iqlimiga to’liq moslashib ketgan. G’arbiy va Mrkaziy Yevropa mamlakatlarida (ayniqsa, Fransiya, Belgiya, Germaniyada) tarkibidagi Inulin moddasi hamda kofe o’rnini bosuvchi ildizi uchun maxsus plantatsiyalarda dorivor ekin sifatida ekib yetishtiriladi. O’zbekiston florasida sacgratqi deyarli barcha viloyatlarda uchraydi. Ayniqsa yurtimizning sug’oriladigan ekin maydonlarida, bedazorlarda, bog’ va poliz chetlarida juda ko’p uchraydi.

Ibn Sino o’zining “TIB QONUNLARI” asarida dorivor sachratqi haqida shunday deydi: sachratqining barcha o’simliklardan afzalligi- unda o’tkazuvchan quvvaqtning borligidadir’’. Yana Ibn Sino asarda sachratqining inson a’zolariga ta’ sirini alohida bayon qilgan: Sachratqi sovuq va quruq mijozlidir. Yovvoyi (toshloq yerda o’sadigan) turi madaniy (bog’da ekilgan) turiga qaraganda quruqroq hamda sovuqroq bo’ladi. Biroq, unda o’ziga hos nordonlik xususiyati mavjud.

Dorivor sachratqi oshqozon faoliyatini yaxshilaydi hamda, uning qizishini bosadi. Ayniqsa, safro suyuqligi tufayli kelib chiqqan me’da buzilishi va ko’ngil aynishlarida juda foydalali hisoblanadi. U nafaqat oshqozon balki, ko’z kasalliklarida ha, foydali , uning yangi siqib olingan sutsimon shirasi ko’zga tushgan oqni (katarakta)ni so’rish va davolash uchun ko’zga tomiziladi.

Issqdan bo’lgan surunkali istimalarni tushiradi. Agar tana harorati me’yordan oshib ketsa, uning suvi istimani pasaytiruvchi ajoyib vositadir.

Sachratqining yangi, quritilmagan ildizini ezib chayon, ari, ilon chaqqan joylarga, hamda bo’g’im og’riqlari bor a’zolarga bog’lansa, zahar kuchini kesadi va shishni qaytaradi.

2025-2026- yillardagi ilmiy taqdiqotlarga ko’ra, Sachratqi tarkibida Insulin, Shikorat kislotasi, Kofein kislotasi va Lyuteolin flavnoidlari qandli diabetga qarshi kuchli multi-target ta’sir ko’rsatadi. Sachratqi ildizining etilatsetatli ekstrakti yo’g’on ichak saratoni hujayralarida o’sma nekrozi omili-alfa tomonidan qo’zg’atiladigan siklooksigenaza ishlab chiqarishini sezilarli darajada susaytiradi va prostaglandin E2 sintezini kamaytiradi. Bu xususiyat o’simlikning ichak yallig’lanish kasalliklari (kolit) va stomotologiya (gingvit, parodontit) yallig’lanishiga qarshi samarali vosita ekanligini tasdiqlaydi.

Shunday qilib sachratqi bo’yicha olib borilgan tarixiy-zamonaviy qiyosiy tahlil sharq tabobati merosining hozirgi fan uchun ham amaliy ahamiyat kasb etishini tasdiqlaydi. Kelgusida sachratqining biologik faol moddalarini chuqurroq o’rganish, shuningdek, Ibn Sino kabi mutafakkirlar merosidagi dorivor o’simliklar haqiadagi ma’lumotlarni zamonaviy usullar yordamida tekshirish botanika, farmakognoziya sohalari uchun istiqbolli yo’nalish bo’lib qolmoqda.

FOYDALANILGAN ADABIYOTLAR RO’YXATI:

1. Abu Ali ibn Sino. Tib qonunlari (Al-Qonun fit-tibb). 2-jild. – Toshkent: Fan nashriyoti / Abu Ali ibn Sino nomidagi tibbiyot nashriyoti.

2. Allanazarov, O. T., Muzropov, SH. N. (2026). Sachratqi o‘simligining dorivor xususiyatlari. Ilmiy maqolalar to‘plami / Akademik jurnal.

3. Xolmatov, H. X., Ahmedov, O‘. A. (2021). Farmakognoziya: dorivor o‘simliklar anatomiyasi va morfologiyasi (Darslik). – Toshkent: "EFFECT-D" nashriyoti.

4. Muradov, Q. M., Toshmatov, Z. O. va b. (2015). Fitoterapiya asoslari (Tibbiyot o‘quvchilari uchun qo‘llanma). – Toshkent: Tibbiyot nashriyoti.

5. Xolmatov, H. X., Qosimov, A. I. (1994). Dorivor o‘simliklar (Oliy ta’lim muassasalari uchun qo‘llanma). – Toshkent: Ibn Sino nomidagi nashriyot-matbaa birlashmasi.

QORA SEDANANING *(NIGELLA SATIVA L.)* XALQ XO’JALIGIDAGI AHAMIYATI.

Baltabayeva Ayman Seytmurat qizi.

Jizzax davlat pedagogika universiteti . Tabiiy fanlar pedagogika oliy maktabi, Biologiya yo’nalishi 2-bosqich talabasi.

Ilmiy rahbar: dotsent Qarshiboyeva N.H.

Annotatsiya: *Ushbu maqolada qora sedananing (Nigella sativa L.) xalq xo’jaligidagi ahamiyati yoritilib berilgan. Sedanadan xalq tabobatida, oziq-ovqat sohasida, efir moyi va ziravor, shuningdek parxez ovqatlarda, farmetsevtika sohasida foydalaniladi.Tibbiyotda oshqozon , jigar , buyrak kasalliklari, yurak -qon tomir kassaliklari, saraton tadqiqotlarida ham qo’llanilmoqda. Shu bilan birga uni qo’llash usullari haqida ma’lumotlar berilgan.*

Kalit so’zlar: *Qora sedana (Nigella sativa L.) oziq – ovqat sanoati , tabiiy davo, sistematikasi , qo’llash usuli , xalq xo’jaligi, kimyoviy tarkibi, kelib chiqishi va tarixiy manbalari.*

Qora sedana – (*Nigella sativa L.*) xalq orasida qora zira, sedana , kalonji va habba al-baraka(barakali don) deb ataladi. Sedana -ikki urug’pallalilar sinfiga *Ayiqtovondoshlar* oilasiga mansub 1 yillik o’simlik. Odatda bo’yi 20-60 sm balandlikda o’sadi. Uning poyasi tik o’suvchi va shoxlangan tuzilishga ega. Barglari patsimon shaklda bo’lib, ko’pincha oq, ko’kimtir yoki och binafsha rangda bo’ladi.Gullari besh yoki undan ortiq gulbarglardan iborat, markazida ko’plab changchilari joylashgan. Gullash odatda bahor oxiri va yoz boshiga tog’ri keladi. O’simlik mevasi kapsula shaklida bo’ladi. Meva ichida mayda , qora rangli urug’lar hosil bo’ladi. Aynan shu urug’lar o’zining o’ziga xos hid va ta’mi bilan ajralib turadi hamda dorivor xususiyatlarga boy hisoblanadi.

Dorivor xususiyatlari. Avitsena o’zining “ Tibbiyot qonunlari “ asarida Nigella sativa L. ni nafas qisishini davolovchi sifatida tasvirlagan.

- Sedana urug’i va moyi immun hujayralari faoliyatini kuchaytiradi. Tana qarshiligini oshirib , shamollash va gripp kabi infeksiyalardan himoya qiladi.
- Nafas qisilishda oldini oladi va davolaydi.
- Sistolik va diastolik qon bosimni pasaytirishda foydalaniladi.
- Qora urug’ tarkibidagi ekstraktlar, triglitseridlar LDH va umumiy xolesterin miqdorini kamaytirish va HDL xolesterin miqdorini oshiradi.
- Yallig’lanishni pasaytiradi.
- Qon bosimni tog’irlaydi va meyorda ushlab turadi.
- Metabolik buzilish va vazn yo’qotishga yordam beradi.

- Sedana urug’lari choy shaklida siydik haydovchi, ich yumshatuvchi, sut keltiruvchi va gijjaga qarshi ishlatiladi.
- Antispalzmatik va og’riq qoldiruvchi vosita.
- Qon shakarini pasaytiruvchi (diabet davosida) sifatida qo’llaniladi.
- Urug’dagi timoksinan moddasi zararli mikroblar va viruslarga qarshi kurashadi.
- Bo’g’im og’riqlari (astrit , revmatizm) da og’riqlarni kamaytiradi.
- Ekzema , psoriaz va soch to’kilishini davolashda, shuningdek jarohtlarni tiklashda ishlatiladi.
- Qorin dam bo’lishi, diareya (ich ketishi), oshqozan yarasi va qurtlarni (gelmint) tushirishda yordam beradi.

Xalq tabobatida qo’llanilishi.

- Gemorroyda : qovurilgan qora sedana urug’ini kuniga 3 marta 1g miqdorda iste’mol qilish tavsiya etiladi.Kasallikdan xalos bo’lgandan so’ng darhol uni qabul qilish to’xtatiladi.
- Safro tutib qolishini oldini olish : sedana urug’ini 1 stakan issiq suvga solinadi. 2 soat davomida damlanadi, so’ngra suzib olib foydalaniladi. Damlamani kuniga 4 marta ovqatdan oldin ichiladi (katta yoshdagilar uchun 1 osh qoshiq).
- Sut kelishini yaxshilash uchun : idishga sedana urug’i (1 choy qoshiq) va oddiy suv (300ml) solinadi. 8 daqiqa qaynatilib , 60 daqiqa qoldiradi. Shundan so’ng dokadan o’tkaziladi va kuniga 3 marta 50 ml dan ichiladi.

Yo’tal , shamollash , bronxit va astmada asal bilan aralashtirib ichiladi.

- Oshqozon va ichak kasalliklarida mayda kukun holida iste’mol qilinadi.
- Tashqi yaralarda qora sedana moyi bilan surtma qilinadi.
- Soch to’kilishda – urug’ moyi ishlatiladi.

Kelib chiqishi. O’simlikning xalqaro ilmiy nomi lotincha so’zlardan olingan bo’lib , uning tashqi ko’rinishi va inson hayotidagi o’rnini ifodalaydi:

NIGELLA: bu so’z lotinchadagi “niger” (qora) so’zining kichraytilgan shakli bo’lib, “qorachadan kelgan” yoki “qoracha” ma’nosini bildiradi. Bu nom tog’ridan- tog’ri uning urug’larining rangiga qarab nomlanadi.

SATIVA: lotincha “sativum”so’zidan olingan bo’lib, “maydalashtirilgan” yoki “ekiladigan” degan ma’noni bildiradi. Bu o’simlik tabiatda yovvoyi holda o’sishidan ko’ra, insonlar tomonidan ming yillar davomida maxsus yetishtirib kelinganini ko’rsatadi.

- Botanik tasnifi va ilmiy tizimga solinishi.

Qora sedana botanika fanida 1753-yil shved tabiatshunos olimi Karl Linney o’zining o’simliklar dunyosini tartibga solgan fundamental “Species Plantarum” aarida sedana *Ranunculaceae*

(Ayiqtovondoshlar) oilasiga kiritgan va unga ilk bor *Nigella sativa L*. (L- Linney familyasi qisqartmasi) deb rasmiy nom bergan.

- Arxeologik va tarixiy manbalar.

Qadimgi Misr: Arxeologik qazishmalar qora sedananing qadimda naqadar qadrlanganini isbotlaydi. Uning urug’I milloddan avvalgi 1325-yillarga oid firavn Tutanxon daxmasida topilgan. Qadimgi misrliklar uni “firavnlar yog’I” sifatida go’zallik va tibbiyotda ishlatishgan.

Qadimgi Yunoniston va Rim : Milodiy I asrda yashagan yunon tabibi Dioskorid o’zining “ De Materia Medica” (tibbiy moddalar haqida) asarida sedanani bosh og’rig’i, tish og’rig’I va ichak qurtlariga qarshi dori sifatida tasvirlagan.

Yaqin Sharqda va Markaziy Osiyoda “Habbatul barakah “ (baraka urug’i) nomi bilan ommalashgan. Ibn Sino esa o’z asarlarida uning o’pka va nafas yo’llari kasalliklariga foydasini ilmiy asoslab bergan.

Xulosa qilib aytganda, sedana dorivor va foydali xususiyatlari bilan ajralib turadi. Uning tarkibida biologik faol moddalar , efir moylari , vitaminlar va mineral komponetlar mavjud bo’lib , ushbu moddalar o’simlikning xalq tabobatida keng qo’llanishiga sabab bo’lgan. Sedana urug’laridan oziq-ovqat mahsulotlarida ziravor sifatida, shuningdek, turli dorivor maqsadlarda foydalanib kelinadi. Bugungi kunda *Nigella sativa L*. dunyoning ko’plab laborotoriyalarida fundamental tibbiyot va farmakologiya yo’nalishida eng ko’p o’rganilayotgan dorivor o’simliklardan biri bo’lib qolmoqda. Shunday qilib, sedana – qadimdan foydalanib kelinayotgan, bugungi kunda ham o’zining biologik va dorivor qiymatini saqlab qolgan o’simliklardan biri xisoblanadi.

FOYDALANILGAN ADABIYOTLAR.

1. Abdullayev A.A, Xoliqov P.Botanika: O’simliklar sistematikasi.-Toshkent : O’zbekiston, 2016-yil, 248-255-betlar.
2. Tojiboyev Sh.J., Qarshiboyeva N.H. Botanika. O’quv qo’llanma.Namangan. 2015-yil. 260 bet.
3. Ahmad M, Khan M.A, Zafar M. Nigella sativa L: A revive of its phytochemistry and pharmacological properties.- Journal of Medicinal Plants Research 2021 y.130-140 bet.
4. Axmedov Ye.,Berdiyev Ye. – Dorivor o’simliklarni yetishtirish texnologiyasi. Toshkent, 2017-yil, 25-bet.
5. Yuldashev E.- Qora sedana yog’ining dorivorlik xususiyatlari va salomatlikni tiklashdagi o’rni: Shifokor tavsiyalari va amaliy qo’llanma. Toshkent ,Fan, 2021-yil, 32-36 -betlar.

DORIVOR MOYCHECHAK (MATRICARIA CHAMOMILLA L.) NING BIOLOGIK XUSUSIYATLARI VA DORIVOR AHAMIYATI

Nasrullayeva Farangiz

Jizzax davlat pedagogika universiteti

Tabiiy fanlar fakulteti, Biologiya yo‘nalishi, 2-kurs talabasi

Annotatsiya: *Ushbu maqolada dorivor moychechak (Matricaria chamomilla L.) ning biologik xususiyatlari, morfologik tuzilishi, tarqalishi va dorivor ahamiyati yoritilgan. Moychechakning xalq tabobati va farmatsevtikada qo‘llanilishi, shuningdek, uning tarkibidagi biologik faol moddalar haqida ma’lumotlar keltirilgan. Maqolada o‘simlikning tabiatdagi ahamiyati va undan oqilona foydalanish masalalari ham tahlil qilingan.*

Kalit so‘zlar*: dorivor moychechak, Matricaria chamomilla L., dorivor o‘simlik, Asteraceae, biologik xususiyatlar, dorivor ahamiyat, biologik faol moddalar.*

KIRISH: O‘simliklar tabiatdagi ekologik muvozanatni saqlashda, atmosferani kislorod bilan boyitishda hamda inson hayotini zarur biologik resurslar bilan ta’minlashda muhim ahamiyatga ega. Dorivor o‘simliklar esa insoniyat tomonidan qadimdan turli kasalliklarning oldini olish va davolashda foydalanib kelingan tabiiy manbalardan biridir.

Dorivor moychechak (Matricaria chamomilla L.) dorivor xususiyatlari bilan qadrlanadigan o‘simliklardan biri hisoblanadi. U Asteraceae (qoqio‘tdoshlar) oilasiga mansub bo‘lib, bir yillik o‘tsimon o‘simlik sifatida tavsiflanadi. Moychechakning asosan savatcha to‘pgullari dorivor xomashyo sifatida qo‘llaniladi. Moychechak tarkibida biologik faol birikmalar mavjud bo‘lib, uning dorivor xususiyatlari aynan shu moddalar bilan bog‘liq. Shu sababli mazkur o‘simlikning biologik xususiyatlarini, tarqalishini va dorivor ahamiyatini o‘rganish botanika hamda dorivor o‘simlikshunoslik nuqtayi nazaridan muhimdir.

Ushbu maqolaning maqsadi dorivor moychechakning biologik xususiyatlari va dorivor ahamiyatini ilmiy manbalar asosida yoritish hamda uning inson hayoti va tabiatdagi o‘rnini tahlil qilishdan iborat.

Dorivor moychechakning sistematik o‘rni: Dorivor moychechak — Matricaria chamomilla L. — Qoqio‘tdoshlar (Asteraceae) oilasiga mansub bir yillik o‘tsimon o‘simlikdir. Ushbu tur Matricaria turkumiga kiradi. Moychechak dorivor o‘simliklar orasida keng tarqalgan bo‘lib, uning asosan gul savatchalari dorivor xomashyo sifatida foydalaniladi. Dorivor moychechakning sistematik o‘rnini quyidagicha ifodalash mumkin: Bo‘lim: Yopiq urug‘lilar (Angiospermae) Sinf: Ikki urug‘pallalilar (Magnoliopsida) Oila: Qoqio‘tdoshlar (Asteraceae) Turkum: Moychechak (Matricaria) Tur: Dorivor moychechak

(Matricaria chamomilla L.) oychechakning o‘ziga xos belgilaridan biri uning savatcha to‘pgul hosil qilishidir. Savatchaning chetki qismida oq rangli tilsimon gullar, markazida esa sariq rangli naysimon gullar joylashadi. Bu tuzilish Qoqio‘tdoshlar oilasiga xos bo‘lgan muhim morfologik belgilaridan biridir. Moychechakning poyasi tik o‘suvchi, shoxlangan va nisbatan nozik bo‘ladi. Barglari navbatma-navbat joylashgan, bir necha marta patsimon bo‘lingan. Ildiz tizimi yaxshi rivojlangan bo‘lib, tuproqdan suv va mineral moddalarni o‘zlashtirishda muhim vazifani bajaradi. O‘simlikning gullash davrida uning savatchalari yig‘ib olinadi va tegishli sharoitda quritilib, dorivor xomashyo sifatida saqlanadi. Moychechakning biologik xususiyatlarini o‘rganishda uning morfologik tuzilishi, o‘sish sharoiti va gullash xususiyatlarini hisobga olish muhimdir.

Dorivor moychechakning morfologik tuzilishi: Dorivor moychechak bir yillik o‘tsimon o‘simlik bo‘lib, uning morfologik tuzilishi dorivor o‘simlik sifatidagi xususiyatlarini belgilovchi muhim belgilar majmuasidan iborat. O‘simlikning asosiy vegetativ organlariga ildiz, poya va barg, generativ organlariga esa gul va meva kiradi.

Ildizi. Moychechakning ildiz tizimi asosan o‘q ildiz tipida bo‘lib, undan yon ildizlar rivojlanadi. Ildiz o‘simlikni tuproqqa mahkam biriktirib turadi hamda tuproqdagi suv va mineral moddalarni o‘zlashtirishda ishtirok etadi. Ildizning rivojlanishi o‘simlikning o‘sish sharoiti, tuproq namligi va oziqa moddalariga bog‘liq. Poyasi. Poyasi tik o‘suvchi, yashil rangli, silliq yoki yuqori qismida shoxlangan bo‘lishi mumkin. Poyaning shoxlanishi natijasida bir nechta gul savatchalari hosil bo‘ladi. Poya barglar va gullarni yuqorida tutib turish bilan birga, o‘simlik bo‘ylab suv va mineral moddalarning harakatlanishida ham muhim rol o‘ynaydi. Barglari. Barglari poyada navbat bilan joylashadi. Barg yaprog‘i ingichka bo‘laklarga chuqur patsimon ajralgan bo‘lib, bu belgi moychechakni boshqa ayrim o‘simliklardan farqlashda yordam beradi. Barglarda fotosintez jarayoni amalga oshadi va o‘simlikning organik moddalar hosil qilishi ta’minlanadi. Guli va to‘pguli. Moychechakning eng muhim morfologik belgilaridan biri savatcha to‘pgulidir. Savatchaning tashqi qismida oq rangli tilsimon gullar, markaziy qismida esa sariq rangli naysimon gullar joylashadi. Oq tilsimon gullar hasharotlarni jalb qilishda muhim ahamiyatga ega. Sariq naysimon gullarda esa changlanish va urug‘ hosil bo‘lish jarayonlari kechadi. Moychechak gullari odatda yoqimli hidga ega. Gullash davrida savatchalar to‘liq ochilgan holatga keladi. Aynan shu davr dorivor xomashyoni yig‘ib olish uchun muhim hisoblanadi. Mevasi va urug‘i. Moychechak mevasi quruq, ochilmaydigan meva bo‘lib, botanik jihatdan pista meva — donacha tipiga kiradi. Urug‘lari mayda bo‘lib, ular orqali o‘simlik tabiiy sharoitda ko‘payadi. Urug‘larning unib chiqishi uchun yetarli namlik, harorat va boshqa qulay ekologik sharoitlar zarur.

Shunday qilib, moychechakning ildiz, poya, barg, gul va mevasining o‘ziga xos tuzilishi uning biologik xususiyatlarini belgilaydi. Ayniqsa, savatcha to‘pgulining tuzilishi o‘simlikni aniqlashda muhim diagnostik belgi hisoblanadi.

Dorivor moychechakning tarqalishi va ekologik xususiyatlari

Dorivor moychechak turli ekologik sharoitlarga ma’lum darajada moslasha oladigan o‘simlik hisoblanadi. U tabiiy holda yo‘l yoqalari, dalalar, bo‘sh yerlar, ekin maydonlari chetlari va boshqa ochiq joylarda uchrashi mumkin. Shuningdek, dorivor xomashyo olish maqsadida maxsus ekin sifatida ham yetishtiriladi.

Moychechakning o‘sishi va rivojlanishida tuproq, namlik, harorat va yorug‘lik kabi ekologik omillar muhim ahamiyatga ega. O‘simlik yorug‘sevar bo‘lib, yetarli quyosh nuri mavjud bo‘lgan joylarda yaxshi rivojlanadi. Yorug‘likning yetarli bo‘lishi fotosintez jarayonining normal kechishiga va o‘simlik biomassasining shakllanishiga yordam beradi. Tuproqning mexanik tarkibi va unumdorligi ham moychechakning o‘sishiga ta’sir ko‘rsatadi. Oziqa moddalariga boy va yaxshi ishlangan tuproqlarda o‘simlikning vegetativ organlari yaxshi rivojlanadi. Tuproqdagi ortiqcha namlik esa ildiz tizimining normal faoliyatiga salbiy ta’sir ko‘rsatishi mumkin. Moychechakning rivojlanishida harorat ham muhim ekologik omillardan biridir. Urug‘larning unishi, vegetativ organlarning shakllanishi va gullash jarayonlari ma’lum harorat sharoitida amalga oshadi. Vegetatsiya davrida qulay harorat va yetarli namlik o‘simlikning yaxshi rivojlanishiga yordam beradi. Moychechakni yetishtirishda agrotexnik tadbirlarni to‘g‘ri tashkil etish muhimdir. Tuproqni tayyorlash, begona o‘tlarni nazorat qilish, zarur hollarda sug‘orish va o‘simlikni o‘z vaqtida yig‘ib olish dorivor xomashyo sifatini oshirishga xizmat qiladi. Moychechakning tabiiy va madaniy populyatsiyalarini muhofaza qilish ham muhim hisoblanadi. Dorivor o‘simliklardan me’yoridan ortiq foydalanish ularning tabiiy zaxiralariga salbiy ta’sir ko‘rsatishi mumkin. Shu sababli dorivor o‘simliklarni yig‘ishda ekologik talablar va resurslardan oqilona foydalanish tamoyillariga rioya qilish zarur.

Dorivor moychechakning dorivor ahamiyati: Dorivor moychechak qadimdan dorivor o‘simlik sifatida qadrlanib keladi. Hozirgi vaqtda ham uning gul savatchalaridan tayyorlangan xomashyo farmatsevtika va fitoterapiyada keng o‘rganiladi. Moychechakning dorivor xususiyatlari, avvalo, uning tarkibidagi efir moylari, flavonoidlar va boshqa biologik faol birikmalar bilan bog‘liq. Moychechak preparatlari an’anaviy ravishda ovqat hazm qilish tizimi bilan bog‘liq ayrim yengil holatlarda, shuningdek, teri va shilliq qavatlarga mahalliy qo‘llash uchun ishlatiladi. Moychechak tarkibidagi ayrim birikmalarning yallig‘lanishga qarshi, antioksidant va mikroorganizmlarga qarshi xususiyatlari laboratoriya va boshqa ilmiy tadqiqotlarda o‘rganilgan. Moychechakdan dorivor xomashyo sifatida foydalanishda uning sifatiga katta e’tibor beriladi.

O‘simlikning gullari ekologik jihatdan toza hududlardan yig‘ilishi, to‘g‘ri quritilishi va mos sharoitda saqlanishi biologik faol moddalar saqlanishiga yordam beradi. Moychechakning dorivor ahamiyatini baholashda uning foydali xususiyatlari bilan bir qatorda ehtiyot choralarini ham hisobga olish zarur. Ayrim odamlarda, ayniqsa, Qoqio‘tdoshlar oilasiga mansub o‘simliklarga allergiyasi bo‘lganlarda nojo‘ya reaksiyalar kuzatilishi mumkin. Shuning uchun dorivor o‘simliklardan foydalanish, ayniqsa davolash maqsadida, mutaxassis tavsiyasiga asoslanishi lozim. Moychechakning farmatsevtikadagi ahamiyati uning tabiiy biologik faol moddalar manbai ekanligi bilan belgilanadi. Shu sababli ushbu o‘simlikning kimyoviy tarkibi, biologik faolligi va xomashyo sifatini o‘rganish botanika, farmakognoziya va farmatsevtika yo‘nalishlari uchun muhim ilmiy ahamiyatga ega.

6. Moychechakning amaliy va ekologik ahamiyati

Dorivor moychechak nafaqat farmatsevtika va xalq tabobatida, balki biologiya, botanika va dorivor o‘simlikshunoslik sohalarida ham muhim ahamiyatga ega. Uning gul savatchalaridan dorivor xomashyo sifatida foydalanilishi o‘simlikning amaliy qiymatini oshiradi. Moychechak asosidagi xomashyolar turli dorivor vositalar va o‘simlik preparatlarini tayyorlashda o‘rganiladi. Moychechakning amaliy ahamiyati uni yetishtirish imkoniyati bilan ham bog‘liq. O‘simlikning biologik xususiyatlarini hisobga olgan holda uni qishloq xo‘jaligida dorivor xomashyo olish maqsadida madaniy holda yetishtirish mumkin. Bunda urug‘lik materialining sifati, tuproq sharoiti, namlik, yorug‘lik va agrotexnik tadbirlarning to‘g‘ri tashkil etilishi muhim hisoblanadi. Moychechak ekologik jihatdan ham ma’lum ahamiyatga ega. Uning gullari hasharotlarni, xususan, changlatuvchi organizmlarni jalb etishda ishtirok etadi. Gullash davrida o‘simlik va hasharotlar o‘rtasidagi munosabatlar tabiiy ekotizimdagi biologik aloqalarning bir qismini tashkil qiladi. Dorivor o‘simliklarni tabiiy muhitdan yig‘ishda ekologik muvozanatni saqlash muhimdir. Moychechakning tabiiy zaxiralaridan oqilona foydalanish, o‘simliklarni haddan tashqari yig‘ib olmaslik va ularning tabiiy tiklanish imkoniyatlarini hisobga olish zarur. Madaniy sharoitda yetishtirish esa tabiiy populyatsiyalarga tushadigan bosimni kamaytirishga yordam beradi. Shuningdek, moychechakning biologik xususiyatlarini o‘rganish dorivor o‘simliklarni muhofaza qilish, ulardan samarali foydalanish va yangi biologik faol moddalarni tadqiq etish uchun ilmiy asos bo‘lib xizmat qiladi. Shu jihatdan moychechak biologik va amaliy qiymatga ega bo‘lgan dorivor o‘simliklardan biri hisoblanadi.

XULOSA: Tadqiqot davomida moychechakning biologik xususiyatlari, morfologik tuzilishi, tarqalishi, ekologik talablari, kimyoviy tarkibi va dorivor ahamiyati tahlil qilindi. Olingan ma’lumotlar shuni ko‘rsatadiki, o‘simlikdan samarali foydalanish uchun uni yetishtirish, yig‘ib olish, quritish va saqlash jarayonlariga belgilangan talablar asosida yondashish muhimdir.

Moychechakning dorivor qiymati bilan bir qatorda ekologik ahamiyatini ham hisobga olish lozim. Tabiiy resurslardan oqilona foydalanish, o‘simliklarning tabiiy zaxiralarini asrash va dorivor o‘simliklarni madaniy sharoitda yetishtirish ularni muhofaza qilishning muhim yo‘nalishlaridan hisoblanadi. Umuman olganda, dorivor moychechak biologik, dorivor va amaliy jihatdan qimmatli o‘simlik bo‘lib, uning biologik xususiyatlari va biologik faol moddalarini chuqur o‘rganish botanika, dorivor o‘simlikshunoslik, farmakognoziya hamda farmatsevtika sohalari uchun muhim ilmiy ahamiyatga ega.

FOYDALANILGAN ADABIYOTLAR

1. European Medicines Agency. European Union herbal monograph on Matricaria recutita L., flos. EMA/HMPC/55858/2012. European Medicines Agency.

2. World Health Organization. WHO Monographs on Selected Medicinal Plants. Volume 1. Geneva: World Health Organization, 1999.

3. Singh O., Khanam Z., Misra N., Srivastava M.K. Chamomile (Matricaria chamomilla L.): An overview. Pharmacognosy Reviews. 2011. Vol. 5, No. 9. P. 82–95.

4. McKay D.L., Blumberg J.B. A review of the bioactivity and potential health benefits of chamomile tea. Phytotherapy Research. 2006. Vol. 20, No. 7. P. 519–530.

5. Srivastava J.K., Shankar E., Gupta S. Chamomile: A herbal medicine of the past with a bright future. Molecular Medicine Reports. 2010. Vol. 3, No. 6. P. 895–901.

6. O‘zbekiston Respublikasi Fanlar akademiyasi. O‘zbekiston florasi: dorivor o‘simliklarga oid ma’lumotlar. Toshkent.

7. Dorivor o‘simliklarni yetishtirish va ulardan foydalanish bo‘yicha o‘quv-uslubiy manbalar. Toshkent.

CAPPARIS SPINOSA L. O‘SIMLIGINING BIOTEXNOLOGIYA VA TIBBIYOTDAGI O‘RNI

Eshboyeva Sayyora Rustam qizi*, Samarqand davlat pedagogika instituti 4-kurs talabasi, e-mail: eshboyevasayyora316@gmail.com*

Jumayeva Zebo*, Samarqand davlat pedagogika instituti 4-kurs talabasi*

Annotatsiya. *Maqolada Capparis spinosa L. (kapari) o‘simligining kimyoviy tarkibi, farmakologik xususiyatlari va biotexnologik qo‘llanilishi tahlil qilingan. O‘simlik flavonoidlar va glyukozinolatlarga boy bo‘lib, eksperimental tadqiqotlarda antioksidant, yallig‘lanishga qarshi, gipoglikemik va antimikrob ta’sirlari aniqlangan. In vitro mikroko‘paytirish va ekstraktlardan foydalanish istiqbollari ko‘rsatilgan.*

Kalit so‘zlar: *Capparis spinosa, kapari, flavonoidlar, rutin, glyukokapparin, antioksidant, mikroko‘paytirish.*

Abstract. *The article reviews the chemical composition, pharmacological properties and biotechnological applications of caper bush (Capparis spinosa L.). The plant is rich in flavonoids and glucosinolates, and experimental studies report antioxidant, anti-inflammatory, hypoglycemic and antimicrobial effects. Prospects of in vitro micropropagation and extract-based products are discussed.*

Keywords: *Capparis spinosa, caper, flavonoids, rutin, glucocapparin, antioxidant, micropropagation.*

Kirish. Dorivor o‘simliklar farmatsevtika va biotexnologiya uchun muhim xomashyo manbaidir. Qurg‘oqchilikka chidamli turlar orasida kapar daraxtchasi — Capparis spinosa L. (Capparaceae) alohida e’tiborga loyiq. U O‘rta dengiz havzasidan Markaziy Osiyogacha keng tarqalgan; gul kurtaklari (kapari) va mevalari qadimdan oziq-ovqat hamda xalq tabobatida ishlatiladi [10, 93–101-b.]. Maqolaning maqsadi — turning kimyoviy tarkibi, tibbiy ahamiyati va biotexnologik qo‘llanilish yo‘nalishlarini ilmiy adabiyotlar asosida tahlil qilishdir.

Asosiy qism. Kimyoviy tarkibi. O‘simlikning eng muhim guruhi — flavonoidlar: kapari kurtaklarida rutin, shuningdek kversetin va kempferol glikozidlari aniqlangan; ularning miqdori kelib chiqish joyi va tayyorlash usuliga qarab sezilarli farq qiladi [4, 70–74-b.]. O‘simlikka xos achchiq ta’m glyukokapparin (metilglyukozinolat) bilan bog‘liq; mirozinaza ta’sirida u antimikrob faollikka ega metil izotiotsianatga aylanadi [5, 7323–7325-b.]. Bundan tashqari alkaloidlar, polisaxaridlar, fenol kislotalar va vitaminlar topilgan [11].

C. spinosani urug‘dan ko‘paytirish qiyin: urug‘larning qattiq qobig‘i va fiziologik tinim holati unuvchanlikni pasaytiradi, qalamchalarning ildiz otishi ham past. Shu sababli bug‘in oralig‘i (nodal) eksplantlardan in vitro mikroko‘paytirish usullari ishlab chiqilgan; ular sog‘lom va bir xil ekish materialini kam vaqt ichida olish imkonini beradi [8, 9]. Muvaffaqiyat eksplant manbai, o‘sish regulyatorlari (sitokininlar, auksinlar) va sterilizatsiya rejimiga bog‘liq.Kallus va hujayra suspenziyasi kulturalari tabiiy populyatiyalarga zarar yetkazmasdan, nazorat qilinadigan sharoitda flavonoid va boshqa ikkilamchi metabolitlarni olish imkonini beradi. Bu yo‘nalishda elisitorlar va oziq muhit tarkibini optimallashtirish istiqbolli hisoblanadi, biroq C. spinosa bo‘yicha sanoat miqyosidagi texnologiyalar hali yetarlicha rivojlanmagan. Tuzlangan yoki sirkalangan kapari kurtaklari mashhur ziravor mahsulotidir. Ekstraktlar funksional oziq-ovqat qo‘shimchalari va tabiiy antioksidantlar sifatida, shuningdek kosmetik kremlarda teri himoyasi uchun qo‘llanish potensialiga ega [10, 12]. Ayrim tadqiqotlarda C. spinosa ekstraktlaridagi fenol va flavonoidlar metall ionlarini qaytaruvchi va stabillovchi agent sifatida ishlatilib, kumush kabi nanozarralar olingan. Bu usul

kimyoviy reagentlarga nisbatan ekologik jihatdan qulay deb hisoblanadi; biroq nanozarralarning xavfsizligi va standartlashtirish masalalari hali yechilishi lozim.O‘simlikning qurg‘oqchilik va sho‘rlanishga chidamliligi uni eroziyaga uchragan, kambag‘al yerlarni rekultivatsiya qilishda va quruq hududlarda muqobil qishloq xo‘jaligi ekini sifatida ko‘rib chiqishga asos bo‘ladi [9].

Oziq-ovqat sifatida iste’mol qilinganda C. spinosa odatda xavfsiz hisoblanadi, ammo yuqori dozadagi ekstraktlarning xavfsizligi, dori vositalari bilan (masalan, qondagi qandni pasaytiruvchi yoki qon ivishiga ta’sir qiluvchi preparatlar) o‘zaro ta’siri va homilador hamda emizikli ayollarda qo‘llanilishi yetarli o‘rganilmagan. Qo‘shimcha muammolar: kimyoviy tarkibning ekologik sharoit va nav bilan o‘zgaruvchanligi, standartlashtirilgan ekstraktlarning yo‘qligi, klinik sinovlarning kamligi [3]. Shu sababli C. spinosa asosidagi vositalardan foydalanishdan oldin shifokor bilan maslahatlashish lozim.

Xalq tabobatida C. spinosa revmatizm, jigar va ichak kasalliklari, qand diabeti va teri kasalliklarida qo‘llanilgan [10, 93–101-b.]. Eksperimental tadqiqotlarda ekstraktlarning antioksidant faolligi, jumladan oshqozonda hazm qilinishni taqlid qiluvchi tizimda ham namoyon bo‘lishi [9, 8465–8471-b.], ultrabinafsha nurlaridan himoya qilish xususiyati [1, 321–335-b.] va xondrositlarda yallig‘lanishni kamaytirishi [7, 2479–2488-b.] qayd etilgan. 2-toifa qand diabeti bilan og‘rigan bemorlarda meva ekstrakti bilan o‘tkazilgan sinovda glikemik ko‘rsatkichlarning yaxshilanishi xabar qilingan [3, 447–452-b.]. Ekstraktlarning bakteriyalar va zamburug‘larga qarshi faolligi ham aniqlangan [2, 727–733-b.]. Biroq dalillarning aksariyati hujayra va hayvon modellariga tegishli, klinik tadqiqotlar esa kam va kichik hajmli [11].

Xulosa. C. spinosa flavonoidlar va glyukozinolatlarga boy, ko‘p qirrali dorivor va biotexnologik ahamiyatga ega o‘simlikdir. Uning antioksidant, yallig‘lanishga qarshi, gipoglikemik va antimikrob ta’sirlari eksperimental tasdiqlangan, ammo inson ishtirokidagi klinik dalillar cheklangan. Istiqbolli vazifalar: O‘zbekiston populyatsiyalarining fitokimyoviy profilini aniqlash, mikroko‘paytirish texnologiyalarini takomillashtirish, standartlashtirilgan ekstraktlar yaratish va sifatli klinik sinovlar o‘tkazish.

FOYDALANILGAN ADABIYOTLAR

1. Bonina F., Puglia C., Ventura D., et al. In vitro antioxidant and in vivo photoprotective effects of a lyophilized extract of Capparis spinosa L. buds // Journal of Cosmetic Science. – 2002. – Vol. 53. – P. 321–335.

2. Gull T., Sultana B., Bhatti I.A., Jamil A. Antibacterial potential of Capparis spinosa and Capparis decidua extracts // International Journal of Agriculture and Biology. – 2015. – Vol. 17, No. 4. – P. 727–733.

3. Huseini H.F., Hasani-Rnjbar S., Nayebi N., et al. Capparis spinosa L. (caper) fruit extract in treatment of type 2 diabetic patients // Complementary Therapies in Medicine. – 2013. – Vol. 21, No. 5. – P. 447–452.

4. Inocencio C., Rivera D., Alcaraz F., Tomás-Barberán F.A. Flavonoid content of commercial capers produced in Mediterranean countries // European Food Research and Technology. – 2000. – Vol. 212. – P. 70–74.

5. Matthäus B., Özcan M. Glucosinolate composition of young shoots and flower buds of capers growing wild in Turkey // Journal of Agricultural and Food Chemistry. – 2002. – Vol. 50, No. 25. – P. 7323–7325.

6. Musallam I., Duwayri M., Shibli R., Al-Qudah T. Micropropagation of caper (Capparis spinosa L.) from wild plants // Functional Plant Science and Biotechnology. – 2011. – Vol. 5, No. 1. – P. 17–21.

7. Panico A.M., Cardile V., Garufi F., et al. Protective effect of Capparis spinosa on chondrocytes // Life Sciences. – 2005. – Vol. 77, No. 20. – P. 2479–2488.

8. Sozzi G.O. Caper bush: botany and horticulture // Horticultural Reviews. – 2001. – Vol. 27. – P. 125–188.

9. Tesoriere L., Butera D., Gentile C., Livrea M.A. Bioactive components of caper (Capparis spinosa L.) from Sicily and antioxidant effects in a red meat simulated gastric digestion // Journal of Agricultural and Food Chemistry. – 2007. – Vol. 55, No. 21. – P. 8465–8471.

10. Tlili N., Elfalleh W., Saadaoui E., et al. The caper (Capparis L.): ethnopharmacology, phytochemical and pharmacological properties // Fitoterapia. – 2011. – Vol. 82, No. 2. – P. 93–101.

11. Zhang H., Ma Z.F. Phytochemical and pharmacological properties of Capparis spinosa as a medicinal plant // Nutrients. – 2018. – Vol. 10, No. 2. – Art. 116.

IV-SHU'BA

BIOLOGIYA TA'LIMIDA INNOVATSION PEDAGOGIK YONDASHUVLAR.

DEVELOPING STUDENTS' HIGHER-ORDER THINKING SKILLS IN BIOLOGY EDUCATION IN THE ERA OF ARTIFICIAL INTELLIGENCE: CONCEPTUAL FOUNDATIONS OF THE «BESTIK AI» TECHNOLOGY

Aidana Berikkyzy Aidarova

Al-Farabi Kazakh National University, PhD Student

Specialized Lyceum No. 178, Biology Teacher

E-mail: go.gette1992@gmail.com, Phone: +7 700 626 02 92

Abstract. *This article examines the conceptual foundations of the «BESTIK AI» pedagogical technology, which aims to develop students' higher-order thinking skills in biology education. The theoretical framework draws on the revised Bloom's taxonomy, critical thinking, scientific reasoning, inquiry-based learning, and the principles of responsible artificial intelligence (AI) use. Particular attention is given to the role of AI as a resource for supporting students' independent reasoning rather than replacing their cognitive activity. The article outlines potential criteria for assessing higher-order thinking skills and identifies priorities for future empirical research. The proposed framework provides a theoretical basis for investigating the pedagogical potential of the "BESTIK AI" technology in biology education.*

Keywords: *artificial intelligence, biology education, higher-order thinking skills, critical thinking, scientific reasoning, inquiry-based learning, pedagogical technology.*

1. Introduction

The rapid development of artificial intelligence (AI), particularly generative AI, is creating new opportunities and challenges for education. In biology education, AI tools can support the explanation of biological phenomena, the analysis of scientific information, and the exploration of complex problems. However, access to information does not automatically ensure scientific understanding, critical evaluation of evidence, or the ability to formulate well-founded conclusions. Therefore, integrating AI into education requires pedagogical approaches that promote students' independent thinking.

Biology learning involves interpreting data, identifying relationships between biological processes, evaluating scientific claims, and drawing evidence-based conclusions. In the revised Bloom's taxonomy, analysing, evaluating, and creating are classified as higher-order cognitive processes [1, 352 p.]. Developing these abilities is therefore an important objective of biology education.

A central challenge of AI-supported learning is ensuring that students evaluate generated information rather than accept it uncritically. AI-generated responses may contain inaccuracies or incomplete explanations, making verification and critical assessment essential components of the learning process.

The aim of this article is to establish the conceptual foundations of the «BESTIK AI» pedagogical technology for developing students’ higher-order thinking skills in biology education. The article examines its theoretical basis, pedagogical orientation, and potential assessment criteria without disclosing the technology’s specific stages or implementation algorithm.

2. Theoretical and Methodological Foundations of the Study

The theoretical framework of the «BESTIK AI» technology draws on the revised Bloom’s taxonomy, critical thinking, scientific reasoning, inquiry-based learning, and responsible AI use.

Anderson and Krathwohl’s revised Bloom’s taxonomy identifies six cognitive processes: remembering, understanding, applying, analysing, evaluating, and creating [1, 352 p.]. In biology education, these processes range from recalling biological concepts to interpreting data, assessing scientific claims, and developing evidence-based explanations. Crowe, Dirks, and Wenderoth [2, p.368-381] demonstrate the relevance of Bloom’s taxonomy to designing and assessing learning activities in biology.

Critical thinking involves evaluating information, examining the validity of claims, and considering alternative explanations. Scientific reasoning focuses on interpreting data, identifying relationships, and drawing conclusions supported by evidence. These abilities are particularly important when students analyse biological processes or assess AI-generated explanations.

Inquiry-based learning provides a pedagogical framework for developing these skills through questioning, hypothesis examination, data analysis, and the construction of scientific explanations. In this context, AI can support the exploration of alternative interpretations, while students remain responsible for evaluating evidence and justifying their conclusions.

UNESCO’s guidance on generative AI in education and research emphasises a human-centred and responsible approach to its use [3, 44 p.]. Accordingly, AI-generated information should be treated as material for critical examination rather than as unquestionable knowledge.

These perspectives complement one another: Bloom’s taxonomy informs the selection of cognitive objectives; critical thinking and scientific reasoning define the abilities to be developed; inquiry-based learning provides the pedagogical context; and responsible AI use establishes principles for integrating technological support into learning.

3. Conceptual Foundations of the «BESTIK AI» Technology

The «BESTIK AI» pedagogical technology aims to integrate AI-supported learning with the development of students' higher-order thinking skills. Its central objective is to establish learning conditions that encourage students to analyse biological information, evaluate scientific claims, reason on the basis of evidence, and formulate independent conclusions.

The technology emphasises the student's active role in learning. Rather than merely reproducing information, students are expected to interpret data, examine relationships, and substantiate their conclusions using scientific evidence.

A defining feature of the technology is its pedagogical treatment of AI as a resource for examining information, comparing alternative explanations, and evaluating reasoning. Since AI-generated responses may contain errors or unsupported claims, students need to assess their accuracy and compare them with reliable scientific information.

The teacher formulates the learning problem, guides students in selecting appropriate information sources, and evaluates the quality of their reasoning. Students participate actively in analysing information, examining evidence, and justifying their conclusions.

The relevance of this approach can be illustrated through biology tasks involving the factors affecting photosynthesis, changes in ecosystems, genetic data, and physiological processes. Such tasks connect subject knowledge with critical thinking and scientific reasoning. This article focuses on the general conceptual foundations of the technology; its specific stages and implementation algorithm are beyond the scope of the present publication.

4. Discussion

The pedagogical potential of the «BESTIK AI» technology lies in its capacity to support learning activities that require students to analyse scientific information, compare explanations, and evaluate evidence. Comparing AI-generated responses with established biological knowledge may encourage students to adopt a more critical approach to information.

However, AI should not replace independent reasoning. Accepting generated responses without verification may limit students' cognitive engagement. Therefore, learning tasks should require students to assess the validity of claims, justify their interpretations, and formulate evidence-based conclusions.

Potential assessment criteria include the analysis of biological information, evaluation of scientific claims, evidence-based reasoning, formulation of conclusions, and identification of inaccuracies in AI-generated responses. These criteria should be translated into clearly defined indicators and appropriate assessment tasks.

The conceptual framework does not establish the effectiveness of the technology. Its effectiveness should be investigated through empirical research, potentially involving control and

experimental groups and comparisons of pre-intervention and post-intervention results. Appropriate assessment instruments and procedures are necessary to ensure the validity and reliability of the findings.

5. Conclusion

The «BESTIK AI» technology is conceptually oriented towards integrating artificial intelligence into biology education to support the development of students’ higher-order thinking skills. Its theoretical foundations combine Bloom’s taxonomy, critical thinking, scientific reasoning, inquiry-based learning, and the principles of responsible AI use.

Its central pedagogical principle is to use AI as a resource for analysing information and evaluating scientific evidence rather than as a substitute for students’ own reasoning. Further research should establish measurable indicators of higher-order thinking skills, develop and validate appropriate assessment instruments, and evaluate the technology through a pedagogical experiment. Such research will provide empirical evidence of its effectiveness and inform recommendations for its application in biology education.

REFERENCES

1. Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom’s Taxonomy of Educational Objectives*. Longman.

2. Crowe, A., Dirks, C., & Wenderoth, M. P. (2008). Biology in Bloom: Implementing Bloom’s Taxonomy to Enhance Student Learning in Biology. *CBE—Life Sciences Education, 7*(4), 368–381. https://doi.org/10.1187/cbe.08-05-0024

3. Miao, F., & Holmes, W. (2023). *Guidance for Generative AI in Education and Research*. UNESCO. https://doi.org/10.54675/EWZM9535

BIOLOGIYA DARSLARIDA GUL MORFOLOGIYASI VA CHANGLANISH JARAYONLARINI O‘QITISHDA PALINOLOGIK PREPARATLARGA ASOSLANGAN INNOVATSION YONDASHUV

Axrorova Sarvinoz Alisher qizi

Samarqand davlat pedagogika instituti Biologiya yo‘nalishi talabasi

E-mail: sarvinozaxrorova19@gmail.com

Annotatsiya *Maqolada umumiy o‘rta ta’lim maktablarining biologiya darslarida gulning morfologik tuzilishi va changlanish jarayonlarini o‘qitishda palinologik preparatlardan foydalanishning didaktik imkoniyatlari yoritilgan. Kislotali atsetolizsiz, maktab sharoitiga*

moslashtirilgan vaqtinchalik va doimiy preparatlar tayyorlash, chang donachalarini o‘stirish hamda maktab hovlisida havodagi changni gravimetrik usulda yig‘ish usullari taklif etilgan. Shamol va hasharotlar yordamida changlanadigan o‘simliklar changini qiyoslash orqali «tuzilish – funksiya» bog‘liqligini o‘rgatuvchi 5E modelidagi dars loyihasi hamda o‘quvchilar bilim va ko‘nikmalarini baholash mezonlari ishlab chiqilgan.

Kalit so‘zlar: *biologiya ta’limi, palinologiya, chang donachasi, gul morfologiyasi, changlanish, palinologik preparat, tadqiqotga asoslangan ta’lim, 5E modeli.*

Аннотация. *В статье раскрываются дидактические возможности использования палинологических препаратов при изучении морфологического строения цветка и процессов опыления на уроках биологии в общеобразовательной школе. Предложены адаптированные к школьным условиям методы приготовления временных и постоянных препаратов без кислотного ацетолиза, проращивания пыльцевых зёрен и гравиметрического сбора пыльцы из воздуха на пришкольном участке. Разработаны проект урока по модели 5E, формирующий понимание связи «строение – функция» через сравнение пыльцы ветро- и насекомоопыляемых растений, а также критерии оценки знаний и умений учащихся.*
Ключевые слова: *биологическое образование, палинология, пыльцевое зерно, морфология цветка, опыление, палинологический препарат, исследовательское обучение, модель 5E.*

Abstract. *The article examines the didactic potential of palynological preparations (pollen slides) for teaching flower morphology and pollination in school biology lessons. School-adapted methods are proposed for making temporary and permanent pollen slides without acid acetolysis, germinating pollen grains, and gravimetric sampling of airborne pollen in the schoolyard. A 5E lesson design that builds understanding of the structure–function relationship by comparing the pollen of wind- and insect-pollinated plants is presented, together with criteria for assessing students’ knowledge and skills.*

Keywords: *biology education, palynology, pollen grain, flower morphology, pollination, pollen slide, inquiry-based learning, 5E model.*

Tabiiy fanlar ta’limini amaliyotga yo‘naltirish bugungi ta’lim islohotlarining ustuvor vazifalaridan biri. O‘zbekiston Respublikasi Prezidentining 2020-yil 12-avgustdagi PQ-4805-son qarorida umumta’lim maktablarida kimyo va biologiya fanlarini o‘qitish sifati zamon talablariga javob bermasligi, o‘qitish metodologiyasi va laboratoriyalar ma’nan eskirganligi qayd etilgan hamda tabiiy fanlar o‘quv dasturlarida amaliy mashg‘ulotlar ulushini ko‘paytirish vazifasi belgilangan [1].

Xalqaro baholash natijalari ham bu zaruratni tasdiqlaydi. O‘zbekiston ilk bor qatnashgan PISA-2022 tadqiqotida o‘quvchilarimizning tabiiy-ilmiy savodxonlik bo‘yicha o‘rtacha natijasi 355

ballni tashkil etib, OECD mamlakatlari o‘rtacha ko‘rsatkichidan (485 ball) ancha past bo‘lgan [2]. Kuzatish, faraz qilish va dalil asosida xulosa chiqarish ko‘nikmalari esa o‘quvchi laboratoriya ishi va tadqiqot jarayonida bevosita ishtirok etgandagina samarali shakllanadi [3; 4].

Gul, changlanish va urug‘lanish mavzulari umumiy o‘rta ta’lim maktablarining 6-sinf «Biologiya (Botanika)» kursida o‘rganiladi [5]. Bu mavzulardagi asosiy jarayonlar chang donachasining hosil bo‘lishi, uning urug‘chi tumshuqchasiga tushishi va chang naychasining o‘sishi mikroskopik darajada kechadi. Shu sababli o‘quvchi bilimi ko‘pincha sxematik rasm va ta’riflarni yodlashga tayanib qoladi.

Bunga o‘quvchilarning o‘simliklarga hayvonlarga nisbatan kamroq e’tibor qaratishi adabiyotda «o‘simliklar ko‘rligi» (plant blindness) deb nomlangan hodisa ham qo‘shiladi [6]. Biologiya o‘qitish metodikasida esa ko‘rgazmalilik va laboratoriya mashg‘ulotlari tabiat obyektlari haqida aniq tasavvur hosil qilishning asosiy sharti sifatida qaraladi [5].

Palinologiya o‘simliklarning chang donachalari va sporalarini o‘rganuvchi fan bu muammoni hal etish uchun qulay vosita beradi. Chang donachasining tashqi qobig‘i (ekzina) kimyoviy jihatdan o‘ta chidamli sporopolleninidan tuzilgan, uning shakli, aperturalari (teshik va egatchalari) va yuza naqshi ko‘pincha oila yoki turkum darajasida farqlanadi. Shu bois changni oson yig‘ish, uzoq saqlash va qiyoslash mumkin. Palinologik preparatlar gulning makrotuzilishini (changchi, changdon, urug‘chi) mikroskopik tuzilmalar bilan bog‘lab, changlanishni ko‘z bilan ko‘rinadigan jarayonga aylantiradi.

Tadqiqot maqsadi biologiya darslarida gul morfologiyasi va changlanish jarayonlarini o‘qitishda palinologik preparatlardan foydalanishning didaktik imkoniyatlarini asoslash va ularni maktab sharoitiga moslashtirilgan metodik tizim sifatida taklif etish.

Tadqiqotda botanika, palinologiya va biologiya o‘qitish metodikasiga oid adabiyotlarni nazariy tahlil qilish, o‘quv dasturi va darslik mazmunini tahlil qilish, pedagogik loyihalash, pedagogik tajriba-sinov hamda matematik-statistik tahlil metodlaridan foydalaniladi. Preparatlar uchun Samarqand sharoitida keng tarqalgan, changlanish usuli va chang donachasi tipi bilan bir-biridan aniq farq qiladigan madaniy va yovvoyi o‘simliklar tanlandi (1-jadval). Tanlovda ikki tamoyilga amal qilindi: shamol va hasharotlar yordamida changlanadigan turlarni bir xil sharoitda qiyoslash hamda bir oila ichidagi farqlarni ko‘rsatish (masalan, Asteraceae oilasida hasharotlar yordamida changlanadigan kungaboqar va shamol yordamida changlanadigan shuvoq).

Maktab sharoitiga moslashtirilgan to‘rt xil ish usuli taklif etiladi:

- vaqtinchalik preparat. Yangi ochilgan gulning changdoni buyum oynasidagi bir tomchi suv yoki glitserin ustida silkitiladi, zarur bo‘lsa asosiy fuksin yoki safraninning kuchsiz eritmasi

qo‘shiladi va qoplagich oyna bilan yopiladi. Bo‘yoq ekzinani pushti-qizil rangga bo‘yab, aperturalar va yuza naqshini yaqqol ko‘rsatadi; preparat 3–5 daqiqada tayyor bo‘ladi.

- doimiy preparat va palinoteka. R.P. Wodehouse usulining soddalashtirilgan varianti qo‘llaniladi: chang spirt bilan yog‘ va smolalardan tozalanadi, bo‘yalgan glitserin-jelatinaga joylanadi, qoplagich oyna chetlari parafin yoki rangsiz lak bilan germetiklanadi. Klassik palinologiyadagi atsetoliz usuli (sirka angidridi va konsentrlangan sulfat kislota aralashmasida qizdirish) [1] xavfsizlik talablariga ko‘ra maktabda qo‘llanilmaydi; bunday preparatlar zarur bo‘lsa oliy ta’lim muassasasi laboratoriyasidan tayyor holda olinadi.

- chang donachalarini o‘stirish. Chang 10–15 % li saxaroza eritmasi tomchisiga sepiladi va nam kamerada (ichiga nam filtr qog‘oz to‘shalgan Petri idishida) saqlanadi; eritmaga oz miqdorda bor kislotasi qo‘shilsa, unuvchanlik ortadi. Ko‘plab turlarda 30–60 daqiqadan so‘ng chang naychalarining o‘sishi kuzatiladi.

- havodagi changni gravimetrik yig‘ish. O.C. Durham taklif etgan usul asosida vazelin yoki glitserin-jelatina surtilgan buyum oynasi maktab hovlisida, yomg‘irdan himoyalangan joyda gorizontal holatda 24 soatga qo‘yiladi. So‘ng chang donachalari sanalib, ularning 1 sm^2 ga to‘g‘ri keladigan soni hisoblanadi [1]. Bu ish o‘quvchilarni changlanishning mavsumiy dinamikasi va pollinoz (changga allergiya) muammosi bilan tanishtiradi.

Kuzatishlar maktab yorug‘lik mikroskopida (×100–×400) olib boriladi, chang donachasining o‘lchami okulyar-mikrometr bilan aniqlanadi. Tasvirlar okulyarga moslangan smartfon kamerasi orqali suratga olinib, sinfning raqamli palinoatlasiga jamlanadi; turlarni aniqlashda PalDat xalqaro palinologik ma’lumotlar bazasidan foydalaniladi [2]. Metodikaning samaradorligi 6-sinf o‘quvchilaridan tuzilgan tajriba (TG) va nazorat (NG) guruhlarida tekshiriladi: TG darslari palinologik preparatlar asosida, NG darslari an’anaviy usulda o‘tiladi. Tajriba-sinov boshida va oxirida bir xil diagnostik topshiriqlar beriladi, natijalar Pirsonning χ^2 mezoni yordamida statistik baholanadi [3].

1-jadval.

Maktab mashg‘ulotlari uchun tavsiya etiladigan o‘simliklar changining qiyosiy tavsifi (adabiyot ma’lumotlari asosida [8; 12])

O‘simlik (oila)	Changlanish	Chang tipi (aperturalar)	Ekzina yuzasi	O‘lcham sinfi	Darsdagi didaktik vazifasi
Qarag‘ay –	Shamol	Ikki havo	Xaltachalari	Yirik	Shamol

O‘simlik (oila)	Changlanish	Chang tipi (aperturalar)	Ekzina yuzasi	O‘lcham sinfi	Darsdagi didaktik vazifasi
Pinus sp. (Pinaceae)		xaltachali (bisakkat)	to‘rsimon tuzilishli		orqali tarqalishga moslanishni yaqqol ko‘rsatadi
Makkajo‘xori – *Zea mays* (Poaceae)	Shamol	Bir teshikli (monoporat), teshik atrofida halqa	Silliq, mayda donador	Yirik – juda yirik	Bir pallalilarga xos tip; «shamol – mayda chang» qoidasidan istisno
Oq sho‘ra – *Chenopodium album* (Amaranthaceae)	Shamol	Ko‘p teshikli (periporat), «golf to‘pi»ga o‘xshash	Mayda donador	Mayda – o‘rta	Havoda keng tarqalgan allergen; gravimetrik namunada oson aniqlanadi
Shuvoq – *Artemisia* sp. (Asteraceae)	Shamol	Uch egatcha-teshikli (trikolporat)	Tikanchalari reduksiyalangan, mayda donador	Mayda	Kungaboqar bilan qiyoslash: bir oila ichida shamolga moslanish
Kungaboqar – *Helianthus annuus* (Asteraceae)	Hasharotlar	Uch egatcha-teshikli (trikolporat)	Yirik tikanchali (ekhinat), yopishqoq	O‘rta	Tikanchalar va yopishqoq qoplama hasharot

O‘simlik (oila)	Changlanish	Chang tipi (aperturalar)	Ekzina yuzasi	O‘lcham sinfi	Darsdagi didaktik vazifasi
					tanasiga yopishishni ta’minlaydi
Qovoq – *Cucurbita pepo* (Cucurbitaceae)	Hasharotlar	Ko‘p teshikli, teshiklari qopqoqchali	Yirik tikanchali	Juda yirik	Kichik kattalashtirishda ham ko‘rinadi — mikroskop bilan ishlashni o‘rganish uchun qulay
Gulxayri – *Alcea rosea* (Malvaceae)	Hasharotlar	Ko‘p teshikli (periporat)	Yirik tikanchali	Juda yirik	Entomofiliyaning klassik namunasi: tikanli sharsimon chang
Liliya – *Lilium* sp. (Liliaceae)	Hasharotlar	Bir egatchali (monosulkat)	Yirik katakli to‘rsimon (retikulat)	Yirik – juda yirik	Bir pallalilarning bir egatchali changini ikki pallalilarning uch aperturali changi bilan qiyoslash

Izoh: o‘lcham sinflari mayda (10–25 mkm), o‘rta (26–50 mkm), yirik (51–100 mkm), juda yirik (100 mkm dan katta) [2]. Qarag‘ay ochiq urug‘li o‘simlik bo‘lib, gul hosil qilmaydi; u shamolga moslanishni qiyoslash uchun olingan.

Jadvaldagi o‘simliklar bahordan kuzgacha turli muddatlarda gullaydi. Shu bois chang gullash davrida yig‘ilib, qog‘oz paketlarda quruq holda saqlanadi va o‘quv yili davomida morfologik kuzatishlar uchun ishlatiladi; o‘stirish tajribasi uchun esa yangi chang olinadi.

2-jadval.

«Changlanish» mavzusidagi darsning 5E modeli asosidagi loyihasi

Bosqich (vaqt)	O‘qituvchi faoliyati	O‘quvchi faoliyati	Palinologik resurs
Qiziqtirish – Engage (5 daq.)	Muammoli savol beradi: «Nega makkajo‘xori va kungaboqar turlicha changlanadi?»; chang donachalari mikrofotosuratlarini ko‘rsatadi	Faraz bildiradi va daftarga yozib qo‘yadi	Raqamli palinoatlasdan 4–6 ta surat
Izlanish – Explore (15 daq.)	Guruhlarga yo‘riqnoma va kuzatish varag‘ini beradi, xavfsizlik qoidalarini eslatadi	Shamol va hasharotlar yordamida changlanadigan 2 tadan o‘simlik changidan vaqtinchalik preparat tayyorlaydi, kuzatadi, o‘lchaydi, rasmini chizadi	Yangi gullar yoki quritilgan chang, glitserin, fuksin, okulyar-mikrometr
Tushuntirish – Explain (8 daq.)	Guruh natijalarini umumlashtiradi, ekzina, aperturalar va moslanish belgilarini izohlaydi	Natijalarni taqdim etadi, farazini tasdiqlaydi yoki rad etadi	Kuzatish varag‘i, 1-jadval
Kengaytirish – Elaborate (10 daq.)	Oldindan qo‘yilgan chang o‘stirish tajribasini va maktab hovlisidan olingan	Chang naychasini kuzatadi, changlanishni urug‘lanish bilan	Saxaroza eritmasidagi chang, gravimetrik buyum oynasi

Bosqich (vaqt)	O‘qituvchi faoliyati	O‘quvchi faoliyati	Palinologik resurs
	gravimetrik namunani ko‘rsatadi, pollinoz haqida suhbat o‘tkazadi	bog‘laydi	
Baholash – Evaluate (7 daq.)	«Noma’lum» doimiy preparatlarni tarqatadi, mezonlar asosida baholaydi	Changlanish usulini aniqlaydi va asoslaydi, refleksiya qiladi	Palinotekadagi doimiy preparatlar

O‘quvchilar bilim va ko‘nikmalarini baholash uchun uchta mezon taklif etiladi:

kognitiv mezon gul qismlari va ularning vazifasi, chang donachasining tuzilishi (ekzina, intina, aperturalar), changlanish turlari va moslanishlarni bilish.

Amaliy-faoliyat mezoni mikroskopda ishlash, preparat tayyorlash, o‘lchash, rasm chizish, chang tipini aniqlash va qiyoslash.

Motivatsion-qadriyat mezoni biologiya va tadqiqot faoliyatiga qiziqish, ekologik hamda salomatlik masalalariga (pollinoz) ongli munosabat.

Har bir mezon bo‘yicha o‘quvchilar yuqori, o‘rta va past o‘zlashtirish darajalariga ajratiladi. Tajriba va nazorat guruhlaridagi taqsimot farqi Pirsonning χ^2 mezoni bilan $p < 0,05$ ahamiyatlilik darajasida tekshiriladi [3].

Xulosa qilib aytganda, palinologik preparatlar gul morfologiyasi va changlanish mavzularida makro- va mikrodarajadagi bilimlarni birlashtirib, abstrakt jarayonlarni ko‘rgazmali va tadqiq etiladigan obyektga aylantiradi, atsetolizsiz vaqtinchalik va glitserin-jelatinali doimiy preparatlar, changni saxaroza eritmasida o‘stirish va gravimetrik namuna olish usullari arzon, xavfsiz va maktab sharoitida bajarilishi oson, maktablarda mahalliy floraga asoslangan palinoteka va raqamli palinoatlas yaratishni pedagogika oliy ta’lim muassasalari bilan hamkorlikda tashkil etish tavsiya etiladi. Metodikaning samaradorligi keyingi bosqichda pedagogik tajriba-sinov natijalari asosida baholanadi.

FOYDALANILGAN ADABIYOTLAR

1. O‘zbekiston Respublikasi Prezidentining 2020-yil 12-avgustdagi «Kimyo va biologiya yo‘nalishlarida uzluksiz ta’lim sifatini va ilm-fan natijadorligini oshirish chora-tadbirlari to‘g‘risida»gi PQ-4805-son qarori. – URL: lex.uz/docs/4945470
2. Pratov O‘., To‘xtayev A., Azimova F., Saparboyev I., Umaraliyeva M. Biologiya (Botanika). 6-sinf uchun darslik. – Toshkent: O‘zbekiston, 2017.

3. Wandersee J.H., Schussler E.E. Preventing plant blindness // The American Biology Teacher. – 1999. – Vol. 61, № 2. – P. 82–86.
4. Tolipova J.O., G‘ofurov A.T. Biologiya o‘qitish metodikasi: o‘quv-metodik qo‘llanma. – Toshkent: Bilim, 2004. – 160 b.
5. Durham O.C. The volumetric incidence of atmospheric allergens. IV. A proposed standard method of gravity sampling, counting, and volumetric interpolation of results // Journal of Allergy. – 1946. – Vol. 17, № 2. – P. 79–86.
6. PalDat – a palynological database [Elektron resurs]. – URL: www.paldat.org

UDC 378.147:57:004

DEVELOPING PRE-SERVICE BIOLOGY TEACHERS’ STEM AND DIGITAL COMPETENCE THROUGH THE INTEGRATION OF VIRTUAL LABORATORIES AND GENERATIVE ARTIFICIAL INTELLIGENCE

Boranbayeva L.

Phd Doctoral Candidate, Al-Farabi Kazakh National University, Almaty, Kazakhstan

Kuralbayevna Z.K.

PhD, Assistant Professor Al-Farabi Kazakh National University, Almaty, Kazakhstan,

*e-mail: g_2076@mail.ru., Boranbayeva-Laura@mail.ru

Аннотация *В статье представлена методика формирования STEM- и цифровой компетентности будущих учителей биологии посредством интеграции виртуальных лабораторий и генеративного искусственного интеллекта. Исследование основано на интегративном анализе современных работ по цифровой компетентности, TPACK, виртуальному эксперименту, исследовательскому обучению и генеративному ИИ в подготовке педагогов. Авторская модель Vlab-GenAI-STEM включает пять этапов: постановку проблемы, виртуальное исследование, интерпретацию при поддержке ИИ, инженерно-педагогическое проектирование и доказательную рефлексию. Цифровая компетентность конкретизирована через информационную грамотность, цифровой эксперимент, создание контента, педагогическую интеграцию, грамотность и этику ИИ, а также рефлексивную профессиональную самостоятельность. Результат генеративного*

ИИ не рассматривается как научное доказательство и должен проверяться на основе экспериментальных данных и надежных биологических источников. Предложены учебные задания, показатели оценивания и квазиэкспериментальный дизайн для эмпирической проверки модели.

Ключевые слова: будущие учителя биологии, STEM-образование, цифровая компетентность, виртуальная лаборатория, генеративный искусственный интеллект, TPACK, ИИ-грамотность.

Abstract

The rapid expansion of virtual laboratories and generative artificial intelligence is changing the knowledge and practices expected of biology teachers. This article develops a methodological framework for integrating these technologies into STEM-oriented pre-service biology teacher education. The study uses an integrative review and design-oriented synthesis of recent research on digital competence, technological pedagogical content knowledge, virtual experimentation, inquiry-based biology education, and generative AI in science teacher preparation. The proposed Vlab-GenAI-STEM model consists of five interconnected phases: problem framing, virtual investigation, AI-supported interpretation, engineering design, and evidence-based reflection. Digital competence is operationalised through six dimensions: information and data literacy, digital experimentation, content creation, pedagogical integration, AI literacy and ethics, and reflective professional agency. The model positions virtual laboratories as environments for generating and testing biological evidence, while generative AI functions as a scaffold for questioning, explanation, modelling, feedback, and lesson design. AI output is not treated as evidence; it must be verified against experimental data and authoritative biological sources. The article proposes learning activities, assessment indicators, and a quasi-experimental research design suitable for evaluating the framework. It concludes that technology contributes to teacher competence only when it is embedded in authentic biological inquiry, explicit pedagogical reasoning, ethical verification, and the creation of assessable teaching products.

Keywords: pre-service biology teachers, STEM education, digital competence, virtual laboratory, generative artificial intelligence, TPACK, AI literacy, inquiry-based learning.

Biology teacher education is being reshaped by two parallel developments. The first is the growing expectation that science teachers can design interdisciplinary STEM learning in which scientific knowledge is connected to technology, engineering design and quantitative reasoning. The second is the rapid spread of virtual laboratories, simulations and generative artificial intelligence tools. Together, these developments create opportunities to visualise biological

processes, investigate phenomena that are difficult to reproduce in a conventional laboratory, analyse complex data and design adaptive learning materials. They also create new risks, including inaccurate AI-generated explanations, uncritical dependence on automated outputs, inequitable access and the substitution of superficial digital activity for scientific inquiry.

Digital competence in teacher education therefore cannot be reduced to the ability to operate software. A competent biology teacher must select a technology for a defensible pedagogical reason, connect it with a biological concept, evaluate the reliability of digital information, protect learners’ data, and assess whether technology improves scientific reasoning. The TPACK framework captures the integration of technological, pedagogical and content knowledge, but current conditions require a more explicit focus on AI literacy, data ethics and epistemic verification. Recent studies show that pre-service teachers may report positive attitudes and relatively high technological confidence while using digital content infrequently or at a low level of pedagogical complexity [1]. This gap between self-perception and enacted practice is particularly relevant in biology, where digital tools should support observation, experimentation, modelling and evidence-based explanation.

Virtual laboratories provide a suitable bridge between STEM pedagogy and digital competence. They allow repeated trials, safe manipulation of variables and access to experiments constrained by time, cost, biosecurity or equipment. However, a simulation becomes educationally meaningful only when learners formulate questions, make predictions, control variables, record evidence and justify conclusions. Generative AI can support these actions by offering alternative hypotheses, explaining patterns, generating feedback and helping future teachers design differentiated tasks. Yet its outputs can contain fabricated references, oversimplified mechanisms and biologically implausible claims. Consequently, AI must be framed as a fallible cognitive partner whose output is tested rather than accepted.

The aim of this article is to develop a theoretically grounded and practically usable methodology for forming pre-service biology teachers’ STEM and digital competence through the integrated use of virtual laboratories and generative AI. The study addresses three questions: (1) Which components of digital competence are most relevant to STEM-oriented biology teacher preparation? (2) How can virtual laboratories and generative AI be combined without weakening authentic scientific inquiry? (3) Which learning tasks and assessment procedures can document changes in competence beyond self-report questionnaires?

Literature Review

Research on pre-service teacher competence consistently identifies a difference between general digital confidence and subject-specific pedagogical use. Funke et al. found that pre-service biology teachers' beliefs varied substantially across tools such as smartphone microscopes, digital cameras, augmented-reality visualisations and spreadsheets [2]. Their findings suggest that intention to use technology should not be treated as one stable personal characteristic; it depends on the perceived value, constraints and subject-specific affordances of each medium. For biology teacher education, this means that generic software training is insufficient. Students need repeated experiences of choosing and evaluating digital tools in relation to concrete biological objectives.

López, Meneses and Montenegro analysed learning activities created by pre-service physics, chemistry and biology teachers and reported that content-specific technologies were associated with higher cognitive demand and scientific inquiry skills [3]. Their performance-based approach is important because TPACK is often measured only through self-report. A future teacher may claim confidence in technology integration while producing a lesson plan in which the technology merely displays information. Authentic assessment should instead examine whether a designed activity enables students to collect data, test a model, construct an explanation or solve a biologically meaningful problem.

Evidence from Kazakhstan reinforces this concern. A recent study of pre-service biology teachers in three universities reported generally positive attitudes toward digital content but lower frequency of use and lower practical technological proficiency [1]. The authors recommended hands-on workshops, simulations, virtual laboratories, mentoring and performance-based assessment. These findings provide a direct rationale for an intervention that requires pre-service teachers to create, implement and reflect on digital STEM lessons rather than only study technology theoretically.

Virtual laboratories have become increasingly prominent in blended and online STEM education. Recent reviews highlight their capacity to provide flexible and repeatable experimentation, improve engagement and reduce material constraints [4]. In biology, they can make invisible or slow processes observable, including membrane transport, enzyme kinetics, population dynamics, genetic inheritance and ecosystem change. Nevertheless, virtual experiments may encourage procedural clicking if tasks provide every step and a predetermined answer. Their pedagogical value depends on inquiry structure, opportunities to make decisions and explicit connections with physical observations or authentic datasets.

Generative AI has added a new layer to this landscape. A systematic review of 21 studies in pre-service science teacher education found that GenAI was used for conceptual clarification, hypothesis generation, self-regulated learning, lesson planning, differentiation and classroom simulation [5]. At the same time, integration was fragmented and frequently confined to pilot activities. The absence of structured guidance led to superficial use and limited evaluation of AI-generated content. Other studies have shown that GenAI tasks can reveal pre-service science teachers’ pedagogical content knowledge and create opportunities for targeted feedback [6]. AI literacy must therefore include prompt design, source checking, recognition of uncertainty, bias awareness, privacy protection and decisions about when not to use AI.

The literature reveals a clear research gap. Digital competence, virtual laboratories, STEM project design and GenAI-supported teacher education are commonly investigated as separate domains. Few methodological models explain how a future biology teacher should move from a biological problem to virtual evidence, compare that evidence with an AI-generated explanation, design a STEM solution, and justify the pedagogical use of each technology. The present framework responds to this gap.

Methodology

This study is a conceptual and design-oriented investigation. It combines an integrative review of recent peer-reviewed literature with methodological synthesis. Sources were selected when they addressed at least one of the following areas: pre-service biology or science teacher education, digital competence or TPACK, virtual laboratories in STEM, and generative AI in science education. Priority was given to empirical studies, systematic reviews and publications from 2023–2026. The analysis focused on four categories: competence construct, learning activity, role of technology, and form of assessment.

The synthesis followed three stages. First, recurrent competence requirements were identified across the literature. Second, the affordances and limitations of virtual laboratories and generative AI were mapped onto phases of scientific inquiry and STEM design. Third, learning outcomes and assessment indicators were formulated as observable performances. The resulting model is intended as a design proposition that can be tested in a future quasi-experimental study; the article does not claim empirical effectiveness without implementation data.

The VLab–GenAI–STEM Methodological Model

The proposed model is based on the principle that digital tools should serve an epistemic and pedagogical purpose. A virtual laboratory is used to produce or manipulate evidence, while GenAI supports reasoning, communication and design. Neither technology replaces direct observation, disciplinary knowledge or teacher judgement. The model contains five phases.

Phase 1: problem framing. Pre-service teachers encounter a socially or environmentally relevant biological problem, such as antibiotic resistance, water eutrophication, pollinator decline, hereditary disease risk or the effect of temperature on enzyme activity. They formulate a researchable question, identify STEM connections and distinguish known information from assumptions. GenAI may be used to generate alternative questions, but students must select and refine them using biological criteria.

Phase 2: virtual investigation. Students choose an appropriate simulation or virtual laboratory, define variables, predict outcomes, run repeated trials and export data. They document parameters and limitations so that the investigation is reproducible. Where possible, virtual results are compared with a physical micro-experiment, field observation or open scientific dataset. This combination prevents the virtual environment from being treated as reality itself.

Phase 3: AI-supported interpretation. Students provide selected data to a GenAI tool and request possible explanations, counterarguments or visualisation suggestions. They then conduct an epistemic audit: every claim is classified as supported by data, supported by an external source, uncertain, or incorrect. The purpose is not to obtain an answer but to practise verification, disciplinary judgement and responsible AI use.

Phase 4: engineering and pedagogical design. Teams develop a solution or teaching product: a low-cost biosensor concept, an ecosystem monitoring protocol, a model of disease transmission, a digital herbarium, an inquiry worksheet, or a lesson sequence. The product must integrate science, technology, engineering and mathematics meaningfully. Future teachers also explain how it would be adapted for learner diversity and available school resources.

Phase 5: evidence-based reflection. Students compare their initial prediction, virtual evidence, AI suggestions and final interpretation. They justify which technologies added value, identify errors and revise the lesson product. Reflection is supported by peer review and a rubric. This phase transforms technical activity into professional learning.

Phase	Core activity	Virtual laboratory role	GenAI role	Assessed product
1. Frame	Define a biological problem	Explore feasible variables	Generate and critique questions	Problem map and hypothesis
2. Investigate	Plan and run	Manipulate	Suggest controls	Reproducible

	trials	variables and record data	without deciding them	dataset
3. Interpret	Construct an explanation	Provide experimental evidence	Offer alternatives for verification	AI audit and evidence claim
4. Design	Develop a STEM teaching solution	Test the biological model	Support adaptation and feedback	Lesson or prototype
5. Reflect	Evaluate learning and ethics	Identify simulation limits	Document errors, bias and revisions	Portfolio and oral defence

Table 1. Structure of the VLab–GenAI–STEM model

Digital Competence Dimensions and Assessment

The model operationalises digital competence in six dimensions. Information and data literacy concerns search strategy, source quality, data cleaning and visualisation. Digital experimentation includes selecting a simulation, controlling variables and documenting procedures. Digital content creation covers models, interactive materials and accessible representations. Pedagogical integration concerns alignment among biological outcomes, STEM practices, technology and assessment. AI literacy and ethics include prompt design, verification, bias, privacy, authorship and disclosure. Reflective professional agency concerns the ability to defend, revise and transfer a technology-supported design to a real school context.

Assessment should combine self-report with performance evidence. A pre/post questionnaire may capture confidence and attitudes, but the primary evidence should come from lesson plans, experimental datasets, screen-recorded decision making, AI interaction logs, teaching demonstrations and reflective commentaries. A four-level analytic rubric can assess biological accuracy, inquiry quality, STEM integration, digital tool selection, AI verification, ethical compliance and pedagogical feasibility. Inter-rater agreement should be calculated, and assessors should be blinded to group membership where possible.

For an empirical evaluation, a quasi-experimental pre-test/post-test design is appropriate. The experimental group would complete a six- to eight-week VLab–GenAI–STEM module, while the comparison group would study the same biology themes through conventional digital presentations and lesson planning. Both groups would complete an equivalent performance task before and after

the intervention. Quantitative analysis could include reliability testing, analysis of covariance using pre-test scores, effect sizes and dimension-level comparisons. Interviews and portfolio analysis would explain how participants' reasoning changed and which barriers remained.

Illustrative Learning Scenario

An illustrative unit may address eutrophication in a local water ecosystem. Teams formulate the question: How do nutrient concentrations affect algal growth and dissolved oxygen, and what monitoring solution could a school implement? In a virtual ecosystem, students vary nitrate and phosphate levels, record algal biomass and oxygen, and graph relationships over time. They ask GenAI to propose explanations and intervention strategies, then verify each claim using their data and peer-reviewed sources. The engineering task is to design a low-cost school monitoring protocol that combines test strips, a spreadsheet dashboard and a communication plan. The pedagogical product is a secondary-school STEM lesson with differentiated roles, safety guidance and an assessment rubric.

This scenario develops biology content, data analysis, systems thinking, model criticism and solution design. It also makes AI ethics visible. Students must not upload identifiable learner data, must document prompts and revisions, and must disclose where AI contributed. The final oral defence asks them to explain why the virtual model may differ from a real pond and which conclusions remain uncertain.

Discussion

The proposed framework addresses several limitations reported in recent research. First, it moves beyond positive attitudes and self-reported competence by requiring observable products. Second, it makes technology subject-specific. Virtual laboratories are selected because they allow biological investigation, not because they are novel. Third, it links AI use to epistemic responsibility. Students learn that fluent language is not equivalent to scientific validity and that biological claims require evidence. Fourth, it connects digital competence with STEM design, so data are used to develop a solution rather than remain an isolated graphing exercise.

The model also has constraints. Access to stable internet, suitable devices and licensed simulations may vary. English-dominant tools may reproduce linguistic inequality or provide weaker explanations in Kazakh. GenAI platforms may change rapidly, making tool-specific training obsolete. Teacher educators therefore need to emphasise transferable principles: verification, transparency, privacy, interoperability and pedagogical purpose. Low-bandwidth alternatives, shared-device tasks and downloadable simulations should be included so that competence is not defined by access to expensive systems.

A further challenge is the preparation of teacher educators and practicum mentors. If university coursework promotes inquiry and digital design but school placements model only presentation-based technology use, students may revert to familiar routines. Partnership with schools is therefore necessary. Mentor workshops, shared rubrics and co-designed STEM units can align university learning with classroom practice. Institutional policy should also clarify acceptable AI use, authorship, data protection and assessment integrity.

Conclusion

Virtual laboratories and generative AI can strengthen pre-service biology teachers’ STEM and digital competence, but only when they are integrated through a disciplined methodology. The VLab–GenAI–STEM model proposed in this article begins with a biological problem, uses virtual experimentation to generate evidence, subjects AI output to verification, transforms findings into a STEM teaching product, and concludes with reflective defence. This sequence preserves the central role of scientific inquiry and teacher judgement.

The framework offers a basis for curriculum design and future empirical testing. Its main contribution is the operational connection among subject-specific digital competence, STEM practices, virtual experimentation and responsible AI literacy. Future research should implement the model across institutions, compare different biology domains, examine long-term transfer into teaching practicum, and analyse how Kazakh-language AI tools influence participation and disciplinary reasoning.

REFERENCES

1. Ayanwale, M. A., Adelana, O. P., Molefi, R. R., Adeeko, O., & Ishola, A. M. (2024). Examining artificial intelligence literacy among pre-service teachers for future classrooms. *Computers and Education Open, 6*, 100179. https://doi.org/10.1016/j.caeo.2024.100179

2. Blonder, R., Feldman-Maggor, Y., & Rap, S. (2024). Are they ready to teach? Generative AI as a means to uncover pre-service science teachers’ PCK and enhance their preparation program. *Journal of Science Education and Technology*. https://doi.org/10.1007/s10956-024-10180-2

3. Ceylan, B., & Altiparmak Karakus, M. (2024). Development of an artificial intelligence-based mobile application platform: Evaluation of prospective science teachers’ project on creating virtual plant collections. *International Journal of Technology in Education and Science, 8*(4), 668–688. https://doi.org/10.46328/ijtes.595

3. Funke, M., Bergmann-Gering, A., Müller, K., & Zabel, J. (2025). Pre-service teachers’ beliefs on the subject-specific use of digital media in biology classrooms. *Technology, Knowledge and Learning, 30*, 789-807. https://doi.org/10.1007/s10758-024-09800-y

4. Guemide, B., Benachaiba, C., & Maouche, S. (2025). Virtual laboratories in STEM education: A scoping literature review. *Engineering Proceedings, 112*(1), 17. https://doi.org/10.3390/engproc2025112017

5. Kaliyev, I., Anuash, Z., Yesserkepova, Z., Ibadullayeva, Y., & Sarkulova, G. (2025). Teacher competencies and digital integration into teaching practices: Perceptions from pre-service biology teachers in Kazakhstan. *Frontiers in Education, 10*, 1628034. https://doi.org/10.3389/feduc.2025.1628034

6. López, A., Meneses, A., & Montenegro, M. (2025). Pre-service teachers' TPACK and its relationship to technology integration in science learning activities. *Journal of Science Education and Technology, 34*, 436-451. https://doi.org/10.1007/s10956-025-10201-8

7. Spasopoulos, T., Sotiropoulos, D., & Kalogiannakis, M. (2025). Generative AI in pre-service science teacher education: A systematic review. *Advances in Mobile Learning Educational Research, 5*(2), 1501-1523. https://doi.org/10.25082/AMLER.2025.02.007

8. Stinken-Rösner, L., Hofer, E., Rodenhauser, A., & Abels, S. (2023). Technology implementation in pre-service science teacher education based on the transformative view of TPACK. Education Sciences, 13(7), 732. https://doi.org/10.3390/educsci13070732

9. Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017-1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

10. Schmid, M., Brianza, E., & Petko, D. (2021). Self-reported TPACK of pre-service teachers in relation to digital technology use in lesson plans. Computers in Human Behavior, 115, 106586. https://doi.org/10.1016/j.chb.2020.106586

11. von Kotzebue, L. (2022). Beliefs, self-reported or performance-assessed TPACK: What can predict the quality of technology-enhanced biology lesson plans? Journal of Science Education and Technology, 31, 570-582. https://doi.org/10.1007/s10956-022-09974-z

12. Cooper, G. (2023). Examining science education in ChatGPT: An exploratory study of generative artificial intelligence. Journal of Science Education and Technology, 32, 444-452. https://doi.org/10.1007/s10956-023-10039-y

13. Chiu, T. K. F. (2024). Future research recommendations for transforming higher education with generative AI. Computers and Education: Artificial Intelligence, 6, 100197. https://doi.org/10.1016/j.caeai.2023.100197

14. Shailendra, S., Kadel, R., & Sharma, A. (2024). Framework for adoption of generative artificial intelligence in education. IEEE Transactions on Education, 67(5), 777-785. https://doi.org/10.1109/TE.2024.3432101

РАЗВИТИЕ ИССЛЕДОВАТЕЛЬСКИХ НАВЫКОВ ШЕСТИКЛАССНИКОВ НА УРОКАХ БИОЛОГИИ ЧЕРЕЗ СЦЕНАРНОЕ ОБУЧЕНИЕ

Воробьева О.А., аспирант кафедры естествено научного образования и коммуникативных технологий МПГУ, г. Москва, Российская Федерация, 89168166073, olesya02vorobyeva@yandex.ru

Аннотация. *В статье рассмотрены ключевые исследовательские навыки, приобретаемые учащимися в ходе выполнения работы: от постановки проблемы до проверки гипотез и подведения итогов. Автор обосновывает методологическую ценность интеграции натуральных объектов в практикум по биологии. Доказывается, что непосредственный контакт с живым материалом незаменим для освоения биологической вариативности и развития наблюдательности. Кроме того, такой подход позволяет нивелировать когнитивные искажения, вызванные чрезмерной цифровизацией образовательного процесса.*

Ключевые слова*: исследовательские умения, лабораторная работа, сценарный подход, физиология растений.*

В структуре школьного образования биологическая составляющая играет фундаментальную роль. Освоение данной дисциплины формирует естественно-научное мировоззрение, закладывает основы экологической культуры, а также развивает у учащихся осознанное стремление к ведению здорового образа жизни.

Действующие федеральные государственные образовательные стандарты (ФГОС ООО и ФГОС СОО) постулируют переход от традиционной репродуктивной передачи знаний к системно-деятельностной парадигме. Данный вектор предполагает акцент на самостоятельной поисковой активности школьников: работе с разнообразными информационными источниками, натурных наблюдениях, постановке опытов и проведении базовых экспериментов. Однако в реальной педагогической практике реализация этих требований наталкивается на серьезные институциональные препятствия.

Ключевое противоречие обусловлено резким сокращением объема учебного времени на биологию в 5–7 классах (практически вдвое) при одновременном усложнении и расширении теоретического ядра Федеральных основных общеобразовательных программ (ФООП). Стремление педагогов адаптироваться к дефициту времени негативно отражается на практической компоненте курса. В качестве примера рассмотрим структуру курса 6 класса, рассчитанного на 34 академических часа в год. Из них около 4–5 часов расходуется

на оценочные процедуры (стартовый срез, ВПР, промежуточный и итоговый контроль), а еще 2–3 часа уходит на повторение и подготовку к тестированиям. Таким образом, на непосредственное изучение нового материала и лабораторный практикум остается не более 26–28 часов. В таких временных рамках организация полноценного научного поиска (включающего детекцию проблемы, формулирование гипотез, проведение эксперимента и верификацию результатов) становится практически невозможной.

Ситуация обостряется тем, что согласно нормативным требованиям ФООП, шестиклассники должны выполнить 25 обязательных практических и лабораторных работ. Проведение полноценного практикума (с самостоятельным приготовлением микропрепаратов, изучением живых образцов и фиксацией наблюдений) требует ресурсов целого урока. Если следовать этой методике, то на освоение теоретического базиса останется менее 18 часов за весь учебный год. Столь жесткий дефицит деформирует классическую методику преподавания. Педагог вынужден выбирать между начиткой теории и лабораторным практикумом. Чаще всего приоритет отдается теоретическим блокам, поскольку именно они проверяются в рамках внешнего независимого мониторинга качества образования. Как следствие, лабораторные работы редуцируются до пятиминутного показа иллюстраций (часто виртуального характера) либо переносятся на домашнее изучение.

Отсутствие систематического взаимодействия с натуральным биологическим материалом (живыми объектами, гербарными образцами, влажными препаратами, микропрепаратами и коллекциями) обесценивает предмет, превращая живую науку в монотонное заучивание текстовых массивов. Это прямо нарушает задекларированные принципы деятельностного обучения. Попытки компенсировать дефицит за счет домашних заданий неэффективны: без профессиональной фасилитации со стороны учителя и доступа к лабораторному оборудованию самостоятельная работа превращается в формальное списывание готовых решений из интернета или механическое заполнение табличных форм.

Внедрение в учебный процесс цифровых симуляторов и виртуальных лабораторий также влечет за собой скрытые риски. Во-первых, замещение реального эксперимента цифровыми моделями лишает учащихся возможности освоить прикладные исследовательские навыки (например, технику микроскопирования или алгоритмы постановки физиологических опытов). Данный дефицит критичен для дальнейшей профориентации школьников в сфере медицины, агрономии и биотехнологий. Во-вторых, интерактивная симуляция снижает когнитивную достоверность обучения. Только взаимодействие с живой природой позволяет осознать биологическую вариативность и сложность структуры организмов, которые всегда оказываются шире и многограннее

рафинированных цифровых моделей или идеализированных иллюстраций учебника. В-третьих, элиминация «живого» экспериментального компонента неизбежно влечет за собой угасание познавательного интереса, выступающего триггером внутренней учебной мотивации.

В сложившихся условиях исследовательское обучение приобретает статус стратегического ориентира биологического образования. Под ним понимается особый формат интеллектуально-творческой деятельности учащихся, движущей силой которого выступает поисковая активность при решении научно-ориентированных задач [2].

Развитие исследовательских компетенций способствует не только интеллектуальному росту, но и творческому раскрытию личности, обеспечивая достижение личностных и метапредметных образовательных результатов [3]. Процесс формирования таких умений создает прочный фундамент для интеграции, актуализации и практического применения биологических знаний. Логика этого процесса может быть представлена в виде циклического когнитивного контура, объединяющего последовательные этапы исследовательского действия.

Необходимо подчеркнуть, что формирование исследовательских навыков трудно поддается жесткой алгоритмизации и шаблонизации. Этим обусловлена целесообразность применения сценарного подхода при проектировании исследовательских заданий. В отличие от стандартного поурочного планирования, фиксирующего лишь внешнюю канву действий участников, сценарное моделирование фокусируется на внутренних ментальных процессах ученика. Именно это мыследеятельностное содержание становится основой работы над научно-ориентированной задачей.

Вектор мыследеятельностной педагогики [1] позволяет утверждать, что базовым элементом проектирования для учителя в рамках сценарного подхода становится «ситуация учения-обучения». Данный конструкт характеризуется тремя детерминантами:

1. Дефицит у учащихся готовых алгоритмов и средств для решения научно-ориентированной задачи (ситуация когнитивной неопределенности).
2. Экспликация исследовательской задачи перед школьниками и стимулирование их внутренней мотивации к поиску. При этом спонтанный вектор мыслительного движения учащихся не всегда предсказуем, что включает в поисковый процесс и самого педагога.
3. Организация коммуникативного взаимодействия внутри ученического коллектива и по линии «ученик — учитель», направленного на рефлексию

деятельности (анализ целей, способов реализации, причин затруднений, дефицита знаний и альтернативных путей решения).

Запуском такой ситуации учения-обучения выступает эвристическая беседа, предваряющая лабораторный практикум. Вектор ситуации учения направлен на самостоятельное обнаружение и освоение школьниками недостающих когнитивных инструментов. В свою очередь, цель ситуации обучения заключается в выявлении, фиксации и последующем проектировании педагогом тех методических средств, которые обеспечат продуктивное разрешение проблемы. Важно отметить, что статус научно-ориентированной задачи приобретает исключительно то исследовательское задание, которое прошло процесс субъективизации — то есть было принято учеником как личный интеллектуальный вызов. В данном контексте научно-ориентированная задача представляет собой познавательный барьер, преодоление которого требует личных волевых и ментальных усилий учащегося в процессе интериоризации полученных знаний.

БИБЛИОГРАФИЧЕСКИЙ СПИСОК

1. Из опыта освоения мыследеятельностной педагогики (Опыт освоения мыследеятельностного подхода в практике педагогической работы) / Под ред. Алексеевой Л.Н., Устиловской А.А. – М.: МИОО, 2007. – 208 с.
2. Карпов А. О. Образование в обществе знаний: исследовательская модель // Вестник РАН. Т. 82, № 2. 2012. С. 146-152.
3. Леонтович А.В. Построение образовательной среды для реализации исследовательской деятельности учащихся // Преподаватель XXI век. -Т. 1. № 2. 2013. С. 123-130.
4. Середенко П. В. Развитие исследовательских умений и навыков младших школьников в условиях реализации ФГОС НОО : монография / П. В. Середенко. – Южно-Сахалинск : Изд-во СахГУ, 2014. – 184 с.
5. Зимняя И. А. Исследовательская работа как специфический вид человеческой деятельности : методическое пособие / И. А. Зимняя, Е. А. Шашенкова. – Ижевск ; Москва : Исследовательский центр проблем качества подготовки специалистов, 1989. – 103 с.

DEVELOPMENT OF ECOLOGICAL COMPETENCE IN THE COURSE OF GENERAL AND INORGANIC CHEMISTRY

Viktor Kovalenko, Master of Chemistry; Nonna Stupen, Candidate of Technical Sciences, Brest State A. S. Pushkin University, Brest, Republic of Belarus,
(+375 162) 21-70-41, biochemt@brsu.by

The paper summarizes the experience of forming a subject-specific ecological competence within the framework of the academic discipline “General and Inorganic Chemistry”.

Keywords: general and inorganic chemistry, ecology, ecological competence.

Ecology is an interdisciplinary field of knowledge that is closely interconnected with other sciences, in particular with general and inorganic chemistry. Traditionally students’ chemical education at the university begins with general and inorganic chemistry, since it is general and inorganic that lays the foundation for the entire system of chemical knowledge for future specialists. Thus, general and inorganic chemistry is studied by first-year students of the Faculty of Natural Sciences majoring in “Natural Science Education (Biology and Chemistry).” This discipline helps students develop not only knowledge of the basic concepts, laws and theories of chemistry, as well as the patterns governing the structure and chemical behavior of substances and the relationship between the structure and the physical and chemical properties of compounds but also fosters a systematic approach and critical thinking.

The task of developing subject-specific ecological competence can be accomplished using the academic material of general and inorganic chemistry. The implementation of this task is largely facilitated by the substantive connections between ecology and general and inorganic chemistry.

Let us characterize some interconnections between general and inorganic chemistry and ecology by giving examples of course topics and the interdisciplinary issues studied within them. When studying the topic “Atomic structure and the periodic system of chemical elements” the problem of “The use of nuclear energy for peaceful purposes” is studied; in the topic “Electrolyte solutions” the issues of “The value of pH constancy in chemical and biological processes” and “The role of hydrolysis in chemical synthesis, biological processes and weathering processes of minerals and rocks” are studied; in the topic “Redox reactions” the issue studied is “The significance of redox reactions in living and non-living nature”; in the topic “Complex compounds” the issue studied is “The significance of complex formation processes in chemistry and biology”; the topic “Elements of Group 17 of the Periodic Table” includes the issues of “Environmental protection from chlorine pollution. The concept of maximum permissible concentrations of harmful substances. Maximum permissible concentration of chlorine. Refrigerants”; in the topic “Elements

of Group 16 of the Periodic System" the issues studied are "The physiological effect of hydrogen sulfide and its maximum permissible concentration" and "The production of sulfuric acid and the problem of environmental protection"; in the topic "Elements of Group 15 of the Periodic System" the issue studied is "Environmental protection from pollution by nitrogen oxides".

Currently, environmental competence is one of the conditions for the socialization of students. Environmental competence is defined as a multifaceted concept. Several components are identified in its content. The motivational component includes a combination of interests and needs that encourage environmental activity. The cognitive component implies the formation of a system of environmental knowledge and ways of thinking that serve as a guiding basis for environmental activity. The practical and activity-based component means the ability to practically apply environmental knowledge in solving environmental problems, improving the state of the environment and having practical experience in environmental activity. The emotional and volitional component determines the attitude towards nature, environmental problems and their solutions. The value-semantic component means the presence of value orientations and an understanding of the meanings of environmental activities, which determine the awareness of the need to preserve the natural environment as the most important value [1].

The above examples of content interconnections between general and inorganic chemistry and ecology demonstrate the interdependence of chemical and ecological factors.

Knowledge of the chemistry underlying the functioning of biological systems and an understanding of the influence of chemical factors on ecological processes contribute to the implementation of fundamental and practice-oriented training for future specialists. It is no coincidence that one of the goals of chemistry education is listed as fostering readiness to implement the strategy of sustainable development, a conviction of the need to use the potential of chemistry in studying nature to develop recommendations for rational use of natural resources and to create optimal conditions for the existence and development of humanity [2, p. 275]. A thorough study of the principles underlying any chemical process or phenomenon, combined with an understanding of its essence, shows that chemistry itself is not dangerous. Rather, danger arises from the consequences of improper use of substances and chemical reactions, from technological errors at chemical production facilities, etc.

Conclusion

Due to the significant interconnection between the content of the academic material of the discipline "General and Inorganic Chemistry" and ecology, the task of developing subject-specific ecological competence can be implemented quite effectively within the framework of this discipline.

REFERENCES

1. Ермаков Д. С. Экологическая компетенция учащихся: содержание, структура, особенности формирования. Вестник РУДН. Серия Психология и педагогика. 2008. № 1. С. 86–91.

2. Мычко Д. И. Вопросы методологии и истории химии: от теории научного метода к методике обучения. Минск. БГУ. 2014. 295 с.

O‘SIMLIK NEMATODALARINI ANIQLASH VA ANAL - VULVAR QISMIDAN VAQTINCHALIK VA DOIMIY PREPARAT TAYYORLASH METODIKASI.

Mirzayev U.N., magistr Atajanov B.A

Elektron manzil: *uktam1486@gmail.com, amangaldiyevich05@gmail.com.*

Manzil: *Samarqand davlat pedagogika instituti, Spitamen shox ko‘chasi 161.*

Anotatsiya: *Ushbu maqolada o‘simlik nematodalaridan vaqtinchalik va doimiy mikroskopik preparatlar tayyorlash metodikasi yoritilgan. Unda tuproqdan hamda o‘simlik to‘qimalari va ildiz qismlaridan fitonematodalarni ajratib olish, ularni yig‘ish, tirik holda kuzatish, fiksatsiya qilish hamda mikroskopik tekshiruvlar uchun preparat tayyorlashning asosiy bosqichlari bayon etilgan. Shu bilan birga, vaqtinchalik preparatlar orqali nematodalarning morfologik xususiyatlari va harakatlanishini o‘rganish, doimiy preparatlar yordamida esa ularning tashqi tuzilishi va turga xos bo‘lgan xususiyatlari ko‘rib chiqish aytib o‘tilgan. Mazkur metodika orqali o‘simlik nematodalarini morfologik va anatomik tuzilishini o‘rganish, ularni morfologik jihatdan tavsiflash, aniqlash va laboratoriya mashg‘ulotlarini samarali ravishda tashkil etishda muhim amaliy ahamiyatga ega.*

Kalit so‘zlar: *o‘simlik nematodalari, vaqtinchalik preparat, doimiy preparat, mikroskopik tahlil, fiksatsiya, jelatin, glitserin, fenol kristallari, ildiz namunalari, laboratoriya metodikasi.*

Kirish. O‘simlik nematodalaridan vaqtinchalik va doimiy preparat tayyorlashdan ko‘zlangan asosiy maqsad nematodalar kuzatish va o‘zganishdan tashqari ularning turini aniqlash hamda identifikatsiya qilish hisoblanadi. Buning uchun avvalo na’muna yig‘ish zarur. Tuproqdan namuna olishda o‘simliklarning ildiz zonalaridan, 15-30 sm chuqurlikda, ba’zida ozroq ildiz qismlari (yemlovchi ildizlar) bilan birgalikda ham olinadi. Agar ko‘p yillik chuqur ildizli o‘simliklar yoki daraxt bo‘lsa, namunalar 60 sm chuqurlikdan olishi kerak. Ildiz namunalarini yig‘ishda nematodalar bilan zararlanish belgilari mavjud bo‘lgan o‘simliklarga e’tibor berish zarur.

Masalan, ildizda shishlar (gall), tugunaklar, qorayishlar, nekroz, ildiz uchlarining zararlanishi yoki o‘sishning susayishi, barg chetlarining bujmayishi kuzatilishi mumkin. Biroq bu belgilar nematodalar borligini o‘z-o‘zidan tasdiqlamaydi. Albatta laboratoriya tekshiruvi zarur bo‘ladi. Muhim jihati yana shundaki o‘simliklar ildiz qismidan namuna olishda, ildizni to’liq tuproqlardan tozalamaslik, aksincha ozroq ildiz atrofidagi tuproq bilan birga olish maqsadga muvofiq. Buning asosiy sababi ba’zi nematoda turlari faqat ildiz atrofidagi tuproqlarda uchrashi va ildiz to’qimasida faqat urg‘ochi nematodalar bo’lishi yoki turli rivojlanish bosqichidagi nematodalarning bo‘lmasligi ehtimoli borligi sanaladi.

O‘simlik nematodalarini tuproqdan ajratib olish. ***Cobbning elash va quyish usuli (Cobb, 1918).*** Cobbning elash va quyish usuli (Cobb, 1918) yoki chelak elagi usuli: Bu tuproqdan fitonematodlarni ajratib olishning oddiy va oson usuli hisoblanadi. Bu metodda turli xil teshikli o‘lchamlarga ega 3-4 xil elaklar ketma-ketlikda ishlatiladi. Misol tariqasida katta, o‘rta va kichik teshikli elaklar. Bu usul ommalashgan bo‘lib, faol va nofaol nematodlarni katta miqdordagi tuproqdan ajratib olishda foydali hisoblanadi.

Bu usulda 250–500 g tuproq namunasi suv bilan to‘ldirilgan chelakka yoki plastik idish solinadi. Aralashma yaxshilab aralashtirilib, bir xil hajmli suspenziya hosil qilinadi va 15–20 soniya mobaynida tindirish uchun qoldiriladi. Loyqalar barmoqlar bilan sinchikovlik bilan maydalanib, yirik bo‘laklar va toshlar olib tashlanadi. Hosil bo‘lgan suspenziya 1-2 daqiqa mobaynida qoldiriladi hamda og‘ir zarralar chelak tubiga cho‘kishiga imkon beriladi. So‘ngra tuproq aralashmasi yana aralashtiriladi va ustki suv qavati 36 mesh o‘lchamga ega bo‘lgan katta elak orqali ikkinchi chelakka quyiladi, birinchi chelakda qolgan qoldiqlar esa tashlab yuboriladi. Chelak tubida qolgan ildiz qismlari yig‘ib olinib, qolgan chiqindilar tashlab yuboriladi. Ikkinchi chelakdagi aralashma yaxshilab aralashtirilib, 30 soniya cho‘kishi uchun qoldiriladi va so‘ngra ehtiyotkorlik bilan 100 mesh elak yordamida uchinchi chelakka quyiladi. Bu namuna stereomikroskop ostida kuzatiladi. [1;3]

O‘simlik nematodalarini ildizdan ajratib olish. ***Vizual metod.*** Buning uchun bir bo‘lak barg, poya, ildiz namunalaridan foydalaniladi. O‘simlik ildizlari to‘liqligicha tuproqdan tozalash maqsadida ehtiyotkorlik bilan yaxshilab yuviladi. Suv esa endoparazitlar bor yoki yo‘qligini tekshirish maqsadida mikroskop ostida sinchiklab tekshiriladi. Tozalangan ildiz namunalari idishning kattaligiga qarab 3-4sm uzunlikda qirqib olinadi va formalinning 5-6 % li eritmasida probirkalarda yoki plastik idishlarda fiksirlangan holda saqlanadi. Eritma ildizlar to‘liq botishgunicha solinadi. Shundan so‘ng fiksrlangan ildiz namunalari Petri idishiga 1-2 dona olinadi. Ustiga ildiz qismlari botishadigan darajada iliq suv solinadi hamda o‘simlik to‘qimasi entomologik igna yordamida tilib-tilib tashlanadi. Bundan tashqari entomologik pichoq yordamida ildiz

to‘qimalari kichik bo‘laklarga maydalanadi. Nematodalar juda tez suvga chiqadi va ularni binokulyar mikroskop ostida bemalol kuzatish mumkin. Ba’zi nematodalar ildiz to‘qimalari ichida qolib ketishi mumkin. Ayniqsa urg‘ochi fitonematodalar to‘qimalarda qolib ketishi mumkin. Namunalar titilgan vaqtda urg‘ochi nematodalar zararlanishi nobud bo‘lishi ehtimoli borligi uchun ildiz ehtiyotkorlik bilan tilinishi kerak. Ildizdagi har xil kattalikdagi fitonematodalar entomologik nina yoki mikropipetka orqali terib olinadi va binokulyar ostida yorib o‘rganiladi.

Fitonematodalar anal-vulvar qismidan vaqtinchalik va doimiy preparat tayyorlash. Fitonematodalar anal-vulvar (perineal) qismidan vaqtinchalik preparat tayyorlashdan asosiy maqsad fitogelmintlarning shakli, tuzilishi, harakati va ayrim morfologik belgilarini tezda kuzatish hisoblanadi. Bunda Petri idishidagi urg‘ochi nematodalar entomologik igna yoki mikropipetka yordamida 1-2 tomchi toza suv tomizilgan buyum oynasiga o‘tkaziladi. Oftalmalogik pichoq (skalpel) yordamida noksimon urg‘ochi nematoda ehtiyotkorlik bilan ko‘ndalangiga kesiladi va anal-vulvar qismi olinib, entomologik nina yordamida ichki organlardan tozalanadi. So‘ngra nematodali suvga 1-2 tomchi glitserin va – 96 % li spirt aralashmasi 1:1 nisbatda tomizildi. Aralashmada fitonematodalar 14-16 soat saqlandi. Bu vaqt mobaynida aralashmadagi suv bug‘lanib keatadi, glitserin nematodalarning ichki organlariga kirib boradi, organlar mikroskopda ko‘rinadigan bo‘lib qoladi. Vaqtinchalik preparat tayyorlashda jarayonida terib olingan nematodalar buyum oynachasiga bir tomchi toza glitseringa o‘tkazildi. Doimiy mikropreparat tayyorlashdan ko‘zlangan asosiy maqsad — ularning morfologik tuzilishini uzoq vaqt saqlash va turlarini aniq identifikatsiya qilishdir. Doimiy preparatlar tayyorlash uchun xuddi shu jarayonlar o‘tkaziladi. Faqat nematodalar predmet oynachasiga tomizilgan bir tomchi toza glitserin o‘rniga glitserin-jelatin aralashmasiga o‘tkazildi. Bu texnika o‘simlik nematodalarining anal-vulva sohasidan vaqtinchalik va doimiy preparat tayyorlashning umumlashtirilgan, oddiy hamda oson usuli hisoblanadi. [5]

Bundan tashqari nematodalardan preparat tayyorlashdagi asosiy qiyinchiliklardan biri bu ularning anal-vulvar qismini tozalash bo‘lgan. Buning natijasi o‘laroq nematodalarning anal-vulvar qismidan tayyorlangan preparatlarda anal-vulvar sohasidagi konsentrik chiziqlarning xira bo‘lib qolishi va turni identifikatsiya qilish, aniqlash muammo sanalardi. Quyidagi usul orqali bu muammoga yechim topilgan. D. P. Taylor va C. Netschlar, Triantaphyllou va Hirschmann (1966) usuli bo‘yicha sitologik tekshiruv jarayonida ushbu preparatlardagi perineal naqshlar nihoyatda tiniq va tana to‘qimalaridan toza ekanligini kuzatishgan. Shunga asosan bu usulning modifikatsiyasini ishlab chiqishgan. Bunga ko‘ra *meloidogyne* urg‘ochilari organik shisha (pleksiglas) buyum oynachasidagi 45 % li sut kislotasiga joylashtiriladi va nematodaning orqa uchi optik skalpel yordamida kesib olinadi. Kutikulaning ichki yuzasini biroz egiluvchan tukchali cho‘tka bilan ehtiyotkorlik bilan yengil ishqalash orqali tana to‘qimalari tozalanadi. Barcha

to‘qimalar olib tashlangandan so‘ng, kesma glitserin tomchisiga o‘tkaziladi va u yerda perineal naqshdan salgina kattaroq shaklda ehtiyotlik bilan kesiladi.So‘nggi bosqichda perineal naqshli kutikula bo‘lagi buyum oynasidagi glitserin tomchisiga o‘tkaziladi. Ustiga qoplag‘ich oyna yopiladi va chetlari glitsel bilan yopilib zichlanadi.[4]

O‘simlik nematodalarini aniqlash. Eng keng tarqalgan usul nematodalarning morfologik belgilari asosida identifikatsiya qilishdir. Ko‘pchilik fitogelmintolog olimlarning maqolalarida bayon qilingan an’anaviy morfologik aniqlash metodi voyaga yetgan urg‘ochi bo‘rtma nematodalar anal-vulvar (perineal) qismidagi konsentrik chiziqlarning tuzilishiga asoslanadi. Buning uchun ildiz bo‘rtma nematodasi bilan kasallangan o‘simlik ildizining bir qismi Petri idishidagi suvga solinib, voyaga yetgan, tuxum qo‘yishni boshlagan urg‘ochi nematodalar stereomikroskop ostida entomologik nina orqali ildizdan suvga chiqariladi. So‘ng bo‘rtma nematoda tanasining anal teshigi hamda vulvasi joylashgan keyingi anal-vulvar plastinkasi atrofidagi kutikulasi oftalmalogik skalpel orqali kesib olinib, soat oynasidagi laktofenol eritmasiga (sut kislotasi, glitserin, distillangan suv 1:2:1 nisbatda, bir nechta fenol kristallari) solinadi. Mikroskop ostida namuna ichki organlar qoldig‘idan ehtiyotkorlik bilan tozalanib, bir sutka mobaynida laktofenol eritmasida saqlandi. Nematodalarda ushbu konsentrik chiziqlarning, naqshning dorsal yoyning balandligi va shakli, chiziqlarning tuzilishi silliq, to‘lqinsimon yoki notekisligi, chiziqlarning zich yoki siyrak joylashishi, yon chiziqlarning mavjudligi yoki yo‘qligi, Naqshning shakli yumaloq, oval yoki cho‘zilganligi kabi belgilar asoosida aniqlanadi. Kesma kutikulasi chiziqlarini o‘rganish uchun esa doimiy va vaqtinchalik preparatlar tayyorlandi.[5;6]

Bundan tashqari nematodalarda uchraydigan ferment fenotiplari orqali aniqlash usuli ham mavjud. 1985-yilda P. R. Esbenshade va A. C. Triantaphyllou *Meloidogyne* turlarini ferment fenotiplari orqali identifikatsiya qilish bo‘yicha asosiy ilmiy ishlarini e’lon qilishgan. Ushbu ish PubMed va Journal of Nematology jurnalida chop etilgan. Ishning mazmuni shundan iboratki aynan bir xildagi elektroforetik sharoitda, bitta plastinkali gelda 20 yoki undan ortiq nematoda oqsili ekstraktlarini taqqoslash natijasida tur ichidagi va populyatsiyalararo, hatto turlararo mavjud bo‘lishi mumkin bo‘lgan nozik izozim farqlarini ham aniqlash mumkin bo‘ladi.[2]

FOYDALANILGAN ADABIYOTLAR:

1. Cobb, N. A. (1918). *Estimating the nema population of soil, with special reference to the sugar-beet and root-gall nemas, Heterodera schachtii Schmidt and Heterodera radicicola (Greeff) Müller, and with a description of Tylencholaimus aequalis n. sp.* Agricultural Technology Circular 1. Washington, D.C.: United States Department of Agriculture.

2. Esbenshade, P. R., & Triantaphyllou, A. C. (1985). Identification of major *Meloidogyne* species employing enzyme phenotypes as differentiating characters. *Journal of Nematology, 17*(1), 6–20.
3. Mirzayev, U. N., Xo‘jamov, Sh., Narzullayev, S. N., & magistr Atajanov, B. (2026). SHARQ FALSAFASI – 2026. Nematodalarni o‘rganish uchun asosiy usullar.
4. Taylor, D. P., & Netscher, C. (1974). An improved technique for preparing perineal patterns of *Meloidogyne* spp. *Nematologica, 20*, 268–269.
5. Хуррамов, Ш. Х., & Хуррамов, А. Ш. (2008). *Фитогельминтология* (ўқув қўлланма). Термиз.
6. https://nemaplex.ucdavis.edu/Methods/Perineal%20Patterns.htm, https://nemaplex.ucdavis.edu/taxadata/G076s3.aspx, https://www.findmenematode.org/me-morphological-identification.

TALABALARGA XALQ TABOBATI VA ETNOBOTANIKA ATAMALARINI TUSHUNTIRISH

Murodov Sirojiddin Ahmatovich
Osiyo xalqaro universiteti dotsenti, b.f.f.d., (PhD)
+99890 612-72-66
sirojiddin_sma@mail.ru

Annotatsiya. *Mazkur tezisda xalq tabobati va etnobotanika atamalarining mazmun-mohiyati, kelib chiqishi, o‘zaro bog‘liqligi hamda biologiya ta’limidagi ahamiyati yoritilgan. Shuningdek, xalqning dorivor o‘simliklardan foydalanish bo‘yicha an’anaviy bilimlarini o‘rganish, ularni ilmiy jihatdan tahlil qilish, milliy tabobat merosini asrash va talabalarda ekologik madaniyatni shakllantirish masalalariga e’tibor qaratilgan.*

Kalit so‘zlar: *xalq tabobati, etnobotanika, dorivor o‘simliklar, an’anaviy bilimlar, mahalliy flora, fitoterapiya, biologik xilma-xillik, ekologik madaniyat, ilmiy tadqiqot.*

Kirish

Insoniyat tarixida tabiat bilan uzviy aloqada yashash, atrof – muhitdagi o‘simlik va hayvonlardan turli maqsadlarda foydalanish muhim o‘rin tutgan. Qadim zamonlardan boshlab insonlar turli o‘simliklarning xususiyatlarini kuzatish, ularni oziq – ovqat sifatida iste’mol qilish hamda ayrim kasalliklarni yengillashtirish maqsadida qo‘llash orqali muayyan tajribalarni to‘plab borganlar. Ushbu tajribalar avloddan – avlodga o‘tib, xalqning an’anaviy bilimlari va tabobat madaniyatining shakllanishiga zamin yaratgan.

Bugungi kunda xalq tabobati va etnobotanika tushunchalarini o‘rganish biologiya, botanika, farmakognoziya, antropologiya va tibbiyot fanlari o‘rtasidagi muhim ilmiy yo‘nalishlardan biri hisoblanadi. Ayniqsa, dorivor o‘simliklarning mahalliy aholi hayotidagi o‘rni, ulardan foydalanish usullari va bu boradagi an’anaviy bilimlarni ilmiy asosda o‘rganish dolzarb ahamiyat kasb etadi.

Oliy ta’lim muassasalarida biologiya ta’lim yo‘nalishida tahsil olayotgan talabalarga mazkur atamalarni to‘g‘ri tushuntirish va talabalarning biologik bilimlarini kengaytirish, milliy merosga hurmat bilan munosabatda bo‘lish va tabiiy resurslardan oqilona foydalanish ko‘nikmalarini rivojlantirishga xizmat qiladi.

Xalq tabobati atamasining mazmuni

Xalq tabobati — muayyan xalq yoki mahalliy jamoa tomonidan tarixiy tajriba, kuzatishlar va an’analar asosida shakllantirilgan sog‘liqni saqlash, kasalliklarning oldini olish hamda ularning ayrim belgilarini yengillashtirishga qaratilgan bilim va amaliyotlar majmuasidir.

Xalq tabobati doirasida dorivor o‘simliklardan foydalanish, uqalash, parhezga rioya qilish, ayrim tabiiy mahsulotlarni qo‘llash va boshqa an’anaviy muolajalar uchraydi. Bunday usullar turli xalqlarda yashash muhiti, iqlim, o‘simliklar xilma-xilligi, urf-odatlar va tarixiy sharoitlarga qarab farqlanadi.

Xalq tabobatining muhim xususiyati shundaki, undagi ko‘plab bilimlar yozma manbalar bilan bir qatorda og‘zaki an’analar orqali ham saqlanib qolgan. Biroq an’anaviy tajribaning mavjudligi har qanday muolajaning samaradorligi va xavfsizligi ilmiy jihatdan isbotlanganini anglatmaydi. Shu sababli xalq tabobatiga oid ma’lumotlarni zamonaviy tibbiyot va farmakologiya yutuqlari asosida baholash zarur.

Etnobotanika atamasining mazmuni va kelib chiqishi

Etnobotanika — botanika fanining insonlar va o‘simliklar o‘rtasidagi tarixiy, madaniy hamda amaliy munosabatlarni o‘rganuvchi yo‘nalishidir. Ushbu fan mahalliy aholining o‘simliklardan oziq-ovqat, dori-darmon, kiyim-kechak, qurilish materiallari, bo‘yoqlar, yoqilg‘i va boshqa ehtiyojlar uchun foydalanish usullarini tadqiq etadi.

“Etnobotanika” atamasi ingliz tilidagi *ethnobotany* so‘zidan olingan bo‘lib, “etno” xalq yoki etnik jamoaga, “botanika” esa o‘simliklar haqidagi fanga taalluqlidir. Ushbu atama amerikalik botanik Jon Uilyam Harshberger tomonidan 1895-yilda ilmiy muomalaga kiritilgan. Etnobotanikaning dastlabki tadqiqotlari mahalliy xalqlarning o‘simliklardan foydalanish usullarini qayd etishga qaratilgan bo‘lsa, hozirgi vaqtda u ekologiya, etnografiya, antropologiya, farmakologiya va tabiatni muhofaza qilish bilan chambarchas bog‘liq holda rivojlanmoqda.

Etnobotanika faqat dorivor o‘simliklarni emas, balki inson hayotida foydalaniladigan barcha o‘simliklarning ahamiyatini o‘rganadi. Jumladan, mahalliy aholining yovvoyi va madaniy

o‘simliklarni tanish, yig‘ish, saqlash, qayta ishlash va ulardan foydalanish tajribalari ushbu fanning tadqiqot obyektlari hisoblanadi.

Xalq tabobati va etnobotanikaning o‘zaro bog‘liqligi

Xalq tabobati va etnobotanika o‘zaro chambarchas bog‘liq bo‘lsa-da, ularning mazmuni bir xil emas. Xalq tabobati an’anaviy sog‘liqni saqlash va muolaja usullarini qamrab olsa, etnobotanika insonlarning o‘simliklar bilan bog‘liq bilimlari va amaliy faoliyatini kengroq doirada o‘rganadi.

Masalan, mahalliy aholi tomonidan yalpiz, moychechak, na’matak yoki dalachoy kabi o‘simliklardan foydalanish tajribasi xalq tabobatining bir qismi sifatida namoyon bo‘lishi mumkin. Ushbu o‘simliklarning mahalliy nomlari, tarqalishi, qaysi qismlaridan foydalanilishi, yig‘ish va saqlash usullari hamda xalq orasidagi qo‘llanish an’analarini o‘rganish esa etnobotanik tadqiqotlarga kiradi.

Demak, etnobotanika xalq tabobatida foydalaniladigan o‘simliklar haqidagi bilimlarni hujjatlashtirish, ularning botanik identifikatsiyasini aniqlash va ilmiy tadqiqotlar uchun muhim ma’lumotlar to‘plash imkonini beradi. Shu bilan birga, an’anaviy bilimlarni ilmiy tekshirish orqali istiqbolli dorivor o‘simlik turlarini aniqlashga zamin yaratiladi.

Dorivor o‘simliklarni o‘rganishda etnobotanikaning ahamiyati

Dorivor o‘simliklar insoniyatning tarixiy tajribasida muhim o‘rin tutgan tabiiy resurslardan biridir. Ularning tarkibida biologik faol moddalar, jumladan, alkaloidlar, flavonoidlar, terpenoidlar, fenol birikmalari va efir moylari uchrashi mumkin. Ushbu moddalar o‘simlik turiga, uning rivojlanish bosqichiga, ekologik sharoitga va boshqa omillarga qarab farqlanadi.

Etnobotanik tadqiqotlar mahalliy aholining dorivor o‘simliklar haqidagi bilimlarini o‘rganish, istiqbolli turlarni aniqlash va ularning tabiiy zaxiralarini muhofaza qilishga yordam beradi. Tadqiqotlar davomida o‘simlikning mahalliy nomi, ilmiy nomi, tarqalish hududi, ishlatiladigan organi, an’anaviy qo‘llanish usuli va yig‘ish davri kabi ma’lumotlar qayd etilishi mumkin.

O‘zbekistonning boy florasi ham etnobotanik tadqiqotlar uchun muhim manba hisoblanadi. Mamlakatimizning cho‘l, adir, tog‘ va vodiy hududlarida uchraydigan o‘simliklar mahalliy aholining turmush tarzi, oziq-ovqat an’analari va an’anaviy tabobatida turlicha ahamiyatga ega.

Biroq dorivor o‘simliklarni tabiatdan me’yoridan ortiq yig‘ish ularning tabiiy populyatsiyalariga salbiy ta’sir ko‘rsatishi mumkin. Shu sababli etnobotanik bilimlarni o‘rganish bilan bir qatorda o‘simlik resurslarini baholash, noyob turlarni muhofaza qilish, madaniy holda yetishtirish va tabiiy zaxiralardan barqaror foydalanish masalalariga ham e’tibor qaratish lozim.

Oliy ta’limda talabalarga atamalarni tushuntirishning pedagogik ahamiyati

Oliy ta’lim muassasalarida “xalq tabobati” va “etnobotanika” atamalarini o‘rgatishda nazariy ma’lumotlarni amaliy misollar bilan uyg‘unlashtirish maqsadga muvofiq. Talabalarga atamalarning lug‘aviy ma’nosi, ilmiy ta’rifi, o‘zaro farqi va amaliy ahamiyatini tushuntirish orqali mavzuni chuqurroq o‘zlashtirish mumkin.

Mashg‘ulotlarda quyidagi pedagogik usullardan foydalanish tavsiya etiladi:

1. **Taqqoslash usuli.** Xalq tabobati va etnobotanikaning umumiy hamda farqli jihatlarini jadval asosida tahlil qilish.
2. **Mahalliy misollar usuli.** Hududda uchraydigan dorivor va oziq-ovqat o‘simliklari haqida ma’lumot to‘plash.
3. **Kuzatish va gerbariy usuli.** O‘simliklarning morfologik belgilarini o‘rganish va ularni ilmiy nomlar bilan tanishtirish.
4. **Loyiha usuli.** Mahalliy aholining o‘simliklardan foydalanish tajribasi bo‘yicha kichik tadqiqotlar tashkil etish.
5. **Muammoli ta’lim usuli.** Dorivor o‘simliklardan foydalanishda samaradorlik, xavfsizlik va tabiatni muhofaza qilish masalalarini muhokama qilish.

Mazkur yondashuvlar talabalarda ilmiy fikrlash, axborotni tahlil qilish, kuzatish natijalarini qayd etish va biologik xilma-xillikka mas’uliyatli munosabatda bo‘lish ko‘nikmalarini rivojlantiradi.

Xulosa

Xalq tabobati va etnobotanika insoniyatning tabiat bilan o‘zaro munosabatlari davomida shakllangan bilim va tajribalarni o‘rganishda muhim ahamiyatga ega. Xalq tabobati asosan an’anaviy sog‘liqni saqlash va muolaja usullarini qamrab olsa, etnobotanika insonlarning o‘simliklardan turli maqsadlarda foydalanishi bilan bog‘liq bilim va amaliyotlarni keng doirada tadqiq etadi.

Ushbu atamalarni oliy ta’lim talabalariga ilmiy asosda tushuntirish biologiya va botanika fanlarini o‘zlashtirish sifatini oshirish, mahalliy o‘simliklar haqidagi bilimlarni boyitish hamda milliy tabiat merosini asrashga xizmat qiladi. Shuningdek, etnobotanik tadqiqotlar istiqbolli dorivor o‘simliklarni aniqlash, an’anaviy bilimlarni saqlash va tabiiy resurslardan oqilona foydalanish uchun muhim ilmiy asos yaratadi.

Shu bilan birga, xalq tabobatiga oid amaliyotlarni baholashda ilmiy dalillar, dori vositalarining xavfsizligi va zamonaviy tibbiyot talablariga rioya qilish zarur. Natijada xalqning tarixiy tajribasi va zamonaviy ilm-fan yutuqlarini uyg‘unlashtirish orqali talabalarda mustahkam nazariy bilim va amaliy ko‘nikmalarni shakllantirish mumkin.

FOYDALANILGAN ADABIYOTLAR

1. Harshberger J. W. The Purposes of Ethno-Botany. Botanical Gazette, 1896.
2. Martin G. J. Ethnobotany: A Methods Manual. Chapman & Hall, 1995.
3. Murodov S. A., Teshayeva M. I. Maktab o‘quvchilariga xalq tabobati va etnobotanika atamalarini tushuntirish. Biologiya fanini rivojlantirishda zamonaviy tadqiqotlar: muammolar, istiqbolli yechimlar. Ilmiy-amaliy anjuman materiallari to‘plami. Buxoro, 2026-yil 27-fevral.
4. O‘zbekiston Respublikasi Qizil kitobi. O‘simliklar va zamburug‘lar bo‘yicha nashrlar.
5. World Health Organization. WHO Traditional Medicine Strategy: 2014–2023. Geneva: WHO, 2013.

BIOLOGIYA FANINI O‘QITISHDA ZAMONAVIY PEDAGOGIK TEXNOLOGIYALARDAN FOYDALANISHNING SAMARADORLIGI

Berdimurodova Ruxshona Shuhrat qizi
Samarqand Davlat Pedagogika Instituti Biologiya yo’nalishi talabasi
Pardayeva Durdona Said qizi
Samarqand Davlat Pedagogika Instituti Biologiya yo’nalishi talabasi
Ilmiy rahbar: Ibodullayeva Baxora Xamidullayevna
Samarqand davlat pedagogika instituti Biologiya kafedrasi o‘qituvchisi

Annotatsiya: *Mazkur maqolada biologiya fanini o‘qitishda zamonaviy pedagogik texnologiyalardan foydalanishning ahamiyati, ta’lim jarayoniga ta’siri hamda o‘quvchilarning bilim, ko‘nikma va kompetensiyalarini rivojlantirishdagi o‘rni yoritilgan. Shuningdek, interfaol metodlar, axborot-kommunikatsiya texnologiyalari, muammoli ta’lim, loyihaviy yondashuv va virtual laboratoriyalardan foydalanish imkoniyatlari tahlil qilingan.*

Kalit so’zlar: *biologiya, zamonaviy pedagogik texnologiyalar, innovatsion ta’lim, interfaol metodlar, axborot-kommunikatsiya texnologiyalari, mustaqil fikrlash, laboratoriya mashg‘ulotlari, ta’lim samaradorligi.*

Kirish: Bugungi globallashuv va raqamli rivojlanish davrida ta’lim tizimini takomillashtirish, o‘qitish sifatini oshirish hamda zamonaviy bilim va ko‘nikmalarga ega yoshlarni tarbiyalash muhim vazifalardan biri hisoblanadi. Ta’lim jarayonida an’anaviy o‘qitish usullari bilan bir qatorda zamonaviy pedagogik texnologiyalardan foydalanish ham katta ahamiyat kasb etmoqda. Chunki zamonaviy ta’lim o‘quvchilarga tayyor bilimlarni berish bilangina cheklanmay, ularning mustaqil

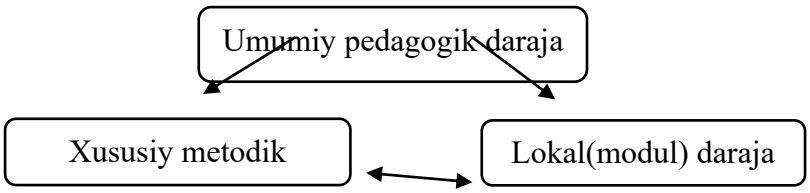
fikrlashi, izlanishi, muammolarni tahlil qilishi va o‘z bilimlarini amaliyotda qo‘llay olish qobiliyatini rivojlantirishni ham nazarda tutadi. Biologiya fani tirik organizmlarning tuzilishi, hayotiy faoliyati, kelib chiqishi, rivojlanishi va atrof-muhit bilan munosabatlarini o‘rganuvchi muhim tabiiy fanlardan biridir. Ushbu fan inson salomatligi, tabiatni muhofaza qilish, biologik xilma-xillikni saqlash va ekologik madaniyatni shakllantirishda muhim o‘rin tutadi. Shu sababli biologiya fanini o‘qitishda zamonaviy pedagogik texnologiyalarni qo‘llash orqali o‘quvchilarning nazariy bilimlarini mustahkamlash, amaliy ko‘nikmalarini rivojlantirish va fanga bo‘lgan qiziqishini oshirish mumkin. Pedagogik texnologiya atamasiga shu muammo bo'yicha izlangan har bir olim o'z nuqtayi nazaridan kelib chiqqan holda ta’rif bergan. Hozircha bu tushunchaga to'liq va yagona ta’rif qabul qilinmagan. Ushbu ta’riflarning ichida eng maqsadga muvofig'i YUNESKO tomonidan berilgan ta’rif sanaladi. Unga ko'ra, pedagogik texnologiya — o'qitish shakllarini optimallashtirish maqsadida o'qitish va bilimlarni o'zlashtirish jarayonida inson salohiyati va texnik resurslami qo'llash, ularning o'zaro ta’sirini aniqlashga imkon beradigan tizimli metodlar majmuasidir. Ushbu ta’rifdagi inson salohiyati atamasida o'qituvchining pedagogikva o'quvchilarning bilish faoliyati, texnik resurslar atamasi o'qitish metodlari va vositalari nazarda tutilmoqda. Bizning nazarimizda, pedagogik texnologiya — ta’lim jarayonining samaradorligini oshirish maqsadida o'qitish va bilimlarni o'zlashtirish jarayonida o'qituvchining pedagogik va o'quvchining o'quv-bilish faoliyatini uyg'un ravishda tashkil etish, mazkur faoliyatni faollashtirish maqsadida, samarali o'qitish metodlari, vositalari va shakllarini qo'llash,ularning o‘zaro ta’sirini aniqlashga imkon beradigan tizimlar majmuasidir. Pedagogik texnologiyalarning uchta darajasi mavjud:

1. Umumiy metodik daraja. Umumiy pedagogik (umumdidaktik,umumtarbiyaviy) darajada pedagogik texnologiyaning umumiy qonuniyatlari, konseptual asoslari, o'qituvchi va o'quvchining bilish faoliyatini tashkil etish va boshqarishning o'ziga xos xususiyatlari ishlab chiqiladi.

2. Xususiy metodik darajada muayyan bir o'quv fani, kursni o'qitish jarayonining maqsadi va vazifalarini amalga oshirish maqsadida ta’lim mazmunini o'quvchilar ongiga singdirishda foydalaniladigan o'qitish metodlari, vositalari va shakllarining majmuasi tushuniladi.

3. Lokal (modul) darajada ta’lim-tarbiya jarayonining ma’lum bir qismida mazkur qismning xususiy didaktik va tarbiyaviy maqsadini hal etishga qaratilgan texnologiya tushuniladi.

Pedagogik texnologiyalarning qo’llanish darajalari



Zamonaviy pedagogik texnologiyalar — belgilangan ta’lim maqsadlariga erishish uchun o‘qitish jarayonini rejalashtirish, tashkil etish, amalga oshirish va natijalarini baholashga xizmat qiluvchi metodlar, vositalar hamda yondashuvlar tizimidir. Bunday texnologiyalar ta’lim jarayonida o‘qituvchi va o‘quvchi o‘rtasidagi hamkorlikni kuchaytirib, o‘quvchilarning faol ishtirokini ta’minlaydi.

Biologiya fanining o‘ziga xos xususiyati shundaki, unda ko‘plab jarayonlarni faqat nazariy tushuntirish orqali to‘liq anglash qiyin. Masalan, hujayraning ichki tuzilishi, fotosintez, mitoz va meyoz jarayonlari, irsiyat mexanizmlari kabi mavzularni animatsiyalar, modellar, laboratoriya tajribalari va interaktiv topshiriqlar orqali o‘rgatish mavzuning mazmunini chuqurroq tushunishga yordam beradi. *Jumladan, “Aqliy hujum”, “Klaster”, “BBB”, “Venn diagrammasi”, “Insert” va muammoli vaziyatlarni tahlil qilish kabi metodlardan samarali foydalanish mumkin.* Masalan, “O‘simliklarda fotosintez jarayoni” mavzusini o‘rganishda “Aqliy hujum” metodidan foydalanib, o‘quvchilarga “O‘simliklar nima uchun yorug‘likka muhtoj?” degan savol beriladi. O‘quvchilar o‘z fikrlarini bildiradilar, keyin esa ilmiy ma’lumotlar asosida javoblar tahlil qilinadi. Bu usul mavjud bilimlarni faollashtirish va yangi bilimlarni o‘zlashtirishga yordam beradi. “Venn diagrammasi” yordamida mitoz va meyoz jarayonlarining o‘xshash hamda farqli jihatlarini aniqlash mumkin. Bunday topshiriqlar o‘quvchilarning taqqoslash, umumlashtirish va xulosa chiqarish qobiliyatini rivojlantiradi.

Shuningdek, guruhli ishlardan foydalanish orqali o‘quvchilar biologik muammolarni birgalikda hal qilish, o‘z fikrlarini asoslash va boshqalarning fikrlarini tinglashni o‘rganadilar.

Raqamli texnologiyalarning rivojlanishi biologiya fanini o‘qitish uchun yangi imkoniyatlarni yaratmoqda. Elektron darsliklar, multimedia taqdimotlari, videodarslar, virtual laboratoriyalar, uch o‘lchamli modellar va ta’lim platformalari o‘quv materiallarini ko‘rgazmali va tushunarli tarzda yetkazishga yordam beradi.

Masalan, inson yuragining tuzilishi va qon aylanish jarayonini videolar yoki animatsiyalar orqali tushuntirish o‘quvchilarga jarayonning ketma-ketligini yaxshiroq anglash imkonini beradi. Hujayra organoidlarini uch o‘lchamli modellar yordamida o‘rganish esa ularning shakli, joylashuvi va

vazifalarini tasavvur qilishni osonlashtiradi. Virtual laboratoriyalar ayrim tajribalarni xavfsiz va takroriy bajarish imkonini beradi. Ayniqsa, murakkab, qimmat yoki maktab sharoitida bajarish qiyin bo‘lgan tajribalarni modellashtirishda bu vositalar foydalidir. Biroq virtual laboratoriyalar imkon qadar haqiqiy kuzatish va amaliy mashg‘ulotlar bilan uyg‘unlashtirilishi lozim. Zamonaviy pedagogik texnologiyalarning samaradorligi bir qator omillar bilan belgilanadi. Avvalo, ular o‘quvchilarning darsga bo‘lgan qiziqishini oshiradi va o‘quv jarayonida faol ishtirok etishiga yordam beradi. Ko‘rgazmali materiallar va amaliy mashg‘ulotlar murakkab biologik tushunchalarni osonroq anglashga ko‘maklashadi. Ta’lim samaradorligini aniqlash uchun o‘quvchilarning darsdan oldingi va keyingi bilimlarini taqqoslash, test natijalarini tahlil qilish, amaliy topshiriqlarni bajarish darajasini baholash va o‘quvchilarning darsdagi faolligini kuzatish mumkin. Bunday yondashuv qaysi metodlar samarali ekanini aniqlashga yordam beradi.

Zamonaviy texnologiyalarni maqsadga muvofiq qo‘llash biologiya darslarini mazmunli, qiziqarli va hayot bilan bog‘liq holda tashkil etish imkonini beradi. Shu sababli o‘qituvchi har bir mavzuning xususiyatidan kelib chiqib, samarali metodlarni tanlashi, nazariy bilimlarni amaliy faoliyat bilan uyg‘unlashtirishi va o‘quvchilarning individual imkoniyatlarini hisobga olishi zarur. Xulosa qilib aytganda, biologiya fanini o‘qitishda zamonaviy pedagogik texnologiyalardan foydalanish ta’lim sifatini oshirishning muhim shartlaridan biridir. Interfaol metodlar, axborot-kommunikatsiya texnologiyalari, muammoli va loyihaviy ta’lim o‘quvchilarning biologik bilimlarini chuqurlashtirish, amaliy ko‘nikmalarini rivojlantirish va mustaqil fikrlash qobiliyatini shakllantirishga xizmat qiladi. Kelgusida biologiya ta’limida raqamli resurslar, virtual laboratoriyalar va tadqiqotga asoslangan o‘qitish usullaridan oqilona foydalanish ilmiy fikrlaydigan, ekologik madaniyatga ega va zamonaviy bilimlarni amaliyotda qo‘llay oladigan yoshlarni tayyorlashga yordam beradi.

FOYDALANILGAN ADABIYOTLAR RO’YXATI:

1. J.O.Tolipova Biologiyani o’qitishda pedagogik texnologiyalar Toshkent 2011.
2. Klara Kubakova Biologiya o’qitish metodikasi fanidan amaliy mashg’ulotlar olib borish texnologiyasi Toshkent – 2018.
3. UNESCO. UNESCO ICT Competency Framework for Teachers. — UNESCO, 2018.
4. Biologiya fanini o‘qitish metodikasiga oid darsliklar va o‘quv-metodik qo‘llanmalar.

QURG‘OQCHILIK VA SHO‘RLANISH MAVZUSINI O‘QITISHDA INTERAKTIV RAQAMLI USULLARDAN FOYDALANISH

Biologiya fanlari bo’yicha falsafa doktori **Usmonova Mahliyo Ibodullayevna** SamDPI Biologiya kafedrasi o’qituvchisi

Arzimurodova Muqaddas Jamol qizi SamDPI Tabiiy fanlar fakulteti 2-kurs magistranti

Annotatsiya. *Mazkur tezisda qurg‘oqchilik va tuproq sho‘rlanishi mavzularini o‘qitishda interaktiv raqamli texnologiyalardan foydalanishning pedagogik imkoniyatlari tahlil qilinadi. Iqlim o‘zgarishi, suv resurslarining cheklanganligi va tuproq degradatsiyasi sharoitida o‘quvchilarda qurg‘oqchilik va sho‘rlanishning kelib chiqish sabablari, ekologik va iqtisodiy oqibatlari hamda ularning oldini olish choralariga oid bilimlarni shakllantirish muhim ahamiyat kasb etadi. Mazkur jarayonda raqamli xaritalar, GIS texnologiyalari, interaktiv xaritalash, sun’iy yo‘ldosh tasvirlari, virtual laboratoriyalar, simulyatsiyalar, raqamli testlar va gamifikatsiya elementlaridan foydalanish o‘quvchilarning mavzuga qiziqishi hamda faol ishtirokini oshirishga xizmat qilishi mumkin. Tezisda ushbu usullarni ta’lim jarayoniga integratsiya qilishning amaliy mexanizmlari taklif etiladi.*

Kalit so‘zlar: *qurg‘oqchilik, sho‘rlanish, ekologik ta’lim, raqamli ta’lim, interaktiv metodlar, GIS, sun’iy yo‘ldosh tasvirlari, simulyatsiya, virtual laboratoriya, gamifikatsiya.*

Abstract. *This thesis analyzes the pedagogical potential of using interactive digital technologies in teaching the topics of drought and soil salinization. In the context of climate change, limited water resources, and soil degradation, it is important to develop students’ knowledge about the causes of drought and salinization, their ecological and economic consequences, and measures for their prevention. In this process, the use of digital maps, GIS technologies, interactive mapping, satellite imagery, virtual laboratories, simulations, digital tests, and gamification elements can contribute to increasing students’ interest in the topic and their active participation. The thesis proposes practical mechanisms for integrating these methods into the educational process.*

Keywords: *drought, salinization, environmental education, digital education, interactive methods, GIS, satellite imagery, simulation, virtual laboratory, gamification.*

Kirish

Bugungi kunda iqlim o‘zgarishi va suv resurslaridan oqilona foydalanish masalalari ekologik ta’limning dolzarb yo‘nalishlaridan birini tashkil etmoqda. Qurg‘oqchilik va tuproq

sho‘rlanishi qishloq xo‘jaligi mahsuldorligiga, suv resurslariga, tuproq unumdorligiga va ekotizimlarning barqarorligiga ta’sir qiluvchi muhim ekologik muammolardandir.

O‘zbekiston sharoitida ushbu mavzularni o‘qitish alohida ahamiyatga ega. Mamlakatning qurg‘oqchil iqlim sharoiti, suv resurslaridan foydalanishning yuqori darajasi va sug‘oriladigan hududlarda tuproq sho‘rlanishi bilan bog‘liq muammolar o‘quvchilarda ekologik bilim va mas’uliyatni shakllantirishni talab qiladi.

An’anaviy darslarda qurg‘oqchilik va sho‘rlanish asosan matn, jadval, xarita yoki statik rasmlar yordamida tushuntiriladi. Bunday yondashuv o‘quvchilarga nazariy bilim berish imkonini bersa-da, jarayonlarning dinamikasini to‘liq tasavvur qilishni qiyinlashtirishi mumkin. Raqamli texnologiyalar esa ekologik jarayonlarni xarita, grafik, animatsiya va modellashtirish vositalari orqali vizual namoyish etish imkonini beradi.

Asosiy qism

Qurg‘oqchilik va sho‘rlanish mavzusini o‘qitishda interaktiv raqamli usullardan foydalanishning asosiy afzalligi o‘quvchini tayyor ma’lumotni qabul qiluvchi emas, balki raqamli ma’lumotni tahlil qiluvchi va xulosa chiqaruvchi faol subyekt sifatida shakllantirish imkoniyatidir.

Raqamli xaritalardan foydalanish

GIS va interaktiv xaritalar yordamida o‘quvchilarga qurg‘oqchilik yoki sho‘rlanish darajasi turlicha bo‘lgan hududlarni taqqoslash topshirig‘i berilishi mumkin.

Masalan, o‘quvchilarga O‘zbekiston xaritasi taqdim etilib, quyidagi vazifalar beriladi:

- qurg‘oqchilik xavfi yuqori hududlarni aniqlash;
- sug‘oriladigan yerlarning joylashuvini ko‘rsatish;
- sho‘rlanish kuzatiladigan hududlarni aniqlash;
- suv resurslari va qishloq xo‘jaligi hududlari o‘rtasidagi bog‘liqlikni tahlil qilish.

Bunday topshiriq o‘quvchilarda geografik fikrlash, ma’lumotni xarita orqali o‘qish va tahlil qilish ko‘nikmalarini rivojlantiradi.

Sun’iy yo‘ldosh tasvirlari asosida tahlil

Qurg‘oqchilik va sho‘rlanishni o‘rgatishda sun’iy yo‘ldosh ma’lumotlaridan foydalanish mavzuni real hududlar bilan bog‘lash imkonini beradi.

Masalan, o‘qituvchi bir hududning turli yillardagi sun’iy yo‘ldosh tasvirlarini ko‘rsatishi va o‘quvchilarga quyidagi savollarni berishi mumkin:

“Hududda qanday o‘zgarish sodir bo‘lgan?”

“O‘simlik qoplami nima sababdan kamaygan bo‘lishi mumkin?”

“Tuproq namligi yoki sho‘rlanish bilan bog‘liq qanday belgilarni kuzatish mumkin?”

Shunday qilib, o‘quvchi tayyor xulosani olish o‘rniga vizual ma’lumot asosida mustaqil fikr yuritadi.

Virtual laboratoriya

Tuproq sho‘rlanishini tushuntirishda virtual laboratoriyadan foydalanish ham samarali usullardan biridir. O‘quvchi turli miqdordagi tuz konsentratsiyasining o‘simlik o‘sishiga ta’sirini virtual muhitda kuzatishi mumkin.

Masalan, simulyatsiyada uchta sharoit yaratiladi:

1. sho‘rlanish darajasi past;
2. sho‘rlanish darajasi o‘rtacha;
3. sho‘rlanish darajasi yuqori.

O‘quvchilar har bir sharoitda o‘simlik rivojlanishidagi farqlarni kuzatib, natijalarni jadvalga kiritadilar va yakunda xulosa chiqaradilar.

Bu usul real laboratoriya sharoitida uzoq vaqt talab qiladigan jarayonlarni qisqa vaqt ichida tushuntirish imkonini beradi.

Interaktiv simulyatsiyalar

Qurg‘oqchilik va sho‘rlanish ko‘plab o‘zaro bog‘liq omillarning ta’siri natijasida yuzaga keladi. Shu sababli interaktiv simulyatsiyalar yordamida sabab-oqibat munosabatlarini tushuntirish mumkin.

Masalan, o‘quvchiga quyidagi parametrlarni o‘zgartirish imkoniyati beriladi:

- yog‘in miqdori
- sug‘orish hajmi
- bug‘lanish
- tuproq namligi
- sho‘rlanish darajasi
- hosildorlik.

O‘quvchi parametrlarning birini o‘zgartirib, boshqa ko‘rsatkichlarda qanday o‘zgarish yuz berishini kuzatadi. Natijada mavzu oddiy nazariy ma’lumot emas, balki amaliy tajriba sifatida o‘zlashtiriladi.

Gamifikatsiya

Mavzuni mustahkamlash bosqichida gamifikatsiya elementlaridan foydalanish mumkin. Masalan, “Qurg‘oqchilikka qarshi kurash” nomli raqamli topshiriqda o‘quvchiga shartli fermer xo‘jaligini boshqarish vazifasi beriladi.

O‘quvchi:

- suv miqdorini belgilaydi;

- ekin turini tanlaydi;
- sug‘orish usulini tanlaydi;
- tuproq holatini nazorat qiladi;
- hosildorlikni baholaydi.

Har bir qaror natijaga ta’sir qiladi. Shu orqali o‘quvchi suvdan oqilona foydalanish va tuproqni muhofaza qilish o‘rtasidagi bog‘liqlikni amaliy ravishda tushunadi.

Raqamli viktorina va tezkor baholash

Dars yakunida interaktiv test va viktorinalardan foydalanish o‘quvchilarning mavzuni qay darajada o‘zlashtirganini aniqlash imkonini beradi.

Masalan:

Savol: Tuproq sho‘rlanishining kuchayishiga qaysi omillar sabab bo‘lishi mumkin?

A) noto‘g‘ri sug‘orish va kuchli bug‘lanish

B) faqat havo haroratining pasayishi

C) faqat yog‘ingarchilikning ko‘payishi

D) shamol tezligining kamayishi

Bunday topshiriqlar orqali o‘quvchi darhol javob beradi va natijani ko‘radi. O‘qituvchi esa sinfning umumiy natijasini tezkor tahlil qilishi mumkin.

O‘zbekiston ta’lim tizimida qo‘llash imkoniyatlari

O‘zbekiston maktablarida ushbu usullarni geografiya, biologiya, ekologiya va tabiiy fanlar doirasida integratsiyalash mumkin. Ayniqsa, qurg‘oqchilik va sho‘rlanishni mamlakat hududlari misolida o‘rganish o‘quvchilarning mahalliy ekologik muammolarga nisbatan qiziqishini oshiradi.

Masalan, darsni uch bosqichda tashkil etish mumkin:

1-bosqich — muammoni aniqlash.

O‘quvchilarga O‘zbekistonning turli hududlariga oid xarita yoki sun’iy yo‘ldosh tasviri ko‘rsatiladi va “Nima uchun ayrim hududlarda qurg‘oqchilik yoki sho‘rlanish xavfi yuqoriroq?” degan muammo qo‘yiladi.

2-bosqich — raqamli tadqiqot.

O‘quvchilar interaktiv xarita, grafik va boshqa raqamli ma’lumotlardan foydalanib, sabablarni aniqlaydilar.

3-bosqich — yechim ishlab chiqish.

Guruhlar suvni tejash, sug‘orishni takomillashtirish, tuproq unumdorligini saqlash va ekologik xavflarni kamaytirish bo‘yicha raqamli taqdimot yoki infografika tayyorlaydilar.

Bunday yondashuv o‘quvchilarda nafaqat mavzu bo‘yicha bilim, balki muammoni aniqlash, ma’lumot to‘plash, tahlil qilish, hamkorlik qilish va yechim taklif etish kompetensiyalarini rivojlantiradi.

Xulosa

Qurg‘oqchilik va sho‘rlanish mavzusini o‘qitishda interaktiv raqamli usullardan foydalanish ekologik ta’limning amaliy va tadqiqotga yo‘naltirilganligini kuchaytirishi mumkin. Raqamli xaritalar, GIS, sun’iy yo‘ldosh tasvirlari, virtual laboratoriyalar, simulyatsiyalar, gamifikatsiya va interaktiv baholash vositalari o‘quvchilarga murakkab ekologik jarayonlarni vizual va amaliy shaklda o‘rganish imkonini beradi.

Mazkur usullarning muhim jihati shundaki, o‘quvchi tayyor ma’lumotni yodlash bilan cheklanmaydi. U raqamli ma’lumotni kuzatadi, taqqoslaydi, sabab-oqibat aloqalarini aniqlaydi va mustaqil xulosa chiqaradi.

Shu sababli qurg‘oqchilik va sho‘rlanish mavzusida raqamli texnologiyalardan foydalanish o‘quvchilarning ekologik savodxonligi, raqamli kompetensiyasi va muammoli vaziyatlarda qaror qabul qilish ko‘nikmalarini rivojlantirishga xizmat qiladi.

O‘zbekiston sharoitida mazkur metodlarni mahalliy ekologik muammolar bilan bog‘lash, xususan, suv resurslaridan foydalanish, sug‘oriladigan yerlarning holati va tuproq degradatsiyasi masalalari bilan integratsiyalash ta’limning amaliy ahamiyatini yanada oshiradi.

FOYDALANILGAN ADABIYOTLAR

1. UNESCO. (2023). Global Education Monitoring Report 2023: Technology in Education – A Tool on Whose Terms? Paris: UNESCO.

2. OECD. (2023). OECD Digital Education Outlook 2023: Towards an Effective Digital Education Ecosystem. Paris: OECD Publishing.

3. FAO. (2021). The State of the World’s Land and Water Resources for Food and Agriculture – Systems at Breaking Point. Rome: Food and Agriculture Organization of the United Nations.

4. FAO. (2022). The State of the World’s Land and Water Resources for Food and Agriculture: Systems at Breaking Point. Rome: FAO.

5. O‘zbekiston Respublikasi Prezidentining 2020-yil 5-oktabrdagi PF-6079-son Farmoni. “Raqamli O‘zbekiston – 2030” strategiyasini tasdiqlash va uni samarali amalga oshirish chora-tadbirlari to‘g‘risida.

6. O‘zbekiston Respublikasi Prezidentining 2019-yil 29-oktabrdagi PF-5863-son Farmoni. “Ilm-fan va ilmiy faoliyat to‘g‘risida”gi O‘zbekiston Respublikasi Qonunini amalga oshirish chora-tadbirlari to‘g‘risida.

7. Mayer, R. E. (2021). Multimedia Learning (3rd ed.). Cambridge University Press.

8. Redecker, C. (2017). European Framework for the Digital Competence of Educators: DigCompEdu. Luxembourg: Publications Office of the European Union.

RAQAMLI TA’LIM MUHITIDA O‘QUVCHILARNING FAOL ISHTIROKINI OSHIRISH USULLARI

Biologiya fanlari bo’yicha falsafa doktori **Usmonova Mahliyo Ibodullayevna** SamDPI Biologiya kafedrasi o’qituvchisi

Arzimurodova Muqaddas Jamol qizi SamDPI Tabiiy fanlar fakulteti 2-kurs magistranti

Annotatsiya. *Mazkur tezisda raqamli ta’lim muhitida o‘quvchilarning o‘quv jarayonidagi faol ishtirokini oshirishning pedagogik va texnologik usullari tahlil qilinadi. Raqamli texnologiyalarning O‘zbekiston ta’lim tizimiga joriy etilishi sharoitida o‘quvchilarning faolligini ta’minlash faqat texnik vositalar bilan ta’minlash masalasi emas, balki ta’lim metodlarini qayta tashkil etish, o‘qituvchilarning raqamli kompetensiyasini rivojlantirish va o‘quvchilarning mustaqil hamda hamkorlikdagi faoliyatini kuchaytirish bilan bog‘liq jarayon sifatida ko‘rib chiqiladi. Tadqiqotda interaktiv topshiriqlar, gamifikatsiya, loyiha asosida o‘qitish, multimedia vositalari, tezkor teskari aloqa, individual ta’lim va sun’iy intellekt vositalaridan foydalanishning imkoniyatlari yoritilgan. Shuningdek, raqamli ta’limda teng imkoniyat, raqamli xavfsizlik va inson omilining ahamiyatiga e’tibor qaratiladi.*

Kalit so‘zlar: *raqamli ta’lim, raqamli ta’lim muhiti, o‘quvchi faolligi, raqamli kompetensiya, interaktiv ta’lim, gamifikatsiya, loyiha asosida ta’lim, sun’iy intellekt, teskari aloqa, raqamli pedagogika.*

Abstract. *This thesis analyzes pedagogical and technological approaches to increasing students’ active participation in the educational process within a digital learning environment. In the context of the introduction of digital technologies into the education system of Uzbekistan, ensuring students’ engagement is considered not merely as a matter of providing technical tools, but as a comprehensive process involving the restructuring of teaching methods, the development of teachers’ digital competencies, and the enhancement of students’ independent and collaborative activities. The study highlights the possibilities of using interactive tasks, gamification, project-based learning, multimedia tools, immediate feedback, personalized learning, and artificial intelligence technologies. In addition, attention is paid to the importance of equal opportunities, digital safety, and the human factor in digital education.*

Keywords: *digital education, digital learning environment, student engagement, digital competence, interactive learning, gamification, project-based learning, artificial intelligence, feedback, digital pedagogy.*

Kirish: Raqamli texnologiyalarning jadal rivojlanishi ta’lim tizimining mazmuni, shakli va metodlariga sezilarli ta’sir ko‘rsatmoqda. Ta’lim jarayoniga elektron ta’lim resurslari, onlayn platformalar, multimedia vositalari, masofaviy ta’lim texnologiyalari hamda sun’iy intellekt imkoniyatlarining kirib kelishi o‘quvchi va o‘qituvchi o‘rtasidagi o‘zaro munosabatlarning yangi shakllarini yuzaga keltirmoqda.

O‘zbekistonda ham ta’lim tizimini raqamlashtirish davlat siyosatining muhim yo‘nalishlaridan biriga aylangan. Xususan, “Raqamli O‘zbekiston – 2030” strategiyasida raqamli texnologiyalarni turli sohalarga, jumladan, ta’lim tizimiga keng joriy etish masalalariga alohida e’tibor qaratilgan. Shuningdek, oliy ta’lim tizimini 2030-yilgacha rivojlantirish konsepsiyasida ta’lim jarayoniga zamonaviy texnologiyalarni joriy etish va ta’lim sifatini oshirishga qaratilgan vazifalar belgilangan.

Biroq ta’lim jarayonining raqamlashtirilishi avtomatik ravishda o‘quvchilarning faolligini oshirmaydi. OECD ma’lumotlariga ko‘ra, samarali raqamli ta’lim ekotizimi faqat texnik infratuzilmadan iborat bo‘lmay, raqamli vositalar, ta’lim resurslari, o‘qituvchi va o‘quvchilarning kompetensiyalari hamda tegishli boshqaruv mexanizmlarining o‘zaro uyg‘unligini talab qiladi.

Shu nuqtayi nazardan, raqamli ta’lim muhitida o‘quvchilarning faol ishtirokini ta’minlashning samarali pedagogik mexanizmlarini aniqlash dolzarb ilmiy-amaliy masalalardan biridir.

Asosiy qism

O‘quvchining ta’lim jarayonidagi faol ishtiroki uning faqat darsni tinglashi yoki topshiriqlarni bajarishi bilan cheklanmaydi. Faol ishtirok o‘quvchining savol berishi, muammoni mustaqil tahlil qilishi, muhokamada qatnashishi, guruh bilan hamkorlik qilishi, raqamli resurslardan foydalanishi va o‘z ta’lim natijalarini baholashi kabi faoliyatlarni qamrab oladi.

Raqamli ta’lim muhitida mazkur faollikni oshirish uchun, avvalo, interaktiv ta’lim metodlaridan foydalanish maqsadga muvofiq. Elektron testlar, interaktiv savollar, virtual doskalar, onlayn viktorinalar va muammoli vaziyatlarga asoslangan topshiriqlar o‘quvchini passiv axborot qabul qiluvchidan faol ishtirokchiga aylantirish imkonini beradi. Bunda raqamli vosita darsning maqsadi emas, balki pedagogik vazifani amalga oshirish vositasi sifatida qo‘llanishi lozim.

Ikkinchi muhim yo‘nalish — gamifikatsiya. Ta’lim jarayoniga o‘yin elementlarini kiritish orqali o‘quvchilarning qiziqishi va topshiriqlarni bajarishga bo‘lgan motivatsiyasini kuchaytirish mumkin. Ball to‘plash, bosqichlardan o‘tish, topshiriqlarni ketma-ket bajarish va natijani ko‘rish kabi mexanizmlar o‘quvchini muntazam faoliyatga undashi mumkin. Biroq gamifikatsiya ta’lim mazmunining o‘rnini egallamasligi, balki uni o‘zlashtirishni qo‘llab-quvvatlashi zarur.

Uchinchi usul — loyiha asosida va muammoli ta’limni raqamli vositalar bilan uyg‘unlashtirish. Masalan, o‘quvchilarga muayyan ijtimoiy, ekologik yoki iqtisodiy muammo bo‘yicha ma’lumot to‘plash, uni tahlil qilish, raqamli taqdimot yoki infografika tayyorlash va o‘z xulosalarini himoya qilish topshirig‘i berilishi mumkin. Bunday yondashuv nafaqat fan bo‘yicha bilimlarni, balki tanqidiy fikrlash, axborot bilan ishlash, kommunikativ va raqamli kompetensiyalarni ham rivojlantiradi.

To‘rtinchi yo‘nalish — multimedia vositalaridan maqsadli foydalanish. Video, animatsiya, infografika, audio materiallar va interaktiv modellar murakkab mavzularni turli formatlarda tushuntirish imkonini beradi. Shu bilan birga, multimedia materiallarini haddan tashqari ko‘paytirish o‘quvchining diqqatini asosiy o‘quv maqsadidan chalg‘itishi mumkin. Shuning uchun har bir raqamli material muayyan didaktik vazifaga xizmat qilishi kerak.

Beshinchi muhim omil — tezkor teskari aloqa. Raqamli platformalar orqali o‘quvchi topshiriqni bajarganidan keyin o‘z natijasi haqida tezkor ma’lumot olishi mumkin. Bu unga xatolarini aniqlash va bilimlarini mustahkamlash imkonini beradi. O‘qituvchi uchun esa raqamli natijalar o‘quvchilarning qaysi mavzularda qiyinchilikka duch kelayotganini aniqlashga xizmat qiladi. OECD raqamli ta’lim ekotizimida o‘quv jarayoni va baholashga oid raqamli vositalarning uyg‘un ishlashini muhim tarkibiy qism sifatida ko‘rsatadi.

Oltinchi usul — individual ta’lim imkoniyatlarini kengaytirish. Raqamli muhit o‘quvchining bilim darajasi, qiziqishi va o‘zlashtirish sur’atiga mos materiallarni tanlash imkonini beradi. Masalan, bir mavzu bo‘yicha asosiy, qo‘shimcha va murakkablashtirilgan topshiriqlarni taklif qilish orqali turli tayyorgarlik darajasiga ega o‘quvchilarni bir xil ta’lim jarayoniga faol jalb etish mumkin.

Yettinchi yo‘nalish — sun’iy intellekt vositalaridan pedagogik maqsadlarda mas’uliyatli foydalanish. Sun’iy intellekt o‘quv materiallarini tushuntirish, qo‘shimcha savollar yaratish, g‘oyalarni shakllantirish va individual mashqlar tayyorlashda yordamchi vosita bo‘lishi mumkin. Shu bilan birga, undan foydalanish o‘quvchining mustaqil fikrlashi va akademik halolligini cheklamasligi kerak. UNESCO ta’lim texnologiyalaridan foydalanishda inson manfaatlari markazda turishi, texnologiya esa insonlar o‘rtasidagi ta’limiy muloqotni almashtirish emas, uni qo‘llab-quvvatlashga xizmat qilishi kerakligini ta’kidlaydi.

Shuningdek, raqamli ta’limda o‘qituvchining roli alohida ahamiyatga ega. O‘qituvchi raqamli vositalarni shunchaki texnik jihatdan qo‘llay olishi emas, balki ularni ta’lim maqsadi, o‘quvchilarning ehtiyoji va fan xususiyatiga moslashtira olishi zarur. OECD samarali raqamli ta’lim ekotizimining muhim shartlaridan biri sifatida o‘qituvchilarning raqamli pedagogik kompetensiyalarini rivojlantirishni ko‘rsatadi.

O‘zbekiston ta’lim tizimida ushbu yondashuvlarni quyidagi model asosida amalga oshirish mumkin:

Yo‘nalish	Amaliy usul	Kutiladigan natija
Interaktiv ta’lim	Elektron test, viktorina, muammoli topshiriq	Darsdagi faollik oshadi
Gamifikatsiya	Ball, bosqich, topshiriq va rag‘bat	Motivatsiya kuchayadi
Loyiha ta’limi	Guruhli raqamli loyiha	Hamkorlik va ijodkorlik rivojlanadi
Multimedia	Video, infografika, animatsiya	Mazmunni tushunish osonlashadi
Teskari aloqa	Tezkor elektron baholash	Xatolarni o‘z vaqtida tuzatish imkoniyati paydo bo‘ladi
Individual ta’lim	Turli darajadagi topshiriqlar	Individual ehtiyojlar hisobga olinadi
Sun’iy intellekt	Qo‘shimcha tushuntirish va mashqlar	Mustaqil ta’lim imkoniyatlari kengayadi

Biroq raqamli ta’limni rivojlantirishda texnologiyadan foydalanishning o‘zi yetarli emas. UNESCOning 2023-yilgi Global Education Monitoring hisobotida ta’lim texnologiyalarining samaradorligi bo‘yicha ishonchli dalillar barcha holatlarda yetarli emasligi va texnologiyani joriy etishda uning ta’limiy maqsadga muvofiqligi, tenglik va barqarorlik masalalariga e’tibor qaratish zarurligi qayd etilgan.

Shu sababli O‘zbekiston sharoitida raqamli ta’limni tashkil etishda uchta omilni o‘zaro bog‘liq holda ko‘rish maqsadga muvofiq: texnologik infratuzilma, pedagogik kompetensiya va o‘quvchi faolligi. Faqat texnik vositalar bilan ta’minlash ta’lim sifatini avtomatik ravishda oshirmaydi. OECD ham raqamli qurilmalar va internetning o‘zi ta’limdagi raqamli transformatsiya uchun yetarli emasligini ta’kidlaydi.

Xulosa

Raqamli ta’lim muhitida o‘quvchilarning faol ishtirokini oshirish zamonaviy ta’lim tizimining muhim vazifalaridan biridir. O‘zbekiston ta’lim tizimida raqamlashtirish jarayonlarining rivojlanishi ushbu vazifani amalga oshirish uchun yangi imkoniyatlar yaratmoqda.

Tahlil natijasida o‘quvchilarning faol ishtirokini oshirishda interaktiv topshiriqlar, gamifikatsiya, loyiha asosida ta’lim, multimedia vositalari, tezkor teskari aloqa, individual ta’lim va sun’iy intellekt texnologiyalaridan maqsadli foydalanish muhim ahamiyatga ega ekanligi aniqlandi. Bunda asosiy e’tibor texnologiyaning mavjudligiga emas, balki uning o‘quvchining bilim olishi, mustaqil fikrlashi, hamkorligi va ijodiy faolligiga qanday xizmat qilayotganiga qaratilishi lozim.

Shuningdek, raqamli ta’limni rivojlantirish jarayonida raqamli tengsizlikni kamaytirish, o‘qituvchilarning raqamli-pedagogik kompetensiyalarini oshirish, o‘quvchilarning raqamli xavfsizligini ta’minlash va sun’iy intellektdan mas’uliyatli foydalanish tamoyillarini shakllantirish muhimdir.

Demak, samarali raqamli ta’lim muhiti — bu faqat kompyuter, internet yoki elektron platformalar majmuasi emas, balki o‘qituvchi, o‘quvchi, raqamli resurs va pedagogik metodlarning yagona tizimda ishlashini ta’minlaydigan ta’limiy ekotizimdir.

FOYDALANILGAN ADABIYOTLAR

1. O‘zbekiston Respublikasi Prezidentining 2020-yil 5-oktabrdagi PF-6079-son Farmoni. “Raqamli O‘zbekiston – 2030” strategiyasini tasdiqlash va uni samarali amalga oshirish chora-tadbirlari to‘g‘risida.

2. O‘zbekiston Respublikasi Prezidentining 2019-yil 8-oktabrdagi PF-5847-son Farmoni. “O‘zbekiston Respublikasi oliy ta’lim tizimini 2030-yilgacha rivojlantirish konsepsiyasini tasdiqlash to‘g‘risida”.

3. OECD. (2023). OECD Digital Education Outlook 2023: Towards an Effective Digital Education Ecosystem. Paris: OECD Publishing. https://doi.org/10.1787/c74f03de-en.

4. UNESCO. (2023). Global Education Monitoring Report 2023: Technology in Education – A Tool on Whose Terms? Paris: UNESCO.

5. UNESCO. (2023). Technology in Education: A Tool on Whose Terms? Recommendations. Global Education Monitoring Report.

6. Redecker, C. (2017). European Framework for the Digital Competence of Educators: DigCompEdu. Luxembourg: Publications Office of the European Union.

7. Mayer, R. E. (2021). Multimedia Learning (3rd ed.). Cambridge University Press.

8. OECD. (2023). Country Digital Education Ecosystems and Governance: A Companion to Digital Education Outlook 2023. OECD Publishing.

MUTAXASSISLIK FANLARINI O‘QITISHDA BUGUNGI KUNDAGI AXBOROT-KOMMUNIKATSIYA TEXNOLOGIYALAR IMKONIYATLARI

Gulboyev D.T., *Samarqand davlat pedagogika instituti, Samarqand, O‘zbekiston*

dostongulboyev2@gmail.com

Annotatsiya: *Ushbu maqolada mutaxassislik fanlarini o‘qitishda axborot-kommunikatsiya texnologiyalaridan foydalanish imkoniyatlari, ularning ta’lim sifatini oshirishdagi ahamiyati hamda zamonaviy raqamli vositalarni o‘quv jarayoniga joriy etish masalalari yoritilgan. Shuningdek, elektron ta’lim platformalarining talabalarning bilim va kasbiy kompetensiyalarini rivojlantirishdagi o‘rni ko‘rib chiqilgan.*

Kalit so‘zlar: *axborot-kommunikatsiya texnologiyalari, mutaxassislik fanlari, raqamli ta’lim, elektron ta’lim, innovatsion texnologiyalar, kasbiy kompetensiya.*

Kirish: Mutaxassislik fanlarini o‘qitish oliy ta’lim muassasalarida fanlarni o‘qitishning o‘ziga mos xususiyatlaridan kelib chiqqan holda yangi axborot va pedagogik texnologiyalarni qo‘llash imkoniyatlari kengaytirish lozim [1; 15-25-b].

XX-XXI asrlarga kelib bu imkoniyatlar yanada kengaytirildi. Elektron ta’lim resurslarini keng joriy etilishi, axborot-kommunikatsiya texnologiyalari hamda internet tarmoqlarini jadal rivojlanishi tufayli masofaviy ta’limni, shuningdek ta’lim sifatini yangi bosqichga ko‘tarilishiga zamin yaratdi [2; 1-10-b].

Oliy ta’lim muassasalarida axborot-kommunikatsiya texnologiyalaridan samarali foydalanish muayyan didaktik qoidalarga qat’iy amal qilishni talab etadi. Xususan, o‘quv materiallari hajmining an’anaviy o‘quv qo‘llanma yoki darsliklar hajmiga to‘liq mos bo‘lmaganligi sababli turli texnologik yechimlardan, jumladan multimedia texnologiyalaridan foydalanishni taqozo etadi. Maskur yondashuv asosida talabalar o‘quv ma’lumotlarni to‘liq va sifatli o‘zlashtirishlari mumkin bo‘ladi, bu esa didaktik ta’minotdagi mavjud bo‘shliqlarini axborot-kommunikatsiya texnologiyalari yordamida to‘ldirish imkoniyatini yaratadi [3; 66-76-b].

Bugungi kunda mamlakatimizda axborot-kommunikatsion texnologiyalariga asosida ta’lim jarayonining sifatini oshirish maqsadida elektron ta’lim resurslarini ishlab chiqish, takomillashtirish hamda ularni ta’lim jarayoniga joriy etishga alohida e’tibor qaratilmoqda. Jumladan, multimediali dasturlar yaratilib, ular o‘quv jarayonini sifatini oshirishga xizmat qilmoqda. Multimediali elektron resurslar muayyan bir fan, ya’ni aniq sohaga yoki ta’lim yo‘nalishiga mo‘ljallangan bo‘lib, talabalarnining bilim olishi, mustaqil o‘rganishi va ko‘nikmalarini shakllanishiga imkoniyat yaratadi [4; 94-104-b].

Oliy ta’lim tizimida mutaxassislik fanlarini o‘qitishda zamonaviy axborot-kommunikatsiya texnologiyalarining joriy etish jarayonlarini tahlil qilganimizda quyidagi muhim pedagogik imkoniyatlarga ega ekanligini ko‘rsatdi:

-ta’lim oluvchilarning o‘z mutaxassisligi bo‘yicha bilimlarni egallash jarayonini samarali tashkil etishga xizmat qilish;

-o‘rganilayotgan o‘quv materiallarini modellashtirish orqali fan sohasiga chuqur, tizimli va ongli ravishda o‘zlashtirish imkoniyati yaratilishi;

- o‘quv jarayonini tashkil etish shakllarini turli tumanligi hisobiga ta’lim oluvchilarni mustaqil bilim olishga yo‘naltirilishi;

-interfaol muloqot imkoniyatlarini joriy etish orqali o‘qitish jarayonini individuallashtirish va differensiyalashtirishga ta’minlash uchun zarur pedagogik shart-sharoitlar yaratishi;

-sun’iy intellekt tizimi imkoniyatlarini qo‘llash ta’lim oluvchilarda o‘quv materiallarini o‘zlashtirishning samarali strategiyalarini tizimli ravishda shakllantirilishi;

-har bir shaxsning jamiyatdagi axborot madaniyatini shakllantirish va rivojlantirishga ko‘maklashishi;

-mutaxassisligi bo‘yicha o‘qitilayaotgan fanlarni axborot-kommunikatsiya texnologiyalari yordamida vizual, interfaol va tushunarli shaklda taqdim etish ta’lim oluvchilarni o‘quv jarayoniga bo‘lgan qiziqishi va faolligini oshirishda muhim ahamiyatga ega ekanligini ko‘rsatadi [5; 14-24-b].

O‘quv jarayonini zamonaviy texnologik rivojlantirish deganda, ta’lim maqsadlariga muvofiq samarali didaktik jarayonni tashkil etish tushuniladi. Professor-o‘qituvchilarning kasbiy-pedagogik mahoratini rivojlantirish esa ularning o‘quv-bilish faoliyatini texnologik yondashuv asosida tashkil etishni talab qiladi [6; 157-161-b].

Ta’lim muassasalarida pedagoglar dastlab kompyuter va boshqa texnologilardan foydalanishni boshlaganlaridan buyon, tadqiqotchilar ta’lim texnologiyasining talabalar akademik yutuqlariga sezilarli va ishonchli ta’sir ko‘rsatdimi yoki aksincha ta’sirini aniqlashga harakat qilishgan. Shu jarayonda ular texnologiyani tizimda yagona mustaqil rivojlantiruvchi sifatida ko‘rib chiqish mumkin emasligini va talabalarning yutuqlari nafaqat standartlashtirilgan o‘quv jarayonida erishgan natijalariga, balki tanqidiy fikrlash, tahlil qilish, xulosa chiqarish va murakkab muammolarni hal qilishda yuqori darajadagi fikrlash ko‘nikmalarini qo‘llay olish qobilyatiga ham bog‘liq ekanligini aniqladilar [6; 157-161-b]. Har qanday zamonaviy texnologiyalarni o‘quv jarayoniga ta’sirini baholash uning dars mashg‘ulotlarida qanday va qay tarzda qo‘llanilishi, professor-o‘qituvchi tomonidan belgilangan o‘quv maqsadlarini va

talabalarning yutuqlarini baholash uchun ishlatiladigan vositalarni chuqur tushunishni talab qiladi, shuningdek yangi texnologiyalarni murakkablik darajasi ham e’tiborga olinishi lozim [7; 62-68-b].

Axborot-kommunikatsiya texnologiyalari yordamida tashkil etilgan aralash ta’lim modellarini joriy etish an’anaviy ta’limni elektron resurs komponentlar bilan uyg‘unlashtirish imkonini beradi, bu esa talabalarning o‘quv jarayonidagi faoliyati va akademik natijalarining yaxshilanishi bilan bog‘liq. Shu kabi aralash modellar orqali ta’lim muassasalari bosma nashrlardan foydalanishni kamaytirish va elektron ta’lim vositalarini samarali qo‘llash orqali turli talabalar guruhlariga, jumladan chekka hududlarda yoki resurslari cheklangan sharoitlarda yashovchi ta’lim oluvchilarning ham ta’lim olish imkoniyatini kengaytirish, qulayliklar yaratish orqali mustahkamlanadi [8; 5-12].

Shuningdek, raqamli resurslardan qayta foydalanish ta’lim muassasalarga o‘quv tajribasi sifatini saqlab qolish yoki oshirish bilan birga bo‘lgan xarajatlarni optimallashtirish imkonini berish orqali barqarorlikka saqlaydi. Bir qator tadqiqotlar axborot-kommunikatsiya texnologiyasi vositalarining o‘quv jarayonini va talabalarning faolligini oshirish imkoniyatlarini ko‘rsatgan bo‘lsa-da, bu natijalar ko‘pincha aniq fan sohalariga xos bo‘lib, ularning ko‘lami va metodologik qat’iyligi jihatidan sezilarli darajada farqlanadi. Pedagoglar uchun axborot-kommunikatsiya texnologiyasi bilan boyitilgan ta’lim muhitlarini amaliyotda samarali loyihalash va qo‘llash bo‘yicha asosli qarorlar qabul qilishni osonlashtiradigan tushunchalarni taqdim etadi, natijada ta’lim jarayoni yanada qiziqarli va samarali bo‘lish imkoniyati yuzaga keladi [9; 643–656-b].

Multimedia texnologiyasi integratsiya, xilma-xillik va o‘zaro ta’sir kabi xususiyatlarga ega bo‘lib, foydalanuvchilarga ma’lumot yoki g‘oyalarni raqamli va bosma elementlar orqali birlashtirish imkonini beradi. Axborot-kommunikatsiya texnologiyalari (AKT) paydo bo‘lishi bilan inson faoliyatining turli jabhalari, xususan ta’lim sohasi sezilarli darajada ta’sir ko‘rastdi. Axborot-kommunikatsiya texnologiyalari asosan raqamli ma’lumotlarni to‘plash, qayta ishlash, saqlash, taqdim etish va almashish jarayonlarini apparat va dasturiy ta’minot vositalari yordamida amalga oshirishni nazarda tutadi. Shu nuqtai nazardan, multimedia texnologiyasi axborot-kommunikatsiya texnologiyalarining muhim komponenti bo‘lib, ma’lumotlarni matn, audio, video va boshqa turli vositalardan foydalangan holda raqamli tarzda yaratish va taqdim etishga qaratilgan [10; 414-b].

Jamiyatning zamonaviy rivojlanishi bilan uzviy bog‘liq bo‘lgan o‘zgarishlar ta’lim tizimida axborot va kompyuter texnologiyalarini, xususan multimedia vositalarini joriy etishni ustuvor vazifa sifatida belgilashni taqozo etadi. Bu yo‘nalishlar ta’lim maqsadlarini yangilash, o‘qitish metodlari, vositalari va shakllarini modernizatsiya qilish bilan uzviy bog‘liqdir.

Multimedia vositalarini o‘qitish jarayonida samarali qo‘llash masalasi bilan R.X. Ayupov, S. Beknazarova, Ya. Mamatova, S. Sulaymanova, S.S. Babadjonov, N.A. Muslimov, A.X. Maxmudov, Yu.N. Egorova, I.G. Zaxarov, N.V. Klemeshova, O.G. Molyaninova va boshqa olimlar shug‘ullangan. Shu bilan birga, ta’lim-tarbiya jarayonida multimedia vositalarining samaradorligini N.G. Popova, I.V. Robert, Ye.M. Savchenko va boshqalar tadqiq etgan.

Muammoni har tomonlama o‘rganish shuni ko‘rsatadiki, axborot-kommunikatsiya texnologiyalariga asoslangan o‘qitish vositalari talabalarga noan’anaviy manbalardan foydalanish imkonini yaratib, ma’lumotlarni samarali tushunishga imkon yaratadi. Bu esa o‘qitishning tubdan yangi shakllari va metodlarini joriy etish orqali ta’lim sifatini sezilarli darajada oshirishga xizmat qiladi [11; 1215-1234-b]. Oliy ta’limda sifatni oshirishning muhim sharti professor-o‘qituvchilarning axborot-pedagogik kompetensiyalarini shakllantirishdir, jumladan, yangi axborotni kiritish va zamonaviy o‘qitish texnologiyalaridan samarali foydalanish qobiliyatini rivojlantirish. Bu kompetensiyalarning darajasi va professor- o‘qituvchining kasbiy faoliyati talabalarning rivojlangan kompetensiyalarini shakllantirish va ularning o‘quv fanlarini samarali o‘zlashtirishiga bevosita ta’sir ko‘rsatadi [12; 37-45-b].

FOYDALANILGAN ADABIYOTLAR RO‘YXATI

1. Liu T., Luo Y. T., Pang P. C.-I., Kan H. Y. 2025. Exploring the Impact of Information and Communication Technology on Educational Administration: A Systematic Scoping Review. Education Sciences. 15(9): 15-25.
2. Vlasova I., Pisarenko S. 2022. Pedagogical conditions for the effective organization of distance draw learning in the digital space of modern culture. E3S Web of Conferences. Interagromash. 1-10.
3. Akhmedjanova D., Begmatova Kh., Abdurakhmanova N. 2023. Integration of information and communication technologies in online teaching of acadeic english in higher education in Uzbekistan. Перспективы развития высшего образования. (13): 66-76.
4. Uspayeva M.G., Gachaev A.M. 2023. Informatization and technologies in the educational process in the aspect of quality improvement. Управление образованием: теория и практика. 6(64): 94-104.
5. Xonboboyev H. 2023. Mutaxassislik fanlarini o‘qitish metodikasi. O‘quv qo‘llanma. “Ilm va fan” nashriyoti. 14-24.
6. Shadmanova N.I. 2024. The technology of developing learning in modern teaching methods. Academic research in educational sciences. 5(5): 157-161.

7. Eltahir M.E. 2015. For Effective Use of Multimedia in Education, Teachers Must Develop their Own Educational Multimedia Applications. Turkish Online Journal of Educational Technology. 4(4): 62-68.
8. Dziuban C., Graham C.R., Moskal P.D. 2018. et al. Blended learning: the new normal and emerging technologies. Int J Educ Technol High Educ. 15(3): 5-12.
9. Urbina Coronado P.D., Demeneghi J.A.A. Ahuett-Garza H.; Orta Castañon P.; Martínez M.M. 2022. Representation of Machines and Mechanisms in Augmented Reality for Educative Use. Int. J. Interact. Des. Manuf. 16: 643–656.
10. Romero-Ochoa M.A., Romero-González J.A., Perez-Soltero A., Terven J., García-Ramírez T., Córdova-Esparza D.-M., Espinoza-Zallas F.A. 2025. Knowledge Management Strategies Supported by ICT for the Improvement of Teaching Practice: A Systematic Review. Information. 16(5): 414.
11. Abedi E.A. 2024. Tensions between technology integration practices of teachers and ICT in education policy expectations: implications for change in teacher knowledge, beliefs and teaching practices. J. Comput. Educ. 11: 1215–1234.
12. Tayirova A.T. 2023. Advantages and disadvantages of using multimediatechnologies in the educational system. Frontline social sciences and history journal. 3(2): 37-45.

PEDAGOGNING KASBIY MAHORATINI OSHIRISHDA VAQTNI SAMARALI BOSHQARISH VA KASBIY KO‘NIKMALARNING O‘RNI

Gulboyev D.T., *Samarqand davlat pedagogika instituti, Samarqand, O‘zbekiston*
Munojidinova G.M.*, Samarqand davlat pedagogika instituti, Samarqand, O‘zbekiston*

dostongulboyev2@gmail.com

Annotatsiya: *Ushbu tezisda zamonaviy pedagogning kasbiy kompetentligini rivojlantirish, vaqtni samarali boshqarish, pedagogik ko‘nikmalarni shakllantirish hamda ta’lim samaradorligini oshirish masalalari yoritilgan.*

Kalit so‘zlar: *pedagog, kasbiy kompetentlik, vaqt menejmenti, pedagogik ko‘nikma, kasbiy mahorat, ta’lim samaradorligi*

Kirish

Zamonaviy ta’lim sharoitida o‘qitish jarayoni kundan kunga murakkablashib borayotganligi sir emas. Endilikda, o‘qituvchi uchun o‘z mutaxassisligini a’lo darajada bilish orqali auditoriyada to‘plangan talabalarga ulkan bilimlar bazasini berish yo‘nalishidagi kasbiy

kompetentligini namoyon qilishning o‘zi kamlik qiladi. Zamonaviy faol o‘qituvchilar nafaqat o‘z fanlari bo‘yicha chuqur bilimlarini yetkazish, balki talabalar haqida ham ba’zi ma’lumotlar, ya’ni ularning ushbu bilimlarni qanday tarzda o‘zlashtirishlari haqida ham tasavvurga ega bo‘lishlari zarur. Bundan tashqari o‘qituvchilar o‘zlariga tanish bo‘lmagan, ammo yuksak samara beradigan turli o‘qitish metodlari va baholash shakllarini faoliyat mazmunlariga singdirishga majbur bo‘ladilar[1; .168-170-b].

Vaqt taqsimotining ta’siri: Bilim o‘rganuvchidan unga vaqt ajratishni hamda muntazamlilikni talab qiladi. O‘quvchilar orasida o‘tkazilgan so‘rovnomada turli hil sabablarga ko‘ra ijtimoiy, oilaviy va boshqa yumushlarning ko‘pligidan o‘quvchilarning 16% bilim olishga vaqt ojrata olmasliglarini bildirishgan[2; 123-125-B].

Ijtimoiy va texnalogik omillar: O‘quvchilarning oila holati va ijtimoiy sharoitlari ta’lim tizimining samaradorligiga bevosita ta’sir qiladi. O‘quvchilarning ijtimoiy holati ularning o‘qishga bo‘lgan motivatsiyasini shakllantiradi, bu esa o‘z navbatida ta’lim jarayoniga bevosita ta’sir qiladi. Ijtimoiy imkoniyatlar va oila daromadining pastligi bilan bog‘liq muammolar ko‘plab o‘quvchilar uchun ta’lim olishda to‘siqlar yaratadi. Shu o‘rinda, davlat va ta’lim muassasalarining o‘quvchilarga qo‘shimcha yordam ko‘rsatishi, masalan, bepul o‘qish resurslarini taqdim etish yoki oila holatiga qarab stipendiyalar va grantlar ajratish ta’lim tizimining samaradorligini oshirishi mumkin.

Ijtimoiy omillarning ta’siri, ayniqsa, o‘qishdagi muvaffaqiyatni ta’minlashda jamoat tashkilotlari va ota-onalar bilan hamkorlik qilishning ahamiyatini yanada oshiradi. Ta’lim olish jarayonida ta’lim beruvchilar va ta’lim oluvchilar o‘rtasida o‘zaro mustahkam do‘stona aloqa o‘rnatilishi zarur albatta bu ko‘prikni dastlabki g‘ishlarini qo‘yish va uni mustahkamlab turish o‘rgatuvchining zimmasiga tushadi, o‘quvchilarni ishontirish va ularni ta’lim jarayoniga ruhlantirish bularning hammasi nafaqat o‘qtuvchidan bilim balki psihalogig tajriba o‘z harakatida sabr bilan turishni talab qiladi. Bularni o‘qtuvchilarda rivojlantirish uchun ularga qo‘shimcha turli hil kasbiy trening larni kuchli mutahasislar tomonidan o‘tkazdirilishi maqsadga muofiq [2; 123-125-B].

Vaqtni boshqarishdan oldin uni hisoblab oling Vaqtni boshqarish uchun o‘zingizda qancha vaqt borligini bilishingiz juda muhimdir. To‘g‘ri, o‘qituvchilarning aksar vaqti avvaldan tuzilgan dars jadvali asosida o‘tadi. Shaxsiy tajribamdan kelib chiqib aytishim mumkinki, aslida unday emas. Vaqtingiz qanday o‘tayotganini nazoratga ola boshlashingiz bilan o‘zingiz tushunasiz. Vaqtingiz nimalarga sarflanayotganini aniqlash uchun 3–5 kun davomida kun tartibingizni yozib yuring. Ertalab nechada uyg‘ondingiz, nima ishlar qildingiz, ularga qancha vaqt ketdi. Undan keyin maktabga yetib borish uchun yo‘lda qancha vaqt sarfladingiz, ishda

nimalar bilan band bo‘ldingiz. Uyga qaytgach nimalar bo‘ldi, qachon uxlashga yotdingiz. Ijtimoiy tarmoqlar, filmlar uchun sarflagan vaqtingizni ham belgilash yoddan chiqmasin. Buni qog‘ozga, SMS shaklida yozib yurishingiz yoki Telegram, diktofon orqali ovozli xabar tarzida saqlab yurishingiz ham mumkin.

Bir necha kun kuzatgach, tahlil qiling:

Nimalarga vaqt sarflayapsiz?

O‘zi kun tartibingiz qanday?

Qayerlarda bo‘shliqlar bor?

Qaysi ishlar foydali bo‘lyapti-yu, qaysilari samara bermayapti?

Ishlarni qanday tartiblash yaxshi bo‘lishi mumkin?

Bo‘sh vaqtda qaysi ishlarni amalga oshirib olsa bo‘ladi?

O‘zim shunday taftish o‘tkazganimda kunimning 2,5 soatini aslida kerakmas ishlarga sarflab yuborayotganim ayon bo‘ldi. Shuning uchun sizga bu qadamni, albatta, bajarishni tavsiya qilaman. Yuqoridagi savollarga javob topganingizdan keyin ikkinchi bosqich – kunni rejalashtirish orqali vaqtni boshqarishga o‘tsangiz bo‘ladi. Shu o‘rinda ayrim tadqiqotlar xulosasini taqdim etaman: 2012-yilda Scholastic va Bill & Melinda Gates jamg‘armasi tomonidan o‘tkazilgan tadqiqot shuni ko‘rsatdiki, o‘qituvchilar haftasiga o‘rtacha 53-soat ishlaydi. 2023-yilgi tadqiqotlarda bu 54-soatni tashkil etadi. Boshqa bir tadqiqotda esa haftasiga 40 soatdan ko‘p (45 soat) ishlaydiganlarning 46 foizida qayta tiklanish bilan bog‘liq muammolar borligi, 32 foizida esa horg‘inlik, hissiy charchoq kuzatilishi aniqlangan. Demak, siz ham haftasiga necha soat ishlab, necha soat dam olayotganingizni hisoblashga harakat qilishingiz lozim.

“Yo‘q” deyishni ham o‘rganing Kunimni tahlil qilganimda ancha-muncha vaqtim ko‘ngilchanlik oqibatida “ha” deb yuborgan mayda ishlar uchun sarf bo‘layotganini aniqladim – qaysidir tadbirda qatnashish, turli ma’ruzalar o‘qish (garchi bularga haq olsam ham), ijtimoiy tarmoq orqali kelgan savollarga javob berish. Keyin sekin-asta meni yaxshi o‘qituvchi qilmaydigan ishlarga “yo‘q” deyishni boshladim. To‘g‘ri, daromadim biroz kamaygan bo‘lishi mumkin, ammo kayfiyatim yaxshilandi, stresslarim kamaydi, ishimga sifat kirdi. Siz ham reja tuzishdan oldin “ha” yoki “yo‘q” deyish mezonlaringizni aniqlab oling. Bu mezonlar hammada har xil bo‘ladi. Masalan, ishxonangizda bitta o‘qituvchi kelmadi, sizning orada bo‘sh vaqtingiz bor, ammo o‘sha vaqtga o‘quvchilar daftarini tekshirishni yoki biror nima o‘qib-o‘rganishni reja qilgansiz. O‘quv ishlari bo‘yicha direktor o‘rinbosari kelmagan o‘qituvchining sinfiga qarab turishni aytdi. Shunday vaziyatda har doim ham “ha” deyaverish yaramaydi. Ishlaringiz borligini, kuningizni reja qilib qo‘yganingizni yotig‘i bilan tushuntirib “yo‘q” deyishingiz mumkin. Yoki

biror keraksiz tadbirga tomoshabin sifatida yuborishmoqchi. Bunday vaziyatda ham o‘z sabablaringizni keltirib, boshqa safar oldinroqdan aytib qo‘yishsa, albatta, borishingizni bildirib “yo‘q” desangiz bo‘ladi[3; 1-10-b].

Kasb (lotincha professio — rasmiy faoliyat turi, profiteor — “bayon qilmoq” so‘zidan kelib chiqqan) — bu ma’lum tayyorgarlik va tajriba asosida egallangan maxsus nazariy bilimlar, amaliy mashqlar hamda ko‘nikma va malakalarning yig‘indisi asosida bajariladigan mehnat faoliyatidir. Kasb — bu insonning ma’lum bir sohada faoliyat yuritishi uchun zarur bo‘lgan nazariy bilim, amaliy tajriba va ko‘nikmalarning jamlanmasidir. Bu jarayonda jismoniy holat, aqliy salohiyat va huquqiy asoslar muhim o‘rin tutadi.

Ko‘nikma — bu belgilangan maqsad va sharoitlar asosida faoliyatni muvaffaqiyatli amalga oshirish imkoniyatidir. Ko‘nikma — bu ongli harakatni samarali, kam kuch sarflab, to‘g‘ri va tez bajarishga xizmat qiluvchi tajriba natijasi bo‘lib, shaxsda mavjud bilimlar asosida shakllanadi. Dastlabki bosqichda harakatlar katta e’tibor bilan amalga oshiriladi, vaqt o‘tishi bilan bu jarayon avtomatik tarzda bajara boshlanadi. Harakatlar quyidagi turlarga bo‘linadi: jismoniy harakatlar, sezuvchanlikka asoslangan ko‘nikmalar, aqliy faoliyat asosidagi ko‘nikmalar. Ko‘nikmalar uzluksiz mashq qilish orqali mustahkamlanadi va saqlanib qoladi. Shu boisdan, ularning ta’lim va tarbiyada tutgan o‘rni beqiyosdir. Ko‘nikmalar uzoq vaqt mashq qilinmasa, ularning faollik darajasi pasayadi. Biroq, muntazam mashq va tajriba orqali ularni qayta tiklash mumkin.

Ko‘nikma — bu biror faoliyatni avtomatlashtirilgan shaklda bajarish usuli bo‘lib, ongli nazoratni kamaytiradi va harakatni aniq maqsadga yo‘naltiradi. Ko‘nikma inson tomonidan ilgari egallangan malakalarga asoslanadi va ular bilan chambarchas bog‘liq holda faoliyatda namoyon bo‘ladi. Aksariyat hollarda ko‘nikma malakani shakllantirishga xizmat qiladi, ba’zida esa, malakaga salbiy ta’sir o‘tkazib, uni o‘zgartirib yuboradi. Bu hodisa — malaka va ko‘nikmaning o‘zaro ta’siri sifatida baholanadi. Demak, ko‘nikma — bu egallangan bilim asosida shakllanadigan maqsadga yo‘naltirilgan faoliyat turi bo‘lib, o‘quv va amaliy mashg‘ulotlar orqali rivojlanadi va insonni har xil holatlarda ham to‘g‘ri yo‘nalishda harakat qilishga tayyorlaydi.

Pedagog — bu yosh avlodni hayotga va ongli mehnatga tayyorlashdek ulug‘ vazifani bajaruvchi, davlat va jamiyat oldida mas’uliyatli bo‘lgan, zarur pedagogik tayyorgarlikka ega mutaxassisdir. Shunday ekan, pedagog kasbiga xos bo‘lgan asosiy ko‘nikmalar haqida aniq tasavvurga ega bo‘lish uchun, avvalo o‘qituvchining kasbiy vazifalari va roli to‘g‘risida chuqur bilimga ega bo‘lish lozim[4; 255-256-b].

Xulosa: Xulosa qilib aytganda, pedagogning kasbiy kompetentligini rivojlantirishda vaqtni samarali boshqarish, pedagogik ko‘nikmalarni takomillashtirish va zamonaviy ta’lim metodlaridan

foydalanish muhim ahamiyatga ega. Bu omillar ta’lim sifatini oshirish va o‘quvchilarning bilim olish samaradorligini ta’minlashga xizmat qiladi.

FOYDALANILGAN ADABIYOTLAR

1. Baxramova M.R., O‘qituvchi – talaba faoliyatini samarali tashkil etish omillari., "Экономика и социум" №12(127)-2 2024: 168-170.
2. Muxammadjonov Muslimbek Muxsinjon o‘g‘li., Qo‘qon universiteti xabarnomasi., 26-iyun 2025-yil 15-son; 123-125.
3. Shokir Tursun., O‘qituvchilar uchun vaqt boshqaruvi., Mohirdev Onlayn Ta’lim Platformasi 17-mart, 2025. 1-10.
4. Xolmatova Zulfiya., Qurbonova Munira Toshpulatovna., Ta’lim sifatini yuksaltirishda bo‘lajak o‘qituvchilarning kasbiy ko‘nikmalarini rivojlantirish., “Ilm-fan va ta’lim-tarbiyani rivojlantirishdagi zamonaviy yondashuvlar”., Farg‘ona – 2025-yil; 255-256.

OLIY TA’LIMDA ZOOLOGIYA FANINI O‘QITISHDA GENERATIV SUN’IY INTELLEKT VA RAQAMLI IDENTIFIKATSIYA VOSITALARINI INTEGRATSIYALASHNING METODIK IMKONIYATLARI

U.N.Mirzayev[1], S.N.Narzullayev[1], N.X.Xakimov[2]

Samarqand davlat pedagogika instituti

Sharof Rashidov nomidagi Samarqand davlat universiteti

Email: snarzullayev684@gmail.com, uktam1486@gmail.com

Annotatsiya. *Mazkur tezisda oliy ta’lim muassasalarida zoologiya fanini o‘qitishda generativ sun’iy intellekt va raqamli identifikatsiya vositalaridan foydalanishning metodik imkoniyatlari ilmiy adabiyotlar asosida tahlil qilingan. Generativ sun’iy intellektning o‘quv materiallari, nazorat savollari va interaktiv topshiriqlarni ishlab chiqishdagi imkoniyatlari, raqamli identifikatsiya vositalarining hayvon turlarini tasvirlar orqali dastlabki aniqlash va morfologik belgilarni o‘rganishdagi o‘rni ko‘rib chiqilgan. Ilmiy manbalar qiyosiy tahlil qilinib, mazkur texnologiyalarni zoologiya mashg‘ulotlariga integratsiyalashning uch bosqichli metodik yondashuvi taklif etilgan. Shuningdek, SI natijalarining ishonchliligini tekshirish, talabalarning mustaqil fikrlashini rivojlantirish va akademik halollikni ta’minlash bo‘yicha tavsiyalar ishlab chiqilgan.*

Kalit so‘zlar: *zoologiya, generativ sun’iy intellekt, raqamli identifikatsiya, iNaturalist, biologiya ta’limi, kompyuter dasturlari, metodik integratsiya, tanqidiy fikrlash.*

Kirish. Raqamli texnologiyalarning jadal rivojlanishi oliy ta’limda fanlarni o‘qitish metodikasini takomillashtirish, ta’lim sifatini oshirish va talabalarning mustaqil ta’lim faoliyatini samarali tashkil etish uchun yangi imkoniyatlarni yaratmoqda. O‘zbekiston Respublikasida ham ta’lim tizimini raqamlashtirish, innovatsion texnologiyalarni joriy etish va sun’iy intellektdan foydalanishni rivojlantirishga alohida e’tibor qaratilmoqda. Jumladan, O‘zbekiston Respublikasi Prezidentining 2019-yil 8-oktabrdagi PF-5847-son Farmoni bilan tasdiqlangan “O‘zbekiston Respublikasi oliy ta’lim tizimini 2030-yilgacha rivojlantirish konsepsiyasi”da ta’lim jarayoniga raqamli texnologiyalar va zamonaviy usullarni joriy etish ustuvor yo‘nalishlardan biri sifatida belgilangan [1]. Shuningdek, 2020-yil 5-oktabrdagi PF-6079-son Farmon bilan tasdiqlangan “Raqamli O‘zbekiston — 2030” strategiyasi mamlakatda raqamli texnologiyalarni rivojlantirishning muhim huquqiy asoslaridan hisoblanadi [2]. O‘zbekiston Respublikasi Prezidentining 2021-yil 17-fevraldagi PQ-4996-son qarori sun’iy intellekt texnologiyalarini jadal joriy etish uchun shart-

sharoitlar yaratishga qaratilgan bo‘lsa, 2024-yil 14-oktabrdagi PQ-358-son qaror bilan Sun’iy intellekt texnologiyalarini 2030-yilga qadar rivojlantirish strategiyasi tasdiqlangan [3]. Mazkur hujjatlarda belgilangan ustuvor yo‘nalishlar ta’lim jarayonida raqamli va intellektual texnologiyalardan foydalanishning dolzarbligini asoslaydi. Xususan, generativ sun’iy intellekt (SI) hamda kompyuter ko‘rishiga asoslangan raqamli identifikatsiya tizimlari o‘quv materiallarini tayyorlash, biologik obyektlarni tahlil qilish, nazariy bilimlarni mustahkamlash va talabalarning mustaqil ta’lim faoliyatini tashkil etishda muhim metodik imkoniyatlarga ega [9]. UNESCOning generativ SI bo‘yicha qo‘llanmasida ushbu texnologiyalarni ta’limga joriy etishda pedagogik maqsadga muvofiqlik, inson nazorati, axborot xavfsizligi va mas’uliyatli foydalanish tamoyillariga rioya etish zarurligi ta’kidlangan [4].

Zoologiya fani hayvonlarning sistematikasi, morfologiyasi, anatomiyasi, fiziologiyasi, ekologiyasi va evolyutsion rivojlanishini o‘rganadi. Ushbu fan bo‘yicha bilimlarni chuqur o‘zlashtirish biologik obyektlarni kuzatish, ularning morfologik belgilarini taqqoslash, turli hayvon guruhlarini farqlash hamda ilmiy xulosalar chiqarishni talab qiladi [10]. Biroq ayrim hayvon turlarini tabiiy muhitda kuzatish, noyob namunalarni o‘rganish yoki murakkab anatomik tuzilmalarni bevosita namoyish etish imkoniyatlari cheklangan bo‘lishi mumkin. Bunday sharoitda generativ SI vositalari ilmiy tushuntirishlar, taqqoslash jadvallari, nazorat savollari va amaliy topshiriqlarni tayyorlashga ko‘maklashadi. Kompyuter ko‘rishiga asoslangan identifikatsiya tizimlari esa hayvonlarning tasvirlari asosida ehtimoliy taksonomik mansubligini aniqlash, tashqi morfologik belgilarini tahlil qilish va o‘xshash turlarni taqqoslash imkonini beradi. Ushbu texnologiyalarni yagona o‘quv jarayoniga integratsiyalash nazariy bilimlar, amaliy kuzatuv va tanqidiy tahlil o‘rtasidagi uzviylikni ta’minlashga xizmat qilishi mumkin [5].

Tadqiqotning maqsadi — oliy ta’limda zoologiya fanini o‘qitishda generativ sun’iy intellekt va raqamli identifikatsiya vositalarining metodik imkoniyatlarini ilmiy adabiyotlar asosida tahlil qilish hamda ularni o‘quv mashg‘ulotlariga integratsiyalash bo‘yicha tavsiyalar ishlab chiqish.

Tadqiqot materiallari va metodlari. Tadqiqotning metodologik asosini zoologiya ta’limi, biologik obyektlarni raqamli identifikatsiyalash va generativ SI vositalaridan ta’limda foydalanishga oid ilmiy manbalar tashkil etdi. Jumladan, Zhang va hammualliflarning zoologik tadqiqotlarda sun’iy intellektdan foydalanishga bag‘ishlangan sharhi [5], Rode va Torkarning iNaturalist platformasining biologiya ta’limidagi qo‘llanilishiga oid tizimli sharhi [6], Cotton va Cottonning biologiya ta’limidagi SI vositalariga bag‘ishlangan tahlili [7] hamda UNESCO metodik qo‘llanmasi [4] o‘rganildi.

Tadqiqotda ilmiy adabiyotlarni tahlil qilish, qiyosiy tahlil, mazmuniy umumlashtirish va pedagogik loyihalash metodlaridan foydalanildi. Manbalar quyidagi mezonlar asosida tahlil qilindi: texnologiyaning vazifasi, zoologiya ta’limida qo‘llash imkoniyati, talaba faoliyatiga ta’sir etishi mumkin bo‘lgan jihatlar va mavjud cheklovlar. Tadqiqot nazariy-tahliliy xarakterga ega bo‘lib, unda yangi pedagogik tajriba o‘tkazilmagan. Shu sababli taklif etilgan metodik yondashuvlar empirik jihatdan isbotlangan natijalar sifatida emas, ilmiy manbalar tahlilidan kelib chiqqan metodik tavsiyalar sifatida qaraladi.

Natijalar va muhokama:

1. Generativ sun’iy intellekt va raqamli identifikatsiya vositalarining metodik imkoniyatlari. Generativ SI va raqamli identifikatsiya tizimlari bir-birini to‘ldiruvchi, biroq vazifalari jihatidan farqlanuvchi texnologiyalardir. Generativ SI matnli izohlar, savollar, taqqoslash jadvallari va o‘quv topshiriqlarini yaratishga yordam beradi. Raqamli identifikatsiya vositalari esa tasvirlardan foydalanib, biologik obyektning ehtimoliy taksonomik mansubligini aniqlashga ko‘maklashadi [8].

Zhang va hammualliflar [5] sun’iy intellektning zoologik tadqiqotlardagi imkoniyatlarini, jumladan hayvonlarni tasniflash, xulq-atvorini tahlil qilish va biologik xilma-xillikni o‘rganishdagi ahamiyatini ko‘rsatgan. Ushbu yo‘nalishlar zoologiya ta’limida real biologik ma’lumotlar va tasvirlar asosida topshiriqlar tuzish uchun ilmiy zamin yaratadi.

Rode va Torkar [6] iNaturalist platformasidan biologiya ta’limida foydalanishga oid tadqiqotlarni tizimli ravishda ko‘rib chiqqan. Mazkur platforma foydalanuvchilarga biologik kuzatuvlarni qayd etish, organizmlarning fotosuratlarini joylashtirish va ularni identifikatsiyalash jarayonida ishtirok etish imkonini beradi. Bunda raqamli identifikatsiya faqat texnik aniqlash bilan cheklanmay, kuzatuvlarni muhokama qilish va biologik xilma-xillik to‘g‘risidagi bilimlarni rivojlantirishga ham xizmat qiladi.

Cotton va Cotton [7] biologiya ta’limida generativ SI va boshqa sun’iy intellekt vositalarining imkoniyatlarini tahlil qilib, ularni o‘quv jarayoniga joriy etishda ta’limiy foyda bilan birga akademik halollik va natijalarning ishonchliligini ham hisobga olish zarurligini ko‘rsatadi.

Ushbu manbalarni qiyoslash asosida generativ SI va raqamli identifikatsiya vositalarini integratsiyalashning uchta asosiy yo‘nalishini (1-jadval) ajratish mumkin:

1-jadval. Zoologiya ta’limida generativ sun’iy intellekt va raqamli identifikatsiya vositalarini integratsiyalash yo‘nalishlari

№	Integratsiya yo‘nalishi	Qo‘llash mazmuni	Kutiladigan ta’lim natijalari
1	**Nazariy bilimlarni mustahkamlash**	Generativ SI yordamida hayvonlar sistematikasi, morfologiyasi va ekologiyasi bo‘yicha tushuntirishlar, savollar hamda taqqoslash jadvallarini yaratish	Nazariy bilimlarni chuqurlashtirish, tushunchalar o‘rtasidagi bog‘liqlikni anglash va mavzuni mustaqil o‘zlashtirish
2	**Amaliy kuzatuv va identifikatsiya**	Raqamli platformalar orqali hayvonlar tasvirlarini o‘rganish, ehtimoliy turini aniqlash va morfologik belgilarini taqqoslash	Kuzatuvchanlikni, morfologik belgilarni farqlash va organizmlarni identifikatsiya qilish ko‘nikmalarini rivojlantirish
3	**Tanqidiy tahlil va tekshirish**	SI tomonidan berilgan javoblarni ilmiy adabiyotlar, aniqlash kalitlari va o‘qituvchi tavsiyalari asosida tekshirish.	Axborotning ishonchliligini baholash, xatolarni aniqlash va ilmiy-tanqidiy fikrlashni shakllantirish.

2. Zoologiya mashg‘ulotlarida integratsiyalashning amaliy usullari. Mazkur texnologiyalardan samarali foydalanish uchun ularni aniq mavzu va o‘quv natijalari bilan bog‘lash lozim. Quyidagi mashg‘ulot namunasi integratsiyalashning amaliy ko‘rinishini ifodalaydi.

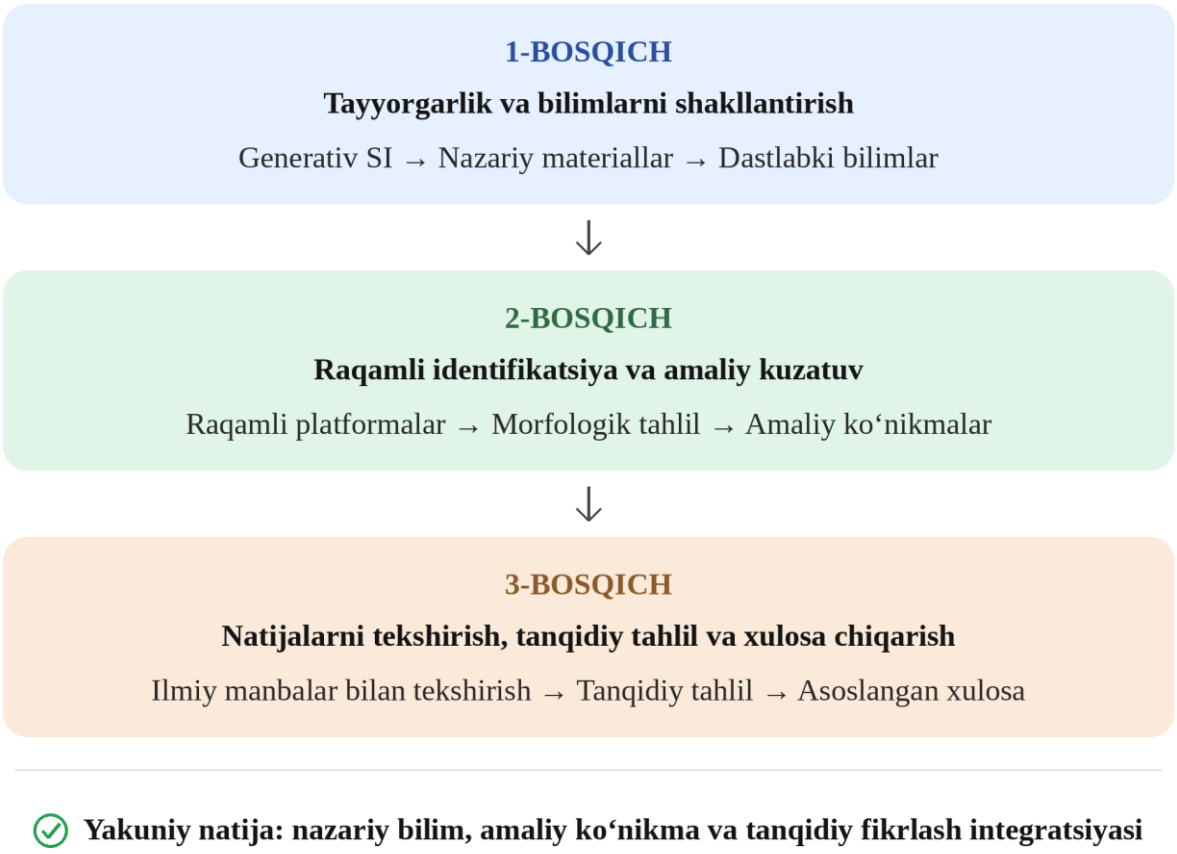
Amaliy mashg‘ulot: “Hasharotlarni morfologik belgilar asosida aniqlash”.

Mashg‘ulotning maqsadi — talabalarda hasharotlarning tashqi tuzilishini kuzatish, asosiy morfologik belgilarini aniqlash va raqamli identifikatsiya natijalarini ilmiy manbalar bilan tekshirish ko‘nikmalarini shakllantirish. Birinchi bosqichda o‘qituvchi generativ SI yordamida hasharotlarning tana bo‘limlari, mo‘ylovlari, oyoqlari, qanotlari va boshqa diagnostik belgilariga oid savollar hamda taqqoslash jadvalini tayyorlaydi. Tayyorlangan ma’lumotlar darslik va ishonchli ilmiy manbalar bilan tekshiriladi. Ikkinchi bosqichda talabalar hasharotlar fotosuratlarini o‘rganadilar va mavjud imkoniyatlardan kelib chiqib, iNaturalist kabi platformalarda raqamli identifikatsiya natijalarini oladilar. Ular tasvirda ko‘rinadigan belgilarni qayd etib, tizim taklif qilgan ehtimoliy identifikatsiyani morfologik xususiyatlar bilan taqqoslaydilar. Uchinchi bosqichda talabalar aniqlash natijasini tegishli taksonomik kalitlar yoki ilmiy manbalar orqali tekshiradilar.

Agar raqamli tizim va morfologik tahlil natijalari o‘rtasida farq kuzatilsa, buning sabablari muhokama qilinadi. Masalan, tasvir sifati, ko‘rinmay qolgan diagnostik belgilar yoki o‘zaro o‘xshash turlar aniqlash natijasiga ta’sir qilishi mumkin. Mashg‘ulot yakunida har bir talaba aniqlangan yoki ehtimoliy takson, kuzatilgan morfologik belgilar, raqamli vosita bergan natija va xulosani tasdiqlovchi manbalar ko‘rsatilgan qisqa hisobot tayyorlaydi. Ushbu topshiriqda generativ SI nazariy tayyorgarlikni qo‘llab-quvvatlasa, raqamli identifikatsiya vositasi amaliy kuzatuvga yordam beradi. Yakuniy xulosani dalillar asosida shakllantirish esa talabaning mustaqil vazifasi bo‘lib qoladi.

3. Generativ SI va raqamli identifikatsiyani integratsiyalash modeli.

Ilmiy manbalar tahlili asosida zoologiya fanini o‘qitish uchun quyidagi uch bosqichli metodik yondashuv taklif etiladi (1-rasm).



1-rasm. Zoologiya fanini o‘qitishda generativ SI va raqamli identifikatsiya vositalarini integratsiyalashning uch bosqichli metodik modeli.

Birinchi bosqich — tayyorgarlik va bilimlarni shakllantirish. O‘qituvchi mashg‘ulot maqsadini belgilaydi, generativ SI yordamida o‘quv savollari va taqqoslash materiallarini tayyorlaydi hamda ularning ilmiy to‘g‘riligini tekshiradi. Talabalar mavzu bo‘yicha dastlabki bilimlarini shakllantiradilar.

Ikkinchi bosqich — raqamli identifikatsiya va amaliy kuzatuv. Talabalar hayvonlar tasvirlarini tahlil qiladilar, morfologik belgilarni aniqlaydilar va raqamli identifikatsiya vositalari taklif etgan natijalarni qayd etadilar. Zarur hollarda kuzatuvlar mikroskopik tekshiruvlar, real namunalar va laboratoriya ishlari bilan to‘ldiriladi.

Uchinchi bosqich — tekshirish va refleksiya. Talabalar SI natijalarini ishonchli manbalar bilan taqqoslaydilar, ehtimoliy xatolarni aniqlaydilar va mustaqil xulosalar chiqaradilar. O‘qituvchi esa natijalarni dalillarning to‘g‘riligi, morfologik tahlil sifati va xulosalarning asoslanganligi bo‘yicha baholaydi.

Mazkur modelning metodik ahamiyati ikki xil texnologiyani yagona pedagogik jarayonga birlashtirishida namoyon bo‘ladi. Generativ SI o‘quv materiallarini tayyorlashga, raqamli identifikatsiya amaliy kuzatuvga, tanqidiy tekshirish esa ilmiy fikrlashni rivojlantirishga yo‘naltiriladi.

4. Muammolar va metodik tavsiyalar. SI vositalaridan foydalanishda ayrim cheklovlar mavjud. Generativ tizimlar biologik jihatdan noto‘g‘ri ma’lumotlarni ishonchli ohangda taqdim etishi yoki mavjud bo‘lmagan manbalarni keltirishi mumkin. Raqamli identifikatsiya vositalari esa tasvir sifati, organizmning ko‘rinishi va tizimdagi ma’lumotlar bazasiga bog‘liq ravishda xato qilishi ehtimoliga ega. Bundan tashqari, faqat avtomatik natijalarga tayanish talabalarning mustaqil kuzatish va tahlil qilish faoliyatini cheklashi mumkin.

Shu munosabat bilan quyidagi metodik tavsiyalar ishlab chiqildi:

1. Generativ SI vositalaridan foydalanishni aniq o‘quv maqsadlari bilan bog‘lash.
2. SI tomonidan tayyorlangan biologik ma’lumotlar va bibliografik havolalarni ishonchli manbalar orqali tekshirish.
3. Raqamli identifikatsiya natijalarini yakuniy xulosa emas, balki tekshirilishi lozim bo‘lgan dastlabki taxmin sifatida qabul qilish.
4. Raqamli vositalarni real biologik obyektlar, laboratoriya ishlari va morfologik aniqlash kalitlari bilan uyg‘unlashtirish.
5. Talabalardan natijani shunchaki ko‘chirishni emas, balki aniqlash jarayoni va xulosalarini dalillar bilan asoslashni talab qilish.
6. Shaxsiy ma’lumotlarni himoya qilish, foydalanilgan SI vositalarini zarur hollarda ko‘rsatish va akademik halollik qoidalariga rioya etish.

Ushbu tavsiyalar UNESCO tomonidan ilgari surilgan inson nazorati, xavfsizlik va pedagogik maqsadga muvofiqlik tamoyillari bilan hamohangdir [4].

Xulosa. Ilmiy adabiyotlar tahlili generativ sun'iy intellekt va raqamli identifikatsiya vositalari zoologiya fanini o'qitishda turli, ammo o'zaro to'ldiruvchi vazifalarni bajarishi mumkinligini ko'rsatadi. Generativ SI o'quv materiallari va topshiriqlarni tayyorlashga yordam bersa, raqamli identifikatsiya tizimlari hayvonlarning tasvirlari asosida dastlabki aniqlash va morfologik belgilarni taqqoslash imkonini beradi.

Taklif etilgan uch bosqichli metodik yondashuv nazariy tayyorgarlik, amaliy identifikatsiya va natijalarni tanqidiy tekshirishni yagona ta'lim jarayoniga birlashtiradi. Bunda asosiy e'tibor texnologiyaning o'ziga emas, balki talabaning biologik bilimlarni o'zlashtirishi, kuzatish olib borishi, dalillarni tekshirishi va ilmiy xulosa chiqarishiga qaratiladi. Shunday qilib, generativ sun'iy intellekt va raqamli identifikatsiya vositalarini zoologiya ta'limiga maqsadli integratsiyalash istiqbolli metodik yo'nalish hisoblanadi. Shu bilan birga, taklif etilgan yondashuvning ta'lim natijalariga real ta'sirini aniqlash uchun kelgusida nazorat qilinadigan pedagogik tajribalar, talabalarning bilim ko'rsatkichlari va amaliy identifikatsiya aniqligini qiyosiy baholash zarur.

ADABIYOTLAR RO'YXATI

1. O'zbekiston Respublikasi Prezidentining 2019-yil 8-oktabrdagi PF-5847-son Farmoni. O'zbekiston Respublikasi oliy ta'lim tizimini 2030-yilgacha rivojlantirish konsepsiyasini tasdiqlash to'g'risida.
2. O'zbekiston Respublikasi Prezidentining 2020-yil 5-oktabrdagi PF-6079-son Farmoni. "Raqamli O'zbekiston — 2030" strategiyasini tasdiqlash va uni samarali amalga oshirish chora-tadbirlari to'g'risida.
3. O'zbekiston Respublikasi Prezidentining 2021-yil 17-fevraldagi PQ-4996-son qarori. Sun'iy intellekt texnologiyalarini jadal joriy etish uchun shart-sharoitlar yaratish chora-tadbirlari to'g'risida.
4. Miao, F., & Holmes, W. (2023). *Guidance for Generative AI in Education and Research*. UNESCO. https://doi.org/10.54675/EWZM9535
5. Zhang, Y.-J., Luo, Z., Sun, Y., Liu, J., & Chen, Z. (2023). From beasts to bytes: Revolutionizing zoological research with artificial intelligence. *Zoological Research, 44*(6), 1115–1131. https://doi.org/10.24272/j.issn.2095-8137.2023.263
6. Rode, Ž., & Torkar, G. (2023). The iNaturalist Application in Biology Education: A Systematic Review. *International Journal of Educational Methodology, 9*(4), 725–744. https://eric.ed.gov/?id=EJ1409228

7. Cotton, P. A., & Cotton, D. (2026). Beyond ChatGPT: a review of the use of AI tools in biological education. *Journal of Biological Education*. https://doi.org/10.1080/00219266.2026.2628797

8. Wang, M. (2026). Artificial Intelligence-Empowered Zoology Teaching in Higher Education: Pathways and Practical Strategies. *Medical Research Archives, 14*(4). https://doi.org/10.18103/mra.v14i4.7412

9. Kalandarova D.S., Karimov D.T. (2026). Zoologiya fanini o‘qitishda sun’iy intellektdan foydalanish // Scientific Journal. — URL: https://scientific-jl.com/new/article/view/4954

10. Bagimbayeva, Z., Maimatayeva, A., Kabatayeva, Z., Alipina, K., Tergenbayeva, Z., & Safarov, R. (2026). Digital transformation in zoology education: A methodology for training future biology teachers. Journal of Turkish Science Education, 23(3), 554–579. https://www.tused.org/index.php/tused/article/view/4294

ЭКОЛОГИЧЕСКИЙ ОБРАЗОВАНИЕ И ВОСПИТАНИЕ В ШКОЛАХ РЕСПУБЛИКА ТАДЖИКИСТАН

Каримзода А. И - Таджикский национальный университет, доктор биологических наук, профессор кафедры физиологии человека и животных имен академика **Сафарова Х.М.** тел. 919.41.64.72. karimov.akobir@inbox.ru

Аннотация. *Человеку необходимо образование с незапамятных времен. Непрерывное экологическое образование и воспитание было признано одной из важнейших основ устойчивого развития Республики Таджикистан. Активизировалось общественное экологическое движение в республики. Программа экологического образования и воспитания школьников представляет собой воспитание нового поколения. Вся жизнь и природоохранная деятельность учащихся происходит в родной природной среде, что играет немаловажную роль в формировании у них ценностей на основе культурных традиций родного народа. Формирование у молодежи сознания о поддержании чистоты и порядка в окружающей среде является залогом их здоровья и благополучия.*

Ключевые слова*: человек, природа, среда, экологическое образование и воспитание, учащиеся, формирование, ценности, здоровья, благополучия. культурных традиции народа.*

Abstract. *Humans have required education since time immemorial. Continuous*

environmental education and upbringing have been recognized as a crucial foundation for the sustainable development of the Republic of Tajikistan. The public environmental movement within the republic has gained momentum. The program for the environmental education and upbringing of schoolchildren aims to nurture a new generation. Students live and engage in environmental protection activities within their native natural environment; this plays a significant role in shaping their values based on the cultural traditions of their people. Instilling in young people an awareness of the need to maintain cleanliness and order in the environment is key to their health and well-being.

Keywords: *human, nature, environment, environmental education and upbringing, students, formation, values, health, well-being, cultural traditions of the people.*

Человеку необходимо образование с незапамятных времен. Аспекты образования разнообразны, и помимо нравственного воспитания и упорного труда, важным элементом является экологическое образование. Этот предмет стал современным требованием. Понятие экология было введено в науку в 1866 году немецким ученым Эрнстом Геккелем и означает «дом, жилище», а также логос-науку, учение. В контексте экологии он имел в виду совокупность знаний об экономном использовании природных ресурсов (4, с.7)

Сегодня понятие экологии значительно расширилось и включает природу, Вселенную, живые и неживые организмы, их взаимоотношения с окружающей средой, заботу о природе и рациональное использование ее ресурсов, поддержание чистоты и порядка в окружающей среде. Экологическое образование стало одним из важнейших вопросов, начинать его нужно с детского сада и продолжать в школах и высших учебных заведениях. В Республике Таджикистан экологическое воспитание студентов рассматривается как важнейшая политико-социальная концепция педагогики, соответствующая современным запросам общества. (3, с.85)

Экологическое просвещение также упоминается в трудах таджикских и персидских мыслителей, таких как Мухаммад Закария. Рази, Абу Али ибн Сино, Насриддин Туси, Носир Хусрав, Имам Газали, Ахмад Дониш и других. Эти мыслители всегда подчеркивали, что человек является неотделимой частью природы и не может существовать без нее. Жизнь человека зависит от дыхания, получения энергии и света, а также от наличия жилья. Поэтому отношение человека к природе должно быть гуманистическим и воспитываться у подрастающего поколения с раннего возраста. Педагогический подход к природе и экологическим знаниям имеет не только образовательные, но и политические аспекты. (2, с.54).

С момента обретения независимости Правительство Республики Таджикистан во главе имеет все возможности для решения экологических вопросов, в том числе охраны природы и окружающей среды. В рамках экологического образования были приняты соответствующие решения. Закон Республики Таджикистан от 29 декабря 2010 года № 673 «Об экологическом образовании населения» (с изменениями и дополнениями по состоянию на 17.06.2026 г.). Государственную комплексную программу развития экологического воспитания и образования населения Республики Таджикистан на период до 2020 года и План мероприятий по реализации Государственной комплексной программы развития экологического воспитания и образования населения Республики Таджикистан на период до 2020 года. **Программа на 2021–2025 годы:** Государственная комплексная программа развития экологического воспитания и просвещения населения Республики Таджикистан на 2021-2025 годы была утверждена для повышения уровня экологической грамотности.

Важно выделить несколько ключевых аспектов, касающихся экологического воспитания подрастающего поколения. Необходимо формировать у учащихся чувство ответственности за чистоту окружающей среды и сохранение ее красоты, учить понимать ценность природы и бережное отношение к миру флоры и фауны. Также важно объяснить необходимость экономного использования природных ресурсов, активного участия в их обогащении, заботы о природе, любви к животным и птицам. Формирование у молодежи сознания о поддержании чистоты и порядка в окружающей среде является залогом их здоровья и благополучия.

Люди должны с раннего возраста осознавать, что большинство инфекционных заболеваний вызвано загрязнением окружающей среды. В процессе экологического образования важно убедить учащихся в том, что природа, флора и фауна, птицы, леса, деревья, цветы и кустарники придают окружающей среде красоту и превращают ее в среду обитания. Забота о них – гражданский долг. Каждый здравомыслящий человек должен способствовать поддержанию чистоты и порядка вокруг себя: в доме, дворе, классе, на школьной территории, в городах и деревнях. Экологическое воспитание должно начинаться в детском саду, продолжаться в начальных классах через игры, создание живого уголка природы, выращивание цветов, деревьев и заботу о птицах (1, с.310)

Большую роль в экологическом воспитании школьников играет образовательный процесс. В решении этой проблемы значительный вклад вносит изучение каждого учебного предмета. Особенно важную роль в экологическом воспитании и обучении студентов играют такие предметы, как экология, химия, биология и естественная

география Таджикистана. Эти дисциплины способствуют развитию экологических знаний и представлений, а также формированию у учащихся чувства природы. Изучая эти предметы, студенты получают научное представление о мире флоры и фауны, о различных аспектах окружающей среды, природных ландшафтах своей республики. Они знакомятся с понятием экологического баланса, который включает растения, насекомых, птиц, животных, леса и редколесья, а также землю и воздух. Знание этих сложных взаимосвязанных элементов способствует формированию экологического сознания. Наряду с пониманием взаимосвязей природных компонентов и необходимости поддержания их в чистоте и порядке, учащиеся развивают научное воображение и обогащают свое экологическое мировоззрение. (3, с.76)

Учителя биологии и экологии играют ключевую роль в экологическом воспитании подрастающего поколения. В процессе преподавания они объясняют учащимся способы правильного и бережного обращения с природными ресурсами, такими как вода, почва, воздух, растения и животные, и дают научную информацию о взаимном влиянии этих элементов. Учитель является ответственным за экологическое образование в школе и помогает учащимся поддерживать чистоту и порядок в классе, школе и ее окрестностях, заботясь о растениях и цветах. Внеклассные занятия, такие как уход за цветами и деревьями, пробуждают в учащихся чувство прекрасного и любовь к природе (3, с.27).

Экологическое образование детей должно происходить непрерывно: на уроках биологии (природоведение, ботаника, зоология, анатомия, общая биология), окружающего мира, географии, физики, технологии, истории, а также на внеурочных занятиях. Кроме этого, школьники обязательно должны участвовать в общественно полезной деятельности по изучению и охране природы.

Всеобъемлющее и непрерывное экологическое воспитание решает сразу несколько задач:

- прививает осмысленное и заботливое отношение к природе;
- развивает познавательный интерес и навыки наблюдения за флорой и фауной;
- вырабатывает паттерны безопасного поведения;
- помогает осознать себя частью планеты и понять связь человека с окружающей средой;
- культивирует навык беречь мир вокруг;
- учит предугадывать последствия человеческих действий для природы.

Экологическая культура со временем меняет мировоззрение и становится полноценным свойством личности.

Выводы. Любовь к природе и осознанное отношение к ней возникает только в том случае, если школьник видит реальные примеры такого отношения вокруг себя. Чтобы сформировать экологическую культуру личности, одной теории будет недостаточно. Разберемся ниже, какие конкретные шаги может предпринять школа. Включить экологическое образование в учебную программу и планы уроков.

Планы уроков обязательно должны содержать экологические темы. Это помогает подчеркнуть важность бережного отношения к окружающей среде и побуждает школьников критически оценивать влияние, которое их действия оказывают на нее.

Кроме того, для вовлечения и обучения учителя могут использовать различные мультимедийные ресурсы, такие как документальные фильмы, видео и презентации.

ЛИТЕРАТУРА:

1. Забиров Р. Экология. Душанбе 2013. - 480с. с.310
2. Каримзода А.И. «Сохранения биоразнообразия на национальном уровне в Республика Таджикистан.» IV Международной научной конференции «Актуальные вопросы охраны биоразнообразия», посвященной 60-летию Башкирского отделения Русского ботанического общества и 100-летию со дня рождения профессора Е.В.Кучерова. Нижный Тагил. Апрель 2024.
3. Каримов А.И. Экологическое образование в вузах Таджикистана. Международной научно-практической конференции, посвященной 105-летю факультета агрономии, агрохимии и экологии Воронежский ГАУ. – Воронеж, 2018. – 108-109 с.
4. Саидов М. и др. Экология. Душанбе. 2018. 272с. Стр.7

BIOLOGIYA TA’LIMIDA INNOVATSION PEDAGOGIK YONDASHUVLAR

Jo‘raqulova Begoyim Sattor qizi
Samarqand davlat pedagogika instituti magistranti
E-mail: joraqulovabegoyim@gmail.com

Annotatsiya. *Mazkur tezisda biologiya ta’limida innovatsion pedagogik yondashuvlardan foydalanishning nazariy va amaliy jihatlari yoritilgan. Biologiya fanining mazmuni kuzatish, tajriba, muammoli vaziyatlarni tahlil qilish va amaliy faoliyat bilan chambarchas bog‘liq bo‘lganligi sababli zamonaviy pedagogik yondashuvlardan foydalanish muhim ahamiyatga ega. Tezisda faol ta’lim, muammoli ta’lim, loyiha asosida o‘qitish, interfaol metodlar hamda raqamli texnologiyalardan foydalanish imkoniyatlari tahlil qilingan. Innovatsion yondashuvni shunchaki yangi metoddan foydalanish sifatida emas, balki biologiya darsining maqsadi, mazmuni va*

o‘quvchilarning ehtiyojlariga mos ravishda ta’lim jarayonini qayta tashkil etish sifatida qarash maqsadga muvofiqdir.

Kalit so‘zlar: *biologiya, ta’lim, innovatsiya, pedagogik yondashuv, interfaol, texnologiyalar.*

Abstract. *This paper discusses the theoretical and practical aspects of using innovative pedagogical approaches in biology education. Since the content of biology as a subject is closely linked to observation, experimentation, the analysis of problem situations and practical activities, the use of modern pedagogical approaches is of great importance. The paper analyzes the possibilities of active learning, problem-based learning, project-based learning, interactive methods and digital technologies. It is advisable to regard an innovative approach not merely as the use of a new method, but as the reorganization of the learning process in accordance with the aims and content of the biology lesson and the needs of students.*

Keywords: *biology, education, innovation, pedagogical approach, interactive methods, technologies.*

Bugungi kunda ta’lim jarayonining asosiy vazifalaridan biri o‘quvchiga faqat tayyor bilimlarni berish emas, balki unda mustaqil fikrlash, ma’lumotni tahlil qilish, muammoni aniqlash va uning yechimini izlash ko‘nikmalarini shakllantirishdan iborat. Shu nuqtayi nazardan biologiya fanini o‘qitishda innovatsion pedagogik yondashuvlardan foydalanish dolzarb masalalardan biri hisoblanadi.

Pedagogik texnologiya ta’lim-tarbiya jarayonini maqsadli va tizimli tashkil etishga qaratilgan yondashuv bo‘lib, unda o‘quvchining rivojlanishi va mustaqilligi muhim o‘rin tutadi. Tolipov va Usmonboyeva pedagogik texnologiyaning muhim xususiyatlari qatorida ta’lim jarayonini takomillashtirish, shaxsni rivojlantirish va ta’lim-tarbiya jarayonini muayyan sharoitlardan kelib chiqib tashkil etish imkoniyatlarini ko‘rsatib berganlar [1, 23–24-b.].

Biologiya fanining boshqa fanlardan o‘ziga xos jihati shundaki, uning mazmunida tirik organizmlar, biologik jarayonlar, ekologik munosabatlar va tajribaviy faoliyat katta o‘rin egallaydi. Shuning uchun biologiya darsini faqat o‘qituvchining tushuntirishi va o‘quvchining tayyor ma’lumotni eslab qolishi asosida tashkil etish yetarli emas. O‘quvchi biologik hodisani kuzatishi, savol berishi, taxmin qilishi, dalillarni taqqoslashi va xulosa chiqarishi uchun imkoniyat yaratilishi lozim.

Innovatsion pedagogik yondashuv deganda ta’lim jarayonini yangi maqsad, metod, vosita va tashkiliy shakllar asosida takomillashtirishga qaratilgan faoliyat tushuniladi. Bunda “innovatsiya” tushunchasini faqat texnik vositalar yoki zamonaviy dasturlardan foydalanish bilan chegaralab qo‘yish to‘g‘ri emas. Innovatsionlik, avvalo, o‘quvchining ta’lim jarayonidagi faol ishtirokini ta’minlash bilan bog‘liq. Ishmuhamedov, Abduqodirov va Pardaev tomonidan ta’lim jarayonida treninglar, ochiq munozaralar, yakka tartibda, juftlikda, kichik guruh va jamoada ishlash kabi

usullardan foydalanish masalalariga alohida e’tibor qaratilgan [2]. Bu yondashuvlarni biologiya darslariga moslashtirish orqali o‘quvchilarning o‘zaro fikr almashishi va biologik muammolarni birgalikda hal qilishi uchun sharoit yaratish mumkin.

Biologiya ta’limida interfaol metodlardan foydalanish o‘quvchilarning darsdagi faolligini oshirishga xizmat qilishi mumkin. Masalan, “Aqliy hujum” metodi orqali mavzuga oid dastlabki fikrlarni aniqlash, “Klaster” orqali biologik tushunchalar o‘rtasidagi bog‘liqlikni ko‘rsatish, “Venn diagrammasi” orqali ikki biologik obyekt yoki jarayonni taqqoslash mumkin. Masalan, “O‘simlik va hayvon hujayralari” mavzusida Venn diagrammasidan foydalanilganda o‘quvchilar umumiy va farqli belgilarni mustaqil aniqlaydilar. “Fotosintez” mavzusida esa muammoli savollar asosida o‘quvchilarning avvalgi bilimlari faollashtirilishi mumkin.

Interfaol metodni darsga shunchaki “zamonaviy metod ishlatildi” degan maqsadda kiritish kerak emas. Metod biologiya darsining aniq maqsadiga xizmat qilishi kerak. Agar metod o‘quvchining mavzuni tushunishiga, taqqoslashiga yoki xulosa chiqarishiga yordam bermasa, undan foydalanishning o‘zi innovatsion ta’limni anglatmaydi.

Faol ta’lim va biologiya darsi

Zamonaviy biologiya ta’limi tadqiqotlarida faol ta’lim o‘quvchining dars jarayonida fikrlashi, muhokama qilishi, savolga javob izlashi va bilimni faol qo‘llashi bilan bog‘lanadi. Biologiya ta’limiga bag‘ishlangan tadqiqotlarda faol ta’lim strategiyalarining ko‘plab turlari mavjudligi qayd etilgan [3, 47-b.].

Faol ta’limning biologiya darslaridagi ahamiyati shundaki, o‘quvchi biologik tushunchalarni faqat yodlab qolmay, ularni vaziyatlarda qo‘llashga harakat qiladi. Masalan, “Ekotizim” mavzusida o‘quvchilarga tayyor ta’rifni berish o‘rniga ma’lum hududdagi oziq zanjirini tuzish topshirig‘i berilishi mumkin. Bunday topshiriq o‘quvchini biologik bog‘liqliklarni mustaqil aniqlashga undaydi.

Guruhda ishlash ham faol ta’limning samarali shakllaridan biridir. Biologiya ta’limida guruh ishiga bag‘ishlangan meta-tahlilda guruhda ishlashning o‘quvchilarning akademik natijalari bilan ijobiy bog‘liqligi o‘rganilgan [4, 207-b.]. Biroq guruhda ishlash ham aniq topshiriq, vaqt va baholash mezonlari asosida tashkil etilishi kerak.

Muammoli ta’limning biologiya fanidagi imkoniyatlari. Muammoli ta’lim o‘quvchini tayyor javobni qabul qilishdan ko‘ra, muammoning sababini izlashga yo‘naltiradi. Biologiya fanida bunday yondashuv uchun juda ko‘p imkoniyatlar mavjud. Masalan, o‘qituvchi “Nima sababdan yorug‘lik yetishmagan o‘simlikning barglari rangida o‘zgarish kuzatiladi?”, “Nima uchun suv ifloslanishi suv ekotizimidagi organizmlarga ta’sir qiladi?” yoki “Antibiotiklardan noto‘g‘ri foydalanish qanday oqibatlarga olib kelishi mumkin?” kabi savollarni qo‘yishi mumkin. Bunday

savollarning afzalligi shundaki, o‘quvchi biologik bilimni real hayotdagi vaziyat bilan bog‘lashga harakat qiladi. Biologiya ta’limida muammoli ta’limning sog‘liq savodxonligi kabi amaliy yo‘nalishlar bilan bog‘lanishi ham ilmiy tadqiqotlarda o‘rganilgan [5, 230-b.].

Loyiha asosida o‘qitish. Loyiha asosida o‘qitish o‘quvchilarning ma’lum bir muammoni mustaqil yoki guruh bo‘lib o‘rganishi va yakunda muayyan mahsulot yoki taqdimot yaratishiga asoslanadi. Biologiya fanida ekologiya, botanika, zoologiya, odam anatomiyasi va mikrobiologiya kabi yo‘nalishlarda loyiha ishlaridan foydalanish mumkin. Masalan, “Maktab hududidagi o‘simliklar xilma-xilligi”, “Mahalliy hududdagi ekologik muammolar”, “Suv sifatiga ta’sir qiluvchi omillar” yoki “Dorivor o‘simliklardan oqilona foydalanish” mavzularida kichik loyihalar tashkil etish mumkin. Bunday faoliyat davomida o‘quvchi ma’lumot izlash, kuzatish, guruh bilan ishlash, ma’lumotlarni tizimlashtirish va natijani taqdim etish ko‘nikmalarini rivojlantiradi. Biologiya ta’limida loyiha asosidagi yondashuvning ilmiy jarayon ko‘nikmalari va konseptual tushunchalarni shakllantirish bilan bog‘liqligi ham tadqiq etilgan [6].

Raqamli texnologiyalardan foydalanish Bugungi biologiya ta’limini raqamli texnologiyalarsiz tasavvur qilish tobora qiyinlashmoqda. Elektron taqdimot, animatsiya, videomaterial, interaktiv test, virtual laboratoriya va raqamli modellar biologik jarayonlarni ko‘rgazmali tushuntirish imkonini beradi. Ayniqsa, hujayra bo‘linishi, DNK tuzilishi, genetik jarayonlar, fotosintez va modda almashinuvi kabi jarayonlarni oddiy rasm orqali tushuntirish qiyin bo‘lgan vaziyatlarda animatsiya va modellashtirishdan foydalanish foydali bo‘lishi mumkin. Biroq raqamli texnologiyaning o‘zi darsni avtomatik ravishda samarali qilib qo‘ymaydi. Asosiy masala texnologiyani tanlashda emas, balki uni qaysi pedagogik maqsad uchun va qanday topshiriq bilan qo‘llashdadir. Shu sababli o‘qituvchi avval dars maqsadini belgilab, keyin unga mos raqamli vositani tanlashi maqsadga muvofiq.

O‘qituvchining roliInnovatsion ta’lim sharoitida o‘qituvchining roli ham o‘zgaradi. O‘qituvchi faqat ma’lumot beruvchi emas, balki o‘quvchilarning mustaqil izlanishini tashkil etuvchi, yo‘naltiruvchi va natijani baholovchi shaxs sifatida faoliyat yuritadi. Biologiya o‘qituvchisining innovatsion faoliyati uchta jihatning uyg‘unligiga asoslanishi kerak: birinchisi — biologik mazmunni chuqur bilish; ikkinchisi — zamonaviy pedagogik metodlarni bilish; uchinchisi — ushbu metodlarni muayyan biologik mavzuga moslashtira olish. Aynan uchinchi jihat darsning haqiqiy metodik qiymatini belgilaydi.

Xulosa qilib aytganda, biologiya ta’limida innovatsion pedagogik yondashuvlardan foydalanish o‘quvchilarning darsdagi faolligini oshirish, biologik bilimlarni amaliy vaziyatlar bilan bog‘lash va mustaqil fikrlash ko‘nikmalarini rivojlantirish uchun muhim imkoniyat yaratadi. Interfaol metodlar, faol ta’lim, muammoli ta’lim, loyiha asosida o‘qitish va raqamli texnologiyalar

biologiya darsining mazmuniga mos ravishda tanlanganida samarali pedagogik vositaga aylanishi mumkin. Kelgusida biologiya ta’limida innovatsion yondashuvlarning samaradorligini mahalliy ta’lim muassasalari sharoitida tajriba-sinov ishlari orqali o‘rganish, o‘quvchilarning biologik kompetensiyalarini baholash mezonlarini ishlab chiqish va raqamli ta’lim resurslaridan foydalanish metodikasini takomillashtirish maqsadga muvofiqdir.

FOYDALANILGAN ADABIYOTLAR

1. Tolipov O‘., Usmonboyeva M. Pedagogik texnologiyalarning tatbiqiy asoslari. – Toshkent: Fan, 2006. – 261 b.

2. Ishmuhamedov R., Abduqodirov A., Pardaev A. Ta’limda innovatsion texnologiyalar. – Toshkent: Iste’dod, 2008. – 180 b.

3. Alabi O.A., Gbigbadua A.D., Kayode O.O., Abdulraheem O.Y. Trends in Active Learning Pedagogies in Biology Education: A Systematic Documentary Content Analysis of Global Research Evidence // Jurnal Saintifik (Multi Science Journal). – 2026. – Vol. 24, №1. – B. 47–56.

4. Theobald E.J., et al. Group work enhances student performance in biology: A meta-analysis // BioScience. – 2024. – Vol. 74, №3. – B. 207–217.

5. The problem-based learning (PBL) of biology for promoting health literacy in secondary school students // Journal of Biological Education. – 2023. – Vol. 57, №1. – B. 230–244.

6. Abas A., Amin M., Ibrohim I., Indriwati S.E. Integration of project-based learning to improve scientific process skills and conceptual understanding in the learning process of invertebrate zoology // Jurnal Pendidikan Biologi Indonesia. – 2024. – Vol. 10, №2.

7. Azizxo‘jayeva N.N. Pedagogik texnologiyalar va pedagogik mahorat. – Toshkent: O‘zbekiston Yozuvchilar uyushmasi Adabiyot jamg‘armasi nashriyoti, 2006. – 160 b.

MAKTAB BOTANIKA DARSLARIDA MAHALLIY O‘SIMLIKLAR CHANGINING RAQAMLI ATLASI VA QR-KODLI O‘QUV KARTOCHKALARIDAN FOYDALANISH METODIKASI

Ilmiy rahbar: Djumayeva Zamira Utkirovna

Biologiya fanlari bo‘yicha falsafa doktori (PhD), assistent.

Jo‘raqulova Begoyim Sattor qizi

Samarqand davlat pedagogika instituti magistranti

E-mail: joraqulovabegoyim@gmail.com

Annotatsiya. *Ushbu tezisda maktab botanika darslarida mahalliy o‘simliklar chang donalarini o‘rganish uchun raqamli atlas va QR-kodli o‘quv kartochkalaridan foydalanishning metodik imkoniyatlari yoritilgan. Raqamli ta’lim resurslarining o‘quvchilarda o‘simliklarning generativ organlari, chang donalarining morfologik xususiyatlari va biologik xilma-xillik haqidagi bilimlarni shakllantirishdagi ahamiyati asoslangan. Shuningdek, raqamli atlasni tashkil etish tamoyillari, QR-kodli kartochkalarning tarkibi va ulardan botanika mashg‘ulotlarida foydalanish bosqichlari tavsiflangan.*

Kalit so‘zlar: *botanika, mahalliy o‘simliklar, chang donalari, raqamli atlas, QR-kod, elektron ta’lim resurslari, innovatsion metodika, biologiya ta’limi.*

ABSTRACT*. This paper examines the methodological potential of using a digital atlas of pollen grains of local plants and QR-code-based educational cards in school botany lessons. It substantiates the importance of digital educational resources in developing students’ knowledge of the reproductive organs of plants, the morphological characteristics of pollen grains, and biological diversity. The paper also describes the principles of developing a digital atlas, the structure of QR-code-based educational cards, and the stages of their use in botany lessons.*

Keywords: *botany, local plants, pollen grains, digital atlas, QR code, digital educational resources, innovative methodology, biology education.*

Bugungi kunda umumiy o‘rta ta’lim maktablarida biologiya fanini o‘qitish jarayoniga zamonaviy axborot-kommunikatsiya texnologiyalarini joriy etish, o‘quvchilarning mustaqil bilim olishini qo‘llab-quvvatlash va nazariy bilimlarni amaliy mashg‘ulotlar bilan uyg‘unlashtirish muhim ahamiyat kasb etmoqda. Ayniqsa, botanika darslarida o‘simliklarning tuzilishi, ko‘payishi va tabiatdagi ahamiyatini o‘rganishda ko‘rgazmali vositalar hamda raqamli resurslardan foydalanish o‘quv materialini tushunarli tashkil etishga yordam beradi.

O‘simliklar chang donalari ularning ko‘payish jarayonida muhim vazifani bajaradi. Chang donalarining shakli, o‘lchami, sirt tuzilishi va boshqa morfologik belgilari o‘simliklarni mikroskopik darajada o‘rganish imkonini beradi. Biroq maktab botanika darslarida ushbu

obyektlarni o‘rganish uchun barcha zarur preparatlar, mikroskopik tasvirlar va mahalliy o‘simliklarga oid tizimlashtirilgan ma’lumotlar doimo ham mavjud bo‘lmasligi mumkin. Shu nuqtayi nazardan, mahalliy o‘simliklar chang donalarining raqamli atlasini yaratish va QR-kodli o‘quv kartochkalaridan foydalanish botanika mashg‘ulotlarini axborot jihatidan boyitishning istiqbolli yo‘nalishlaridan biri hisoblanadi.

Raqamli atlas — o‘simliklar chang donalariga oid tasvirlar, tavsiflar va ilmiy ma’lumotlarni elektron shaklda birlashtiruvchi tizimlashtirilgan ta’lim resursidir. Uni maktab ta’limiga moslashtirishda ma’lumotlarning ilmiy aniqligi, tasvirlarning sifati, foydalanish qulayligi va o‘quv dasturiga muvofiqligi asosiy mezonlar sifatida qaralishi lozim. Raqamli atlas tarkibiga mahalliy hududda uchraydigan o‘simliklarning nomi, sistematik o‘rni, chang donasining mikroskopik tasviri, asosiy morfologik xususiyatlari, gullash davri va ekologik ahamiyati haqidagi ma’lumotlarni kiritish mumkin. Zarur hollarda chang donasining o‘lchami va tasvirga olish usuli ham qayd etiladi. Bunda ma’lumotlar ishonchli botanika manbalari, ilmiy adabiyotlar va tadqiqot davomida olingan kuzatuv natijalariga asoslanishi kerak.

Atlasning muhim xususiyatlaridan biri mahalliy o‘simliklarga alohida e’tibor qaratilishidir. O‘quvchilar o‘z hududida uchraydigan o‘simliklarni o‘rganish orqali biologik xilma-xillik, o‘simliklarning ko‘payishi va tabiatni muhofaza qilish masalalarini kundalik hayot bilan bog‘lash imkoniga ega bo‘ladilar. Bunda o‘simlik turlarini tanlashda ularning mahalliy hududda tarqalishi, ta’limiy ahamiyati va xavfsiz o‘rganish imkoniyatlari hisobga olinadi. Raqamli atlasdan foydalanishni yanada qulaylashtirish maqsadida QR-kodli o‘quv kartochkalarini ishlab chiqish mumkin. Har bir kartochkada o‘simlikning nomi, rasmi, qisqacha tavsifi, chang donasini o‘rganishga doir topshiriq va tegishli elektron ma’lumotlarga olib boruvchi QR-kod joylashtiriladi. QR-kod yordamida o‘quvchi telefon yoki planshet orqali atlasdagi tegishli sahifani ochishi, mikroskopik tasvirlarni ko‘rishi va qo‘shimcha ma’lumotlarni o‘rganishi mumkin. QR-kodli kartochkalar asosida tashkil etiladigan mashg‘ulotlarni bir necha bosqichda amalga oshirish tavsiya etiladi.

Birinchi bosqichda o‘qituvchi mashg‘ulotning maqsadini tushuntiradi va o‘quvchilarni o‘rganiladigan o‘simliklar bilan tanishtiradi. O‘simliklarning tashqi tuzilishi, gul organlari va changlanish jarayoni haqida dastlabki savollar beriladi.

Ikkinchi bosqichda o‘quvchilarga QR-kodli kartochkalar tarqatiladi. Ular kodni skanerlash orqali raqamli atlasdagi ma’lumotlarni ochadilar va chang donalarining tasvirlarini kuzatadilar. Agar laboratoriya sharoiti mavjud bo‘lsa, raqamli tasvirlar mikroskop yordamida olingan preparatlar bilan taqqoslanadi.

Uchinchi bosqichda o‘quvchilar chang donalarining ko‘rinadigan morfologik belgilarini taqqoslaydilar. Ular kuzatuv natijalarini jadvalga qayd etib, o‘rganilgan namunalar o‘rtasidagi o‘xshashlik va farqlarni aniqlaydilar. Bunda chang donalarining shakli va sirt tuzilishi kabi belgilarni faqat tasvirda aniq ko‘rinadigan darajada tavsiflash lozim.

To‘rtinchi bosqichda o‘quvchilar olingan ma’lumotlarni umumlashtirib, savollarga javob beradilar va xulosalar chiqaradilar. O‘qituvchi ularning kuzatuv natijalarini baholaydi, noto‘g‘ri talqinlarni tuzatadi hamda biologik tushunchalarni mustahkamlaydi.

Mazkur metodikani amalga oshirishda bir qator pedagogik imkoniyatlar yuzaga keladi. Jumladan, raqamli atlas murakkab mikroskopik obyektlarni ko‘rgazmali shaklda taqdim etishga, QR-kodli kartochkalar esa o‘quvchilarning mustaqil axborot izlash faoliyatini tashkil etishga yordam beradi. Taqqoslash va kuzatish topshiriqlari o‘quvchilarning tahliliy fikrlashini rivojlantirishga xizmat qilishi mumkin.

Shu bilan birga, raqamli resurslardan foydalanish haqiqiy laboratoriya mashg‘ulotlarining o‘rnini to‘liq egallamasligi kerak. Imkoniyat mavjud bo‘lganda raqamli tasvirlarni mikroskopik kuzatuvlar bilan uyg‘unlashtirish maqsadga muvofiq. Shuningdek, QR-kodlar orqali ochiladigan sahifalar muntazam tekshirilishi, ulardagi ma’lumotlar ishonchli manbalarga asoslanishi va o‘quvchilar uchun tushunarli tilda berilishi zarur.

Xulosa. Maktab botanika darslarida mahalliy o‘simliklar chang donalarining raqamli atlasidan va QR-kodli o‘quv kartochkalaridan foydalanish ta’lim mazmunini ko‘rgazmali hamda interaktiv tashkil etish uchun metodik imkoniyat yaratadi. Ushbu resurslar orqali o‘quvchilar o‘simliklarning chang donalarini kuzatish, ularning morfologik belgilarini taqqoslash va biologik ma’lumotlarni tahlil qilishga yo‘naltirilishi mumkin. Raqamli atlasni yaratishda mahalliy o‘simlik turlarini to‘g‘ri aniqlash, sifatli mikroskopik tasvirlardan foydalanish, ilmiy ma’lumotlarning ishonchliligini ta’minlash va materiallarni o‘quvchilarning yosh xususiyatlariga moslashtirish muhimdir. QR-kodli kartochkalarni amaliy topshiriqlar bilan birgalikda qo‘llash esa o‘quvchilarning mustaqil izlanishi va o‘quv faoliyatidagi ishtirokini qo‘llab-quvvatlashi mumkin. Kelgusida mazkur metodikaning samaradorligini aniqlash uchun maktablarda tajriba-sinov mashg‘ulotlarini tashkil etish, o‘quvchilarning mavzu bo‘yicha bilimlarini dastlabki va yakuniy baholash hamda olingan natijalarni qiyosiy tahlil qilish maqsadga muvofiq.

FOYDALANILGAN ADABIYOTLAR

1. Evert R.F., Eichhorn S.E. *Raven Biology of Plants*. 8th edition. W.H. Freeman and Company, 2013.
2. Urry L.A. va boshqalar. *Campbell Biology*. 12th edition. Pearson, 2020.
3. UNESCO. *ICT Competency Framework for Teachers*. Version 3. Paris: UNESCO, 2018.
4. Mayer R.E. *Multimedia Learning*. 2nd edition. Cambridge University Press, 2009.
5. O‘zbekiston Respublikasi umumiy o‘rta ta’lim maktablari uchun amaldagi biologiya fanidan o‘quv dasturi va darsliklari.

BOTANIKA FANIDAN AMALIY MASHG‘ULOTLARNI O‘TKAZISHDA INNOVATSION TEXNOLOGIYALARNI QO‘LLASH METODIKASI

Ro‘ziyeva Mahliyo Kamoliddin qizi

Samarqand davlat pedagogika instituti Tabiiy fanlar fakulteti Biologiya ta’lim yo‘nalishi 4-kurs talabasi

E-mail: roziyevamahliyo85@gmail.com

Annotatsiya. *Maqolada umumta’lim maktablarida botanika mavzulari bo‘yicha amaliy mashg‘ulotlarni innovatsion texnologiyalar asosida tashkil etish masalasi yoritilgan. Amaliy mashg‘ulot turlari va o‘quvchilar tadqiqotchilik faoliyatining darajalari tahlil qilingan; botanika mashg‘ulotlariga mos innovatsion texnologiyalar yetti guruhga tasniflanib, ularni tanlash mezonlari taklif etilgan. 5E sikli: qiziqtirish – izlanish – tushuntirish – kengaytirish – baholash asosida interaktiv metodlar, raqamli-mobil vositalar va loyiha faoliyatini uyg‘unlashtiruvchi to‘rt blokli metodik model, namunaviy mashg‘ulot tuzilmasi hamda amaliy ko‘nikmalarni baholashning besh mezonli rubrikasi bayon etilgan.*

Kalit so‘zlar: *botanika, amaliy mashg‘ulot, laboratoriya ishi, innovatsion texnologiyalar, 5E modeli, raqamli mikroskop, mobil ilovalar,*

Abstract. *The article addresses the organization of practical botany lessons in general secondary schools on the basis of innovative technologies. Types of practical lessons and levels of students' inquiry activity are analyzed; innovative technologies suitable for botany lessons are classified into seven groups, and criteria for selecting them are proposed. The article describes a four-block methodological model that integrates interactive methods, digital and mobile tools, and project work within the 5E cycle engage – explore – explain – elaborate – evaluate, the structure of a sample lesson, and a five-criterion rubric for assessing practical skills.*

Keywords: *botany, practical lesson, laboratory work, innovative technologies, 5E model, digital microscope, mobile applications, inquiry-based learning.*

Tabiiy fanlarni o‘qitishda bugungi asosiy talab o‘quvchining bilimni kuzatish, tajriba va tahlil orqali mustaqil egallashi hamda uni yangi vaziyatda qo‘llay olishidir. Prezidentning 2020-yil 12-avgustdagi PQ-4805-son qarorida kimyo va biologiya yo‘nalishlarida uzluksiz ta’lim sifati va ilm-fan natijadorligini oshirish vazifalari belgilangan [1]. Xalqaro baholash dasturlari bu vazifaning dolzarbligini raqamlarda ko‘rsatadi. O‘zbekiston ilk bor ishtirok etgan TIMSS 2023 tadqiqotida tabiiy fanlar bo‘yicha 4-sinf o‘quvchilarining o‘rtacha bali 412, 8-sinf o‘quvchilariniki 396 ni tashkil etdi [2]. PISA 2025 dasturida 15 yoshli o‘quvchilarning tabiiy-ilmiy savodxonlik bali 2022-yildagi 355 dan 438 ga ko‘tarildi, ammo OECD davlatlarining o‘rtacha ko‘rsatkichi 482 balldan hali past [3]. Bu natijalar bilimni amalda qo‘llash, tajriba natijasini talqin qilish va dalilga asoslangan xulosa chiqarish ko‘nikmalarini rivojlantirish zarurligini ko‘rsatadi.

Maktab o‘quv rejasida ham muhim o‘zgarishlar yuz berdi: 2022–2023-o‘quv yilidan 6-sinfda, 2024–2025-o‘quv yilidan esa 5-sinfda fizika, biologiya va geografiya mazmunini birlashtirgan «Tabiiy fan (Science)» fani joriy etildi [4; 5]. Natijada o‘simliklar dunyosiga oid mavzular integratsiyalashgan, tadqiqotchilikka yo‘naltirilgan kurs tarkibida o‘rganilmoqda.

Botanika amaliy mashg‘ulotlar uchun eng qulay fan: uning ob’ekti o‘quvchi har kuni ko‘radigan, mikroskopda kuzatish va tajriba qilish mumkin bo‘lgan tirik o‘simlik. Shunga qaramay, o‘quvchilarning o‘simliklarni hayvonlarga nisbatan kamroq payqashi «o‘simliklarga befarqlik» hodisasi sifatida qayd etilgan [6]. Maktab laboratoriya ishlarining tayyor yo‘riqnomani bajarishga aylanib, o‘quvchi izlanishiga o‘rin qoldirmasligi ham tanqid qilinadi [7]. Raqamli mikroskop, smartfon sensorlari, o‘simliklarni aniqlovchi mobil ilovalar va interaktiv metodlar bu muammolarni arzon yo‘l bilan hal etish imkonini beradi, biroq ularni botanika mashg‘ulotlari mazmuni bilan tizimli bog‘laydigan metodik ishlanmalar hali yetarli emas. Maktab botanika fanlaridagi amaliy mashg‘ulotlarda innovatsion texnologiyalarni 5E sikli asosida uyg‘unlashtirish metodikasini asoslash va uning tarkibiy qismlarini bayon etish.

Biologiya o‘qitish metodikasida amaliy metodlar ob'ektlarni tanib olish va aniqlash, kuzatish hamda tajribaga ajratiladi [8]. Respublikamizda biologiyadan laboratoriya mashg‘ulotlarini tashkil etish masalalari J.O. Tolipova va A.T. G‘ofurov ishlarida yoritilgan [9]. R. Bybee va hammualliflari ishlab chiqqan 5E modeli o‘quv faoliyatini qiziqtirish, izlanish, tushuntirish, kengaytirish va baholash bosqichlari orqali tashkil etadi [1].

H. Banchi va R. Bell tadqiqotchilik faoliyatining to‘rt darajasini ajratadi: tasdiqlovchi, tuzilmali, yo‘naltirilgan va ochiq tadqiqot. Bu darajalar savol, usul va natijadan qaysi biri o‘quvchiga oldindan berilishi bilan farqlanadi [1]. P. Mishra va M. Koehlerning TPACK modeli

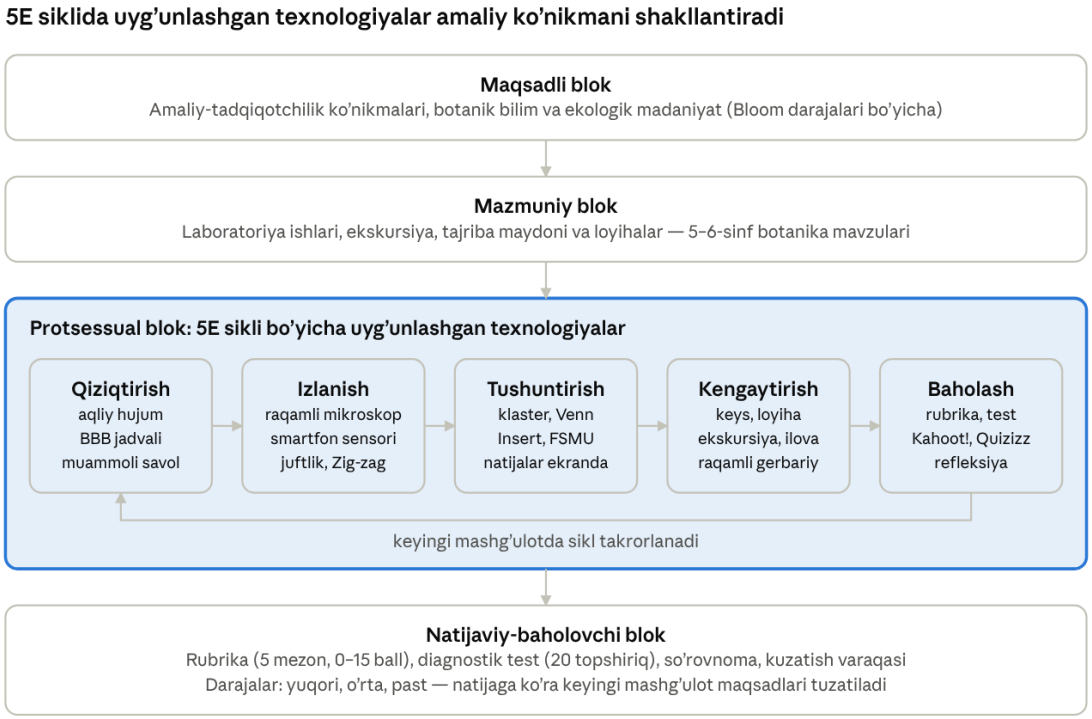
texnologiyani tanlash fan mazmuni va pedagogik maqsaddan boshlanishi kerakligini asoslaydi [2]. S. Freeman va hammualliflari 225 ta tadqiqotni meta-tahlil qilib, faol ta’limda imtihon natijalari o‘rtacha 6 foizga yuqori bo‘lishini, an'anaviy ma’ruza tinglagan talabalarning esa kursni o‘zlashtira olmaslik ehtimoli 1,5 marta yuqoriligini aniqlagan [3].

Botanikadan amaliy mashg‘ulotlarning yetti turi ajratildi: laboratoriya mashg‘uloti, amaliy ish, namoyish tajribasi, ekskursiya, maktab tajriba maydonidagi ish, mustaqil kuzatish va loyiha-tadqiqot ishi. Ularning samaradorligi o‘quvchiga beriladigan mustaqillik darajasiga bog‘liq. Masalan, barg og‘izchalarini o‘rganishda tasdiqlovchi darajada o‘quvchi mikroskopdagi tasvirni darslikdagi rasm bilan solishtiradi, tuzilmali darajada esa bargning ikki tomonidagi og‘izchalarni berilgan usulda sanab, qaysi tomonda ko‘pligini o‘zi aniqlaydi [1]. 5–6-sinflar uchun tuzilmali va yo‘naltirilgan darajalarni asosiy shaklga aylantirish maqsadga muvofiq.

Botanika amaliy mashg‘ulotlariga mos innovatsion texnologiyalar yetti guruhga ajratildi: 1) interaktiv metodlar va grafik organayzerlar. Aqliy hujum, BBB jadvali, Klaster, Venn diagrammasi, Zig-zag, FSMU, Keys-stadi [14]; 2) muammoli va tadqiqotga asoslangan ta’lim; 3) raqamli va mobil texnologiyalar raqamli mikroskop, smartfon sensorlari, aniqlovchi ilovalar, virtual laboratoriya, QR-kodlar; 4) aralash ta’lim, jumladan teskari sinf; 5) o‘yin texnologiyalari; 6) loyiha va STEAM ta’limi; 7) zamonaviy baholash vositalari.

Texnologiyani tanlash uchun yetti mezon taklif etildi: mazmunga moslik; tirik ob'ekt bilan ishlashni to‘ldirish, uning o‘rnini bosmaslik; har bir o‘quvchining faolligi; arzonlik va mavjudlik; 45 daqiqalik darsga sig‘ishi; natijani o‘lchash imkoniyati; jismoniy va axborot xavfsizligi.

Taklif etilgan model to‘rt blokdan iborat: maqsadli blok (Bloom darajalari bo‘yicha ifodalangan natijalar), mazmuniy blok (laboratoriya ishlari, ekskursiya, tajriba maydoni, loyiha), protsessual blok (5E sikli) va natijaviy-baholovchi blok (1-rasm). Modelning markazida texnologiyalarni 5E siklining har bir bosqichiga mos ravishda uyg‘unlashtirish g‘oyasi turadi (1-jadval).



metodik model · 4 blok, 5E sikli

1-rasm. Botanikadan amaliy mashg‘ulotlarda innovatsion texnologiyalarni qo‘llashning metodik modeli

1-jadval.

45 daqiqalik laboratoriya mashg‘ulotida 5E sikli bosqichlari va texnologiyalar

5E bosqichi	Vaqt, daq	Interaktiv metod	Raqamli vosita	O‘quvchi mahsuli
Qiziqtirish	5	Aqliy hujum, BBB jadvali, muammoli savol	Qisqa video yoki so‘z buluti	BBB jadvali
Izlanish	15–17	Juftlikda ishlash, Zig-zag	Raqamli mikroskop, smartfon, sensor	Rasm, fotosurat, o‘lchov jadvali
Tushuntirish	8–10	Klaster, Venn diagrammasi, FSMU	Natijalarni proyektorda ko‘rsatish	To‘ldirilgan grafik organayzer
Kengaytirish	5–7	Keys-stadi, loyiha topshirig‘i	Aniqlovchi ilova	Keys yechimi

5E bosqichi	Vaqt, daq	Interaktiv metod	Raqamli vosita	O‘quvchi mahsuli
Baholash	5	O‘z-o‘zini baholash, BBB jadvalining 3-ustuni	Kahoot! yoki Quizizz	Test natijasi, rubrika bali

Bir darsda 2–3 tadan ortiq interaktiv metod qo‘llanmaydi: metod laboratoriya ishiga xizmat qilishi, uni siqib chiqarmasligi kerak. Jihozlar yetishmaganda stansiyalar bo‘ylab aylanish, guruhda rollarga bo‘linib ishlash va okulyar-kamera orqali butun sinf bilan preparatni birgalikda tahlil qilish tavsiya etiladi.

«Barg epidermisi va og‘izchalar» mashg‘ulotining qiziqtirish bosqichida polietilen paket bilan o‘ralgan novdada to‘plangan suv tomchilari ko‘rsatilib, «Barg suvni qaysi tomoni orqali ko‘proq bug‘latadi?» degan savol qo‘yiladi. Izlanish bosqichida o‘quvchilar bargning ikki tomonidan rangsiz tirnoq loki yordamida nusxa olib, uchta ko‘rish maydonidagi og‘izchalarni sanaydi va natijani sinfning umumiy elektron jadvaliga kiritadi. Tushuntirish bosqichida sinf natijalari ustunli diagrammada tahlil qilinib, FSMU usulida xulosa shakllantiriladi. Kengaytirish bosqichida suv yuzasida qalqib turuvchi nilufar bargida og‘izchalar qayerda joylashishi muhokama qilinadi, baholash esa rubrika va qisqa test bilan amalga oshiriladi. Shu tariqa o‘quvchi «ko‘pchilik o‘simliklarda og‘izchalar bargning ostki tomonida ko‘p bo‘ladi» degan qoidani yodlamaydi, balki uni o‘z ma’lumotlari asosida kashf etadi.

Raqamli vositalardan foydalanishda ikki shartga e'tibor qaratish lozim. Birinchidan, aniqlovchi ilova bergan nom ehtimoliy taxmin bo‘lib, aniqlagich yordamida tekshiriladi. iNaturalist platformasida hisob ochish uchun foydalanuvchi kamida 13 yoshda bo‘lishi talab etiladi, shu bois 5–6-sinf o‘quvchilari bilan ro‘yxatdan o‘tishni talab qilmaydigan Seek ilovasidan foydalanish maqsadga muvofiq [5]. Ikkinchidan, phyphox ilovasidagi yorug‘lik sensori o‘lchovi Android qurilmalarida ishlaydi, iPhone'da esa ilovalar bu sensorga kira olmaydi [6]. Shu sababli fotosintez tezligiga yorug‘lik ta’sirini o‘rganish tajribasida har bir guruhga Android smartfon biriktiriladi.

Amaliy ko‘nikmalar besh mezonli rubrika bilan baholanadi: asbob va qurilmalar bilan ishlash, preparat tayyorlash yoki tajribani bajarish, natijalarni qayd etish, tahlil va xulosa, hamkorlik va xavfsizlik. Har bir mezon 0 dan 3 gacha ball bilan baholanadi; jami 15 balldan 12–15 ball yuqori, 8–11 ball o‘rta, 0–7 ball past darajaga mos keladi. Rubrika 20 topshiriqli diagnostik test, o‘quvchilar so‘rovnomasi va mashg‘ulotni kuzatish varaqasi bilan to‘ldiriladi. Metodikaning samaradorligi 2026–2027-o‘quv yilida Samarqand shahridagi umumta’lim maktabida tajriba va

nazorat guruhlari ishtirokida tekshiriladi; natijalar Styudentning t-mezoni va χ^2 mezoni yordamida tahlil qilinadi [7].

Taklif etilgan yondashuvning asosiy farqi shundaki, innovatsion texnologiyalar alohida «qiziqarli usul» sifatida emas, balki 5E siklining muayyan bosqichiga biriktirilgan vosita sifatida qo‘llanadi. Bu A. Hofstein va V. Lunetta tanqid qilgan, tayyor yo‘riqnoma bo‘yicha bajariladigan laboratoriya ishlaridan [7] o‘quvchi savol qo‘yadigan, ma’lumot yig‘adigan va xulosani o‘zi chiqaradigan tadqiqotchilik faoliyatiga o‘tish imkonini beradi. Texnologiyani vositadan emas, mazmun va maqsaddan kelib chiqib tanlash TPACK modeli talablariga mos keladi [9].

Faol ta’lim samaradorligiga oid meta-tahlil natijalari [8] modelning nazariy asosini mustahkamlaydi. Biroq bu natijalar asosan oliy ta’lim kurslarida olingani sababli, ularni maktab botanika mashg‘ulotlariga ko‘chirish pedagogik tajriba-sinov orqali alohida tekshirilishi lozim. Metodikani qo‘llashda bir qator cheklovlar mavjud: har bir o‘quvchida smartfon bo‘lmasligi, maktabdagi mikroskoplar sonining kamligi, 45 daqiqalik dars vaqti va internet aloqasining barqaror emasligi. Ularni guruhlarda ishlash, stansiyalar bo‘ylab aylanish, okulyar-kamera orqali frontal tahlil va oflayn bosma materiallar yordamida yumshatish mumkin. Raqamli vositalarning yangiligi qisqa muddatda o‘quvchilar qiziqishini vaqtincha oshirishi ham natijalarni talqin qilishda hisobga olinishi kerak.

Xulosa qilib aytganda, botanika mazmunan amaliyotga yo‘naltirilgan fan bo‘lib, 5–6-sinflarda «Tabiiy fan»ning joriy etilishi amaliy mashg‘ulotlarni tadqiqotchilik va fanlararo asosda qayta loyihalashni talab qiladi hamda innovatsion texnologiyalarning yetti guruhi va ularni tanlashning yetti mezoni o‘qituvchiga mashg‘ulot maqsadiga mos vositani asosli tanlash imkonini beradi. 5E sikliga asoslangan to‘rt blokli model interaktiv, raqamli-mobil va loyiha texnologiyalarini 45 daqiqalik darsga tizimli joylashtiradi hamda o‘quvchini tasdiqlovchi darajadan yo‘naltirilgan tadqiqot darajasiga bosqichma-bosqich olib chiqadi. Besh mezonli rubrika o‘quvchining faqat nimani bilishini emas, nimani bajara olishini ham baholaydi. Metodikaning samaradorligi pedagogik tajriba-sinov natijalari asosida keyingi ishlarda baholanadi.

FOYDALANILGAN ADABIYOTLAR

1. O‘zbekiston Respublikasi Prezidentining «Kimyo va biologiya yo‘nalishlarida uzluksiz ta’lim sifatini va ilm-fan natijadorligini oshirish chora-tadbirlari to‘g‘risida»gi 2020-yil 12-avgustdagi PQ-4805-son Qarori.
2. TIMSS 2023 International Results in Mathematics and Science. – IEA, 2024.
3. New OECD Assessment Reveals Central Asia’s Student Performance // The Times of Central Asia. – 2026.

4. Maktabgacha va maktab ta’limi vazirining 2024-yil 26-martdagi 94-son buyrug‘i bilan tasdiqlangan umumiy o‘rta ta’lim maktablarining 2024–2025-o‘quv yili uchun tayanch o‘quv rejasi.
5. Tabiiy fan darsini kimlar o‘tishi va sertifikatni kim berishi ma’lum qilindi // InfoEdu.uz. – 08.09.2026.
6. Wandersee J.H., Schussler E.E. Preventing plant blindness // The American Biology Teacher. – 1999. – Vol. 61, No. 2. – P. 82–86.
7. Hofstein A., Lunetta V.N. The laboratory in science education: Foundations for the twenty-first century // Science Education. – 2004. – Vol. 88, No. 1. – P. 28–54.
8. Верзилин Н.М., Корсунская В.М. Общая методика преподавания биологии. – М.: Просвещение, 1983.
9. Tolipova J.O., G‘ofurov A.T. Biologiya o‘qitish metodikasi: o‘quv-metodik qo‘llanma. – Toshkent: «Bilim», 2004.

BIOLOGIYA FANINI O‘QITISHDA ILG‘OR PEDAGOGIK TEXNOLOGIYALARDAN FOYDALANISH

N. R.Turniyozova

Samarqand davlat pedagogika instituti

Email: turniyozovanargiza@gmail.com

Annotatsiya. *Biologiya fanini o‘qitishda ilg‘or pedagogik texnologiyalardan foydalanish ta’lim jarayonini mazmunan boyitish, o‘quvchilarning fanga bo‘lgan qiziqishini kuchaytirish hamda ularning faol ishtirokini ta’minlashga imkon beradi. Mazkur mavzuda biologiya ta’limida zamonaviy pedagogik yondashuvlarning o‘rni, ularni dars jarayoniga samarali tatbiq etish imkoniyatlari va o‘quvchilarning bilim, ko‘nikma hamda kompetensiyalarini rivojlantirishdagi ahamiyati yoritiladi. Ilg‘or pedagogik texnologiyalar asosida darslarni tashkil etish orqali o‘quvchilarda mustaqil fikrlash, muammoni aniqlash va hal etish, kuzatish, tahlil qilish, taqqoslash hamda xulosa chiqarish kabi faoliyatlar shakllantiriladi. Shuningdek, interfaol metodlar, muammoli ta’lim, loyihaviy faoliyat, hamkorlikda o‘qitish, axborot-kommunikatsiya va raqamli texnologiyalardan biologiya darslarida foydalanishning pedagogik imkoniyatlari ochib beriladi. Bunday yondashuvlar biologik bilimlarning puxta o‘zlashtirilishi bilan bir qatorda, o‘quvchilarning ijodiy va amaliy faoliyatini rivojlantirish, ta’lim jarayonini samarali hamda mazmunli tashkil etishga xizmat qiladi.*

Abstract. *The use of advanced pedagogical technologies in biology teaching makes it possible to enrich the educational process, enhance students' interest in the subject, and ensure their active participation. This topic highlights the role of modern pedagogical approaches in biology education, the possibilities for their effective implementation in the classroom, and their importance in developing students' knowledge, skills, and competencies. Organizing lessons based on advanced pedagogical technologies helps students develop independent thinking, problem identification and solving, observation, analysis, comparison, and conclusion-drawing skills. Furthermore, the pedagogical potential of using interactive methods, problem-based learning, project-based activities, collaborative learning, information and communication technologies, and digital technologies in biology lessons is explored. These approaches not only promote the thorough acquisition of biological knowledge but also contribute to the development of students' creative and practical abilities and the effective and meaningful organization of the educational process.*

Kirish. Bugungi ta'lim jarayonida o‘quvchiga faqat tayyor bilimlarni yetkazish bilan cheklanib qolmasdan, uni bilimni mustaqil egallash, o‘z fikrini asoslash, mavjud ma'lumotlarni tahlil qilish va amaliy faoliyatda qo‘llashga o‘rgatish muhim vazifalardan biri hisoblanadi. Ayniqsa, biologiya fanining mazmuni tirik tabiat hodisalari, organizmlar hayot faoliyati, ekologik jarayonlar va inson salomatligi bilan chambarchas bog‘liq bo‘lganligi sababli uni o‘qitishda o‘quvchining bevosita kuzatuvi, amaliy faoliyati va izlanishiga asoslangan yondashuvlardan foydalanish alohida ahamiyat kasb etadi.

Biologiya darslarining mazmuni o‘ziga xos ko‘rgazmalilik va amaliy yo‘nalishga ega. O‘simlik va hayvonlarni kuzatish, biologik jarayonlarni tajriba orqali o‘rganish, tabiiy obyektlarni taqqoslash, ekologik muammolarni tahlil qilish kabi faoliyatlar o‘quvchining nazariy bilimlarini hayotiy tasavvurlar bilan bog‘lash imkonini beradi. Shu sababli dars jarayonini faqat og‘zaki bayon qilish asosida tashkil etish o‘rniga o‘quvchini fikrlashga undaydigan, izlanishga yo‘naltiradigan va amaliy harakatga jalb qiladigan pedagogik texnologiyalardan foydalanish zarur.

Ilg‘or pedagogik texnologiyalar biologiya ta'limining mazmunini o‘quvchiga yetkazish vositasi bo‘lish bilan birga, ta'lim jarayonining ichki tuzilishini ham o‘zgartiradi. Bunda o‘qituvchi ma'lumot beruvchi asosiy manba sifatidagi vazifadan tashqari, o‘quv faoliyatini yo‘naltiruvchi, muammoli vaziyatlarni tashkil etuvchi va o‘quvchilarning mustaqil faoliyatini qo‘llab-quvvatlovchi subyekt sifatida namoyon bo‘ladi. O‘quvchi esa dars mazmunini o‘zlashtirish jarayonida savol qo‘yuvchi, fikr bildiruvchi, dalil izlovchi va xulosa chiqaruvchi faol ishtirokchiga aylanadi.

Biologiya fanini o‘qitishda interfaol metodlar, muammoli ta'lim, loyihaviy faoliyat, hamkorlikda

o‘qitish, axborot-kommunikatsiya texnologiyalari, virtual va raqamli ta’lim vositalaridan foydalanish o‘quv jarayonining turli bosqichlarini mazmunan boyitishi mumkin. Bunday texnologiyalarni qo‘llashda ularning mavjudligi emas, balki biologiya fanining muayyan mavzusi, dars maqsadi va o‘quvchilarning tayyorgarlik darajasiga mosligi asosiy mezon bo‘lishi lozim. To‘g‘ri tanlangan texnologiya o‘quvchiga murakkab biologik tushunchalarni yaxshiroq anglash, sabab-oqibat munosabatlarini ko‘rish va o‘zlashtirilgan bilimlardan foydalanish imkonini beradi.

Mazkur mavzuning dolzarbligi shundaki, biologiya ta’limida ilg‘or pedagogik texnologiyalardan oqilona foydalanish o‘quvchilarning fanga bo‘lgan munosabatini faollashtirish, darsdagi bilish faoliyatini kuchaytirish va nazariy bilimlarni amaliy faoliyat bilan uyg‘unlashtirish uchun keng imkoniyat yaratadi. Shu bilan birga, har bir pedagogik texnologiyaning biologiya darslaridagi imkoniyatlarini aniqlash, ularni maqsadga muvofiq tanlash va darsning mazmuni bilan uyg‘unlashtirish metodik jihatdan muhim masala hisoblanadi. Biologiya fanini o‘qitishda ilg‘or pedagogik texnologiyalardan foydalanish natijasida ta’lim jarayonining samaradorligini oshirish bilan bir qatorda, o‘quvchilarda biologik hodisalarga ilmiy yondashish, kuzatish natijalarini tahlil qilish, mustaqil qaror qabul qilish va o‘z xulosalarini asoslash kabi muhim faoliyatlar rivojlanadi. Shuning uchun zamonaviy pedagogik texnologiyalarni biologiya ta’limining mazmuni va amaliy imkoniyatlari bilan uyg‘un holda qo‘llash bugungi pedagogik jarayonning muhim yo‘nalishlaridan biri sifatida qaraladi.

Tadqiqot metodi. “Biologiya fanini o‘qitishda ilg‘or pedagogik texnologiyalardan foydalanish” mavzusini yoritishda biologiya ta’limining mazmuni, dars jarayonining tashkil etilishi va zamonaviy pedagogik texnologiyalarning o‘quv faoliyatiga ta’sirini aniqlashga yo‘naltirilgan metodlardan foydalanildi. Tadqiqot jarayonida pedagogik kuzatish, suhbat, taqqoslash, tahlil va umumlashtirish, pedagogik tajriba-sinov hamda o‘quvchilarning o‘quv faoliyati natijalarini o‘rganish metodlari qo‘llanildi.

Pedagogik kuzatish orqali biologiya darslarida o‘quvchilarning faolligi, topshiriqlarni bajarish jarayonidagi ishtiroki, mustaqil fikrlashi va guruhdagi hamkorlik faoliyati o‘rganildi. Suhbat metodi yordamida o‘quvchilarning ilg‘or pedagogik texnologiyalar asosida tashkil etilgan mashg‘ulotlarga munosabati hamda biologik mavzularni o‘zlashtirishdagi qiyinchiliklari aniqlandi. Tahlil va taqqoslash asosida an’anaviy hamda zamonaviy yondashuvlardan foydalanilgan darslarning o‘ziga xos jihatlari ko‘rib chiqildi.

Tajriba-sinov jarayonida biologiya darslariga interfaol, muammoli, loyihaviy va raqamli ta’lim elementlari kiritilib, ularning o‘quvchilarning bilimlarni o‘zlashtirishi va amaliy faoliyatiga

ta’siri kuzatildi. Olingan natijalar umumlashtirilib, ilg‘or pedagogik texnologiyalardan foydalanishning biologiya fanini o‘qitishdagi metodik imkoniyatlari aniqlandi.

Tadqiqot natijalari. Biologiya fanini o‘qitishda ilg‘or pedagogik texnologiyalardan foydalanish natijasida ta’lim jarayonini mazmunan boyitish va o‘quvchilarning darsdagi faol ishtirokini ta’minlash imkoniyatlari aniqlandi. Dars mashg‘ulotlarida zamonaviy yondashuvlardan foydalanish o‘quvchilarning biologik tushunchalarni anglash, ularni o‘zaro bog‘lash va o‘rganilgan bilimlardan amaliy vaziyatlarda foydalanish faoliyatini kuchaytirishi kuzatildi.

Interfaol metodlardan foydalanish o‘quvchilarning fikr almashishi, savollarga mustaqil javob izlash va o‘z qarashlarini asoslashiga sharoit yaratdi. Muammoli ta’lim biologik hodisalarning sabablarini izlash va mavjud bilimlar asosida yechim topishga yo‘naltirgan bo‘lsa, loyihaviy faoliyat ma’lumot izlash, uni saralash, qayta ishlash va natijani taqdim etish ko‘nikmalarini rivojlantirishga xizmat qildi. Raqamli ta’lim vositalaridan foydalanish biologik jarayonlarni ko‘rgazmali ifodalash va murakkab mavzularni tushunishni yengillashtirish imkonini berdi.

O‘rganishlar natijasida ilg‘or pedagogik texnologiyalarni biologiya fanining mazmuni, darsning maqsadi va o‘quvchilarning tayyorgarlik darajasiga mos ravishda tanlash muhimligi belgilandi. Texnologiyalarni maqsadli qo‘llash o‘quvchilarda mustaqil ishlash, kuzatish, tahlil qilish, taqqoslash, muammoni hal etish va xulosa chiqarish kabi faoliyatlarni rivojlantirishga yordam berishi aniqlandi.

Umuman, ilg‘or pedagogik texnologiyalardan oqilona foydalanish biologiya darslarida o‘qituvchi va o‘quvchi o‘rtasidagi hamkorlikni kuchaytirish, o‘quv jarayonini faol tashkil etish va biologik bilimlarning amaliy yo‘nalishini oshirish uchun samarali imkoniyat yaratishi ko‘rsatildi.

Xulosa. Biologiya fanini o‘qitishda ilg‘or pedagogik texnologiyalardan foydalanish ta’lim jarayonini zamonaviy talablar asosida tashkil etish, o‘quvchilarning bilish faoliyatini faollashtirish va biologik bilimlarni amaliy faoliyat bilan bog‘lash imkonini beradi. Bunday yondashuv o‘quvchilarning dars jarayonidagi ishtirokini kuchaytirib, ularni mustaqil fikrlash, izlanish va o‘zlashtirilgan bilimlardan foydalanishga yo‘naltiradi.

Biologiya darslarida interfaol, muammoli, loyihaviy va hamkorlikka asoslangan texnologiyalardan foydalanish o‘quvchilarning kuzatish, tahlil qilish, taqqoslash, fikr almashish va xulosa chiqarish ko‘nikmalarini rivojlantirishga xizmat qiladi. Shuningdek, raqamli texnologiyalar va axborot-kommunikatsiya vositalari biologik jarayonlarni ko‘rgazmali yoritish hamda murakkab tushunchalarni osonroq o‘zlashtirish uchun qo‘shimcha imkoniyat yaratadi. Ilg‘or pedagogik texnologiyalarning samaradorligi ularni darsda shunchaki qo‘llash bilan emas, balki ta’lim maqsadi, mavzu mazmuni va o‘quvchilarning imkoniyatlariga mos ravishda tanlash

bilan belgilanadi. Shu sababli o‘qituvchi har bir mavzuning xususiyatidan kelib chiqib, mos metod va vositalarni belgilashi muhimdir.

Xulosa qilib aytganda, biologiya fanini o‘qitishda ilg‘or pedagogik texnologiyalardan maqsadli va izchil foydalanish o‘quvchilarning biologik bilimlarini chuqurlashtirish, amaliy faoliyatini rivojlantirish hamda ta’lim jarayonini faol va mazmunli tashkil etishga xizmat qiladi.

ADABIYOTLAR RO’YXATI

1. Tolipov O‘.Q., Usmonboyeva M. **Pedagogik texnologiyalarning tatbiqiy asoslari.** – Toshkent: Fan, 2006. – 261 b.
2. Tolipova J.O. **Biologiyani o‘qitishda pedagogik texnologiyalar.** – Toshkent: Cho‘lpon nomidagi nashriyot-matbaa ijodiy uyi, 2011. – 160 b.
3. Ishmuhamedov R.J., Abduqodirov A.A., Pardaev A. **Ta’limda innovatsion texnologiyalar: ta’lim muassasalari pedagog-o‘qituvchilari uchun amaliy tavsiyalar.** – Toshkent: Iste’dod jamg‘armasi, 2008. – 180 b.

GUL CHANGI NAMUNALARINI SHAFFOF SMOLADA SAQLASH ORQALI MAKTAB BIOLOGIYA DARSLARINI AMALIY VA INTERAKTIV TASHKIL ETISH

Nodira Hamdullayeva
Samarqand pedagogika instituti talabasi

Annotatsiya. *Ushbu loyiha maktablarda biologiya fanini o‘qitish jarayonida o‘quvchilarning nazariy bilimlarini amaliy kuzatishlar bilan bog‘lashga qaratilgan. Loyiha doirasida turli o‘simliklardan olingan gul changi - polen namunalarini shaffof polimer smola ichida mustahkamlangan holda saqlash va ulardan biologiya darslarida ko‘rgazmali o‘quv materiali sifatida foydalanish taklif etiladi. Gul changi o‘simliklarning ko‘payish jarayonida muhim biologik ahamiyatga ega bo‘lib, uning shakli, o‘lchami va tashqi tuzilishi turli o‘simliklarda farq qilishi mumkin. Oddiy dars sharoitida bunday mikroskopik obyektlarni doimiy ravishda saqlash va namoyish qilish qiyin. Taklif qilinayotgan BIO-POLLEN to‘plami esa gul changi namunalarini uzoq muddat saqlash imkonini beradi. Loyihaning asosiy maqsadi biologiya darslarini ko‘rgazmali, interaktiv va amaliy shaklga yaqinlashtirish hamda o‘quvchilarda ilmiy kuzatuv, taqqoslash va xulosa chiqarish ko‘nikmalarini rivojlantirishdan iborat.*

Kalit so‘zlar: *polen, botanika, mikroskop, ta’lim, chang.*

Abstract. *This project aims to establish a connection between students’ theoretical knowledge and practical observations in the process of teaching biology in schools. The project*

proposes preserving pollen samples collected from different plants in transparent polymer resin and using them as visual educational materials during biology lessons. Pollen plays an important biological role in plant reproduction, while its shape, size, and external structure may vary among different plant species. Under ordinary classroom conditions, it can be difficult to preserve and demonstrate such microscopic objects for a long period of time. The proposed BIO-POLLEN kit makes it possible to preserve pollen samples for long-term use and incorporate them into the educational process. The main goal of the project is to make biology lessons more visual, interactive, and practice-oriented, while developing students' skills in scientific observation, comparison, and drawing conclusions.

Keywords: *pollen, botany, microscope, education, pollination.*

Bugungi kunda biologiya fanini o‘qitishda o‘quvchilarning nazariy bilimlarini amaliy mashg‘ulotlar bilan uyg‘unlashtirish muhim ahamiyat kasb etmoqda. Ayniqsa, o‘simliklarning ko‘payishi va changlanish jarayonlarini o‘rganishda gul changi - polenni bevosita kuzatish o‘quvchilarning mavzuni yaxshiroq tushunishiga yordam beradi. Biroq polen kabi mikroskopik namunalarni uzoq muddat saqlash va dars jarayonida qayta-qayta namoyish etish imkoniyati cheklangan. Shu sababli BIO-POLLEN loyihasida turli o‘simliklarning gul changi namunalarini shaffof polimer smolada saqlash va ulardan biologiya darslarida ko‘rgazmali o‘quv materiali sifatida foydalanish taklif etiladi. Ushbu yondashuv o‘quvchilarning kuzatish, taqqoslash va mustaqil xulosa chiqarish ko‘nikmalarini rivojlantirishga xizmat qiladi.

Tadqiqot davomida gul changi namunalarini yig‘ish, saqlash va biologiya darslarida qo‘llash imkoniyatlari o‘rganildi. Turli o‘simliklardan olingan gul changi namunalari tanlab olinib, quritilgandan so‘ng shaffof polimer smola tarkibida mustahkamlandi. Tayyor namunalar tashqi ko‘rinishi va saqlanish holati bo‘yicha kuzatildi. Tadqiqotda kuzatish, taqqoslash, tajriba-sinov va tahlil metodlaridan foydalanildi. Tayyorlangan BIO-POLLEN namunalaridan biologiya darslarida ko‘rgazmali material sifatida foydalanish imkoniyati o‘rganildi. O‘quvchilarga turli namunalarni kuzatish va taqqoslash asosida topshiriqlar berilib, ularning mavzuni o‘zlashtirish jarayoni tahlil qilindi. Tadqiqot natijalari asosida gul changi namunalarini shaffof smolada saqlash biologiya darslarini ko‘rgazmali va amaliy tashkil etishda qo‘shimcha ta’limiy vosita sifatida qo‘llanishi mumkinligi aniqlandi.

Tadqiqotning asosiy maqsadi turli o‘simliklarning gul changi namunalarini shaffof polimer smolada saqlash va ularni maktab biologiya darslarida ko‘rgazmali ta’lim vositasi sifatida qo‘llash imkoniyatini o‘rganishdan iborat bo‘ldi. Pollenning shakli, o‘lchami va tashqi yuzasi turli o‘simliklarda farqlanishi mikroskopik tadqiqotlarda ham ko‘rsatilganTadqiqot uchun maktab o‘quvchilariga tanish bo‘lgan turli o‘simliklardan gul changi namunalari tanlab olindi. Namunalarni

tanlashda ularning mavjudligi, gul changining ko‘rinishi va dars mavzularida foydalanish imkoniyati hisobga olindi. Mikroskopik tasvirlarda turli o‘simliklarning pollen donachalari shakli va sirt tuzilishi jihatidan bir-biridan farq qilishi ko‘rinadi. Bunday farqlar o‘quvchilarga namunalarni taqqoslash imkonini beradi. Yig‘ilgan gul changi namunalari namlikdan holi holatga keltirilib, shaffof polimer smola uchun tayyorlandi. So‘ng namuna kichik qolipga joylashtirilib, ustidan shaffof smola quyildi. Qotish jarayonidan so‘ng namuna shaffof blok ichida mustahkamlangan holatga keltirildi. Biologik namunalarni polimer material ichida saqlash va mikroskopik tadqiqotlar uchun resin ichiga joylashtirish ilmiy namuna tayyorlash amaliyotlarida ham qo‘llanadi. Mazkur rasm sizning loyihangizning aynan tayyor namunasi emas, balki o‘simlik materialini shaffof smola ichida saqlash qanday ko‘rinishga ega bo‘lishi mumkinligini ko‘rsatuvchi vizual namuna sifatida berilishi mumkin. Qotirilgan namunalar tashqi ko‘rinishi, shaffofligi, gul changining ko‘rinib turishi va saqlanish holati bo‘yicha kuzatildi. Namunalarni bir xil o‘lchamdagi qoliplarda tayyorlash ularni o‘quv kolleksiyasi shaklida tartibga solish imkonini beradi.

Har bir namunaga: o‘simlik nomi, gul changi namunasi, olingan sana, qisqacha biologik ma’lumot, QR-kodjoylashtirish taklif etildi.

Tayyorlangan BIO-POLLEN namunalaridan biologiya fanining “Gulning tuzilishi”, “Changlanish”, “O‘simliklarning ko‘payishi” kabi mavzularini o‘rganishda foydalanish mumkin.

O‘quvchilarga turli namunalar berilib, quyidagi topshiriqlar taklif qilinadi:

1-topshiriq: Namunalarni kuzating.

2-topshiriq: Ularning shakli va tashqi ko‘rinishini taqqoslang.

3-topshiriq: O‘xshash va farqli jihatlarini aniqlang.

4-topshiriq: Kuzatuv asosida xulosa yozish. Shu tariqa o‘quvchi tayyor ma’lumotni faqat o‘qib qolmay, balki: kuzatadi → taqqoslaydi → tahlil qiladi → xulosa chiqaradi.



1-rasm. BIO-POLLEN namunalari.

Tadqiqot natijasida gul changi namunalarini shaffof polimer smolada mustahkamlash ularni ko‘rgazmali ta’lim vositasi sifatida uzoq muddat saqlash imkonini berishi aniqlandi. Tayyorlangan namunalar orqali o‘quvchilarga gul changining real namunasini ko‘rsatish va turli o‘simliklardan olingan namunalarni o‘zaro taqqoslash imkoniyati yaratildi.

Ko‘rsatkich	Tadqiqot natijasi
Namunani saqlash	Shaffof smolada mustahkamlash imkoniyati mavjud
Ko‘rgazmalilik	Namuna tashqi ko‘rinishda saqlanadi
Taqqoslash	Turli o‘simlik pollenlarini bir kolleksiyada taqqoslash mumkin
Ta’limiy ahamiyati	Nazariy bilimni real biologik namuna bilan bog‘laydi
Qayta foydalanish	Namunalardan takroriy darslarda foydalanish mumkin
Rivojlantirish imkoniyati	QR-kod, mikroskopik tasvir va elektron ma’lumotlar bilan boyitish mumkin

Tadqiqotning asosiy natijasi BIO-POLLEN namunalarini bir martalik preparat emas, balki biologiya kabinetida qayta-qayta foydalanish mumkin bo‘lgan o‘quv kolleksiyasi sifatida shakllantirish imkoniyatidir. Mikroskopik pollen tadqiqotlarida ham turli o‘simliklarda donachalar shakli, yuzasi va apertural tuzilishlari farqlanishi ko‘rsatilgan. Shu sababli bunday namunalarni taqqoslash botanika mavzularini amaliy kuzatish bilan bog‘lash uchun qulay material bo‘la oladi.

Xulosa olib borilgan tadqiqot natijalari shuni ko‘rsatdiki, turli o‘simliklarning gul changi namunalarini shaffof polimer smolada saqlash orqali biologiya darslarida uzoq muddat foydalanish mumkin bo‘lgan ko‘rgazmali o‘quv materialini yaratish mumkin. BIO-POLLEN to‘plami o‘quvchilarga gul changini bevosita kuzatish, turli o‘simlik namunalarini taqqoslash va ularning o‘ziga xos xususiyatlarini aniqlash imkonini beradi. Mazkur yondashuv biologiya fanidagi nazariy bilimlarni amaliy kuzatuv bilan bog‘lash, darslarning ko‘rgazmaliligi va interaktivligini oshirish hamda o‘quvchilarda ilmiy kuzatish, tahlil qilish va mustaqil xulosa chiqarish ko‘nikmalarini rivojlantirishga xizmat qiladi. Loyihaning muhim jihati shundaki, tayyorlangan namunalar bir martalik tajriba emas, balki biologiya kabinetida qayta-qayta foydalanish mumkin bo‘lgan ta’limiy resurs sifatida xizmat qiladi. Shuningdek, BIO-POLLEN to‘plamini QR-kodlar, mikroskopik tasvirlar va elektron ma’lumotlar bilan boyitish orqali uning ta’limiy imkoniyatlarini yanada kengaytirish mumkin. Shu sababli ushbu loyiha biologiya ta’limida oddiy, ko‘rgazmali va amaliy vosita sifatida foydalanish uchun istiqbolli yechim hisoblanadi.

FOYDALANILGAN ADABIYOTLAR

1. Halbritter H., Ulrich S., Grímsson F., Weber M., Zetter R., Hesse M. va boshqalar. *Illustrated Pollen Terminology*. Springer, Cham, 2018.
2. Halbritter H., Ulrich S., Grímsson F., Weber M., Zetter R., Hesse M. va boshqalar. *Pollen Morphology and Ultrastructure*. In: *Illustrated Pollen Terminology*. Springer, 2018. 37–65-betlar.
3. Halbritter H., Ulrich S., Grímsson F., Weber M., Zetter R., Hesse M. va boshqalar. *Methods in Palynology*. In: *Illustrated Pollen Terminology*. Springer, 2018. 97–127-betlar.
4. Hesse M., Halbritter H., Zetter R., Weber M., Buchner R., Frosch-Radivo A., Ulrich S. va boshqalar. *Pollen Terminology: An Illustrated Handbook*. Springer-Verlag, Vienna, 2009.
5. Shivanna K.R., Rangaswamy N.S. *Pollen Biology: A Laboratory Manual*. Springer, Berlin, Heidelberg, 1992.
6. Clark M.A., Douglas M., Choi J. *Biology 2e*. OpenStax, 2018. 32-bob: Plant Reproduction.
7. OpenStax. *Pollination and Fertilization*. Biology 2e, Chapter 32.2. O‘simliklarda changlanish va urug‘lanish jarayonlari.
8. OpenStax. *Reproductive Development and Structure*. Biology 2e, Chapter 32.1. O‘simliklarning reproduktiv tuzilishi va gul changining biologik xususiyatlari.

PALINOLOGIYANING FANLARARO BOG‘LIQLIGI VA BIOLOGIK TIZIMLAR MONITORINGIDAGI O‘RNI

Djumayeva Z.U.

Samarqand davlat pedagogika instituti

e-mail: djumayevazamira5@gmail.com

Annotatsiya. *Maqolada palinologiya fanining shakllanish va rivojlanish tarixi, uning tibbiyot, geologiya, arxeologiya, o‘rmonshunoslik va paleookeanologiya kabi fanlar bilan bog‘liqligi yoritilgan. Spora-gulchang tahlilining biologik tizimlar monitoringidagi, xususan, havodagi allergen gulchanglarni kuzatish, o‘simliklar qoplami va iqlim o‘zgarishlarini baholashdagi ahamiyati ochib berilgan. Palinologik bilimlarning ekologik ta’limda fanlararo integratsiya vositasi sifatidagi imkoniyatlari ko‘rsatilgan.*

Kalit so‘zlar: *palinologiya, aeropalinologiya, gulchang, spora, spora-gulchang tahlili, pollinoz, ekologik monitoring, barqaror rivojlanish, ekologik ta’lim.*

Abstract. *The article reviews the history of the formation and development of palynology and its links with medicine, geology, archaeology, forestry and palaeoceanography. The importance of spore-pollen analysis for monitoring biological systems is revealed, in particular for*

tracking allergenic airborne pollen and assessing changes in vegetation cover and climate. The potential of palynological knowledge as a means of interdisciplinary integration in environmental education is shown.

Keywords: *palynology, aeropalynology, pollen, spores, spore-pollen analysis, pollinosis, environmental monitoring, sustainable development, environmental education.*

Barqaror rivojlanish maqsadlari, xususan, aholi salomatligini muhofaza qilish, iqlim o‘zgarishiga qarshi kurashish va quruqlikdagi ekotizimlarni saqlash bilan bog‘liq vazifalarni amalga oshirish biologik tizimlar holatini muntazam kuzatib borishni talab etadi. Mamlakatimizda ham 2030-yilgacha bo‘lgan davrda barqaror rivojlanish sohasidagi milliy maqsad va vazifalarni amalga oshirishni jadallashtirish bo‘yicha qo‘shimcha chora-tadbirlar belgilangan [1]. Bunday monitoringda o‘simliklarning gulchang donalari va sporalari alohida o‘rin tutadi: ular o‘simliklar qoplamining holatini aks ettiruvchi indikator, o‘tmishdagi tabiiy muhitning ishonchli «arxivi» hamda havodagi asosiy aeroallergenlardan biri hisoblanadi.

Palinologiya – o‘simliklarning gulchang donalari va sporalarini, shuningdek, havo, tuproq, torf va cho‘kindi jinslarda ulardan tashkil topgan gulchang-spora spektrlarining tarkibi va shakllanishini o‘rganuvchi zamonaviy biologiya sohasidir [5; 11]. Botanik olimlar bu fan usullaridan havo palinologik spektrining sifat va miqdoriy tarkibini hamda mavsumiy dinamikasini aniqlashda, ayrim o‘simlik turlari gullashining biologik xususiyatlarini o‘rganishda, abiotik omillarning changlanish jarayoniga, gulchang donalarining morfologiyasi va allergenlik xossalariga ta’sirini baholashda keng foydalanadilar. Shu bois ushbu maqolada palinologiyaning rivojlanish tarixi, fanlararo aloqalari hamda biologik tizimlar monitoringi va ekologik ta’limdagi o‘rni tahlil qilinadi.

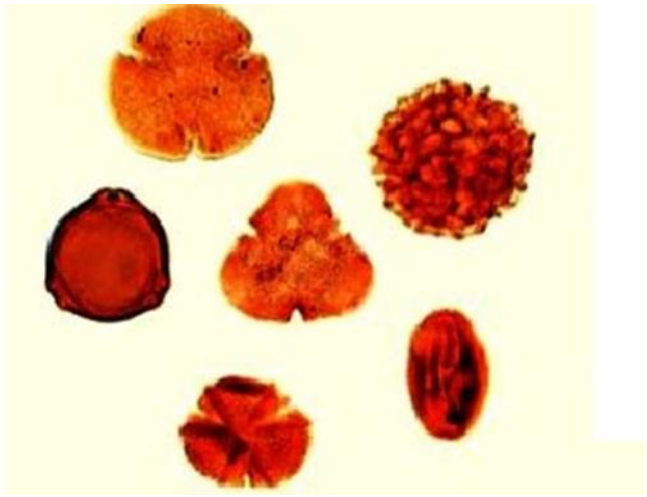
Palinologiya ko‘plab ilmiy fanlar bilan uzviy bog‘langan: u geologiya, arxeologiya, tuproqshunoslik, tibbiyot, o‘rmon tipologiyasi kabi fanlarda keng qo‘llaniladi.

Tibbiyotda palinologiyaning o‘rni alohida ahamiyat kasb etadi. Britaniyalik palinolog H.A. Hyde Yevropada pichan isitmasi (pollinoz) boshoqdoshlar (Poaceae) va ayrim daraxtlarning, shuningdek, ba’zi begona o‘tlarning gulchanglari ta’sirida kelib chiqishini aniqlagan. Bunday o‘simliklar qatoriga daraxtlardan qayin, eman, terak, qarag‘ay, archa va chinor, o‘t o‘simliklardan esa makkajo‘xori, javdar, sholi, bug‘doy va tariq kiradi. Begona o‘tlardan shuvoq (Artemisia), ambroziya (Ambrosia) va sho‘radoshlar (Chenopodiaceae) gulchanglari ham kuchli allergenlik xususiyatiga ega [7]. So‘nggi yillarda aeroallergenlar keltirib chiqaradigan kasalliklarning keng tarqalishi palinologiyaning tibbiyotdagi ahamiyatini yanada oshirdi. Gulchang donalari tarkibida

o‘ziga xos oqsillar – allergenlar mavjudligi sababli ular odamlar va hayvonlarda allergik kasalliklarni keltirib chiqarishi mumkin.

Allergik kasalliklarning ko‘payishi urbanizatsiya va zamonaviy turmush tarzi bilan bog‘liq. Sintetik dori vositalari va kimyoviy moddalarning kundalik hayotga keng kirib kelishi, inson yashash muhiti – havo, suv va tuproqning ifloslanishi, shuningdek, organizmning fiziologik imkoniyatlari bilan hayot va ishlab chiqarish jarayonlarining tobora tezlashib borayotgan sur’ati o‘rtasidagi nomuvofiqlik tufayli yuzaga keladigan asabiy zo‘riqish bunda muhim rol o‘ynaydi. Havoning avtotransport va sanoat chiqindilari bilan ifloslanishi gulchang allergenlarining ta’sirini kuchaytiradi, iqlimning isishi esa changlanish mavsumini uzaytirib, havodagi gulchang miqdorini oshirmoqda [7; 13]. Shuni ta’kidlash kerakki, allergik kasalliklarni barcha o‘simliklarning gulchanglari emas, balki faqat ma’lum xususiyatlarga ega gulchanglar – shamol yordamida changlanuvchi o‘simliklarda ko‘p miqdorda hosil bo‘ladigan, havoda uzoq masofalarga tarqaladigan va allergen oqsillarga boy gulchanglar keltirib chiqaradi [7].

Spora-gulchang tahlili foydali qazilmalar geologiyasida, neft va gaz geologiyasida, gidrogeologiyada, torf konlari geologiyasida keng qo‘llanilib kelinmoqda. Ko‘mir konlarining spora-gulchang komplekslarini o‘rganish ularning yoshi va geologik tuzilishini aniqlash, ko‘mir qatlamlarini o‘zaro taqqoslash (korrelyatsiya qilish) va zaxiralarini baholashga yordam beradi. Palinologik ma’lumotlar asosida ko‘plab yirik ko‘mir havzalarining toshko‘mir va perm davrlarida shakllangani asoslangan. Gulchang va spora tahlili paleozoy hamda mezozoy-kaynozoy eralarida hosil bo‘lgan neft va gaz qatlamlarining yosh diapazonini aniqlashda, mintaqaviy va umumiy stratigrafik sxemalarni hamda ularning o‘zaro bog‘liqligini asoslashda muhim ahamiyat kasb etadi [5; 12]. Bunda qazilma holdagi gulchang va sporalarning morfologik xususiyatlari asosiy diagnostik belgi bo‘lib xizmat qiladi (1-rasm).



1-rasm. Qazilma gulchanglar va o‘simlik sporalari

Torf konlari geologiyasini o‘rganishda spora-gulchang tahlilining roli juda katta. Torf botqoqlarining kelib chiqishi va yoshi turli botqoqlardan olingan kesmalarning gulchang diagrammalari asosida aniqlanadi. Palinologik ma’lumotlar o‘simliklar qoplamidagi o‘zgarishlarni kuzatishga, turli kesmalarni o‘zaro taqqoslash orqali esa iqlim o‘zgarishi bosqichlarini aniqlashga imkon beradi [3; 4; 5].

Arxeologiyada spora-gulchang tahlili muhim rol o‘ynaydi. U nafaqat qadimgi manzilgohlarning mavjud bo‘lgan davrini aniqlash, balki ajdodlarimiz yashagan hududlarning tabiiy muhitini – landshafti va o‘simliklar qoplamini tiklash imkonini ham beradi [2]. Spora va gulchang tadqiqotlari o‘rmon xo‘jaligiga ham katta foyda keltiradi; bu, ayniqsa, o‘simlik jamoalarini hisobga olgan holda o‘rmon tiplarining tabiiy tasnifini ishlab chiqishda muhimdir. Bu haqda S.I. Korjinskiy shunday yozgan edi: «O‘simliklarning tarixdan oldingi sharoitlariga oid barcha faktlar katta qiziqish bilan to‘planadi, chunki olimlar o‘simliklar dunyosining hozirgi hodisalarini tushunish kalitini aynan ulardan izlashlari lozim». Paleookeanologiyada spora va gulchang tahlilidan foydalanish okean va dengizlarning tub cho‘kindilarini o‘rganuvchi olimlarning ishini ham sezilarli darajada osonlashtiradi [12].

Hozirgi kunda palinologiyaning ekologik monitoring bilan bevosita bog‘liq yo‘nalishi – aeropalinologiya jadal rivojlanmoqda. Dunyoning ko‘plab mamlakatlarida havodagi gulchang va sporalar Hirst prinsipi asosida ishlaydigan hajmiy tutqichlar yordamida muntazam kuzatib boriladi: bu usul 600 dan ortiq monitoring stansiyasida qo‘llaniladi va Yevropa standarti sifatida qabul qilingan [6; 8; 10]. Kuzatuv sifatini ta’minlash uchun namuna olish, preparat tayyorlash va gulchanglarni hisoblashga qo‘yiladigan minimal talablar ishlab chiqilgan [9]. Monitoring natijalari

asosida gulchang kalendarlari tuziladi, allergen o‘simliklarning changlanish mavsumi bashorat qilinadi, pollinoz bilan og‘rigan bemorlar, shifokorlar va aholi o‘z vaqtida ogohlantiriladi.

Aeropalinologik ma’lumotlar biologik tizimlardagi o‘zgarishlarning sezgir indikatori hisoblanadi. Shimoliy yarimsharning uch qit’asidagi 17 ta stansiyada olib borilgan uzoq muddatli kuzatuvlar natijalariga ko‘ra, stansiyalarning 71 foizida havodagi gulchang miqdori sezilarli ortgan, 65 foizida esa changlanish mavsumi uzaygan; bu o‘zgarishlar havo haroratining ko‘tarilishi bilan bog‘liq ekani aniqlangan [13]. Gulchang spektrlari tarkibidagi o‘zgarishlar orqali shahar ko‘kalamzorlashtirishda allergen turlarning ulushini, ambroziya kabi invaziv begona o‘tlarning tarqalishini va o‘simliklar qoplamining antropogen o‘zgarishlarini baholash mumkin. Tuproq, ko‘l va torf yotqiziqlaridagi spora-gulchang spektrlari esa o‘simliklar qoplamining tabiiy holati haqida uzoq muddatli ma’lumot beradi [5; 11] va buzilgan ekotizimlarni qayta tiklashda tabiiy andoza vazifasini o‘taydi. Samarqand viloyati sharoitida ham havodagi gulchanglar tarkibi va ularning mavsumiy dinamikasini o‘rganishga qaratilgan aeropalinologik tadqiqotlar olib borilmoqda.

Palinologiya biologiya ta’limida fanlararo integratsiyani amalga oshirish uchun qulay vosita hisoblanadi: bitta mavzu doirasida botanika, ekologiya, geologiya, geografiya, tibbiyot va arxeologiya bilimlari uyg‘unlashadi. Talabalar havodagi gulchanglarni gravimetrik usulda (yopishqoq modda surtilgan buyum oynalarida) yig‘ish, ularni mikroskopda aniqlash, mahalliy flora turlarining etalon gulchang preparatlari kolleksiyasini yaratish va gulchang kalendarini tuzish kabi amaliy-tadqiqot ishlarini bajarish orqali ekologik monitoring ko‘nikmalarini egallaydilar. Bunday mashg‘ulotlar talabalarda tadqiqotchilik kompetensiyasini hamda atrof-muhit holati va inson salomatligi o‘rtasidagi bog‘liqlikni anglash qobiliyatini shakllantiradi. Samarqand davlat pedagogika institutida 2026/2027-o‘quv yilidan boshlab magistratura talabalari uchun «Aerobiologiya» fanining o‘qitilishi yo‘lga qo‘yilayotgani ham shu ehtiyojga javobdir.

Xulosa qilib aytganda, spora va gulchang tahlili eng xilma-xil fanlar bilan chambarchas bog‘liq. O‘simliklarning qazilma holdagi juda kichik qoldiqlari uzoq geologik davrlarning guvohi sifatida botaniklar, geolog-qidiruvchilar, quruvchilar, arxeologlar, okeanologlar va o‘rmonchilarga katta yordam berishi mumkin. Bugungi kunda palinologiya biologik tizimlar monitoringining ham muhim vositasiga aylanmoqda: havodagi gulchanglarni muntazam kuzatish aholi salomatligini muhofaza qilish, iqlim o‘zgarishining ekotizimlarga ta’sirini baholash va o‘simliklar qoplamini barqaror boshqarish uchun ilmiy asos bo‘lib xizmat qiladi. Shu sababli hududlarda aeropalinologik monitoring tizimini rivojlantirish, uning natijalarini aholi va sog‘liqni saqlash muassasalariga yetkazish hamda palinologiya asoslarini biologiya va ekologiya ta’limiga kengroq joriy etish maqsadga muvofiq. Spora va gulchang tahlilidan foydalanish hali ko‘plab yangi kashfiyotlarga yo‘l ochishi shubhasiz.

FOYDALANILGAN ADABIYOTLAR

1. O‘zbekiston Respublikasi Vazirlar Mahkamasining 2022-yil 21-fevraldagi «2030-yilgacha bo‘lgan davrda barqaror rivojlanish sohasidagi milliy maqsad va vazifalarni amalga oshirishni jadallashtirish bo‘yicha qo‘shimcha chora-tadbirlar to‘g‘risida»gi 83-son qarori // Qonunchilik ma’lumotlari milliy bazasi. – URL: https://lex.uz/uz/docs/-5870397

2. Алешинская А.С., Спиридонова Е.А. Особенности природной среды Волго-Окского междуречья в железном веке и средневековье // Отчёт лаборатории естественнонаучных методов Института археологии РАН. – М., 2001. – Архив ИА РАН.

3. Болиховская Н.С. Эволюция лёссово-почвенной формации Северной Евразии. – М.: Изд-во МГУ, 1995. – 270 с.

4. Гричук В.П. Опыт реконструкции некоторых элементов климата Северного полушария в атлантический период голоцена // Голоцен: к VIII Конгрессу INQUA (Париж, 1969). – М.: Наука, 1969. – С. 41–57.

5. Сладков А.Н. Введение в спорово-пыльцевой анализ. – М.: Наука, 1967. – 270 с.

6. Buters J.T.M., Antunes C., Galveias A. et al. Pollen and spore monitoring in the world // Clinical and Translational Allergy. – 2018. – Vol. 8. – Art. 9. – DOI: 10.1186/s13601-018-0197-8.

7. D’Amato G., Cecchi L., Bonini S. et al. Allergenic pollen and pollen allergy in Europe // Allergy. – 2007. – Vol. 62, № 9. – P. 976–990. – DOI: 10.1111/j.1398-9995.2007.01393.x.

8. EN 16868:2019. Ambient air – Sampling and analysis of airborne pollen grains and fungal spores for networks related to allergy – Volumetric Hirst method. – Brussels: CEN, 2019.

9. Galán C., Smith M., Thibaudon M. et al. Pollen monitoring: minimum requirements and reproducibility of analysis // Aerobiologia. – 2014. – Vol. 30, № 4. – P. 385–395. – DOI: 10.1007/s10453-014-9335-5.

10. Hirst J.M. An automatic volumetric spore trap // Annals of Applied Biology. – 1952. – Vol. 39, № 2. – P. 257–265. – DOI: 10.1111/j.1744-7348.1952.tb00904.x.

11. Moore P.D., Webb J.A., Collinson M.E. Pollen analysis. – 2nd ed. – Oxford: Blackwell Scientific Publications, 1991. – 216 p.

12. Traverse A. Paleopalynology. – 2nd ed. – Dordrecht: Springer, 2007. – 814 p. – (Topics in Geobiology; Vol. 28).

13. Ziska L.H., Makra L., Harry S.K. et al. Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis // The Lancet Planetary Health. – 2019. – Vol. 3, № 3. – P. e124–e131. – DOI: 10.1016/S2542-5196(19)30015-4.

TALABALARDA YURAK-QON TOMIR TIZIMI FUNKSIONAL KO‘RSATKICHLARINI KOMPLEKS TAHLIL QILISH VA ULARNI O‘QITISHNING INNOVATSION METODIKASI

Elmirzayeva Sabohat Begmat qizi

Samarqand Davlat Pedagogika instutiti magistranti

E-mail:sabohatelmirzayeva4@gmail

Annotatsiya. *Mazkur tezisda talabalarda yurak-qon tomir tizimining funksional holatini ifodalovchi fiziologik ko‘rsatkichlarni kompleks baholash, ularning jismoniy yuklamaga nisbatan adaptiv reaksiyalarini aniqlash hamda olingan natijalarni ta’lim jarayoniga integratsiyalash masalalari ilmiy-metodik jihatdan yoritilgan. Yurak urish chastotasi, arterial qon bosimi, yurak ritmining tiklanish dinamikasi va yurak-qon tomir tizimining funksional imkoniyatlarini baholashga qaratilgan yondashuvlar tahlil qilingan. Shuningdek, muammoli ta’lim, tadqiqotga yo‘naltirilgan o‘qitish, raqamli monitoring, matematik-statistik tahlil va kompetensiyaviy yondashuv asosida talabalarning fiziologik savodxonligini rivojlantirish imkoniyatlari asoslab berilgan.*

Kalit so‘zlar: *yurak-qon tomir tizimi, funksional ko‘rsatkichlar, yurak qisqarishlari chastotasi, arterial qon bosimi, fiziologik moslashuv, jismoniy yuklama, yurak ritmi variabelligi, pedagogik texnologiyalar, raqamli monitoring, matematik-statistik tahlil, kompetensiyaviy yondashuv.*

Abstract. *This thesis examines the comprehensive assessment of functional indicators of the cardiovascular system in university students, the analysis of their adaptive responses to physical exercise, and the integration of the obtained results into the educational process. It discusses approaches to evaluating heart rate, arterial blood pressure, heart rate recovery dynamics, and functional capacity of the cardiovascular system. Furthermore, the study explores opportunities to improve students’ physiological literacy through innovative pedagogical technologies, including problem-based learning, research-oriented instruction, digital monitoring, mathematical and statistical analysis, and a competency-based approach. The proposed methodological framework aims to develop students’ analytical thinking, practical research skills, and ability to interpret physiological data scientifically. The integration of theoretical knowledge with practical measurements and digital analytical tools may contribute to improving the effectiveness of physiology education and fostering a responsible attitude toward physical activity and health promotion.*

Keywords: *Cardiovascular system, functional indicators, heart rate, arterial blood pressure, physiological adaptation, physical exercise, heart rate variability, pedagogical technologies, digital monitoring, mathematical and statistical analysis, competency-based approach.*

Kirish: Tadqiqotning nazariy asosini yurak-qon tomir tizimi fiziologiyasi, organizmning funksional adaptatsiyasi, fiziologik gomeostaz, kompetensiyaviy ta’lim va tadqiqotga yo‘naltirilgan pedagogik yondashuvlar tashkil etadi. Yurak-qon tomir tizimining funksional holatini baholashda yurak urish chastotasi (YuCh), sistolik va diastolik arterial qon bosimi, jismoniy yuklamadan keyingi tiklanish sur’ati hamda mavjud sharoitlarda yurak ritmi variabelligi (YRV) kabi ko‘rsatkichlardan foydalanish mumkin. Biroq ushbu ko‘rsatkichlarning har biri turli fiziologik mexanizmlarni ifodalashi sababli, ularni izohlashda o‘lchash sharoiti, jismoniy tayyorgarlik darajasi, yosh, ruhiy zo‘riqish, uyqu sifati va boshqa omillar hisobga olinishi lozim.Yurak urish chastotasi yurakning vaqt birligidagi qisqarishlar sonini ifodalasa, arterial qon bosimi qon tomirlar tizimidagi gemodinamik holatni ko’rsatadi. Yurak ritmi variabelligi esa ketma-ket yurak sikllari oralig‘idagi o‘zgarishlarni aks ettiradi va tegishli metodika asosida avtonom nerv tizimi faoliyatining ayrim jihatlarini o‘rganishga yordam beradi.Shu nuqtayi nazardan, yurak-qon tomir tizimining funksional holatini o‘qitishda tizimli-funksional, individual-differensial, kompetensiyaviy va dalillarga asoslangan ta’lim yondashuvlarini o‘zaro uyg‘unlashtirish maqsadga muvofiq.[1; 16-b]

Zamonaviy oliy ta’lim tizimida talabalarning jismoniy salomatligi, funksional imkoniyatlari va fiziologik jarayonlar to‘g‘risidagi bilimlarini rivojlantirish biologiya, odam fiziologiyasi, sport fiziologiyasi hamda jismoniy tarbiya nazariyasining o‘zaro integratsiyasini talab etadi. Ayniqsa, yurak-qon tomir tizimining funksional holatini o‘rganish organizmning ichki muhit barqarorligini ta’minlash, gemodinamik jarayonlarning o‘ziga xos xususiyatlarini tushunish va jismoniy yuklamaga moslashish mexanizmlarini izohlashda muhim ilmiy-amaliy ahamiyat kasb etadi.Yurak-qon tomir tizimi faoliyati yurak urish chastotasi, arterial qon bosimi, yurak ritmining o‘zgaruvchanligi, periferik qon aylanishi va jismoniy yuklamadan keyingi tiklanish jarayonlari orqali tavsiflanadi. Ushbu ko‘rsatkichlar o‘zaro funksional bog‘liqlikka ega bo‘lib, ularni alohida emas, balki kompleks ravishda o‘rganish organizmning fiziologik javob reaksiyalarini chuqurroq tushunish imkonini beradi.[2; 34-b]. Talabalarga mazkur jarayonlarni o‘rgatishda faqat nazariy ma’lumotlarni bayon qilish bilan cheklanib qolmasdan, kuzatish, tajriba, o‘lchash, taqqoslash, statistik tahlil va ilmiy xulosa chiqarish bosqichlarini birlashtirgan metodik tizimdan foydalanish zarur. Bunday yondashuv talabalarning reproduktiv bilim olish faoliyatidan tadqiqotchilik, tahliliy fikrlash va mustaqil qaror qabul qilishga yo‘naltirilgan faoliyatga o‘tishini ta’minlaydi. Fiziologik ko‘rsatkichlarni tahlil qilish jarayoni bir-biri bilan uzviy bog‘langan besh bosqichda tashkil etilishi

mumkin. **Birinchi bosqich — boshlang‘ich funksional holatni aniqlash.** Talabalar belgilangan muddat davomida tinch holatda bo‘lgach, yurak urish chastotasi va arterial qon bosimini o‘lchash tartibini o‘zlashtiradi. O‘lchovlarni imkon qadar bir xil sharoitda bajarish, tana holati va o‘lchash vaqtini qayd etish natijalarning taqqoslanuvchanligini oshiradi.**Ikkinchi bosqich — standartlashtirilgan jismoniy yuklamaga javob reaksiyasini kuzatish.** Sog‘liq holati va jismoniy tayyorgarlik darajasiga mos, xavfsiz yuklama qo‘llanadi. Yuklamadan oldingi va keyingi yurak urish chastotasi qayd etilib, organizmning fiziologik javob reaksiyasi tavsiflanadi. Jismoniy yuklama o‘qituvchi nazoratida va zarur xavfsizlik shartlariga rioya etilgan holda tashkil etilishi kerak.**Uchinchi bosqich — tiklanish dinamikasini baholash.** Yuklama tugagandan keyin belgilangan vaqt oralig‘ida yurak urish chastotasi takroriy o‘lchanadi. Ko‘rsatkichning boshlang‘ich qiymatga qaytish dinamikasi organizmning tiklanish jarayonini tavsiflashga yordam beradi. Bunda yagona universal me’yor o‘rniga yuklama xususiyati, kuzatuv vaqti va individual farqlar hisobga olinadi.**To‘rtinchi bosqich — ma’lumotlarni matematik-statistik tahlil qilish.[3;78-b].** Olingan natijalar elektron jadvalga kiritilib, o‘rtacha qiymat, standart og‘ish, mutlaq o‘zgarish va zarur hollarda foizli o‘zgarish aniqlanadi. Guruh ko‘rsatkichlarini taqqoslashda ma’lumotlarning taqsimoti va tadqiqot dizayniga mos statistik usullar tanlanadi.**Beshinchi bosqichda va pedagogik xulosalarni shakllantirish.** Talabalar aniqlangan o‘zgarishlarni fiziologik qonuniyatlar bilan izohlaydi, natijalarning cheklovlarini belgilaydi va olingan bilimlarni sog‘lom turmush tarzi hamda jismoniy faollikni rejalashtirish masalalari bilan bog‘laydi.Yurak-qon tomir tizimi ko‘rsatkichlarini o‘qitishning innovatsion metodik modeli. Mazkur mavzuni o‘qitish jarayonida nazariy bilim, amaliy kuzatish, raqamli tahlil va refleksiv baholashni birlashtiruvchi to‘rt komponentli metodik modeldan foydalanish taklif etiladi[.4;108-b].Birinchi komponent — **kognitiv komponent**. Ushbu bosqichda talabalar yurak faoliyati, qon aylanishi, gemodinamika, arterial qon bosimi va fiziologik adaptatsiyaning asosiy mexanizmlarini o‘zlashtiriladi.Ikkinchi komponent — **operatsion-amaliy komponent**. Talabalar pulsni aniqlash, arterial qon bosimini o‘lchash, natijalarni qayd etish va o‘lchashdagi xatoliklarni kamaytirish ko‘nikmalari egallanadi.Uchinchi komponent — **analitik-tadqiqot komponenti**. Talabalar yig‘ilgan ma’lumotlarni elektron jadvallar va grafiklar yordamida tahlil qilindi, guruhlararo farqlarni aniqlanadi va fiziologik qonuniyatlar asosida izohlanadi.To‘rtinchi komponent — **refleksiv-baholash komponenti**. Talabalar o‘z faoliyatini baholaydi, xulosalarning ishonchliligini muhokama qiladi, ma’lumotlarni talqin qilishdagi cheklovlarni aniqlanadi va bilimlarini amaliy vaziyatlarga tatbiq etiladi. Mazkur modelda muammoli ta’lim, kichik guruhlarda ishlash, keys-stadi, laboratoriya tajribasi, raqamli vizualizatsiya va loyiha asosida o‘qitish usullarini uyg‘unlashtirish mumkin. Masalan, “Bir xil jismoniy yuklama nima sababdan turli talabalarda yurak urish chastotasining turlicha o‘zgarishiga

olib keladi?” degan muammoli savol asosida talabalar individual farqlar, jismoniy tayyorgarlik, stress va tiklanish omillarini tahlil qilinadi.[5;189-b].

Xulosa.

Xulosa qilib aytganda, talabalarda yurak-qon tomir tizimining funksional ko’rsatkichlarini kompleks tahlil qilish va uni o’qitishning innovatsion metodikasini takomillashtirish biologiya ta’limining muhim yo’nalishlaridan biri hisoblanadi.

FOYDALANILGAN ADABIYOTLAR:

Hall J. E., Hall M. E. *Guyton and Hall Textbook of Medical Physiology*. Elsevier.

1. Barrett K. E. va boshqalar. *Ganong’s Review of Medical Physiology*. McGraw Hill.
2. World Health Organization. *WHO Guidelines on Physical Activity and Sedentary Behaviour*. Geneva: WHO, 2020.
3. Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart Rate Variability: Standards of Measurement, Physiological Interpretation, and Clinical Use. *Circulation*. 1996;93(5):1043–1065.
4. American Heart Association. Arterial blood pressure measurement and cardiovascular health bo‘yicha ilmiy-uslubiy materiallar.

ISSIQXONA SHAROITIDAGI SABZI VA UNING RIZOSFERASI NEMATODALARI JAMOASINING TAKSONOMIK TAHLILI

G’ofirjonova G.G’.[1], Narzullayev S.B.[2]

[1] Samarqand davlat universiteti magistranti

Email:gulnozagofurjonova75@gmail.com

[2] Samarqand davlat universiteti dotsenti

Annotatsiya. *Ushbu ilmiy tadqiqot Samarqand viloyati Paxtachi tumani issiqxonalarida parvarishlanadigan sabzida uchraydigan fitonematodalarni o‘rganishga qaratildi. Tadqiqotlar davomida sabzi o’simligi va uning rizosferasi bilan bog’liq 32 tur aniqlanib ularning taksonomik tahlili o’tkazildi.*

Kalit so’zlar: *fitonematoda, rizosfera, taksanomiya, Paxtachi, agroekotizim.*

Kirish. O‘zbekistonning turli hududlarida ochiq agrotsenozlarda yetishtiriladigan sabzavot va poliz ekinlarining fitonematodalar bilan zararlanishi hamda ular bilan bog‘liq fauna tarkibini o‘rganishga doir ilmiy izlanishlar amalga oshirilgan. Biroq yilning har bir mavsumi davomida aholining yangi sabzavot-poliz mahsulotlariga bo‘lgan ehtiyojini uzluksiz ta’minlash masalasi

ushbu ekinlarni himoyalangan tuproq, ya’ni issiqxona sharoitida yetishtirish hajmini oshirishni taqozo etmoqda. Bunday agroekotizimlarda o‘simliklarning o‘sishi va rivojlanishiga turli omillar, jumladan, kasallik qo‘zg‘atuvchilari, zararkunanda organizmlar hamda o‘simlik to‘qimalari va ildiz tizimida parazitlik qiluvchi nematodalar sezilarli ta’sir ko‘rsatishi mumkin.

Ayni paytda issiqxonalarda yetishtiriladigan sabzavot ekinlari orasida uchraydigan fitoparazit nematodalarning xilma-xilligi, ularning alohida turlarining tarqalish darajasi, iqtisodiy jihatdan xavfli vakillarining ekinlarga ta’siri va yetkazadigan zarari masalalari yetarli darajada tizimli o‘rganilmagan. Ayniqsa, muayyan hudud va issiqxona agroekotizimi sharoitida nematodalar faunasining shakllanishi hamda ularning ekologik xususiyatlarini aniqlash bo‘yicha tadqiqotlarni kengaytirish zarurati mavjud.

Shu nuqtayi nazardan, 2025–2026-yillar davomida Samarqand viloyati Paxtachi tumanidagi ba’zi fermer xo‘jaliklariga qarashli issiqxonalarda yetishtirilayotgan sabzi ekinlari tadqiqot obyekti sifatida tanlab olindi. Tadqiqotlar kuzgi, qishki va qisman erta bahorgi vegetatsiya davrlarini qamrab olib, ushbu davrlarda sabzi agrotsenozida shakllanuvchi parazit fitonematodalar majmuasini aniqlashga yo‘naltirildi. Shuningdek, sabzi ekiniga zarar yetkazuvchi nematoda turlarining o‘rganish, ularning ekin bilan munosabatlarini baholash hamda zararli organizmlarning oldini olishga qaratilgan profilaktik chora-tadbirlarni ishlab chiqish tadqiqotning muhim vazifalari sifatida belgilandi.

Tadqiqotning dastlabki bosqichida esa Paxtachi tumani issiqxonalarida yetishtirilayotgan sabzi ekini bilan bog‘liq fitonematodalar majmuasi aniqlanib, uning fauna tarkibini o‘rganishga asosiy e’tibor qaratildi.

Shu vaqtgacha mamlakatimizda sabzavot va poliz ekinlari bilan bog‘liq nematodalar tarkibini aniqlash hamda ularning biologik xususiyatlarini o‘rganish bo‘yicha bir qator ilmiy izlanishlar olib borilgan [2, 3, 4]. Biroq ushbu yo‘nalishdagi tadqiqotlarning asosiy qismi ochiq maydonlarda yetishtiriladigan ekinlarga qaratilgan bo‘lib, issiqxona sharoitida o‘stiriladigan sabzavot-poliz ekinlarining nematodalar majmuasini o‘rganish masalasi nisbatan kam tadqiq etilgan.

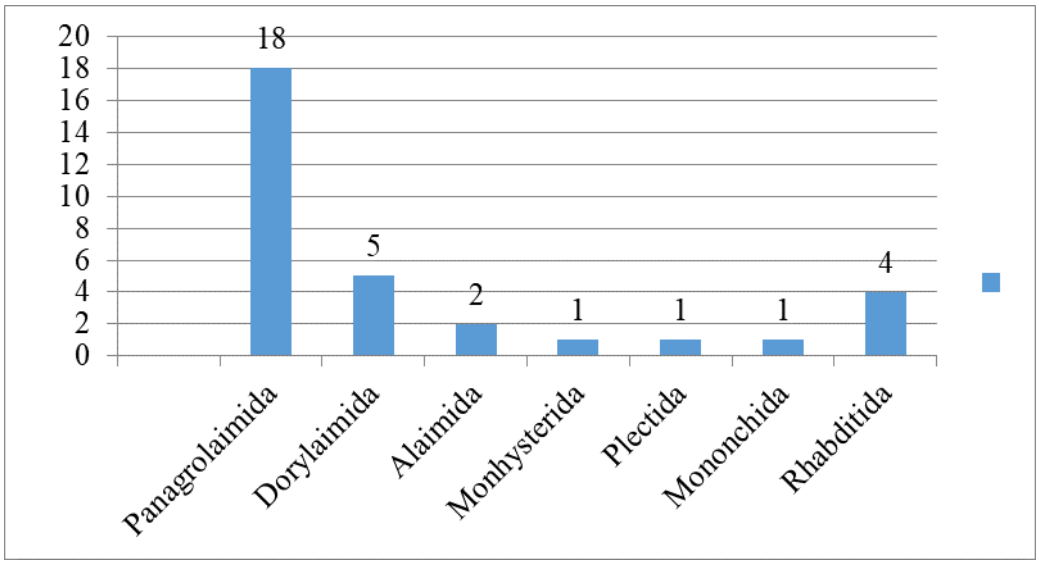
Mazkur muammo Samarqand viloyati aynan, Paxtachi tumanida ham mavjuddir. Ayniqsa, parazit fitonematodalar tarkibi va ularning tarqalishi haqida mavjud ilmiy ma’lumotlar hozircha yetarli emas. Shu sababli ushbu hududda issiqxona sharoitida uchraydigan parazit nematodalarni aniqlash, ularning miqdoriy ko‘rsatkichlarini baholash va zararli turlarni cheklash usullarini ishlab chiqish muhim ilmiy-amaliy ahamiyatga ega. Mazkur tadqiqotlar natijasida aniqlangan ma’lumotlar kelgusida fitonematodalarning zararli turlariga qarshi biologik kurash choralarini takomillashtirish va samarali himoya tadbirlarini tashkil etish uchun ilmiy asos bo‘lib xizmat qilishi mumkin.

Tadqiqot materiallari 2025–2026-yillarda Samarqand viloyati Paxtachi tumani Go‘ro‘g‘li mahallasida faoliyat yuritayotgan issiqxona xo‘jaliklaridan yig‘ib olindi. Nematodalarni aniqlash maqsadida issiqxonalarning uchta sabzi seksiyasi tadqiqot uchun ajratildi. Har bir seksiyada 10 ta namuna olish nuqtasi belgilandi. Ushbu nuqtalardan sabzining yer ustki vegetativ qismlari, ildiz tizimi va ildiz atrofidagi tuproqdan namunalar yig‘ildi. Rizosfera tuprog‘i esa chuqurligiga ko‘ra 0–10 sm hamda 10–20 sm qatlamlarga ajratilgan holda alohida olindi.

Material yig’ish jarayonida jami 120 ta namuna olindi. Shundan 60 tasi sabzining yer ustki vegetativ organlariga, qolgan 60 tasi esa rizosfera tuprog‘ining 0–10 sm va 10–20 sm chuqurlikdagi qatlamlariga tegishli bo‘ldi. Yig‘ilgan materiallar laboratoriya sharoitida nematodalarni ajratib olish uchun qayta ishlanib, aniqlangan nematodalar keyingi morfologik tadqiqotlar uchun 4–5% li formalin eritmasida fiksatsiya qilindi.

Nematodalar namunalarini mikroskopik jihatdan o‘rganish uchun fiksatsiyalangan materiallardan vaqtinchalik hamda doimiy mikropreparatlar tayyorlandi. Ajratilgan nematodalarning tur tarkibini aniqlashda ularning morfologik va morfometrik belgilariga asoslanildi. Bunda asosiy o‘lchov ko‘rsatkichlarini baholash uchun de Man formulasi [1] qo‘llanildi. Aniqlangan nematoda turlarini taksonomik jihatdan aniqlashda esa tegishli umumiy aniqlagichlar va mavjud adabiyot manbalaridan [5, 6] foydalanildi.

Issiqxona sharoitida sabzi nematoda faunasini aniqlash davomida turlar soni 32 tani tashkil etdi. Ushbu turlar sistematik jihatdan tahlil qilinganda nematodalar sinfining 7 ta turkumiga mansubligi aniqlandi. Lekin, turkumlar o‘z tarkibidagi turlari bilan bir-biridan farq qildi. Jumladan, o‘rganilgan sabzi nematodafaunasida Panagrolaimida turkumi 18 tur, Rhabditida turkumi 4 tur, Alaimida 2 tur, Dorylaimida 5 tur va Monhysterida, Plectida hamda Mononchida turkumlari bittadan turlarga ega bo‘ldi (1-rasm).



1-rasm. Sabzida aniqlangan fitonematodalarning sistematik tahlili

Sabzi agrobiotsenozida aniqlangan nematodalar jamoasining taksonomik tarkibi nisbatan xilma-xil bo‘lib, 32 turga mansub 22 avlod vakillari keltirilgan. Oilalar kesimida Cephalobidae, Dorylaimidae va Rhabditidae guruhlari individlar soni bilan ajralib turadi. Avlodlar orasida *Eudorylaimus* eng ko‘p individ va tur bilan ifodalangan guruh hisoblanadi. Shuningdek, *Heterocephalobus, Rhabditis, Aphelenchoides* va *Ditylenchus* avlodlari ham jamoa tarkibida muhim o‘rin egallaydi. Tarkibda o‘simlik bilan bog‘liq nematodalar va erkin yashovchi tuproq nematodalarining birgalikda uchrashi sabzi agrotsenozidagi trofik munosabatlarning murakkabligini ko‘rsatadi.



2-rasm. Bo’rtma nematodasi bilan zararlangan sabzi ildizmevalari (orig.)

Ayniqsa, *Ditylenchus, Pratylenchus* va *Helicotylenchus* avlodlariga mansub turlarni o‘simlik salomatligi nuqtayi nazaridan alohida o‘rganish maqsadga muvofiq. Tadqiqot natijalarining muhim amaliy jihatlaridan biri sifatida sabzi o’simligining xavfli bo’rtma nematodalari bilan kuchli darajada zararlanganligini qayd etish joiz (2-rasm). Kelgusida olib boriladigan tadqiqotlarda sabzi o’simligi nematodafaunasini nafaqat taksonomik jihatdan balki, trofo-ekologik xususiyatlariga ko’ra tahlil qilish parazit turlarning tarqalish darajasini aniqlash, ularni monitoring qilish va qarshi kurash hamda profilaktik tadbirlarni ishlab chiqishga imkon beradi.

FOYDALANILGAN ADABIYOTLAR

1. Man J.G. de. Nouvelles researches sur les nematodes libres terricoles de la Hollande Capital Zool. 1(1) 1921, p. 1-62.
2. Кирьянова Е.С., Кралль Э.Л., 1971. Паразитические нематоды растений и меры борьбы с ними. - Ленинград: Наука. - Т.II. – 522 с.
3. Мавлонов О. М. 1969. "Борьба с галловыми нематодами в теплицах и парниках" сельское хозяйства. Узбекистан №1 стр. 46-47

4. Мавлонов О.М., Эшова Х.С. Биоценотические взаимоотношения фитонематод с культурными растениями. Зоологиянинг долзарб муаммолари. Республика илмий-амалий конф. материаллари. ЎзМУ нашр, Тошкент, 2008. 70-73 бет.
5. Парамонов А.А. Основы фитогельминтологии. т. I Изд. Ан СССР, Москва, 1962. Стр. 3-474
6. Парамонов А.А. Основы фитогельминтологии. Том I. Москва, 1964. Изд. АН СССР.

BO'LAJAK TABIIY FANLAR O'QITUVCHILARINING KASBIY KOMPETENTLIGINI SHAKLLANTIRISHDA INNOVATSION TEXNOLOGIYALARNING O'RNI VA AHAMIYATI

Karimova Jasmina G'anijonovna

Jizzax davlat pedagogika universiteti Tabiiy fanlar pedagogika Oliy maktabi talabasi

Annotatsiya. *Ushbu maqolada bo'lajak tabiiy fanlar o'qituvchilarining kasbiy kompetentligini rivojlantirishda zamonaviy innovatsion texnologiyalardan foydalanishning pedagogik asoslari, usullari va ahamiyati yoritilgan. Ta'lim tizimini raqamlashtirish sharoitida talabalarning mustaqil fikrlash, muammoli vaziyatlarni hal qilish va amaliy ko'nikmalarini shakllantirishda raqamli resurslar, virtual laboratoriyalar hamda interaktiv metodlarning o'rni tahlil qilingan. Jizzax davlat pedagogika universiteti tajribasi misolida tabiiy fanlarni o'qitish samaradorligini oshirish bo'yicha amaliy tavsiyalar ishlab chiqilgan.*

Kalit so'zlar: *tabiiy fanlar, kasbiy kompetentlik, innovatsion texnologiyalar, virtual laboratoriya, pedagogik mahorat, raqamli ta'lim, interaktiv metodlar.*

KIRISH: Zamonaviy dunyoda ta'lim tizimini tubdan isloh qilish va uni jahon standartlar darajasiga ko'tarish har qanday jamiyatning barqaror rivojlanish garovidir. Ayniqsa, tabiiy fanlar (kimyo, biologiya, fizika, geografiya) yo'nalishida faoliyat yuritadigan bo'lajak o'qituvchilarni tayyorlash bugungi kunning eng dolzarb masalalaridan biri bo'lib qolmoqda. Globallashuv va axborot texnologiyalari shiddat bilan rivojlanayotgan davrda an'anaviy o'qitish usullari o'z o'rnini innovatsion, kreativ va texnologik yondashuvlarga bo'shatib bermoqda. Bu esa bo'lajak mutaxassislardan faqatgina nazariy bilimlarga ega bo'lishni emas, balki ularni amaliyotda samarali qo'llash ko'nikmasini, ya'ni yuqori darajadagi kasbiy kompetentlikni talab etadi. O'zbekiston Respublikasida ta'lim sohasida amalga oshirilayotgan keng ko'lamli islohotlar, xususan, oliy ta'lim

muassasalarida kadrlar tayyorlash sifatini tubdan yaxshilashga qaratilgan normativ-huquqiy hujjatlar bo'lajak o'qituvchilarning metodik va raqamli tayyorgarligini kuchaytirishni maqsad qilgan. Tabiiy fanlar o'qituvchisi nafaqat o'z fanining chuqur bilimdoni, balki dars jarayonida multimedia vositalari, virtual modellar va innovatsion pedagogic texnologiyalarni erkin qo'llay oladigan integrator bo'lishi lozim. Shu sababli, oliy pedagogik ta'lim muassasalarida bo'lajak o'qituvchilarning kasbiy kompetentligini tarkib toptirish va rivojlantirishning ilmiy-pedagogik mexanizmlarini tadqiq etish muhim ahamiyat kasb etadi. Kasbiy kompetentlik tushunchasi o'z ichiga pedagogik, psixologik, metodik va texnologik bilimlarning sintezini oladi. Bo'lajak o'qituvchi dars o'tish davomida o'quvchilarning qiziqishini uyg'ota olishi, murakkab tabiiy jarayonlarni oddiy va tushunarli shaklda yetkaza bilishi shart. Buning uchun an'anaviy ma'ruza darslaridan voz kechib, talabalarni faol o'quv jarayoniga jalb qiluvchi loyihaviy ta'lim, muammoli o'qitish va keys-stadi kabi usullardan keng foydalanish zaruriyati tug'iladi. Mazkur maqolada ushbu innovatsiyalarning bo'lajak o'qituvchilar salohiyatiga ko'rsatadigan ta'siri batafsil muhokama qilinadi.

MAVZUNING O'RGANILGANLIK DARAJASI: Pedagogika fanida o'qituvchilarning kasbiy kompetentligi va uning tarkibiy qismlarini o'rganish bo'yicha ko'plab xorijiy va mahalliy olimlar tomonidan tadqiqotlar olib borilgan. Jumladan, g'arb olimlaridan L.Shulman o'qituvchining pedagogik kontent bilimini (Pedagogical Content Knowledge - PCK) alohida ajratib ko'rsatgan bo'lib, unga ko'ra fan bilimi bilan pedagogik usullarning uyg'unligi kasbiy muvaffaqiyatning asosi hisoblanadi. Shuningdek, raqamli texnologiyalar asrida ushbu model rivojlantirilib, TPACK (Technological Pedagogical Content Knowledge) konsepsiyasi yaratildi. Bu konsepsiya zamonaviy tabiiy fanlar o'qituvchisidan texnologik bilimlarni chuqur egallashni talab qiladi. Mustaqil Davlatlar Hamdo'stligi (MDH) olimlaridan N.V.Kuzmina, A.K.Markova va V.A.Slasteninlar pedagogik faoliyatning psixologik va kasbiy jihatlarini tizimli ravishda tadqiq etganlar. Ularning fikricha, kompetentlik — bu shunchaki faoliyatni amalga oshirish qobiliyati emas, balki shaxsning o'z faoliyati natijalariga mas'uliyati, refleksiyasi va doimiy ravishda o'z ustida ishlash ehtiyojidir. Tabiiy fanlarni o'qitishda esa bu jarayon eksperimental va laboratoriya ko'nikmalari bilan bevosita bog'liq holda kechadi. O'zbekistonlik olimlardan R.X.Djo'rayev, N.A.Muslimov, Sh.S.Sharipov va boshqalar oliy va professional ta'limda bo'lajak mutaxassislarning kasbiy kompetentligini shakllantirishning nazariy-metodik asoslarini ishlab chiqqanlar. N.A.Muslimov o'z tadqiqotlarida o'qituvchining kasbiy shakllanishini bosqichma-bosqich jarayon sifatida tahlil qilib, uning tarkibida kreativlik va mustaqillik muhim o'rin tutishini ta'kidlaydi. Biroq, aynan tabiiy fanlar pedagogika yo'nalishi talabalari uchun zamonaviy interaktiv dasturlar va virtual platformalardan foydalanish metodikasi hali ham maxsus tadqiqotlarni va yangi amaliy

yondashuvlarni talab qilmoqda.

TADQIQOT METODOLOGIYASI: Ushbu tadqiqot Jizzax davlat pedagogika universiteti Tabiiy fanlar pedagogika Oliy maktabi talabalari ishtirokida tashkil etildi. Tadqiqotning maqsadi innovatsion texnologiyalar va raqamli ta'lim resurslarining talabalar kasbiy kompetentligini oshirishdagi samaradorligini eksperimental asoslashdan iborat. Buning uchun universitetning kimyo, biologiya va geografiya yo'nalishlarida tahsil olayotgan 3- va 4-bosqich talabalaridan iborat guruhlar tanlab olindi. Tadqiqot jarayonida kuzatish, anketa so'rovnomalari, pedagogic eksperiment va statistik tahlil metodlaridan foydalanildi. Eksperiment jarayonida an'anaviy dars o'tish shakllaridan farqli o'laroq, talabalar mashg'ulotlariga interaktiv virtual laboratoriyalar integratsiya qilindi. Xususan, PhET (University of Colorado) interaktiv simulyatsiyalari va ChemCollective virtual laboratoriya platformalari yordamida talabalarga real sharoitda bajarish qiyin bo'lgan yoki xavfli hisoblangan kimyoviy va jismoniy jarayonlarni modellashtirish vazifalari topshirildi. Bu texnologiyalar talabalarga tajribalarni ko'p marotaba takrorlash, parametrlarni o'zgartirish va natijalarni vizual tarzda ko'rish imkonini berdi, bu esa ularning mustaqil tadqiqotchilik ko'nikmalarini shakllantirishga yordam berdi. Bundan tashqari, darslarda loyihaviy o'qitish (Project-Based Learning) metodikasi keng qo'llanildi. Talabalarga kichik guruhlarda tabiiy fanlarning dolzarb muammolariga (masalan, ekologik muammolar, Orol dengizining qurishi oqibatlari, hududiy bioxilma-xillik) oid loyihalar tayyorlash va ularni zamonaviy multimedia (Prezi, Canva, Genially) vositalari orqali taqdim etish topshirig'i berildi. Bu usul ularning nafaqat fan bo'yicha bilimini, balki jamoada ishlash, kommunikativlik va axborot-kommunikatsiya texnologiyalari (AKT) bilan ishlash bo'yicha kompetensiyalarini ham rivojlantirdi.

TAHLIL VA NATIJALAR: Pedagogik eksperiment natijalari shuni ko'rsatdiki, dars jarayoniga innovatsion texnologiyalarning tizimli ravishda kiritilishi talabalarning kasbiy tayyorgarlik darajasini sezilarli darajada oshiradi. Eksperimentdan oldin va keyin talabalarning kasbiy kompetentlik darajasi uchta asosiy mezon bo'yicha baholandi: motivatsion-qadriyatli, kognitiv (bilish) va faoliyatli-amaliy mezonlar. Baholash natijalari ballik tizim asosida (past, o'rta, yuqori) tasniflandi. An'anaviy usulda tahsil olgan nazorat guruhlarida yuqori kompetentlik ko'rsatkichi eksperiment yakunida 18% ni tashkil etgan bo'lsa, innovatsion metodlar qo'llanilgan eksperimental guruhlarda bu ko'rsatkich 42% gacha ko'tarildi. O'rta darajadagi talabalar ulushi eksperimental guruhlarda 48% ni tashkil etdi, past ko'rsatkich esa 10% gacha kamaydi. Bu raqamlar virtual modellashtirish va loyihaviy ta'lim metodlarining talabalar faolligini oshirishdagi bevosita ta'sirini tasdiqlaydi. Talabalarning dars ishlanmalarini (konspektlarini) mustaqil tuzish

jarayoni ham tahlil qilindi. Innovatsion guruh talabalari pedagogik amaliyot davomida maktab o'quvchilari uchun darslarni qiziqarli tashkil etishda AKT elementlaridan, Kahoot va Quizizz kabi interaktiv test o'yinlaridan unumli foydalanganliklarini namoyish etdilar. Bu esa bo'lajak o'qituvchilarning maktab ta'lim muhitiga moslashishini osonlashtiradi va ularning raqobatbardoshligini ta'minlaydi.

MUAMMO VA MUNOZARA: Olingan ijobiy natijalarga qaramay, bo'lajak tabiiy fanlar o'qituvchilarini tayyorlashda innovatsion texnologiyalarni joriy etish jarayoni bir qator tizimli muammo va to'siqlarga duch kelmoqda. Eng birinchi navbatda, oliy ta'lim muassasalarining moddiy-texnik bazasi, xususan, zamonaviy kompyuter texnikasi va yuqori tezlikdagi internet bilan ta'minlanganlik darajasi hamma joyda ham bir xil emas. Virtual laboratoriya va og'ir simulyatsion dasturlarni ishlatish uchun yuqori texnik ko'rsatkichlarga ega qurilmalar talab etiladi, bu esa ba'zan dars formatini cheklab qo'yadi. Ikkinchi muhim muammo — bu pedagog kadrlarning o'zlari bilan bog'liq. Professor-o'qituvchilarning ko'pchiligi an'anaviy ta'lim shakllariga ko'nikib qolganliklari sababli, yangi raqamli platformalarni o'zlashtirish va ularni dars rejasiga kiritishda ma'lum qiyinchiliklarga duch kelmoqdalar. Bu muammoni hal qilish uchun oliy ta'lim muassasalarida professor-o'qituvchilarning raqamli savodxonligini oshirish bo'yicha doimiy malaka oshirish kurslarini tashkil etish lozim. Innovatsiya faqat talaba uchun emas, balki eng avvalo dars beruvchi uchun kundalik ehtiyojga aylanishi zarur. Shuningdek, xorijiy virtual platformalar va simulyatsiyalarning ko'pchiligi o'zbek tiliga tarjima qilinmagan. Bu holat talabalarning materialni chuqur tushunishida til to'siqlarini yuzaga keltiradi. Mahalliy dasturchilar va metodist olimlar hamkorligida milliy virtual laboratoriya komplekslarini, electron darsliklarni va tabiiy fanlarga oid interaktiv mobil ilovalarni yaratish davr talabidir. Ushbu yo'nalishdagi investitsiyalar kelajakda ta'lim sifatining keskin oshishiga olib keladi.

XULOSA VA TAVSIYALAR: Olib borilgan tadqiqotlar va pedagogik tajriba-sinov ishlari natijasida quyidagi xulosalarga kelindi. Birinchidan, bo'lajak tabiiy fanlar o'qituvchilarining kasbiy kompetentligini shakllantirishda innovatsion texnologiyalar shunchaki yordamchi vosita emas, balki ta'lim samaradorligini belgilovchi strategik komponent hisoblanadi. Ikkinchidan, PhET, ChemCollective kabi virtual simulyatsiyalar talabalarning ijodiy va tanqidiy fikrlashini faollashtiradi, ularda fanga nisbatan ijobiy motivatsiyani kuchaytiradi. Tadqiqot natijalari asosida oliy pedagogik ta'lim tizimini yanada takomillashtirish uchun quyidagi tavsiyalar ilgari suriladi: 1. Tabiiy fanlar yo'nalishidagi o'quv rejalariga virtual modellashtirish va loyihaviy o'qitish metodikasi bo'yicha maxsus amaliy modullarni kiritish. 2. Oliy ta'lim muassasalari va o'rta maktablar o'rtasida integratsiyani kuchaytirish, talabalarning innovatsion ishlanmalarini maktab

amaliyotida keng sinovdan o'tkazish. 3. Tabiiy fanlar o'qituvchilari uchun o'zbek tilidagi ochiq elektron ta'lim resurslari va simulyatsiyalar bazasini yaratish hamda ulardan bepul foydalanish imkoniyatini kengaytirish. Xulosa qilib aytganda, Jizzax davlat pedagogika universiteti misolida ko'rsatilganidek, bo'lajak mutaxassislarni innovatsion muhitda tayyorlash ta'lim sifatini yangi bosqichga ko'taradi. Bu esa o'z navbatida respublikamiz maktablari uchun munosib, zamonaviy fikrlaydigan va har qanday texnologik vaziyatda to'g'ri qaror qabul qila oladigan yuqori malakali pedagog kadrlar korpusini shakllantirishga xizmat qiladi.

FOYDALANILGAN ADABIYOTLAR RO'YXATI

1. Mirziyoyev Sh.M. Yangi O'zbekiston strategiyasi. - Toshkent: 'O'zbekiston' nashriyoti, 2021. - 464 b.
2. Muslimov N.A. Bo'lajak o'qituvchining kasbiy kompetentligini shakllantirish texnologiyalari. - Toshkent: Fan va texnologiya, 2013. - 120 b.
3. Djo'rayev R.X. Ta'limda innovatsion texnologiyalar. - Toshkent: Sharq, 2008. - 240 b.
4. Shulman L. S. Those who understand: Knowledge growth in teaching // Educational Researcher. - 1986. - Vol. 15. - No. 2. - P. 4-14.
5. Mishra P., Koehler M. J. Technological pedagogical content knowledge: A framework for teacher knowledge // Teachers College Record. - 2006. - Vol. 108. - No. 6. - P. 1017-1054.
6. Kuzmina N. V. Professionalizm lichnosti prepodavatelya i masterstva obucheniya. - Moskva: Vysshaya shkola, 1990. - 119 s.
7. Jizzax davlat pedagogika universiteti ilmiy axborotnomasi. - Jizzax, 2024. - No. 2. - B. 45-52.

SHAXS SALOMATLIGIDA BIOGENETIK VA PEDAGOGIK YONDASHUVLAR.

Zaripov Otabek Murodullayevich

Samarqand Davlat pedagogika instituti, Psixologiya kafedrasi dotsenti

+998939376334 otabekzaripov80gmail.com

Annotasiya. *Maqolada shaxsning rivojlanish muammosi zamonaviy psixologiya va biologiya nuqtai nazaridan tahlil qilinadi. Shaxs rivojlanishining biologik, psixologik va ijtimoiy omillari o‘zaro uzviy bog‘liq yaxlit tizim sifatida yoritilgan,shuningdek, shaxs rivojlanishini tushuntiruvchi biogenetik, sotsiogenetik, psixogenetik yondashuvlarning ilmiy mohiyati ochib beriladi, shaxs rivojlanishining psixologik qonuniyatlari, zamonaviy pedagogik yondashuvlarning ahamiyati asoslab beriladi.*

Kalit so‘zlar. *ijtimoiy-madaniy muhit, faoliyat, rivojlanish, yondashuv, ta’lim va tarbiya, pedagogika, biologiya, instinkt, irsiyat, sharoit, shaxslararo munosabat, qonuniyat.*

Abstract. *The article analyzes the issue of personality development from the perspectives of modern psychology and biology. It examines the biological, psychological, and social factors of personality development as an integrated system of interconnected elements; elucidates the scientific essence of the biogenetic, sociogenetic, and psychogenetic approaches to explaining personality development; and substantiates the psychological principles of personality development and the significance of modern pedagogical approaches.*

Key words. *socio-cultural environment, activity, development, approach, education and upbringing, pedagogy, biology, instinct, heredity, conditions, interpersonal relations, regularity.*

Shaxs salomatligi va rivojlanishi biologik omillar (irsiyat, fiziologik yetilish) hamda pedagogik-ijtimoiy ta’sirlarning (tarbiya, muhit, turmush tarzi) o‘zaro uzviy birligiga asoslanadi.

Shaxs shakllanishida biogenetik yondashuv

- Irsiyat va tabiat: Biogenetik yondashuv shaxsning jismoniy, ruhiy va fiziologik rivojlanishini, avvalo, tug‘ma omillar, genetik dastur va organizmning tabiiy biologik yetilishi bilan bog‘liq hisoblanadi.
- Yosh davrlari: Shaxs ontogenezi (individual rivojlanishi) muayyan biologik dastur asosida kechadi va har bir yosh bosqichining o‘ziga xos fiziologik chegaralari mavjud.
- Shaxs salomatlikdagi asosiy roli: nasliy xususiyatlari, genetik kasalliklarga moyillik va tana a’zolarining tabiiy rivojlanishi shaxs salomatligining asosiy negizi hisoblanadi.

Pedagogik yondashuvning asosiy omillari:

- Tarbiya va ijtimoiy-muhit: Pedagogik yondashuv ta’sirida shaxsning biologik imkoniyatlarini namoyon bo‘lishida ta’lim, tarbiya, ijtimoiy muhit hal qiluvchi hisoblanadi.

• Faoliyatda ko‘nikmalar shakllantirishi: Shaxs sog‘lom turmush tarzini (to‘g‘ri ovqatlanish, jismoniy faollik, gigiena va ruhiy barqarorlik) ongiga singdirish pedagogik faoliyat orqali amalga oshadi.

• Korreksiya va rivojlantirish: Pedagogik ta’lim va tarbiya yordamida irsiy yoki jismoniy kamchiliklarning salbiy ta’sirini yumshatish, shaxsning jismoniy va ruhiy salomatligini mustahkamlash aniqlangan.

Yondashuvlarning o‘zaro bog‘liqligi.

• Biogenetik yondashuv shaxs organizmining tabiiy imkoniyatlari va chegaralarini belgilab bersa, pedagogik yondashuv ushbu salohiyatni to‘g‘ri yo‘naltiradi, mustahkamlaydi va rivojlantiradi.

• Sog‘lom barkamol shaxsni tarbiyalash uchun har ikki omil - biologik tabiat hamda pedagogik-ijtimoiy muhitning ta’siri muhimligi birgalikda inobatga olinishi zarur**.**

Biogenetik qonun - organizmlarning individual taraqqiyoti (ontogenezi) va tarixiy taraqqiyoti (filogenezi) o‘rtasidagi munosabatlarni ifodalovchi tushunchalar yig’indisi hisoblanadi. Bu atama birinchi marta F. Myuller (1864) va E. Gekkel (1866) tomonidan tavsiflab berilgan.Ontogenezning hamma davrlarida yashash muhiti sharoitiga moslashish tufayli yangi belgilar paydo bo‘ladi, biogenetik qonun embriologik dalillardan filogenez jarayonini tushuntirishda foydalanishga imkon berib, Gekkel filogenetik tadqiqotlar uchun uchlik parallelizmi metodini, ya’ni paleontologiya, solishtirma anatomiya va embriologiya dalillarini solishtirishni taklif etgan. Olimning fikricha, ontogenezda filogenetik davrlar bir butunligicha takrorlanadi.Kuzatishlar davomida pedagog olimlarning e’tirof etishicha shaxs shakllanishida eng muhim bosqich rivojlanish bosqichi hisoblanib, rivojlanish tushunchasiga ta’rif beradigan bo‘lsak, pedagogik, falsafiy, psixologik adabiyotlarda shaxs rivojlanishi tushunchasiga turli xil yondashuvlar mavjud ekanligi aniqlangan. Pedagogikada rivojlanish deganda shaxsni ma’lum bir yosh davridan ikkinchi yosh davriga o‘tganda sodir bo‘ladigan miqdor va sifat o‘zgarishlari kuzatiladi.

Psixologiya fanida rivojlanish atamasiga quyidagicha ta’rif berilgan, rivojlanish -inson tanasidagi, uning ruhiyatidagi, aqliy va ma’naviy sohasidagi, boshqariladigan va boshqarilmaydigan omillar ta’siridagi miqdor va sifat o‘zgarishlardir. Shaxs rivojlanish jarayonida biologik, sotsiologik, biosotsiologik konsepsiyalar mavjudligi ta’riflangan. Z.Freydning ta’kidlashicha, shaxsning ma’naviyati biologik asosga ega, shaxs rivojlanishi va xulq-atvori uning ehtiyojlari, instinktlari asosida vujudga keladi. Sotsiologik konsepsiya tarafdorlarining fikricha, inson biologik mavjudot (individ)sifatida tug‘ilib, hayoti davomida asta-sekin muhit ta’siri ostida

ijtimoiylashadi,muhit o‘z navbatida shaxs shakllanishining ijtimoiy omili sifatida qaraladi,tarbiya shaxs xarakterini tuzatishga xizmat qiladi.

Biosotsiologik konsepsiya vakillarining ta’kidlashicha, shaxs biologik va ijtimoiy mavjudot hisoblanadi, psixik jarayonlar, jumladan, sezish, eshitish, tafakkur va boshqalar biologik xarakterga ega,shaxsning qiziqishi, qobiliyati, ijtimoiy hodisa sifatida muhit ta’siriga mos ravishda rivojlanib boradi.

Pedagogika fani shaxsni ijtimoiy va biologik omil sifatida bir butun ajralmagan holda o‘rganadi,shaxs rivojlanishi to‘g‘risida turli konsepsiyalar asosida pedagogik nazariyalar shakllanib,ta’lim tarbiya shakllari, metodlari ishlab chiqiladi.Shaxsini shakllanishiga biologik va ijtimoiy, ichki va tashqi omillar ta’sir qiladi.

Pedagogikada shaxsning rivojlanishi, shakllanishi, tarbiyasi kabi tushunchalardan tashqari shaxs ijtimoiylashuvi tushunchasi ham keng qo‘llanilmoqda. Ijtimoiylashuv deganda, shaxsni jamiyat va atrofidagi odamlar bilan aloqasi, ijtimoiy muhit bilan o‘zaro ta’siri jarayonida jamiyatga moslashuvi tushiniladi.

Ijtimoiylashuv shaxsni yashab turgan jamiyat me’yorlarini,qadriyatlarini xulq-atvor normalarini tajriba va ijtimoiy aloqalarni o‘zlashtirishni aniqlaydi.Ijtimoiylashuv jarayoni ta’lim va tarbiya jarayoni orqali amalga oshiriladi. Demak ta’lim va tarbiya bir-biribilan uzviy bog‘liqlikda amalga oshiriladi. Tarbiya so‘z bilan emas amal bilan singdirilaishi yuqori samaradorlik natijasi hisoblanadi deb ta’kidlaydi pedagogik olimlardan biri. Tarbiya shaxs rivojlanishiga ta’sir etuvchi omillarni tartibga solib, uni ijtimoiylashuvini rivojlanishini tartibga solib turadi.

Biogenetik va sotsiogenetik nazariyalar - psixologiya va pedagogikada shaxsning shakllanishi hamda rivojlanishiga ta’sir etuvchi asosiy omillarni tushuntiruvchi qarama-qarshi yondashuvlardir.

1. Biogenetik nazariya- inson shaxsi va uning psixologik rivojlanishi asosan biologik omillar, irsiyat va organizmning tabiiy-fiziologik yetilishi bilan belgilanadi.

Tashqi muhit, tarbiya va ijtimoiy sharoitlar faqatgina biologik dastur (irsiyat)ning yuzaga chiqishiga yordam beradi yoki biroz to‘sqinlik qiladi, lekin shaxsning tub mohiyatini o‘zgartira olmaydi.

Biologiyadagi biogenetik qonun (ontogenez filogenezning qisqacha rekapitulyatsiyasi) va Stenli Xoll kabi olimlarning qarashlariga borib taqaladi.

Individ tug‘ilgandayoq o‘zining irsiy xususiyatlari, qobiliyatlari va rivojlanish trayektoriyasi bilan oldindan belgilab qo‘yilgan bo‘ladi.

2. Sotsiogenetik nazariya - shaxs va uning psixikasi asosan ijtimoiy muhit, muloqot, ta’lim-tarbiya va ijtimoiy tajriba ta’sirida shakllanadi.

Individ "toza taxta" (tabula rasa) yoki ijtimoiy munosabatlar mahsuli sifatida dunyoga keladi.Uning kim bo‘lib yetilishi qaysi muhitda yashashi, qanday muloqotda bo‘lishi va qanday ijtimoiy faoliyat bilan shug‘ullanishiga bog‘liq.

L. S. Vygotskiy, A. N. Leontyev, S. L. Rubinshteyn kabi olimlarning madaniy-tarixiy nazariyasi va faoliyat yondashuviga asoslanadi.Inson shaxsini tushunish uchun uning biologik tabiatidan ko‘ra, u yashayotgan jamiyat va madaniy muhitni o‘rganish kerak.

Zamonaviy psixologiyada bu ikki yondashuvning har biri yakka holda mutlaq deb qaralmaydi bugungi kunda inson rivojlanishi biologik (irsiy) imkoniyatlar va ijtimoiy muhitning o‘zaro uzviy birligi sifatida talqin etiladi.

Foydalanilgan adabiyotlar.

1. N. Boymurodov Amaliy psixologiya.T.2008y.
2. M.G.Davletshin.Umumiy psixologiya.T.2002y.
3. A. To‘xtayev va boshqalar. Umumiy biologiya T.2022y.
4. W.Wundt.Fiziologik psixologiya asoslari.T.2000y.
5. R. Xoliqov Biologiya. T.2005y.
6. Internet manbalari.

BIOLOGIYA DARSLARIDA INTERFAOL METODLARDAN FOYDALANISH VA ULARNING O‘QUVCHILAR FAOLLIGIGA TA’SIRI

Abdushukurova Marg‘iyona
Samarqand davlat pedagogika instituti Biologiya yo‘nalishi talabasi
Ibodullayeva Baxora Xamidullayevna
Samarqand davlat pedagogika instituti Biologiya kafedrasi o‘qituvchisi

Annotatsiya: *Mazkur maqolada biologiya darslarida interfaol metodlardan foydalanishning ahamiyati, ularning ta’lim samaradorligini oshirishdagi o‘rni hamda o‘quvchilar faolligiga ta’siri yoritilgan. Shuningdek, biologiya fanini o‘qitishda aqliy hujum, klaster, BBB va kichik guruhlarda ishlash kabi interfaol metodlardan foydalanish imkoniyatlari ko‘rib chiqilgan. Mazkur yondashuv biologiya darslarini mazmunli tashkil etish va o‘quvchilarda barqaror motivatsiyani shakillantirishda muhim omil sifatida baholangan.*

Kalit so‘zlar: *biologiya ta’limi, interfaol metodlar, zamonaviy ta’lim texnologiyalari, o‘quvchilar faolligi, pedagogik texnalogiya, mustaqil fikirlash, ta’lim samaradorligi.*

Kirish: Bugungi kunda ta’lim tizimida zamonaviy pedagogik texnologiyalardan foydalanish muhim ahamiyat kasb etmoqda. Ta’lim jarayonida o‘quvchilarning bilim olishi, mustaqil fikrlashi

va olgan bilimlarini amaliyotda qo‘llay olishi asosiy vazifalardan biri hisoblanadi. Ayniqsa, biologiya fanini o‘qitishda interfaol metodlardan foydalanish o‘quvchilarning fanga bo‘lgan qiziqishini oshirishga yordam beradi.

Biologiya fani inson hayotida muhim o‘rin tutadi. Biologiya tirik organizmlar, ularning tuzilishi, hayotiy jarayonlari, o‘zaro munosabatlari va atrof-muhit bilan aloqalarini o‘rganuvchi fandir. Ushbu fanni samarali o‘qitishda faqat nazariy ma’lumotlarni tushuntirish bilan cheklanib qolmasdan, o‘quvchilarni dars jarayoniga faol jalb etish zarur. Shu sababli interfaol metodlardan foydalanish zamonaviy biologiya ta’limining muhim yo’nalishlaridan biridir.

Interfaol metodlar haqida tushuncha: Interfaol metodlar — o‘qituvchi va o‘quvchilar o‘rtasidagi faol hamkorlikka asoslangan ta’lim usullaridir. Ushbu metodlar orqali o‘quvchilar dars jarayonida faol ishtirok etadi, o‘z fikrlarini bildiradi, savollarga javob beradi va boshqa o‘quvchilar bilan hamkorlikda ishlaydi.

An’anaviy ta’limda o‘qituvchi asosiy ma’lumot beruvchi sifatida ishtirok etsa, interfaol ta’limda o‘quvchi ham bilim olish jarayonining faol ishtirokchisiga aylanadi. O‘qituvchi esa o‘quvchilarni yo‘naltiradi, ularga muammolarni hal qilishda yordam beradi va mustaqil izlanish uchun sharoit yaratadi.

Interfaol metodlardan foydalanish o‘quvchilarning darsga qiziqishini oshirish, bilimlarni mustahkamlash va o‘zlashtirilgan ma’lumotlarni uzoq vaqt eslab qolishiga yordam beradi.

Biologiya darslarida qo‘llaniladigan interfaol metodlar: Biologiya darslarida turli interfaol metodlardan foydalanish mumkin. Ularning har biri dars maqsadi va o‘rganilayotgan mavzuning mazmuniga qarab tanlanadi.

Aqliy hujum metodi. Ushbu metod o‘quvchilarning erkin fikrlashi va mavzu yuzasidan turli g‘oyalarni ilgari surishiga yordam beradi. Masalan, “Tabiatni muhofaza qilish uchun nimalar qilishimiz kerak?” degan savol orqali o‘quvchilarning ekologik bilimlarini faollashtirish mumkin.

Klaster metodi. Bu metod yordamida mavzuga oid tushunchalar o‘zaro bog‘langan holda tasvirlanadi. Masalan, “O‘simliklar” mavzusida ildiz, poya, barg, gul, meva va urug‘ kabi tushunchalar bir-biri bilan bog‘lab ko‘rsatiladi. Natijada o‘quvchilar mavzuning asosiy qismlarini yaxshiroq tushunadilar.

BBB metodi. Ushbu metod “Bilaman, bilishni xohlayman, bilib oldim” bosqichlaridan iborat. Masalan, “Fotosintez” mavzusini o‘rganishda o‘quvchilar dastlab mavjud bilimlarini yozadilar, so‘ng bilishni istagan savollarini belgilaydilar va dars yakunida yangi o‘rgangan ma’lumotlarini qayd etadilar.

Kichik guruhlarda ishlash metodi. O‘quvchilar kichik guruhlarga bo‘linib, muayyan topshiriqlarni bajaradilar. Masalan, birinchi guruh o‘simlik hujayrasini, ikkinchi guruh hayvon hujayrasini, uchinchi guruh esa ularning o‘xshash va farqli jihatlarini o‘rganishi mumkin. Bu usul hamkorlikda ishlash va o‘zaro fikr almashish ko‘nikmalarini rivojlantiradi.

Interfaol metodlarning o‘quvchilar faolligiga ta’siri: Interfaol metodlardan foydalanish o‘quvchilarning dars jarayonidagi faolligini oshirishga xizmat qiladi. Bunday mashg‘ulotlarda o‘quvchilar tayyor ma’lumotlarni qabul qilish bilan cheklanmay, savollar beradi, muammolarni muhokama qiladi va o‘z xulosalarini shakllantiradi.

Birinchidan, interfaol metodlar o‘quvchilarning mustaqil fikrlash qobiliyatini rivojlantiradi. O‘quvchi muayyan biologik hodisaning sababini tushuntirishga va dalillar asosida xulosa chiqarishga harakat qiladi.

Ikkinchidan, ushbu metodlar o‘quvchilarning muloqot madaniyatini shakllantiradi. Guruhlarda ishlash davomida ular bir-birining fikrini tinglash, o‘z nuqtayi nazarini tushuntirish va umumiy qarorga kelishni o‘rganadilar.

Uchinchidan, interfaol metodlar biologik bilimlarni amaliyot bilan bog‘lash imkonini beradi. Masalan, ekologik muammolarni muhokama qilish orqali o‘quvchilar tabiatni asrashning ahamiyatini anglaydilar.

Shuningdek, interfaol metodlar o‘qituvchiga o‘quvchilarning mavzuni qay darajada o‘zlashtirganini aniqlash, tushunilmagan jihatlarni belgilash va keyingi mashg‘ulotlarni samarali tashkil etishda yordam beradi.

Xulosa: Xulosa qilib aytganda, biologiya darslarida interfaol metodlardan foydalanish ta’lim jarayonini samarali tashkil etishning muhim omillaridan biridir. Aqliy hujum, klaster, BBB va kichik guruhlarda ishlash kabi metodlar o‘quvchilarning darsdagi ishtirokini kuchaytirish, mustaqil fikrlash va hamkorlik ko‘nikmalarini rivojlantirishga yordam beradi.

Interfaol metodlardan maqsadli foydalanish biologik bilimlarni chuqurroq o‘zlashtirish, nazariy bilimlarni amaliyot bilan bog‘lash hamda o‘quvchilarning tabiatga nisbatan ongli munosabatini shakllantirish imkonini beradi. Shu sababli biologiya o‘qituvchilari darslarni rejalashtirishda interfaol metodlarni mavzu mazmuni va o‘quvchilarning ehtiyojlariga mos ravishda qo‘llashlari maqsadga muvofiqdir.

Foydalanilgan adabiyotlar

1. Biologiya fanini o‘qitish metodikasiga oid o‘quv-uslubiy qo‘llanmalar
2. Ishmuhamedov R., Abduqodirov A., Pardaev A. Ta’limda innovatsion texnologiyalar. — Toshkent, 2008.
3. Umumiy o‘rta ta’lim maktablari uchun biologiya fanidan amaldagi darslar.
4. Tolipov O‘.Q., Usmonboyeva M. Pedagogik texnologiyalarning tatbiqiy asoslari. — Toshkent, 2006.

5.Tolipova J., Numonova N. Ta’lim-tarbiya jarayonida zamonaviy pedagogik texnologiyalar. / “Xalq ta’limi” jurnali, 2002.

6.Tolipov O‘., Usmonboyeva M. “Pedagogik texnologiya: nazariya va amaliyot”. Toshkent “Fan”- 2005.

BIOLOGIYA FANINI O‘QITISHDA STEAM YONDASHUVDAN FOYDALANISH IMKONIYATLARI

Muzaffarova Mohinur Xudoyberdi qizi

Samarqand davlat pedagogika instituti Biologiya yo‘nalishi talabasi

Ilmiy rahbar: Ibodullayeva Baxora Xamidullayevna

Samarqand davlat pedagogika instituti Biologiya kafedrasi o‘qituvchisi

Annotation: *Ushbu maqolada biologiya fanini o‘qitishda STEAM yondashuvining ahamiyati va imkoniyatlari tahlil qilinadi. STEAM yondashuvi o‘quvchilarning ijodiy fikrlashini rivojlantirish va muammolarni hal etish qobiliyatini oshirishga yordam beradi.*

Keywords: *biologiya, STEAM, ta'lim, ijodiy fikrlash, o'qitish.*

Kirish: Biologiya fani, hayot jarayonlarini o'rganish orqali insoniyatning tabiat bilan bo'lgan munosabatini chuqur anglash imkonini beradi. U nafaqat biologik tizimlar va ularning funksiyalarini o'rganadi, balki ekologik muvozanat va biosferaning barqarorligini saqlashda ham muhim rol o'ynaydi. STEAM (Fan, Texnologiya, Muhandislik, San'at va Matematika) yondashuvi esa ta'lim tizimini integratsiyalashgan tarzda rivojlantirishga qaratilgan bo'lib, biologiyani boshqa fanlar bilan bog'lash orqali o'quvchilarning ijodkorlik va muammolarni hal qilish qobiliyatini oshiradi. Bu yondashuv, talabalarga ko'p jihatdan bilim berish bilan birga, ularning kelajakdagi kasbiy faoliyatlariga tayyorgarlik ko'rishda muhim ahamiyatga ega. Biologiya va STEAM

yondashuvi birgalikda, ta'lim jarayonining sifatini oshirish va o'quvchilarning qiziqishini yanada kuchaytirishga xizmat qiladi.

STEAM yondashuvi haqida umumiy ma'lumot

STEAM yondashuvi, fan, texnologiya, muhandislik, san'at va matematika sohalarini birlashtirgan ta'lim modeli bo'lib, o'quvchilarning ijodkorligini va tanqidiy fikrlash qobiliyatini rivojlantirishga qaratilgan. Ushbu yondashuvning asosiy tamoyillari, interdisiplinar o'qitish, amaliy tajriba, va kooperativ o'rganish orqali o'quvchilarning bilim va ko'nikmalarini kengaytirishga qaratilgan. Ta'lim jarayonida STEAM yondashuvi o'quvchilarga muammolarni yechish, innovatsion fikrlash va ijodiy yondashuvlarni qo'llash imkoniyatini beradi. Shuningdek, bu yondashuv, o'quvchilarning qiziqishini oshirish va ularda o'z-o'zini anglash hissini kuchaytirishga yordam beradi. Natijada, STEAM yondashuvi ta'lim sifatini oshirib, kelajakdagi kasbiy muvaffaqiyatlar uchun zarur bo'lgan ko'nikmalarni shakllantirishda muhim rol o'ynaydi. STEAM yondashuvi fan, texnologiya, muhandislik, san'at va matematikani birlashtirgan ta'lim modelidir. Bu yondashuv o'quvchilarga muammolarni hal qilishda ijodkorlik va analitik fikrlashni rivojlantirishga yordam beradi. Ta'lim jarayonida STEAM yondashuvi interaktiv va amaliy tajribalarni taqdim etadi, bu esa o'quvchilarning bilimlarini hayotiy vaziyatlarda qo'llash qobiliyatini oshiradi.

Biologiya fanida STEAM yondashuvini qo'llashning afzalliklari

Biologiya fanida STEAM yondashuvini qo'llash o'quvchilarning qiziqishini oshirish va bilimlarni amaliyotga tatbiq etish imkoniyatlarini kengaytiradi. Bu yondashuv o'quvchilarga biologik jarayonlarni tushunish va ularni real hayotdagi muammolar bilan bog'lash imkonini beradi. STEAM yondashuvi orqali o'quvchilar tajribalar o'tkazish, tadqiqotlar olib borish va natijalarni tahlil qilish kabi amaliy faoliyatlarga jalb etiladi. Bu esa ularning ilmiy fikrlash qobiliyatini rivojlantiradi hamda o'z bilimlarini kengaytiradi. Biologiya fanidagi STEAM yondashuvi, shuningdek, o'quvchilarning jamoaviy ishlash ko'nikmalarini ham oshiradi, chunki ular birgalikda muammolarni hal qilish va innovatsion yechimlar topishda ishtirok etadilar. Natijada, bu yondashuv o'quvchilarning biologiyaga bo'lgan qiziqishini kuchaytiradi va ularni kelajakda ilmiy faoliyatga tayyorlaydi.

Ijodiy fikrlash va muammolarni hal etish

Ijodiy fikrlash va muammolarni hal etish qobiliyatlarini rivojlantirishda STEAM yondashuvi muhim rol o'ynaydi. Bu yondashuv, fan, texnologiya, muhandislik, san'at va matematika o'rtasidagi integratsiyani ta'minlab, o'quvchilarga murakkab muammolarni turli xil perspektivalardan ko'rish

imkonini beradi. O'quvchilar amaliy tajribalar orqali ijodiy fikrlash jarayonini qo'llab-quvvatlashadi, bu esa ularning analitik qobiliyatlarini oshiradi. STEAM dasturlari orqali o'quvchilar ijodiy loyihalarda ishtirok etish orqali muammolarni hal qilish strategiyalarini o'rganadilar va o'z fikrlarini samarali ifodalashni o'zlashtiradilar. Shunday qilib, bu yondashuv nafaqat akademik ko'nikmalarni rivojlantirishga, balki ijtimoiy va hissiy intellektni ham oshirishga yordam beradi, bu esa o'quvchilarning kelajakdagi muvaffaqiyatlari uchun asos bo'ladi. Ijodiy fikrlash va muammolarni hal etish qobiliyatini rivojlantirishda STEAM yondashuvi muhim ahamiyatga ega. Bu yondashuv o'quvchilarga fan, texnologiya, muhandislik, san'at va matematikani birlashtirib, ijodiy yechimlar topishga imkon beradi. O'quvchilar amaliy loyihalar orqali real hayotdagi muammolarni hal qilishni o'rganadilar, bu esa ularning innovatsion fikrlash qobiliyatini oshiradi.

Amaliy tadqiqotlar va tajribalar

Biologiya fanida STEAM yondashuvi asosida o'tkazilgan amaliy tadqiqotlar va tajribalar o'quvchilarning ilmiy bilimlarini chuqurlashtirishda muhim ahamiyatga ega. Masalan, o'quvchilar o'simliklarning fotosintez jarayonini tushunish uchun laboratoriya sharoitida eksperimentlar o'tkazadilar. Bu jarayonda ularga o'simliklarning o'sishiga turli omillar, masalan, yorug'lik darajasi va namlikning ta'siri o'rganiladi. Shuningdek, biologik tizimlar va ekosistemalarni o'rganishda simulyatsiyalar va interaktiv dasturlar yordamida o'zaro ta'sirlarni ko'rish imkoniyati beriladi. Ushbu tadqiqotlar o'quvchilarda biologik jarayonlar haqida chuqur tushuncha shakllantirib, ularni muammolarni hal qilish va ijodiy fikrlashga undaydi. Natijada, STEAM yondashuvi orqali o'quvchilar nafaqat biologiya fanida, balki boshqa sohalarda ham kompleks fikrlash qobiliyatini rivojlantiradilar.

O'qituvchilar uchun tavsiyalar

O'qituvchilar biologiya darslarida STEAM yondashuvini muvaffaqiyatli qo'llash uchun interaktiv metodlardan foydalanishlari zarur. O'quvchilarning qiziqishini oshirish maqsadida tajribalar va loyihalar orqali amaliy mashg'ulotlar tashkil etilishi muhimdir. Masalan, biologik jarayonlarni o'rganishda laboratoriya ishlarida o'quvchilar o'zlari tajribalar o'tkazishlari va natijalarni tahlil qilishlari orqali bilimlarini mustahkamlashlari mumkin. Shuningdek, boshqa fanlar bilan integratsiya qilish, masalan, san'at va matematikani biologiya bilan birlashtirib, o'quvchilarga ko'p tomonlama yondashuvni taqdim etish foydalidir. O'qituvchilar o'quvchilarning ijodiy fikrlash qobiliyatini rivojlantirish maqsadida muammolarni hal qilishda guruh ishlarini tashkil etishlari ham samarali bo'ladi. Bu yondashuv o'quvchilarda biologiyaga bo'lgan qiziqishni oshiradi va ularni kelajakda ilmiy izlanishlarga yo'naltiradi.

Xulosa

Maqolaning asosiy natijalari shuni ko'rsatadiki, STEAM yondashuvi biologiya fanini o'qitishda o'quvchilarning ko'nikmalarini rivojlantirishda samarali vosita hisoblanadi. U nafaqat biologik bilimlarni oshirishga, balki o'quvchilarning ijodiy va tanqidiy fikrlash qobiliyatlarini ham kuchaytirishga yordam beradi. STEAM yondashuvi orqali o'quvchilar amaliy laboratoriya ishlarida ishtirok etish, muammolarni hal qilish va jamoa bilan ishlash imkoniyatiga ega bo'lishadi, bu esa ularning o'qitish jarayonida faol ishtirok etishiga olib keladi. Kelajakda bu yondashuv biologiya fanini o'qitishda yangi imkoniyatlar yaratishi, o'quvchilarning ilmiy izlanishlarga qiziqishini oshirishi va ularni innovatsion fikrlashga yo'naltirishi kutilmoqda. Bu esa, o'z navbatida, biologiya sohasida yangi kadrlar tayyorlashda muhim ahamiyatga ega bo'ladi.

FOYDALANILGAN ADABIYOTLAR

1.Sousa D.A., Pilecki T. From STEM to STEAM: Brain-Compatible Strategies and Lessons That Integrate the Arts. – 2nd ed. – Thousand Oaks, CA: Corwin, 2018. – 264 p.

2.Khine M.S., Areepattamannil S. (Eds.). STEAM Education: Theory and Practice. – Cham: Springer, 2019. – 188 p.

3.Martinez J.E. The Search for Method in STEAM Education. – Cham: Palgrave Macmillan, 2017. – 165 p.

4.Shernoff D.J. Integrative STEM and STEAM Education for Real-Life Learning. – Cham: Springer, 2024.

5.Bybee R.W. The Case for STEM Education: Challenges and Opportunities. – Arlington, VA: NSTA Press, 2013.

6.Tolipova J.O., G‘ofurov A.T. Biologiya ta’limi texnologiyalari. – Toiyani o‘qitishda innovatsion texnologiyalar. – Toshkent: Nizomiy nomidagi TDPU bosmaxonasi, 2013.

7.Ge X., Ifenthaler D., Spector J.M. (Eds.). Emerging Technologies for STEAM Education. – Cham: Springer, 2015.

8.Kommers P., Saralar İ. (Eds.). AI for STEAM in Education: Thematic Learning in Practice. – Cham: Springer, 2026.

МЕТОДИКА ФОРМИРОВАНИЯ И РАЗВИТИЯ БИОЛОГИЧЕСКИХ ПОНЯТИЙ, УМЕНИЙ И НАВЫКОВ УЧАЩИХСЯ

Н.З.Ражамурадова

Самаркандский педагогический институт

rajamurodovan@gmail.com

Аннотация. *В статье рассматриваются теоретические и методические основы формирования и развития биологических понятий, умений и навыков учащихся в процессе обучения биологии. Раскрываются этапы формирования научных понятий, особенности взаимосвязи специальных и общебиологических знаний, а также классификация практических умений в основных разделах биологии. Обосновывается значение систематического и последовательного усвоения учебного материала, организации наблюдений, сравнений, лабораторных работ и биологических экспериментов. Особое внимание уделяется применению наглядных средств и цифровых образовательных ресурсов, способствующих активизации познавательной деятельности учащихся и развитию их исследовательских компетенций. Определены педагогические условия, обеспечивающие повышение эффективности формирования биологических знаний и практических навыков.*

Ключевые слова: *биологическое образование, методика преподавания биологии, биологические понятия, познавательная деятельность, практические умения, навыки, лабораторные работы, наблюдение, эксперимент, исследовательская деятельность, цифровые образовательные технологии.*

Abstract. *The article examines the theoretical and methodological foundations of developing biological concepts, skills, and abilities among students in biology education. It discusses the stages of scientific concept formation, the relationship between specialized and general biological knowledge, and the classification of practical skills across the main branches of biology. The importance of systematic and consistent learning, observation, comparison, laboratory activities, and biological experiments is substantiated. Particular attention is paid to visual learning materials and digital educational resources that promote students' cognitive engagement and research competencies. The article identifies pedagogical conditions that contribute to improving the effectiveness of biological knowledge acquisition and practical skill development.*

Keywords: *biology education, biology teaching methodology, biological concepts, cognitive activity, practical skills, abilities, laboratory work, observation, experiment, research activities, digital educational technologies.*

Введение

Современное биологическое образование ориентировано не только на усвоение учащимися научных знаний о живой природе, но и на развитие критического мышления, исследовательских способностей, практических умений и навыков самостоятельной деятельности. В связи с этим особую актуальность приобретает совершенствование методики формирования биологических понятий, обеспечивающей осознанное усвоение учебного материала и применение полученных знаний при объяснении природных явлений и решении практических задач.

Биология представляет собой систему взаимосвязанных научных знаний о строении, жизнедеятельности, развитии и взаимодействии живых организмов с окружающей средой. Понимание биологических закономерностей невозможно без последовательного формирования понятий, отражающих существенные свойства живых систем и взаимосвязи между ними.

Эффективность обучения биологии во многом определяется правильной организацией познавательной деятельности учащихся. Наблюдение биологических объектов, сравнение их признаков, проведение опытов, анализ результатов и формулирование выводов способствуют переходу от непосредственного восприятия к научному обобщению. При этом важное значение имеют преемственность знаний, систематичность обучения и взаимосвязь теоретической и практической деятельности.

В условиях цифровизации образования расширяются возможности использования виртуальных лабораторий, интерактивных моделей, образовательных платформ и мультимедийных материалов. Их целенаправленное применение позволяет наглядно представлять процессы, которые трудно наблюдать непосредственно, и повышает доступность сложного биологического содержания.

Цель исследования — определить теоретические и методические особенности формирования и развития биологических понятий, умений и навыков учащихся, а также обосновать педагогические условия повышения эффективности обучения биологии.

Для достижения поставленной цели определены следующие задачи:

1. Раскрыть сущность и основные этапы формирования биологических понятий.
2. Охарактеризовать особенности развития специальных и общебиологических понятий.

3. Систематизировать основные виды практических умений и навыков учащихся.
4. Определить методические условия эффективного сочетания теоретического обучения и практической деятельности.

Методы исследования. В работе использованы анализ и обобщение научно-методической литературы, сравнительный анализ педагогических подходов, систематизация методических положений и теоретическое обобщение особенностей формирования биологических понятий, умений и навыков.

Научно-практическая значимость работы заключается в систематизации методических подходов к формированию биологических понятий и определении способов их применения при организации уроков, лабораторных и практических занятий по биологии.

Основная часть

1. Теоретические основы формирования биологических понятий

Формирование научных понятий является одним из важнейших компонентов образовательного процесса. Понятие представляет собой форму мышления, отражающую существенные признаки, свойства и отношения предметов и явлений действительности.

Каждое понятие характеризуется содержанием и объёмом. Содержание включает совокупность существенных признаков изучаемого объекта или явления, а объём охватывает совокупность объектов, обладающих соответствующими признаками. В процессе обучения содержание биологических понятий расширяется, уточняется и обогащается новыми научными сведениями.

Формирование понятий предполагает последовательное развитие познавательной деятельности учащихся. На начальном этапе осуществляется непосредственное восприятие биологических объектов и явлений. Учащиеся рассматривают натуральные объекты, иллюстрации, модели и микропрепараты, выделяя их характерные особенности.

На следующем этапе происходит анализ наблюдаемых признаков, их сравнение и выявление существенных свойств. Важную роль играет установление сходства и различий между объектами, а также определение взаимосвязей между их строением и функциями.

Затем осуществляется обобщение полученных сведений, формулирование определения понятия и установление его связей с ранее изученным материалом. Завершающим этапом является применение сформированного понятия при объяснении биологических процессов, выполнении практических заданий и решении проблемных ситуаций.

Таким образом, методически обоснованное формирование биологических понятий предполагает переход от конкретного наблюдения к анализу, сравнению, обобщению и практическому применению знаний. Для реализации данного процесса необходимо использовать разнообразные средства обучения: натуральные биологические объекты, гербарии, коллекции, схемы, таблицы, модели, лабораторные задания и проблемные вопросы.

2. Классификация и особенности развития биологических понятий

Биологические понятия образуют взаимосвязанную систему, содержание которой определяется основными разделами биологии: ботаникой, зоологией, анатомией и физиологией человека, общей биологией и экологией.

По степени обобщённости и характеру содержания можно выделить конкретные, более сложные, специальные и общебиологические понятия.

Конкретные понятия отражают определённые признаки биологических объектов. Например, при изучении листа учащиеся первоначально знакомятся с его формой, окраской, жилкованием и расположением на стебле. В дальнейшем знания дополняются сведениями о внешнем и внутреннем строении листа, его клеточной организации и функциях.

На основе изучения отдельных признаков формируется более целостное представление о листе как органе растения, выполняющем определённые функции. Аналогичным образом осуществляется изучение корня, стебля, цветка и плода.

Специальные биологические понятия связаны преимущественно с конкретными разделами или темами учебного предмета. К ним относятся понятия «фотосинтез», «строение корня», «клеточная структура», «газообмен», «пищеварение» и другие.

По содержанию специальные понятия можно объединить в следующие группы:

1. Понятия о биологических объектах, организмах, органах и клеточных структурах.
2. Понятия о физиологических и биохимических процессах.
3. Понятия о взаимосвязи строения и функций живых систем.
4. Понятия об экологических отношениях и эволюционных преобразованиях.

Общебиологические понятия характеризуются более высокой степенью обобщения и объединяют знания, полученные при изучении различных разделов биологии. К ним относятся клеточная организация живого, обмен веществ и энергии, наследственность, изменчивость, эволюция, приспособленность организмов и взаимосвязь живых систем с окружающей средой.

Формирование общебиологических понятий осуществляется на основе ранее усвоенных специальных знаний. Например, изучение клеточного строения растений, животных и человека создаёт предпосылки для понимания клетки как структурной и функциональной единицы живых организмов.

Следовательно, формирование системы биологических понятий должно основываться на принципах преемственности, последовательности и постепенного усложнения учебного материала. Это обеспечивает установление связей между отдельными фактами и способствует формированию целостной научной картины живой природы.

3. Методические особенности формирования понятий в различных разделах биологии

Методика формирования биологических понятий определяется содержанием конкретного раздела учебного предмета, возрастными особенностями учащихся и характером изучаемых объектов.

При изучении ботаники основное внимание уделяется формированию понятий о строении, жизнедеятельности и развитии растений. Изучение корня, стебля, листа, цветка и плода целесообразно сопровождать анализом взаимосвязи их строения и функций. Например, при изучении листа учащиеся могут сравнивать его внешние признаки, рассматривать микропрепараты и устанавливать связь между особенностями строения и процессами фотосинтеза, газообмена и испарения воды.

При изучении зоологии формируются представления о разнообразии животных, особенностях их организации, физиологических процессах и приспособлениях к условиям среды. Сравнение представителей различных систематических групп позволяет выявлять общие и отличительные признаки, устанавливать закономерности организации животных и объяснять особенности их образа жизни.

При изучении анатомии и физиологии человека необходимо обеспечивать взаимосвязь знаний о клетках, тканях, органах и системах органов. Например, изучение сердечно-сосудистой системы предполагает рассмотрение строения сердца, его функциональной роли и механизмов кровообращения. Полученные знания следует связывать с вопросами гигиены, профилактики заболеваний и формирования здорового образа жизни.

При изучении общей биологии происходит обобщение и углубление знаний, приобретённых в предыдущих разделах. Учащиеся осваивают понятия, связанные с наследственностью, изменчивостью, эволюцией, обменом веществ и энергии, экологическими закономерностями. На этом этапе особое значение приобретают анализ

научных фактов, интерпретация результатов экспериментов и установление причинно-следственных связей.

Таким образом, каждый раздел биологии способствует формированию определённой системы понятий, а их последовательное объединение обеспечивает понимание общих закономерностей организации и функционирования живых систем.

4. Формирование и развитие умений и навыков учащихся на уроках биологии

Усвоение биологических знаний тесно связано с развитием практических умений и навыков. Умение предполагает способность осознанно выполнять определённые действия на основе приобретённых знаний, тогда как навык характеризуется устойчивым и отработанным способом выполнения действий в результате практики.

В процессе обучения биологии целесообразно выделять следующие группы практических умений.

1. Морфологические умения. Предполагают определение внешнего строения растений и животных, распознавание органов, описание их формы, размеров и расположения.

2. Систематические умения. Включают сравнение организмов, выявление общих и отличительных признаков, классификацию объектов и определение их принадлежности к определённым систематическим группам.

3. Анатомические умения. Связаны с использованием лупы и микроскопа, изготовлением и изучением микропрепаратов, исследованием внутреннего строения биологических объектов.

4. Физиологические умения. Предполагают наблюдение за жизненными процессами, проведение доступных биологических опытов, регистрацию результатов и формулирование обоснованных выводов.

5. Экологические умения. Направлены на выявление взаимосвязей организмов с окружающей средой, изучение влияния экологических факторов и анализ особенностей существования организмов в различных условиях.

6. Исследовательские умения. Включают постановку исследовательского вопроса, формулирование гипотезы, планирование наблюдения или эксперимента, сбор и анализ данных, интерпретацию результатов и представление выводов.

Формирование перечисленных умений требует систематической организации практической деятельности учащихся. При этом необходимо учитывать уровень их подготовки, возрастные особенности и доступность используемых методов исследования.

Например, при изучении строения листа учащимся можно предложить определить его форму и тип жилкования, сравнить листья нескольких растений и установить сходства и различия

между ними. При наличии соответствующего оборудования задание можно дополнить изучением микропрепарата и анализом особенностей внутреннего строения листа.

В ходе выполнения работы учащиеся не только усваивают соответствующие биологические понятия, но и развивают наблюдательность, способность сравнивать объекты, систематизировать сведения и делать выводы на основе полученных данных.

Лабораторные и практические занятия также создают условия для формирования самостоятельности, ответственности и культуры научного исследования.

5. Педагогические условия эффективного формирования понятий, умений и навыков

Эффективность обучения биологии определяется совокупностью педагогических условий, обеспечивающих осознанное усвоение знаний и развитие практических компетенций.

Во-первых, необходимо обеспечивать систематичность и последовательность обучения. Новые понятия должны опираться на ранее изученный материал, а содержание учебных заданий — постепенно усложняться. Это позволяет учащимся устанавливать связи между фактами и формировать целостную систему биологических знаний.

Во-вторых, важно сочетать теоретическое обучение с практической деятельностью. Использование натуральных объектов, гербариев, коллекций, микропрепаратов, схем и моделей способствует конкретизации изучаемого материала. Практические задания помогают проверить понимание теоретических положений и закрепить способы применения знаний.

В-третьих, следует активизировать познавательную деятельность учащихся. Проблемные вопросы, сравнительные задания, самостоятельные наблюдения и исследовательские проекты стимулируют аналитическое мышление. Важно предлагать учащимся не только воспроизводить готовую информацию, но и самостоятельно выявлять признаки объектов, устанавливать закономерности и аргументировать выводы.

В-четвёртых, целесообразно применять современные образовательные технологии. Цифровые образовательные ресурсы, виртуальные лаборатории, интерактивные модели и мультимедийные презентации расширяют возможности визуализации биологических процессов. Особенно полезны они при изучении микроскопических структур, клеточных процессов, физиологических механизмов и явлений, непосредственное наблюдение которых затруднено в школьных условиях.

При этом цифровые средства должны дополнять, а не полностью заменять натуральные объекты, реальные наблюдения и доступные лабораторные эксперименты.

В-пятых, необходимо организовывать систематическую оценку результатов обучения. Для определения уровня усвоения понятий и сформированности практических умений могут использоваться тестовые задания, устные ответы, лабораторные отчёты, исследовательские проекты и самооценка учащихся. Оценивание должно учитывать не только правильность ответа, но и способность объяснять биологические явления, обосновывать решения и применять знания в новых ситуациях.

В-шестых, следует учитывать индивидуальные особенности учащихся. Дифференциация заданий по сложности, использование различных способов представления информации и предоставление методической поддержки позволяют создавать условия для активного участия обучающихся с разным уровнем подготовки.

Реализация указанных педагогических условий способствует формированию осознанных биологических знаний, развитию практических навыков и повышению познавательной активности учащихся.

Заключение

Формирование и развитие биологических понятий, умений и навыков является одним из ключевых направлений совершенствования методики преподавания биологии. Результативность данного процесса определяется последовательным переходом от наблюдения конкретных объектов к анализу их признаков, обобщению полученных сведений, установлению закономерностей и практическому применению знаний.

Система биологических понятий включает специальные понятия отдельных разделов и общебиологические понятия, объединяющие знания о строении, функциях, развитии и взаимодействии живых организмов с окружающей средой. Последовательное формирование этих понятий способствует развитию научного мышления и пониманию целостности живой природы.

Развитие морфологических, систематических, анатомических, физиологических, экологических и исследовательских умений обеспечивается систематическим выполнением лабораторных и практических работ, проведением наблюдений, сравнений и экспериментов. Существенное значение имеет использование наглядных материалов, проблемных заданий и цифровых образовательных ресурсов.

К основным педагогическим условиям эффективного формирования биологических понятий, умений и навыков относятся преемственность знаний, сочетание теоретического и практического обучения, активизация самостоятельной познавательной деятельности, учёт

индивидуальных особенностей учащихся и систематическая оценка образовательных результатов.

Таким образом, совершенствование методики преподавания биологии предполагает комплексный подход, объединяющий научное содержание учебного материала, практическую деятельность и современные образовательные технологии. Реализация данного подхода создаёт условия для осознанного усвоения биологических знаний, развития исследовательских компетенций и формирования способности применять полученные знания в учебной и повседневной деятельности.

СПИСОК ИСПОЛЬЗОВАННОЙ ЛИТЕРАТУРЫ

1. Карташова Н. С., Кулицкая Е. В. Методика преподавания биологии: общая методика: учебно-методическое пособие для лабораторно-практических занятий и самостоятельной работы студентов. — 4-е изд., испр. — Москва; Берлин: Директ-Медиа, 2015. — 70 с. — ISBN 978-5-4475-4591-8. — URL: http://biblioclub.ru/index.php?page=book&id=277853.
2. Карташова Н. С., Кулицкая Е. В. Инновационное обучение биологии в общеобразовательных заведениях: учебное пособие для студентов бакалавриата. — Москва; Берлин: Директ-Медиа, 2016. — 86 с. — ISBN 978-5-4475-6594-7. — URL: http://biblioclub.ru/index.php?page=book&id=430599.
3. Теремов А. В., Петросова Р. А., Перелович Н. В., Косорукова Л. А. Теория и методика обучения биологии: учебные практики: методика преподавания биологии. — Москва: МПГУ; Прометей, 2012. — 160 с. — ISBN 978-5-7042-2356-6. — URL: http://biblioclub.ru/index.php?page=book&id=363882.
4. Андрианова Е. И. Подготовка и проведение педагогического исследования: учебное пособие для вузов. — Ульяновск: УлГПУ, 2013. — 116 с. — ISBN 978-5-86045-614-3. — URL: http://biblioclub.ru/index.php?page=book&id=278048.
5. Андреева Н. Д., Азизова И. Ю., Малиновская Н. В. Методика обучения биологии в современной школе: учебник и практикум для бакалавриата и магистратуры / под ред. Н. Д. Андреевой. — 2-е изд., испр. и доп. — Москва: Юрайт, 2017. — 294 с. — ISBN 978-5-9916-9923-5.
6. Карташова Н. С., Кулицкая Е. В. Инновационное обучение биологии в общеобразовательных заведениях: учебно-методическое пособие для студентов бакалавриата. — Москва; Берлин: Директ-Медиа, 2016. — 57 с. — ISBN 978-5-4475-6595-4. — URL: http://biblioclub.ru/index.php?page=book&id=430601.
7. Мандель Б. Р. Инновационные процессы в образовании и педагогическая инноватика: учебное пособие для обучающихся в магистратуре. — Москва; Берлин: Директ-Медиа, 2017. — 343 с. — ISBN 978-5-4475-9050-5. — URL: http://biblioclub.ru/index.php?page=book&id=455509.

TIRIK TIZIMLARNING RAQAMLI EGIZAGI: ODAM ANATOMIYASI VA FIZIOLOGIYASIDA VEGETATIV ORGANLAR ISHINI IMITATSION TEXNOLOGIYALAR VOSITASIDA VIZUALLASHTIRISH

Pardayeva Marjona Oybek qizi

Samarqand davlat pedagogika Instituti magistranti

Annotatsiya: *Ushbu maqolada oliy pedagogik ta'lim muassasalarida "Odam anatomiyasi va fiziologiyasi" fanini o'qitish samaradorligini tubdan oshirishda zamonaviy raqamli didaktika va imitatsion texnologiyalar, xususan, "Raqamli egizak" (Digital Twin) konsepsiyasini tatbiq etishning chuqur ilmiy-nazariy va metodik asoslari tahlil qilingan. Vegetativ organlar tizimi — ovqat hazm qilish, nafas olish, qon aylanish, ayirish va ularni boshqaruvchi vegetativ nerv tizimining mikroskopik hamda uzluksiz dinamik jarayonlarini an'anaviy statik ko'rgazmalar orqali tushuntirishdagi gnoseologik va metodik to'siqlar atroflicha yoritilgan. Muallif qarashlarida 3D-modellashtirish, VR/AR simulyatsiyalari hamda Sun'iy intellektga tayanuvchi raqamli platformalarning didaktik imkoniyatlari ilmiy-fiziologik nuqtai nazardan asoslab berilgan. Ushbu yondashuvning talabalar akademik o'zlashtirishini, emotsional-vizual xotirasini hamda bo'lajak biologiya o'qituvchilarining kasbiy-pedagogik kompetentligini rivojlantirishdagi o'rni keng yoritib berilgan.*

Kalit so'zlar: *Raqamli egizak, vegetativ organlar, 3D-modellashtirish, imitatsion texnologiyalar, BioDigital Human, Complete Anatomy, VR-simulyatsiya, pedagogik ta'lim, fiziologik jarayonlar, didaktik transformatsiya.*

Annotation: *This paper examines the deep theoretical, scientific, and methodological foundations of integrating modern digital didactics and simulation technologies-specifically the "Digital Twin" concept-into higher pedagogical education to enhance the teaching of "Human Anatomy and Physiology." The study highlights the epistemological and methodological barriers associated with explaining the microscopic and continuous dynamic processes of vegetative organ systems (digestive, respiratory, circulatory, excretory, and autonomic nervous systems) through conventional static visual aids. From the author's scientific perspective, the didactic potential of 3D modeling, VR/AR simulations, and AI-driven digital platforms is rigorously substantiated from an anatomical and physiological standpoint. Furthermore, the work thoroughly articulates how this innovative approach boosts student academic performance, enhances long-term visual-cognitive retention, and fosters the professional-pedagogical competence of future biology teachers.*

Keywords: *Digital Twin, vegetative organs, 3D modeling, simulation technologies, BioDigital Human, Complete Anatomy, VR simulation, pedagogical education, physiological processes, didactic transformation.*

Kirish: O‘zbekiston Respublikasining “Ta’lim to‘g‘risida”gi Qonuni hamda 2022–2026-yillarga mo‘ljallangan Yangi O‘zbekistonning taraqqiyot strategiyasida oliy ta’lim tizimini raqamlashtirish, ta’lim jarayoniga ilg‘or xalqaro standartlarga mos keluvchi axborot-kommunikatsiya va pedagogik texnologiyalarni keng joriy etish eng ustuvor vazifalardan biri sifatida belgilangan. Xususan, oliy ta’limda bo‘lajak biologiya va tabiatshunoslik o‘qituvchilarini tayyorlash sifatini oshirish, ularning dunyoqarashi va kasbiy maxoratini zamonaviy ilm-fan yutuqlari asosida shakllantirish bevosita o‘quv fanlarining didaktik ta’minotini zamonaviylashtirishni talab etadi.

Pedagogika OTMlarida o‘qitiladigan “Odam anatomiyasi va fiziologiyasi” fani biologik va tibbiy bilimlarning tayanch poydevori hisoblanadi. Ushbu fanning eng murakkab, shu bilan birga nazariy va amaliy jihatdan muhim bo‘limlaridan biri bu - vegetativ organlar va ularning boshqarilishidir. Ovqat hazm qilish, nafas olish, qon va limfa aylanishi, ayirish hamda ko‘payish organlari inson organizmining ichki muhiti doimiyligini (gomeostazni) ta’minlovchi, ongga bo‘ysinmaydigan vegetativ (avtonom) nerv tizimi orqali boshqariladigan yaxlit biologik mekhanizmdir.

Hozirgi kunda pedagogik amaliyotda vegetativ organlar fiziologiyasini o‘qitishda jiddiy didaktik ziddiyat ko‘zga tashlanmoqda: bir tomondan, tirik organizmdagi fiziologik jarayonlar mikroskopik, biokimyoviy va dinamik xarakterga ega bo‘lsa, ikkinchi tomondan, ularni o‘qitishda hali-hanuz statik xarakterdagi an’anaviy vositalardan (bosma plakatlar, gipsli yoki plastik statik maketlar, tekis 2D rasmlar va klassik darsliklar) foydalanib kelinmoqda. Statik tasvirlar va matnli tushuntirishlar orqali, masalan, yurak klapanlarining dinamik ishi, nefron kanalchalaridagi sekretor hamda reabsorbsiya jarayonlari, metabolizm natijasida gazlar almashinuvi va simpatik-parasimpatik innervatsiyaning antagonist ta’sirini talabaning tasavvurida to‘liq va aniq shakllantirish juda mushkul.

Aynan ushbu muammoni hal etishda zamonaviy muhandislik va tibbiyotda jadallik bilan rivojlanayotgan “Raqamli egizak” konsepsiyasi hamda imitatsion texnologiyalar pedagogik didaktikaga kirib kelmoqda. Tirik organ va uning murakkab fiziologik funksiyasining aniq kompyuter modelini yaratish - talabalarga inson organizmidagi murakkab hayotiy jarayonlarni mikronit darajasida, real vaqt rejimida kuzatish, vizuallashtirish va uni harakatda tahlil qilish imkonini beradi. Ushbu tadqiqot aynan vegetativ organlar bo‘limini o‘qitishda raqamli egizak konsepsiyasini qo‘llashning ilmiy-metodik asoslarini va uning talabalar hamda pedagoglar uchun qulayliklarini yoritishga bag‘ishlanadi.

Vegetativ organlar fiziologiyasini o‘rganishda gnoseologik muammolar va raqamli didaktikaga ehtiyoj

Inson biologiyasida vegetativ organlar organizmning hayot faoliyatini uzluksiz ta’minlovchi "Ichki xizmat ko‘rsatish tizimi" vazifasini bajaradi. Animal (somatic) organlardan farqli ravishda, vegetativ organlarning ishi insonning irodasi va ongiga bog‘liq bo‘lmagan holda, avtonom tarzda kechadi. Ushbu organlar fiziologiyasini o‘rgatishda pedagog duch keladigan asosiy ilmiy va didaktik qiyinchiliklar quyidagilardan iborat:

Birinchidan, ko‘p bosqichli va mikroskopik dinomika. Masalan, ayirish organlari fiziologiyasida buyrakning structural-funksional birligi bo‘lmish nefronning ishi mikroskopik darajada kechadi. An’anaviy doskadagi chizma yoki 2D sxemalarda filtratsiya bosimining o‘zgarishi va Bumen kapsulasi hamda kapillyarlar o‘rtasidagi moddalar almashinuvini jonli ko‘rsatishning iloji yo‘q.

Ikkinchidan, fiziologik jarayonlarning uzluksizligi va tezligi. Yurak-qon tomir tizimida diastola va sistola bosqichlari, qon tomirlardagi gidrodinamik bosim va klapanlarning ochilib-yopilishi millisekundlar ichida sodir bo‘ladi. Talaba buni statik maketda ko‘rganda organ faoliyatini bosqichma-bosqich harakatda emas, balki qotib qolgan holatda qabul qiladi.

Uchinchidan, bioetika va laboratoriya cheklovlari. Fiziologiya fanida tirik organizmlar va organlar ustida tajriba o‘tkazish (masalan, tajriba hayvonlarining vegetativ nervlarini qirqish yoki ta’sirlash orqali organlar reaksiyasini kuzatish) zamonaviy bioetika normalari talablariga ko‘ra keskin cheklangan. Qolaversa, inson organizmining ichki a’zolari faoliyatini bevosita auditoriya sharoitida vizual namoyish etib bo‘lmaydi.

Shu sababli, ta’lim jarayoniga imitatsion texnologiyalarni joriy etish zudlik bilan hal etilishi lozim bo‘lgan ob’ektiv zaruriyatdir. Imitatsion vizuallashtirish bu oddiygina multiplikatsiya yoki 3D tasvir emas, balki biologik va fiziologik qonuniyatlarga tayanuvchi, interaktiv, parametrlari o‘zgaruvchan hisoblash va modellashtirish tizimidir.

“Raqamli egizak” Konsepsiyasi va amaliyatda qo‘llaniladigan platformalarning ilmiy tahlili

Raqamli egizak - bu obyekt, tizim yoki jarayonning fizik xususiyatlari va fiziologik xatti-harakatlarini aniq takrorlaydigan virtual modelidir. Odam anatomiyasi va fiziologiyasida raqamli egizak tushunchasi inson a’zosi yoki butun organlar tizimining anatomo-topografik, histologic va fiziologik xususiyatlarini kompyuter xotirasida 3D ko‘rinishda aks ettirilishini anglatadi.

Vegetativ organlar bo‘limini o‘qitishda quyidagi zamonaviy raqamli platformalar va dasturiy vositalar yuqori ilmiy-metodik natija beradi:

1. BioDigital Human platformasining didaktik imkoniyatlari.

Ushbu platforma inson tanasining eng mukammal va realistik 3D-interaktiv modelini taqdim etadi. Vegetativ organlarni o‘rganishda u orqali organlarni nafaqat anatomik joylashuvini, balki ularning patofiziologik holatlarini ham kuzatish mumkin. Masalan, oshqozon-ichak traktida ozuqa

moddalarning fermentativ parchalanishi va ichak vorsinkalari orqali qonga so‘rilishi jarayonini molekulyar darajagacha kattalashtirib kuzatish imkoniyati bor. Talaba simpatik va parasimpatik nerv tizimi tugunlarining faollashuvi natijasida oshqozon sekresiyasining oshishi yoki kamayishini simulyatsiya qila oladi.

2. Complete Anatomy va Anatomy Learning (3D Anatomy Atlas) dasturlari.

Ushbu dasturiy ta’minotlar vegetativ organlarning qatlamli (layer-by-layer) disseksiyasini o‘tkazishga sharoit yaratadi. Talabalar va o‘qituvchilar yurak, o‘pka, jigar yoki buyrakning qon bilan ta’minlanishi (vaskulyarizatsiya) hamda vegetativ innervatsiyasini alohida ajratib olgan holda o‘rganishadi. Ayniqsa, yurak mushagining qisqarishi, gipoksiya yoki jismoniy zo‘riqish holatida toj tomirlardagi qon oqimi dinamikasini vizual tahlil qilish imkoniyati darsning ilmiy saviyasini mislsiz darajada oshiradi.

3. Immersiv VR/AR (Virtual va To‘ldirilgan borliq) garnituralari.

Meta Quest yoki HTC Vive kabi virtual borliq ko‘zoynaklari orqali talaba shunchaki tomoshabin emas, balki jarayonning faol qatnashchisiga aylanadi. Virtual borliqda talaba “qon tomiri ichiga kirib”, eritrotsitlarning o‘pka alveolalarida kislorod bilan to‘yinishi va karbonat angidridni ajratib chiqarishi jarayonini kinestetik va uch o‘lchamli fazoda idrok etadi. Bu holat talabada o‘rganilayotgan obyekt haqida yaxlit va chuqur ilmiy tasavvur hosil qiladi.

Ushbu yondashuvning talabalar va pedagoglar uchun qulayligi va afzalliklari

Raqamli egizaklar va imitatsion texnologiyalarni o‘quv jarayoniga joriy etish ta’limning ikki asosiy sub’ekti - pedagoglar va talabalar uchun birdek ko‘plab qulayliklar hamda afzalliklarni taqdim etadi.

Talabalar uchun qulaylik va afzalliklar: Mavhum tushunchalarni ko‘rgazmali va aniq idrok etish: Talaba murakkab va ko‘z bilan ko‘rib bo‘lmaydigan fiziologik jarayonlarni (masalan, vegetativ nerv reflekslari, fermentlar ta’siri, gormonal boshqaruv) ancha oson va tez tushunib yetadi.

Mustaqil ta’lim va masofaviy foydalanish imkoniyati: Talabalar audiotoriyadan tashqarida ham smartfon, planshet yoki kompyuter orqali 3D modellar bilan ishlay oladi. Ular organni xohlagan burchakdan aylantirib, qatlamma-qatlam kesib ko‘rish va bilimlarni o‘zi sinab ko‘rish imkoniga ega bo‘ladi.

Tadqiqotchilik va simulyatsion ko‘nikmalarni shakllantirish: Talaba virtual muhitda fiziologik ko‘rsatkichlarni o‘zgartirib kuzatish imkoniga ega bo‘ladi. Masalan, qon bosimi keskin oshganda buyrak filtrlash tezligining o‘zgarishini o‘zi simulyatsiya qilib ko‘radi. Bu ularda ilmiy-tadqiqotchilik tafakkurini rivojlantiradi.

Uzoq muddatli va mustahkam xotira: Vizual va interaktiv vositalar orqali olingan bilimlar miyaning assotsiativ zonalarida saqlanib, an’anaviy yodlash usuliga qaraganda ancha mustahkam va davomiy bo‘ladi.

Pedagoglar uchun qulaylik va afzalliklar: Dars samaradorligi va vaqt tejamkorligi: O‘qituvchi murakkab jarayonlarni soatlab doskada chizib yoki tushuntirib berishiga hojat qolmaydi. Bitta aniq va mukammal 3D simulyatsiya orqali mavzuning mag‘zini bir necha daqiqada talabalarga yetkazib bera oladi.

Ko‘rgazmali va zamonaviy dars uslubi: O‘qituvchi darsni zamonaviy, interaktiv va qiziqarli shaklda tashkil etadi. Bu talabalarning fanga bo‘lgan qiziqishi va motivatsiyasini keskin oshiradi.

Nazorat va baholashning qulayligi: Dasturlarga biriktirilgan interaktiv testlar hamda 3D-disseksiya topshiriqlari orqali pedagog talabaning anatomik tuzilmalarni qanchalik to‘g‘ri o‘zlashtirganini real vaqt rejimida va xolis baholay oladi.

Kasbiy va raqamli kompetentlikning oshishi: Zamonaviy AI va 3D dasturlar bilan ishlash pedagogning doimiy o‘z ustida ishlashiga hamda uning ilg‘or pedagogik texnologiyalardan xabardorlik darajasini yuqori ushlab turishga xizmat qiladi.

Maqolaning ilmiy yangiligi va zamonaviy ilm-fandagi o‘rni

Ushbu tadqiqot ishining ilmiy yangiligi shundaki, unda ilk bor oliy pedagogik ta’lim tizimida "Odam anatomiyasi va fiziologiyasi" fanini o‘qitishda ilgari faqat muhandislik va yuqori texnologik tibbiyotda qo‘llanilgan "Raqamli egizak" konsepsiyasi didaktik invariant sifatida nazariy va metodik jihatdan asoslab berildi.

Tadqiqot doirasida erishilgan asosiy ilmiy natijalar quyidagilardan iborat:

Vegetativ organlarning mikroskopik va uzluksiz fiziologik jarayonlarini o‘qitishda klassik statik ko‘rgazmalar va zamonaviy raqamli imitatsion modellarning o‘zaro nisbati tahlil qilindi hamda raqamli didaktikaning ustunligi ilmiy va metodik jihatdan isbotlandi.

Pedagogika OTMlarida bo‘lajak biologiya o‘qituvchilarini tayyorlashda ularning didaktik va raqamli kompetentligini shakllantirishning uch bosqichli (Nazariy-vizual, Interaktiv-simulyatsion, Tahliliy-pedagogik) innovatsion didaktik modeli ishlab chiqildi.

BioDigital Human, Complete Anatomy va VR platformalarini pedagogik va didaktik jarayonga integratsiya qilish orqali talabalarda nafaqat anatomik-fiziologik bilimlarni, balki ularda kelajakda maktab biologiya kursini ("Inson va uning salomatligi") zamonaviy va raqamli vositalar orqali o‘qitish mahoratini oshirish imkoniyati ko‘rsatib berildi.

Xulosa. Xulosa o‘rnida shuni aytish munkinki ushbu maqola Oliy ta’lim muassasalarida “Odam anatomiyasi va fiziologiyasi” fanidan vegetativ organlar bo‘limini o‘qitishda “Raqamli egizak” va imitatsion texnologiyalardan foydalanish ta’lim sifatini tubdan yangi bosqichga olib

chiqadi. Ushbu yondashuv vegetativ organlar faoliyatiga xos bo‘lgan mikroskopik, ko‘p omilli va uzluksiz fiziologik jarayonlarni oson va aniq vizuallashtirish orqali an’anaviy ta’limdagi metodik va gnoseologik to‘siqlarni batamom bartaraf etadi.

Tadqiqot va tahlillar shuni ko‘rsatadiki, 3D modellashtirish hamda VR/AR simulyatsiyalaridan foydalanish bir tomondan talabalarda fanga bo‘lgan yuqori motivatsiyani va uzoq muddatli vizual-mantiqiy xotirani shakllantirsa, ikkinchi tomondan pedagog uchun darsni samarali, vaqtni tejagan holda va zamonaviy darajada tashkil etish uchun cheksiz qulayliklar yaratadi.

Xulosa qilib aytganda, raqamli egizaklar konsepsiyasini pedagogik ta’limga joriy etish shunchaki texnik vositalardan foydalanish emas, balki bo‘lajak biologiya o‘qituvchilarining zamonaviy raqamli jamiyat va maktab ta’limi talablariga mos kasbiy-pedagogik kompetentligini shakllantirishning eng samarali vositasidir.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI.

1. O‘zbekiston Respublikasi Prezidentining “Raqamli O‘zbekiston - 2030” strategiyasini tasdiqlash to‘g‘risida”gi PF-6079-son Farmoni. – Toshkent, 2020.

2. Mirziyoyev Sh.M. Yangi O‘zbekiston strategiyasi. – Toshkent: “O‘zbekiston” nashriyoti, 2021.

3. Aminov B.A., Xudoyberdiyev R.E. Odam anatomiyasi va fiziologiyasi (Darslik). – Toshkent: “O‘qituvchi”, 2018. – 380 b.

4. Ziyamukhamedov S.S., Mavlonov O.M. Biologiyani o‘qitishda innovatsion va imitatsion texnologiyalar. – Toshkent: "Fan va texnologiya", 2022. – 210 b.

5. Ahmedov K.A. Odam va hayvonlar fiziologiyasi. – Toshkent: "Noshir", 2020. – 312 b.

6. Allen, A. P., & Smith, R. J. (2022). Digital Twins in Medical and Biological Education: Transforming Human Anatomy and Physiology Learning Through 3D Simulation. Journal of Educational Technology in Health Sciences, 15(3), 142–158.

7. Henssen, D. J., & van den Heuvel, L. (2020). Anatomy education in the digital era: The role of 3D visualization tools in cognitive load management. Anatomical Sciences Education, 13(5), 589–601.

8. BioDigital Human Platform: Interactive 3D Human Visualization Software and Physiology Engine. https://www.biodigital.co.

9. Complete Anatomy (3D4Medical): Advanced 3D Anatomy and Physiology Platform for Education. https://3d4medical.com.

10. AnatomyLearning – 3D Anatomy Atlas: Interactive visual guide for medical and biological education. https://anatomylearning.co.

ТЕМАТИЧЕСКИЕ РАЗРАБОТКИ В ПРЕПОДАВАНИИ ДИСЦИПЛИН БОТАНИЧЕСКОГО ЦИКЛА

Шкуратова Н. В., кандидат биологических наук, доцент, shkuratova@brsu.by;
Левковская М. В., старший преподаватель, levkovskaya@brsu.by
Брестский государственный университет имени А. С. Пушкина, г. Брест,
Республика Беларусь

Аннотация. *В статье представлен опыт разработки практико-ориентированных материалов по учебным дисциплинам ботанического цикла, подготовленных с учетом современного состояния флоры Бугско-Полесского региона. Применение тематических гербарных материалов, ботанических паспортов и конспектов флор способствует повышению эффективности образовательного процесса.*

Ключевые слова: *образовательный процесс, принцип наглядности, разработка, гербарий, флора.*

Многоаспектность образовательного процесса, специфика решаемых задач обучения, развитие личности в образовательной среде в современных условиях требуют диверсификации методического обеспечения процесса обучения [1, с. 3]. Применение приемов визуализации информации способствует формированию естественнонаучной грамотности, повышению познавательного интереса [3]. Однако при обучении биологии современные технические средства (мультимедийные программы, электронные учебники, видеоматериалы) должны использоваться в комплексе с натуральными объектами (гербарии, коллекции и др.). В системе экологического образования знакомство с живыми коллекциями объектов флоры или гербарными материалами является важным инструментом изучения биологического разнообразия растительного мира, что особенно актуально при преподавании ботанических дисциплин [2]. Применение гербариев и коллекций, как натуральной наглядности, которая предполагает использование подлинных, неискаженных объектов живой природы, позволяет обучающимся непосредственно воспринимать морфологические особенности растений, что способствует более глубокому усвоению материала по сравнению с абстрактными описаниями или даже качественными изображениями.

В настоящее время гербарии существуют в научных и учебных заведениях. В учреждениях образования они представляют собой принципиально незаменимую базу для подготовки высококвалифицированных специалистов-ботаников, повышения уровня преподавания различных ботанических дисциплин, а также для научной работы студентов. Основной задачей любого гербария является создание, хранение и систематизация

коллекционных фондов, особенно по высшим растениям. В структуре фонда также могут быть представлены коллекции водорослей, грибов, лишайников, семян, плодов и других ботанических объектов [5, с. 4].

В Брестском государственном университете имени А.С. Пушкина в процессе выполнения научно-исследовательской работы «Использование объектов культурной и дикорастущей флоры Бугско-Полесского региона в образовательном процессе» (номер государственной регистрации 20201614 от 08.09.2020 г.) проведено обновление содержания и разработано учебно-методическое обеспечение ряда учебных дисциплин ботанического цикла с учетом современного состояния флоры геоботанического округа.

На основе проведенных маршрутных исследований, накопленного материала о составе аборигенной и адвентивной фракции региональной флоры, включая интродуцированную дендрофлору ряда семейств, были подготовлены учебно-методические разработки. В их содержание включена информация о видовом разнообразии, морфологических и экологических особенностях культурных и дикорастущих растений.

Подготовка объектов наглядности для использования в образовательном процессе по учебным дисциплинам ботанического цикла велась с учетом региональных особенностей растительных сообществ по трем основным направлениям. Состояние флоры природных сообществ отражают разработки «Флора сосновых лесов» и «Флора лугов», а видовой состав и особенности развития в условиях антропогенного прессинга – разработки «Флора синантропных местообитаний», «Хомофиты урбоэкосистем», «Растения рудеральных местообитаний», «Раннецветущая интродуцированная дендрофлора», коллекция «Видовое разнообразие бриофитов отдела «Агробиология». Результаты исследований местной флоры представлены в разработке «Конспект флоры аг. Плотница Столинского района» и др.

Остановимся подробнее на некоторых примерах. В разработке «Хомофиты урбоэкосистем» представлены гербарные образцы растений, типичных для различного типа нарушенных местообитаний, находящихся под постоянным или периодическим антропогенным воздействием (карьеры, транспортные пути, пустыри, свалки и т. п.), а также характерных для интенсивно вытаптываемых участков [4, с. 172]. Обучающиеся знакомятся с разнообразием распространенных растений рудеральных сообществ в пределах города, их специфическими морфологическими адаптациями к условиям существования.

Разработка «Раннецветущая интродуцированная дендрофлора» включает результаты исследований декоративных древесных покрытосеменных растений, цветущих весной, на примере коллекции Сада непрерывного цветения Брестского государственного университета имени А.С. Пушкина. Непосредственно эта группа насчитывает более 55 видов и

внутривидовых таксонов, принадлежащих к семействам *Magnoliaceae*, *Berberidaceae*, *Paeoniaceae*, *Ericaceae*, *Grossulariaceae*, *Rosaceae*, *Caprifoliaceae*, *Oleaceae*. Разработка включает ботанические паспорта представителей декоративной дендрофлоры с указанием названий вида и семейства на русском и латинском языках, родины, количества особей, сопровождается фотографиями и кратким описанием морфолого-биологических характеристик объектов с привязкой к географическим координатам. Полученные материалы позволяют обучающимся в течение всего года отрабатывать навыки определения растений по диагностическим признакам семейств, а также выделять биологические особенности деревьев и кустарников, цветущих в весенний период, что необходимо при проведении лабораторных занятий, учебных практик, выполнении исследовательских работ.

Составление конспекта флоры является необходимым этапом при изучении, рациональном использовании и охране растительного мира, служит основой для создания определителей растений. Разработка «Конспект флоры аг. Плотница Столинского района» отражает результаты научных исследований местной флоры, знакомит обучающихся с таксономическим составом, экологическими и хорологическими особенностями аборигенных и адвентивных видов сосудистых растений.

Приведенные и другие разработки были внедрены в образовательный процесс факультета естествознания Брестского государственного университета имени А.С. Пушкина по дисциплинам «Ботаника», «Флора и растительность Беларуси», «Спецпрактикум», «Методы экологических исследований», применяются в ходе учебной зоолого-ботанической практики, учебной ознакомительной практики и т. д.

Таким образом, рассмотренные тематические разработки способствуют повышению уровня наглядности изучаемого ботанического материала, знакомят обучающихся с видовым разнообразием флоры, особенностями флористического состава и растительного покрова Бугско-Полесского региона. Студенты осваивают методы диагностики, инвентаризации ботанических объектов, составления коллекций, приобретают навыки исследовательской работы.

Список использованной литературы

1. Берденникова, Н. Г. Методическое обеспечение процесса обучения как фактор повышения качества образования в вузе : автореф. дис. ... канд. пед. наук : 13.00.08 / Н. Г. Берденникова ; СПб. ун-т Гос. противопожар. службы МЧС России. – СПб., 2007. – 21 с.

2. Иванова, А. В. Роль гербария в экологическом образовании / А. В. Иванова, Г. Э. Кудинова, А. Г. Розенберг // Проблемы развития предприятий: теория и практика :

материалы XVI Междунар. науч.-практ. конф., Самара, 16–17 нояб. 2017 г. : в 3 ч. / Самар. гос. экон. ун-т. – Самара, 2017. – Ч. 3. – С. 224–226.

3. Лев, Я. Б. Применение приемов визуализации информации как средство формирования естественнонаучной грамотности / Я. Б. Лев, О. А. Яскина // Проблемы современного педагогического образования. – 2021. – № 72-4. – С. 178–181.

4. Лемеза, Н. А. Геоботаника : Учебная практика : учеб. пособие / Н. А. Лемеза, М. А. Джус. – Мн. : Выш. шк., 2008. – 255 с.

5. Сауткина, Т. А. Гербарий Белорусского государственного университета (MSKU) / Т. А. Сауткина, В. Д. Поликсенова, С. М. Дробышевская. – Мн. : БГУ, 2016. – 87 с.

OLIY TA’LIMDA TADQIQOTGA YO‘NALTIRILGAN O‘QITISH (RBL) VA MANTIQIY FIKRLASHNI RIVOJLANTIRISHNING PEDAGOGIK-PSIXOLOGIK ASOSLARINI BOTANIKA FANI XUSUSIYATLARIDAN KELIB CHIQQAN HOLDA OCHIB BERISH.

Obloqulov Jahongir

Samarqand davlat pedagogika instituti Tabbiy fanlar fakulteti Biologiya kafedirasi assistenti

jahongirobloqulov1992@gmail.com 99.730.02.37

Annotatsiya. *Mazkur tezisda oliy ta’limda tadqiqotga yo‘naltirilgan o‘qitish (RBL) yondashuvi orqali talabalarda mantiqiy fikrlashni rivojlantirishning pedagogik-psixologik asoslari botanika fanining empirik va nazariy xususiyatlari bilan uyg‘unlikda tahlil qilinadi. Maqsad RBLning didaktik mexanizmlarini asoslash va botanika ta’limida muammo, gipoteza, dalillash hamda xulosa chiqarish ko‘nikmalarini shakllantirish modelini yoritishdan iborat.*

Annotatsiya. *This thesis examines pedagogical and psychological foundations for developing logical thinking in higher education through research-based learning (RBL), grounded in the specific features of botany. The aim is to justify RBL didactic mechanisms and present a model for cultivating problem formulation, hypothesis building, evidence-based reasoning, and conclusion drawing in botany education by integrating empirical observation with theoretical explanation and reflective inquiry.*

Kalit so‘zlar *(o‘zbek): tadqiqotga yo‘naltirilgan o‘qitish; botanika didaktikasi; mantiqiy fikrlash; muammoli ta’lim; gipoteza; dalillash; refleksiya*

Keywords (ingliz): *research-based learning; botany didactics; logical thinking; problem-based learning; hypothesis; evidence-based reasoning; reflection*

Oliy ta’limda fanlarni o‘qitish natijadorligi tobora ko‘proq talabaning tayyor bilimni qayta aytishi bilan emas, balki u bilimni qanday hosil qilishi, tekshirishi va asoslab bera olishi bilan o‘lchanmoqda. Shu nuqtai nazardan tadqiqotga yo‘naltirilgan o‘qitish (RBL) mazmunan laboratoriya yoki dala amaliyotini ko‘paytirish bilangina cheklanmaydi; u o‘quv jarayonining mantiqiy tuzilmasini o‘zgartirib, bilishning ilmiy usullarini ta’limiy vazifaga aylantiradi. Botanika fanining predmeti tirik tabiatning shakl va funksiyasi, muhit bilan o‘zaro aloqalari, xilma-xilligi hamda tarixiy rivojlanish qonuniyatlarini o‘rganishga qaratilgani uchun RBL aynan shu fanda tabiiy ravishda “yashirin” ilmiy tadqiqot mantiqini ochib berish imkonini beradi. Botanika bo‘yicha kuzatish, taqqoslash, tasniflash, eksperiment, daladan namuna yig‘ish, gerbariylash, mikroskopik tahlil, statistik ishlov singari amallar talabaning mantiqiy fikrlashini bosqichma-bosqich faollashtiradigan kognitiv harakatlar tizimini tashkil etadi. Demak, botanika ta’limi sharoitida RBL nafaqat metod, balki mantiqiy fikrlashni rivojlantirishning pedagogik-psixologik mexanizmlarini ishga tushiruvchi integrativ yondashuv sifatida talqin qilinishi lozim.

RBLning pedagogik asosi konstruktivistik va faoliyatga yo‘naltirilgan ta’lim g‘oyalari bilan uzviy bog‘liq bo‘lib, unda bilim tashqi axborot sifatida “berilmaydi”, balki muammo vaziyati, izlanish savollari va dalillar bilan ishlash jarayonida quriladi. O‘qituvchi bu jarayonda ma’lumot manbai rolidan ko‘ra, ilmiy bilish faoliyatini loyihalovchi va boshqaruvchi fasilitator vazifasini bajaradi. Bunday o‘zgarish didaktik rejalashtirishga ham ta’sir etadi: maqsadlar kompetensiya sifatida ifodalanadi, natijalar esa mantiqiy amallarni bajarish sifati orqali baholanadi. RBLning psixologik asosi esa motivatsiya va metakognitsiya mexanizmlarida namoyon bo‘ladi: talaba o‘z savoliga javob topish zarurati tufayli ichki motivatsiyani his qiladi, izlanish strategiyalarini tanlaydi, xatolarni aniqlaydi va tuzatadi, ya’ni o‘z bilish jarayonini nazorat qiladi. Bu jihatlar oliy ta’lim psixologiyasida shaxsning mustaqilligi va o‘zini-o‘zi boshqaradigan o‘qish modeli bilan mos keladi [1; 6]. Ayniqsa, botanika kabi ko‘p manbali, ko‘p omilli va kontekstga bog‘liq hodisalarni o‘rganishda metakognitiv nazorat kuchli bo‘lmasa, talaba faktlar to‘plamini yodlashga berilib ketadi; RBL esa faktlarni izchil tushuntirish, sabab-oqibat bog‘lanishlarini tekshirish va dalillarni saralashga majbur qiladi.

Mantiqiy fikrlash mazmunan tushuncha hosil qilish, hukm yuritish, xulosa chiqarish, dalillash, umumlashtirish va tasniflash kabi amallar birligi sifatida namoyon bo‘ladi. Botanika fani bu amallarni tabiiy tarzda talab qiladi, chunki “nima?” degan savol (morfologik belgi), “nima uchun?” degan savol (moslanish va funksional izoh), “qanday?” degan savol (jarayon mexanizmi) va “qaysi sharoitda?” degan savol (ekologik determinantlar) bir-birini to‘ldiradi. Talaba, masalan, barg plastinkasining qalinligi yoki tuklilik darajasi haqida kuzatish olib borar ekan, u shunchaki belgi qayd etmaydi; u belgi va muhit o‘rtasidagi bog‘lanish bo‘yicha gipoteza ilgari suradi, analog

misollar bilan taqqoslaydi, farqlovchi belgilarni ajratadi va xulosaga keladi. Bu jarayon mantiqiy fikrlashning induktiv va deduktiv yo‘nalishlarini uyg‘unlashtiradi: konkret kuzatuvdan umumiy qoida tomon ko‘tarilish va umumiy biologik tamoyildan konkret holatni tushuntirishga qaytish.

RBLni botanika ta’limiga moslashtirishda fan xususiyatlaridan kelib chiqadigan uchta didaktik holat muhimdir. Birinchisi, obyektning ko‘p ko‘rinishliligi va variativligi: bitta tur doirasida ham morfologik o‘zgaruvchanlik mavjud bo‘lib, bu talabaning “bir belgi bitta javob” stereotipini sindiradi va ehtimollik, tipik va atipik holatlarni farqlash madaniyatini shakllantiradi. Ikkinchisi, tasnif va identifikatsiya jarayonining mantiqiy tabiati: dikotomik kalitlar bilan ishlash, diagnostik belgilarni tanlash, sinf-turkum-urug‘-tur ketma-ketligida umumlashtirish botanika mazmunining o‘zida mantiqiy qaror qabul qilishni talab etadi. Uchinchi holat, dala va laboratoriya dalillarini integratsiyalash zarurati: o‘simlikni tabiiy muhitda ko‘rish (ekologik kontekst) va mikroskop ostida to‘qima tuzilishini tekshirish (strukturaviy izoh) bir-birini to‘ldiradi; RBL esa aynan shu integratsiyani o‘quv topshiriqlariga aylantiradi.

Taklif etilayotgan pedagogik-psixologik modelning ichki mantiqi “muammo savoli – izlanish rejasini tuzish – dalil yig‘ish – tahlil va talqin – dalillash – refleksiya” ketma-ketligiga tayanadi. Modelning birinchi bo‘g‘ini muammo savolini didaktik jihatdan to‘g‘ri qo‘yishni talab qiladi: savol kuzatuvga tayanuvchi, tekshiriladigan va mavzuning konseptual markaziga tegishli bo‘lishi lozim. Masalan, “Nega sho‘rxok hududlarda barglar ko‘pincha sukkulentlashadi?” kabi savol talabaning moslanish nazariyasi, suv rejimi, osmotik bosim va anatomik tuzilma haqidagi bilimlarini bir tizimga soladi. Ikkinchi bo‘g‘in izlanish rejasini tuzishda o‘lchov va mezon masalasini kiritadi: talaba qaysi belgilarni tanlashi, namunalar sonini qanday belgilashi, taqqoslash guruhini qanday shakllantirishi haqida qaror qabul qiladi; bu esa metodologik fikrlashni kuchaytiradi va ilmiy mantiqning operatsion tomonini ochib beradi [6]. Uchinchi bo‘g‘inda dalil yig‘ish faqat fakt to‘plash emas, balki faktning ishonchliligini ta’minlash (takror o‘lchash, protokollash, fotosuratlash, herbariy etiketi) orqali mas’uliyatli akademik xulqni ham shakllantiradi.

Tahlil va talqin bosqichida mantiqiy fikrlashning asosiy “sinovi” yuz beradi: talaba yig‘ilgan ma’lumotni jadallashtiradi, oddiy statistik ko‘rsatkichlar yoki vizual taqdimotlar orqali qonuniyat izlaydi, alternativ izohlarni solishtiradi. Bu yerda o‘qituvchining psixologik qo‘llab-quvvatlashi muhim: talaba xatoni “muvaffaqiyatsizlik” emas, balki tekshiruv natijasi sifatida qabul qilsa, kognitiv qat’iyat va izlanishga chidamlilik ortadi. Vygotskiy ta’kidlagan yaqin rivojlanish zonasi nuqtai nazaridan, o‘qituvchi tomonidan beriladigan “skafolding” savollari (Qaysi dalil kuchli? Qaysi faraz zaif? Qanday qarshi misol keltirasan?) talabaning mantiqiy amallarini yuqori darajaga ko‘taradi [2]. Dalillash bosqichida talaba ilmiy matn yoki og‘zaki himoya ko‘rinishida o‘z xulosasini asoslaydi, sabab-oqibat zanjirini mantiqan tiklaydi, tushunchalarni to‘g‘ri ishlatadi,

chegara shartlarini ko‘rsatadi. Bu ko‘nikmalar oliy ta’limda akademik yozuv madaniyati bilan bevosita bog‘liq bo‘lib, botanika bo‘yicha referat yoki mini-loyiha himoyasi RBLning tabiiy yakuniy mahsuliga aylanadi [5].

Modelning yakuniy bo‘g‘ini refleksiya bo‘lib, u mantiqiy fikrlashni barqarorlashtiradi: talaba qaysi usul ishlaganini, qaysi joyda dalil yetishmaganini, kelgusida tadqiqotni qanday yaxshilash mumkinligini tahlil qiladi. Refleksiya psixologik jihatdan metakognitiv “orqaga qarash” mexanizmini faollashtiradi, natijada keyingi vazifalarda strategiya tanlash ongliroq bo‘ladi. Botanika ta’limida refleksiya dala kundaligi, laboratoriya protokoli, konsept-xarita yoki “gipoteza kartasi” kabi vositalar bilan qo‘llab-quvvatlanishi mumkin; biroq ular formal hisobotga aylanib qolmasligi uchun baholash mezonlari mantiqiy izchillik va dalilga tayanganlikni ustun qo‘yishi zarur. Bu yondashuv Bloom taksonomiyasining yuqori darajalari bilan hamohang bo‘lib, “tushunish” va “qo‘llash”dan “tahlil”, “baholash” va “yaratish”ga o‘tishni tezlashtiradi [4].

Botanika fanining amaliy xususiyati RBLni tashkil etishda ta’lim muhitiga qo‘yiladigan talablarni ham aniqlashtiradi. Dala va laboratoriya resurslari cheklangan sharoitda ham RBLni kichik tadqiqot sikllari orqali yo‘lga qo‘yish mumkin: masalan, kampus hududidagi o‘simliklar xilma-xilligini inventarizatsiya qilish, fenologik kuzatuvlar, tuproq namligi va o‘simlik holati o‘rtasidagi bog‘lanishni tahlil qilish. Muhimi, topshiriq “tayyor yo‘riqnoma”ni bajarishdan iborat bo‘lmasin; talaba kamida bitta mustaqil qaror qabul qilsin: savolni aniqlashtirsin, mezonni tanlasin, dalilni talqin qilsin. Shunda pedagogik jihatdan talabaning subyektiv pozitsiyasi kuchayadi, psixologik jihatdan esa ichki motivatsiya va o‘ziga ishonch ortadi. Shuningdek, RBL jamoaviy izlanishda ham samarali bo‘ladi: rollar taqsimoti (kuzatuvchi, protokollovchi, tahlilchi, taqdimotchi) ijtimoiy-kognitiv o‘rganishni kuchaytiradi, biroq yakuniy natija har bir talabaning individual mantiqiy hissasini aks ettirishi uchun shaxsiy refleksiv yozuv yoki individual himoya komponenti saqlanishi lozim [1; 3].

Xulosa qilib aytganda, botanika fanining empirik dalilga tayanuvchi, tasnifiy-mantiqiy va kontekstual izohga muhtoj xususiyatlari RBLni oliy ta’limda mantiqiy fikrlashni rivojlantirishning tabiiy va ilmiy asoslangan mexanizmiga aylantiradi. Taklif etilgan model muammo savolini qo‘yishdan refleksiyagacha bo‘lgan izlanish sikli orqali talabaning tushuncha hosil qilish, gipoteza ilgari surish, dalil yig‘ish, tahlil va dalillash ko‘nikmalarini bir tizimda shakllantiradi. Pedagogik jihatdan RBL o‘qituvchining rolini ilmiy bilish faoliyatini loyihalovchi va boshqaruvchi sifatida qayta belgilaydi, psixologik jihatdan esa motivatsiya, metakognitsiya va kognitiv qat’iyatni kuchaytiradi. Natijada botanika ta’limi faktlarni yodlash maydonidan ilmiy tafakkur va akademik madaniyatni rivojlantiruvchi ta’limiy-tadqiqot muhitiga aylanadi.

Foydalanilgan adabiyotlar ro‘yxati

1. Zimnyaya I. A. Pedagogicheskaya psikhologiya. Moskva, Logos, 2004. 384 s.

2. Vygotskiy L. S. Myshlenie i rech. Moskva, Labirint, 1999. 352 s.

3. Leontyev A. N. Deyatelnost. Soznanie. Lichnost. Moskva, Politizdat, 1975. 304 s.

4. Anderson L. W., Krathwohl D. R. A taxonomy for learning, teaching, and assessing: A revision of Bloom’s taxonomy of educational objectives. New York, Longman, 2001. 352 p.

5. Dewey J. Experience and education. New York, Macmillan, 1938. 116 p.

6. Saidahmedov N. S. Zamonaviy pedagogik texnologiyalar. Toshkent, Fan va texnologiya, 2012. 256 b.

МЕТОДИКА ПРЕПОДАВАНИЯ КРОВЕТВОРЕНИЯ В КРАСНОМ КОСТНОМ МОЗГЕ СТУДЕНТАМ БИОМЕДИЦИНСКИХ СПЕЦИАЛЬНОСТЕЙ

Ибрагимова Наиля Ахтамовна

Казахский национальный университет имени аль-Фараби, кандидат биологических наук, старший преподаватель

Тел.: + 77052661608 E-mail: nailya.73@mail.ru

Аннотация. *В работе предложена методика преподавания кроветворения в красном костном мозге студентам биомедицинских специальностей. Методика объединяет схему дифференцировки гемопоэтической стволовой клетки, анализ микропрепаратов и цифровых изображений, решение клинической задачи и формирующее оценивание. Учебное занятие строится как последовательный переход от клеточной ниши и регуляции гемопоэза к морфологическому распознаванию клеток и интерпретации изменений общего анализа крови. Такой подход помогает преодолеть фрагментарное запоминание клеточных рядов и формирует умение связывать строение, функцию и клинические проявления.*

Ключевые слова: *гемопоэз, красный костный мозг, гемопоэтическая стволовая клетка, эритропоэз, лейкопоэз, тромбоцитопоэз, виртуальная микроскопия, клиническая задача.*

Введение

Кроветворение требует одновременно усвоить иерархию клеток, признаки созревания, механизмы регуляции и клиническое значение изменений крови. При традиционном объяснении материал нередко превращается в перечень клеточных форм: студент запоминает названия, но затрудняется объяснить сочетанное изменение нескольких ростков кроветворения.

Цель работы - предложить воспроизводимую структуру занятия, обеспечивающую переход от понимания организации красного костного мозга к распознаванию клеток и решению клинико-биологических задач. Методика предназначена для студентов направления «Биомедицина» и может быть адаптирована для курсов гистологии, физиологии, гематологии и клеточной биологии.

Методические принципы

Содержание занятия организуется не по принципу последовательного перечисления всех клеток, а вокруг трёх вопросов: где происходит кроветворение, как принимается решение о направлении дифференцировки и по каким признакам можно установить стадию созревания клетки. Красный костный мозг рассматривается как система, включающая гемопоэтические клетки, синусоидные сосуды, ретикулярную строму, мезенхимальные и эндотелиальные клетки, макрофаги и регуляторные сигналы. Современное представление о нише подчёркивает, что судьба гемопоэтической стволовой клетки определяется не только внутренней программой, но и пространственными взаимодействиями с микроокружением [4, с. 303–320].

Второй принцип - движение от общего к частному. Студенты строят карту от гемопоэтической стволовой клетки через миелоидное и лимфоидное направления к зрелым форменным элементам. Затем линии изучаются через закономерности созревания: уменьшение клетки, конденсацию ядра и накопление гемоглобина в эритроидном ряду; появление зернистости и изменение ядра в гранулоцитарном; эндомитоз и образование тромбоцитов в мегакариоцитарном. Механическое заучивание заменяется системой диагностических признаков.

Третий принцип - сочетание оптической и виртуальной микроскопии. Цифровой препарат позволяет всей группе одновременно обсуждать одну область, изменять увеличение и маркировать признаки клетки. В рандомизированном исследовании внедрение виртуальной микроскопии в курс морфологии крови сопровождалось более высокими результатами по сравнению с традиционной микроскопией [1, с. 149–155]. Систематический обзор также показал улучшение успеваемости студентов и высокую принимаемость виртуального формата, хотя оптическая микроскопия сохраняет значение для формирования практического навыка работы с прибором [3, с. 678–685]. Поэтому цифровое изображение используется для совместного разбора, а индивидуальная работа с микроскопом - для подтверждения и переноса навыка.

Структура учебного занятия

Занятие рассчитано на 90 минут и включает пять взаимосвязанных этапов. До занятия студентам предлагается короткая схема нормального общего анализа крови и изображение красного костного мозга без подписей. В начале преподаватель задаёт проблемный вопрос: «Почему снижение активности одной ткани может привести одновременно к анемии, инфекционным осложнениям и кровоточивости?» Ответ фиксируется, но не оценивается; к нему группа возвращается в конце занятия.

Время	Этап	Действия студентов
0–10 мин	Проблематизация	Интерпретируют сочетание анемии, инфекций и кровоточивости; формулируют гипотезу о роли костного мозга.
10–30 мин	Карта гемопоэза	В группах собирают схему дифференцировки и связывают зрелые клетки с их функциями.
30–55 мин	Морфологический анализ	Сравнивают клетки эритроидного, гранулоцитарного и мегакариоцитарного рядов на цифровых и реальных препаратах.
55–75 мин	Клиническая задача	Сопоставляют показатели крови, возможный уровень нарушения и ожидаемую картину костного мозга.
75–90 мин	Оценивание и рефлексия	Выполняют мини-тест, объясняют одну клеточную

		линию и возвращаются к исходному вопросу.

При построении карты группы получают карточки с названиями клеток, регуляторов и функций. Они располагают элементы и обосновывают связи: например, объясняют усиление эритропоэза эритропоэтином при гипоксии и роль тромбопоэтина. Преподаватель отмечает, что классическая схема удобна дидактически, но современные данные указывают на неоднородность гемопоэтических предшественников и раннее формирование отдельных направлений дифференцировки [2, с. 120–136].

Для морфологического анализа используется алгоритм «размер - ядро - цитоплазма - специфические признаки - функция». Студенты сначала описывают клетку без называния, затем относят её к линии кроветворения и предполагают стадию созревания. При работе с препаратом костного мозга важно сопоставлять отдельную клетку с окружением: островками эритропоэза, мегакариоцитами, жировыми клетками и синусоидами. Такой порядок уменьшает угадывание по одному яркому признаку и развивает систематическое наблюдение.

Клиническая задача: после курса цитостатической терапии у пациента снижены гемоглобин, нейтрофилы и тромбоциты. Студенты определяют, какой орган и какие клеточные линии затронуты, прогнозируют риски и ожидаемые изменения костного мозга.

Оценивание результатов обучения

Оценивание включает три компонента. Первый - точность карты дифференцировки и объяснение не менее трёх причинно-следственных связей. Второй - распознавание клеток по совокупности морфологических признаков. Третий - перенос знаний в клиническую ситуацию. Мини-тест содержит задания разного уровня: назвать зрелую клетку, установить последовательность созревания, объяснить изменение показателя и спрогнозировать последствия угнетения определённого ростка. Для формирующей обратной связи применяется правило «признак - вывод - обоснование»: студент называет наблюдаемый признак, делает вывод и связывает его с биологическим механизмом.

Критерием достижения результата является способность студента самостоятельно: 1) изобразить общую схему гемопоэза; 2) различить основные направления созревания; 3) распознать типичные клетки на препарате; 4) связать нарушение кроветворения с

изменениями общего анализа крови; 5) объяснить роль микроокружения костного мозга. Итоговая рефлексия проводится повторным ответом на исходный проблемный вопрос. Изменение ответа показывает, произошло ли объединение клеточного, тканевого и клинического уровней.

Заключение

Предлагаемая методика превращает изучение кроветворения из запоминания клеточных рядов в последовательное решение биологической задачи. Сочетание карты дифференцировки, морфологического алгоритма, микроскопии и клинического случая формирует целостное представление о красном костном мозге как о динамической системе. Методика не требует сложного оборудования: при отсутствии сканера препаратов можно использовать качественные микрофотографии, а групповую схему выполнять на доске или карточках. В дальнейшем эффективность подхода целесообразно оценить по результатам входного и итогового тестирования, точности морфологического распознавания и качеству объяснения клинических случаев.

Список использованной литературы

1. Brueggeman M.S., Swinehart C., Yue M.J., Conway-Klaassen J.M., Wiesner S.M. Implementing virtual microscopy improves outcomes in a hematology morphology course. Clinical Laboratory Science. 2012. Vol. 25, No. 3. P. 149–155.

2. Doulatov S., Notta F., Laurenti E., Dick J.E. Hematopoiesis: a human perspective. Cell Stem Cell. 2012. Vol. 10, No. 2. P. 120–136.

3. Kuo K.H., Leo J.M. Optical versus virtual microscope for medical education: a systematic review. Anatomical Sciences Education. 2019. Vol. 12, No. 6. P. 678–685. DOI: 10.1002/ase.1844.

4. Pinho S., Frenette P.S. Haematopoietic stem cell activity and interactions with the niche. Nature Reviews Molecular Cell Biology. 2019. Vol. 20. P. 303–320.

ZOOLOGIYA FANINI O‘QITISHDA MUAMMOLI TA’LIM TEXNOLOGIYALARI ASOSIDA PEDAGOGIK KOMPETENSIYALARNI RIVOJLANTIRISH

Ismoilova Dilnora Dilshodovna

Samarqand davlat pedagogika instituti

Annotatsiya. *Zoologiya fanini o‘qitishda muammoli ta’lim texnologiyalaridan foydalanish orqali biologiya o‘qituvchilarining pedagogik kompetensiyalarini rivojlantirish masalalari yoritilgan. Muammoli vaziyatlarni yaratish, biologik hodisalarni sabab-oqibat asosida tahlil qilish, o‘quvchilarni mustaqil izlanishga yo‘naltirish va o‘qitish natijalarini baholashning metodik imkoniyatlari ko‘rib chiqilgan. Shuningdek, zoologiya mashg‘ulotlariga tatbiq etish mumkin bo‘lgan bosqichli metodik yondashuv va amaliy topshiriqlar taklif etilgan.*

Kalit so‘zlar*: zoologiya, muammoli ta’lim, pedagogik kompetensiya, biologiya o‘qituvchisi, muammoli vaziyat, tanqidiy fikrlash, tadqiqotchilik faoliyati, innovatsion metodlar.*

Abstract. *This article examines the development of biology teachers’ pedagogical competencies through the use of problem-based learning technologies in the teaching of zoology. It explores the methodological potential of creating problem situations, analyzing biological phenomena on the basis of cause-and-effect relationships, guiding students towards independent inquiry, and assessing learning outcomes. In addition, a step-by-step methodological approach and practical assignments suitable for implementation in zoology lessons are proposed.*

Keywords: *zoology, problem-based learning, pedagogical competence, biology teacher, problem situation, critical thinking, research activities, innovative methods.*

Zamonaviy ta’lim jarayonida o‘qituvchining kasbiy tayyorgarligi nafaqat fan mazmunini chuqur bilishi, balki o‘quvchilarning mustaqil fikrlashi, muammolarni aniqlashi va ilmiy asoslangan xulosalar chiqarishini tashkil eta olishi bilan ham belgilanadi. Shu jihatdan muammoli ta’lim texnologiyalari biologiya, xususan, zoologiya fanini o‘qitishda muhim didaktik vosita hisoblanadi. Zoologiya hayvonlarning tuzilishi, hayot faoliyati, yashash muhiti, moslanish xususiyatlari va ekologik munosabatlarini o‘rganuvchi fan sifatida o‘quvchilarda sabab-oqibat bog‘lanishlarini anglash uchun keng imkoniyat yaratadi. Masalan, hayvonlarning tashqi tuzilishi nima sababdan yashash sharoitlariga qarab farqlanishi yoki muayyan turning oziq zanjiridan yo‘qolishi ekotizimga qanday ta’sir ko‘rsatishi kabi savollar o‘quvchilarni tayyor ma’lumotlarni takrorlashdan ko‘ra, muammoni tahlil qilishga undaydi [1,2].

Muammoli ta’limni samarali tashkil etish biologiya o‘qituvchisidan o‘quv maqsadiga mos vaziyatlarni tanlash, yo‘naltiruvchi savollar tuzish, o‘quvchilarning turli fikrlarini muhokama qilish va o‘quv natijalarini tegishli mezonlar asosida baholashni talab qiladi. Demak, muammoli ta’lim texnologiyalaridan foydalanish o‘quvchilarning bilim faoliyatini faollashtirish bilan birga, o‘qituvchining metodik va refleksiv kompetensiyalarini rivojlantirish uchun ham imkoniyat yaratadi [2].

Muammoli ta’lim — o‘quvchilarning bilimlarni tayyor shaklda qabul qilishi bilan cheklanmay, muammoli vaziyatni tahlil qilish, mavjud bilimlarni qo‘llash, taxminlarni ilgari surish va asoslangan yechimlarni izlashiga yo‘naltirilgan ta’lim yondashuvidir. Hmelo-Silver (2004) muammoga asoslangan ta’limni o‘quvchilarni murakkab muammolar ustida ishlash orqali bilimlarni egallash va muammolarni hal etish ko‘nikmalarini rivojlantirishga yo‘naltiruvchi yondashuv sifatida tahlil qilgan [1]. Ushbu yondashuv zoologiya fanida nazariy bilimlarni amaliy va hayotiy vaziyatlar bilan bog‘lash uchun metodik asos bo‘lib xizmat qiladi.

Biologiya o‘qituvchisining pedagogik kompetensiyasi muammoli ta’lim jarayonida bir necha jihatda namoyon bo‘ladi. Birinchidan, o‘qituvchi o‘quv dasturidagi mavzularni tahlil qilib, muammoli savol yaratishga mos biologik hodisalarni tanlaydi. Ikkinchidan, o‘quvchilarning yosh xususiyatlari va tayyorgarlik darajasini hisobga olib, topshiriqlar murakkabligini belgilaydi. Uchinchidan, o‘quvchilarni mustaqil izlanishga yo‘naltirib, zarur hollarda qo‘shimcha manbalar, kuzatuv materiallari va dalillar bilan ishlashga o‘rgatadi. To‘rtinchidan, o‘quvchilarning javoblarini faqat to‘g‘ri yoki noto‘g‘ri deb baholamasdan, ularning fikrlash jarayoni va xulosalarini asoslash darajasini ham hisobga oladi [1,2].

Shulman (1986) pedagogik bilimlarni o‘qituvchining fan mazmunini o‘quvchilar tushunishi mumkin bo‘lgan shaklda taqdim etish qobiliyati bilan bog‘liq holda tahlil qilgan [2]. Mazkur qarash zoologiya fanini o‘qitishda muhim ahamiyatga ega, chunki o‘qituvchi biologik bilimlarni shunchaki bayon etish bilan cheklanmay, ularni o‘quvchilar uchun tushunarli muammolar, taqqoslashlar va izlanish topshiriqlari orqali o‘zlashtirishga yordam berishi kerak.

Zoologiya darslarida muammoli ta’limni qo‘llashning metodik imkoniyatlarini quyidagi misollar orqali ko‘rsatish mumkin.

Birinchi misol — hayvonlarning muhitga moslanishi. O‘qituvchi: «Nima sababdan suvda yashovchi hayvonlarning tana shakli va harakatlanish usullari bir-biridan farq qiladi?» degan muammoli savolni qo‘yadi. O‘quvchilar baliqlar, kitlar va boshqa suv hayvonlarining tana tuzilishi, harakatlanishi hamda yashash sharoitlarini taqqoslaydi. Natijada ular moslanish belgilarini aniqlash va biologik xulosalarni dalillar bilan asoslashga o‘rganadi. O‘qituvchi esa taqqoslash mezonlarini

belgilash, ilmiy jihatdan to‘g‘ri tushunchalarni shakllantirish va noto‘g‘ri umumlashtirishlarni bartaraf etish kompetensiyasini namoyon qiladi.

Ikkinchi misol — oziq zanjiridagi o‘zgarishlar. «Muayyan hududda hasharotxo‘r qushlar soni keskin kamayib ketsa, qanday ekologik oqibatlar yuzaga kelishi mumkin?» degan savol o‘quvchilarni bir nechta ehtimoliy holatni tahlil qilishga undaydi. Ular oziq aloqalari, organizmlar soni va ekotizimdagi muvozanat o‘rtasidagi bog‘lanishlarni muhokama qiladi. Bunda o‘qituvchi o‘quvchilar fikrini dalillarga tayangan holda yo‘naltirishi va ehtimoliy xulosalarni ilmiy asoslangan ma’lumotlardan ajratishi zarur.

Uchinchi misol — hayvonlar xilma-xilligi va yashash muhitining o‘zgarishi. O‘quvchilarga yashash muhiti buzilganidan keyin muayyan hayvon turining soni kamayishi aks etgan shartli vaziyat beriladi. Ular muammoning ehtimoliy sabablarini aniqlaydi, mavjud ma’lumotlarni taqqoslaydi va biologik xilma-xillikni muhofaza qilish bo‘yicha takliflar ishlab chiqadi. Ushbu topshiriq ekologik tafakkur, hamkorlikda ishlash va muammolarni hal etish ko‘nikmalarini rivojlantirishga xizmat qiladi.

Mazkur misollar asosida zoologiya mashg‘ulotlarida pedagogik kompetensiyalarni rivojlantirishga qaratilgan quyidagi bosqichli metodik yondashuvni taklif etish mumkin.

Birinchi bosqich — muammoli vaziyatni loyihalash. O‘qituvchi mavzu mazmuniga mos, o‘quvchilarni fikrlashga undaydigan savol yoki ziddiyatli vaziyatni tanlaydi. Muammo aniq, tushunarli va o‘quvchilarning mavjud bilimlari bilan bog‘liq bo‘lishi lozim.

Ikkinchi bosqich — muammoni anglash va taxminlarni shakllantirish. O‘quvchilar muammoning mohiyatini aniqlaydi, mavjud bilimlarini esga oladi va ehtimoliy javoblarni ilgari suradi. O‘qituvchi barcha javoblarni darhol baholash o‘rniga, ularning asoslarini aniqlashga yordam beruvchi savollar beradi.

Uchinchi bosqich — dalillarni izlash va tahlil qilish. O‘quvchilar darslik, kuzatuv materiallari, biologik rasmlar, jadvallar yoki ishonchli elektron manbalardan foydalanib, o‘z taxminlarini tekshiradi. O‘qituvchi axborotning ishonchliligini baholash, manbalardan maqsadli foydalanish va dalillarni solishtirishni tashkil etadi.

To‘rtinchi bosqich — yechimni asoslash. O‘quvchilar o‘z xulosalarini taqdim etadi, boshqa fikrlarni tinglaydi va qarashlarini biologik dalillar bilan himoya qiladi. O‘qituvchi ilmiy aniqlik, mantiqiy izchillik va dalillardan foydalanish sifatini baholaydi.

Beshinchi bosqich — refleksiya va pedagogik tahlil. Mashg‘ulot yakunida o‘quvchilar qanday xulosaga kelgani va qaysi dalillar muhim bo‘lganini izohlaydi. O‘qituvchi esa tanlangan muammoli vaziyatning samaradorligini, berilgan ko‘rsatmalarning aniqligini va o‘quvchilarning ishtirok darajasini tahlil qiladi. Ushbu jarayon keyingi mashg‘ulotlarni takomillashtirishga yordam beradi.

Taklif etilgan yondashuvning metodik ahamiyati shundaki, muammoli ta’lim o‘qituvchining bir vaqtning o‘zida bir nechta kasbiy vazifani bajarishini talab etadi: biologik mazmunni tanlash, muammoni pedagogik jihatdan shakllantirish, o‘quvchilar faoliyatini boshqarish, o‘zlashtirishni baholash va ta’lim natijalarini tahlil qilish. Shu sababli mazkur texnologiyani tizimli qo‘llash pedagogik kompetensiyalarni amaliy faoliyat bilan bog‘lashga xizmat qilishi mumkin.

Muammoli ta’limning samaradorligi o‘qituvchining muammoni qanchalik murakkab qo‘yganiga emas, balki o‘quvchilarning mustaqil fikrlashi uchun qanday sharoit yaratganiga bog‘liq. Haddan tashqari murakkab yoki mavjud bilimlar bilan bog‘lanmagan savollar o‘quvchilarni izlanishdan uzoqlashtirishi mumkin. Shu bois muammoli topshiriqlar bosqichma-bosqich murakkablashtirilishi, zarur manbalar bilan ta’minlanishi va aniq baholash mezonlari bilan qo‘llab-quvvatlanishi lozim.

Xulosa. Zoologiya fanini o‘qitishda muammoli ta’lim texnologiyalaridan foydalanish biologiya o‘qituvchilarining pedagogik kompetensiyalarini rivojlantirish uchun muhim metodik imkoniyat yaratadi. Mazkur yondashuv o‘qituvchidan muammoli vaziyatlarni loyihalash, o‘quvchilarning mustaqil izlanishini tashkil etish, biologik dalillarni tahlil qilishga yo‘naltirish va ta’lim natijalarini refleksiv baholashni talab qiladi.

Tezisda ko‘rib chiqilgan metodik yondashuv zoologiya mashg‘ulotlarini muammoli vaziyatni yaratish, taxminlarni shakllantirish, dalillarni tahlil qilish, yechimni asoslash va refleksiya bosqichlari asosida tashkil etishni nazarda tutadi. Ushbu yondashuvni amaliyotda qo‘llash biologiya o‘qituvchilarining metodik mahorati va pedagogik qaror qabul qilish ko‘nikmalarini takomillashtirishga yordam berishi mumkin. Uning samaradorligini aniqlash uchun esa tegishli baholash mezonlari asosida pedagogik tajriba-sinov ishlarini olib borish maqsadga muvofiq.

Foydalanilgan adabiyotlar

1. Hmelo-Silver, C. E. (2004). Problem-Based Learning: What and How Do Students Learn? *Educational Psychology Review, 16*, 235–266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3
2. Shulman, L. S. (1986). Those Who Understand: Knowledge Growth in Teaching. *Educational Researcher, 15*(2), 4–14. https://doi.org/10.3102/0013189X015002004
3. Savery, J. R. (2006). Overview of Problem-based Learning: Definitions and Distinctions. *Interdisciplinary Journal of Problem-Based Learning, 1*(1), 9–20. https://doi.org/10.7771/1541-5015.1002
4. Prince, M. (2004). Does Active Learning Work? A Review of the Research. *Journal of Engineering Education, 93*(3), 223–231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

TALABALARNING JISMONIY YUKLAMAGA FUNKSIONAL MOSLASHUVINI BAHOLASHDA PULSOKSIMETRIYADAN FOYDALANISH METODIKASI

Xolm'minova Lobar Alisher qizi

Samarqand davlat pedagogika instituti magistranti

E-mail:xolmominovalobar5@gmail.com

Annotatsiya. *Mazkur tezisda talabalarning jismoniy yuklamaga funksional moslashuvini baholashda pulsoksimetriya usulidan foydalanish imkoniyatlari yoritilgan. Jismoniy mashqlar oldidan va undan keyin periferik qonning kislorod bilan to'yinganlik darajasi hamda puls chastotasini kuzatish, natijalarni taqqoslash va tiklanish jarayonini baholashning metodik jihatlari tahlil qilingan.*

Kalit so'zlar: *pulsoksimetriya, jismoniy yuklama, talabalar, funksional moslashuv, kislorod saturatsiyasi, puls chastotasi, tiklanish.*

Abstract. *This thesis explores the possibilities of using pulse oximetry to assess students' functional adaptation to physical exertion. It analyzes the methodological aspects of monitoring peripheral blood oxygen saturation and pulse rate before and after physical exercise, comparing the results, and evaluating the recovery process.*

Keywords: *pulse oximetry, physical exertion, students, functional adaptation, oxygen saturation, pulse rate, recovery.*

Talabalarning jismoniy yuklamaga funksional moslashuvini baholash jismoniy tarbiya mashg'ulotlarini to'g'ri tashkil etish, organizmning jismoniy faollikka javob reaksiyasini kuzatish va tiklanish jarayonini tahlil qilishda muhim ahamiyatga ega. Jismoniy mashqlar davomida yurak-qon tomir hamda nafas olish tizimlari faoliyati o'zgaradi. Ushbu o'zgarishlarni muntazam kuzatish talabalarning funksional holatini baholashga yordam beradi.

Pulsoksimetriya periferik arterial qonning kislorod bilan to'yinganlik darajasini (SpO_2) va puls chastotasini aniqlash imkonini beruvchi noinvaziv usuldir. Pulsoksimetr barmoq uchiga o'rnatilib, yorug'likning gemoglobin tomonidan yutilishidagi farqlar asosida kislorod saturatsiyasini taxminiy hisoblaydi. Mazkur usulning qulayligi o'lchashning tezkorligi, foydalanishning soddaligi va organizm holatini takroriy kuzatish imkoniyati bilan belgilanadi [1].

Talabalarning jismoniy yuklamaga funksional javobini baholashda o'lchashlarni muayyan ketma-ketlikda tashkil etish maqsadga muvofiq. Dastlab talaba 5–10 daqiqa tinch holatda o'tiradi va boshlang'ich SpO_2 hamda puls ko'rsatkichlari qayd etiladi. Keyingi bosqichda uning jismoniy tayyorgarligi va sog'lig'iga mos yengil yoki o'rtacha jismoniy mashq bajariladi. Mashq yakunlangach, puls chastotasi va SpO_2 ko'rsatkichlari qayta o'lchanadi. Tiklanish jarayonini kuzatish uchun ko'rsatkichlarni mashq tugaganidan keyin 1- va 3-daqiqalarda ham qayd etish

mumkin. Taqqoslashning ishonchliligini oshirish uchun mashq turi, davomiyligi, intensivligi va o‘lchash sharoitlari bir xil saqlanishi kerak.

Jismoniy yuklama vaqtida puls chastotasining ortishi organizmning tabiiy fiziologik javobidir. Mashq tugaganidan keyin pulsning pasayishi esa tiklanish jarayonini tavsiflovchi ko‘rsatkichlardan biri hisoblanadi. Bir daqiqalik puls tiklanishini quyidagi formula yordamida aniqlash mumkin:

$$\mathbf{HRR_{60} = HR_{tugash} - HR_{60}}$$

Bu yerda:

- $\mathbf{HRR_{60}}$ — yuklama tugaganidan 60 soniya keyingi puls kamayishi;
- $\mathbf{HR_{tugash}}$ — yuklama tugagan paytdagi puls chastotasi;
- $\mathbf{HR_{60}}$ — tiklanishning 60-soniyasida qayd etilgan puls chastotasi.

Ushbu ko‘rsatkichni tahlil qilishda jismoniy yuklama intensivligi, talabaning tayyorgarlik darajasi va tiklanish sharoitlarini hisobga olish lozim [2].

Masalan, yuklama tugaganida puls 150 zarba/minut, 60 soniyadan keyin esa 125 zarba/minut bo‘lsa, puls kamayishi 25 zarba/minutni tashkil etadi. Bu faqat formulani tushuntirish uchun keltirilgan shartli misol bo‘lib eksperimental natija emas.

SpO_2 ko‘rsatkichi organizmning periferik qon kislorod bilan to‘yinganligi haqida qo‘shimcha ma’lumot beradi. Biroq jismoniy mashq vaqtida ushbu ko‘rsatkichning o‘zgarmasligi organizm yuklamaga moslashmaganligini anglatmaydi. Xuddi shuningdek, SpO_2 ning o‘zi jismoniy chidamlilikni yoki umumiy funksional tayyorgarlikni to‘liq baholay olmaydi. Shu sababli pulsoksimetriya natijalarini puls dinamikasi, tiklanish tezligi, nafas olish holati va jismoniy yuklamaning xususiyatlari bilan birgalikda talqin qilish zarur.

O‘lchash natijalarining aniqligiga barmoqning sovuqligi, periferik qon aylanishining sustligi, tana harakati, datchikning noto‘g‘ri joylashtirilishi va qurilmaning texnik xususiyatlari ta’sir ko‘rsatishi mumkin. Ayrim sharoitlarda teri pigmentatsiyasi ham o‘lchash aniqligiga ta’sir qilishi ehtimoli mavjud [3]. Shuning uchun o‘lchashdan oldin datchik to‘g‘ri o‘rnatilishi, barmoq iliq bo‘lishi va ko‘rsatkich barqarorlashishi kutilishi kerak. Jismoniy mashqlar xavfsiz sharoitda, talabaning salomatligi va individual imkoniyatlariga muvofiq bajarilishi lozim.

Xulosa qilib aytganda, pulsoksimetriya talabalarning jismoniy yuklamaga funksional javobini kuzatishda qulay yordamchi usul hisoblanadi. SpO_2 va puls chastotasini mashqdan oldin hamda undan keyingi tiklanish davrida qayd etish organizmdagi fiziologik o‘zgarishlarni taqqoslash imkonini beradi. Ushbu metodikadan jismoniy tarbiya mashg‘ulotlarida, sog‘lom turmush tarziga oid ta’lim jarayonida va funksional holatni kuzatishda foydalanish mumkin. Biroq pulsoksimetr

ko‘rsatkichlari mustaqil diagnostik mezon sifatida qo‘llanmasligi, zarur hollarda boshqa baholash usullari bilan to‘ldirilishi kerak.

FOYDALANILGAN ADABIYOTLA:

1. Mengelkoch L.J., Martin D., Lawler J. A Review of the Principles of Pulse Oximetry and Accuracy of Pulse Oximeter Estimates During Exercise // *Physical Therapy*. — 1994. — Vol. 74, No. 1. — P. 40–49.
2. Bellenger C.R., et al. A Systematic Review on Heart-Rate Recovery to Monitor Changes in Training Status in Athletes // *International Journal of Sports Physiology and Performance*. — 2013. — Vol. 8, No. 3. — P. 251–260.
3. U.S. Food and Drug Administration. *Pulse Oximeters*. https://www.fda.gov/medical-devices/products-and-medical-procedures/pulse-oximeters

AQLLI ANATOMIYA: VEGETATIV ORGANLAR FIZIOLOGIYASINI O‘QITISHTA SUN’IY INTELLEKT VA INTERAKTIV SIMULYATSIYALARNING O‘RNI

Pardayeva Marjona Oybek qizi

Samarqand davlat pedagogika Instituti magistranti

Annotatsiya: *Ushbu maqolada oliy pedagogik ta’lim muassasalarida “Odam anatomiyasi va fiziologiyasi” fanidan vegetativ organlar bo‘limini o‘qitishda “Aqlli anatomiya” (Smart Anatomy) konsepsiyasi, Sun’iy intellekt (AI) hamda interaktiv simulyatsion texnologiyalarni qo‘llashning chuqur ilmiy, nazariy va metodik asoslari tahlil qilingan. Zamon avlodi (Gen Z va Gen Alpha) dunyoqarashiga mos keluvchi interaktiv va vizual ta’lim muhitini yaratish, vegetativ organlarning (ovqat hazm qilish, nafas olish, qon va limfa aylanishi, ayirish hamda ularning neyrogumoral boshqaruvi) mikroskopik va uzluksiz fiziologik dinamikasini anglashdagi metodik to‘siqlarni bartaraf etish masalalari yoritilgan. Jahon va mahalliy olimlarning ilmiy qarashlariga tayanib, AI va simulyatsiyalarning ta’limdagi afzalliklari, ilmiy yangiligi, pedagog hamda talabalar uchun qulayliklari hamda ushbu yo‘nalishning yaqin kelajakdagi rivojlanish tendensiyalari keng yoritib berilgan. Maqola so‘ngida uch dildagi annotatsiyalar taqdim etilgan.*

Kalit so‘zlar: *Aqlli anatomiya, Sun’iy intellekt, interaktiv simulyatsiya, vegetativ organlar, adaptiv ta’lim, Gen Z ta’limi, BioDigital Human, Complete Anatomy, generativ AI, raqamli didaktika.*

Annotation: *This paper explores the scientific, theoretical, and methodological foundations of "Smart Anatomy," Artificial Intelligence (AI), and interactive simulation technologies in teaching the vegetative organ systems in "Human Anatomy and Physiology" at pedagogical universities. It addresses the alignment of educational methods with the worldview of digital natives (Gen Z and Gen Alpha), overcoming cognitive barriers in understanding the microscopic, continuous dynamic physiological processes of vegetative organs. Drawing upon the research of global and domestic scholars, the article details the advantages of AI and simulations, their scientific novelty, practical conveniences for educators and students, and prospective future trends in educational technology.*

Keywords: *Smart Anatomy, Artificial Intelligence, interactive simulation, vegetative organs, adaptive learning, Gen Z education, BioDigital Human, Complete Anatomy, generative AI, digital didactics.*

Kirish va mavzuning dolzarbligi. O‘zbekiston Respublikasining “Ta’lim to‘g‘risida”gi Qonuni, Yangi O‘zbekistonning taraqqiyot strategiyasi hamda Oliy ta’lim tizimini raqamlashtirishga doir davlat dasturlarida ta’lim jarayoniga Sun’iy intellekt texnologiyalarini va innovatsion raqamli platformalarni keng joriy etish belgilangan. Oliy pedagogik ta’lim tizimida bo‘lajak biologiya o‘qituvchilarining kasbiy kompetentligini oshirish, eng avvalo, ularga o‘qitiladigan fundamental tabiatshunoslik fanlari, xususan, “Odam anatomiyasi va fiziologiyasi” darslarining pedagogik va texnologik mazmunini tubdan yangilashni talab etadi.

Zamonaviy auditoriyalarga kirib kelayotgan talabalar avlodi - Z avlodi (Gen Z) va yaqin kelajakdagi Alpha avlodi raqamli dunyoda tug‘ilib o‘sgan digital natives hisoblanadi. Ularning axborotni idrok etish xususiyati, mantiqiy fikrlash tarzi hamda dunyoqarashi o‘tmishdagi an’anaviy ta’lim usullaridan tubdan farq qiladi. Zamonaviy yoshlar matnli va statik axborotdan ko‘ra, dinamik, immersiv, visual va interaktiv formatdagi bilimlarni ancha tez va samarali o‘zlashtiradilar. Ularning psixofiziologik xususiyatlariga eski uslubdagi statik ko‘rgazmali qurollar (qog‘oz plakatlar, gipsli qotgan maketlar, tekis 2D rasmlar va quruq ma’ruzalar) mos kelmay qoldi.

Ayniqsa, “Odam anatomiyasi va fiziologiyasi” fanining vegetativ organlar va ularning boshqarilishi bo‘limi o‘zining biokimyoviy hamda mikroskopik murakkabligi bilan ajralib turadi. Ovqat hazm qilish, nafas olish, qon va limfa aylanishi, ayirish organlari hamda ularni idora etuvchi vegetativ nerv tizimi inson hayotini ta’minlovchi murakkab avtonom mexanizmdir. Ushbu organlar faoliyatini statik vositalar orqali tushuntirish talabalarda mavhumlik va chalkashlikni keltirib chiqaradi.

Shu sababli, biologik ta’limda “Aqlli anatomiya” (Smart Anatomy) konsepsiyasini shakllantirish, Sun’iy intellekt (AI) hamda interaktiv simulyatsiyalarni ta’limga integratsiya qilish dolzarb ilmiy-pedagogik vazifa sifatida namoyon bo‘lmoqda. AI ta’lim oluvchining qobiliyatiga

moslashuvchi adaptiv muhitni yaratsa, interaktiv simulyatsiyalar harakatdagi tirik biologik jarayonlarni real vaqt rejimida namoyish etadi.

Zamonaviy yoshlar dunyoqarashi va vegetativ organlar fiziologiyasini o‘rganishdagi metodik dilemma. Raqamli texnologiyalar asrida ulg‘ayayotgan yoshlar kognitiv jarayonlarda yuqori vizuallik va darhol qaytar aloqa (instant feedback) olishga ko‘nikishgan. Ilmiy-pedagogik tahlillar shuni ko‘rsatadiki, Gen Z va Alpha avlodi vakillari bilimlarni passiv tinglash orqali emas, balki interaktiv muloqot hamda tajriba-simulyatsiya vositasida o‘zlashtirishga moyil.

Pedagogika OTMlarida vegetativ organlar fiziologiyasini o‘rgatishda an’anaviy metodika va zamonaviy talaba dunyoqarashi o‘rtasida jiddiy metodik dilemma yuzaga kelmoqda:

Birinchidan, jarayonlarning mikro-dinamik va neyrogumoral murakkabligi. Vegetativ organlar ishi (masalan, oshqozon va ichak peristaltikasi, yurak avtomatiyasi va uning o‘tkazuvchanlik tizimi, nefronlardagi glomerulyar filtratsiya va reabsorbsiya) mikroskopik darajada va uzluksiz kechadi. Statik rasmlarda filtratsiya bosimining o‘zgarishi yoki gormonlar va simpatik/parasimpatik innervatsiyaning antagonist ta’sirini dinamikada ko‘rsatib bo‘lmaydi. Zamonaviy talaba buni ko‘rmasa, jarayonni to‘liq tasavvur eta olmaydi.

Ikkinchidan, kognitiv yuklama va diqqatni jamlash muammosi. Uzoq davom etuvchi monologik ma’ruzalar zamonaviy talabalarda diqqatning tez bo‘linishiga olib keladi. Akademik olim D. Henssen va L. van den Heuvel o‘z tadqiqotlarida ta’kidlaganidek, an’anaviy matnli-statik ta’lim vositalari talabada kognitiv ortiqcha yuklamani (cognitive overload) yuzaga keltirib, fanga bo‘lgan qiziqishni pasaytiradi.

Uchinchidan, bioetika va amaliy tajriba cheklovlari. Fiziologiya kursida jonli a’zolar va organizmlar ustida tajribalar o‘tkazish zamonaviy bioetika talablariga ko‘ra keskin cheklangan. Auditoriya sharoitida insonning ichki organlari ishini bevosita kuzatish va fiziologik ko‘rsatkichlarni (masalan, gipoksiya, jismoniy zo‘riqish yoki stress holatida) o‘zgartirib tajriba o‘tkazish imkonsizdir.

Ushbu muammolarni hal etishning yagona yechimi — Sun’iy intellekt va interaktiv simulyatsiyalarga asoslangan “Aqlli anatomiya” ekotizimini dars jarayoniga tatbiq etishdir.

“Aqlli anatomiya” Ekotizimida ai va interaktiv simulyatsiyalar: Olimlar qarashlari va texnologiyalar tahlili: Raqamli didaktikada “Aqlli anatomiya” (Smart Anatomy) tushunchasi — bu shunchaki uch o‘lchamli obyektlar to‘plami emas, balki Sun’iy intellekt (AI) algoritmlari, mashinali o‘rgatish (Machine Learning), neyron tarmoqlar hamda yuqori darajali interaktiv simulyatsiyalarning sinergik birlashmasidir. Vegetativ organlar fiziologiyasida AI algoritmlari biologik reaksiyalarni mantiqiy-matematik va patofiziologik qonuniyatlar asosida real vaqt rejimida modelga aylantirib beradi.

Jahon va mahalliy ilm-fanda ushbu raqamli transformatsiyani baholashda yetakchi olimlar va tadqiqotchilar tomonidan muhim konsepsiyalar ilgari surilmoqda:

A. Allen va R. Smith (2022): Olimlar ta’kidlashicha, Sun’iy intellekt bilan integratsiyalashgan 3D simulyatsiyalar biologik ta’limda passiv axborot olish davrini tugatib, "fiziologik tajriba muhiti"ni yaratadi. AI algoritmlari talabalarning har bir interaktiv harakatiga mos ravishda vegetativ organlarning javob reaksiyasini modellashtirib beradi, bu esa fazoviy va mantiqiy tafakkurni bir vaqtda rivojlantiradi.

K. Sugand, P. Abrahams va A. Khurana (2010): Anatomik ta’limni modernizatsiya qilish bo‘yicha fundamental tadqiqotlarida raqamli visual vositalar va interaktiv platformalar an’anaviy sekseya hamda statik atlaslarning o‘rnini bosuvchi va ularni to‘ldiruvchi eng samarali metodik ko‘prik ekanligini isbotlaganlar.

M. Morrow va C. Johnstone (2021): Virtual borliq (VR) va AI modellarining vegetativ nerv tizimi va ichki a’zolar fiziologiyasini o‘qitishdagi o‘rnini tadqiq etib, interaktiv simulyatsiyalar talabalarga bioetik qoidalarni buzmagan holda murakkab fiziologik tajribalarni cheksiz takrorlash imkonini berishini ko‘rsatib berishgan.

S.S. Ziyamukhamedov va O.M. Mavlonov (2022): Mahalliy tadqiqotchi olimlar biologiyani o‘qitishda imitatsion va interaktiv texnologiyalardan foydalanish talabalarning kasbiy-metodik tayyorgarligini oshirish va biologik jarayonlarning sabab-o‘qibat bog‘liqliklarini tushuntirishda hal qiluvchi ahamiyatga ega ekanligini ta’kidlaydilar.

Ushbu yo‘nalishda oliy pedagogik ta’limda yuqori samaradorlik ko‘rsatayotgan asosiy AI va interaktiv platformalar texnologik va metodik jihatdan quyidagicha guruhlanadi:

BioDigital Human va AI-Driven Physiology Engine. Ushbu platforma inson anatomiyasining eng mukammal 3D modelini taqdim etadi. Unga integratsiya qilingan Sun’iy intellekt dvigateli vegetativ organlarning fiziologik va patofiziologik holatlarini real vaqtda simulyatsiya qiladi. Masalan, talaba platformada sympathic nervous system (simpatik nerv tizimi) faolligini oshirganda, AI algoritmi yurak urishi chastotasining ortishi, toj tomirlarning kengayishi, bir vaqtning o‘zida oshqozon-ichak trakti peristaltikasi hamda sekresiyasining tormozlanishini dinamik visual modelda darhol namoyish etadi.

Complete Anatomy (3D4Medical) va Neyron Tarmoqlar Integratsiyasi. Platforma vegetativ organlarning (o‘pka, jigar, buyrak, taloq, ichak qavatlari) qatlamli va mikroskopik anatomiyasini o‘rganishga imkon beradi. Neyron tarmoqlari binar va ko‘p darajali disseksiya jarayonida talabaning xatti-harakatlarini kuzatib boradi. Agar talaba nefron kanalchalari yoki glomerulyar apparatni ajratishda xatolikka yo‘l qo‘ysa, AI assistent darhol anatomik xatoni tuzatadi va ushbu a’zoning fiziologik funksiyasiga oid interaktiv test va izohlarni ekranga chiqaradi.

Interaktiv Generativ AI Assistentlar va Tadqiqot Platformalari (SciSpace, ChatDOC, Elicit). Ushbu intelektual vositalar talabalarga vegetativ organlar bo‘yicha ilmiy maqolalar, ilmiy gipotezalar va murakkab fiziologik mexanizmlarni (masalan, Renin-angiotenzin-aldosteron tizimining qon bosimiga ta’sirini) tezkor tahlil qilish, matnli savol-javoblar orqali tushunchalarni oydinlashtirish imkonini beradi.

Immersiv VR/AR Simulyatsion Ekotizimlar (Meta Quest, HTC Vive, Anatomy Learning). Virtual va to‘ldirilgan borliq vositalari orqali talaba vegetativ organlarning ichki bo‘shliqlariga (masalan, bronxial daraxt, oshqozon shilliq qavati yoki qon tomirlar lyumeni) "kirish" va qon oqimi, gazlar almashinuvi hamda fermentativ parchalanish jarayonlarini uch o‘lchamli fazoda kuzatish imkoniyatiga ega bo‘ladi.

Ushbu yondashuvning talabalar va pedagoglar uchun qulayligi va afzalliklari. "Aqlli anatomiya" va interaktiv simulyatsiyalarni ta’lim jarayoniga joriy etish o‘quv jarayonining har ikkala subyekti — pedagog-o‘qituvchilar va talabalar uchun ko‘plab qulayliklar hamda amaliy afzalliklarni yaratadi.

Qulayliklar: Shaxsga yo‘naltirilgan adaptiv ta’lim (Personalized & Adaptive Learning): AI platformalari har bir talabaning bilimlarni o‘zlashtirish tezligini va yo‘l qo‘yayotgan xatolarini tahlil qiladi. O‘zlashtirishi sekinroq bo‘lgan talabaga AI tizimi vegetativ organlar fiziologiyasini (masalan, o‘pka ventilyatsiyasi va perfuziya nisbatini) uning individual sur’atiga mos ravishda takroran visual simulyatsiyalar bilan tushuntiradi.

Faol tadqiqotga asoslangan ta’lim (Inquiry-Based Learning): Talaba passiv tinglovchidan faol eksperimentatorga aylanadi. Simulyatorda u turli fiziologik ko‘rsatkichlarni (masalan, qonda CO_2 konsentratsiyasi, gormonlar miqdori yoki asab impulslari chastotasi) o‘zgartirib, vegetativ organlarning javob reaksiyasini bevosita kuzatadi.

Talabalarda kognitiv yuklamaning kamayishi va uzoq muddatli xotira: D. Henssen va L. van den Heuvel tadqiqotlarida ko‘rsatilganidek, 3D va VR visual simulyatsiyalar murakkab biologik matnlarni idrok etishdagi kognitiv zorijishni kamaytiradi. Natijada axborot talabaning uzoq muddatli vizual va mantiqiy xotirasida muhrlanadi.

Kasbiy-pedagogik kompetentlikni shakllantirish: Bo‘lajak biologiya o‘qituvchisi OTMda o‘qish davridayoq zamonaviy raqamli va AI texnologiyalari bilan ishlash tajribasini oshiradi. Bu unga kelgusida maktablarda biologiya darslarini yuqori interaktivlik va qiziqarlilik darajasida tashkil etish imkonini beradi.

O‘qituvchi vegetativ organlarning murakkab fiziologiyasini (masalan, ayirish va qon bosimining humoral boshqarilishi) doskada soatlab tushuntirish o‘rniga, 3D/AI simulyatsiyasi orqali bir necha daqiqada yaqqol va ko‘rgazmali tarzda namoyish etadi.

O‘zlashtirishni obyektiv va avtomatlashtirilgan diagnostika qilish: AI platformalari talabalarning topshiriqlarni bajarish jarayoni, simulyatsiyadagi harakatlari va bilim darajasini avtomatik ravishda baholaydi va o‘qituvchiga har bir talaba bo‘yicha tahliliy hisobot beradi.

Pedagogik kreativlik va metodik erkinlik: O‘qituvchi qolipga tushgan an’anaviy ma’ruzalardan voz kechib, darslarni interaktiv bahs-munozara, keys-stadi (Case-study) hamda muammoli vaziyatlarni virtual simulyatsiyalar orqali yechish shaklida o‘tkazadi.

Laboratoriya resurslari va bioetik cheklovlardan xalos bo‘lish: Qimmatbaho reaktivlar, tayyor preparatlar yoki biologik obyektlarsiz auditoriya sharoitida istalgan murakkablikdagi fiziologik tajribalarni xavfsiz va yuqori aniqlikda namoyish etish imkoni yaratiladi.

Maqolaning ilmiy yangiligi va yaqin kelajakdagi rivojlanish istiqbollari

Maqolaning ilmiy yangiligi: Ushbu ilmiy ishning fundamental yangiligi shundaki, unda ilk bor oliy pedagogik ta’lim tizimida “Odam anatomiyasi va fiziologiyasi” fanini o‘qitishda “Aqlli anatomiya” (Smart Anatomy) konsepsiyasi va Sun’iy intellekt algoritmlarining metodik va didaktik Sinergiyasi ilmiy jihatdan asoslab berildi.

Tadqiqot natijasida quyidagi asosiy ilmiy natijalarga erishildi: Vegetativ organlar fiziologiyasining mikroskopik va neyrogumoral jarayonlarini o‘rgatishda Sun’iy intellekt va interaktiv simulyatsion texnologiyalarning (BioDigital Human, Complete Anatomy, VR ilovalar) didaktik imkoniyatlari tizimlashtirildi.

Z va Alpha avlodi talabalarining raqamli dunyoqarashiga mos keluvchi adaptiv va immersiv ta’lim muhitini yaratishning ilmiy-pedagogik modeli taklif etildi.

An’anaviy statik ko‘rgazmalilik va zamonaviy AI-simulyatsion ko‘rgazmalilik o‘rtasidagi kognitiv va fiziologik farqlar ilmiy jihatdan ko‘rsatib berildi.

Yaqin kelajakda mavzuning rivojlanish istiqbollari: Yaqin kelajakda (2026–2030-yillar) “Aqlli anatomiya” va biologik ta’lim quyidagi yo‘nalishlarda jadal rivojlanadi:

Generativ AI va "Digital Twin" (Raqamli egizak) texnologiyasi: Har bir talaba yoki patologiya uchun inson organizmining to‘liq dinamik "Raqamli egizagi" yaratiladi. AI real vaqtda bio-datchiklar ma’lumotlari va genetik kodlar asosida vegetativ organlarning individual ishlash rejimini modelda aks ettiradi.

Gaptik (Uch o‘lchamli ushlab sezish) VR/AR simulyatorlar: Haptic feedback texnologiyalari rivojlanib, talabalar virtual muhitda vegetativ organlarning to‘qima qattiqligi, pulsatsiyasi va qisqarish kuchini ushlab sezish (tactile sensing) imkoniga ega bo‘ladilar.

Multimodal AI Pedagogic Agents: Sun’iy intellekt o‘qituvchi o‘rnini bosmagan holda, har bir talabaga shaxsiy 24/7 tutor (yo‘naltiruvchi) sifatida biriktiriladi. U talabaning savollariga ovozli

va vizual simulyatsiyalar orqali javob beradi, uning emotsional va kognitiv holatiga qarab dars murakkabligini moslashtiradi.

Xulosa. Oliy pedagogik ta’lim muassasalarida "Odam anatomiyasi va fiziologiyasi" fanidan vegetativ organlar fiziologiyasini o‘qitishda Sun’iy intellekt hamda interaktiv simulyatsiyalardan foydalanish strategik va metodik zaruriyatdir. Ushbu yondashuv vegetativ organlar faoliyatiga xos bo‘lgan mikroskopik, ko‘p omilli va dinamik fiziologik jarayonlarni yuqori aniqlikda vizuallashtirish orqali an’anaviy ta’limdagi mavhumlik hamda statiklikni bartaraf etadi.

"Aqlli anatomiya" konsepsiyasining amaliyotga joriy etilishi Z va Alpha avlodi talabalari dunyoqarashiga to‘la mos kelib, ularni passiv axborot qabul qiluvchidan faol tadqiqotchiga aylantiradi. AI texnologiyalari talabalar uchun adaptiv, shaxsga yo‘naltirilgan va kognitiv qulay ta’lim muhitini yaratadi, pedagoglar uchun esa dars samaradorligini keskin oshirish va talabalar bilimini obyektiv diagnostika qilish uchun cheksiz imkoniyatlarni taqdim etadi.

Xulosa qilib aytganda, Sun’iy intellekt va interaktiv simulyatsiyalarni ta’lim jarayoniga integratsiya qilish bo‘lajak biologiya o‘qituvchilarining raqamli jamiyat talablariga hamda xalqaro ta’lim standartlariga mos keluvchi yuqori kasbiy kompetentligini shakllantirishning eng samarali va istiqbolli omilidir.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI.

1. O‘zbekiston Respublikasi Prezidentining “2022–2026-yillarga mo‘ljallangan Yangi O‘zbekistonning taraqqiyot strategiyasi to‘g‘risida”gi Farmoni. – Toshkent, 2022.

2. Mirziyoyev Sh.M. Yangi O‘zbekiston strategiyasi. – Toshkent: “O‘zbekiston” nashriyoti, 2021.

3. Aminov B.A., Xudoyberdiyev R.E. Odam anatomiyasi va fiziologiyasi (Darslik). – Toshkent: “O‘qituvchi”, 2018. – 380 b.

4. Qodirov A.L. Pedagogik ta’limda raqamli texnologiyalar va interaktiv mediamatnlardan foydalanish metodikasi //Zamonaviy ta’lim/ Sovremennoye obrazovaniye. – Toshkent, 2023. – № 4. – B. 12-19.

5. Ziyamukhamedov S.S., Mavlonov O.M. Biologiyani o‘qitishda innovatsion va imitatsion texnologiyalar. – Toshkent: "Fan va texnologiya", 2022. – 210 b.

6. Allen, A. P., & Smith, R. J. (2022). Digital Twins in Medical and Biological Education: Transforming Human Anatomy and Physiology Learning Through 3D Simulation. Journal of Educational Technology in Health Sciences, 15(3), 142–158.

7. Sugand, K., Abrahams, P., & Khurana, A. (2010). The anatomy of anatomy: A review for its modernization. Anatomical Sciences Education, 3(2), 83–93.

8. Henssen, D. J., & van den Heuvel, L. (2020). Anatomy education in the digital era: The role of 3D visualization tools in cognitive load management. Anatomical Sciences Education, 13(5), 589–601.

9. BioDigital Human Platform: Interactive 3D Human Visualization Software and Physiology Engine. https://www.biodigital.co.

10. Complete Anatomy (3D4Medical): Advanced 3D Anatomy and Physiology Platform for Education. https://3d4medical.com.

11. AnatomyLearning – 3D Anatomy Atlas: Interactive visual guide for medical and biological education. https://anatomylearning.co.

12. SciSpace & ResearchRabbit AI: AI-powered literature discovery and scientific analysis platforms. Manzil: https://typeset.io.

BIOLOGIYA TA’LIMIDA RAQAMLI TRANSFORMATSIYA VA FANLARARO INTEGRATSIYAGA INNOVATSION YONDASHUVLAR

Abdujabborova Muxlisa Iskandar qizi

Samarqand davlat pedagogika instituti, Tabiiy fanlar fakulteti 1-bosqich talabasi.

Tel.: +998 70 045-74-08

Jo‘raqulova Madina Akram qizi

Samarqand davlat pedagogika instituti, Tabiiy fanlar fakulteti 1-bosqich talabasi.

Tel: +998 95 445-21-70

Annotatsiya: *Mazkur maqolada biologiya fanini o‘qitish jarayonida raqamli texnologiyalar va fanlararo integratsiyani joriy etishning nazariy hamda amaliy jihatlari atroflicha yoritilgan. Shuningdek, zamonaviy ta’lim muhitida talabalarning mustaqil fikrlash, tahlil qilish va tadqiqotchilik ko‘nikmalarini shakllantirishda innovatsion pedagogik yondashuvlarning o‘rni, raqamli laboratoriyalar va 3D modellashtirish vositalarining samaradorligi ilmiy-metodik jihatdan asoslab berilgan.*

Kalit so‘zlar: *Biologiya ta’limi, raqamli transformatsiya, fanlararo integratsiya, innovatsion pedagogik texnologiyalar, elektron laboratoriyalar, biometriya, virtual muhit.*

Kirish

Bugungi kunda jahon ta’lim tizimida kechayotgan tub o‘zgarishlar, xususan, raqamli transformatsiya jarayonlari tabiiy fanlarni, jumladan, biologiyani o‘qitish metodikasiga ham yangi,

yanada yuksak talablar qo‘ymoqda. Biologiya fanining zamonaviy rivojlanish bosqichi molekulyar biologiya, genetika, biotexnologiya va ekologiya kabi sohalarning jadal taraqqiyoti bilan tavsiflanadi. Ushbu fanlardagi murakkab jarayonlarni o‘quvchilar va talabalarga tushunarli yetkazib berish, ularda ilmiy dunyoqarashni shakllantirishda an’anaviy usullar bilan bir qatorda raqamli vositalar va fanlararo integratsiyadan foydalanish muhim ahamiyat kasb etmoqda [1, 45-b.].

Prezidentimiz Sh.M. Mirziyoyev ta’kidlaganidek, *"Ta’lim sifatini oshirish – Yangi O‘zbekiston taraqqiyotining eng muhim sharti hisoblanadi"*. Shu bois, biologiya ta’limini zamonaviy axborot-kommunikatsiya texnologiyalari va aniq fanlar yutuqlari bilan uyg‘unlashtirish dolzarb pedagogik vazifalardan biridir. Ushbu maqolaning asosiy maqsadi – biologiya darslarida raqamli texnologiyalar va fanlararo integratsiyani qo‘llashning uslubiy imkoniyatlarini ochib berishdan iborat.

Asosiy qism: Biologiya ta’limida raqamli transformatsiyaning o‘rni va ahamiyati

Raqamli texnologiyalar ta’lim jarayoniga faol kirib borishi natijasida o‘quvchilarning biologik obyektlar va jarayonlarni virtual muhitda kuzatish, ularni chuqur tahlil qilish imkoniyati keskin kengaydi. Masalan, hujayra darajasida kechadigan mitoz va meyoz bo‘linish jarayonlarini, DNK transkripsiyasi hamda translyatsiyasini 3D modellashtirish dasturlari orqali namoyish etish o‘quvchilarning mavzuni o‘zlashtirish ko‘rsatkichini sezilarli darajada oshiradi [2, 112-b.].

Biologiya darslarida quyidagi raqamli vositalardan foydalanish yuqori samaradorlik beradi:

Virtual laboratoriyalar (PhET, Labster va boshqalar): Real sharoitda o‘tkazish qiyin yoki moddiy jihatdan qimmat bo‘lgan biokimyoviy tajribalarni xavfsiz bajarish imkonini beradi.

Interaktiv infografika va raqamli xaritalar: Genetik kodlar, biosferadagi moddalar aylanishi, ekotizimlardagi oziq zanjirlari va populyatsiyalar dinamikasini vizuallashtiradi.

Loyiha asosida o‘qitish platformalari: O‘quvchilarning jamoada ishlash va global ekologik muammolarni raqamli ma’lumotlar tahlili orqali hal etish ko‘nikmalarini rivojlantiradi.

Raqamli transformatsiya ta’lim oluvchining passiv tinglovchidan faol tadqiqotchiga aylanishiga zamin yaratadi. Bu esa o‘z navbatida ta’lim samaradorligini sifat jihatidan yangi bosqichga ko‘taradi.

Fanlararo integratsiyaning metodik asoslari va uning afzalliklari

Biologiya fani tabiatshunoslikning markaziy yo‘nalishlaridan biri bo‘lib, u fizika, kimyo, matematika va axborot texnologiyalari bilan chambarchas bog‘liqdir. Fanlararo integratsiya talabalarga tabiatdagi hodisalarni alohida ajratilgan holda emas, balki yaxlit tizim sifatida tushunishga yordam beradi [3, 78-b.].

Jumladan, o‘quv jarayonida quyidagi fanlararo bog‘liqliklarni qo‘llash muhim natija beradi:

Biologiya va Kimyo (Biokimyo yo‘nalishi): Fotosintez, hujayraviy nafas olish, moddalar almashinuvi va fermentlarning katalitik ta’sir mexanizmini o‘rganishda kimyoviy qonuniyatlarga va valentlik tushunchalariga tayaniladi.

Biologiya va Matematika (Biometriya yo‘nalishi): Genetik qonuniyatlarni (Mendel qonunlari, dihybrid chatishtirish) matematik hisob-kitoblar, kombinatorika va ehtimollar nazariyasi orqali isbotlash o‘quvchilarning mantiqiy tafakkurini rivojlantiradi.

Biologiya va Fizika (Biofizika yo‘nalishi): Hujayra membranalarining osmotik bosimi va o‘tkazuvchanligi, nerv impulslarining tarqalish tezligi, bioelektrik potensiallar hamda yorug‘lik nurlarining tirik organizmlarga ta’sirini tahlil qilish.

Integratsiyalashgan darslar o‘quvchilarning fanlarni o‘rganishga bo‘lgan qiziqishini oshiradi hamda olingan nazariy bilimlarni real hayotdagi amaliy vazifalarni hal etishda qo‘llash ko‘nikmasini shakllantiradi.

Innovatsion pedagogik yondashuvlar va ularning amaldagi samaradorligi

Ta’lim jarayonida zamonaviy pedagogik texnologiyalar va interaktiv metodlardan foydalanish o‘quvchilarning kognitiv faolligini ta’minlaydi. Bugungi kunda “Blended learning” (aralash ta’lim), “Flipped classroom” (teskari sinf), “Gamification” (o‘yinlashtirish) va “Project-based learning” (loyihaviy ta’lim) kabi yondashuvlar biologiya darslarida keng qo‘llanilmoqda [4, 204-b.].

Tadqiqotlar shuni ko‘rsatmoqdaki, talabalar darslikdagi quruq matnni yodlashdan ko‘ra, muammoli vaziyatlarni hal etish jarayonida biologik qonuniyatlarni chuqurroq anglab yetadilar. Masalan, o‘quvchilarga o‘z huduidagi ekologik vaziyatni (suv havzalarining ifloslanishi, daraxtlarning kesilishi yoki tuproq sho‘rlanishi) o‘rganish bo‘yicha kichik loyiha topshirilganda, ular mustaqil ravishda ma’lumot yig‘adilar, tahlil qiladilar va o‘z yechimlarini taqdim etadilar. Bu jarayon yoshlarda ekologik madaniyat, mas’uliyat va jamoada ishlash ko‘nikmalarini tarbiyalaydi.

Tajriba-sinov natijalari va ularning tahlili

Mavzu doirasida olib borilgan kuzatishlar shuni ko‘rsatdiki, raqamli texnologiyalar va fanlararo integratsiyaga asoslangan darslarni o‘tish o‘quvchilarning o‘zlashtirish ko‘rsatkichini an’anaviy darslarga nisbatan o‘rtacha 20–25 foizga oshirdi. Xususan, murakkab mavzularni (genetika, embriologiya, ekologiya) tushunishda virtual simulyatsiyalar va interaktiv topshiriqlarning hissasi juda yuqori bo‘ldi. O‘qituvchilarning raqamli savodxonligini oshirish va ularni zamonaviy pedagogik dasturlar bilan ta’minlash ta’lim sifatini kafolatlovchi asosiy omillardan biri ekanligi isbotlandi.

Xulosa qilib aytganda, biologiya fanini o‘qitish jarayonida raqamli transformatsiya va fanlararo integratsiyani qo‘llash zamonaviy ta’lim talablariga to‘la javob beradi. Bu yondashuv

o‘quvchilarning ijodiy va tanqidiy fikrlashini rivojlantiribgina qolmay, ularni kelgusida raqobatbardosh, zamonaviy kasb-hunar egasi bo‘lib yetishishlarida muhim poydevor bo‘lib xizmat qiladi. Pedagog kadrlar oldida turgan asosiy vazifa – doimiy ravishda o‘z ustida ishlash, raqamli texnologiyalar va innovatsion metodikalarni dars jarayoniga ijodiy joriy etishdan iboratdir.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI

1. Karimov I.A. Barkamol avlod – O‘zbekiston taraqqiyotining poydevori. — Toshkent: Sharq, 2021. — 45-b.

2. Mavlonov O‘.M., va boshqalar. Biologiyani o‘qitish metodikasi. — Toshkent: O‘qituvchi, 2023. — 112-b.

3. Saidov X.X. Tabiiy fanlarni o‘qitishda integratsion yondashuvlar. // Pedagogik ta’lim jurnali. — Samarqand, 2024. — №2. — 78–82-betlar.

4. UNESCO. Digital Learning and Transformation in Education. — Paris: UNESCO Publishing, 2024. — 204 p.

5. Yo‘ldoshev J.G‘., Usmonov S.A. Pedagogik texnologiya asoslari. — Toshkent: O‘qituvchi, 2022. — 134-b.

V-SHU’BA
OZIQ-OVQAT MAHSULOTLARI BILAN BOG‘LIQ MAHALLIY VA GLOBAL MUAMMOLARNI HAL ETISH.

НАКОПЛЕНИЕ ФЕНОЛЬНЫХ СОЕДИНЕНИЙ В ВИНОГРАДЕ СЕН ПЕПИН И АЛЕШЕНЬКИН, КУЛЬТИВИРУЕМЫХ В УСЛОВИЯХ г. БРЕСТА РЕСПУБЛИКИ БЕЛАРУСЬ

Колбас Н.Ю.[1], Левый А.В.[2]

[1]кандидат биологических наук, доцент, доцент кафедры биологических и химических технологий Брестского государственного университета имени А. С. Пушкина, г. Брест, Республика Беларусь, старший научный сотрудник Лаборатории биогеохимии Полесского аграрно-экологического института НАН Беларуси, г. Брест, Республика Беларусь; n.kolbas@gmail.com

[2]кандидат биологических наук, старший научный сотрудник Лаборатории Агробиологии Полесского аграрно-экологического института НАН Беларуси, г. Брест, Республика Беларусь; a30413@mail.ru

В статье приведены данные о содержании фенольных соединений (ФС), в том числе фенолкарбоновых кислот и флавонолов в плодах и листьях винограда сортов Сен Пепин и Алешенькин. Содержание ФС (в мг галловой кислоты/100 г) для изученных сортов снижается в последовательности: семена > листья> мякоть > кожица ягод. Указаны направления практического использования полученных результатов.

Ключевые слова: виноград, лист, плод, сорт, фенольные соединения, фенолкарбоновые кислоты, флавонолы.

Плоды винограда, являются природным источником ценных биологически активных веществ, одними из которых являются **фенольные соединения (ФС). Экстрагируемые ФС в ягодах винограда содержатся в следующем соотношении: 10 % в мезокарпии (мякоти), 28–35 % – в экзокарпии (кожице) и 60–70 % – в семенах.** Состав ФС винограда зависит в большей степени от сорта, а содержание – от климатических условий и агротехники выращивания **[1, с. 38]**.

История интродукции винограда в Республике Беларусь началась в XIII-XIV веках благодаря интенсивному развитию торговли; научное сортоизучение ведется с 1935 г. сотрудниками Центрального ботанического сада АН БССР и продолжается до сих пор. В настоящее время самую крупную ампелографическую коллекцию в Беларуси имеет РУП

«Институт плодоводства» [5]. По состоянию на 2026 г. в Государственный реестр республики включены 18 сортов винограда [3, с. 136, 157].

В качестве объектов исследования нами были выбраны 2 сорта– Сен Пепин и Алешенькин, которые являются перспективными родительскими формами для получения нового сорта винограда, обладающего комплексной устойчивостью и пригодного для культивирования в условиях аридизации Брестской области Республики Беларусь.

Сен Пепин (St. Pepin) – универсальный сорт винограда селекции США (1981 г.), раннего срока созревания, среднерослые, с вертикальным ростом побегов и небольшим пасынкообразованием. Имеет функционально-женский цветок. При этом, в неблагоприятные для цветения годы указанный сорт требует дополнительного опыления. Обладает повышенной устойчивостью к грибным болезням и зимостойкостью (до -29°С). Благодаря гибридному происхождению (с участием европейского и североамериканских видов) данный сорт имеет генетическую устойчивость к филлоксере, что позволяет его культивировать корнесобственным способом. Виноград Алешенькин (выведен в 1956 г. на Волгоградской опытной станции, в Государственном реестре с 2014 г. [3, с. 136]) относится к столовым сортам, зимостойкий, очень раннего срока созревания, сильнорослый, высокоурожайный, характеризуется хорошим вызреванием лозы, высокими дегустационными качествами (8,8 балла). Недостатком сорта Алешенькин является восприимчивость к грибным заболеваниям [5].

Плоды винограда, культивируемые в г. Бресте, были собраны в 2025 г. по достижении ими потребительской зрелости. В день сбора каждую гроздь взвешивали, определяли количество ягод, затем сепарировали и получали виноградный сок. Листья без признаков повреждения были отобраны со средней части лозы одновременно с плодами. Листья, кожицу ягод и семена подвергали лиофильной сушке (LyoQuest «Telstar»), сок анализировали сразу, без дополнительной подготовки. ФС кожицы и семян винограда после лиофилизации экстрагировали 70 %-ым этанолом в пропорции 1 г:10 мл. Содержание ФС, в том числе фенолкарбоновых кислот и флавонолов определяли спектрофотометрически (МС 122М, «СОЛ инструментс») согласно методикам описанными нами ранее [4]. Общее количество ФС выражали в мг галловой кислоты (ГК), фенольных кислот – в мг кофейной кислоты, флавонолов – в мг кверцетина в пересчете на 100 г растительного материала естественной влажности (семян, кожицы плодов и листьев) или на л сока.

Все опыты выполнены в трехкратной повторности. Статистическую обработку результатов проводили с использованием пакета программы Microsoft Office Excel.

Данные о содержании ФС в плодах и листьях винограда представлены в таблице 1. Полученные результаты для сока винограда Сен Пепин согласуются с ранее опубликованными нами результатами [2]. В кожице и мякоти (соке) винограда Сен Пепин содержится больше общих ФС (на 92 % и 84 % соответственно), фенолкарбоновых кислот (на 96,45 % и 38 % соответственно), а также флавонолов (в 2,1 раза и на 31 % соответственно), чем у сорта Алешенькин. В тоже время семена этого сорта содержат больше ФС (на 49 %), а также фенолкарбоновых кислот (на 43 %), чем Сен Пепин, но меньше флавонолов (на 23 %).

При сопоставлении полученных результатов о содержании ФС в плодах других сортов *Vitis*, культивируемых в г. Бресте, необходимо отметить, что виноград Сен Пепин является лидером по данному параметру среди других сортов (Рудик, Минский розовый, Валерия, Дарья, Сенатор Бурдака, Альфа [3]). Виноград сорта Алешенькин ранее нами не изучался. Стоит отметить, что его сок характеризуется средним содержанием ФС (в сравнении с имеющимися данными для белого винограда).

Таблица 1 – Содержание фенольных соединений (ФС) в плодах и листьях винограда, выращенного в условиях г. Бреста (2025 г.)

Объект	Сухое вещество (%)	Общие ФС, мг ГК/100 г	Фенолкарбоновые кислоты, мг КфК/100 г	Флавонолы, мг Кв/100 г
сорт Сен Пепин				
Мякоть (сок*) ягоды	22,37±0,72	793,14±33,31	620,71±29,20	238,78±10,15
Кожица ягоды	26,18±1,1	240,85±29,39	117,40±10,64	56,31±0,56
Семена	76,66±1,45	3010,68±224,86	1462,01±47,45	338,58±14,32
Лист	27,1±0,87	1716,03±66,47	738,93±30,1	428,65±6,42
сорт Алешенькин				
Мякоть (сок*)	17,4±0,73	431,14±22,08	449,84±15,41	182,06±5,64
Кожица ягоды	20,49±0,32	125,28±14,54	59,76±2,81	18,18±0,96
Семена	63,03±4,58	5901,38±569,3	2570,80±103,06	275,89±26,78
Лист	26,6±0,92	1257,35±51,07	615,23±19,69	345,7±7,12

Примечание: ГК – галловая кислота, КфК – кофейная кислота, Кв – кверцетин; * – для сока показатели выражены в мг/л

Согласно полученным нами результатам, содержание ФС в листьях Сен Пепин было на 26,7 % больше, чем у сорта Алешенькин (таблица 1). Отметим, что показатель в листьях

превышал аналогичный в ягодах: для сорта Сен Пепин – в 2,2 раза в мякоти и в 7 раз в кожице, у сорта Алешенькин – в 2,9 раз в мякоти и в 10 раз в кожице, но был ниже (соответственно в 1,7 и 4,7 раз), чем в семенах.

По содержанию фенольных кислот и флавонолов листья Сен Пепин также достоверно отличаются от сорта Алешенькин (превышают на 20 % и 24 %) (таблица 1). Содержание фенолкарбоновых кислот, как и общих ФС (в пересчете на 100 г растительного материала естественной влажности), для изученных сортов снижается в последовательности: семена > листья > мякоть > кожица ягод; содержание флавонолов – листья > семена > мякоть > кожица ягод.

Таким образом, сорта Сен Пепин и Алешенькин являются перспективными донорами признаков высокого содержания ФС в ягодах и листьях и могут быть использованы в селекции для создания новых сортов винограда, характеризующихся повышенным накоплением БАВ фенольной природы. Плоды сорта Сен Пепин являются источником фитонутриентов и могут быть использованы для разработки продуктов функционального назначения.

Работа выполнена при финансовой поддержке Белорусского республиканского фонда фундаментальных исследований (грант Б26Б-001).

СПИСОК ЛИТЕРАТУРЫ:

1. Ribéreau-Gayon P., Dubourdieu D., Doneche B., Lonvaud A., Handbook of enology [Traitré d’oenologie. English], Vol. 1. The Chemistry of Wine Stabilization and Treatments, 2006, West Sussex : John Wiley & Sons Ltd., 498 p.

2. Василевская А.В., Колбас Н.Ю., Биохимические показатели спелости и антиоксидантная активность плодов *Vitis* L., культивируемых в г. Бресте, 2025, Веснік Брэсцкага ўніверсітэта, сер. 5. Хімія. Біялогія. Навукі аб зямлі, № 2, С. 12–27.

3. Государственный реестр сортов сельскохозяйственных растений / Министерство сельского хозяйства и продовольствия Республики Беларусь, Государственное учреждение «Государственная инспекция по испытанию и охране сортов растений» ; под ред. В. В. Гринкевича ; сост.: Т. В. Семашко [и др.], 2026, Минск : ИВЦ Минфина, 310 с.

4. Колбас Н.Ю., Кайдалова М.О., Колбас А.П., Дашкевич М.М. Влияние биопрепаратов на содержание фенольных соединений, антиоксидантную активность и элементный состав плодов *Rubus idaeus* L., 2025, Вестник Фонда фундаментальных исследований, № 4, С. 91–103.

5. Леонович И.С., Устинов В.Н. История развития виноградарства и виноделия, 2015, Плодоводство, Т. 27, С. 421–436.

НЕКОТОРЫЕ СВЕДЕНИЯ О БИОРАЗНООБРАЗИИ БАССЕЙНА РЕКИ ШИРКЕНТ

Сатторов Рахматулло Бобоевич – доктор биологических наук, профессор кафедры ботаники и дендрологии Таджикского национального университета Тел: (+992) 918-94-96-74

Мирзоев Нуриддин Махмадович – кандидат биологических наук, доцент кафедры зоологии Таджикского национального университета, Тел: (+992) 93-405-86-05,

E-mail:mir.nur78@mail.ru

Аннотация: *В статье на основе собственных исследований и анализа литературных данных приводится сведения о разнообразии растений и животных бассейна реки Ширкент. В районе исследования выявлено 1340 видов растений, относящихся к 516 родам и 87 семействам. Животный мир района исследований также разнообразна и дана характеристика позвоночных животных района исследований.*

Ключевые слова: *биоразнообразия, Таджикистан, Ширкент, экосистемы, растений, животные, охрана.*

Abstract*: The article presents information on the diversity of plants and animals in the Shirkent River basin based on the author's own research and an analysis of the scientific literature. A total of 1,340 plant species belonging to 516 genera and 87 families have been identified in the study area. The fauna of the study area is also diverse, and the article provides a description of the vertebrate animals occurring in this region.*

Keywords: *biodiversity, Tajikistan, Shirkent, ecosystems, plants, animals, conservation.*

Биологическое разнообразие, определяемое как вариабельность живых организмов из всех источников, служит основой всех форм жизни на Земле. Оно охватывает внутривидовое и межвидовое разнообразие и разнообразие экосистем и является проявлением генетического полиморфизма растений, животных и микроорганизмов, а также сложности экосистем. Биоразнообразие во многом является основой жизни людей.

Утрата биоразнообразия чревата серьезными прямыми последствиям для здоровья в тех случаях, когда экосистемные услуги перестают обеспечивать потребности общества. Поэтому оценка состояния биоразнообразия является актуальной проблемой.

Одним из уголков, где сохранено уникальные биоразнообразия является бассейн реки Ширкент расположенной на южном склоне Гиссарского хребта Республики Таджикистан. По геологическому строению и геоморфологи данный район очень сложен и своеобразен. Вся горная часть и равнины подвержены водной и ветровой эрозии. Главная водная артерия ущелья – река Ширкент и её составляющие Сандалдарья и Хазор-Хона.

Водные ресурсы парка формируются густой гидрографической сетью,

насчитывающей около 30 постоянных водотоков. Главная водная артерия парка - это река Ширкент и её притоки Сандал-Дарья и Хазорзона. Питание этих рек снежно-ледниковое.

В верховьях реки Ширкент имеется 14 некрупных ледников и снежников, общей площадью в 4,5 км^2. Река Ширкент впадает в реку Сурхандарья и имеет общую протяженность 47 км.

Любопытные этнографические объекты, локализованные главным образом в кишлаке Пашми-Кухна, демонстрируют некоторые бытовые, культурные и религиозные традиции современного населения долины реки Ширкент. В его пределах эрозия сформировала очень живописный скульптурный рельеф: скалы причудливых очертаний (местные иногда называют их «саллой» — по форме напоминающей чалму), башни, пики, балконы и карнизы. Выступающие края пластов были закруглены. Также здесь встречаются каньоны, водопады и эрозионные пещеры.

Биоразнообразия флоры бассейна реки Ширкент. В районе исследования выявлено 1340 видов, относящихся к 516 родам и 87 семействам. Ведущими семействами разнообразия флоры района являются: *Asteraceae* -183 видов (13.6%), *Poaceae*-131видов (9.7%), *Fabaceae* - 111 видов (8.2%), *Brassicaceae* – 91 видов (6.79%), *Rosaceae* -63 видов (4.7.%) и др. [4, с. 54-57].

В результате сбора флоры и анализов определили, что в составе флоры района произрастают 65 видов эндемиков: *Festuca krilovii, Carex enervis, Asparagus bucharicus, Eremurus tadshicorum, Allium dollichomischum, Silene hissarica, Corydalis macrocentra, Alchimella fontinalis, Conringia orientalis, Astrogalus macroodium* и др. и 12 видов редких растений: *Allium lipskianum, A. stypitatum, Ungernia victoris, Crocus korolkovii, Tulipa praestans, Iris hoggiana, Astrogalus artemisoformis, A. taschutanus, Ficus carica* и др.

Результаты исследований показывают, что в составе флоры района произрастает 600 видов полезных растений, из них лекарственных – 124 вида, ядовитых 80 видов, медоносных – 70, масличных – 40, эфиромасличных – 24, пищевых – 90 видов [6, с. 115-119].

Животный мир исследуемого района отличается большим разнообразием и включает более 1000 видов беспозвоночных, около 150 видов позвоночных животных. Некоторые сведения о животных района исследования находятся в ряде работ [1,2,3,5].

Ихтиофауна р. Ширкент представлено 4 вида рыб, относящихся к 4 семействам: лососевые – *Salmonidae*, карповые – *Cuprinidae,* семейство Вьюновые – *Cobitidae* и семейство Сомики – *Sisoridae.* В реке обитают амударьинская форель – *Salmo trutta oxianu,* обыкновенная маринка –*Schizothorax intermedius,* гребенчатый голец – *Nemashilus longicauda* и туркестанский сомик – *Cluptosternum reticulatum* .

Земноводные (Amphibia). Здесь нами обнаружено 2 вида земноводных представители отряда бесхвостатых земноводных (Anura) - зелёная жаба – *Buffo viridis* и озёрная лягушка- *Rana ridibunda.*

Пресмыкающиеся (Reptilia). По литературным данным [3, с.284-345] в районе исследования зарегистрировано 9 видов пресмыкающихся, в том числе среднеазиатская черепаха – *Agrionemys horsfieldii;* туркестанский гекон – *Cyrtopodion fedtschenkoi,* туркестанская агама – *Paralaudakia lehmanni,* азиатский гологлаз – *Ablepharus panonicus,* желтопузик –*Pseudopus apodus,* водяной уж – *Natrix tessellate,* полоз разноцветный –*Coluberl ravregieri,* среднеазиатская кобра – *Naja oxiana* и гюрза – *Macrovipera lebetina.*

Птицы (Aves). Наибольшим видовым разнообразием представлены представители класса птиц**.** По характеру пребывания птицы разделяются на оседлых – 40 и перелётных – 55 видов птиц. Орнитологический анализ орнитофауны обследованного района показывает, что здесь встречаются перепелятник – *Assipiter nisus melasehistos*, стервятник – *Neophron perenopterus L*, белоголовый сип – *Gyps fulvus*), бородач – *Gypaëtus barbatus hemachalanus Hutt*, беркут – *Aquila chrysaetus*, филин – *Alectoris shukar*, домовой сыч – Athene noctua bactriana Hutton, кеклик – *Alectoris kakelik*, сизый голубь – *Columba livia*, удод – *Upupa epops*, синяя птица – *Meophonus coeruleus* и др. [1,6.с.20].

Млекопитающие (Mammalia). В ходе исследований и анализа литературных данных выясненно, что на территории ущелья обитают 37 видов млекопитающих, относящихся к 6 отрядам (парнокопытные, хищные, зайцеобразные, грызуны, насекомоядные, рукокрылые) млекопитающих Таджикистана [2, с.165-210]

В районе исследования из млекопитающих встречаются кабан – *Sus scrofa;* туркестанская рысь – *Lynx lynx* , степной кот – *Felis silvestris libica*, волк – *Canis lupus,* лисица – *Vulpes vulpes*, среднеазиатская выдра – *Lutra lutra,* заяц-толай – *Lepus tolai,* дикобраз – *Hystrix indica,* лесная соня – *Dryomys nitedula,* лесная мышь – *Apodemus sylvaticus*, восточная слепушонка – *Ellobius tancrei*, *домовая мышь – Mus musculus,* ушастый еж – *Hemiechinus auritus,* большой подковонос – *Rhinolophus ferrumequinum,* малый подковонос – *Rhinolophus hipposideros,* бухарский подковонос – *Rhinolophus bucharicus,* усатая ночница – *Myotis mystacinus*, серый ушан – *Plecotus austriacus,* белобрюхий стрелоух – *Otonycteris leucophaeis* и др. [6, с.20]

В заключении на основе собранных в ходе исследования данных и анализа текущего состояния биоразнообразия и экосистем окрестностей ущелья Ширкент были определены следующие основные угрозы для флоры и фауны. Перевыпась пастбищ естественных экосистем, вырубка и деградация лесов, освоение земель и строительство новых населенных

пунктов, сенокошение. Из-за увеличения поголовья скота ускоряется и увеличивается пастбищная нагрузка на природные ландшафты, что приводит к ухудшению состояния пастбищ и деградации лесов.

В холмах и предгорьях и на береге рек имеет наблюдается вырубка естественных древесных и кустарниковых пород (можжевельник, миндаль, алыча, боярышник, багряник, ива и др.) Наблюдается чрезмерная деградация древесно-кустарниковых растений.

С целью восстановления биоразнообразия растительного мира и предотвращения процесса деградации естественных экосистем в окрестностях в первую очередь, необходимо уменьшить пастбищные нагрузки и вырубку лесных насаждений также деятельность местного населения, сбором дикорастущих пищевых и декоративных растений, плодов и семян, заготовкой дров и сена и т.д.

ЛИТЕРАТУРА

1. Абдусалямов И.А. Фауна Таджикской ССР. Птицы. Т. 19, ч. 2. Душанбе: Дониш, 1973. - 321 с.

2. Давыдов Г.С. Пространственное размещение населения млекопитающих Таджикистана в зависимости от структуры поясности. – /Г.С.Давыдов // Зоол. сборник. Ч. 1. Душанбе.- 1975. С. 165-210.

3. Красная книга Республики Таджикистан. 2025.- Третье издание.-Том 2. Животные.- 557 с.

4. Кароматуллои К. Анализ флоры бассейна реки Ширкент / К. Курбонали, Р.Б. Сатторов // Кишоварз, Душанбе, 2019, № 1(81). - С.54-57.

5. Мирзоев Н.М. Материалы по ихтиофауне р. Ширкент /Н.М.Мирзоев //Материалы республиканской конференции «Охрана животного мира Таджикистана» Душанбе, 2017. С. 40-41.

RAPS SIDERATIDAN FOYDALANISH ORQALI SABZAVOT EKINLARIDA FITOPARAZIT NEMATODALARNI KAMAYTIRISH VA HOSILDORLIKNI OSHIRISH

Xakimov Najmiddin Xakimovich,[1]Mirzayev Uktam Nuritdinovich[2]

Sharof Rashidov nomidagi Samarqand davlat universiteti,[1] Samarqand davlat pedagogika instituti[2]

E-mail: uktam1486@gmail.com

Annotatsiya: *Mazkur maqolada sug‘oriladigan tipik bo‘z tuproqlar sharoitida raps (Brassica napus L.) sideratidan foydalanishning sabzavot agrotsenozlaridagi fitoparazit nematodalar soni, o‘simlik ildizlarining zararlanish darajasi, tuproq unumdorligi va keyingi ekin hosildorligiga ta’siri o‘rganilgan. Tajriba Samarqand viloyati Payariq tumani sharoitida 2,5 sotix maydonda, 4 takroriylikda olib borildi. Raps 2026-yil 21-martda ekilib, gullash fazasida 1-iyunda tuproqqa haydab yuborildi. Tajriba boshida tuproqdagi Meloidogyne spp. II yosh lichinkalari soni 482 nusxani tashkil etgan bo‘lsa, siderat qo‘llangandan keyin 67 nusxagacha kamaydi. Nematodalar sonining kamayish samaradorligi 86,1 % ni tashkil etdi. O‘simlik ildizlarining zararlanish darajasi 4,8 balldan 1,2 ballgacha pasaydi. Raps sideratidan keyin yetishtirilgan bodring hosildorligi 21,8 t/ga ni tashkil etib, nazoratga nisbatan 75,8 % yuqori bo‘ldi. Tuproqdagi gumus miqdori 0,82 % dan 0,94 % gacha oshdi. Olingan natijalar raps sideratidan foydalanish fitoparazit nematodalarni kamaytirish, tuproqning biologik va agroekologik holatini yaxshilash hamda sabzavot mahsulotlari ishlab chiqarish samaradorligini oshirishga xizmat qilishi mumkinligini ko‘rsatdi.*

Kalit so‘zlar: *raps, Brassica napus, siderat, fitoparazit nematodalar, Meloidogyne, bodring, tuproq, gumus, hosildorlik, oziq-ovqat ta’minoti.*

Abstract: *This study investigated the effects of using rapeseed (Brassica napus L.) as a green manure crop on the population of plant-parasitic nematodes in vegetable agroecosystems, the degree of root damage, soil fertility, and the yield of subsequent crops under irrigated typical sierozem soil conditions. The experiment was conducted on a 2.5-sotix plot (250 m²) in Payariq District, Samarkand Region, with four replications. Rapeseed was sown on March 21, 2026, and incorporated into the soil at the flowering stage on June 1. At the beginning of the experiment, the number of second-stage juveniles (J2) of Meloidogyne spp. in the soil was 482, whereas following the application of green manure, this number decreased to 67. The reduction efficiency of the nematode population was 86.1%. The degree of plant root damage decreased from 4.8 to 1.2 points. Cucumber grown after rapeseed green manuring yielded 21.8 t/ha, which was 75.8% higher than the control. Soil humus content increased from 0.82% to 0.94%. The results indicate that the use of rapeseed as a green manure crop may help reduce plant-parasitic nematode populations,*

improve soil biological and agroecological conditions, and increase the efficiency of vegetable production.

Keywords: *rapeseed, Brassica napus, green manure, plant-parasitic nematodes, Meloidogyne, cucumber, soil, humus, crop yield, food security.*

Kirish: Oziq-ovqat mahsulotlari ishlab chiqarish hajmini barqaror oshirish va mavjud qishloq xo‘jaligi yerlaridan samarali foydalanish bugungi kundagi muhim vazifalardan biridir. Ayniqsa, sabzavotchilikda yuqori hosildorlikni ta’minlash bilan birga tuproq unumdorligini saqlab qolish, o‘simliklarning biologik zararlanishini kamaytirish va ekologik jihatdan xavfsiz agrotexnologiyalarni qo‘llash muhim ahamiyat kasb etadi. Sabzavot ekinlari hosildorligini cheklovchi omillardan biri tuproqda yashovchi fitoparazit nematodalardir. Ushbu organizmlar o‘simliklarning ildiz tizimida oziqlanib, ildizlarning suv va mineral oziqa moddalarini o‘zlashtirish jarayonini buzishi mumkin. Ayniqsa, *Meloidogyne* avlodiga mansub ildiz tugunak nematodalari pomidor, bodring, baqlajon va boshqa sabzavot ekinlarida katta ahamiyatga ega. Fitoparazit nematodalarni boshqarishda kimyoviy vositalardan foydalanish bilan bir qatorda agrotexnik, biologik va ekologik usullarni qo‘llash ham muhimdir. Bunday usullardan biri siderat ekinlardan foydalanish hisoblanadi. Siderat ekinlar vegetativ biomassani shakllantirib, keyinchalik tuproqqa qaytarilishi orqali organik modda manbai bo‘lib xizmat qiladi. Natijada tuproqdagi biologik jarayonlarning faollashishi, organik modda miqdorining ortishi va ayrim zararli organizmlar sonining kamayishi uchun sharoit yuzaga kelishi mumkin. Raps (*Brassica napus* L.) yuqori biomassa hosil qiluvchi siderat ekinlardan biri bo‘lib, uning yashil massasini tuproqqa qaytarish tuproqning organik holatini yaxshilashga xizmat qiladi. Shu bilan birga, rapsdan siderat sifatida foydalanish fitoparazit nematodalarni boshqarishning agrotexnik usullaridan biri sifatida ham ahamiyatli bo‘lishi mumkin. Shu maqsadda mazkur tadqiqotda raps sideratidan foydalanishning *Meloidogyne* spp. II yosh lichinkalari soniga, o‘simlik ildizlarining zararlanish darajasiga, tuproqdagi gumus miqdoriga va sideratdan keyingi bodring hosildorligiga ta’siri o‘rganildi.

Tadqiqot materiali va usullari: Tadqiqot Samarqand viloyati Payariq tumani Olmazor mahallasi Otab qishlog‘ida joylashgan sug‘oriladigan tipik bo‘z tuproqlar sharoitidagi tajriba maydonida olib borildi. Tajriba maydonining umumiy maydoni 2,5 sotixni tashkil etdi va tajriba 4 takroriylikda tashkil qilindi. Har bir bo‘lak 5×5 m o‘lchamda joylashtirildi. Raps (*Brassica napus* L.) 2026-yil 21-martda ekildi. Tajriba davomida mineral o‘g‘itlardan foydalanilmadi. Maydon vegetatsiya davrida 4 marta sug‘orildi, tabiiy yog‘ingarchilik ham o‘simliklarning rivojlanishiga ta’sir ko‘rsatdi. Raps o‘simliklarining o‘rtacha balandligi 1,5 m ga yetdi. O‘simlik biomassasi gullash fazasida, 2026-yil 1-iyunda tuproqqa haydab yuborildi. Tajriba boshlanishida tuproqning

pH ko‘rsatkichi 7,87–7,97, harakatchan fosfor (P_2O_5) miqdori 12,7 mg/kg, gumus miqdori esa 0,82 % ni tashkil etdi. Tuproq va ildiz namunalari asosida nematodalar ajratib olindi. Laboratoriya sharoitida nematodalarni ajratishda Baermann voronkasi va Decker modifikatsiyasi usullaridan foydalanildi. Tadqiqotning asosiy obyekti sifatida Meloidogyne spp. II yosh lichinkalari olindi.



1-Rasm - Tajriba o‘tkazilgan maydonning umumiy ko‘rinishi

Natijalar va muhokama Tajriba natijalari raps sideratidan foydalanish tuproqdagi *Meloidogyne* spp. II yosh lichinkalari sonining sezilarli kamayishiga olib kelganini ko‘rsatdi. Tajriba boshlanishida ularning soni 482 nusxani tashkil etgan bo‘lsa, raps biomassasi tuproqqa haydab yuborilgandan keyingi kuzatuvlarda 67 nusxagacha kamaygan. Demak, raps sideratidan foydalanish natijasida *Meloidogyne* spp. II yosh lichinkalari soni 415 nusxaga kamaygan va hisoblangan samaradorlik 86,1 % ni tashkil etgan. Nematodalar sonining bunday kamayishi raps biomassasining tuproqqa qaytarilishi natijasida tuproqdagi biologik jarayonlarning o‘zgarishi bilan bog‘liq bo‘lishi mumkin. Organik biomassaning parchalanishi tuproq mikroorganizmlari faolligiga, oziq zanjirlariga va nematodalar uchun shakllanadigan ekologik sharoitga ta’sir ko‘rsatadi. Shu bilan birga, sideratning samarasi tuproq namligi, harorat, organik moddaning parchalanish tezligi va nematodalar populyatsiyasining dastlabki holati kabi omillarga ham bog‘liq. Tadqiqotda fitoparazit nematodalar sonining kamayishi o‘simlik ildizlarining zararlanish darajasidagi o‘zgarishlar bilan

ham kuzatildi. Tajriba boshida ildizlarning zararlanish darajasi 4,8 ballni tashkil etgan bo‘lsa, raps sideratidan foydalanilgandan keyin bu ko‘rsatkich 1,2 ballgacha kamaydi.

Ko‘rsatkich	Sideratgacha	Sideratdan keyin
Ildiz zararlanish darajasi, ball	4,8	1,2
Kamayish	—	3,6 ball

1-jadval: O‘simlik ildizlarining sideratgacha va sideratdan keyingi zararlanish darajasi

Ildizlarning zararlanish darajasi 3,6 ballga kamaygani o‘simlik ildiz tizimining fitosanitar holati yaxshilanganini ko‘rsatadi. Bu esa keyingi ekinning suv va oziqa moddalaridan samarali foydalanishi uchun qulay sharoit yaratishi mumkin. Raps sideratining ta’sirini baholashda keyingi ekin hosildorligi ham muhim ko‘rsatkich hisoblanadi. Tajribada raps biomassasi tuproqqa haydab yuborilgandan keyin bodring yetishtirildi. Natijada bodring hosildorligi 21,8 t/ga ni tashkil etdi va bu nazorat variantiga nisbatan 75,8 % yuqori bo‘ldi.

Ko‘rsatkich	Nazorat	Raps sideratidan keyin
Bodring hosildorligi, t/ga	12,4	21,8
Qo‘shimcha hosil, t/ga	—	9,4
Oshish, %	—	75,8

2-jadval-Raps sideratidan keyingi bodring hosildorligi va nazorat varianti

Olingan natijalarga ko‘ra, raps sideratidan keyin bodring hosildorligi 9,4 t/ga ga yuqori bo‘lgan. Hosildorlikdagi ushbu farqni faqat nematodalar sonining kamayishi bilan izohlash mumkin emas. Bunda tuproqqa organik biomassaning qaytarilishi, tuproqning biologik faolligi, oziqa elementlarining aylanishi va ildiz tizimi uchun qulay sharoit shakllanishi kabi omillar ham muhim rol o‘ynashi mumkin. Tajriba davomida tuproqning organik holatidagi o‘zgarishlar ham qayd etildi. Tajriba boshida gumus miqdori 0,82 % bo‘lgan bo‘lsa, raps sideratidan foydalanilgandan keyin ushbu ko‘rsatkich 0,94 % ga yetdi.

Ko‘rsatkich	Tajriba boshida	Sideratdan keyin
Gumus, %	0,82	0,94
O‘zgarish, foiz band	—	+0,12

3-jadval-Tuproq gumus miqdorining sideratgacha va sideratdan keyingi o‘zgarishi.

Gumus miqdorining 0,12 foiz bandga ortishi raps biomassasining tuproqqa qaytarilishi bilan bog‘liq organik modda aylanishining kuchayganligini ko‘rsatadi. Bu holat siderat texnologiyasining faqat nematodalarni kamaytirish emas, balki tuproq unumdorligini saqlash va yaxshilash nuqtayi nazaridan ham ahamiyatli ekanligini ko‘rsatadi. Umuman olganda, tajribada olingan natijalar raps sideratidan foydalanishning bir vaqtning o‘zida bir nechta agroekologik natijalarni yuzaga keltirganini ko‘rsatdi: *Meloidogyne* spp. lichinkalari soni kamaydi, ildizlarning zararlanish darajasi pasaydi, tuproqdagi gumus miqdori oshdi va keyingi bodring hosildorligi yuqori bo‘ldi.

Ko‘rsatkich	Dastlabki holat	Sideratdan keyingi holat	Natija
Meloidogyne spp. II yosh lichinkalari, nusxa	482	67	86,1 % kamayish
Ildiz zararlanishi, ball	4,8	1,2	3,6 ball kamayish
Gumus, %	0,82	0,94	+0,12 foiz band
Bodring hosildorligi, t/ga	12,4	21,8	+75,8 %

4-jadval Raps sideratining asosiy ko‘rsatkichlarga kompleks ta’siri

Mazkur natijalarni oziq-ovqat mahsulotlari ishlab chiqarish nuqtayi nazaridan baholaganda, raps sideratidan foydalanish bir vaqtning o‘zida tuproqning biologik holatini yaxshilash va fitoparazitlar bosimini kamaytirish orqali keyingi sabzavot ekinining mahsuldorligini oshirishga xizmat qilishi mumkin. Ayniqsa, sabzavot yetishtiriladigan sug‘oriladigan agrotsenozlarda bunday agrotexnik yondashuvlar tuproq unumdorligini saqlash va mahsulot ishlab chiqarish barqarorligini ta’minlash uchun muhimdir. Bunda siderat texnologiyasining asosiy afzalligi shundaki, u fitoparazit nematodalarni boshqarish masalasini tuproq unumdorligini saqlash masalasi bilan birgalikda hal qilish imkonini beradi. Raps biomassasining tuproqqa qaytarilishi organik modda manbai bo‘lib xizmat qiladi, nematodalar sonining kamayishi esa o‘simlik ildiz tizimiga tushadigan biologik bosimni pasaytiradi.

Xulosa: Sug‘oriladigan tipik bo‘z tuproqlar sharoitida o‘tkazilgan tajribalar natijasida raps (*Brassica napus* L.)ni siderat sifatida qo‘llash sabzavot agrotsenozlarida fitoparazit nematodalarni kamaytirish, tuproqning organik holatini yaxshilash va keyingi ekinning hosildorligini oshirish

bilan bog‘liq ijobiy natijalarni ko‘rsatdi. Raps sideratidan foydalanish natijasida *Meloidogyne* spp. II yosh lichinkalari soni 482 tadan 67 tagacha, ya’ni 86,1 % ga kamaydi. Ildizlarning zararlanish darajasi 4,8 balldan 1,2 ballgacha pasaydi. Tuproqdagi gumus miqdori 0,82 % dan 0,94 % gacha oshdi. Raps sideratidan keyin yetishtirilgan bodring hosildorligi 21,8 t/ga ni tashkil etib, nazoratga nisbatan 75,8 % yuqori bo‘ldi. Shunday qilib, raps sideratidan foydalanish fitoparazit nematodalarni agrotexnik boshqarish, tuproq unumdorligini saqlash va sabzavot mahsulotlari yetishtirish samaradorligini oshirishga qaratilgan kompleks agroekologik tadbir sifatida qo‘llanishi mumkin. Olingan natijalar raps siderat texnologiyasining mahalliy sharoitda oziq-ovqat mahsulotlari ishlab chiqarish barqarorligini ta’minlash, biologik omillar sababli yuzaga keladigan hosil yo‘qotishlarini kamaytirish va tuproq resurslaridan samarali foydalanishdagi amaliy ahamiyatini ko‘rsatadi.

Adabiyotlar ro’yxati

1. Тулаганов А.Т. Гельминты растений Узбекистана и борьба с ними. – Ташкент: Фан, 1968.
2. Ризаева С.М. Нематоды основных овощных культур и картофеля Северо-восточной зоны Узбекистана: автореф. дисс. … канд. биол. наук. – Ташкент, 1984. – 15 с.
3. Сидиқов Ж.Т. Фитонематоды семейств Heteroderidae и Meloidogynidae различных ландшафтов Узбекистана и сопредельных районов (систематика, биология, экология и меры борьбы): автореф. дисс. … канд. биол. наук. – Ташкент, 1993. – 15 с.
4. Mirzaev U.N., Mavlyanov O. Samarqand viloyati sabzavot ekinlari meloidoginozi // Xorazm Ma’mun akademiyasi axborotnomasi. – 2025.
5. Mirzaev U. Morphological and biological characteristics of root-knot nematodes (Meloidogyne spp.) of vegetable crops under the conditions of the Zarafshan Valley // O‘zbekiston Milliy universiteti xabarlari. – 2026. – Vol. 3, No. 3.3. – P. 65–68.
6. Neher D.A. Ecology of plant and free-living nematodes in natural and agricultural soil // Annual Review of Phytopathology. – 2010. – Vol. 48. – P. 371–394.
7. Jones J.T., Haegeman A., Danchin E.G.J. et al. Top 10 plant-parasitic nematodes in molecular plant pathology // Molecular Plant Pathology. – 2013. – Vol. 14, No. 9. – P. 946–961.
8. Perry R.N., Moens M., Starr J.L. Root-knot Nematodes. – Wallingford: CABI, 2009.
9. Coyne D.L., Cortada L., Dalzell J.J. et al. Plant-parasitic nematodes and food security in Sub-Saharan Africa // Annual Review of Phytopathology. – 2018. – Vol. 56. – P. 381–403.
10. Yeates G.W., Bongers T., de Goede R.G.M., Freckman D.W., Georgieva S.S. Feeding habits in soil nematode families and genera — an outline for soil ecologists // Journal of Nematology. – 1993. – Vol. 25, No. 3. – P. 315–331.

ZARAFSHON VODIYSI SABZAVOT AGROTSENOZLARIDA FITOPARAZIT NEMATODALARNING TARQALISHI VA ULARNING OZIQ-OVQAT TA’MINOTIDAGI AHAMIYATI

Mavlyanov Ochil Mavlyanovich,[1]Mirzayev Uktam Nuritdinovich[2]

Sharof Rashidov nomidagi Samarqand davlat universiteti,[1] Samarqand davlat pedagogika instituti[2]

E-mail: uktam1486@gmail.com

Annotatsiya: *Mazkur maqolada Zarafshon vodiysi sharoitida yetishtiriladigan sabzavot ekinlari agrotsenozlarida uchraydigan nematodalar faunasining tur tarkibi, fitoparazit nematodalarning tarqalishi va ularning sabzavot yetishtirish samaradorligiga ta’siri tahlil qilingan. Tadqiqotlar natijasida pomidor, baqlajon, bodring, sabzi, karam va piyoz agrotsenozlarida jami 155 ta nematoda turi aniqlangan. Aniqlangan turlar 7 ta turkumga mansub bo‘lib, ular orasida Tylenchida, Rhabditida va Dorylaimida vakillari ustunlik qilgan. Fitoparazit guruh tarkibida Ditylenchus, Pratylenchus, Hoplolaimus, Helicotylenchus, Tylenchorhynchus, Rotylenchus, Paratylenchus va Meloidogyne avlodlari qayd etilgan. Ildiz tugunak nematodalari – Meloidogyne spp. sabzavot agrotsenozlari uchun muhim fitoparazit guruhlardan biri sifatida baholangan. Tadqiqot natijalari fitoparazit nematodalarni muntazam aniqlash va ularning tarqalishini nazorat qilish sabzavot yetishtirish barqarorligini ta’minlash hamda oziq-ovqat mahsulotlari ishlab chiqarish hajmini saqlab qolishda muhim ekanligini ko‘rsatadi.*

Kalit so‘zlar: *Zarafshon vodiysi, sabzavot agrotsenozi, nematodafauna, fitoparazit nematodalar, Meloidogyne, nematoda xilma-xilligi, hosildorlik, oziq-ovqat ta’minoti.*

Abstract: *This article analyzes the species composition of the nematode fauna found in vegetable crop agroecosystems cultivated in the Zarafshan Valley, the distribution of plant-parasitic nematodes, and their impact on the efficiency of vegetable production. The study identified a total of 155 nematode species in the agroecosystems of tomato, eggplant, cucumber, carrot, cabbage, and onion. The identified species belonged to seven orders, among which representatives of Tylenchida, Rhabditida, and Dorylaimida were predominant. The plant-parasitic nematode groups included the genera Ditylenchus, Pratylenchus, Hoplolaimus, Helicotylenchus, Tylenchorhynchus, Rotylenchus, Paratylenchus, and Meloidogyne. Root-knot nematodes (Meloidogyne spp.) were identified as one of the major groups of plant-parasitic nematodes affecting vegetable agroecosystems. The findings demonstrate that the regular identification of plant-parasitic nematodes and monitoring of their distribution are essential for ensuring sustainable vegetable production and maintaining food production levels.*

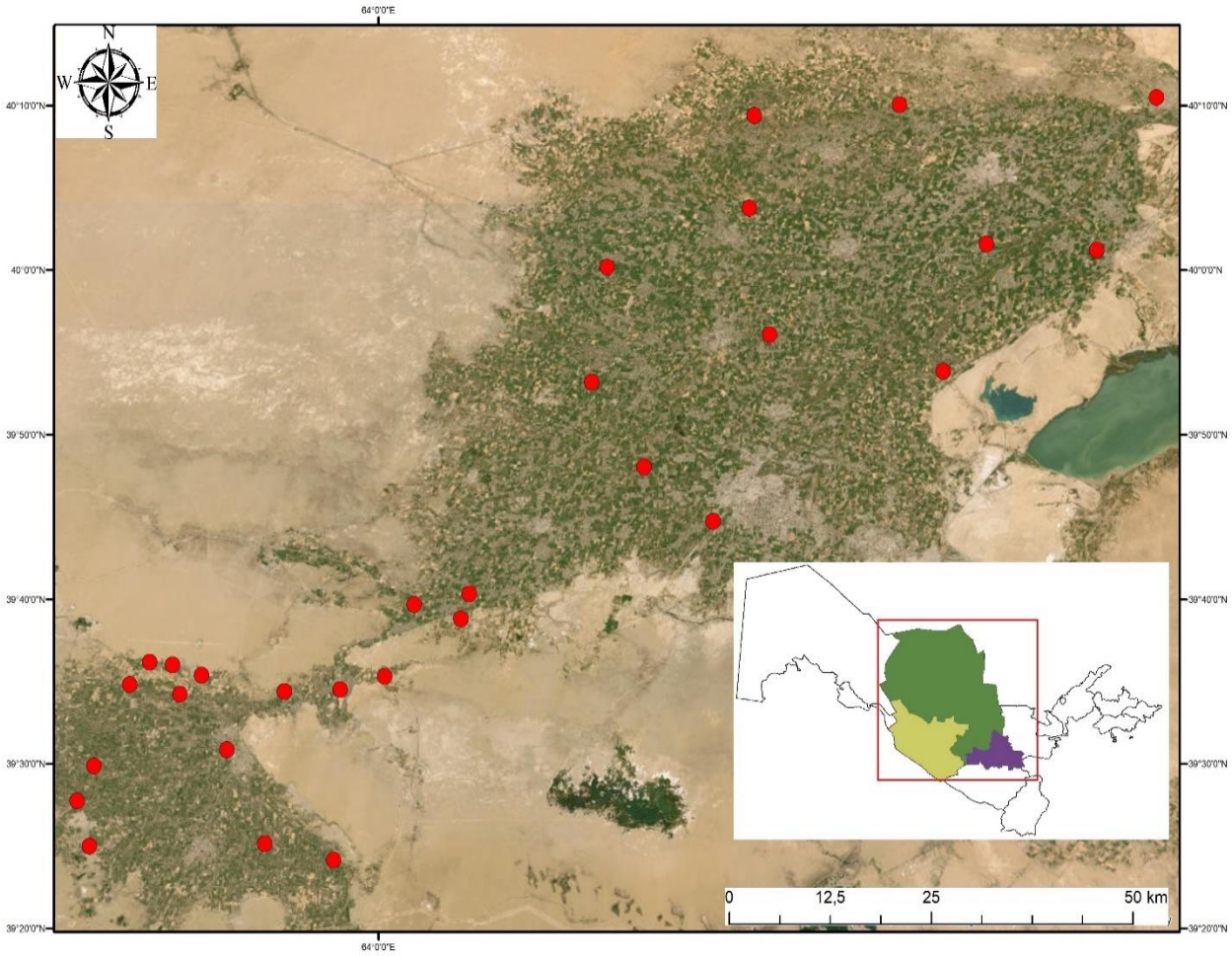
Keywords: *Zarafshan Valley, vegetable agroecosystem, nematode fauna, plant-parasitic nematodes, Meloidogyne, nematode diversity, crop yield, food security.*

Kirish: Sabzavotchilik aholini yil davomida oziq-ovqat mahsulotlari bilan ta’minlash, qishloq xo‘jaligi ishlab chiqarishining barqarorligini oshirish va oziq-ovqat resurslarini ko‘paytirishda muhim yo‘nalishlardan biridir. Biroq sabzavot ekinlarining hosildorligi va mahsulot sifati nafaqat agrotexnik tadbirlarga, balki tuproqdagi turli biologik organizmlar, jumladan, o‘simliklarda parazitlik qiluvchi nematodalarning tarqalishiga ham bog‘liq. Fitoparazit nematodalar ko‘pincha tuproq va o‘simlik ildiz tizimida yashirin holda rivojlanishi sababli ularning zarari dastlab yaqqol ko‘zga tashlanmasligi mumkin. Ular ildizlarning oziqa moddalar va suvni o‘zlashtirish faoliyatini buzib, o‘simliklarning o‘sishi va rivojlanishiga salbiy ta’sir ko‘rsatadi. Ayniqsa, Meloidogyne avlodiga mansub ildiz tugunak nematodalari ko‘plab sabzavot ekinlarida jiddiy muammo hisoblanadi. Ilmiy manbalarda o‘simlik-parazit nematodalar qishloq xo‘jaligi ekinlari hosildorligini cheklovchi muhim biologik omillardan biri sifatida qayd etilgan. Oziq-ovqat ta’minotining barqarorligi nuqtayi nazaridan fitoparazit nematodalarni o‘rganishning ahamiyati shundaki, ekin hosildorligining pasayishi bozor va aholi uchun mavjud bo‘ladigan mahsulot hajmiga bevosita ta’sir qilishi mumkin. Shu sababli sabzavot agrotsenozlarida nematodalar xilma-xilligi va fitoparazit turlarining tarqalishini aniqlash zamonaviy sabzavotchilikning muhim biologik va agroekologik vazifalaridan biridir. Zarafshon vodiysi O‘zbekistonning muhim sug‘oriladigan dehqonchilik hududlaridan biri bo‘lib, bu yerda turli sabzavot ekinlari keng yetishtiriladi. Hududning tuproq-iqlim sharoitlari, sug‘orish tizimi, ekinlarning almashlab ekilishi yoki bir maydonda takroriy yetishtirilishi tuproq nematodalarining shakllanishi va tarqalishiga ta’sir etuvchi omillar qatoriga kiradi.

Shu munosabat bilan mazkur tadqiqotning asosiy maqsadi Zarafshon vodiysi sabzavot agrotsenozlarida nematodalar faunasining tur tarkibini aniqlash, fitoparazit nematodalarning asosiy guruhlarini tavsiflash va ularning sabzavot yetishtirish hamda oziq-ovqat ta’minoti nuqtayi nazaridan ahamiyatini baholashdan iborat.

Tadqiqot materiali va usullari: Tadqiqotlar Zarafshon vodiysining o‘rta va quyi oqimi hududlarida joylashgan sabzavot agrotsenozlarida olib borildi. Tadqiqot hududlari Samarqand, Navoiy va Buxoro viloyatlarining ayrim tumanlarini qamrab oldi.Tadqiqot obyekti sifatida pomidor (*Solanum lycopersicum* L.), baqlajon (*Solanum melongena* L.), bodring (*Cucumis sativus* L.), sabzi (*Daucus carota* L.), karam (*Brassica oleracea* L.) va piyoz (*Allium cepa* L.) agrotsenozlari tanlandi. Nematodalarni aniqlash maqsadida tuproq namunalari o‘simliklarning ildiz tizimi va rizosfera zonasidan 0–10 hamda 10–20 sm chuqurliklardan olindi. Namunalarni olishda agrotsenozning

o‘simlik qoplami, ildiz tizimining rivojlanish holati va tuproq sharoitlari hisobga olindi. Tuproq namunalari laboratoriya sharoitida qayta ishlanib, nematodalarni ajratib olishda Baermann voronkasi hamda Decker modifikatsiyasi usullaridan foydalanildi. Ajratib olingan nematodalar morfologik belgilari asosida mikroskop yordamida o‘rganildi va aniqlagichlar asosida tur darajasigacha aniqlandi. Aniqlangan nematodalar ekologik-trofik guruhlarga ajratildi. Bunda fitoparazit, saprobiotik, mikofag, yirtqich va polifag guruhlar hisobga olindi.

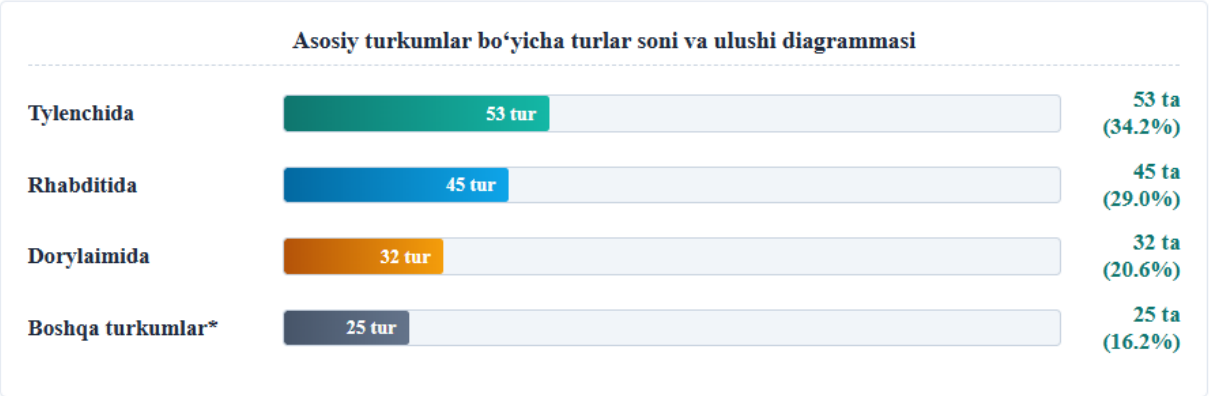


1-rasm joyi. Zarafshon vodiysida tadqiqot olib borilgan hududlar xaritasi

Tadqiqot natijalari va ularning muhokamasi: Tadqiqotlar davomida Zarafshon vodiysi sabzavot agrotsenozlarida jami 155 ta nematoda turi aniqlandi. Ular 7 ta turkumga mansub bo‘lib, aniqlangan nematodalar tarkibida Tylenchida, Rhabditida va Dorylaimida turkumlari nisbatan yuqori ulushni tashkil etdi.

Tylenchida turkumiga 53 ta tur, Rhabditida turkumiga 45 ta tur, Dorylaimida turkumiga 32 ta tur mansubligi aniqlandi. Qolgan turlar Araeolaimida, Mononchida, Monhysterida va Diplogasterida turkumlari tarkibida qayd etildi. Jadval ma’lumotlaridan ko‘rinib turibdiki, nematodalar faunasining

eng katta qismini Tylenchida vakillari tashkil etadi. Ushbu turkum tarkibida o‘simliklarda parazitlik qiluvchi ko‘plab nematoda guruhlari mavjudligi sababli uning agrotsenozlar uchun ekologik va fitosanitar ahamiyati yuqori hisoblanadi. Tylenchida vakillarining yuqori ulushi sabzavot ekinlari ildiz tizimi bilan bog‘liq oziqlanish zanjirlarining faol ekanligini ko‘rsatadi. Shu bilan birga, agrotsenozdagi barcha nematodalarni zararli organizmlar sifatida baholash noto‘g‘ri bo‘lib, aniqlangan turlar orasida saprobiotik, mikofag va yirtqich shakllar ham mavjud.



T/r	Nematoda turkumlari	Turlar soni / Ulushi
1	**Tylenchida** turkumi	**53 ta tur (34.2%)**
2	**Rhabditida** turkumi	**45 ta tur (29.0%)**
3	**Dorylaimida** turkumi	**32 ta tur (20.6%)**
4	**Araeolaimida, Mononchida, Monhysterida va Diplogasterida**	**25 ta tur (16.2%)**

1-Jadval. Zarafshon vodiysi sabzavot agrotsenozlarida nematodalar turlarining turkumlar bo‘yicha taqsimlanishi

Tadqiqotlar davomida turli sabzavot ekinlarida aniqlangan nematodalar soni bir xil bo‘lmadi. Eng ko‘p tur pomidor agrotsenozida qayd etilib, jami **97 ta tur** aniqlandi. Baqlajon agrotsenozida 88 ta, bodringda 82 ta, karamda 76 ta, sabzida 76 ta va piyoz agrotsenozida 69 ta nematoda turi qayd qilindi. Ushbu natijalar sabzavot ekinlari agrotsenozlarida nematodalar xilma-xilligining ekin turiga qarab farqlanishini ko‘rsatadi. Bunda o‘simlik ildiz tizimining tuzilishi, ildiz ajratmalari, tuproqning namlik va fizik-kimyoviy xususiyatlari hamda agrotexnik tadbirlar muhim ekologik omillar sifatida namoyon bo‘lishi mumkin.

Pomidor agrotsenozida turlar sonining nisbatan yuqori bo‘lishi ushbu ekinning vegetatsiya davri, ildiz tizimining rivojlanishi va tuproq biotasi bilan uzoq muddatli o‘zaro aloqasi bilan bog‘liq bo‘lishi mumkin. Biroq tur xilma-xilligining yuqoriligi avtomatik ravishda zararlilik darajasining yuqoriligini anglatmaydi.

Tadqiqotlar natijasida sabzavot agrotsenozlarida fitoparazit nematodalarning bir qator muhim avlodlari aniqlandi. Jumladan, *Ditylenchus, Pratylenchus, Hoplolaimus, Helicotylenchus, Tylenchorhynchus, Rotylenchus, Paratylenchus* va *Meloidogyne* avlodlari qayd qilindi. Mazkur avlodlarning ayrim vakillari o‘simlik ildizlari bilan oziqlanish orqali ildiz tizimining normal faoliyatiga ta’sir qiladi. Natijada o‘simlikning suv va mineral oziqa moddalarini o‘zlashtirishi susayishi, o‘sish sur’atining pasayishi va hosil shakllanishining buzilishi kuzatilishi mumkin.Fitoparazit nematodalar orasida Meloidogyne avlodining vakillari alohida ahamiyatga ega. Ushbu avlodga mansub ildiz tugunak nematodalari o‘simlik ildizlarida xarakterli tugunaklar hosil qilib, ildizning normal fiziologik faoliyatini buzadi. Ilmiy adabiyotlarda Meloidogyne turlari pomidor, bodring, baqlajon va boshqa sabzavot ekinlarining muhim zararkunandalaridan biri sifatida qayd etilgan.

Tadqiqotlarimizda sabzavot agrotsenozlarida *Meloidogyne incognita, M. javanica, M. arenaria va M. hapla* turlari aniqlandi. Ular orasida *M. incognita* dominant, *M. javanica* subdominant, *M. arenaria* kam uchraydigan, *M. hapla* esa juda kam uchraydigan tur sifatida qayd etildi. Meloidogyne turlarining turli ekinlarda qayd etilishi ushbu nematodalar sabzavot agrotsenozlarida xo‘jayin o‘simliklar bilan bog‘liq holda rivojlanishi mumkinligini ko‘rsatadi. Ayniqsa, intensiv sabzavotchilik sharoitida bir xil yoki o‘xshash ekinlarning takroriy yetishtirilishi fitoparazit nematodalar populyatsiyasining saqlanib qolishi uchun qulay sharoit yaratishi mumkin. Fitoparazit nematodalarning qishloq xo‘jaligiga ta’siri ularning tuproqdagi soni, turi, o‘simlikning chidamlilik darajasi, tuproq sharoiti va boshqa ekologik omillarga bog‘liq. Shu sababli nematodalar mavjudligini faqat “bor yoki yo‘q” shaklida baholash yetarli emas. Ularning tur tarkibi, zichligi, tarqalishi va o‘simlik bilan o‘zaro munosabatlarini muntazam kuzatish zarur. Xalqaro tadqiqotlarda ham o‘simlik-parazit nematodalar hosildorlikni cheklovchi yashirin biologik omillardan biri sifatida baholanadi. Ayniqsa, Meloidogyne turlarining keng xo‘jayin doirasiga ega ekanligi ularni sabzavot yetishtirish tizimlari uchun muhim muammo sifatida ko‘rsatadi. Zarafshon vodiysi sharoitida aniqlangan nematodalar tarkibi ham sabzavot agrotsenozlarida tuproq biologik holatini hisobga olish zarurligini ko‘rsatadi. Fitoparazit turlarni erta aniqlash orqali ularning keng tarqalishining oldini olish, ekinlarni almashlab ekish, sog‘lom ko‘chat va urug‘lik materiallaridan foydalanish hamda biologik va agrotexnik kurash choralarini uyg‘unlashtirish mumkin. Bu jarayon oziq-ovqat

ta’minoti bilan ham bog‘liq. Chunki sabzavot ekinlari hosildorligini saqlab qolish va ishlab chiqarishdagi biologik yo‘qotishlarni kamaytirish bozorda mavjud mahsulot hajmining barqaror bo‘lishiga xizmat qiladi. O‘simlik-parazit nematodalar tomonidan yetkaziladigan zarar qishloq xo‘jaligi mahsulotlari ishlab chiqarish hajmini kamaytirishi mumkinligi ilmiy adabiyotlarda ham qayd etilgan. Shu nuqtayi nazardan, fitoparazit nematodalarni boshqarish faqat o‘simliklarni himoya qilish masalasi emas, balki sabzavotchilikda mahsulot ishlab chiqarish barqarorligini ta’minlashning tarkibiy qismi sifatida qaralishi lozim.

Xulosa: Zarafshon vodiysi sabzavot agrotsenozlarida olib borilgan tadqiqotlar natijasida jami **155 ta nematoda turi** aniqlanib, ular 7 ta turkumga mansubligi belgilandi. Nematodalar faunasining asosiy qismini Tylenchida, Rhabditida va Dorylaimida turkumlari tashkil etdi. Sabzavot ekinlari orasida eng yuqori tur xilma-xilligi pomidor agrotsenozida – 97 ta, baqlajonda – 88 ta, bodringda – 82 ta, karam va sabzida – 76 tadan hamda piyozda 69 ta tur bilan ifodalandi.

Fitoparazit nematodalar tarkibida *Ditylenchus, Pratylenchus, Hoplolaimus, Helicotylenchus, Tylenchorhynchus, Rotylenchus, Paratylenchus* va *Meloidogyne* avlodlari aniqlandi. Meloidogyne avlodidan M. incognita, M. javanica, M. arenaria va M. hapla turlari qayd etildi. Ularning ekologik holatida *M. incognita* dominant, *M. javanica* subdominant, *M. arenaria* kam uchraydigan tur sifatida baholandi. Olingan natijalar Zarafshon vodiysi sabzavot agrotsenozlarida fitoparazit nematodalarni muntazam monitoring qilish, ularning tarqalish xususiyatlarini aniqlash va agrotexnik hamda biologik boshqaruv choralarini qo‘llash zarurligini ko‘rsatadi.

Fitoparazit nematodalar populyatsiyasini boshqarish orqali sabzavot ekinlarining biologik mahsuldorligini saqlash, hosil yo‘qotishlarini kamaytirish va sabzavot mahsulotlarini barqaror ishlab chiqarishga erishish mumkin. Shu sababli nematodalarni o‘rganish va ularning tarqalishini nazorat qilish oziq-ovqat ta’minotining barqarorligini ta’minlashga xizmat qiluvchi muhim agrobiologik yo‘nalishlardan biridir.

FOYDALANILGAN ADABIYOTLAR UCHUN ASOSIY MANBALAR

1. Coyne D.L., Cortada L., Dalzell J.J. et al. Plant-parasitic nematodes and food security in Sub-Saharan Africa. *Annual Review of Phytopathology*. 2018. Vol. 56. P. 381–403.
2. Kantor C., Eisenback J.D., Kantor M. Biosecurity risks to human food supply associated with plant-parasitic nematodes. *Frontiers in Plant Science*. 2024. Vol. 15.
3. Singh S.K., Singh S., Hodda M., Ash G.J. Plant-parasitic nematodes of potential phytosanitary importance, their main hosts and reported yield losses. *EPPO Bulletin*. 2013. Vol. 43, No. 2. P. 334–374.

4. Desaeger J., Khan M.R., Silva E.H.C. Nematode problems in tomato, okra, and other common vegetables, and their sustainable management. In: *Nematode Diseases of Crops and their Sustainable Management*. Academic Press, 2023. P. 223–250.
5. Zasada I.A., Coyne D., van den Hoogen J. et al. Understanding the impact of plant-parasitic nematodes on global food security and trade in a changing world. *Journal of Nematology*. 2026. Vol. 58. P. 453–462.
6. Kambarov S., To’xtasinov F., Yakhyoyev A. et al. Nematode diversity in tomato and cucumber agroecosystems of Fergana Valley and control of root-knot nematodes, Uzbekistan. *Biodiversitas*. 2026. Vol. 27, No. 2.

SURXONDARYO VILOYATINING O‘RTACHA SHO‘RLANGAN TUPROQLARI SHAROITIDA KINOA RIVOJLANISH DAVRLARI DAVOMIYLIGIGA EKISH MUDDATI VA ME’YORINING TA’SIRI

Ko‘chkeldiyeva Shahnoza Chorshanbiyevna
Termiz davlat muhandislik va agrotexnologiyalar universiteti tayanch doktoranti tel.: +998 94 464 91 94 e-mail: shahnozachorshanbiyevna4@gmail.com
Jumayev Shuxrat Maxsadovich
Samarqand davlat pedagogika instituti dotsenti, (PhD)
tel.: +998 90 742 52 07 e-mail: sh.jumaev_1980@mail.ru
Abduxalimova Sevinch Abdunazar Qizi
Samarqand davlat pedagogika instituti Biologiya ta’lim yo‘nalishi 4-bosqich talabasi
tel.: +998 33 380 36 80 e-mail: abdukhalimovasevinch11@gmail.com

Annotatsiya. *Maqolada Surxondaryo viloyati Angor tumanining o‘rtacha sho‘rlangan taqirsimon tuproqlari sharoitida 2024-2026-yillarda o‘tkazilgan dala tajribasi asosida kinoaning ICBA-Q5 navi rivojlanish davrlari davomiyligiga ekish muddati (15-17 mart, 1-3 aprel, 15-17 aprel) va ekish me’yorining (166, 238 va 333 ming dona/ga) ta’siri yoritilgan. Ekishni kechiktirish o‘suv davrini 124,7 kundan 110,0 kungacha qisqartirgani, ekish me’yorini 238 ming dona/ga gacha oshirish esa uni o‘rtacha 4,7 kunga qisqartirib, hosilning bir vaqtda pishishini ta’minlagani aniqlangan. Kinoa barcha variantlarda pishib yetilishi uchun deyarli bir xil haroratlar yig‘indisini (3117-3323 °C) talab qilgani ko‘rsatilgan. 1-3 aprel muddatida don to‘lish davri yilning eng issiq kunlaridan oldin yakunlanishi asoslangan.*

Kalit so‘zlar: *kinoa, ICBA-Q5, ekish muddati, ekish me’yori, fenologiya, o‘suv davri, haroratlar yig‘indisi, sho‘rlangan tuproq.*

Kirish

Iqlim o‘zgarishi, suv tanqisligi va sug‘oriladigan yerlarning ikkilamchi sho‘rlanishi sharoitida aholini to‘yimli oziq-ovqat bilan ta’minlash uchun abiotik stress omillariga chidamli muqobil ekinlarni joriy etish dolzarb vazifaga aylanmoqda. Kinoa (*Chenopodium quinoa Willd.)* doni almashtirib bo‘lmaydigan aminokislotalarga boy to‘laqonli oqsil manbai bo‘lib, o‘simlik sho‘rlanish va qurg‘oqchilikka chidamliligi bilan ajralib turadi. Shu bois kinoani Surxondaryo viloyatining sho‘rlangan yerlarida yetishtirish mintaqa oziq-ovqat xavfsizligini mustahkamlashga xizmat qilishi mumkin.

Kinoaning rivojlanish sur’ati harorat va kun uzunligiga sezgir bo‘lib, bu omillar vegetativ davrdan generativ davrga o‘tish muddatini hamda don to‘lish davrining davomiyligini belgilaydi [1; 87-97-b.; 2; 231-243-b.; 3; 539-544-b.]. Gullash va don hosil bo‘lishi davrining 30 °C dan yuqori haroratga to‘g‘ri kelishi chang donachalarining hayotchanligini pasaytirib, donlar sonini kamaytiradi [5; 33-45-b.]. Marokash va Pokiston sharoitida o‘tkazilgan tajribalarda ekish muddatining kechiktirilishi o‘suv davrini qisqartirgani qayd etilgan [6; 371-377-b.; 7; 535-546-b.]. Biroq yozi o‘ta issiq Surxondaryo viloyati sharoitida kinoa rivojlanish fazalari davomiyligining ekish muddati va me’yoriga bog‘liqligi hozirgacha o‘rganilmagan.

Tadqiqotning maqsadi - o‘rtacha sho‘rlangan taqirsimon tuproqlar sharoitida kinoaning ICBA-Q5 navi fazalararo davrlari va o‘suv davri davomiyligiga ekish muddati va me’yorining ta’sirini hamda rivojlanish davrlarining harorat bilan ta’minlanishini aniqlashdan iborat.

Tadqiqot obyekti va uslublari

Dala tajribasi 2024-2026-yillarda Surxondaryo viloyati Angor tumanidagi “Xomkon-Tillabuloq” fermer xo‘jaligining eskidan sug‘oriladigan o‘rtacha sho‘rlangan taqirsimon tuproqlarida (0-30 sm qatlamda quruq qoldiq 0,498 %, xlor-ioni 0,079 %) o‘tkazildi. Tadqiqot obyekti - kinoaning ICBA-Q5 navi. Ikki omilli tajribada A omil sifatida ekish muddati (15-17 mart, 1-3 aprel va 15-17 aprel - nazorat), B omil sifatida 60x10, 60x7 va 60x5 sm sxemalarga mos keluvchi ekish me’yori (166 - nazorat, 238 va 333 ming dona/ga) o‘rganildi. Tajriba 9 variant va 3 takrorlikda joylashtirildi, paykal maydoni 240 m².

Fenologik kuzatishlar «Dala tajribalarini o‘tkazish uslublari» [4] va davlat nav sinovi metodikasi [10] asosida olib borildi: fazaning boshlanishi o‘simliklarning 10 % ida, to‘liq faza 75 % ida kuzatilganda qayd etildi, rivojlanish fazalari BBCH shkalasi bilan solishtirildi

[8; 117-124-b.]. Rivojlanish davrlarining harorat bilan ta’minlanishi Termiz meteorologik stansiyasining oylik o‘rtacha harorat ma’lumotlarini sutkalar bo‘yicha chiziqli interpolyatsiya qilish orqali hisoblandi. Ma’lumotlar B.A.Dospexov uslubida [9] korrelyatsion tahlil qilindi.

Natijalar va ularning tahlili

Ekishdan unib chiqishgacha bo‘lgan davr 15-17 mart muddatida 8,0-9,0 kunni, 1-3 aprelda 7,3-8,3 kunni, 15-17 aprelda 6,3-7,3 kunni tashkil etdi (1-jadval). Barcha muddatlarda 166 ming dona/ga me’yorida unib chiqish yuqori me’yorlarga nisbatan 1,0 kunga kechikdi. Ekish muddatining kechikishi bilan vegetativ bosqichlar izchil qisqardi: unib chiqishdan ro‘vaklashgacha bo‘lgan davr 15-17 martda 46,3-48,3 kun, 1-3 aprelda 43,3-45,6 kun, 15-17 aprelda 39,7-42,3 kun davom etdi. Ro‘vaklash - gullash davrida esa variantlar o‘rtasidagi farq kichik bo‘ldi (16,3-17,7 kun).

1-jadval

Kinoaning fazalararo davrlari va o‘suv davri davomiyligiga ekish muddati va me’yorining ta’siri, kun (2024-2026-yy. o‘rtacha)

Ekish muddati	Ekish me’yori, ming dona/ga	Ekish - unib chiqish	Unib chiqish - ro‘vaklash	Ro‘vaklash - gullash	Gullash - to‘liq pishish	O‘suv davri (ekishdan)
15-17 mart	166	9,0	48,3	17,7	53,0	128,0
	238	8,0	46,3	17,0	51,7	123,0
	333	8,0	46,3	17,0	51,7	123,0
1-3 aprel	166	8,3	45,6	17,0	49,3	120,3
	238	7,3	43,3	17,0	48,7	116,3
	333	7,3	43,3	17,0	48,7	116,3
15-17 aprel (nazorat)	166 (nazorat)	7,3	42,3	16,7	47,0	113,3
	238	6,3	39,7	16,3	46,0	108,3

Ekish muddati	Ekish me’yori, ming dona/ga	Ekish - unib chiqish	Unib chiqish - ro‘vaklash	Ro‘vaklash - gullash	Gullash - to‘liq pishish	O‘suv davri (ekishdan)
	333	6,3	39,7	16,3	46,0	108,3

Izoh: unib chiqish - ro‘vaklash davri unib chiqish - maysalash, maysalash - shoxlanish va shoxlanish - ro‘vaklash davrlari yig‘indisi sifatida berilgan.

Ekishdan to‘liq pishishgacha bo‘lgan o‘suv davri o‘rtacha 15-17 martda 124,7 kunni, 1-3 aprelda 117,6 kunni va 15-17 aprelda 110,0 kunni tashkil etdi. Demak, ekishni 15-17 martdan 1-3 aprelga kechiktirish o‘suv davrini 7,1 kunga, 15-17 aprelga kechiktirish esa yana 7,6 kunga qisqartirdi. Ekish me’yorini 166 mingdan 238 ming dona/ga gacha oshirish o‘suv davrini o‘rtacha 4,7 kunga qisqartirdi, 238 va 333 ming dona/ga me’yorlari o‘rtasida esa farq kuzatilmadi. Siyrak ekinzorda o‘simliklarning ko‘proq yon shox hosil qilishi va yon ro‘vaklarning kechroq pishishi o‘suv davrini uzaytirdi. To‘liq pishish 15-17 mart muddatida 15-22-iyulda, 1-3 aprelda 24-iyul - 1-avgustda, 15-17 aprelda 31-iyul - 7-avgustda kuzatildi.

Ekishning kechiktirilishi vegetativ va generativ davrlarni birgalikda qisqartirdi: 238 ming dona/ga me’yorida gullash - to‘liq pishish davri 51,7 kundan 46,0 kungacha kamaydi, biroq generativ davrning o‘suv davridagi ulushi deyarli o‘zgarmadi (41,9-42,5 %). Bu kinoa rivojlanish sur’ati asosan harorat bilan boshqarilishini va issiqlik tezroq to‘plangan sari barcha fazalar mutanosib qisqarishini ko‘rsatadi [1; 87-97-b.].

2-jadval

Kinoa rivojlanish davrlarining havo harorati bilan ta’minlanishi (2024-2026-yy. o‘rtacha)

Ekish muddati	Ekish me’yori, ming dona/ga	Ekish - gullash, t, °C	Ekish - gullash, Σt, °C	Gullash - don hosil bo‘lishi, t, °C	Gullash - to‘liq pishish, t, °C	Ekishdan to‘liq pishishgacha, Σt, °C
15-17 mart	166	21,7	1630	30,1	31,3	3291
	238; 333	21,4	1526	29,6	31,0	3127

Ekish muddati	Ekish me’yori, ming dona/ga	Ekish - gullash, t, °C	Ekish - gullash, Σt, °C	Gullash - don hosil bo‘lishi, t, °C	Gullash - to‘liq pishish, t, °C	Ekishdan to‘liq pishishgacha, Σt, °C
1-3 aprel	166	24,7	1745	31,4	32,0	3323
	238; 333	24,4	1644	31,1	31,9	3195
15-17 aprel (nazorat)	166 (nazorat)	26,7	1764	32,0	32,1	3274
	238; 333	26,4	1639	31,8	32,1	3117

Izoh: t - davrning o‘rtacha havo harorati; Σt - sutkalik o‘rtacha haroratlar yig‘indisi.

Ekish - gullash davrining o‘rtacha harorati 15-17 martda 21,4-21,7 °C, 1-3 aprelda 24,4-24,7 °C va 15-17 aprelda 26,4-26,7 °C ni tashkil etdi, ya’ni ekishning har 15 kunga kechiktirilishi vegetativ davr haroratini 2-3 °C ga oshirdi (2-jadval). Gullash - don hosil bo‘lishi davrining harorati 15-17 martda 29,6-30,1 °C, 1-3 aprelda 31,1-31,4 °C, 15-17 aprelda esa 31,8-32,0 °C ga yetdi. Shu sababli kechki muddatda don hosil bo‘lishi eng noqulay harorat sharoitida kechdi.

Ekishdan to‘liq pishishgacha bo‘lgan haroratlar yig‘indisi barcha variantlarda 3117-3323 °C oralig‘ida bo‘lib, bir xil me’yorda muddatlar o‘rtasidagi farq 3 % dan oshmadi. Demak, o‘suv davrining 124,7 kundan 110,0 kungacha qisqarishiga qaramay, kinoa pishib yetilishi uchun deyarli bir xil issiqlik miqdorini talab qildi. O‘suv davri davomiyligi bilan don hosildorligi o‘rtasida ishonchli bog‘liqlik aniqlanmadi ($r = -0,52$; $r_{05} = 0,67$): hosildorlik o‘suv davrining uzunligi bilan emas, balki uning alohida bosqichlari qanday harorat sharoitiga to‘g‘ri kelishi bilan belgilanadi. 15-17 mart muddati qaytma sovuqlar xavfi bilan, 15-17 aprel muddati esa don to‘lishining iyul oyi jaziramasiga to‘g‘ri kelishi bilan bog‘liq bo‘lsa, 1-3 aprel muddati har ikkala noqulay omildan nisbatan xoli bo‘ldi.

Xulosa

1. Ekish muddatining kechiktirilishi kinoaning barcha fazalararo davrlarini qisqartirib, o‘suv davrini 124,7 kundan (15-17 mart) 117,6 kunga (1-3 aprel) va 110,0 kunga (15-17 aprel) kamaytirdi.

2. Ekish me’yorini 166 mingdan 238 ming dona/ga gacha oshirish o‘suv davrini o‘rtacha 4,7 kunga qisqartirib, o‘simliklarning bir vaqtda pishishini va hosilni kombayn bilan bir martada yig‘ishtirish imkonini berdi.

3. Kinoa barcha muddatlarda deyarli bir xil haroratlar yig‘indisini (3117-3323 °C) talab qildi, ekishni kechiktirish esa gullash - don hosil bo‘lishi davri haroratini 1,5-2,0 °C ga oshirdi.

4. Surxondaryo viloyatining o‘rtacha sho‘rlangan tuproqlarida kinoaning ICBA-Q5 navini 1-3 aprel muddatida 238 ming dona/ga me’yorida ekish don to‘lish davrini eng yuqori haroratlardan oldin yakunlab, hosil 24-iyul - 1-avgust oralig‘ida pishishini ta’minlaydi.

FOYDALANILGAN ADABIYOTLAR

1. Bertero H.D. Response of developmental processes to temperature and photoperiod in quinoa (Chenopodium quinoa Willd.) // Food Reviews International. - Philadelphia: Taylor & Francis, 2003. - Vol. 19, № 1-2. - P. 87-97.

2. Bertero H.D., King R.W., Hall A.J. Photoperiod-sensitive development phases in quinoa (Chenopodium quinoa Willd.) // Field Crops Research. - Amsterdam: Elsevier, 1999. - Vol. 60, № 3. - P. 231-243.

3. Christiansen J.L., Jacobsen S.-E., Jørgensen S.T. Photoperiodic effect on flowering and seed development in quinoa (Chenopodium quinoa Willd.) // Acta Agriculturae Scandinavica, Section B - Soil & Plant Science. - London: Taylor & Francis, 2010. - Vol. 60, № 6. - P. 539-544.

4. Dala tajribalarini o‘tkazish uslublari. - Toshkent: O‘zPITI, 2007. - 147 b.

5. Hinojosa L., Matanguihan J.B., Murphy K.M. Effect of high temperature on pollen morphology, plant growth and seed yield in quinoa (Chenopodium quinoa Willd.) // Journal of Agronomy and Crop Science. - Berlin: Wiley-Blackwell, 2019. - Vol. 205, № 1. - P. 33-45.

6. Hirich A., Choukr-Allah R., Jacobsen S.-E. Quinoa in Morocco - effect of sowing dates on development and yield // Journal of Agronomy and Crop Science. - Berlin: Wiley-Blackwell, 2014. - Vol. 200, № 5. - P. 371-377.

7. Sajjad A., Ehsanullah H.M., Anjum S.A. et al. Growth and development of Chenopodium quinoa genotypes at different sowing dates // Journal of Agricultural Research. - Lahore, 2014. - Vol. 52, № 4. - P. 535-546.

8. Sosa-Zuniga V., Brito-Salentim V.H., Fuentes F.F., Steinfort U. Phenological growth stages of quinoa (Chenopodium quinoa) based on the BBCH scale // Annals of Applied Biology. - Oxford: Wiley-Blackwell, 2017. - Vol. 171, № 1. - P. 117-124.

9. Доспехов Б.А. Методика полевого опыта (с основами статистической обработки результатов исследований). - М.: Агропромиздат, 1985. - 352 с.

10. Методика государственного сортоиспытания сельскохозяйственных культур. Вып. 1. Общая часть. - М.: Колос, 1985. - 269 с.

GREK SHAMBALASI (*TRIGONELLA FOENUM-GRAECUM* L.) NI FUNKSIONAL OZIQ-OVQAT XOMASHYOSI SIFATIDA YETISHTIRISHNING MAQBUL EKISH MUDDATI VA SXEMASI

Normaxmatov Samar Shuhrat o‘g‘li *– tayanch doktorant,*

Termiz davlat muhandislik va agrotexnologiyalar universiteti.

Tel.: +998 99 584 94 17; E-mail: ibrohimbekkamov@gmail.com

Jumayev Shuxrat Maxsadovich *– ilmiy rahbar, q.x.f.f.d. (PhD), dotsent,*

Samarqand davlat pedagogika instituti.

Tel.: +998 90 742 52 07; E-mail: sh.jumaev19802102@gmail.com

Safarova Nazira Salimjon qizi- *70510105-Aniq va tabiiy fanlarni o`qitish metodikasi (Biologiya) mutaxassisligining 2 bosqich magistranti Samarqand davlat pedagogika instituti*

E-mail: nazirasafarova53@gmail.com

Annotatsiya. *Ishda Surxondaryo viloyatining qumli cho‘l va och tusli bo‘z tuproqlarida 2023–2026-yillardagi tajriba asosida ekish muddati va oziqlanish maydonining Grek shambalasi (Trigonella foenum-graecum L.) urug‘ hosildorligi va biofaol moddalar miqdoriga ta’siri yoritilgan. Kech kuzgi ekish hosildorlikni erta bahorgiga nisbatan 15,8–27,8 % ga oshirdi; eng yuqori yalpi hosil 70×10 sm (nazorat) sxemasida olindi (1543,0–1963,0 kg/ga). Nazoratdan 7,8–8,5 % kam hosil bergan 70×15 sm sxemasida esa urug‘da trigonellin 33,2 %, diosgenin 6,6 % ko‘p to‘planib, gektaridan trigonellin yig‘imi 22,9 % ortdi. Bu sxema funksional oziq-ovqat va farmatsevtika uchun sifatli xomashyo olishga tavsiya etiladi.*

Kalit so‘zlar: *Grek shambalasi, Trigonella foenum-graecum L., ekish muddati, oziqlanish maydoni, urug‘ hosildorligi, trigonellin, diosgenin, funksional oziq-ovqat, oziq-ovqat xavfsizligi, qurg‘oqchil mintaqa.*

Abstract. *A 2023–2026 field experiment on sandy desert and light sierozem soils of Surkhandarya region (Uzbekistan) evaluated the effect of sowing time and plant spacing on seed yield and bioactive compounds of fenugreek (Trigonella foenum-graecum L.). Late-autumn sowing increased seed yield by 15.8–27.8 % over early-spring sowing; the 70×10 cm control gave the highest gross yield (1543.0–1963.0 kg/ha). The 70×15 cm scheme yielded 7.8–8.5 % less seed, but its seeds contained 33.2 % more trigonelline and 6.6 % more diosgenin, increasing trigonelline output per hectare by 22.9 %. This scheme is recommended for high-quality functional food and pharmaceutical raw material.*

Keywords: *fenugreek, Trigonella foenum-graecum L., sowing time, plant spacing, seed yield, trigonelline, diosgenin, functional food, food security.*

Kirish. Iqlim o‘zgarishi, suv tanqisligi va noto‘g‘ri ovqatlanish bilan bog‘liq kasalliklarning ko‘payishi oziq-ovqat xavfsizligining global muammolaridir. Dunyoda 20–79 yoshdagi 589 mln kishi qandli diabet bilan yashaydi va 2050-yilga borib ularning soni 853 mln ga yetishi kutilmoqda [5]. Shu bois qurg‘oqchilikka chidamli, shifobaxsh ekinlar hisobiga ekinlar tarkibini diversifikatsiyalash va funksional oziq-ovqat uchun mahalliy xomashyo bazasini yaratish dolzarbdir. Mamlakatimizda ham oziq-ovqat xavfsizligi, suvdan oqilona foydalanish va dorivor o‘simliklarni madaniy holda yetishtirish ustuvor yo‘nalish etib belgilangan [1; 2].

Grek shambalasi (*Trigonella foenum-graecum* L.) – dukkakdoshlar oilasiga mansub bir yillik ko‘p maqsadli ekin bo‘lib, urug‘i ziravor, oziq-ovqat qo‘shimchasi va dorivor xomashyo sifatida ishlatiladi [3, 300–310-b.]. Urug‘idagi galaktomannan, trigonellin, diosgenin va 4-gidroksiizoleytsin unga gipoglikemik va gipolipidemik xususiyat beradi, shu sababli u non-qandolat va ekstruziyalangan mahsulotlarda funksional qo‘shimcha sifatida qo‘llaniladi [11, 97–106-b.]. Klinik tadqiqotlar meta-tahliliga ko‘ra, urug‘ iste’moli diabetli bemorlarda och qoringa qondagi glyukozani o‘rtacha 0,96 mmol/l ga, glikirlangan gemoglobinni 0,85 % ga pasaytiradi [8].

Ekin hosili va sifati ekish muddati hamda tup qalinligiga bog‘liq: Turkiyada qishki ekish bahorgidan yuqori hosil bergani [6, 296–302-b.], O‘rta Uralda esa tup qalinligi ortishi bilan bitta o‘simlikdagi dukkaklar soni kamayib, birlik maydon hosili ortgani qayd etilgan [12, 3–9-b.]. Biroq Surxondaryoning issiq va quruq iqlimida 70 sm li qator oralig‘ida ekish muddati va o‘simliklar orasidagi masofaning nafaqat hosilga, balki urug‘dagi biologik faol moddalar miqdoriga ta’siri o‘rganilmagan. Tadqiqotning dastlabki natijalari [9, 217–227-b.] da e’lon qilingan.

Tadqiqotdan maqsad – ekish muddati va oziqlanish maydonining Grek shambalasi urug‘ hosili va biologik faol moddalar miqdoriga ta’sirini aniqlab, sifatli oziq-ovqat xomashyosi yetishtirishning maqbul agrotexnikasini asoslash.

Tadqiqot obyekti va usullari. Dala tajribalari 2023–2026-yillarda Termiz tumanidagi universitet o‘quv-tajriba xo‘jaligining qumli cho‘l (gumus 0,52 %, yillik yog‘in 133–160 mm) va Uzun tumanidagi “Jonchekka sarhadlari” fermer xo‘jaligining och tusli bo‘z (gumus 1,12 %, yog‘in 350–400 mm) tuproqlarida o‘tkazildi; har ikki hududda yog‘inning asosiy qismi qish va erta bahorga to‘g‘ri keladi. Ikki omilli tajribada A omili – ekish muddati: kech kuzgi (noyabrning uchinchi o‘n kunligi) va erta bahorgi (fevralning uchinchi o‘n kunligi); B omili – 70 sm li qatorlarda oziqlanish maydoni: 70×8, 70×10 (nazorat), 70×15 va 70×20 sm (mos ravishda 178,6; 142,9; 95,2 va 71,4 ming tup/ga). Variantlar to‘rt qaytariqda rendomizatsiyalangan tartibda joylashtirildi (hisobga olinadigan paykal 30 m²), $N_{30}P_{90}K_{60}$ kg/ga o‘g‘it fonida, Termizda 6–7, Uzunda 4–5 marta sug‘orildi. Biometrik o‘lchashlar har qaytariqda 25 ta model o‘simlikda o‘tkazildi, hosil namunaviy usulda aniqlandi [13, 330–336-b.]. Urug‘dagi biofaol moddalar

miqdori (Uzun tumani, kech kuzgi muddat) O‘zR FA akad. S.Yu. Yunusov nomidagi O‘simlik moddalari kimyosi institutida yuqori samarali suyuqlik xromatografiyasi usulida aniqlandi. Ma’lumotlar Statistica 7.0 dasturida dispersion, korrelyatsion va regression tahlil qilindi [13].

Natijalar va ularning muhokamasi. Kech kuzgi muddatda o‘simliklar qishni yashil maysa holida o‘tkazib, vegetatsiya 196–204 kun davom etdi va urug‘lar iyunning birinchi o‘n kunligida pishdi; erta bahorgi muddatda vegetatsiya 115–127 kunni tashkil etdi. Bahorgi muddatga nisbatan kuzgi ekinlarda poya balandligi 6–9 sm, dukkaklar soni 5–7 dona, bitta o‘simlik urug‘ mahsuldorligi 18–21 % yuqori bo‘lib, urug‘ hosildorligi barcha sxemalarda 15,8–27,8 % ga ortdi (1-jadval).

1-jadval.

Ekish muddati va oziqlanish maydonining Grek shambalasi urug‘ hosildorligiga ta’siri, kg/ga (o‘rtacha 2023–2026-yy.)

Ekish sxemasi (tup qalinligi, ming tup/ga)	**Termiz tumani** (qumli cho‘l tuproq)			**Uzun tumani** (och tusli bo‘z tuproq)		
	erta bahor	**kech kuz**	**kuz/bahor, %**	**erta bahor**	**kech kuz**	**kuz/bahor, %**
70×8 sm (178,6)	1162,7	1485,4	127,8	1491,1	1850,2	124,1
70×10 sm – nazorat (142,9)	1263,2	1543,0	122,2	1635,3	1963,0	120,0
70×15 sm (95,2)	1195,6	1412,6	118,1	1563,2	1810,5	115,8
70×20 sm (71,4)	1064,6	1290,3	121,2	1393,0	1650,4	118,5

Izoh: kech kuzgi muddat uchun EKF_{05} = 1,1–1,4 s/ga; tajriba aniqligi Sx = 2,6–3,1 %.

Nazorat sxemasida kuzgi muddatning ustunligi Termizda 279,8, Uzunda 327,7 kg/ga ni tashkil etib, EKF_{05} qiymatidan (110–140 kg/ga) sezilarli yuqori bo‘ldi. Qumli cho‘l tuproqlarida kuzgi hosil och tusli bo‘z tuproqlardagidan 19,7–22,0 % past bo‘ldi. Oziqlanish maydoni kengayishi bilan o‘simlikning shoxlanishi va dukkak tugishi ortib, poya balandligi kamaydi: Uzun tumanida kech kuzgi muddatda 70×8 sm dan 70×20 sm ga o‘tilganda poya 82,6 dan 72,8 sm gacha qisqardi, dukkaklar soni 32 tadan 44 taga, bitta o‘simlik urug‘ mahsuldorligi 14,5 dan 19,6 g gacha ortdi (2-jadval). Hudud va muddat ta’siri chiqarib tashlanganda tup qalinligi bilan bitta o‘simlik mahsuldorligi o‘rtasida kuchli manfiy bog‘lanish aniqlandi ($r=-0,98$; $n=16$; $P<0,01$). Yalpi hosil esa shu ikki ko‘rsatkich muvozanatida shakllanib, barcha hudud va muddatlarda 70×10 sm sxemasida eng yuqori bo‘ldi; ikkinchi darajali regressiya tenglamalari ($R^2=0,994–0,999$) bo‘yicha maqbul tup qalinligi 131–146

ming tup/ga ni tashkil etdi. Kuzgi muddatda 70×8 va 70×20 sm sxemalarida hosil nazoratdan mos ravishda 3,7–5,7 va 15,9–16,4 % kam bo‘ldi.

2-jadval.

Oziqlanish maydonining Grek shambalasi mahsuldorligi va urug‘idagi biofaol moddalar miqdoriga ta’siri (Uzun tumani, kech kuzgi muddat, o‘rtacha 2023–2026-yy.)

Ko‘rsatkichlar	70×8 sm	70×10 sm (nazorat)	70×15 sm	70×20 sm
Poya balandligi, sm	82,6	78,3	75,2	72,8
Dukkaklar soni, dona/o‘simlik	32	36	41	44
Bitta o‘simlik urug‘ mahsuldorligi, g	14,5	16,8	18,4	19,6
1000 dona urug‘ vazni, g	15,5	16,4	17,2	17,8
Urug‘ hosildorligi, kg/ga	1850,2	1963,0	1810,5	1650,4
Trigonellin, mg/100 g	18,24	26,66	35,51	19,38
Diosgenin, mg/100 g	3,93	7,62	8,12	5,51
Fenugrekin, mg/100 g	1,25	1,64	1,97	1,39
Galaktomannan, mg/100 g	0,39	0,69	0,72	0,48
Trigonellin yig‘imi, *g/ga*	337,5	523,3	642,9	319,8
Diosgenin yig‘imi, *g/ga*	72,7	149,6	147,0	90,9

Izoh: moddalar yig‘imi = urug‘dagi modda miqdori × urug‘ hosildorligi.

Urug‘dagi biologik faol moddalarning eng yuqori miqdori 70×15 sm sxemasida qayd etildi: trigonellin, diosgenin, fenugrekin va galaktomannan miqdori nazoratdagidan mos ravishda 33,2; 6,6; 20,1 va 4,3 % yuqori bo‘ldi. O‘ta zich (70×8 sm) ekishda trigonellin va diosgenin nazoratdagidan 1,5 va 1,9 barobar kam to‘plandi, siyrak sxemada ham ular past bo‘ldi, ya’ni moddalar to‘planishi o‘rtacha tup qalinligida eng yuqori darajaga yetdi. Agrotexnik omillarning bu moddalar miqdoriga ta’siri fosforli o‘g‘it misolida ham qayd etilgan [4, 663–667-b.]; adabiyot bilan miqdoriy taqqoslashda esa namuna tayyorlash va ekstraksiya usullaridagi farqlarni inobatga olish lozim. Urug‘da B_1, B_2, B_3 va C vitaminlari, kaliy, kalsiy, magniy, temir va rux aniqlanib, bu uning ozuqaviy qiymatini tasdiqlaydi.

Dorivor va oziq-ovqat xomashyosining yakuniy qiymati modda miqdori bilan hosildorlik ko‘paytmasi orqali belgilanadi: 70×15 sm sxemasi gektaridan eng ko‘p trigonellin yig‘imini (642,9 g/ga) ta’minlab, nazoratdan 22,9 % ustun keldi, diosgenin yig‘imi esa deyarli teng bo‘ldi (147,0 va 149,6 g/ga). Bu sxemada 1000 dona urug‘ vazni ham yuqori (17,2 va 16,4 g), urug‘lik sarfi esa 2 kg/ga kam bo‘ldi. Demak, yalpi hosil bo‘yicha nazorat ustun bo‘lsa-da, sifatli oziq-ovqat va dorivor xomashyo uchun 70×15 sm sxemasi maqbuldir.

Kech kuzgi muddatdagi hosildorlik (1290–1963 kg/ga) xorijiy natijalar bilan raqobatbardosh: AQShning yarim qurg‘oqchil baland tekisliklarida sug‘orishda 1680 kg/ga dan ortiq [10, 65–71-b.], Hindistonda tomchilatib sug‘orishda 2049,8 kg/ga [7, 838–843-b.], Turkiyada qishki ekishda 1347, bahorgi ekishda 1129 kg/ga [6, 296–302-b.] urug‘ olingan. Kuzgi ekishning ustunligi o‘simliklarning qishki namlikdan foydalanib baquvvat ildiz tizimini shakllantirishi, generativ fazaga rivojlangan holda kirishi va urug‘ to‘lishi 35 °C dan yuqori issiqlar boshlanguncha yakunlanishi bilan izohlanadi. Shu bilan birga, ayrim yillari −5…−8 °C sovuqlar kuzatilishi sababli qishlash barqarorligini ko‘p yillik ma’lumotlar asosida baholash lozim.

Xulosa. Surxondaryo viloyati sharoitida Grek shambalasini kech kuzgi muddatda (noyabrning uchinchi o‘n kunligi) ekish qishki-bahorgi namlikdan unumli foydalanish hisobiga urug‘ hosildorligini 15,8–27,8 % ga oshiradi. Eng yuqori yalpi hosil 70×10 sm sxemasida (1543,0–1963,0 kg/ga) olinsa, 70×15 sm sxemasi urug‘da biologik faol moddalarning eng yuqori miqdorini, gektaridan 22,9 % ko‘p trigonellin yig‘imini va 2 kg/ga urug‘lik tejalishini ta’minlaydi. Funksional oziq-ovqat (ziravor, parhezbop va diabetik mahsulotlar) hamda farmatsevtika sanoati uchun sifatli mahalliy xomashyo yetishtirishda Grek shambalasini kech kuzda 70×15 sm sxemasida, $N_{30}P_{90}K_{60}$ kg/ga fonida ekish tavsiya etiladi. Bu qurg‘oqchil mintaqada ekinlar tarkibini diversifikatsiya qilish, tabiiy namlikdan samarali foydalanish va aholini sog‘lom oziq-ovqat bilan ta’minlashga xizmat qiladi.

FOYDALANILGAN ADABIYOTLAR

1. O‘zbekiston Respublikasi Prezidentining 2019-yil 23-oktyabrdagi PF–5853-son «O‘zbekiston Respublikasi qishloq xo‘jaligini rivojlantirishning 2020–2030-yillarga mo‘ljallangan strategiyasini tasdiqlash to‘g‘risida»gi Farmoni. – URL: https://lex.uz/docs/4567334

2. O‘zbekiston Respublikasi Prezidentining 2022-yil 20-maydagi PQ–251-son «Dorivor o‘simliklarni madaniy holda yetishtirish va qayta ishlash hamda davolashda ulardan keng foydalanishni tashkil etish chora-tadbirlari to‘g‘risida»gi Qarori. – URL: https://lex.uz/docs/6027139

3. Ahmad A., Alghamdi S.S., Mahmood K., Afzal M. Fenugreek a multipurpose crop: potentialities and improvements // Saudi Journal of Biological Sciences. – 2016. – Vol. 23, No. 2. – P. 300–310.

4. Beyzi E., Köngül Şafak E., Gürbüz P. et al. Fatty acid composition, diosgenin and trigonelline contents of fenugreek (*Trigonella foenum-graecum*): effects of phosphorus fertilizer // Plant Biosystems. – 2021. – Vol. 155, No. 4. – P. 663–667.

5. International Diabetes Federation. IDF Diabetes Atlas. – 11th ed. – Brussels: International Diabetes Federation, 2025. – URL: https://diabetesatlas.org

6. Kartal S., Baturay Z., Efe L. Effect of planting times on the yield and quality of fenugreek (*Trigonella foenum-graecum* L.) under the conditions of Kahramanmaraş // Turkish Journal of Agriculture – Food Science and Technology. – 2023. – Vol. 11, No. 2. – P. 296–302.

7. Lal G., Singh R., Mehta R.S. et al. Study on irrigation levels based on IW/CPE ratio and irrigation methods on growth and yield of fenugreek (*Trigonella foenum-graecum* L.) // Legume Research. – 2020. – Vol. 43, No. 6. – P. 838–843.

8. Neelakantan N., Narayanan M., de Souza R.J., van Dam R.M. Effect of fenugreek (*Trigonella foenum-graecum* L.) intake on glycemia: a meta-analysis of clinical trials // Nutrition Journal. – 2014. – Vol. 13. – Art. 7.

9. Normaxmatov S.Sh., Jumayev Sh.M. Grek shambalasi (*Trigonella foenum-graecum* L.)ning introduksiyasi va agrotexnologiyasi // AGROINNOVATSIYA. – 2024. – Vol. 2, Issue 1. – B. 217–227.

10. Pavlista A.D., Santra D.K. Planting and harvest dates, and irrigation on fenugreek in the semi-arid high plains of the USA // Industrial Crops and Products. – 2016. – Vol. 94. – P. 65–71.

11. Wani S.A., Kumar P. Fenugreek: a review on its nutraceutical properties and utilization in various food products // Journal of the Saudi Society of Agricultural Sciences. – 2018. – Vol. 17, No. 2. – P. 97–106.

12. Абрамчук А.В., Карпухин М.Ю., Сапарклычева С.Е. Влияние площади питания на рост, развитие и продуктивность пажитника греческого в условиях интродукции на Среднем Урале // Вестник Курганской ГСХА. – 2020. – № 4. – С. 3–9.

13. Доспехов Б.А. Методика полевого опыта (с основами статистической обработки результатов исследований). – 5-е изд., доп. и перераб. – М.: Агропромиздат, 1985. – 351 с.

MARJUMAKNING TARQALISHI, MORFOLOGIK VA FIZIOLOGIK XUSUSSIYATLARI

Usmanova M.I., Eshmurodova M.

Samarqand davlat pedagogika institute, Samarqand sh, O’zbekiston

e-mail: mahliyousmanova1985@gmail.com

O‘roqov S.X.

Sharof Rashidov nomidagi Samarqand davlat universiteti, Samarqand shahri, O‘zbekiston

Annotatsiya: *Ushbu maqolada marjumak (Fagopyrum esculentum) o‘simligining kelib chiqishi, jahon bo‘ylab tarqalish geografiyasi hamda uning asosiy morfologik va biologik-fiziologik xususiyatlari batafsil yoritilgan. Shuningdek, o‘simlikning noqulay ekologik omillarga chidamliligi, vegetatsiya davridagi o‘sish va rivojlanish qonuniyatlari hamda qishloq xo‘jaligidagi ahamiyati tahlil qilingan.*

Kalit so‘zlar: *Marjumak, tarqalish geografiyasi, morfologik tuzilish, fiziologik xususiyatlar, vegetatsiya davri, ekologik omillar, o‘simlik biologiyasi.*

Abstract:*This article provides a detailed overview of the origin, geographical distribution, and the main morphological, biological, and physiological characteristics of buckwheat (Fagopyrum esculentum). Furthermore, the plant's resistance to unfavorable environmental factors, growth and development patterns during the vegetation period, and its agricultural significance are analyzed.*

Keywords: *Buckwheat, geographical distribution, morphological structure, physiological characteristics, vegetation period, environmental factors, plant biology.*

Ko‘pchilik tadqiqotchilarning fikricha, marjumak (grechixa) 5 yoki 6 ming yil ilgari Janubi-Sharqiy Osiyoda ma’lum bo‘lgan. U yerdan Markaziy Osiyo, Yaqin Sharq va Yevropaga tarqalgan. Arxeologik ma’lumotlarga ko‘ra, insonlar marjumakni 4 ming yil oldin ham bilganlar. Manbalarda keltirilishicha, marjumakning kelib chiqishi Janubi-Sharqiy Osiyo, Himolay tog‘lari deb ko‘rsatiladi. Keyinchalik marjumak boshqa mintaqalarga turli yo‘llar va vositalar orqali tarqalgan [1].

Dunyo bo‘yicha hozirgi vaqtda kelib Rossiya, Xitoy, Ukraina, Amerika qit’asi, Fransiya, Polsha, Qozog‘iston, Hindiston, Uzoq Sharqda va Yevropa davlatlarida marjumak ko‘plab yetishtiriladi [2.].

Marjumak rutinga boy bo‘lgan qimmatli manba hisoblanadi. Marjumak donining po‘stlog‘idan rutin olish samarali usullardan biridir. Marjumakning vegetativ massasidan ham rutin olinadi va uning 84%idan maqsadli mahsulot olinadi Marjumak o‘simligining fenol birikmalari tarkibini biokimyoviy o‘rganish shuni ko‘rsatdiki, u barglarda turli xil fenilpropanoidlar va

flavonoidlar bilan ifodalanadi (rutin, kversetin va lyuteolin), poyalari va ildizlarida esa faqat fenilpropanoidlar (sianidin, kversetin va xlorogen kislota) bilan ifodalanadi [5].

Umuman hozirgi vaqtga kelib ko‘plab davlatlarda marjumak tarqalgan, har bir tabiiy iqlim uchun o‘simlikning biologiyasi, fiziologik xususiyatlariga asoslanib maxsus yetishtirish agrotexnologiyasi ishlab chiqilgan, ammo hosildorlikning pastligiga sabab ilmiy asoslangan agrotexnologiyaning qo‘llanilmasligidir.

Marjumak o‘simligining biologiyasini, fiziologik xususiyatlarini o‘rganish shuni ko‘rsatadiki, uning hosildorligini belgilashda asosiy omil navlarni to‘g‘ri tanlash, agrotexnologik tadbirlarni to‘g‘ri olib borish va yuqori sifatli urug‘larni ekish hisoblanadi. O‘simliklarning yuqori hosil berishini ta’minlashda uning fiziologik jarayonlarini e’tiborga olib, o‘simlikning biologik xususiyatidan kelib chiqib, agrotexnologik tadbirlarni uyg‘unlashgan holda olib borish yuqori samara beradi. Shuning uchun o‘simlik biologiyasini, navlarini, tezpisharlik xususiyatlari va fenologik fazalarning o‘tishini hisobga olgan holda parvarishlash muhim masala hisoblanadi [6].

Marjumakning bir yillik va ko‘p yillik turlari bo‘lib, Polygonaceae-marjumakdoshlar oilasiga kiradi. Polygonaceae oilasining 30 ta avlodi bo‘lib, bu oilaga 800 tur o‘simlik kiradi [2].

Fagopyrum Zearth–marjumaksimonlar avlodining, keng tarqalgan turlariga quyidagilar kiradi:

Bu avlodning eng muhim vakili Fagopyrum esculentum Moench-madaniy marjumak hisoblanadi, bu turning 2 ta kenja turi bor. Birinchi kenja turi oddiy marjumak (S. sp Vulgara stol) bo‘lib, Yevropa va boshqa ko‘plab davlatlarda yetishtiriladi. Ikkinchi kenja turi ko‘p bargli marjumak (S. sp multifolium stol)dir. Bu kenja tur boshqa turlardan bo‘yining balandligi va ko‘plab barg hosil qilishi bilan ajralib turadi. Ko‘p bargli marjumak kenja turi Janubi-Sharqiy Osiyo davlatlarida ko‘p ekiladi.

Fagopyrum tataricum-Tatar marjumagi hayotiy shakli bir yillik, yovvoyi tur. Bu tur madaniy marjumak yetishtiriladigan maydonlarda begona o‘t o‘simlik sifatida o‘sadi. Bu turning quyidagi tur xillari bor: S sp. himolaicum, S sp. tuberculotum, S sp. votundatum. Bu tur xillari orasida, S sp. himolaicum muhitning noqulay omillariga, kasalliklarga, chidamli bo‘lganligi sababli seleksiya ishlarida keng foydalaniladi. Tatar marjumagining xo‘jalik ahamiyati kam [3].

Fagopyrym chinense-Xitoy marjumagi. Dunyo bo‘yicha ko‘plab yetishtiradigan oddiy marjumak (S. sp Vulgara stol) kenja turiga taalluqli. Bu tur navlarining ildizi, poyasi, bargi, to‘pgullari va donlarining tuzilishi boshqa turlarnikidan nisbatan farq qiladi [7].

Marjumakning ildiz tizimi kuchli rivojlanmagan, masalan, uning ildiz massasi suliga nisbatan 2 marta, kartoshkaga nisbatan 10 barobar kam bo‘ladi. Marjumak ildizlarining o‘sishiga urug‘larning ekish chuqurligi, tuproqning mexanik tarkibi, kuchli ta’sir qilgani singari, yer ustki

massasining o‘sishi ham ta’sir qiladi. Marjumak urug‘lari tuproqning yuza qatlamiga ekilganda, qo‘shimcha ildizlar sust rivojlanadi. Marjumakning ildiz tizimini muhim fiziologik xususiyati shundaki, undan organik kislotalar ajraladi, bu esa qiyin eriydigan fosforli birikmalarni o‘zlashtiriladigan shaklga o‘tishiga yordam beradi. Marjumak ildizining shu xususiyati tufayli oziqa moddalarni o‘zlashtirish xususiyati bir necha barobar oshishi mumkin [5].

Urug‘larning unishida tuproq yuzasiga yumaloq buyraksimon urug‘pallabarg paydo bo‘ladi. Urug‘pallabarglar och yashil tusda bo‘ladi, ko‘p yillik shakllarida esa urug‘pallalari yirik, yashil yoki to‘q yashil bo‘ladi. 4-6 kundan so‘ng chinbarglar paydo bo‘la boshlaydi, undan 3-5 kundan so‘ng keyingi barglar hosil bo‘la boshlaydi. Barglarining shakli o‘zgaruvchan, asosan yuraksimon, uchburchak, yoysimon, asosi nayzasimon va qisqa bandli bo‘ladi. Yosh barglari kichik va yupqa, nozik bo‘ladi, kattalashgan sari qalinlashib boradi [7].

Marjumakning nektar ajratishi havo sharoitlari bilan bog‘liq. O‘rtacha bir guldan olinadigan nektar taxminan 0,05 mg ni, qulay sharoitda esa 0,3 mg ni tashkil etadi. Marjumak bir gektarda 10 kg dan 120 kg gacha nektar hosil qiladi. Asalarilar marjumakning changlanishiga ijobiy ta’sir ko‘rsatib, hosildorlikni 10-15%ga oshirish bilan birgalikda, gektaridan 80-100 kg asal beradi.

Marjumakning navlari tezpisharligi bo‘yicha uch guruhga bo‘linadi: tezpishar navlarning o‘suv davri 70 kunni, o‘rtapishar navlar 70-80 kunni, kechpishar navlar 90 kundan ziyodni tashkil etadi [5].

Marjumakning o‘suv davri uchga bo‘linadi.

1. Unib chiqishidan – gullashgacha. 2. Gullash boshlanishidan – mevalarning qo‘ng‘ir tusga kirguncha. 3. Donning qo‘ng‘ir tusga kirishidan- to‘liq pishish davrigacha.

Marjumak biologik xususiyatiga ko‘ra, issiqlikni va namlikni xush ko‘ruvchi, yorug‘likka talabchan o‘simlik hisoblanadi. Marjumakning urug‘lariga yetarlicha namlik bo‘lganda, suvni shimib olib, 3-5 kun ichida una boshlaydi. Tuproqning harorati 7-80S bo‘lganda una boshlaydi, ammo optimal harorat 10-15^{0}C. Harorat 150S dan yuqori bo‘lganda, urug‘larning qiyg‘os unib chiqishi sodir bo‘ladi. Marjumak urug‘i o‘z vazniga nisbatan 40-50% suvni shimib olganda unib chiqadi [5].

Marjumak namga talabchan o‘simlik bo‘lib, o‘z ontogenezida ko‘p suv sarflaydi, gullash, meva hosil qilish fazasi suvga bo‘lgan kritik davr hisoblanadi, ya’ni tariq, oqjo‘xoriga qaraganda suvni 2-3 barobar ko‘p sarflaydi. Uning transpiratsiya koeffitsiyenti ma’lumotlarga ko‘ra, 550-646 ga teng.

Tuproqda namlikning yetishmasligi marjumakni o‘sishi va rivojlanishi sekinlashishiga olib keladi, gullaridan kam nektar ajraladi, gullar changlanmasdan qurib qoladi, natijada hosildorlik keskin kamayadi.

Marjumak urug‘lari unib chiqqach, gullashgacha 10-11%, gullashdan yetilish fazasigacha umumiy suvning 85-90%i sarflanadi [6].

Yuqorida keltirilgan adabiyotlar tahlilidan ma’lum bo‘lishicha, marjumak yetishtiriladigan mintaqalarda o‘simlik navlarining biologik, fiziologik ko‘rsatkichlariga muvofiq holda kompleks agrotexnologik tadbirlar tizimini ishlab chiqish va joriy etish orqali ushbu ekindan yuqori hosil olish mumkin.

ADABIYOTLAR RO’YXATI

1. Cawoy V, Kinet J.M., Jacquemart A.L. Morphology of nectaries and biology of nectar production in the distylous species Fagopyrum esculentum // Ann Bot. 2008;102(5): -P. 675-684.

2. Важов В.М., Козил В.Н., Одинцев А.В. Гречиха в Лесостепи Алтая: монография– Бийск, 2012. – 204 с.

3. Глазова З.И., Наумкин В.Н., Воробьева И.И., Драп И.И. Новое в технологии возделывания гречихи // Земледелие -М:. 2001.-№3. -С.9

4. Гнеушева, И.А. Фотосенсибилизирующее действие гречихи и продуктов ее биотехнологической переработки // Вестник Орел ГАУ. — 2012. - №2 (35). - С.45-47.

5. Жўраева З.Ж. Самарқанд вилояти шароитида гречиханинг ўсишига экиш муддатининг таъсири // Озиқ-овқат хавфсизлиги: миллий ва глобал омиллар: Халқаро илмий-амалий конференция. –Самарқанд, 2019.-Б.179-180.

6. Ўроқов С.Х., Хўжаев Ж.Х., Зарафшон водийси шароитида маржумак етиштириш агротехнологиясининг илмий асослари. Монография.-Самарқанд: СамДУ, 2017.166 б.

7. Хўжаев Ж.Х., Ўроқов С.Х., Усманова М.И. Самарқанд вилояти шароитида етиштирилган маржумак ҳосилидан уруғлик олиш кўрсаткичига маъданли ўғитларнинг таъсири // халқаро илмий-амалий конференцияси материаллари. Самарқанд-2019. –Б. 129-

KAMALAK FORELI (ONCORHYNCHUS MYKISS), BALIG'INING JAHON MIQYOSIDAGI AHAMIYATI

Buvrayev Nurali Ravshan o’g’li

Samarqand davlat pedagogika inistituti o‘qituvchi

buvrayevn@gmail.com

Jabborov Abdurashid Rayimovich

Sharof Rashidov nomidagi Samarqand davlat universiteti Biokimyo instituti

Yuldashov Mansur Arzikulovich

Zarmed universiteti Samarqand kompusi

Annotatsiya: *Ushbu ma'lumotda kamalak foreli (Oncorhynchus mykiss) ning jahon miqyosidagi ahamiyati kompleks tarzda yoritilgan. Kamalak foreli Salmonidae oilasiga mansub bo'lib, tabiiy areali Shimoliy Amerikaning Tinch okeani havzasi hisoblanadi, ammo inson faoliyati natijasida deyarli barcha qit'alarda yetishtirilmoqda va iqlimlashtirilgan. Uning jahon miqyosidagi ahamiyati bir necha o'zaro bog'liq omillar — yuqori biologik moslashuvchanlik, oziq-ovqat xavfsizligidagi rol, iqtisodiy qiymat, ilmiy-tadqiqot obyekti sifatidagi ahamiyat hamda akvakultura texnologiyalarining rivojlanishiga qo'shgan hissasi bilan belgilanadi.*

Kalit so‘zlar: *Kamalak foreli (Oncorhynchus mykiss), Salmonidae oilasi, Akvakultura, Jahon baliqchilik xo'jaligi, Oziq-ovqat xavfsizligi, Biologik moslashuvchanlik, Iqtisodiy qiymat, Global bozor, Yetishtirish hajmi, Triploid va diploid baliqlar, Genomik seleksiya, Ilmiy-tadqiqot obyekti, Yopiq suv aylanma tizimlari (RAS), Eksport va import.*

Annotation: *In this information, the global significance of rainbow trout (Oncorhynchus mykiss) is comprehensively covered. Rainbow trout belongs to the Salmonidae family, and its natural range covers the Pacific Ocean basin of North America; however, as a result of human activity, it is being farmed and acclimatized on almost all continents. Its global significance is determined by several interrelated factors — high biological adaptability, its role in food security, economic value, its importance as a research object, and its contribution to the development of aquaculture technologies.*

Keywords: *Rainbow trout (Oncorhynchus mykiss), Salmonidae family, Aquaculture, World fisheries, Food security, Biological adaptability, Economic value, Global market, Production volume, Triploid and diploid fish, Genomic selection, Research object, Recirculating Aquaculture Systems (RAS), Export and import*

Kirish Kamalak foreli (Oncorhynchus mykiss) zamonaviy jahon akvakulturasining eng muhim va keng tarqalgan turlaridan biri sifatida alohida o‘rin tutadi. Ushbu tur Salmonidae oilasiga mansub bo‘lib, tabiiy areali Shimoliy Amerikaning Tinch okeani havzasini o‘z ichiga oladi, ammo inson faoliyati natijasida deyarli barcha qit’alarda yetishtirilmoqda va iqlimlashtirilgan. Kamalak forelining jahon miqyosidagi ahamiyati bir necha o‘zaro bog‘liq omillar bilan belgilanadi: uning yuqori biologik moslashuvchanligi, oziq-ovqat xavfsizligidagi roli, iqtisodiy qiymati, ilmiy-tadqiqot obyekti sifatidagi ahamiyati hamda akvakultura texnologiyalarining rivojlanishiga qo‘shgan hissasi.

Kamalak forelining jahon miqyosida keng tarqalishining asosiy sababi uning ekologik sharoitlarga nisbatan yuqori moslashuvchanligidir. Robert J. Behnke (2002) tomonidan olib borilgan tadqiqotlar shuni ko‘rsatadiki, aynan shu biologik xususiyatlar kamalak forelini sanoat akvakulturasi uchun eng istiqbolli salmonid turlaridan biriga aylantirgan. Bu tur sovuq va toza suvli tog‘ daryolari, ko‘llar hamda sun’iy suv havzalarida muvaffaqiyatli o‘sishi mumkin. Tabiiy populyatsiyalar orasida ikkita asosiy ekologik shakl farqlanadi: butun hayotini chuchuk suvda o‘tkazuvchi “kamloops” shakli va dengizda o‘sib, ko‘payish uchun daryolarga qaytuvchi “steelhead” shakli. Bu xilma-xillik seleksiya va yetishtirish dasturlarida keng imkoniyatlar yaratadi. Galbreath va hamkorlari (1994) triploid va diploid kamalak forellarining o‘sish ko‘rsatkichlarini qiyosiy tahlil qilib, triploid baliqlar ayniqsa jinsiy yetilish davrida yuqori o‘sish sur’atlarini saqlab qolishini isbotlaganlar. Bu kabi ilmiy yutuqlar kamalak forelining jahon akvakulturasidagi mavqeini yanada mustahkamlagan.

Jahon miqyosida kamalak foreli yetishtirish hajmi bugungi kunda sezilarli darajada katta bo‘lib, bu ko‘rsatkich muntazam o‘sib bormoqda. FAO ma’lumotlariga ko‘ra, 2024-yilda dunyo bo‘yicha 1,2 million tonnaga yaqin kamalak foreli yetishtirilgan. Boshqa manbalarga ko‘ra, yillik yetishtirish hajmi 900 mingdan 1 million tonnagacha bo‘lgan oraliqda tebranib turadi. 2023-yilgi ma’lumotlarga ko‘ra, yetishtirish hajmi bo‘yicha yetakchi davlatlar qatoriga Turkiya (taxminan 221 ming tonna), Eron (215 ming tonna), Rossiya (130,3 ming tonna), Norvegiya (90 ming tonna), Chili (44,3 ming tonna) va Xitoy (41,1 ming tonna) kiradi. Ushbu raqamlar kamalak forelining jahon akvakulturasida qanchalik muhim o‘rin egallashini yaqqol ko‘rsatadi. Turkiya va Eron jahon yetishtirishning qariyb 40 foizini ta’minlab, bu sohada mutlaq yetakchi hisoblanadi. Turkiya o‘z mahsulotining katta qismini Yevropa Ittifoqiga eksport qiladi va yiliga 130-150 ming tonna forel yetishtiradi. Eron esa shirin suv havzalarida kamalak foreli yetishtirish bo‘yicha jahonda yetakchi o‘rinni egallaydi.

Kamalak forelining iqtisodiy ahamiyati uning jahon bozoridagi ulkan hajmi bilan belgilanadi. Global kamalak foreli bozori 2023-yilda taxminan 4,5 milliard AQSh dollariga baholangan bo‘lib, 2032-yilga kelib 7,3 milliard dollarga yetishi prognoz qilinmoqda. Bu yillik

o‘sish sur’ati 5,5 foizni tashkil etadi. Bozor o‘sishining asosiy omillari sifatida sog‘lom va barqaror protein manbalariga bo‘lgan talabning ortishi, akvakultura amaliyotlaridagi texnologik yutuqlar hamda omega-3 yog‘ kislotalariga boy baliq mahsulotlarining sog‘liq uchun foydalari haqida iste’molchilarning xabardorligi oshishi ko‘rsatiladi. Shuningdek, peskatarian va flexitarian parhez tendensiyalarining kuchayishi ham bozor kengayishiga sezilarli ta’sir qilmoqda. Turkiyaning kamalak foreli eksporti 2024-yilda 78 ming tonnadan ortiq hajmda amalga oshirilib, bu ko‘rsatkich 2018-yilga nisbatan 16 baravar yuqori. Bu eksportdan qariyb 498 million dollar daromad olingan. Norvegiya va Chili kabi davlatlar ham yirik hajmdagi forel yetishtirish va eksport qilish bilan shug‘ullanadi. Bu raqamlar kamalak forelining nafaqat oziq-ovqat xavfsizligini ta’minlashda, balki davlatlararo savdo-iqtisodiy munosabatlarda ham muhim o‘rin tutishini ko‘rsatadi.

Kamalak foreli oziq-ovqat xavfsizligi nuqtai nazaridan ham beqiyos ahamiyatga ega. Uning go‘shti yuqori darajadagi oqsil, omega-3 yog‘ kislotalari, vitaminlar va minerallarga boy bo‘lib, parhez oziqlanish uchun juda mos hisoblanadi. Bugungi kunda dunyo aholisini sifatli va oqsillarga boy oziq-ovqat mahsulotlari bilan ta’minlashda akvakultura, xususan sovuq suv baliqchiligi alohida o‘rin tutadi. Kamalak foreli tez o‘sishi, intensiv oziqlantirishga moslashuvchanligi va go‘shtining yuqori parhezlik xususiyatlari bilan ajralib turadi. Ayniqsa, rivojlanayotgan mamlakatlarda arzon va sifatli protein manbasiga bo‘lgan talab ortib borayotgan bir sharoitda kamalak foreli yetishtirish muhim ahamiyat kasb etadi. Qayd etish joizki, yetishtirilgan kamalak forelining go‘shti qizg‘ish rangga ega bo‘lishi uchun ozuqaga sintetik astaksantin pigmenti qo‘shiladi, bu esa ozuqa xarajatlarining 15-20 foizini tashkil qiladi. Bu holat kamalak foreli yetishtirishning iqtisodiy jihatlarini yanada chuqurroq o‘rganish zarurligini ko‘rsatadi.

Kamalak foreli ilmiy-tadqiqot obyekti sifatida ham jahon miqyosida katta ahamiyatga ega. U eng ko‘p o‘rganilgan model baliq turlaridan biri hisoblanadi. Katta hajmi tufayli kamalak foreli turli xil hujayra va to‘qima turlarini yetarli miqdorda olishni talab qiluvchi tadqiqotlar uchun alohida qulaylik yaratadi. Bu tur kanserogenez, toksikologiya, qiyosiy immunologiya, kasalliklar ekologiyasi, fiziologiya va ovqatlanish sohalarida keng qo‘llaniladi. Shuningdek, kamalak foreli genomining to‘liq sekvensiyalanishi (Berthelot va boshqalar, 2014) salmonidlar evolyutsiyasi va umurtqali hayvonlarda butun genom duplikatsiyasidan keyingi jarayonlarni o‘rganishda yangi imkoniyatlar ochdi. Genomik seleksiya sohasidagi tadqiqotlar ham kamalak foreli misolida faol olib borilmoqda. D’Ambrosio va boshqalar (2020) tomonidan olib borilgan tadqiqotlar genomik prognozlashning urg‘ochi baliqlarning reproduktiv xususiyatlarini (tana vazni, tuxum qo‘yish sanasi, fekundlik va tuxum hajmi) an’anaviy usullarga qaraganda sezilarli darajada yuqori aniqlikda bashorat qilish imkonini berishini ko‘rsatdi. Bu kabi ilmiy izlanishlar kamalak forelining nafaqat iqtisodiy, balki fundamental fan uchun ham qimmatli obyekt ekanligini tasdiqlaydi.

Kamalak foreli yetishtirish texnologiyalari sohasida ham jiddiy yutuqlarga erishilmoqda. Zamonaviy tadqiqotlar asosan baliq dori-darmonlari, genetik seleksiya (triploid baliqlar yetishtirish) va yopiq suv aylanma tizimlari (UZV) texnologiyalarini rivojlantirishga qaratilgan. Yopiq suv aylanma tizimlari (RAS) va aqlli yetishtirish tizimlarining rivojlanishi kamalak foreli yetishtirishni yanada samarali va barqaror qilmoqda. Bu texnologiyalar suv resurslaridan tejamkor foydalanish, atrof-muhitga ta’sirni kamaytirish va kasalliklarni nazorat qilish imkonini beradi. Turkiyada qafas akvakulturasi tizimi keng qo‘llanilib, bu usul intensiv akvakultura uchun eng istiqbolli yo‘nalish sifatida e’tirof etilgan. Biroq, tez o‘sish bilan birga ba’zi muammolar ham paydo bo‘lmoqda. Turkiyada forelchilikning jadal rivojlanishi baliqlarning omon qolish darajasining nazoratsiz pasayishiga olib kelgani haqida xavotirlar bildirilmoqda. Shuningdek, qafaslar joylashgan hududlardagi mahalliy baliqchilar ushbu qafaslar baliq harakatini to‘sib qo‘yishi va baliq zaxiralarining kamayishiga olib kelishi mumkinligidan shikoyat qilmoqdalar. Bu muammolar kamalak foreli yetishtirishning ekologik va ijtimoiy jihatlarini puxta o‘rganish zarurligini ko‘rsatadi.

Xulosa qilib aytganda, kamalak foreli (Oncorhynchus mykiss) jahon miqyosida bir necha jihatdan beqiyos ahamiyatga ega. Birinchidan, u jahon akvakulturasining eng muhim turlaridan biri bo‘lib, yillik yetishtirish hajmi 1 million tonnadan oshadi va bu ko‘rsatkich muntazam o‘sib bormoqda. Ikkinchidan, kamalak foreli jahon oziq-ovqat xavfsizligini ta’minlashda muhim rol o‘ynaydi, chunki uning go‘shti yuqori sifatli protein va omega-3 yog‘ kislotalariga boy. Uchinchidan, bu turning iqtisodiy qiymati juda katta bo‘lib, jahon bozori hajmi 4,5 milliard dollardan oshadi va bu raqam yil sayin ortib bormoqda. To‘rtinchidan, kamalak foreli ilmiy-tadqiqot sohasida model organizm sifatida keng qo‘llaniladi va genomika, fiziologiya, immunologiya kabi ko‘plab sohalarda qimmatli ma’lumotlar manbai bo‘lib xizmat qiladi. Beshinchidan, kamalak foreli yetishtirish texnologiyalari doimiy takomillashtirilib, zamonaviy yopiq suv aylanma tizimlari va genetik seleksiya usullari joriy etilmoqda. Shu bilan birga, tez o‘sish bilan bog‘liq ekologik va ijtimoiy muammolarni hal qilish ham muhim vazifa bo‘lib qolmoqda. Umuman olganda, kamalak foreli jahon akvakulturasi, oziq-ovqat xavfsizligi, iqtisodiyot va ilm-fan sohalarida ko‘p qirrali va chuqur ahamiyatga ega bo‘lgan tur sifatida o‘z mavqeini mustahkam saqlab qolmoqda.

FOYDALANILGAN ADABIYOTLAR RO'YXATI

1. **Behnke, R. J. (2002).** *Trout and Salmon of North America*. The Free Press.
2. **Galbreath, P. F., et al. (1994).** Triploid va diploid kamalak forellarining o'sish ko'rsatkichlarini qiyosiy tahlil qilgan tadqiqot.
3. **Berthelot, C., et al. (2014).** The rainbow trout genome provides novel insights into evolution after whole-genome duplication in vertebrates.
4. **D'Ambrosio, J., et al. (2020).** Genetic architecture and genomic selection of female reproduction traits in rainbow trout. *BMC Genomics*,
5. **FAO (2024/2026).** *The State of World Fisheries and Aquaculture*. Food and Agriculture Organization of the United Nations.

KAMALAK FORELI (ONCORHYNCHUS MYKISS), BALIG'INING YOSHGA BOG'LIQ XUSUSIYATLARI

Buvrayev Nurali Ravshan o’g’li
Samarqand davlat pedagogika inistituti o‘qituvchi
buvrayevn@gmail.com
Jabborov Abdurashid Rayimovich
Sharof Rashidov nomidagi Samarqand davlat universiteti Biokimyo instituti
Yuldashov Mansur Arzikulovich
Zarmed universiteti Samarqand kompusi

Annotatsiya: *Ushbu ishda kamalak foreli (Oncorhynchus mykiss) ning yoshga bog'liq xususiyatlari kompleks tarzda tahlil qilingan. Tadqiqot natijalari shuni ko'rsatadiki, kamalak forelining umr ko'rish davomiyligi anadrom va chuchuk suvda qoladigan shakllariga qarab farq qiladi: anadrom shakllar 11 yilgacha yashab, 8 martagacha nasl qoldirsa, rezident shakllar 6 yilgacha yashab, 3 martagacha urug'lantirish imkoniyatiga ega. Tabiiy populyatsiyalarda erkaklar 1+ dan 4+ yoshgacha, urg'ochilar esa 2+ dan 5+ yoshgacha uchraydi; eng ko'p tarqalgan yosh guruhlari erkaklarda 1+, urg'ochilarda 2+ bo'lib, jinsiy nisbat urg'ochilar foydasiga 1.3:1 ni tashkil etadi.*

Kalit so‘zlar: *Kamalak foreli, Oncorhynchus mykiss, yoshga bog'liq xususiyatlar, o'sish sur'ati, jinsiy yetilish, umr ko'rish davomiyligi, yosh tarkibi, jinsiy dimorfizm, mushak*

giperplaziyasi, mushak gipertrofiyasi, oqsil almashinuvi, RNK/DNK nisbati, mushak ildiz hujayralari, irsiylik koeffitsienti, anadrom shakllar, rezident shakllar.

Annotation: *In this work, the age-related characteristics of rainbow trout (Oncorhynchus mykiss) have been comprehensively analyzed. The research results show that the lifespan of rainbow trout varies depending on anadromous and resident (freshwater-resident) forms: anadromous forms live up to 11 years and can spawn up to 8 times, whereas resident forms live up to 6 years and have the opportunity to spawn up to 3 times. In natural populations, males are found at ages from 1+ to 4+, while females are found from 2+ to 5+; the most common age groups are 1+ in males and 2+ in females, with a sex ratio of 1.3:1 in favor of females.*

Keywords: *Rainbow trout, Oncorhynchus mykiss, age-related characteristics, growth rate, sexual maturity, lifespan, age structure, sexual dimorphism, muscle hyperplasia, muscle hypertrophy, protein metabolism, RNA/DNA ratio, muscle satellite cells, heritability coefficient, anadromous forms, resident forms.*

Kirish Kamalak foreli (Oncorhynchus mykiss) yoshga bog'liq xususiyatlarining eng muhim jihati shundaki, uning o'sish sur'ati jinsiy yetilish davrida keskin pasayadi, shu bilan birga mushak to'qimalarining o'sish mexanizmi gipertrofiyadan giperplaziyaga o'tadi. Quyida turli tadqiqot ma'lumotlariga asoslanib, batafsil ma'lumotlar keltirilgan. Umr ko'rish davomiyligi va yosh tuzilishi. Kamalak foreli anadrom va chuchuk suvda qoladigan shakllari bo'yicha umr ko'rish davomiyligi sezilarli farq qiladi. Anadrom shakllar 11 yilgacha yashab, 8 martagacha nasl qoldirishi mumkin; chuchuk suvda qoladigan shakllar esa 6 yilgacha yashab, 3 martagacha nasl qoldiradi. O'rtacha umr ko'rish davomiyligi 4-6 yil. Tabiiy populyatsiyalarda erkaklar odatda 1+ dan 4+ yoshgacha, urg'ochilar esa 2+ dan 5+ yoshgacha uchraydi; Eronning Beheshtabad daryosida erkaklar orasida eng ko'p uchraydigan yosh guruhi 1+, urg'ochilar orasida 2+ bo'lib, jinsiy nisbat 1.3 urg'ochi : 1 erkakni tashkil etgan. Michigan shtatidagi tadqiqotda eng ko'p uchraydigan yosh guruhlari III yosh urg'ochilar (54.9%) va III yosh erkaklar (14.3%) bo'lib, jinsiy nisbat 1 erkak : 4 urg'ochi atrofida bo'lgan. AQSh Vashington shtatida 2016-yilda olingan namunalarda 3 yoshli baliqlar 53% ni tashkil etgan, 2 va 4 yoshdagilar ham keng tarqalgan. Jinsiy yetilish yoshi va uning o'sishga ta'siri. Erkak kamalak foreli odatda 2 yoshda, urg'ochisi esa 3 yoshda jinsiy yetuk bo'ladi. Jinsiy yetilishga erishgandan so'ng, baliq energiyasini reproduktiv tizimga yo'naltiradi, natijada o'sish sur'ati sezilarli darajada pasayadi. AQShda olib borilgan tadqiqotda, 13°C haroratda doimiy yorug'lik va kecha-kunduz oziqlantirish sharoitida, butunlay urg'ochi forellar tuxumdan chiqqandan keyin 22 oyda 4.8 kg vaznga yetgan, ammo jinsiy yetilish boshlanishi bilan o'sish sur'ati pasaygan; 26 oyda vazni 5.2 kg bo'lgan. Jinsiy dimorfizm bo'yicha ma'lumotlar qarama-qarshi: Eronning

Beheshtabad daryosida urg'ochi forelning o'sish sur'ati erkaklarnikidan tezroq bo'lib, von Bertalanffy tenglamasidagi L∞ qiymati urg'ochilar uchun 66.39 sm, erkaklar uchun 52.04 sm, o'sish samaradorligi indeksi urg'ochilar uchun 6.14, erkaklar uchun 6.06 bo'lgan. Norvegiyada o'tkazilgan tadqiqotda esa ba'zi guruhlarda erkaklar o'rtacha urg'ochilardan kattaroq bo'lgan. Jinsiy yetilish yoshi yuqori irsiylikka ega: birinchi naslchilik mavsumida irsiylik koeffitsienti 0.86, ikkinchisida 0.60; jinsiy yetilish davridagi tana vaznining irsiyligi birinchi mavsumda 0.89, ikkinchisida 0.27. Jinsiy yetilish va o'sish sur'ati o'rtasidagi individual bog'liqlik. Oregon shtatining John Day daryosi havzasida o'tkazilgan tadqiqotda, tana uzunligi har 5 mm oshganda, erkak forelning 1+ yoshda erta jinsiy yetilish ehtimoli 49% ga oshgan; tana lipid miqdori har 0.5% oshganda bu ehtimol 33% ga oshgan. Issiqroq oqimlarda o'sish tezroq, ammo tana lipid miqdori pastroq; sovuqroq oqimlarda esa aksincha. Bu shuni ko'rsatadiki, erta jinsiy yetilish nafaqat yoshga, balki individual o'sish sur'ati va energiya zahirasiga ham bog'liq.

Mushak to'qimalarining yoshga bog'liq fiziologik o'zgarishlari. Kamalak foreli sutemizuvchilardan farqli o'laroq, butun hayoti davomida mushak giperplaziyasi (yangi tolalar shakllanishi) va gipertrofiyasi (mavjud tolalar hajmining oshishi) qobiliyatini saqlab qoladi. Biroq bu ikki mexanizmning nisbati yosh bilan o'zgaradi. Tadqiqotlar shuni ko'rsatadiki, gipertrofiya 28 haftagacha tez o'sadi, keyin sekinlashadi; giperplaziya esa butun 96 haftalik tajriba davomida chiziqli ravishda o'sishda davom etadi va oxirida giperplaziya gipertrofiyadan 4-5 baravar ustunlik qiladi. Tez o'sish davrlarida mushak tolalarining gipertrofiyasi, sekin o'sish davrlarida esa yangi tolalarning shakllanishi ustunlik qiladi. Tana uzunligi 250 mm dan kichik bo'lgan baliqlarda qizil mushak tolalarining diametri ozuqa miqdoriga ko'proq bog'liq; yirikroq baliqlarda esa tana uzunligiga ko'proq bog'liq. Molekulyar darajada, 6 va 7 oylik forellarda qizil va pushti mushaklarda PAX7A, PAX7B va MYOG genlarining ifodalanishi pasaygan, oq mushakda esa sezilarli o'zgarish kuzatilmagan; IGF1 genining ifodalanishi barcha mushak turlarida pasaygan, MYOD geni esa juda past darajada ifodalangan. Oqsillar almashinuvi va nuklein kislotalar dinamikasi. Yosh va vazn ortishi bilan kamalak forelining oq mushaklarida o'sish sur'ati, nisbiy oziq-ovqat iste'moli, ozuqa samaradorligi koeffitsienti va oqsil samaradorligi koeffitsienti sezilarli darajada pasayadi. Absolyut RNK va DNK miqdori yosh bilan ortadi, ammo ularning nisbiy konsentratsiyasi kamayadi. RNK/DNK nisbati 14-28 haftalarda keskin ko'tarilib, keyin boshlang'ich darajaga qaytadi. Oqsil sintezi tezligi (K(S)) va oqsil sintezi qobiliyati (C(S)) yosh bilan sezilarli darajada pasayadi, oqsil saqlash samaradorligi (PRE) esa barcha yoshlarda yuqori darajada saqlanib qoladi. Energiya almashinuvi fermentlari faolligi ozuqa miqdoridan ko'ra yoshga ko'proq bog'liq: 0.3 yoshdan 1 yoshgacha oq mushakda glikoliz fermentlari faolligi ortadi, qizil mushakda esa kamayadi; β-oksidlanish va limon kislotasi sikli fermentlarida esa teskari holat kuzatiladi. Tuzli suvga o'tish

davrida fermentlar faolligi sezilarli darajada pasayadi (oq mushak glikoliz faolligidan tashqari). Qizil mushakda fermentlar faolligi 2 yoshdan 2.4 yoshgacha ortadi, ammo jins yoki yetilish darajasi bilan bog'liqlik kuzatilmagan. Mushak ildiz hujayralari va yoshga bog'liq o'zgarishlar**.** Kamalak forelining mushak ildiz hujayralari (satellit hujayralar) proliferatsiya qobiliyati yosh bilan pasayadi. 500 g vazndagi donorlarning mushak ildiz hujayralari 100 g vazndagi donorlarga qaraganda past miyogen qobiliyatga ega ekanligi aniqlangan. IGF-I va IGF-II kamalak foreli satellit hujayralarining proliferatsiyasini rag'batlantiradi, ammo bu ta'sir juda past darajada (maksimal proliferatsiya darajasi FCS bilan kuzatilganidan 10% dan kam), shuning uchun IGFlar yagona omil emas. O'sish gormoni va estradiol yoshdagi kamalak foreli satellit hujayralarining proliferatsiyasiga sezilarli ta'sir ko'rsatmagan.

Xulosa Kamalak forelining yoshga bog'liq xususiyatlari ko'p qirrali: o'sish sur'ati birinchi yilda eng yuqori bo'lib, jinsiy yetilishdan keyin keskin pasayadi; erkaklar 2 yoshda, urg'ochilar 3 yoshda yetiladi; jinsiy yetilish yoshi yuqori irsiylikka ega (h^2=0.60-0.86); mushak o'sishida giperplaziya gipertrofiyadan ustunlik qiladi; oqsil sintezi va nuklein kislotalar dinamikasi yoshga qarab o'zgaradi; energiya almashinuvi fermentlari faolligi yoshga ko'proq, ozuqa miqdoriga kamroq bog'liq. Bu xususiyatlar yashash muhiti harorati, oziq-ovqat ta'minoti va populyatsiya zichligi kabi omillar ta'sirida sezilarli o'zgaruvchanlikka ega.

FOYDALANILGAN ADABIYOTLAR RO'YXATI

1. Nævdal, G., Holm, M., Lerøy, R., & Møller, D. (1979). Individual growth rate and age at sexual maturity in rainbow trout.

2. Peragon, J., Barroso, J. B., Garcia-Salguero, L., Higuera, M. de la, & Lupianez, J. A. (2001). Growth, protein-turnover rates and nucleic-acid concentrations in the white muscle of rainbow trout during development.

3. Kiessling, A., Kiessling, K. H., Storebakken, T., & Aasgaard, T. (1991). Changes in the structure and function of the epaxial muscle of rainbow trout (Oncorhynchus mykiss) in relation to ration and age: II. Activity of key enzymes in energy metabolism.

4. Joshi, K. D., Vass, K. K., & Raina, H. S. (2011). Experiments on the rearing of rainbow trout Oncorhynchus mykiss (Walbaum) in Central Himalayas.

ОПРЕДЕЛЕНИЕ СОДЕРЖАНИЯ ФЛАВОЛИГНАНОВ (КОМПЛЕКС СИЛИМАРИНА) В СЕМЕНАХ РАСТОРОПШИ, ВЫРАЩЕННОЙ ПРИ РАЗЛИЧНЫХ АГРОТЕХНИЧЕСКИХ ФАКТОРАХ

Ассистент кафедры биологии Самаркандского государственного педагогического института,

Алавдинов Мухаммад Хакаитхон угли

Студентка 308-ой группы по направлении биология Самаркандского государственного педагогического института, **Камолова Дильбар Хусниддин кизи**

Аннотация. *В настоящих тезисах освещены вопросы определения содержания флаволигнанов, в частности комплекса силимарина, в семенах расторопши пятнистой (Silybum marianum L.), выращенной при различных агротехнических факторах. Проанализировано влияние питания растения, режима орошения, срока и густоты посева, а также срока уборки урожая на накопление биологически активных веществ в семенах. Показано значение определения основных флаволигнанов, входящих в состав силимарина, с помощью современных лабораторных методов. Результаты исследования служат важной научной основой для повышения качества лекарственного сырья и совершенствования агротехнологии возделывания расторопши.*

Ключевые слова: *Silybum marianum L., расторопша, флаволигнаны, силимарин, силибинин, силихристин, силидианин, агротехника, лекарственное сырьё.*

Abstract. *This thesis addresses the determination of flavolignan content, particularly the silymarin complex, in the seeds of milk thistle (Silybum marianum L.) grown under different agrotechnical conditions. The effects of plant nutrition, irrigation regimes, sowing time and density, as well as harvest time, on the accumulation of biologically active compounds in the seeds are analyzed. The importance of determining the major flavolignans that constitute silymarin using modern laboratory methods is highlighted. The research findings provide an important scientific basis for improving the quality of medicinal raw materials and optimizing the agrotechnology of milk thistle cultivation.*

Keywords: *Silybum marianum L., milk thistle, flavolignans, silymarin, silybinin, silychristin, silydianin, agricultural practices, medicinal raw materials.*

Расторопша пятнистая (Silybum marianum L.) выделяется среди лекарственных растений богатством биологически активных соединений. В семенах растения содержится комплекс флаволигнанов, который в совокупности называют комплексом силимарина. К основным компонентам силимарина относятся такие соединения, как силибинин, силихристин и силидианин. Эти вещества отличаются антиоксидантными свойствами и имеют важное значение при определении фармацевтической ценности сырья расторопши.

При возделывании лекарственных растений наряду с высокой урожайностью важна и обогащённость сырья биологически активными веществами. Поэтому выявление агротехнических факторов, влияющих на накопление флаволигнанов в семенах Silybum marianum L., имеет большое практическое значение. Уровень питания растения, влажность

почвы, срок и густота посева, а также время уборки урожая могут влиять на биохимический состав семян.

Комплекс силимарина накапливается преимущественно в семенах растения. Его количество изменяется в зависимости от генетических особенностей растения, стадии развития и условий внешней среды. Поэтому при выращивании растений одного и того же вида в различных агроэкологических условиях химический состав семян также может оказаться неодинаковым.

Основная цель исследования состоит в определении содержания флаволигнанов в семенах расторопши, выращенной при различных агротехнических условиях, и в оценке факторов, оказывающих наибольшее влияние на накопление биологически активных веществ.

В исследованиях изучаются образцы семян, полученные от растений расторопши, выращенных по различным агротехническим вариантам. При формировании вариантов опыта учитываются срок посева, густота посева, органическая подкормка, режим орошения и другие агротехнические мероприятия. Семена, полученные из каждого варианта, готовятся к отдельному лабораторному анализу.

При подготовке семян к анализу важны их очистка от посторонних примесей и приведение к однородному состоянию. Определяется влажность образца, и при необходимости семена подсушивают в нормативных условиях. Затем семена измельчают и подготавливают к процессу экстракции для выделения биологически активных веществ.

Для определения флаволигнанов могут быть использованы современные инструментальные методы, такие как высокоэффективная жидкостная хроматография. С помощью этого метода можно разделить основные компоненты комплекса силимарина и определить их количество. Результаты анализа, как правило, оцениваются на основе количественных показателей вещества в образце.

Условия питания — один из важных агротехнических факторов, влияющих на накопление флаволигнанов. Для нормального развития растения необходимы азот, фосфор, калий и микроэлементы. Однако при превышении нормы элементов питания вегетативная масса растения может чрезмерно усилиться. Поэтому систему подкормки необходимо приспосабливать к биологическим потребностям растения.

Использование органических удобрений способствует улучшению физических, химических и биологических свойств почвы. Компост, перепревший навоз и другие органические источники способствуют постепенному высвобождению питательных веществ

в почве. Это, в свою очередь, может обеспечить относительно стабильное питание растения в течение вегетации.

Режим орошения — также важный фактор формирования биохимического состава семян. Дефицит воды может усиливать физиологический стресс у растения и ослаблять процесс фотосинтеза. В результате возможно ограничение полноценного формирования семян и накопления биологически активных веществ. Вместе с тем избыточное орошение также нежелательно для растения.

Умеренная влажность почвы улучшает активную работу корневой системы и усвоение элементов питания. Особенно важно водообеспечение в период цветения и формирования семян. Недостаток влаги в этот период может привести к тому, что семена будут мелкими и неполноценно сформированными.

Густота посева определяет конкуренцию между растениями. При чрезмерно загущённом посеве растения конкурируют за свет, воду и питательные вещества. В таких условиях у некоторых растений может ослабевать вегетативное развитие, а формирование генеративных органов — также ограничиваться. Нормальная же густота обеспечивает растениям достаточную площадь питания.

Важен и правильный выбор срока посева. Поскольку прорастание семян и последующая вегетация зависят от температурного и влажностного режима, время посева необходимо приспосабливать к агроклиматическим условиям региона. Совпадение периодов цветения и созревания семян с благоприятными экологическими условиями может способствовать улучшению качества сырья.

При определении содержания флаволигнанов в семенах расторопши большое значение имеет и срок уборки урожая. С полным созреванием семян формируется их химический состав. В семенах, убранных слишком рано, биологически активные компоненты могут быть накоплены в недостаточной степени. Запоздалая же уборка может привести к осыпанию семян и снижению урожая.

Раздельное определение компонентов комплекса силимарина позволяет глубже оценить качество семян расторопши. Наряду с общим содержанием силимарина определение количества силибинина, силихристина и силидианина важно для характеристики биохимического профиля сырья. Эти показатели служат дополнительным критерием при сравнении различных агротехнических вариантов.

При оценке влияния агротехнических факторов на содержание флаволигнанов необходимо учитывать не только один фактор, но и их взаимодействие. Например, действие удобрений может быть тесно связано с влажностью почвы, а действие орошения — с типом

почвы и густотой посева. Поэтому целесообразно определять наиболее эффективное агротехническое сочетание с помощью комплексных схем опыта.

Накопление биологически активных веществ в семенах расторопши связано с общим физиологическим состоянием растения. У здоровых и хорошо развитых растений активно протекает фотосинтез и образуется достаточное количество ассимилятов для полноценного формирования семян. В результате качественные показатели семян могут улучшиться.

Условия хранения после уборки семян также важны для сохранности флаволигнанов. При высокой влажности качественные показатели семян могут ухудшаться. Высокая температура и прямой солнечный свет также могут отрицательно влиять на стабильность биологически активных веществ. Поэтому сырьё рекомендуется хранить в сухом, прохладном и защищённом от света месте.

Результаты определения содержания флаволигнанов важны и для стандартизации лекарственного сырья. Если в семенах расторопши, выращенной в определённых агротехнических условиях, содержание силимарина высокое и стабильное, эту технологию можно рекомендовать для производства. Это позволяет получать для фармацевтики растительное сырьё однородного качества.

При возделывании расторопши важно определить баланс между урожайностью и содержанием биологически активных веществ. Некоторые агротехнические условия могут повышать урожай семян, однако концентрация активных веществ при этом может не меняться или снижаться. Поэтому оптимальная технология должна одновременно обеспечивать высокую урожайность и высокие показатели качества.

На основе полученных научных данных при выращивании семян расторопши агротехнические мероприятия можно направить на накопление биологически активных веществ. При этом важны сохранение плодородия почвы, обеспечение оптимальной влажности, нормирование густоты посева, своевременная уборка урожая и правильное хранение семян.

В заключение следует отметить: содержание флаволигнанов в семенах Silybum marianum L. зависит как от генетических особенностей растения, так и от агротехнических условий. Правильная организация питания, орошения, сроков посева, густоты посева и срока уборки урожая влияет на формирование химического состава семян.

Определение комплекса силимарина с помощью современных лабораторных методов позволяет объективно оценить эффективность различных агротехнических вариантов. Особенно анализ основных флаволигнанов силимарина по отдельности помогает ещё глубже охарактеризовать качество лекарственного сырья.

В дальнейшем целесообразно изучить флаволигнановый состав различных сортов и генотипов, повторить опыты в разных агроэкологических регионах и оценить взаимодействие агротехнических факторов. На основе этих исследований можно разработать научно обоснованную технологию возделывания, направленную на получение сырья расторопши с высоким содержанием комплекса силимарина.

Список использованной литературы

1. Abenavoli L., Capasso R., Milic N., Capasso F. Milk thistle in liver diseases: past, present, future. Phytotherapy Research.
2. Bijak M. Silybin, a major bioactive component of milk thistle: chemistry, bioavailability, and biological activity. Molecules.
3. Karkanis A., Bilalis D., Efthimiadou A. Cultivation of milk thistle: a review. Industrial Crops and Products.
4. European Medicines Agency. Silybum marianum (L.) Gaertn., fructus. Herbal medicinal product assessment report.
5. Polyak S.J., Morishima C., Lohmann V., Pal S., Lee D.Y.W., Liu Y., Graf T.N., Oberlies N.H. Identification of hepatoprotective flavonolignans from milk thistle.
6. Statti G.A., Conforti F., Sacchetti G. Milk thistle: phytochemical composition and biological properties.

ИНТРОДУКЦИЯ РАСТОРОПШИ ПЯТНИСТОЙ (SILYBUM MARIANUM L.) В УСЛОВИЯХ КУЛЬТУРНОГО АГРОЦЕНОЗА И БИОЛОГИЯ ВСХОЖЕСТИ СЕМЯН

Ассистент кафедры биологии Самаркандского государственного педагогического института,
Алавдинов Мухаммад Хакаитхон угли,

Студентка 308-ой группы по направлении биология Самаркандского государственного педагогического института, **Намозова Севинч Шухратовна**

Аннотация. *В настоящих тезисах освещены биологические особенности интродукции расторопши пятнистой (Silybum marianum L.) в условиях культурного агроценоза и всхожести её семян. Проанализированы адаптация растения к новым агроэкологическим условиям, прорастание семян, энергия прорастания, а также влияние температуры и влажности на развитие семян. В качестве важных факторов получения высоких и дружных всходов названы использование качественного семенного материала, правильное определение сроков посева и создание благоприятных агротехнических условий в начальный период вегетации. Результаты исследования могут служить научной основой для совершенствования технологии возделывания лекарственного растения в культуре.*

Ключевые слова: *Silybum marianum L., расторопша пятнистая, интродукция, агроценоз, семена, всхожесть, энергия прорастания, лекарственное растение, агротехнология.*

Abstract. *This thesis examines the biological aspects of the introduction of milk thistle (Silybum marianum L.) into a cultivated agroecosystem, with particular emphasis on seed germination. The study analyzes the plant's adaptation to new agroecological conditions, seed germination, germination energy, and the effects of temperature and moisture on seed development. The use of high-quality seed material, the proper determination of sowing dates, and the establishment of favorable agrotechnical conditions during the initial stage of vegetation are identified as important factors for achieving high and uniform seedling emergence. The research findings may serve as a scientific basis for improving the cultivation technology of this medicinal plant under cultivated conditions.*

Keywords: *Silybum marianum L., milk thistle, introduction, agroecosystem, seeds, germination, germination energy, medicinal plant, agrotechnology.*

Расторопша пятнистая (Silybum marianum L.) относится к числу перспективных растений, имеющих лекарственное значение. Это растение принадлежит к семейству Астровые (Asteraceae) и благодаря богатству биологически активными веществами изучается

как важное растительное сырьё в фармацевтике и медицине. Особый научный и практический интерес к расторопше повышает наличие в её семенах комплекса силимарина. Поэтому одной из актуальных задач является адаптация растения к условиям культурного агроценоза различных регионов и разработка эффективной технологии его возделывания.

Процесс интродукции растения в новые условия требует изучения не только его биологических особенностей, но и способности приспосабливаться к факторам внешней среды. В ходе интродукции температура, влажность, освещённость, плодородие почвы, её механический состав и агротехнический уход оказывают непосредственное влияние на рост и развитие растения. Возможность регулировать эти факторы в условиях культурного агроценоза создаёт благоприятные условия для устойчивого развития растения.

При оценке интродукционных возможностей расторопши особое значение имеет качество семенного материала. Биологическая зрелость семян, их полноценная сформированность, отсутствие механических повреждений и условия хранения — важные показатели, определяющие уровень всхожести. Использование высококачественных семян обеспечивает получение дружных всходов в полевых условиях.

Прорастание семян — сложный физиологический процесс, на начальном этапе которого семя поглощает влагу. Затем активизируются ферментативные процессы, расщепляются запасные питательные вещества и начинает развиваться зародыш. Сначала образуется корешок, а затем проросток выходит на поверхность почвы. Для нормального протекания этих процессов необходимо достаточное количество влаги, тепла и кислорода.

Всхожесть семян обычно оценивают путём определения того, сколько семян из определённого их количества дали нормальные проростки. Наряду со всхожестью важным показателем является и энергия прорастания. Энергия прорастания отражает, насколько быстро и дружно семена прорастают в первые дни. Семена с высокой энергией прорастания могут быстрее давать всходы в полевых условиях и обладать преимуществом в конкуренции с сорняками в начальный период развития.

Влияние температуры на прорастание семян расторопши существенно. Чрезмерно низкая температура может привести к замедлению физиологических процессов и позднему прорастанию семян. Слишком высокая температура, в свою очередь, может стать причиной быстрой потери семенами влаги и нарушения процесса прорастания. Поэтому важно определять сроки посева в соответствии с климатическими условиями региона.

Влага — один из основных факторов, необходимых для прорастания семян. После поглощения семенем воды в его клетках активизируются метаболические процессы. Однако избыточная влажность почвы также не даёт положительного результата. Скопление

большого количества воды ухудшает воздухообмен в почве и может отрицательно влиять на процесс дыхания семян.

Глубина посева — также агротехнический фактор, влияющий на всхожесть семян и развитие всходов. Слишком глубокая заделка семян затрудняет выход всходов на поверхность почвы. Мелкий посев, напротив, может ослабить прорастание семян из-за быстрой потери влаги в верхнем слое почвы. Поэтому глубину посева следует согласовывать с механическим составом и влажностью почвы.

В условиях культурного агроценоза регулярное наблюдение за этапами развития растения позволяет оценить успешность интродукции. Фиксируются такие фенологические фазы, как появление всходов, формирование первых листьев, увеличение числа листьев, развитие стебля, образование корзинок, цветение и созревание семян. Эти показатели важны для определения степени адаптации растения к новым условиям.

Поскольку расторопша — светолюбивое растение, при выборе посевной площади в культурном агроценозе необходимо учитывать световой режим. Достаточное освещение обеспечивает активное протекание фотосинтеза и положительно влияет на развитие вегетативных и генеративных органов растения. В условиях затенения развитие растений может замедляться, а урожай семян — снижаться.

Плодородие почвы — также один из важных факторов в процессе интродукции расторопши. В почвах с достаточным содержанием элементов питания хорошо развиваются корни и надземная часть. Почва, богатая органическими веществами, улучшает не только питание растения, но и влагоудерживающую способность. Однако при определении норм подкормки необходимо учитывать биологические потребности растения.

В начальный период развития всходов расторопши особое значение имеет борьба с сорняками. Сорняки конкурируют с молодыми всходами за воду, питательные вещества и свет. В результате рост растений может замедляться, а их развитие на площади — становиться неравномерным. Поэтому в начальный период вегетации целесообразны междурядная механическая обработка и своевременное удаление сорняков.

В процессе интродукции оценивается также выживаемость растений. Сохранность всходов, выросших из семян, в течение вегетации показывает степень приспособленности растения к конкретным условиям. Высокая выживаемость свидетельствует о соответствии условий агроценоза биологическим требованиям растения.

Между всхожестью семян и выживаемостью растений существует прямая взаимосвязь. Высокая всхожесть обеспечивает формирование равномерного агроценоза на

начальном этапе. Однако в последующий период развития на сохранность всходов влияют такие факторы, как влажность почвы, питание, температура и конкуренция с сорняками.

Успешная интродукция Silybum marianum L. в культурный агроценоз в дальнейшем позволит устойчиво выращивать его семенное сырьё. Особенно важно изучить в местных условиях продолжительность вегетационного периода растения, сроки созревания семян, урожайность и накопление биологически активных веществ. На основе этих данных можно разработать агротехнологические рекомендации, подходящие для региона.

В заключение следует отметить: для интродукции расторопши пятнистой в условиях культурного агроценоза необходимо использовать качественный семенной материал, правильно определять сроки посева, поддерживать умеренную влажность почвы и создавать оптимальные агротехнические условия на начальном этапе развития. Всхожесть семян является одним из важных биологических показателей адаптации растения к культурным условиям.

В дальнейших исследованиях целесообразно комплексно изучить влияние различных сроков и глубины посева, способов предпосевной подготовки семян, режима орошения и органической подкормки на всхожесть семян и последующее развитие растений. Такие исследования послужат созданию научных основ эффективного возделывания Silybum marianum L. в местных условиях.

Список использованной литературы

1. Abenavoli L., Capasso R., Milic N., Capasso F. Milk thistle in liver diseases: past, present, future. Phytotherapy Research.
2. Bijak M. Silybin, a major bioactive component of milk thistle: chemistry, bioavailability, and biological activity. Molecules.
3. Karkanis A., Bilalis D., Efthimiadou A. Cultivation of milk thistle: a review. Industrial Crops and Products.
4. European Medicines Agency. Silybum marianum (L.) Gaertn., fructus. Herbal medicinal product assessment report.
5. Халматов Х.Х., Касимов А.И. Лекарственные растения Узбекистана. Ташкент.

ХОЗЯЙСТВЕННОЕ ЗНАЧЕНИЕ РОДА *FERULA* L. ВО ФЛОРЕ УЗБЕКИСТАНА

Мукумов И.У.[1], Шодиева З.Ш.[2], Расулова З.А[1]., Курбанова Ф.Н.[3]

1Самаркандский государственный университет им.Шароф Рашидова, Институт Биохимии

2Самаркандский государственный университет ветеринарной медицины, животноводства и биотехнологии

3Университет Зармета г.Самарканд

O‘zbekiston florasidagi *Ferula* L. turkumining xujalik ahamiyati

Annotatsiya. *Maqolada ferula turlarining O'zbekistonda tarqalish doirasiga oid materiallar keltirilgan. Materiallar dala tadqiqotlari natijasida olingan, gerbariy materiallari to'plangan, har xil turlarning kimyoviy tarkibi ko’rsatilgan. Ferula turlarining iqtisodiy xususiyatlari berilgan.*

Kalit so'zlar: *ferula, em-xashak, oziq-ovqat, asalarichilik uchun o'simlik, dorivor o'simliklar, dala tadqiqotlari, gerbariy materiallari, kimyoviy tarkibi*

Economic significance of the genus Ferula L. in the flora of Uzbekistan

Abstract. *The article presents materials on the distribution area of ferula species in Uzbekistan. The materials were obtained as a result of field research, herbarium materials were collected, and the chemical composition of various species was determined. The economic characteristics of the ferula species are given.*

Keywords: *ferula, plants forage, food, honey, medicinal plants, field research, herbarium materials, chemical composition*

Род Ferula L. – относится к трибе Peucedaneae Dumort. подсемейства Apioideae Drude. семейства Apiaceae (Сельдерейные) Lindl. (Umbelliferae Juss). По современным представлениям, он насчитывает около 180-210 видов, распространенных почти исключительно в области Древнего Средиземья. Максимальное число видов в Центральной Азии 105 видов *Ferula* L. многолетние травянистые растения, геофита (1,2).

Большой вклад в изучение рода *Ferula* L. внесли E. Regel (1878, 1882), Б. А. Федченко (1902), Б. М. Козо – Полянский (1914, 1915, 1922, 1924), М. П. Петров (1933), Л. А. Уткин (1938), И. А. Захарьянц (1943), И.Т. Васильченко (1941), Е. П. Коровин (1939, 1947), Р. В. Камелин (1970), М. С. Байтенов (1970, 1975), М. Г. Пименов (1974, 1979, 1980, 1983), Х. А. Нишанбаева (1972), С. Мелибаев (1985), И. У. Мукумов (1993), также ученые из Ирана, Афганистана, Турции, Китая.

Многие виды *Ferula* L., содержащие значительное количество смол, могут быть использованы в мыловаренной, лакокрасочной, текстильной и бумажной промышленности. Плоды *Ferula* L. содержат протеин и белковые вещества и используются как на жировочный корм для птицы, а также при лечении гемонхотозов у животных.

Следует отметить, что многочисленные виды *Ferula* L. находят применение в сельском хозяйстве как кормовые растения. Они охотно поедаются крупным рогатым скотом и овцами, при этом используется как трава, так и плоды. При добавлении плодов *F. foetida* в рацион крупного рогатого скота повышаются удои молока.

Растения рода *Ferula* L. занимают важное место в формировании растительного покрова Узбекистана. К числу важных эдификаторов, имеющих ландшафтное значение, относятся *F. kuhistanica, F. foetida, F. tenuisecta* и др.

В результате полевых исследований 2021-2026 годов на территории Узбекистана было проведено обследование, и были собраны гербарные материалы, обработка данного материала, а также анализ литературных источников. В Узбекистане виды рода *Ferula* L. около 39 видов содержит смолы, эфирномасличные - 41, крахмалоносные – 4, медоносные – 22, кормовые - 13, пищевые – 10, лекарственные – 22 (таблица).

Таблица

Хозяйственное значение рода Ferula L. в Узбекистане

№	Вид	Смоло-носы	Эфирно-маслич-ные	Крахма-лоносы	Медоно-сы	Кормо-вые	Пищевые	Лекарст-венные
1	*F.diversivittata*	+	+	-	+	-	-	+
2	*F.gigantea*	+	+	-	-	-	-	-
3	*F.foetidissima*	+	+	-	+	+	+	+
4	*F.kuhistanica*	+	+	+	+	+	+	+
5	*F.kokanica*	+	+	-	+	-	-	+
6	*F.tuberifera*	+	+	-	+	-	-	-

7	*F.samarkandica*	+	+	-	+	+	-	-
8	*F.juniperina*	+	+	-	-	-	-	-
9	*F.nevskii*	+	+	-	+	-	-	+
10	*F.dubjanskyi*	-	-	-	-	-	-	-
11	*F.lithophila*	+	+	-	-	-	-	+
12	*F.renardii*	-	-	-	-	-	-	+
13	*F.oopoda*	+	+	-	-	-	-	-
14	*F.nuda*	+	+	-	-	-	-	-
15	*F.varia*	+	+	-	-	+	-	+
16	*F.helenae*	+	+	-	-	-	-	-
17	*F.tadshikorum*	+	+	-	+	+	+	+
18	*F.foetida*	+	+	+	+	+	+	+
19	*F.szowitsiana*	+	+	-	-	-	+	+
20	*F.ovczinnikovii*	+	+	-	+	-	-	-
21	*F.Lehmannii*	+	+	+	-	-	+	-
22	*F.Litwinowiana*	-	+	-	+	-	-	+
23	*F.Lipskyi*	-	-	-	-	-	-	-
24	*F.fedschenkoana*	+	+	-	-	-	-	-
	1.							
25	*F.prangifolia*	+	+	-	+	+	-	-
26	*F.tschimganica*	+	+	-	+	+	+	+
27	*F.ovina*	+				+	-	-

			+	-	+					
28	*F.kyzylkumica*	-	-	-	-		-	-	-	
29	*F.dshizakensis*	+	+	-		-	-	-	-	
30	*F.pallida*	+	+	-	+		-	-	+	
31	*F.tenuisecta*	+	+	-	+		+	-	+	
32	*F.angrenii*	+	+	-	+		-	-	-	
33	*F.ugamica*	+	+	-	-		+	-	-	
34	*F.karatavica*	+	+	-	+		+	-	+	
35	*F.korshinskyi*	+	+	-	-		-	-	+	
36	*F.clematidifolia*	+	+	-	-		-	-	-	
37	*F.penninervis*	+	+	-	-		-	-	+	
38	*F.schtschurowskiana*	+	+	+	+		+	+	+	
39	*F.sumbul*	+	+	-	-		-	+	+	
40	*F.karelinii*	+	+	-	+		-	+	+	
41	*F.vicaria*	-	-	-	-		-	-	-	

42	*F.nuratavica*	-	-	-	-	-	-	-
43	*F.transiliensis*	+	+	-	-	-	-	-
44	*F.karategina*	+	+	-	-	-	-	-
45	*F.kelifi*	-	+	-	+	-	-	-
46	*F.kirialovii*	+	+	-	+	-	-	+
47	*F.rubroarenosa*	+	+	-	-	-	-	-
48	*F.pratovii*	-	-	-	-	-	-	-
49	*F.mollis*	-	-	-	-	-	-	
50	*F.ferganensis*	-	-	-	-	-	-	

Таким образом, исследованиями установлено, что на территории Узбекистана произрастает около 50 видов ферул, кроме того в Красную Книгу Узбекистана занесены виды *F.sumbul, F.tuberifera, F.kyzylkumica, F.fedtschenkoana, F.korshinskyi, F.vicaria* и *F.pratovii*.

ЛИТЕРАТУРА

1. М.Г.Пименов, Е.В.Клюйков – Зонтичные (Umbelliferae) Киргизии. М., 2002 г, 286 стр.

2.Mukumov I. U. Resource characteristics of some species of the genus ferula L.-sources of biologically active compounds. Diss. Cand. Biol. Science, Tashkent, 1993, 22 p.

SAMARQAND VILOYATI FLORASIDA JUNCUS BUFONIUS L. TURINING TAKSONOMIK VA EKOLOGIK XUSUSIYATLARI

K.I.Sharifmurodov, Samarqand davlat pedagogika instituti o'qituvchisi,
S.S. Abdumanonova, Samarqand davlat pedagogika instituti talabasi

Annotatsiya. *Ushbu maqolada Juncaceae oilasiga mansub Juncus bufonius L. turining sistematik o‘rni, nomenklaturasi, morfologik xususiyatlari, fenologiyasi, ekologiyasi va geografik tarqalishi yoritilgan. Turning hayotiy shakli, vegetativ va generativ organlarining o‘ziga xos belgilari, shuningdek, tur ichidagi morfologik o‘zgaruvchanlik hamda unga yaqin taksonlar bilan munosabatlari tahlil qilingan. Juncus bufonius nam tuproqlar, vaqtinchalik suv havzalari qirg‘oqlari, ariqlar bo‘yi, nam o‘tloqlar va mavsumiy namlanadigan ochiq maydonlarda o‘suvchi bir yillik o‘simlik sifatida tavsiflangan. O‘zbekistonda, jumladan, Samarqand viloyatining ayrim botanik-geografik rayonlarida tarqalishi va may–avgust oylaridagi fenologik xususiyatlari bayon etilgan. Shuningdek, turning yaylov ekotizimlaridagi ekologik ahamiyati va ozuqaboplik xususiyatlarini baholash istiqbollari ko‘rib chiqilgan. Maqola tur tarqalishi, ekologik moslashuvchanligi va taksonomik xususiyatlarini o‘rganishga qaratilgan.*

Kalit so‘zlar: *Juncus bufonius, Juncaceae, taksonomiya, morfologiya, ekologiya, fenologiya, geografik tarqalish, areal, namsevar o‘simliklar, Samarqand viloyati, botanik-geografik rayonlar, yaylov ekotizimlari.*

Abstract. *This article examines the systematic position, nomenclature, morphological characteristics, phenology, ecology, and geographical distribution of Juncus bufonius L., a species belonging to the family Juncaceae. The life form of the plant, the diagnostic features of its vegetative and generative organs, its intraspecific morphological variability, and its relationships with closely related taxa are discussed. Juncus bufonius is described as an annual plant that grows on moist soils, along the banks of temporary water bodies, irrigation canals, wet meadows, and open areas subject to seasonal moisture. The distribution of the species in Uzbekistan, including certain botanical-geographical regions of Samarkand Province, and its phenological characteristics during the period from May to August are presented. In addition, the ecological significance of the species in pasture ecosystems and the prospects for evaluating its forage potential are considered. The article aims to contribute to the understanding of the species’ distribution, ecological adaptability, and taxonomic characteristics.*

Keywords: *Juncus bufonius, Juncaceae, taxonomy, morphology, ecology, phenology, geographical distribution, range, moisture-loving plants, Samarkand Province, botanical-geographical regions, pasture ecosystems.*

Kirish. O‘zbekiston Respublikasi hududi Markaziy Osiyoning floristik jihatdan eng boy va xilma-xil mintaqalaridan biri hisoblanadi. Mamlakat hududida cho‘l, adir, tog‘ va yaylov ekotizimlarining mavjudligi o‘simliklar dunyosining yuqori darajada boyishi va turli ekologik guruhlarning shakllanishiga zamin yaratgan. Respublikada hozirgi kunga qadar 4500 dan ortiq yuksak o‘simlik turlari qayd etilgan bo‘lib, ular orasida ekologik va sistematik jihatdan muhim ahamiyatga ega bo‘lgan oilalardan biri Juncaceae Juss. — yakandoshlar oilasi hisoblanadi Juncus bufonius L. (Juncaceae) — bir yillik, ekologik sharoitlarga moslashuvchan va dunyoning ko‘plab mintaqalarida tarqalgan o‘simlik turidir. U asosan nam tuproqlarda, vaqtinchalik suv havzalari qirg‘oqlarida, ariqlar bo‘yida, nam o‘tloqlarda va mavsumiy ravishda namlanadigan ochiq maydonlarda uchraydi. Mazkur turning keng geografik tarqalishi va turli namlik sharoitlarida o‘sishi uning ekologik xususiyatlarini o‘rganishda muhim ahamiyat kasb etadi..

Juncus bufonius sinonimlari Juncus erythopodius, Juncus turkistanica, Juncus nasthanthus, Juncus aphaerjcarpus. 1. Juncus bufonius birinchi bo’lib Karl Lenni 1753 *Species Plantarum* asarida (1-jild 328-betda) keltirilgan.(1) (Juncus bufonius L., Sp. Pl. 1: 328 (1753).) *Juncus bufonius* L. turi **1753-yilda Karl Linney tomonidan** fanga kiritilgan (https://powo.science.kew.) va aniq bir manba yuq edi. Keyinchalik 1978-yilda Cope va Stace Karl Leniy davridan qolgan matriyallardan bitta namuna tanlab oldilar va uni asl nusxa lektotip sifatida saqlab quydilar. 2.

O‘simlik bir yillik, 3–10 sm balandlikda, och yashil rangli, zich tupchalar hosil qiladi. Poyalari ko‘p sonli, nursimon tarqalgan, barglari ipsimon va qisqa. To‘pguli dixotomik shoxlangan, gullari 2–3 tadan joylashgan, 6–6,5 mm uzunlikda. Gulqo‘rg‘on bargchalari lansetsimon, yashil, keng pardasimon hoshiyali va teng emas. Changchilari 1,5 mm uzunlikda. Ko‘sakchasi silindrsimon-teskari tuxumsimon, 4 mm uzunlikda, yuqori qismi yassi. Urug‘lari keng ellipssimon, 0,5 mm uzunlikda, qahrabo-qo‘ng‘ir rangli va yaltiroq (1 rasm) 1.

Juncus bufonius bir-biriga juda o‘xshash va yaqin qarindosh bo‘lgan taksonlar majmuasiga kiradi (Balslev, 1996; Brooks va Clemants, 2000; Kirschner, 2002; Romero Zarco, 2010). Bu tur umumiy tashqi ko‘rinishi jihatidan nihoyatda o‘zgaruvchan bo‘lib, bunday o‘zgaruvchanlik turli xil yashash muhitlari bilan bog‘liq (Kirschner, 2002). Bu holat tur doirasidagi kichik taksonomik birliklar darajasida ko‘plab nomlarning nashr etilishiga sabab bo‘lgan (Barros, 1953; Cope va Stace, 1978; Balslev, 1996; Brooks va Clemants, 2000; Kirschner, 2002). Shimoliy Patagoniyaning botqoq

hududlarida yig‘ilgan namunalar mintaqaviy adabiyotlarga muvofiq Juncus bufonius var. bufonius sifatida qaraladi (Zuloaga va boshq., 2019). 4

Juncus bufoniusning umumiy ko’rinishi



1 rasm. **Fenologiya.** O’sim;ikning gullash va meva berishi may–avgust oylarida. 1.

Ekologiyasi. *Juncus bufonius* nam va mavsumiy namlanadigan tuproqlarda, vaqtinchalik suv havzalari qirg‘oqlarida, ariqlar bo‘yida, nam o‘tloqlarda va pastqam joylarda o‘sadi. Turning tekislik, tog‘oldi hamda tog‘li hududlardagi tarqalishi mahalliy floristik ma’lumotlar va dala kuzatuvlari asosida tavsiflanadi. 2.

Areali. O’zbekistonning diyarli barcha hududlarida tarqalgan. Toshkent, Namangan, Farg’ona, Qashqadaryo, Surxandaryo, Jizzax, Samarqand viloyatining Urgut, Zirabuloq, O’rta zarafshon botanik geografik rayonilarida tarqalgan.



Ahamiyati. Juncus bufonius turi ayrim hududlarda hayvonlar uchun ozuqa o‘simligi sifatida qayd etilgan. Biroq uning chorva mollari oziqlanishidagi ulushi, ozuqaviy qiymati, hosildorligi va xashak sifati hududning ekologik sharoitiga bog‘liq bo‘lishi mumkin. Shu sababli ushbu turni yaylov va xashak o‘simligi sifatida baholashda uning biomassasi, kimyoviy tarkibi, yeyiluvchanligi va boshqa ozuqa o‘simliklari bilan birgalikdagi ishtiroki maxsus tadqiqotlar asosida aniqlanishi lozim.

Turning nam yerlarda o‘sishi uning yaylov ekotizimlaridagi ekologik rolini o‘rganish uchun ham asos bo‘ladi. Ayniqsa, mavsumiy namlanadigan yaylovlarda o‘simliklar qoplamining tur tarkibi, tuproq namligi va antropogen ta’sir o‘rtasidagi munosabatlarni baholashda J. bufoniusning uchrashi va tarqalish zichligini hisobga olish mumkin. 5.

XULOSA

Juncus bufonius L. Juncaceae oilasiga mansub, nam va mavsumiy namlanadigan yashash muhitlariga moslashgan bir yillik o‘simlikdir. Turning morfologik o‘zgaruvchanligi uni aniqlashda diagnostik belgilarni kompleks baholash zarurligini ko‘rsatadi. Taksonomik maqomini aniqlashda zamonaviy nomenklaturaviy manbalar va tegishli floristik adabiyotlardan foydalanish muhimdir.

Samarqand viloyatida turning tarqalishini botanik-geografik rayonlar kesimida ishonchli tavsiflash uchun gerbariy materiallari, geografik koordinatalar va dala kuzatuvlari ma’lumotlarini qiyosiy tahlil qilish lozim. Turning yaylov ekotizimlaridagi ozuqaviy ahamiyati esa biomassasi, kimyoviy tarkibi va chorva mollari tomonidan iste’mol qilinishini o‘rganishga asoslangan maxsus tadqiqotlarni talab etadi.

FOYDALANILGAN ADABIYOTLAR

1. V. P. Botzhantzev, A. J. Butkov, E. G. Czerniakowska, V. P. Drobov, N. A. Ivanova, E. E. Korotkova, E. P. Korovin, O. E. Knorring, V. I. Kretzowicz, S. N. Kudryashev, W. A. Merkulowicz, R. R. Shreder ва A. I. Vvedensky.

2. (https://powo.science.kew.)

2. Bicknell, E.P. (1909). The Ferns and Flowering Plants of Nantucket.—IV. *Bulletin of the Torrey Botanical Club*, **36(1): 1–29**.

3. R. R. Schreder S. N. Kudrjaschev **Flora Uzbekistanica, Tomus I** (1941)

4. Jocou, A. I., & Gandullo, R. (2022). Juncus in Northern Patagonian Wetlands.

5. https://www.gbif.org/species/100343409/verbatim.

IXIOLIRION TATARICUM — TATAR CHUCHMOMOSINING SISTEMATIK O‘RNI, BIOLOGIK XUSUSIYATLARI VA AMALIY AHAMIYATI: ADABIYOTLAR TAHLILI

Aktamova Kamola Zafar qizi-Samarqand davlat pedagogika instituti talabasi

Annotatsiya. *Ushbu tezisda Chuchmomadoshlar — Ixioliriaceae oilasiga mansub Ixiolirion tataricum (Pall.) Schult. & Schult.f. — tatar chuchmomosi haqida mahalliy va xorijiy ilmiy adabiyotlarda keltirilgan ma’lumotlar tahlil qilindi. Turning sistematik o‘rni, turkum tarkibi, geografik tarqalishi, morfologik va ekologik xususiyatlari, oziq-ovqat, dorivor, manzarali hamda biologik faol xususiyatlari yoritildi.*

Kalit so‘zlar: *Ixiolirion tataricum, tatar chuchmomosi, Ixioliriaceae, sistematika, morfologiya, ekologiya, fitosenoz, fenologiya, antioksidant, transkriptom, O‘zbekiston florasi.*

Abstract. *This thesis analyzes information presented in domestic and international scientific literature on Ixiolirion tataricum (Pall.) Schult. & Schult.f., commonly known as Tatar ixolirion, belonging to the family Ixioliriaceae. The taxonomic position of the species, genus composition, geographical distribution, morphological and ecological characteristics, as well as its food, medicinal, ornamental, and biologically active properties are discussed.*

Keywords: *Ixiolirion tataricum, Tatar ixolirion, Ixioliriaceae, taxonomy, morphology, ecology, phytocoenosis, phenology, antioxidant, transcriptome, flora of Uzbekistan.*

Kirish. O‘simliklar xilma-xilligini o‘rganish, ularning tabiiy jamoalardagi o‘rnini aniqlash va foydali xususiyatlarini baholash zamonaviy botanika fanining muhim yo‘nalishlaridan biridir. Shu jihatdan Ixiolirion tataricum (Pall.) Schult. & Schult.f. — tatar chuchmomosi alohida e’tiborga loyiq. Mazkur tur piyozboshli ko‘p yillik o‘simlik bo‘lib, Kew Plants of the World Online ma’lumotlariga ko‘ra Ixioliriaceae oilasi va Asparagales tartibiga mansub. Uning tabiiy areali Sharqiy-Markaziy Turkiyadan G‘arbiy Sibir va G‘arbiy Himolaygacha, shuningdek Arabiston yarim orolining ayrim hududlarini qamrab oladi; O‘zbekiston ham turning tabiiy tarqalish hududiga kiradi. O‘zbekistonda ushbu turning tarqalishi va biologik xususiyatlari floristik manbalarda qayd etilgan bo‘lsa-da, uning ayrim hududlardagi ekologik va fitosenotik xususiyatlarini yanada chuqurroq o‘rganish zarur. Mualliflarning avvalgi tadqiqotida ham I. tataricumning O‘zbekiston tabiiy populyatsiyalari, gerbariy namunalari va Urgut botanik-geografik rayonidagi fitosenotik tarkibi o‘rganilgan.

Asosiy qism. 1. Ixiolirion tataricumning sistematik o‘rni

Zamonaviy Kew Plants of the World Online tasnifiga ko‘ra Ixiolirion tataricum quyidagi sistematik o‘ringa ega:

Olam: Plantae

Bo‘lim: Streptophyta

Sinf: Equisetopsida

Tartib: Asparagales

Oila: Ixioliriaceae

Turkum: Ixiolirion Fisch. ex Herb.

Tur: Ixiolirion tataricum (Pall.) Schult. & Schult.f.

Kew ma’lumotlarida Ixiolirion turkumi qabul qilingan turkum sifatida ko‘rsatilgan va uning tarkibida 5 ta qabul qilingan tur qayd etilgan: I. ferganicum, I. ixiolirioides, I. karateginum, I. songaricum va I. tataricum.

I. tataricum esa zamonaviy nomenklaturada mustaqil qabul qilingan tur hisoblanadi. U piyozboshli geofit bo‘lib, asosan mo‘tadil mintaqa biomlarida uchraydi.

2. Turkumning dunyodagi va O‘zbekistondagi tarqalishi

Ixiolirion turkumining tabiiy areali Markaziy va G‘arbiy Osiyoni qamrab oladi. Kew ma’lumotlariga ko‘ra turkum Afg‘oniston, Eron, Iroq, Qozog‘iston, Qirg‘iziston, Tojikiston, Turkmaniston, Turkiya, O‘zbekiston, Pokiston, Saudiya Arabistoni, G‘arbiy Himolay va boshqa hududlarda tarqalgan. O‘zbekiston florasining tarixiy manbalarida Ixiolirion vakillari, jumladan I. tataricum va I. ferganicum qayd etilgan. Biroq turkum tarkibidagi qabul qilingan turlar soni zamonaviy xalqaro taksonomik bazalarda qayta ko‘rib chiqilgan. Shu sababli ilmiy ishda “dunyoda 5 ta qabul qilingan tur” degan ma’lumotni Kew manbasi bilan berish, O‘zbekiston bo‘yicha esa ma’lumotni mahalliy flora manbalari bilan alohida asoslash maqsadga muvofiq.

3. Tatar chuchmomosining botanik tavsifi

Tatar chuchmomosi — Ixiolirion tataricum — ko‘p yillik piyozboshli geofit o‘simlikdir. Poyasi tik, silliq bo‘lib, barglari ingichka va tasmasimon ko‘rinishga ega. Gullari odatda binafsha yoki ko‘kimtir-binafsha rangda, gulqo‘rg‘oni 6 bo‘lakli va 6 ta changchiga ega. O‘simlikning yerosti organi piyozbosh shaklida bo‘lib, bahorgi qisqa vegetatsiya davridan foydalanib gullaydi va urug‘ hosil qiladi. Kew uni piyozboshli geofit sifatida tavsiflaydi

4. O‘simlikning oziq-ovqat, dorivor va boshqa ahamiyati

Adabiyotlar tahlili I. tataricumning faqat yovvoyi o‘simlik sifatida emas, balki ayrim hududlarda amaliy ahamiyatga ega ekanligini ko‘rsatadi.

Markaziy Osiyoda o‘simlikning yosh novdalari va piyozboshlaridan bahor oylarida oziq-ovqat sifatida foydalanilgani qayd etilgan. Ayrim manbalarda piyozboshlarining xalq tabobatida, xususan oshqozon-ichak tizimi bilan bog‘liq holatlarda qo‘llanilgani haqida ma’lumotlar keltiriladi. Fomina ham I. tataricumni oziq-ovqat va dorivor xususiyatlari bilan tanilgan tur sifatida tavsiflaydi.

Bundan tashqari, o‘simlikning manzarali ahamiyati ham mavjud. Binafsha rangli gullari sababli u manzarali ko‘p yillik o‘simlik sifatida baholanadi. Fominaning tadqiqotida turning G‘arbiy Sibir sharoitida qimmatli manzarali o‘simlik sifatidagi istiqbollari ham ko‘rib chiqilgan.

5. O‘simlikning kimyoviy va biologik ahamiyati

I. tataricumning kimyoviy tarkibi ham xorijiy tadqiqotchilar tomonidan o‘rganilgan.

Yiğitkan va hammualliflarining 2021-yildagi tadqiqotida o‘simlikning ildiz, poya, barg, gul va yer ustki qismlaridan olingan etanol ekstraktlari LC-MS/MS yordamida tahlil qilingan. Tadqiqotda xin kislotasi, protokatex kislota, p-kumar kislota va rutin kabi birikmalar aniqlangan. Barg ekstrakti yuqori antioksidant faollik ko‘rsatgan va mualliflar turning oziq-ovqat sanoatida foydalanish imkoniyatini qayd etgan.

Mazkur natijalar I. tataricumning biologik faol moddalar manbai sifatidagi istiqbolini ko‘rsatadi. Biroq mavjud tadqiqotlar asosida uni tayyor farmatsevtik dori vositasi deb baholash to‘g‘ri emas; hozircha uning farmatsevtik-biologik xususiyatlari ilmiy tadqiqot darajasida o‘rganilgan.

6. Xorijiy mamlakatlarda olib borilgan tadqiqotlar

Rossiya

Fomina T.I. tomonidan 2023-yilda G‘arbiy Sibir sharoitida I. tataricumning biologik xususiyatlari va urug‘ orqali ko‘payishi o‘rganilgan. Tadqiqotga ko‘ra, tur erta yozda gullaydigan gemiephemeroid bo‘lib, mavsumiy rivojlanish davri 94–102 kunni tashkil qilgan. Laboratoriya sharoitida urug‘larning unuvchanligi stratifikatsiyadan keyin 98 foizgacha yetgan.

Bu natijalar turning reproduktiv biologiyasi va introduksiya imkoniyatlarini baholash uchun muhimdir.

Xitoy

Li, Li, Zhang va Lyu tomonidan 2022-yilda Xinjiang sharoitida I. tataricumning quruq-issiq va daraxtzor ostidagi namroq muhitga moslashuvi transkriptom darajasida o‘rganilgan.

Tadqiqot natijasida 150 702 ta noyob gen transkripti (unigene) yig‘ilgan va ikki muhit o‘rtasida 1 929 ta differensial ifodalangan gen aniqlangan. Shulardan 827 tasi yuqori, 1102 tasi esa past darajada ifodalangan. Tadqiqot turning quruq va issiq muhitga moslashishining molekulyar asoslarini tushuntirishga xizmat qiladi.

Turkiya

Yiğitkan va hammualliflari 2021-yilda I. tataricumning kimyoviy tarkibi va biologik faolligini tadqiq qilgan. O‘simlikning turli organlaridan olingan ekstraktlar antioksidant faollik hamda ayrim fermentlarni ingibitsiya qilish xususiyatlari bo‘yicha baholangan.

Eron

2026-yilda Ghonji va hammualliflari Eronning Markaziy viloyatida 10 ta hududdan yig‘ilgan 140 ta tabiiy namunani o‘rganib, o‘simlikning 32 ta morfologik belgisini tahlil qilgan. Statistik tahlil uchun 27 ta belgi ajratilib, ularning katta qismida sezilarli morfologik o‘zgaruvchanlik aniqlangan. Tadqiqot I. tataricum populyatsiyalarida yuqori fenotipik xilma-xillik mavjudligini ko‘rsatgan.

Bu tadqiqot turning morfologik belgilarini ekologik moslanish va kelajakdagi muhofaza hamda manzarali seleksiya ishlari bilan bog‘lash imkonini beradi.

7. O‘zbekistonda o‘simlikning o‘rganilishi

O‘zbekistonda I. tataricum haqida ma’lumotlar turli floristik va botanik manbalarda uchraydi. Jumladan, “Flora Uzbekistana”, “Определитель растений Средней Азии”, hududiy flora va floristik kadastrlar, shuningdek botanika darsliklari ushbu turning sistematikasi, tarqalishi va morfologik belgilarini o‘rganishda muhim manba hisoblanadi.

Samarqand viloyati uchun ayniqsa “Кадастр флоры Узбекистана: Самаркандская область” kabi hududiy manbalar muhim ahamiyatga ega. Chunki bunday asarlar hudud florasining tarkibi, tarqalishi va ekologik xususiyatlarini aniqlashga imkon beradi.

Xulosa. Adabiyotlar tahlili natijasida Ixiolirion tataricumning sistematikasi, morfologiyasi, geografik tarqalishi, fenologiyasi, urug‘ biologiyasi, ekologik moslanishi va amaliy ahamiyati bo‘yicha turli yo‘nalishlarda ilmiy tadqiqotlar olib borilgani aniqlandi. Zamonaviy Kew tasnifida Ixiolirion turkumining 5 ta qabul qilingan turi mavjud bo‘lib, I. tataricum alohida qabul qilingan tur sifatida O‘zbekistonni ham o‘z ichiga olgan keng tabiiy arealga ega. Tadqiqotlar I. tataricumning oziq-ovqat, xalq tabobati va manzarali o‘simlik sifatidagi ahamiyatini ko‘rsatadi. Kimyoviy tadqiqotlar esa uning tarkibida biologik faol birikmalar mavjudligini va ayrim ekstraktlarning yuqori antioksidant faollikka ega ekanligini ko‘rsatgan. Xorijiy tadqiqotlarda turning urug‘ biologiyasi, qurg‘oqchilikka moslanish mexanizmlari va morfologik xilma-xilligi zamonaviy usullar yordamida o‘rganilgan. Shu bilan birga, O‘zbekiston sharoitida, ayniqsa Samarqand viloyatining tog‘oldi va tog‘ hududlarida I. tataricumning fitosenotik xususiyatlari, o‘simlik jamoalaridagi tutgan o‘rni, boshqa turlar bilan munosabati va ekologik moslanish darajasini kompleks o‘rganish dolzarb bo‘lib qolmoqda. Urgut hududida olib borilgan 2×2 m transekt kuzatuvlari bu yo‘nalishdagi tadqiqotlarni mahalliy dala ma’lumotlari bilan boyitadi.

Foydalanilgan adabiyotlar

1.Kew Science. Ixiolirion Fisch. ex Herb. Plants of the World Online. Kew Royal Botanic Gardens.

2.Kew Science. Ixiolirion tataricum (Pall.) Schult. & Schult.f. Plants of the World Online.

3.Fomina T.I. Biological features of the rare species Ixiolirion tataricum (Pall.) Herb. in the forest-steppe conditions of Western Siberia // Samara Journal of Science. 2023.

4.Li Y., Li Z., Zhang X., Lyu G. Comparative Transcriptomic Analysis of Spring Ephemeral Ixiolirion tataricum in Dry and Hot Habitat and Under-Canopy Humid Habitat // Journal of Xinjiang University. 2022.

5.Yiğitkan S., Akdeniz M., Yener İ., et al. Chemical Composition and Biological Activity of Ixiolirion tataricum (Pall.) Schult. & Schult.f. var. tataricum // Records of Agricultural and Food Chemistry. 2021.

6.Ghonji M., Khaleghi A., Khadivi A., Tunç Y. Multivariate analysis of Ixiolirion tataricum (Pall.) Schult. & Schult.f. based on morphological characteristics // Scientific Reports. 2026.

7.Karihaloo J.L., Koul A.K. Bearing of Cytology on the Systematic Position of Ixiolirion (Fischer) Herb. // Cytologia. 1984.

8.Islomov B.S., Hasanov M.A. Botanika. Samarqand: SamDU nashriyoti, 2020.

9.Flora Uzbekistana. Toshkent: O‘zbekiston SSR Fanlar akademiyasi nashriyoti, 1941–1962.

10.Определитель растений Средней Азии. Критический конспект флоры. Toshkent: Fan, 1968–2015.

11.Tojibaev K.Sh., Beshko N.Yu., Kodirov U.H. va boshq. Кадастр флоры Узбекистана: Самаркандская область. Toshkent: Fan, 2018.

12.Aktamova K.Z., Xaydarova X.R. Ixiolirion tataricum L. o‘simligining fitosenotik xususiyatlari. 2026.

O‘SIMLIKLAR KARANTININING OZIQ-OVQAT MAHSULOTLARI XAVFSIZLIGINI TA’MINLASHDAGI AHAMIYATI, XORIJIY TAJRIBALAR VA ULARDAN FOYDALANISH.

Alimov Murodqosim Achilovich. i.f.f.d. (PhD)

O‘simlikar karantini va himoyasi ilmiy-tadqiqot instituti bo’lim boshlig’i

Annotatsiya. *Maqolada O‘zbekiston respublikasida karantin chora-tadbirlar va me’yorlar, o‘simlik dunyosi, ekotizim va oziq ovqat xavfsizligini ta’minlash, qishloq xo‘jaligi mahsulotlari savdosida keraksiz to‘siqlar qo‘yishning oldini olish, karantin nazoratini kuchaytirish bo‘yicha xalqaro tashkilotlar va rivojlangan mamlakatar bilan hamkorlik, “IT texnologiyalari” orqali tahdidlarni tezkor aniqlash, zararkunanda yoki kasallik tarqalishini monitoring qilish, qarshi kurash va karantin tadbirlarni samarali tashkil qilishga oid tadqiqot natijalari keltirilgan*.

Kalit so‘zlar: *Oziq-ovqat xavfizligi*, *karantin nazorati, diskriminatsiya, standart, raqamlashtirish, eksport-import, mexanizm.*

Abstract. *The article presents the results of research on quarantine measures and norms in the Republic of Uzbekistan, ensuring plant life, ecosystem and food security, preventing unnecessary barriers to trade in agricultural products, cooperation with international organizations and developed countries to strengthen quarantine control, rapid detection of threats through "IT technologies", monitoring the spread of pests or diseases, effective organization of control and quarantine measures.*

Keywords: *Food safety, quarantine control, discrimination, standard, digitization, export-import, mechanism.*

Kirish. Oziq-ovqat etishtirish tizimi tabiiy resurslar degradasiyasiga sabab bo‘lishi bilan birgalikda, uning o‘zi ham degradasiyadan aziyat chekmoqda. Bunda oziq-ovqat etishtirishga o‘simliklar kasalliklari, zararli hashoratlar, “COVID-19” kabi yangi kasalliklar paydo bo‘lishi ham kuchli salbiy ta’sir qilishi karantin tizimi aktualligini oshirmoqda[2]. O‘simliklar karantini va himoyasi bo‘yicha halqaro konvensiyasining (IPPC) ma’lumotlariga ko‘ra, dunyoda qishloq xo‘jaligi ekinlari hosilining 20–40% qismi zararkunanda va kasalliklar tufayli yo‘qotilishi, har yili zararkunandalar sababli iqtisodiy zarar 220 mlrd.$ dan ortiqni tashkil etadi. Shu o‘rinda dunyo

aholisi 2050 yilga borib 9,7 mlrd kishidan ortishi esa oziq-ovqat ishlab chiqarishni kamida 50% ga oshirishni talab qiladi[3].

Global iqlim o‘zgarishlari ko‘lami ortishi respublikada o‘simliklar karantini yo‘nalishida ilmiy tadqiqotlar ko‘lami ortishiga olib kelmoqda. Bunda oziq-ovqat halqaro savdosi kengayishi oqibatida yangi invaziv turlar paydo bo‘lishi, biologik xavfni, karantin nazoratini kuchaytirish bo‘yicha xalqaro tashkilotlar bilan hamkorlik, raqamlashtirish, sun’iy intellekt va “IT texnologiyalari” orqali tahdidlarni tezkor aniqlash, sensorlar va dronlar orqali zararkunanda yoki kasallik tarqalishini monitoring qilish, qarshi kurash va fitosanitar karantin tadbirlarini samarali tashkil qilish borasidagi yo‘nalishlarni alohida ajratib ko‘rsatish mumkin.

Oziq-ovqat mahsulotlari eksport-importida o‘simliklar karantin nazorati qishloq xo‘jaligi iqtisodiyotining dinamik rivojlanishiga, teng huquqli va adolatli raqobat uchun shart-sharoitni ta’minlashga, milliy bozorni, aholi hayoti va sog‘ligi,atrof-muhit himoyasiga yo‘naltirilgan ichki va tashqi iqtisodiy faoliyatni kuchaytiruvchi chora-tadbirlarni amalga oshiradi.

Karantin chora-tadbirlar va me’yorlarni qo‘llash bir tomondan o‘simlik dunyosini, ekotizim va oziq ovqat xavfsizligini ta’minlaydi, boshqa tomondan qishloq xo‘jaligi mahsulotlari savdosida keraksiz to‘siqlar qo‘yishning oldini oladi. O‘zbekistondek yirik hajmda meva-sabzavot etishtiruvchi mamlakatlar uchun bu alohida iqtisodiy ahamiyatga ega.

Odatda barcha eksportga chiqariladigan mahsulotlar fitosanitar tozaligi importer mamlakatlar fitosanitar talablari bo‘yicha karantin nazoratidan o‘tkaziladi va talabga javob beradigan bo‘lsa eksportga ruxsat beriladi.

Dunyo mamlakatlari halqaro qishloq xo‘jaligi mahsulotlari savdosida zararli organizmlar, kasalliklar va begona o‘tlarni milliy chegaralarni kesib kirib keluvchi milliy iqtisodiyot uchun havfini oldini olish bo‘yicha karantin xizmatlari kuchli nazorati yo‘lga qo‘yilgan. JST tashkilotiga a’zo bo‘lish jarayonidagi kelishuvda quyidagi iqtisodiy omillar e’tiborga olinadi[4]:

- zararli organizmning kirib kelishi, yashab qolishi yoki tarqalib ketishi oqibatida ishlab chiqarish yoki savdo sohasi qancha zarar ko‘rishi mumkinligi;

- importer mamlakatga kirib kelgach, dastlab aniqlanganda ushbu zararli organizmning tarqalish ko‘lami, unga qarshi kurash yoki yo‘q qilish uchun xarajatlar miqdori hisoblab chiqilishi zarurati;

- fitosanitar xavfni yumshatishda muqobil yo‘llarining afzalliklarini o‘rganib

[3]Международная конвенция по карантину и защите растений (1997). https://openknowledge.fao.Org/items/d0accaf7-3940-4f17-a123-864cae368ae3

[4] Соглашение по применению санитарных и фитосанитарных мер. Марракеш, 15 .04. 1994 г.С-15.

chiqish lozimligi belgilanadi.

Shu bois, JST ga a’zo bo‘lish uchun O‘zbekiston fitosanitar talablarini JST xalqaro fitosanitar talablariga muvofiqlashtirish va JST tashkiloti tomonidan joriy etilgan “Sanitariya va fitosanitariya chora-tadbirlariga amal qilish bo‘yicha bitim” ga rioya qilishi lozim. Bunda fitosanitar talablarga “texnik asoslar” mavjud bo‘lishi lozim. Qishloq xo‘jaligi mahsulotlari savdosida o‘simliklar karantini bo‘yicha texnik asoslanmagan talablar “assosiz talablar” sifatida qabul qilinib, o‘simlik mahsulotlarini eksport qiluvchi mamlakatlar tomonidan JST tashkilotiga importer mamlakatlarning asossiz talablari ustidan e’tiroz bildirilishiga sabab bo‘ladi.

Jaxon savdo tashkiloti besh tamoili amal qilishi belgilangan – savdoda diskriminasiya yo‘qligi; savdo to‘siqlarini kamaytirish; halqaro savdoda to‘siqlarni kamaytirish; halqaro savdoda raqobatbardoshlikni oshirish; rivojlanish jarayonidagi mamlakatlar uchun xalqaro savdoda imtiyozlar; savdo shartlarini prognozlashtirish va ularning barqarorligi masalalari hamma a’zolar uchun tegishli hisoblanadi. Fitosanitar xavf tahlilining ahamiyati yuqoriligi bois hozirda ko‘pgina mamlakatlar JST, YeI tashkilotlarga hamda savdo birlashmalariga a’zo bo‘lishi uchun a’zolik shartlaridan biri sifatida Fitosanitar xavf tahlilini o‘tkazish yuzasidan ekspertlar guruxini tuzish talab etiladi.

Xalqaro savdo munosabatlari kengayishi sharoitida o‘simliklar karantini davlat xizmati faoliyatini takomillashtirish strategik ahamiyatga ega.

Muhokama va natijalar

Tahlillar ko‘rsatishicha, 2017-2024 yillarda respublikadan eksport qilingan meva-sabzavot mahsulotlari nazorati hajmi ortgan (1-rasmga qarang). Jumladan, 2018 yilda meva va sabzavot mahsulotlarini eksport qilish hajmi 2017 yilga nisbatan 36 foizga (1,23 mln. tonnaga), mablag‘ hisobidan 37,5% ga (874,5 mln.$) ortgan. Demak 2018 yilda 2017 yilga nisbatan 1.23 mln tonna, (qiymati 165.7 mln dollar) ko‘p mahsulot karantin nazoratidan o‘tkazilgan.

2020 yilda oziq-ovqat mahsulotlarining asosiy qismi bo‘lgan 1 008,6 mln. $ ga 1 485,0 ming tonnadan ziyod meva-sabzavot eksport qilingan. Bunda 2019-yilning mos davriga nisbatan 199,1 mln. $ ga yoki 16,5 % ga kamaydi. 2023 yilda esa 1 748.9 ming tonna, 1 200 mln. $ mahsulot eksport qilingan. 2024 yilda 2 mln. tonna meva-sabzavot mahsulotlari o‘simliklar karantini nazoratidan o‘tkazilib 1 500 mln. $ mahsulot eksport qilingan.

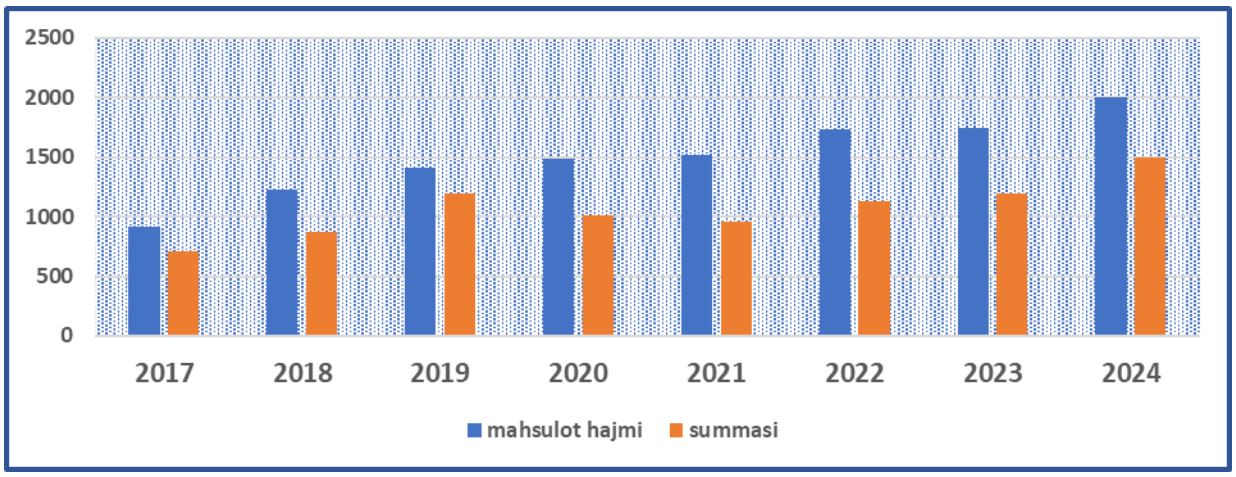
Globallashuv, savdo logistika zanjirlari rivojlanishi va qishloq xo‘jaligi mahsulotlari savdosi hajmining ortishi bilan birga fitosanitar xavf ko‘lami ham ortib boradi. Shu nuqtai nazardan respublikamizda o‘simliklar karantini va himoyasi tizimida quyidagi dolzarb yo‘nalishlar karantin tizimini hozirgi davr talablari darajasida rivojlantirish uchun taklif qilinadi.

Karantin ob’ektlari tarqalishi xavfiga asoslangan o‘simliklar karantini nazoratini amalga oshirish tizimini joriy qilish. Bunda:

- import va eksport operatsiyalarida (RBA) “risk-based approach”ni qo‘llash mexanizmini joriy qilish;

a). O‘simliklar karantini va himoyasi bilan bog‘liq milliy qonunchilik bazasini xalqaro xalqaro standartlarga muvofiqlashtirish talab etiladi: Bunda:

- milliy fitosanitar qonunchilikni JST (World Trade Organization) ning SFS kelishuvi (Sanitary and Phytosanitary Agreement) talablariga moslashtirish tadbirlarini amalga oshirish;



1-rasm. Respublika bo‘yicha eksportga yo‘naltirilgan meva-sabzavot mahsulotlari karantin nazorati hajmi[5]

- halqaro miqyosda qabul qilingan IPP (International Plant Protection Convention) hamda FAO standartlari asosida milliy me’yoriy hujjatlarni muntazam yangilab borish;

- halqaro qabul qilingan karantin xavfi tahlili PRA (Pest Risk Analysis) mexanizmlarini huquqiy jihatdan milliy qonunchilik tizimi bilan integratsiyasini mustahkamlash.

b). Milliy o‘simliklar karantini va himoyasi xizmatlari tizimi faoliyatini raqamlashtirish va zamonaviy axborot texnologiyalarini joriy etish. Bunda:

- karantin nazorati tizimida elektron fitosanitar sertifikatlash (e-Phyto) tizimini halqaro talablar doirasida takomillashtirib borish;

[5] Милий статистика қўмитаси маълумотларига асосан муаллиф томонидан тузилган.



2- rasm. Respublikada o‘simliklar karantini va himoyasi xizmatlari sohasini rivojlantirishning dolzarb yo‘nalishlari.

- respublikaning chegara postlarida (dastlabki bosqichda asosiy chegara postlarida) avtomatlashtirilgan karantin nazorati va monitoringi borasida raqamli platformalarini ishga tushirish;

- karantin nazorati ma’lumotlar bazasini yagona on-layn milliy raqamli platformaga integratsiya qilish maqsadga muvofiq. O‘z o‘rinda ushubu chora-tadbirlar tizimida inson omili ishtirokini kamaytiradi va korrupsiya xavfini sezilarli pasaytirish imkonini beradi.

v). Milliy o‘simliklar karantini va himoyasi tizimida ilmiy-tadqiqotlar o‘tkazish va laboratoriya tahlili moddiy-texnik salohiyatini kuchaytirish. Bunda:

- asosiy o‘simliklar krantini postlarini (birinchi navbatda) zamonaviy diagnostika uskunalari (PSR, molekulyar tahlil) bilan jihozlash va ushbu diagnostika uchun malakali kadrlar tayyorlash;

- karantin ob’ektlari bo‘yicha ilmiy tadqiqotlarni kengaytirish, tadqiqotlarni moliyalashtirishning muqobil manbalarini topish;

- halqaro referens laboratoriyalar bilan hamkorlikni kuchaytirish talab etiladi. Bunday hamkorlik - o‘simliklar karantini (fitosanitariya) sohasida hamkor davlatlar, laboratoriyalar va xalqaro tashkilotlar o‘rtasidagi diagnostika, standartlar, tajriba va bilimlar almashinuvi jarayonlari bo‘lib, hamkorlik global fitosanitar xavflardan samarali himoya qilish, xalqaro savdoni osonlashtirish va zararli organizmlar tarqalishi oldini olish imkoniyatini kengaytiradi.

g). Karantin ob’ektlari tarqalishi xavfiga asoslangan o‘simliklar karantini nazoratini amalga oshirish tizimini joriy qilish. Bunda:

- qishloq xo‘jaligi mahsulotlari import va eksport operatsiyalarida (PBA) “risk-based approach”ni qo‘llash mexanizmini joriy qilish;

- yuqori xavfli tovarlarga kuchaytirilgan tekshiruv, past xavflilarga esa soddalashtirilgan tartib joriy etish;

- respublikadagi chegara va ichki o‘simliklar karantini nazorati tizimilari o‘rtasida o‘zaro integratsiyani ta’minlaydigan raqmli platformalar faoliyatini yo‘lga qo‘yish.

import va eksport operatsiyalarida (PBA) “risk-based approach” (tavakkalchilikga asoslangan yondashuv) tizimi — bojxona, moliyaviy nazorat va tashqi savdo jarayonlarini samarali, shaffof va tezkor qilishga xizmat qiladi. Bu yondashuv xavf darajasi yuqori bo‘lgan operatsiyalarga ko‘proq e’tibor qaratish, xavfi past operatsiyalarni esa soddalashtirilgan tartibda o‘tkazishni nazarda tutadi.

d). O‘simliklar karantini va himoyasi sohasida kadrlar malakasini oshirish borasida va savdo-iqtisodiy aloqalar keng yo‘lga qo‘yilgan davlatlar bilan halqaro hamkorlikni kengaytirish. Bunda:

- milliy mutaxassislarni ilg‘or davlatlarga xalqaro malaka oshirish kurslariga jalb qilish;

- fitosanitar inspektorlar uchun eng zamonaviy bilimlar va usullar doiraisda doimiy trening va attestatsiya tizimini joriy qilish;

- xorijiy tajribani o‘rganish va amaliyotga tatbiq etishga qaratilgan xorijiy mutaxassislarni respublikaga jalb qilish;

- qo‘shni davlatlar bilan chegara fitosanitar nazorati bo‘yicha tezkor axborot almashinuvi tizimini yo‘lga qo‘yish;

- EPPO (European and Mediterranean Plant Protection Organization) kabi mintaqaviy tashkilotlar bilan hamkorlikni kuchaytirish (diagnostik standartlarini milliy tizimda qo‘llash, laboratoriyalararo solishtirma sinovlarda ishtirok etish, EPPO referens laboratoriyalari bilan qo‘shma tadqiqotlar tashkil qilish);

- doimiy savdo-iqtisodiy sherik davlatlar bilan o‘simliklar karantini nazorati hujjatlarini o‘zaro tan olish (mutual recognition) kelishuvlarini imzolash va tizim faoliyatini muvofiqlashtirish;

- o‘simliklar karantini nazorati tizimida laboratoriya molekulyar diagnostikasi (PCR, real-time PCR, DNA barcoding) bo‘yicha qo‘shma o‘quv dasturlarini yo‘lga qo‘yish taklif etiladi.

Shuningdek, halqaro hamkorlik doirasida “Ishonchli ishtirokchilar institutini” joriy qilish va savdo hamkorlar uchun halqaro (“Authorized Economic Operator-AEO)” maqomini berish, chegaralarda karantin tekshiruvlarini kamaytiradi, tovarlarni bojxona rasmiylashtirishni tezlashtirish imkonini beradi, karantin nazoratini sezilarli soddalashtiradi. Ayni paytda bu tizim JST a’zolik doirasida juda qo‘l keladi.

Xulosa

Halqaro savdoni kengayitirishda, O‘zbekistonning JST a’zoligi sharoitida o‘simliklar karantini davlat xizmati nafaqat nazorat qiluvchi organ, balki eksportni rag‘batlantiruvchi va o‘simlik mahsulotlari hamda fitosanitar xavfsizlikni ta’minlovchi strategik institut sifatida faoliyat yuritishi lozim. Shuning uchun uning institutsional, texnologik va kadrlar salohiyatini kompleks ravishda rivojlantirish ustuvor vazifa hisoblanadi.

Shu bilan birgalikda O‘simliklar karantini va himoyasi tizimi qishloq xo‘jaligida ekinlar hosildorligini oshirish, agrar tarmoqning eksport salohiyatini yuksaltirish yo‘nalishidagi tadbirlar doirasida fitosanitar xavfsizlikni ta’minlashda muhim o‘rin tutadi. O‘zbekistonda o‘simliklar karantini va himoyasi sohasi faoliyatini muvofiqlashtiruvchi asosiy davlat organi — Oziq-ovqat mahsulotlari xavfsizligi qo‘mitasi hisoblanib, karantin himoyasi tizimini rivojlantirishning ustuvor yo‘nalishlari doirasidagi tadbirlarni amalga oshirishning mustahkam ilmiy asoslangan mexanizmiga tayanadi.

Foydalanilgan adabiyotlar

O‘zbekiston Respublikasi Prezidenti 2026 yil 12 maydagi PF-84-sonli farmoni.

1. O‘zbekiston Respublikasi Prezidenti 2026 yil 12 maydagi PQ-178-sonli qarori.
2. Создание глобалной консепсии продоволственной безопасности и питания на период до 2030 года.

https://openknowledge.fao.org/server/api/core/bitstreams/bbe0e136-a5fa-4e91-82e2-788c02bff 486/content.

3. Международная конвенсия по карантину и защите растений (1997). https://openknowledge.fao.Org/ items/d0accaf7-3940-4f17-a123-864cae368ae3
4. Соглашение по применению санитарных и фитосанитарных мер. Марракеш, 15 .04. 1994 г.С-15.

LOVIYA (PHASEOLUS VULGARIS) O‘SIMLIGINING BIOLOGIK VA FIZIOLOGIK XUSUSIYATLARI

Usmanova M.I., Boliqulova F.G'

Samarqand davlat pedagogika instituti, Samarqand shahri,

O’zbekiston

Annotatsiya*. Ushbu maqolada loviya (Phaseolus vulgaris L.) o‘simligining biologik va fiziologik xususiyatlari yoritilgan. Loviya o‘simligining morfologik tuzilishi, o‘sishi va rivojlanishi, urug‘ unishi, fotosintez, suv almashinuvi hamda mineral oziqlanish jarayonlari tahlil qilingan. Shuningdek, ushbu fiziologik jarayonlarning tashqi muhit omillari bilan bog‘liqligi ko‘rib chiqilgan.*

Kalit so‘zlar: *Phaseolus vulgaris, loviya, biologik xususiyatlar, fiziologik jarayonlar, fotosintez, suv almashinuvi, o‘sish va rivojlanish.*

Abstract*. This article examines the biological and physiological characteristics of common bean (Phaseolus vulgaris L.). The morphological structure, growth and development, seed germination, photosynthesis, water exchange, and mineral nutrition of the bean plant are analyzed. The relationship between these physiological processes and environmental factors is also considered.*

Keywords*: Phaseolus vulgaris, common bean, biological characteristics, physiological processes, photosynthesis, water exchange, growth and development.*

Loviya dukkakdoshlar oilasiga mansub bir yillik o‘simlik bo‘lib, dunyo bo‘yicha eng ko‘p iste’mol qilinadigan oziq-ovqat ekinlaridan biri hisoblanadi. U yuqori oziqaviy qiymati, tarkibidagi oqsil, vitamin va mineral moddalar miqdorining ko‘pligi sababli inson salomatligi uchun muhim ahamiyatga ega. Tadqiqotlarga ko‘ra, loviya doni tarkibida o‘rtacha 20–25% oqsil, 50–60% uglevod hamda organizm uchun zarur bo‘lgan temir, magniy, kaliy va fosfor kabi mikroelementlar mavjud. Shu sababli loviya ko‘plab mamlakatlarda parhez oziqovqat va dorivor mahsulot sifatida qadrlanadi.Loviyaning biologik xususiyatlari ham alohida ahamiyatga ega. Uning ildiztizimida yashovchi tugunak bakteriyalari atmosferadagi erkin azotni o‘zlashtirib, tuproq unumdorligini oshiradi. Bu esa qishloq xo‘jaligida loviyaning ahamiyatini yanada kuchaytiradi. O‘simlik issiqsevar bo‘lib, unumdor tuproqlarda yaxshi rivojlanadi hamda qisqa muddatda hosil beradi.Tibbiyotda loviya yurak-qon tomir kasalliklari, qandli diabet, kamqonlik va hazmtizimi faoliyatini yaxshilashda foydali mahsulot sifatida qo‘llaniladi. Uning tarkibidagi kletchatka moddasi ichak faoliyatini me’yorga keltiradi, zararli xolesterin miqdorini kamaytiradi

va modda almashinuvini yaxshilaydi. Past glikemik indeksga ega bo‘lgani sababli loviya diabet bilan kasallangan bemorlar ratsionida keng tavsiya etiladi. Bundan tashqari, xalq tabobatida loviya doni va yosh dukkaklaridan tayyorlangan qaynatmalar siydik haydovchi hamda organizmni mustahkamlovchi vosita sifatida ishlatiladi.

O`zbekistonda iqlim kontinental bo`lib,yoz faslida havo harorati 30–40°C gacha ko`tarilishi,qishda esa -10°C gacha pasayishi mumkin. Yog`ingarchilik miqdori yil davomida nobiron bo`lib,asosan bahor va kuz fasllarida kuzatiladi (yiliga o`rtacha 200–400 mm). Loviya yetishtirishdaiqlimning asosiy omillari quyidagilardir: Harorat: Loviya o`sishi uchun optimal harorat 18–25°C ni tashkil qiladi. 30°C dan yuqori va10°C dan past haroratlar o`simlik rivojlanishiga salbiy ta’sir ko`rsatadi.Namlik: Loviya namlikni yaxshi ko`radi, lekin ortiqcha namlik yoki qurg`oqchilik uningunumdorligini pasaytiradi. Suv sig`imi 60–70% bo`lgan tuproqlar ideal hisoblanadi. Loviya qisqa kunli o`simlik bo`lib, kun davomiyligi 10–12 soat bo`lgan sharoitda yaxshirivojlanadi. O`zbekistonning Farg`ona, Andijon, Toshkent va Surxondaryo viloyatlari loviya yetishtirishuchun eng qulay mintaqalardir, chunki bu yerlarda tuproq unumdorligi yuqori va sug`orishimkoniyatlari mavjud. O`zbekistonda loviyaning turli xil navlari, xususan, mahalliy va xorijiy seleksiyada ishlabchiqarilgan navlar qo`llaniladi. Misol uchun: Mahalliy navlar: “Qizil loviya”, “Oq loviya” kabi navlarqurg`oqchilik va mahalliy iqlimga yaxshi moslashgan. Xorijiy navlar: “Pinto”, “Bush bin” va “Kidney” navlari yuqori hosildorlik va kasalliklargachidamlilik bilan ajralib turadi. Nav tanlashda iqlim, tuproq turi va bozor talablariga e’tibor berish lozim. Masalan, qumliloyli tuproqlarda “Qizil loviya” yaxshi natija beradi, og`ir loyli tuproqlarda esa “Pinto” navi afzaldir.Loviya yetishtirishda tuproq tayyorlash muhim ahamiyatga ega. O`zbekistonda ko`pinchasug`oriladigan yerlarda ikkinchi ekin sifatida loviya ekiladi.O`zbekistonda loviyani bahorda (aprel-may) yoki yozda (iyun-iyul) ekish mumkin. Bahoriyekish ko`proq tavsiya etiladi, chunki bu davrda namlik va harorat muvozanati optimal bo`ladi.Loviya hosili odatda ekishdan keyin 90–120 kun ichida yig`ib olinadi. Loviya O`zbekistonda oziq-ovqat mahsuloti sifatida talab yuqori bo`lgan ekindir. Uningeksport potensiali ham yuqori, xususan, yaqin qo`shni davlatlarga (Qozog`iston, Tojikiston) eksportqilinadi. Bundan tashqari, loviyaning azot fiksatsiya qilish xususiyati tufayli u ekin almashinuvida muhim o`rin tutadi, bu esa tuproq unumdorligini oshiradi.Loviya – dukkaklilar oilasiga mansub ko‘p yillik don ekini. Ildizi o‘q ildiz, yaxshi rivojlanadi, tuproqqa 1,5-2 m chuqurlikkacha kirib boradi. Ildizida tuganaklar rivojlanadi. Poyasi o‘tsimon shoxlanadi, ayrim turlari chirmashib, 3-4 m. gacha yetadi. Mevasi dukkak, rangi och pushti yoki to‘q jigarrang, qora. Dukkagida 6-12 ta urug‘ bo‘ladi. Urug‘i buyraksimon, rangi oq, sariq, pushti.

Loviya issiqsevar o‘simlik, urug‘i 8-10°C da unib chiqadi. Maysasi 0,5-1°C sovuqda nobud bo‘ladi. Loviya namsevar, unumdor tuproq sharoitlariga talabchan. O‘suv davri 75-120 kunni tashkil etadi. Loviya yormasi oqsilga boy, yuqori kaloriyaga ega bo’lib, doni tarkibida oqsil 20-31%, moy 0,7-3,6%, kraxmal 50%, kletchatka 2,3-7,1% tashkil etadi. Poyasi chorva mollari uchun yaxshi ozuqa hisoblanadi. Hosildorligi gektar hisobida 2,5-4,0 tonnaga olinadi. Ildizida tuganaklar rivojlanadi.loviyaning ildizi o’q ildiz, 1,5-2 m chuqurlikka kirib boradi. ildizlarda tuganak bakteriyalar uchraydi. lldizida yon ildizchalar ham kuchli rivojlangan, ildizning asosiy massasi tuproqning 40 sm chuqurligida joylashadi.Loviyaning gullari shingil holatida bo’lib, bir qultiqda 2 tadan 12 tagacha gul joylashadi. Gullari yirik oq yoki binafsha rangda bo’ladi. Barglari uchtalik bo’ladi.Asosiy o’g’it sifatida dukkakli don ekinlariga fosfor va kaliy solinadi. Ular o’simliklarning rivojlanishi yaxshilash bilan birga, azot to’plovchi bakteriyalar faoliyatini kuchaytiradi. Ba’zi dukkakli don ekinlari masalan, lyupin, ko’k no’xat tuproqdagi qiyin eriydigan fosfatlar tarkibidagi fosforni yaxshi o’zlashtirishni hisobga olib, ularga fosforit kukunini solish mumkin. Loviya kulga talabchan bo’lib gektariga 4-6 s kul solinsa hosildorlik sezilarli darajada oshadi. Loviya urug’larini ekishdan oldin fosforli hamda organik o’gitlar bilan o’gitlanib tuproqlar sifatli haydalib tayyorlanishi lozim. Tuproq harorati +12-14 C bo'lganda urug'larni 10-15 santimetr oralig’ida, 3-5 sm chuqurlikda, qatorlari 60-70 sm kenglikda jo‘yaklar olinib 60x20 yoki 60x15 sm, 70x20 yoki 70x15 sm sxemalarda ekiladi. Bunda bir metr masofaga 5-6 donadan urug’ ekiladi.

Foydalanilgan adabiyotlar

1. Oripov R., Xalilov N. O‘simlikshunoslik // Toshkent, 2008.

2. Xalilov N., Xalilova L., Ravshanova N., Otayarova GU. Angizga ekishga yaroqli loviya navlarivurug‘chiligi va agrotexnikasi (Tavsiyanoma) // Samarkand, 2017.

3. Ravshanova N., Otayarova G Loviya — to‘kin xayot manbai// Samarkand, 2016.
4. Xalilova L., Otayarova G., Ravshanova N. Takroriy ekish uchun loviyaning yangi navlari //, “Agroilm”, 1-son, 2018. 5. Salomatlik ensiklopediyasi.

SUT ZARDOBI OQSILLARI ASOSIDA YEYILADIGAN BIONANO-QOPLAMALAR OLISH VA ULARNING OZIQ-OVQAT XAVFSIZLIGIDAGI AHAMIYATI

Erkinov Otabek Anvarovich, Umarova Pokiza Muhiddinovna, Abdusayitov Jonibek Sadullayevich,

Samarqand davlat veterinariya meditsinasi, chorvachilik va biotexnologiyalar universiteti, biotexnologiya ta'lim yo'nalishi 202-guruh talabalari

e-mail: erkinovotabek14@gmail.com

Baysariyeva Charos Usmanovna

Samarqand davlat veterinariya meditsinasi, chorvachilik va biotexnologiyalar universiteti, Biotexnologiya kafedrasi dotsenti. Mirzo Ulug'bek 77, Samarqand sh., O'zbeksiton

e-mail: charosbaysariyeva@gmail.com

Annotatsiya*:Ushbu tadqiqotda sut sanoatining ikkilamchi xomashyosi — sut zardobi oqsillari asosida yeyiladigan bionano-qoplamalar olish va ularning tez buziluvchi rezavor mevalarni saqlashdagi samaradorligi o'rganildi. Tajriba davomida glitserin va nano-tsellyuloza kiritilgan matrisalarning mexanik hamda to'siqlik (barrier) xossalari tahlil qilindi. Natijalar shuni ko'rsatdiki, 1,0% nano-komponent kiritilgan bionano-plyonkalar suv bug'i o'tkazuvchanligini 28% ga kamaytirib, uzilishdagi mustahkamligini 5,7 MPa ga yetkazdi. Ushbu bionano-qoplama bilan ishlov berilgan mevalarda namlik yo'qolishi 6,5% dan oshmadi va ularning saqlanish muddati 1,5–2 barobarga uzaydi. Olingan natijalar plastik qadoqlarga ekologik muqobil yaratish va oziq-ovqat isrofining oldini olishda amaliy ahamiyatga ega.*

Kalit so'zlar: *sut zardobi oqsili, yeyiladigan bionano-qoplama, nano-tsellyuloza, suv bug'i o'tkazuvchanligi, rezavor mevalar, saqlanish muddati.*

Abstract: *This study investigated the production of edible bionano-coatings based on whey protein isolate—a dairy industry by-product—and evaluated their effectiveness in preserving highly perishable berries. The mechanical and barrier properties of matrices incorporating glycerol and nanocellulose were analyzed. The results demonstrated that bionano-films containing 1.0% of the nanocomponent reduced water vapor permeability by 28% and achieved a tensile strength at break of 5.7 MPa. Fruit treated with this bionano-coating exhibited moisture loss of no more than 6.5%, and their shelf life was extended by 1.5 to 2 times. These findings hold practical significance for developing eco-friendly alternatives to plastic packaging and reducing food waste.*

Keywords: *whey protein, edible bionano-coating, nanocellulose, water vapor permeability, berries, shelf life.*

Kirish: Bugungi kunda oziq-ovqat xavfsizligini ta’minlash va qishloq xo‘jaligi mahsulotlarini isrofsiz saqlash biologiya hamda biotexnologiya sohasining eng dolzarb vazifalaridan biri bo‘lib qolmoqda. Ayniqsa, rezavor mevalar (qulupnay, golubika, moruq va boshqalar) terib olingandan so‘ng o‘zining suvini tez yo‘qotishi, nafas olish intensivligining yuqoriligi hamda mikroskopik zamburug‘lar ta’sirida tez chirishi sababli ularni uzoq vaqt sifatli saqlash qiyin kechadi. Shu paytgacha qo‘llanib kelinayotgan plastik va polietilen qadoqlar atrof-muhitda yillar davomida parchalanmay, jiddiy ekologik muammolarni keltirib chiqarmoqda, qolaversa, ular mahsulot va atmosfera o‘rtasidagi gaz almashinuvini to‘g‘ri tartibga sola olmaydi Ushbu muammoning oqilona yechimi sifatida biologik parchalanuvchi va to‘g‘ridan-to‘g‘ri iste’mol qilish mumkin bo‘lgan yeyiladigan qoplamalardan (*edible films and coatings*) foydalanish taklif etilmoqda. Bunday qoplamalarni olishda sut sanoatida har kuni tonnalab hosil bo‘ladigan va ko‘pincha atrof-muhitga tashlab yuboriladigan ikkilamchi xomashyo — sut zardobidan foydalanish bir vaqtning o‘zida ikkita global muammoni hal qiladi: chiqindilarni qayta ishlash va ekologik toza qadoq yaratish. Sut zardobi tarkibidagi globulyar oqsillar o‘zining yuqori biologik qiymati hamda termik ishlov berilganda oqsillararo disulfid (S-S) va gidrofob bog‘larni hosil qilib, tutash polymer matrisa yaratish xususiyati bilan ajralib turadi

Sut zardobi oqsillaridan tayyorlangan plyonkalar kislorod hamda xushbo‘y moddalarni o‘tkazmaslik bo‘yicha yuqori ko‘rsatkichga ega bo‘lsa-da, ularning o‘ziga xos kamchiligi bor. Ya’ni, oqsil molekulalaridagi gidrofil guruhlar sababli bunday qoplamalar namlikka o‘ta ta’sirchan bo‘ladi va quriydigan bo‘lsa, mo‘rtlashib tez sinib ketadi. Plyonkaning egiluvchanligini oshirish uchun unga plastifikator sifatda glitserin qo‘shilsa, uning suv bug‘ini o‘tkazish ko‘rsatkichi yana ham ortib ketadi.

Aynan mana shu kamchilikni bartaraf etish uchun so‘nggi yillarda bionanotexnologik yondashuv — biopolimer matrisaga nano-o‘lchamli mustahkamlovchi zarrachalarni (masalan, o‘simlik xomashyosidan ajratib olingan nano-tsellyulozani) kiritish usuli qo‘llanilmoqda. Nano-tsellyuloza zarrachalari oqsil zanjirlari orasidagi bo‘shliqlarni to‘ldirib, suv molekulalarining o‘tishini qiyinlashtiradi hamda plyonkaning mexanik mustahkamligini sezilarli darajada oshiradi.

MATERIAL VA USULLAR

Obyektlar va reaktivlar. Tadqiqotda sut zardobi oqsili izolyati hamda kislotali gidroliz bilan olingan nano-tsellyuloza kristallari ishlatildi. Tajriba obyekti sifatida pishgan, jarohatlanmagan qulupnay va golubika mevalari tanlandi [1, 15–18-b.].

Bionano-qoplama eritmalarini tayyorlash. Qoplama eritmalarini olish Hassan va hammualliflar uslubiyoti [2, 85–88-b.] bo‘yicha amalga oshirildi. 8 g WPI 100 ml distillangan suvda va 35% glitserin aralashtirilib haroratda 30 daqiqa qizdirildi hamdagacha sovitildi. Biopolimer matrisaga NCC suspenziyasi (0,5%, 1,0% va 1,5% dozalarda) ultratovushli gomogenizatorda (20 kHz, 400 W, 15 daq) dispersiyalanib qo‘shildi va vakuumda degazatsiya qilindi.

Plyonkalarni shakllantirish va mevalarga surtish. Eritma teflon qoliplarga quyilib, da 24 soat quritildi va eksikatorda 50% namlik) 48 soat ushlandi. Mevalar tayyor eritmaga 30 soniya botirib olinib havo oqimida 2 soat davomida quritildi.

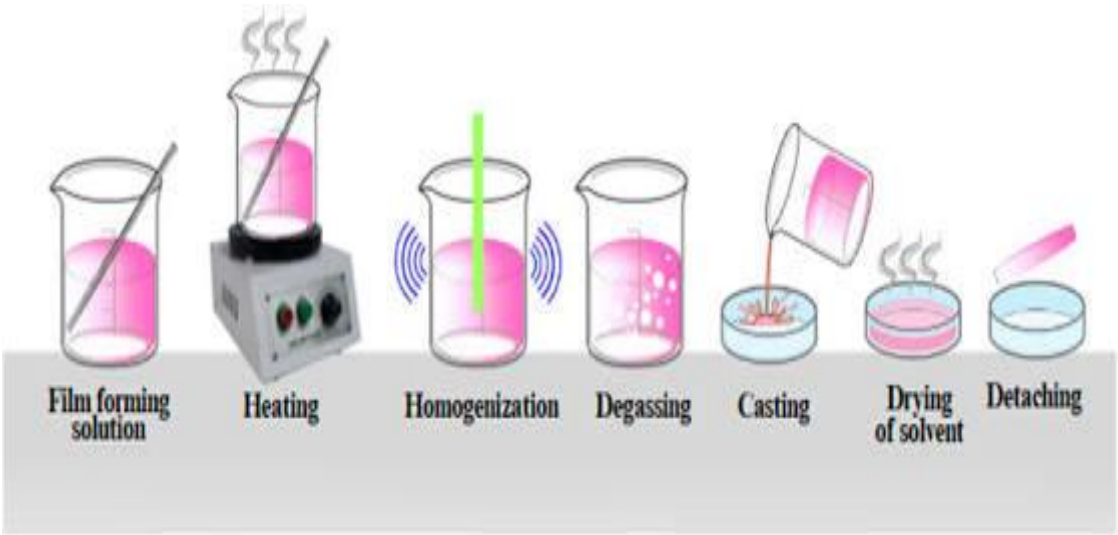
Tahlil usullari:

1. **Fiziko-mexanik ko‘rsatkichlar:** Plyonka qalinligi raqamli mikrometrda (0,001 mm), uzilishdagi kuchlanish hamda nisbiy uzayish universal sinov mashinasida aniqlandi [3, 240–245-b.].

2. **Suv bug‘i o‘tkazuvchanligi (WVP):** Gravimetrik usulda har 2 soatda tortib borish orqali hisoblandi [3, 246–248-b.].

3. **Meva vazn yo‘qotishi:** Bionano-qoplamali va nazorat guruhidagi mevalar 85% namlikda 15 kun saqlandi va har 3 kunda massasi tahlil tarozisida (0,001 g) o‘lchandi.

1-rasm. Laboratoriyada yeyiladigan bionano-plyonkalarni tayyorlash, quritish va qolipdan ajratib olish bosqichlari sxemasi.



Muhokama: Tadqiqotda sut zardobi oqsili va 1,0% nano-tsellyuloza kristallaridan olingan plyonkalar eng yuqori mustahkamlikni namoyish etdi (5,7 MPa), bu sof oqsil plyonkasiga (3,2

MPa) nisbatan sezilarli darajada yuqoridir. Shuningdek, 1,0% kiritilishi suv bug‘i o‘tkazuvchanligini nazorat namunasiga nisbatan 28% ga kamaytirib, 0,75 г·mm/m²·h·kPa ko‘rsatkichni qayd etdi, bu nano-to‘ldiruvchining biopolimer matrisasida samarali to‘siq (bariyer) hosil qilganidan dalolat beradi.

Rezavor mevalarni 15 kun davomida saqlash tajribasi 1,0% NCC saqlovchi bionano-qoplamaning yuqori samaradorligini ko‘rsatdi. Qoplamasiz (nazorat) mevalarda og‘irlik yo‘qolishi 15,2% ni tashkil etgan bo‘lsa, qoplama bilan ishlov berilgan mevalarda bu ko‘rsatkich bor-yo‘g‘i 6,5% dan oshmadi va ularning tashqi ko‘rinishi hamda barqarorligi saqlanib qoldi. Bu bionano-qoplama namlik yo‘qolishini hamda nafas olish jarayonini samarali boshqarishini isbotlaydi.

Foydalanilgan adabiyotlar:

1. Azizov A.A., Toshpulatov SH.K. Oziq-ovqat biotexnologiyasi va biopolimerlar: Darslik. – Toshkent: Fan va texnologiya, 2022. – 180 b. *(Matn ichida: [cite: Kirish, 12-b.], [cite: Mat & Us, 15–18-b.])*.
2. Hassan B., Chatha SAS, Hussain A. Zardob oqsili konsentratiga asoslangan yeyiladigan plyonkalar: Fizik, mexanik va to'siq xususiyatlari // Oziq-ovqat fanlari va texnologiyalari jurnali. – 2018. – 55-jild , 1- son . – 83–92-betlar. doi: 10. 1007/s13197-017-2863-7. *(Matn ichida: [iqtibos: Kirish, 45-b.], [iqtibos: Mat & Us, 85–88-b.], [iqtibos: Nat, 90-b.])* .
3. Bourtoom T. Yeyiladigan plyonkalar va qoplamalar: xususiyatlari va xususiyatlari // Xalqaro oziq-ovqat tadqiqotlari jurnali. – 2008. – 15-jild , № 3. – 237–248-betlar. *(Matn ichida: [iqtibos: Mat & Us, 240–245-b.], [iqtibos: Nat, 240-b.])* .
4. ASTM E96. Materiallarning suv bug'ini o'tkazish uchun standart sinov usullari. – West Conshohocken, PA: ASTM International, 2016. *(Matn ichida: [iqtibos: Mat & Us, 246-b.])* .
5. ISO 527-3:2018. Plastmassalar — Cho'zilish xususiyatlarini aniqlash — 3-qism: Plyonkalar va varaqlar uchun sinov shartlari. – Jeneva: Xalqaro standartlashtirish tashkiloti, 2018. . *(Matn ichida: [cite: Mat & Us, 240-b.])*

MOSH NAVLARINING DALA UNUVCHANLILGIGA EKISH MUDDATLARI HAMDA EKISH SXEMALARINING TA'SIRINI BAHOLASH

Ismailova Farangiz Erali qizi, magistrant
Samarqand davlat vererinariya meditsinasi, chorvachilik va biotexnologiyalar umiversiteti
Ismoilov Voxid Isropilovich, q.x.f.f.d., PhD
Raxmanqulov Bektosh Ilashovich, q.x.f.f.d., (PhD)
Don va dukkakli ekinlar ilmiy tadqiqot instituti Samarqand ilmiy-tajriba stansiyasi

Annotatsiya. *Maqolada sug'oriladigan yerlarda kuzgi bug'doydan bo'shagan maydonda mosh urug'larining dala unuvchanligiga ekish muddatlari va ekish sxemalarining ta'siri natijasida olingan ma'lumotlar bayon qilingan.*

Kalit so'zlar: *Mosh, Durdona, Odilona, ekish muddati, ekish sxemasi, dala univchanligi.*

Abstract. *The article presents data obtained as a result of the influence of sowing dates and sowing schemes on the field germination of mung beans in a field cleared of winter wheat on irrigated lands.*

Keywords: *Mung bean, Durdona, Adilona, sowing date, sowing scheme, field yield.*

Kirish. Mosh yetishtirish texnologiyasida o'simlikning optimal ko'chat qalinligini ta'minlash hamda uning o'sishi va rivojlanish davrlarida qulay suv rejimini yaratish hosildorlikni belgilovchi bosh omillar sirasiga kiradi. Ko'chat qalinligi o'simliklarning yorug'lik, ozuqa va namlikdan foydalanish darajasini belgilab bersa, sug'orish tartiblari ushbu jarayonlarning jadalligini boshqaradi. [1]

Sh.Ernazarov, S.Negmatova va boshqalarning fikricha urug'i ekishdan oldin maxsus bakteriyalar bilan ishlov berib ekilganda, 100 o'simlikda 775 dona dukkaklarbo'lib, og'irligi 11,3 g. ni tashkil etgan. Urug' ekishdan oldin bakteriyalar bilan ishlov berilmasdan ekilganida esa 100 o'simlikda 325 ta dukkaklar hosil bo'lib, og'irligi 2,3 g ni tashkil etgan. Demak, mosh urug'i ekilishidan oldin ilgari dukkakli-don ekinlari ekilmagan yerlardategishli bakteriyalar bilan ishlovberilishi samarali usul hisoblanadi. [3]

Sholichilik ilmiy-tadqiqot institutida olib borilgan tajribalarda mosh navlari o'rtasida o'simlik bo'yi, bir o'simlikdagi dukkaklar soni va 1000 dona don vazni bo'yicha sezilarli farqlar mavjudligi aniqlangan. Eng baland o'simlik bo'yi Radost navida (90,0 sm), eng ko'p dukkak Tyanshan-1 navida (59 ta), eng yuqori 1000 dona don vazni esa Indoneziya oq va Indoneziya qora navlarida (81 g) kuzatilgan. Kompleks baholash natijalariga ko'ra, Durdona

navi o‘simlik bo‘yi (77,6 sm), dukkaklar soni (50 ta) va 1000 dona don vazni (59 g) bo‘yicha muvozanatli yuqori ko‘rsatkichlarga ega bo‘lib, seleksiya ishlarida qimmatli boshlang‘ich manba sifatida tavsiya etilgan. Shuningdek, Tyanshan-1 navi serdukkaklik, Indoneziya oq va Indoneziya qora navlari esa yirik donlilik belgisi bo‘yicha istiqbolli genotiplar sifatida baholangan. [4]

Z.Bobokulov va Z.Erkinovalar olib borgan tadqiqot natijalarida mosh doni tarkibidagi oqsil miqdorini oshirishda erta ekish muddatlari va qatorlab ekish usuli eng maqbul agrotexnik tadbirlar ekanligini ko‘rsatgan. Ayniqsa, 25 iyun muddatida qatorlab ekilgan variantlarda oqsil miqdorining eng yuqori darajada shakllanishi qayd etilgan. Ekish muddatining kechikishi hamda sochma usulning qo‘llanilishi oqsil miqdorining kamayishiga olib kelib, don sifatining pasayishiga sabab bo‘lgan. Shu bois, kuzgi bug‘doy ang‘izida takroriy ekin sifatida mosh yetishtirishda yuqori sifatli va oqsilga boy hosil olish uchun moshni iyun oyining oxirlarida qatorlab ekish tavsiya etganlar. [2.]

Z.Jumayev va A.Sirimovlar bergan ma’lumotlarga qaraganda, Qoraqalpog‘iston sharoitida mosh ang‘izda yetishtirilganda, doni va ko‘k massasidagi oqsilning sezilarli darajada oshishi bilan birga har gektar yer hisobiga tuproqda 100 kg sof azot to‘plangan hamda 200-300 s/ga ko‘k massa ham yetishtirilgan. [3]

Samarqand viloyatining sug‘oriladigan o‘tloqi bo‘z tuproqlar sharoitida bug‘doy hosilidan bo‘shagan maydonga moshning yangi navlarini yetishtirish texnologiyalaridan ekish muddatlari va sxemalarini ishlab chiqish muhim masalalardan biri hisoblanadi.

Yuqoridagilardan kelib chiqib biz tadqiqotlarimizni maqsadi sifatida moshning yangi navlarini sug‘oriladigan yerlar sharoitida o‘sishi, rivojlanishi va urug‘larning dala unuvchanligini aniqladik.

Tadqiqot metodi va metodologiyasi. Material va uslublar. Tadqiqotlarda barcha kuzatuvlar tuproq va o‘simlik namunalari tahlillari hamda hisob kitoblar “Dala tajribalarini o‘tkazish uslublari” (2014) [6] qo‘llanmasi asosida o‘tkazildi. Dala tajribalari Don va dukkakli ekinlar ilmiy tadqiqot instituti Samarqand ilmiy-tajriba stansiyasida o‘tkazildi.

Tajriba o‘tkazilgan maydonning tuprog‘i o‘tloqi bo‘z tuproqlardan iborat. Tajriba ob’ekti moshning Davlat reyestriga kiritilgan Durdona (nazorat) navi va Koreyadan keltirilgan Odilona namunasi olingan. Tajriba tizimi 18 ta variantdan iborat bo‘lib, 4 qaytariq, bir

yarusda joylashtirildi. Bitta paykalning uzunligi – 37 m, eni 3,6 m bo‘lib, umumiy maydon 134,0 m^2 ni tashkil qildi. Hisobga olingan maydon 67 m^2.

Tadqiqot natijalari va ularning tahlili. Mosh navlari urug‘larining dala yunuvchanligini tahlil qilganimizda ekish muddatlari bo‘yicha farqlar sezilarli darajada bo‘ldi. Durdona navida ekish muddati 15 iyunda urug‘larning dala unuvchanligi 86,7 % (96 dona) dan 95,1 (176 dona) gacha, ekish 25 iyunda dala unuvchanligi 85,8 % (95 dona) dan 93,5 % (173 dona) gacha va ekish muddati kechaki nazorat 05 iyulda ekilganda esa 80,4 % (89 dona) dan 89,7 (166 dona) gacha bo‘lganligi aniqlandi (1-jadval).

Durdona navida urug‘larning dala unuvchanligi ekish muddatlari kechikib borishi bilan kamayishi kuzatildi. Bu natija ekish muddati nazorat bo‘lgan 05 iyulda ekilgan variantlarda aniqlandi. Ekish muddati 15 iyunda ekilgan variantlarda ekish muddati nazorat (05 iyul) variantlarga nisbatan urug‘larning dala unuvchanligi variantlarga mos ravishda 5,4 % (10 dona); 6,5 % (9,0 dona) va 6,3 % (7,0 dona) yuqori bo‘lganligi qayd etildi.

Odilona navida ham Durdona navi singari ekish muddati kechikishi bilan urug‘larning dala unuvchanligi kamayishi aniqlandi.

1-jadval

Mosh navlarining dala unuvchanligiga ekish muddatlari hamda usullarning ta’siri (2026 yil)

№	Navlar	Ekish muddatlari	Ekish me’yori	Urug‘larning dala unuvchanligi. dona	
				Dona	%
1	Durdona	15 iyun	60x9-1	176	95,1
2			60x12-1	129	92,8
3			60x15-1	96	86,7
4		25 iyun	60x9-1	173	93,5
5			60x12-1	127	91,4
6			60x15-1	95	85,8

7		05 iyul (nazorat)	60x9-1	166	89,7
8			60x12-1	120	86,3
9			60x15-1	89	80,4
10	Odilona	15 iyun	60x9-1	168	90,8
11			60x12-1	118	84,9
12			60x15-1	92	83,1
13		25 iyun	60x9-1	165	89,2
14			60x12-1	115	82,7
15			60x15-1	90	81,3
15		05 iyul (nazorat)	60x9-1	160	86,5
17			60x12-1	112	80,6
18			60x15-1	87	78,6

Durdona navida Odilona naviga nisbatan ekish muddati 15 iyunda ekilgan variantlarda mos ravishda 4,3 % (8,0 dona); 7,9 % (11,0 dona) va 3,6 % (4,0 dona) yuqori bo‘lganligi qayd etildi. Odilona navida ham urug‘larning dala unuvchanligi eng kam ko‘rsatkich ekish muddati 05 iyulda ekish sxemasi 60x9-1 variantida 86,5 % (160 dona), 60x12-1 variantida 80,6 % (112 dona) va 60x15-1 variantida 78,6 % (87 dona) bo‘lganligi aniqlandi.

Xulosa qilib aytganda, Samarqand viloyatining sug‘oriladigan o‘tloqi bo‘z tuproqlari sharoitida mosh navlari urug‘larining dala unuvchanligi iyun oyining ikkinchi dekadasi (15.07) da 60x9-1 variantda ekilganda eng yuqori ko‘rsatkichga erishildi.

ADABIYOTLAR

1. Agrobank “100 kitob to‘plami”, “Mosh yetishtirish” 12-kitob.www.agrobank.uz

2. Bobokulov Z., Erkinova Z. Mosh navlari don sifat ko‘rsatkichlariga ekish muddatlari va usullarining ta’siri// Agro ilm – O‘zbekiston qishloq va suv xo‘jaligi. №5 [126], 2026. 20-21 b

3. Jumayev Z, Sirimov A.Moshni ang‘izda ekish agrotexnikasi //Sug‘oriladigan yerlarda boshoqli g‘alladan keyin ekiladigan takroriy ekinlarni parvarishlash bo‘yicha tavsiyalar Toshkent, 1995. 18-22 b

4. Саттаров М., Бозорова С. Мош навларининг ҳосилдорлик кўрсаткичлари. // Agro ilm – O‘zbekiston qishloq va suv xo‘jaligi. №6 [127], 2026. 28-29 b.

5. Jumayev Z, Sirimov A.Moshni ang‘izda ekish agrotexnikasi //Sug‘oriladigan yerlarda boshoqli g‘alladan keyin ekiladigan takroriy ekinlarni parvarishlash bo‘yicha tavsiyalar Toshkent, 1995. 18-22 b

6. Nurmatov Sh., Mirzajonov Q., Avliyoqulov A., Bezborodov G., Ahmedov J., Teshaev Sh., Holiqov B., Niyozaliev B., Hasanova F., Mallabaev N., Tillabekov B., Ibragimov N.,.Abdualimov Sh, Shamsiev A., Isaev S. Dala tajribalarini o‘tkazish uslublari. Toshkent 2014. – Б. 175

SUSTAINABILITY OF RANGELAND UTILIZATION IN KYZYLKUM DESERT, UZBEKISTAN

***Kushbokov, A.U[1,2]., Khushbekova, M.S[1].**

1. Samarkand state university 2. University of Szeged

Corresponding author: qabdubakir@mail.ru

Abstract: *Livestock grazing dominates global agricultural land use, and Central Asian rangelands are vital for pastoral livelihoods yet increasingly degraded. This study assesses the restoration potential of soil seed banks (SSB) and indigenous ecological knowledge (IEK) in the Kyzylkum Desert, Uzbekistan. A germination experiment across 20 sites with varying grazing gradients yielded over 1,000 seedlings from 21 species, showing moderate similarity to aboveground vegetation (Sørensen's Index = 0.42). Thirty interviews revealed that 90% of herders depend on a single watering well, most perceive deteriorating conditions driven by drought (61%), and 73% receive no government support. Findings highlight SSBs as reservoirs for natural regeneration and the need to integrate local knowledge into sustainable rangeland management.*

Keywords: *Indigenous ecological knowledge, livestock grazing, soil seed banks, rangelands, land management.*

Introduction: Livestock grazing occupies roughly 80% of global agricultural land (FAO, 2015), and Central Asian rangelands sustain pastoral livelihoods but face widespread degradation (Mirzabaev et al., 2016). In Uzbekistan, rangelands cover about 52% of the land area (Dong et al., 2011), with 10 million hectares degraded (CACILM, 2006) and livestock numbers rising sharply since 1990 (UZSTAT, 2018). Soil seed banks (SSB)—viable seeds stored in soil (Roberts, 1981; Walck et al., 2005)—are critical for natural regeneration after disturbance (Gross et al., 1990; Tessema et al., 2012), yet grazing effects on them remain poorly understood, especially in Central Asia (Mulloy et al., 2019; Kushbokov et al., 2025). Concurrently, indigenous ecological knowledge (IEK) offers valuable insights for locally relevant, sustainable land management (Berkes et al., 2000; Das et al., 2021; Sharifian et al., 2023). This study therefore examines SSB resources and local knowledge across grazing gradients in the Kyzylkum Desert to assess natural recovery potential and inform sustainable rangeland management in Uzbekistan.

Results: *Aboveground and soil seed bank composition:* Over 1,000 seedlings from 21 species emerged from the SSB, with *Peganum harmala*, *Carex physodes*, and *Poa bulbosa* most prevalent. Aboveground vegetation comprised 68 species. Sørensen's Similarity Index was 0.42, indicating moderate similarity; 19 of 21 SSB species also occurred aboveground, with only two unique to the seed bank (Fig. 1). This pattern of relatively low SSB species richness is consistent with previous dryland studies (Erfanzadeh & Kahnuj, 2015; Leder et al., 2017; Loydi & Collins, 2021).

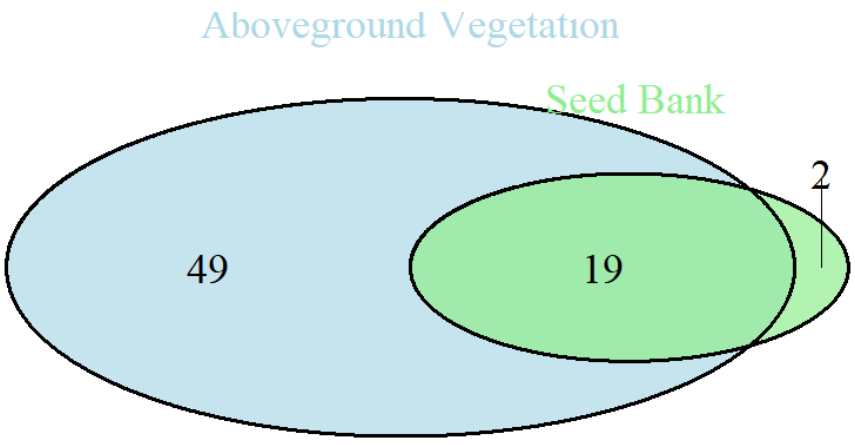


Figure 1. A Venn diagram visualizing a relationship between aboveground vegetation and SSB species richness.

Socio-ecological survey: Interviews with 30 herders and small-scale farmers showed year-round grazing, primarily sheep. About 90% use only one watering well and take no measures to reduce grazing pressure around it, consistent with patterns of degradation near watering points reported by Solomon et al. (2006). Most perceived deteriorating grazing lands, with 61% attributing changes mainly to drought, followed by land shortages—aligning with broader findings on overgrazing and climatic stressors (Chen et al., 2017; Petz et al., 2014). Approximately 93% reported no specific management actions, while 7% practice seasonal rotation. Nearly three-fourths perceived reduced vegetation cover. About 73% receive no government support (Umarov et al., 2025), and 85% could not suggest actionable improvements. Regarding the future, 42% expect deterioration, 42% believe outcomes depend on weather, and 14% were uncertain.

Conclusion: This study highlights the interplay between soil seed banks and indigenous ecological knowledge for rangeland restoration in the Kyzylkum Desert. Although SSB species richness was low (21 species), moderate similarity with aboveground vegetation (S = 0.42) suggests potential for natural regeneration (Tessema et al., 2012; Valkó et al., 2016). Local herders showed strong awareness of degradation driven by drought, land shortages, and insufficient water (Chen et al., 2017; Mirzabaev et al., 2016), yet most lack government support and actionable strategies (Umarov et al., 2025). Integrating scientific findings with local knowledge is essential for sustainable rangeland management (Berkes et al., 2000; Batdelger et al., 2025). Future research should assess long-term impacts of adaptive practices to enhance resilience and biodiversity in Uzbekistan's rangelands.

References

Batdelger, G., Oborny, B., Batjav, B., & Molnár, Z. (2025). The relevance of traditional knowledge for modern landscape management: Comparing past and current herding practices in Mongolia. *People and Nature*, 7, 1056–1072.

Berkes, F., Folke, C., & Colding, J. (Eds.). (2000). *Linking social and ecological systems: Management practices and social mechanisms for building resilience*. Cambridge University Press.

CACILM (Central Asian Countries Initiative for Land Management). (2006). UNCCD National Working Group of the Republic of Uzbekistan. In: *Republic of Uzbekistan National Programming Framework*.

Chen, T., Christensen, M., Nan, Z., & Hou, F. (2017). The effects of different intensities of long-term grazing on the direction and strength of plant-soil feedback in a semi-arid grassland of Northwest China. *Plant and Soil*, 413, 303–317.

Das, M., Das, A., Seikh, S., & Pandey, R. (2021). Nexus between indigenous ecological knowledge and ecosystem services: A socio-ecological analysis for sustainable ecosystem management. *Journal of Ecosystems for Future Generations*, 29, 61561–61578.

Dong, S., Wen, L., Liu, S., Zhang, X., Lassoie, J. P., Yi, S., et al. (2011). Vulnerability of worldwide pastoralism to global changes and interdisciplinary strategies for sustainable pastoralism. *Ecology and Society*, 16(2), 10.

Erfanzadeh, R., & Kahnuj, S. H. (2015). Soil seed bank characteristics about distance from watering-points in arid ecosystems (case study: Kahnuj, Kerman province). *Ecopersia*, 3(2), 975–986.

FAO (Food and Agricultural Organisation of the United Nations). (2015). *Global climate change, food supply and livestock production systems: A bioeconomic analysis*. Statistical pocketbook, Rome.

Gross, K. L. (1990). A comparison of methods for estimating seed numbers in the soil. *Journal of Ecology*, 78, 1079–1093.

Kushbokov, A., Deak, B., & Valkó, O. (2025). Characteristics of soil seed bank in global drylands – A review. *Journal of Arid Land Research and Management*, 39, 1–21.

Leder, C. V., Peter, G., Funk, F. A., & Peláez, D. V. (2017). Consequences of anthropogenic disturbances on soil seed bank diversity and nurse shrub effect in a semiarid rangeland. *Biodiversity and Conservation*, 26(10), 2327–2346.

Loydi, A., & Collins, S. L. (2021). Extreme drought has limited effects on soil seed bank composition in desert grasslands. *Journal of Vegetation Science*, 32(5), e13089.

Mirzabaev, A., Ahmed, M., Werner, J., Pender, J., & Louhaichi, M. (2016). Rangelands of Central Asia: Challenges and opportunities. *Journal of Arid Land*, 8(1), 93–108.

Mulloy, T. A., Barrio, I. C., Björnsdóttir, K., Jónsdóttir, I. S., & Hik, D. S. (2019). Fertilisers mediate the short-term effects of sheep grazing in the Icelandic highlands. *Icelandic Agricultural Sciences*, 32, 75–85.

Petz, K., Alkemade, R., Bakkenes, M., Schulp, C. J. E., van der Velde, M., & Leemans, R. (2014). Mapping and modelling trade-offs and synergies between grazing intensity and ecosystem services in rangelands using global-scale datasets and models. *Global Environmental Change*, 29, 223–234.

Roberts, H. A. (1981). Seed banks in soils. *Advances in Applied Biology*, 6, 1–55.

Sharifian, A., Gantuya, B., Wario, H. T., Kotowski, M. A., Barani, H., Manzano, P., et al. (2023). Global principles in local traditional knowledge: A review of forage plant-livestock-herder interactions. *Journal of Environmental Management*, 328, 116966.

Solomon, T. B., Snyman, H. A., & Smit, G. N. (2006). Soil seed bank characteristics in relation to land-use systems and distance from water in a semi-arid rangeland of southern Ethiopia. *South African Journal of Botany*, 72, 263–271.

Tessema, Z. K., de Boer, W. F., Baars, R. M. T., & Prins, H. H. T. (2012). Influence of grazing on soil seed banks determine the restoration potential of aboveground vegetation in a semi-arid savanna of Ethiopia. *Biotropica*, 44(2), 211–219.

Umarov, Sh., Nurbekov, A., Nishanov, N., Kosimov, M., Bobomurotov, Sh., Umarov, M., Khaitov, B., & Namozov, M. (2025). Land degradation in Uzbekistan: Key challenges and sustainable solutions. *Frontiers in Sustainable Food Systems*, 9, 1676403.

UZSTAT (State Committee of the Republic of Uzbekistan by Statistics). (2018). *Agriculture, forestry, and fishing*. Statistical collection, Tashkent.

Valkó, O., Deák, B., Török, P., Kelemen, A., Miglécz, T., Tóth, K., et al. (2016). Abandonment of croplands: Problem or chance for grassland restoration? Case studies from Hungary. *Ecosystem Health and Sustainability*, 2(2).

Walck, J. L., Baskin, J. M., Baskin, C. C., & Hidayati, S. N. (2005). Defining transient and persistent seed banks in species with pronounced seasonal dormancy and germination patterns. *Seed Science Research*, 15(3), 189–196.

GLYCYRRHIZA TRIPHLLA O‘SIMLIGINING AYRIM XUSUSIYATLARI

Mamarasulova Nozima To‘lqin qizi-Samarqand davlat pedagogika instituti

Annotatsiya: *Mazkur maqolada Glycyrrhiza triphylla Fisch. & C.A. Mey. o‘simligining Qashqadaryo botanik-geografik rayonidagi morfologik belgilari va fitotsenotik xususiyatlari o‘rganilgan. Dala tadqiqotlari asosida o‘simlikning morfometrik ko‘rsatkichlari, fenologik xususiyatlari hamda tabiiy fitotsenoz tarkibida uchrash darajasi aniqlandi. Tadqiqot natijalari turning ekologik xususiyatlarini tavsiflashda muhim ahamiyatga ega.*

Kalit so‘zlar: *Glycyrrhiza triphylla, shirinmiya, morfologik belgilar, morfometriya, fitotsenoz, fitotsenologiya, Drude shkalasi, Qashqadaryo botanik-geografik rayoni.*

Abstract

This article investigates the morphological characteristics and phytocenotic features of Glycyrrhiza triphylla Fisch. & C.A. Mey. in the Kashkadarya botanical-geographical region. Based on field studies, the morphometric parameters, phenological characteristics, and occurrence of the plant within natural phytocenoses were determined. The research findings are important for characterising the ecological features of this species.

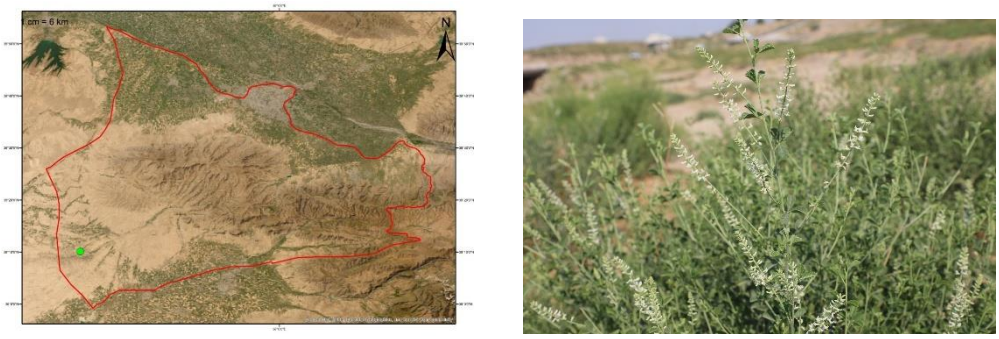
Keywords: *Glycyrrhiza triphylla, liquorice, morphological characteristics, morphometry, phytocenosis, phytocenology, Drude scale, Kashkadarya botanical-geographical region.*

Kirish. *Glycyrrhiza triphlla* Fisch. & C.A. Mey. o‘simligi 1843-yilda botaniklar Friedrich Fischer va Carl Meyer tomonidan dastlab *Meristotropis triphlla* Fisch. & C.A. Mey. nomi ostida ilmiy tavsiflagan. *Glycyrrhiza* turkumi hozirda butun dunyo bo‘ylab tasdiqlangan 16 turni o‘z ichiga oladi [4]. *G.triphlla* turning dastlabki tip gerbariysi Sankt-Peterburgdagi Komarov institutining LE gerbariysida saqlanadi. Yer yuzida taralish joylari Afg’oniston, Eron, Qozog‘iston, Pokiton, Turkmaniston va O‘zbekiston.

O‘zbekistonda bu turkumning 5 turi keng tarqalgan: *G.glabra, G.bucharica, G.uralensis, G.triphylla, G.aspera*. *G.triphlla* Toshkent, Samarqand va Qashqadaryo viloyatlarining tog‘ etaklari va past tog‘larda, daryolarning qumli quruq o‘zanlarida, cho‘kindilar va toshli yonbag‘irlarda, qizilqumtoshlarda, yotqiziqlar va ekinzorlarda uchraydi [1]. *G.triphylla* ozuqabop va asal beruvchi o‘simlik ekanlig ilmiy manbalar bilan tasdiqlangan, biroq uning o‘ziga xos dorivor xususiyatlari batafsil o‘rganilmagan [2]. *Glycyrrhiza* turkumining *G.glabra* va *G.uralensis* kabi asosiy turlari ko‘plab tadqiqotchilar tomonidan dorivor o‘simlik sifatida batafsil o‘rganilgan [5,6,7]. *G.triphlla* turi asosan taksonomik tavsiflangan, ammo o‘simlikning morfologik belgilari, vegetativ generativeorganlarining tuzilishi, tarqalish areallari va fitotsenotik xususiyatlari o‘rganilmagan. Tadqiqotning maqsadi O‘zbekistonning Qashqadaryo botanik-geografik hududida *G.triphlla* ning asosiy morfologik belgilari va fitotsenotik xususiyatlarini aniqlashdan iborat.

Tadqiqot metodologiyasi. O‘simlikning o‘sish joyi GPS ma’lumotlaridan foydalangan holda aniqlandi. Olingan koordinatalar asosida ArgMAP 10.8 dasturi yordamida o‘simlik tarqalgan arealning GAT xaritasi tuzildi. O‘simlikning illusturatsiya fotosuratlarini yaratish uchun Adobe Photoshop 2022 dasturidan foydalanildi. O‘simlikning fitotsenotik tarkibini aniqlash uchun O.Drudening (1890) shkalasi qo‘llanilgan. Olingan ma’lumotlarni statistik qayta ishlashu chun Excel 2019 dasturi va B.A.Dospexov tomonidan taklif etilgan uslub qo‘llanildi (1973).

Natijalar. *G.triphlla* o‘simligini o‘rganishga qaratilgan dala tadqiqotlari 2025-2026-yillarda olib borildi. Tadqiqot o‘tkazilgan joy O‘rta Osiyo tog‘li provinsiyasi, Ko‘histon okrugi, Qashqadaryo botanik-geografik rayoni (koordinatalari: 66,36116039,168917; dengiz sathidan balandligi balandligi 511 m) botanik-geografik rayonlashtirishga tegishli [3]. O‘simlikning tarqalish areali va tadqiqot hududi 1-rasmdagi xaritada ko‘rsatilgan.



1-rasm. Tadqiqot olib borilgan hudud

O‘simlikning morfometrik ko‘rsatkichlarini aniqlashda har bir vegetativ va generativ organlar 30 marta takroriy bilan o‘lchandi (n-30). Olingan ma’lumotlar Dospexov uslubi bo‘yicha statistik qayta ishlandi. *G.triphlla* ko‘p yillik o‘t o‘simlik. Poyalari tik o‘suvchi, oddiy yoki shoxlangan, uzunligi 37.4+1 sm. Poya yuzasi silliq bo‘ladi. Barglari 3 bargchali murakkab bargchalardan iborat. Barglari, qisqa siyrak yotiq tukli bandlarda joylashgan bargchalari teskari keng tuxumsimon eni 3.98 ± 0.08 sm, uzunligi 1.84 ± 0.1 Barg plastinkasi qisqa, uzunligi 4,04±0,5 sm. Gullari shingilga to‘plangan, shingili birmuncha siyrak. Gullari ochbinafsha rangli, zigomorf, kengligi 0,184±0,02 sm, uzunligi 1,47±0,2 sm. To‘pguli shingilsimon, uzunligi 3,34 ±0,34 sm. Gullashi may-iyunda, mevasi iyul-avgustda yetiladi.

Agregatning fitotsenotik xususiyatlari o‘rganilayotgan hududda belgilangan 5×5 m transkektalar yordamida aniqlandi. Har bir transekt uchun o‘simlik turlari, ularning turkumlari va oilalari aniqlandi. Fitotsenoz tarkibiga kiruvchi o‘simlik turlari fenologik fazasi, poya balandligi va Drude shkalasi bo‘yicha mo‘llik va ham jamiyat darajasi bilan tavsiflangan. Batafsil natijalar 1-jadvalda keltirilgan.O‘rganilayotgan tabiiy hudddagi tabiiy fitosenozda 25 m² maydonda 15 o’simlik turi uchrab, shundan *G.Glabra* va menthe asiatika Copiozus1, Cichorium intybus va Rosa Canina esa Unikum, qolgan turlar esa Solitare holatida ekanligi aniqlandi. Demak Qashqadaryo botanik-geografik rayonida *Glycyrrhiza triphlla*, tikanli shirinmiya-yalpiz-tugmachagul-yantoq assotsiatsiyasida ko’proq uchrar ekan.

1-jadval

***Glycyrrhiza triphila* ning Qashqadaryo botanik-geografik rayoni tabiiy sharoitidagi fitotsenologiyasi**

T/r	O’simlik nomi	Vegetatsiyasi	5 balli shkalada tutgan o’rni
1.	*Glycyrrhiza triphlla*	Gullash	Cop1
2.	*Eremostachys nuda*	Mevalash	Sol
3.	*Rumex aquaticus*	Gullash	Sol
4.	*Verbascum songoricum*	Gullash	Sol
5.	*Hypericum perforatum*	Gullash	Sol
6.	*Malva solvestris*	Gullash	Sol
7.	*Cichorium intybus*	Gullash	Sol
8.	*Rubus caesius*	G’unchalash	Un
9.	*Rosa Canina*	Gullash	Un
10.	*Alhagi pseudalhagi*	Mevalash	Sol
11.	*Mentha asiatika*	Vegetetsiya	Cop1
12.	*Althaea officinalis*	Gullash	Sol
13.	*Aluropus litorais*	Vegetatsiya	Sol
14.	*Carthamus turcestanicus*	Gullash	Sol
15.	*Onapordon aenhium*	Vegetatsiya	Sol

Xulosa. Qashqadaryo botanik-geografik rayonida olib borilgan tadqiqotlar natijasida *Glycyrrhiza triphylla* ning asosiy morfologik belgilari va fitotsenotik xususiyatlari aniqlandi. Mazkur tur ko‘p yillik o‘t o‘simlik bo‘lib, may–iyun oylarida gullaydi, mevalari esa iyul–avgust oylarida yetiladi. Tadqiqot hududidagi 25 m² maydonda 15 ta o‘simlik turi qayd etildi. *Glycyrrhiza triphylla* ning boshqa turlar bilan birgalikda tabiiy fitotsenoz tarkibida uchrashi aniqlandi. Olingan

natijalar turning ekologik xususiyatlarini baholash va tabiiy resurslaridan oqilona foydalanish uchun ilmiy asos bo‘lib xizmat qiladi.

Adabiyotlar ro‘yxati

1. Korovin Ye.P. O‘zbekiston florasi. T.III. Toshkent: O‘zFA nashriyoti, 1960. – B. 717-720.

2. Tojibayev K.Sh. va boshqalar. O‘zbekiston florasi kadastri: Samarqand viloyati Toshkent: Fan, 2018. – 216 b.

3. TojiboyevK.Sh., BeshkoN.Yu., Popov V.A. O‘zbekistonning botanik-geografik rayonlashtirilishi // Botanika jurnali. 2016. 101-jild. S. 1105-1132.

4. www.powo.science.kew.org

5. Adianti M. vaboshqalar. *Glycyrrhiza uralensis* va boshqa *Glycyrrhiza* turlaridan olingan gepatit C virusiga qarshi birikmalar /Mikrobiologiya va immunologiya. -2014. Vol. 58. No 3. B. 180-187.

6. Damle M. va boshqalar. *Glycyrrhiza glabra* (Shirinmiya)- kuchlidorivoro‘t // Xalqaroo‘simliklartibbiyotijurnali -2014. Vol. 2. Yo‘q. 2. Pp. 132-136.

7. Ji S, Li Z, Song W. Wang Y, Liang W, Li K, Tang S, Wang Q, Qiao X, Zhou D, Yu S, Ye M. *Glycyrrhiza uralensis* (Qizilmiya) o‘simligining biofaol tarkibiy qismlari: An’anaviy o‘simlik dorisining samarali komponentlarini kashf etish // Jurnal naturalnix produktov. 2016. – 2016. – 79-jild. – № 2. – B. 281–292. – doi: 10.1021/acs.jnatprod.5b00877.

RATSION TARKIBIDAGI OZUQAVIY MODDALARNING QUYONLAR TOMONIDAN O‘ZLASHTIRILISH DINAMIKASI.

Namazova Dilnoza Irzaqulovna — Zarmed universiteti Tibbiyot va bioinjeneriya instituti, Fiziologiya, patofiziologiya va gigiyena kafedrasi assistenti.

dilnozanamazova 22@gmail.com. Tel: +998 99-954-54-81. Samarqand.

Annotatsiya. *Mazkur maqolada ratsion tarkibidagi ozuqaviy moddalarning quyonlar tomonidan hazmlanishi va o‘zlashtirilishiga «Bonaka-APK» hamda «SimbioNorm» probiotik qo‘shimchalarining ta’siri tahlil qilingan. Tadqiqotning maqsadi probiotiklar qo‘llanilganda ozuqaning quruq moddasi, organik va mineral komponentlarining hazmlanish ko‘rsatkichlarini baholashdan iborat. Nazorat va tajriba guruhlarida sutkalik 300 g ozuqa ratsioni asosida hazmlangan ozuqa, namlik, quruq modda, organik modda va xom kul miqdorlari o‘rganilgan. Natijalarga ko‘ra, eng yuqori ko‘rsatkichlar «SimbioNorm» qo‘llanilgan guruhda qayd etilgan. Kuzatilgan o‘zgarishlar ichak mikrobiotasining funksional holati va fermentativ jarayonlarning yaxshilanishi bilan bog‘liq bo‘lishi mumkin. Olingan natijalar probiotik qo‘shimchalardan quyonlar ratsionidagi ozuqaviy moddalardan foydalanish samaradorligini oshirishda qo‘llash istiqbolini ko‘rsatadi.*

Kalit so‘zlar: *quyonlar, ozuqa ratsioni, probiotiklar, Bonaka-APK, SimbioNorm, ozuqa moddalarining hazmlanishi, o‘zlashtirilish dinamikasi, quruq modda, organik modda, xom kul.*

Abstract. *This article analyzes the effects of the probiotic supplements “Bonaka-APK” and “SimbioNorm” on the digestibility and utilization of nutrients in the diets of rabbits. The aim of the study was to evaluate the digestibility of dietary dry matter, organic matter, and mineral components following probiotic supplementation. In the control and experimental groups, the amounts of digested feed, moisture, dry matter, organic matter, and crude ash were investigated based on a daily feed ration of 300 g. According to the results, the highest values were recorded in the group receiving “SimbioNorm.” The observed changes may be associated with improvements in the functional state of the intestinal microbiota and enzymatic processes. The findings indicate the potential of probiotic supplements to improve the efficiency of nutrient utilization in rabbit diets.*

Keywords: *rabbits, feed ration, probiotics, Bonaka-APK, SimbioNorm, nutrient digestibility, nutrient utilization dynamics, dry matter, organic matter, crude ash.*

Quyonlar ovqat hazm qilish tizimining o‘ziga xos anatomik-fiziologik xususiyatlariga ega bo‘lib, ularning ratsionida oqsil, yog‘, uglevodlar, kletchatka, mineral moddalar va vitaminlarning yetarli hamda o‘zaro mutanosib bo‘lishi organizmdagi moddalar almashinuvi jarayonlarining

me’yoriy kechishida muhim ahamiyat kasb etadi. Ozuqa moddalarining hazm bo‘lishi va organizm tomonidan o‘zlashtirilish darajasi ratsion tarkibi, ozuqa komponentlarining sifati va biologik qiymati, hayvonlarning yoshi va fiziologik holati, shuningdek, ichak mikroflorasining tarkibi hamda faolligi bilan uzviy bog‘liq. Ratsion tarkibidagi ozuqaviy moddalarning quyonlar tomonidan o‘zlashtirilish dinamikasini o‘rganish organizmda kechadigan hazm qilish, so‘rilish va moddalar almashinuvi jarayonlarini kompleks baholash imkonini beradi. Ayniqsa, ratsion tarkibidagi asosiy oziq moddalarning hazm bo‘lish va o‘zlashtirilish ko‘rsatkichlarini aniqlash turli oziqlantirish usullarining biologik samaradorligini baholashda muhim ilmiy mezon hisoblanadi. Ozuqa ratsionini quyonlarning fiziologik ehtiyojlariga muvofiq ravishda optimallashtirish ozuqaviy moddalardan samarali foydalanish, hazm bo‘lish jarayonlarini yaxshilash va moddalar almashinuvining barqaror kechishini ta’minlashga xizmat qiladi. Shu bilan birga, ilmiy asoslangan oziqlantirish tizimi ozuqa sarfini maqbullashtirish, quyonlarning o‘sish va rivojlanish ko‘rsatkichlarini yaxshilash hamda quyonchilik mahsulotlari yetishtirishning iqtisodiy samaradorligini oshirish imkonini beradi. Shu nuqtai nazardan, ratsion tarkibidagi ozuqaviy moddalarning o‘zlashtirilish dinamikasini tadqiq etish quyonlarni oziqlantirish me’yorlarini takomillashtirish, ratsionlarning biologik qiymatini oshirish va samarali oziqlantirish texnologiyalarini ishlab chiqishda muhim ilmiy-amaliy ahamiyatga ega. Hayvonlarning sog‘lig‘ini saqlash, yosh hayvonlarning yaxshi o‘sishi va rivojlanishi, normal ko‘payishi, maksimal mahsuldorligi va kam xarajat evaziga yuqori sifatli mahsulot olishi uchun hayvonlar ozuqa tarkibida ma’lum miqdorda oziq moddalar olishlari kerakligini ta’kidlaydi [5, 512]. Oziq-ovqat tarkibidagi ozuqa moddalari va energiyaning yalpi miqdori uning haqiqiy qiymatining ko‘rsatkichi bo‘lib xizmat qila olmaydi, chunki ratsiondagi ozuqa moddalarining katta qismi oshqozon-ichak traktida so‘rilmaydi, balki energiyaning bir qismini olib, najas bilan chiqariladi. Oziq-ovqatning ozuqaviy qiymati to‘g‘risida obyektiv fikr undagi hazm bo‘ladigan ozuqa moddalarining mavjudligi bilan beriladi [2, 624-b]. Ratsion tarkibidagi ozuqa moddalarining hazm bo‘lishi genetik va paratipik omillar ta’sirida bo‘lishi mumkin, bunda ratsionning to‘la qiymatga ega bo‘lishi alohida ahamiyatga ega [4, 52]. Oziq moddalarning hazm bo‘lishi quyidagi omillarga bog‘liq: hayvonning turi, yoshi, fiziologik holati, shuningdek, ozuqa sifati, ratsionning tuzilishi va uning energiya tarkibi. Hayvonlarga beriladigan ozuqalar, kimyoviy tarkibidan qat’iy nazar, ozuqa moddalarining turlicha hazm bo‘lishi, bu esa pirovard natijada ularning mahsuldorligiga ta’sir qilishi mumkin [1,125-127; 3, 94-98-b]. Ozuqaning biologik qiymati va quyonlar mahsuldorligi o‘rtasidagi bog‘liqlik, avvalo, ovqat hazm qilish traktida ozuqaviy moddalarning parchalanishi va so‘rilishi hamda ularning keyingi moddalar almashinuvi jarayonlarida ishtirok etishi bilan belgilanadi. Shu sababli quyonlarning oziqlanish jarayonini ilmiy asosda muvofiqlashtirish va kutilayotgan mahsuldorlik

ko‘rsatkichlarini aniq rejalashtirishda ozuqaning fizik-kimyoviy xususiyatlari, hazmlanish darajasi, biologik qiymati hamda hosil bo‘ladigan metabolitlarning almashinuv jarayonlaridagi ishtirokini hisobga olish muhim ahamiyatga ega. Quyonlarni me’yor asosida oziqlantirishda ularning almashinuvchi energiyaga, hazmlanuvchi proteinga, uglevodlar, yog‘lar, mineral moddalar va vitaminlarga bo‘lgan fiziologik ehtiyoji hisobga olinadi. Ratsionning energetik qiymati almashinuvchi energiya yoki ozuqa birligi orqali ifodalanib, hayvonlarning yoshi, tirik vazni, fiziologik holati va mahsuldorlik yo‘nalishiga muvofiq belgilanadi. Organizm uchun asosiy energiya manbalari oqsillar, yog‘lar va uglevodlar hisoblanadi. Ushbu organik birikmalarning metabolik o‘zgarishlari natijasida ajralib chiqadigan energiya quyon organizmining hayotiy funksiyalarini ta’minlash, tana haroratini saqlash, harakatlanish, o‘sish va boshqa fiziologik jarayonlarga sarflanadi. Tirik organizmlarda kechadigan mexanik va biokimyoviy jarayonlarning yakuniy bosqichida energiyaning muayyan qismi issiqlik shaklida ajraladi. Shu sababli energiya almashinuvi ko‘rsatkichlari ozuqaning energetik qiymatini baholashda muhim mezonlardan biri hisoblanadi. O‘tkazilgan tajriba natijalarining tahlili ratsion tarkibiga turli dozalarda kiritilgan “SimbioNorm” va “Bonaka-APK” yangi probiyotik ozuqa qo‘shimchalari quyonlar organizmida kechadigan hazm qilish va metabolik jarayonlarga ijobiy ta’sir ko‘rsatganini ko‘rsatdi. Ayniqsa, quyonlarni intensiv boqish davrida probiyotik qo‘shimchalardan foydalanish ozuqa moddalarining o‘zlashtirilishini yaxshilash, organizmning fiziologik holatini qo‘llab-quvvatlash hamda o‘sish jarayonlari uchun qulay sharoit yaratishga xizmat qilgan. Probiyotik preparatlar tarkibidagi foydali mikroorganizmlar oshqozon-ichak traktining mikrobiotsenozini me’yorlashtirish, ovqat hazm qilish tizimining funksional faolligini qo‘llab-quvvatlash va ichak mikroflorasi muvozanatini saqlashda muhim ahamiyatga ega. Bunday ta’sir ozuqa komponentlarining parchalanishi va so‘rilishi uchun qulay sharoit yaratib, organizmning patogen mikroorganizmlarga nisbatan tabiiy chidamliligini qo‘llab-quvvatlashi mumkin. Bakterial tarkibli “SimbioNorm” va “Bonaka-APK” probiyotik qo‘shimchalari qo‘llanilganda ovqat hazm qilish samaradorligini baholashning asosiy mezonlaridan biri ozuqa moddalarining hazmlanish darajasi bo‘ldi. Tadqiqot davomida guruhlar bo‘yicha ozuqaviy moddalarning umumiy hazmlanish ko‘rsatkichlari 60,0–70,0 % oralig‘ida qayd etildi. Tajriba davomida quyonlar tomonidan iste’mol qilingan va hazm qilingan ozuqa tarkibidagi ayrim kimyoviy komponentlarning miqdoriy o‘zgarishlari ham tahlil qilindi. Xususan, nazorat guruhidagi quyonlarda ozuqa bilan bog‘liq namlikning o‘zlashtirilgan miqdori 24,30 g ni tashkil etdi. Tajribada qo‘llanilgan quruq granulalangan yem tarkibidagi dastlabki tabiiy namlik o‘rtacha 10–12 % atrofida bo‘lgan. Hazm qilish jarayonida ozuqa so‘lak, oshqozon va ichak shirasi bilan aralashadi hamda suvning asosiy qismi oshqozon-ichak traktida qayta so‘riladi. Birinchi tajriba guruhida ushbu ko‘rsatkich nazorat guruhiga nisbatan 5,62 g ga yuqori bo‘lgan. Mazkur o‘zgarish probiyotik

qo‘shimcha ta’sirida ichak muhitining funksional holati va ozuqa tarkibidagi bog‘langan suvning ajralishi hamda so‘rilishi bilan bog‘liq bo‘lishi mumkin. Ikkinchi tajriba guruhida esa o‘zlashtirilgan namlik miqdori nazorat guruhiga nisbatan 9,53 g ga yuqori bo‘lgan (P<0,05) (1-jadval). Kletchatkaning faol parchalanishi natijasida o‘simlik hujayralari tarkibidagi bog‘langan suvning ajralishi va uning ichaklarda so‘rilishi uchun qulay sharoit yuzaga kelishi mumkin. Mazkur jarayon ratsion tarkibidagi ozuqaviy moddalarning umumiy hazmlanishi va o‘zlashtirilish samaradorligiga ham ta’sir ko‘rsatadi.

1-jadal

Quyonlar tomonidan hazimlangan ozuqa moddalar balansi, 300 *g/sutka n=10, (M*±m)

Hazimlangan moddalar	**Nazorat**	**ProSTART**	**SimbioNorm**
Hazmlangan ozuqa	162,0± 2,96	187,0 ±3,55	199,0 ±4,04
Namlik	24,3±1,21	29,92 ±1,95*	33,83 ±1,76*
Quruq modda	137,7±3,03	157,08 ±3,08	165,17 ±3,10
Organik modda	131,22±3,1	147,73 ±3,26*	153,23 ±3,28*
Xom kul	6,48 ±0,28	9,35 ±0,23	11,94 ±0,26

*Izoh: *- P<0.05;*

1-jadvalda ratsion tarkibidagi biologik qiymatga ega bo‘lgan asosiy ozuqaviy moddalarning quyonlar me’da-ichak tizimida hazmlanish ko‘rsatkichlari keltirilgan. Ozuqaning suvdan tashqari barcha to‘yimli komponentlarini o‘z ichiga oluvchi quruq moddaning hazmlangan miqdori nazorat guruhida 137,7±3,03 g ni tashkil etdi. Ushbu ko‘rsatkich birinchi tajriba guruhida nazorat guruhiga nisbatan 14,07 % ga, ikkinchi tajriba guruhida esa 19,94 % ga yuqori bo‘ldi. Ikkinchi tajriba guruhida aniqlangan farq statistik jihatdan ishonchli bo‘lib, P<0,05 ni tashkil etdi. Bu natijalar probiyotik qo‘shimchalar qo‘llanilgan guruhlarda quruq moddalarning hazmlanish va o‘zlashtirilish darajasi yuqoriroq bo‘lganini ko‘rsatadi. Quruq modda, asosan, organik va mineral moddalardan tashkil topadi. Uning organik qismini oqsillar, yog‘lar, uglevodlar, jumladan, makkajo‘xori va arpa tarkibidagi kraxmal hamda kletchatkaning hazmlanuvchi fraksiyalari tashkil

etadi. Ushbu moddalar quyon organizmida energiya almashinuvi, to‘qimalarning shakllanishi va tirik vazn ortishini ta’minlashda muhim ahamiyat kasb etadi. Nazorat guruhidagi quyonlarda hazmlangan organik moddalar miqdori 131,22±3,10 g ni tashkil etdi. Birinchi tajriba guruhida ushbu ko‘rsatkich nazorat guruhiga nisbatan 16,51 g ga yuqori bo‘lib, farq statistik jihatdan ishonchli ekanligi aniqlandi ($P<0,05$). Bonaka-APK qo‘llanilgan guruhda organik moddalarning hazmlangan miqdori 147,73 g ni tashkil etdi. Mazkur natija probiyotik tarkibidagi mikroorganizmlarning ichak mikrobiotasiga va fermentativ jarayonlarga ko‘rsatgan ta’siri bilan bog‘liq bo‘lishi mumkin. Bonaka-APK tarkibidagi *Lactobacillus acidophilus*, *L. casei* va *L. plantarum* kabi sut kislotasi bakteriyalari ichak muhitining barqarorligini ta’minlash va ozuqa komponentlarining hazmlanishi uchun qulay sharoit yaratishda ishtirok etadi. Shuningdek, *Saccharomyces cerevisiae* ning metabolik faolligi ham ichakdagi ozuqaviy substratlardan foydalanish samaradorligiga ijobiy ta’sir ko‘rsatishi mumkin. Natijada makkajo‘xori va arpadagi kraxmal, shrot va kepak tarkibidagi organik birikmalarning hazmlanishi uchun qulay sharoit yuzaga keladi. Bu jarayonlar o‘sayotgan quyonlarda oziq moddalardan samarali foydalanishga xizmat qilishi mumkin. Ikkinchi tajriba guruhida hazmlangan organik moddalar miqdori 153,23 g ni tashkil etib, nazorat guruhiga nisbatan 22,01 g ga yuqori bo‘ldi ($P<0,05$). SimbioNorm tarkibidagi *Bacillus subtilis* va *B. licheniformis* shtammlarining metabolik hamda fermentativ faolligi ratsiondagi murakkab organik birikmalarning parchalanishiga ko‘maklashishi mumkin. Xususan, amilolitik, proteolitik va kletchatkani parchalash bilan bog‘liq fermentativ jarayonlarning faollashishi yantoq, beda hamda donli ozuqalardagi ozuqaviy moddalardan samaraliroq foydalanish imkonini beradi. Tajriba ratsionida qo‘pol tolali ozuqalar, jumladan, yantoq va beda muhim ulushni tashkil etganligi sababli, SimbioNorm qo‘llanilgan guruhda organik moddalarning nisbatan yuqori hazmlanishi (153,23 g) ushbu ozuqa komponentlarining samaraliroq parchalanishi bilan bog‘liq bo‘lishi mumkin. Bonaka-APK qo‘llanilgan guruhda esa organik moddalarning hazmlanish miqdori 147,73 g ni tashkil etdi. Shunday qilib, har ikkala probiyotik qo‘llanilgan guruhda nazoratga nisbatan yuqoriroq ko‘rsatkichlar qayd etilgan. Quruq moddaning mineral qismini xom kul tashkil etadi. Xom kul tarkibiga kalsiy, fosfor, natriy va boshqa makro- hamda mikroelementlar kiradi. Tadqiqot natijalariga ko‘ra, nazorat guruhida hazmlangan mineral moddalar miqdori 6,48 g ni tashkil etdi. Bonaka-APK qo‘llanilgan birinchi tajriba guruhida ushbu ko‘rsatkich 9,35 g gacha, SimbioNorm qo‘llanilgan ikkinchi tajriba guruhida esa 11,94 g gacha oshganligi qayd etildi. Tajriba davomida barcha guruhdagi hayvonlar asosiy oziq moddalar va energiya miqdori bo‘yicha muvozanatlashtirilgan ratsion asosida oziqlantirildi. Ratsiondagi kletchatka miqdori konsentratlar va pichan nisbatini muvofiqlashtirish orqali boshqarildi. AR+ Bonaka-APK qo‘llanilgan guruhda hazmlangan xom kul miqdori nazorat guruhiga nisbatan 2,87 g ga yuqori bo‘ldi (1-jadval). Bu holat

ichak mikrobiotasining muvozanatlashuvi va ichak muhitidagi o‘zgarishlar natijasida ratsion tarkibidagi mineral komponentlarning biologik o‘zlashtirilishi yaxshilangan bo‘lishi mumkinligini ko‘rsatadi. AR+SimbioNorm qo‘llanilgan ikkinchi tajriba guruhida esa hazmlangan xom kul miqdori nazorat guruhiga nisbatan 5,46 g ga yuqori bo‘ldi. Ushbu guruhda mineral moddalarning 11,94 g gacha yetishi ratsion tarkibidagi mineral komponentlardan foydalanish darajasi yuqoriroq bo‘lganini ko‘rsatadi. Ichak mikrobiotasining barqaror holati va mikroorganizmlar hosil qiladigan metabolitlar mineral moddalarning eruvchanligi hamda ichak epiteliysi orqali so‘rilishi uchun qulay sharoit yaratishi mumkin. Kalsiy va fosfor kabi makroelementlarning yetarli darajada o‘zlashtirilishi, ayniqsa, jadal o‘sish davridagi Hikol quyonlarining suyak va mushak tizimining normal shakllanishida muhim ahamiyatga ega. Umuman olganda, tajriba natijalari Bonaka-APK va SimbioNorm probiyotik ozuqa qo‘shimchalari qo‘llanilgan guruhlarda quruq modda, organik moddalar va mineral komponentlarning hazmlangan miqdori nazorat guruhiga nisbatan yuqori bo‘lganini ko‘rsatdi. Ayniqsa, SimbioNorm qo‘llanilgan guruhda organik moddalarning 153,23 g, xom kulning esa 11,94 g gacha yetishi yuqori ko‘rsatkich sifatida qayd etildi. Bonaka-APK qo‘llanilgan guruhda ushbu ko‘rsatkichlar mos ravishda 147,73 va 9,35 g ni tashkil etdi.

Xulosa. Shunday qilib, muvozanatlashtirilgan asosiy ratsionga Bonaka-APK va SimbioNorm probiyotik qo‘shimchalarining kiritilishi ichak mikrobiotasining funksional holatini qo‘llab-quvvatlash orqali ozuqa tarkibidagi ayrim organik va mineral moddalarning hazmlanishi hamda o‘zlashtirilishi uchun qulay sharoit yaratgan bo‘lishi mumkin. Olingan natijalar probiyotik qo‘shimchalardan quyonlar ratsionining biologik samaradorligini oshirishda foydalanish istiqbolli ekanligini ko‘rsatadi.

Foydalanilgan adabiyotlar.

1. Aboul-Ela S. Alternative feed resources for formulating concentrate diets of rabbits / S. Aboul-Ela // World Rabbit Science. 2000;8:125-127.
2. Богданов, Г.А. Кормление сельскохозяйственных животных: учебное пособие / Г.А. Богданов. – 2-е изд., перераб. и доп. – М.: Агропромиздат, 1990. – 624 с.
3. Левахин, Ю.И. Эффективность использования ростостимулирующего препарата «ОРЕГО-СТИМ» при выращивании на мясо / Ю.И. Левахин, Б.Х. Галиев, Г.В. Павленко // Вестник мясного скотоводства. – Оренбург, 2010. – Вып. 63. – Т.2. – С. 94-98.
4. Струк А.Н. Научно-практическое обоснование использования новых биологически активных добавок на основе лактулозы и стимулирующих средств при производстве мяса

сельскохозяйственных животных и птицы: автореф. дис. д-ра с.-х. наук: 06.02.10; 06.02.08 / Струк Александр Николаевич. – Волгоград, 2010. – 52 с.

5. Хохрин С.Н. Корма и кормление животных: учебное пособие / С.Н. Хохрин. – СПб.: Изд-во «Лань», 2002. – 512 с.

PHASEOLUS VULGARIS L. NING RAVOT VA MAHSULDOR NAVLARIDA PIGMENTLAR MIQDORI.

[1]Nasimova Maftuna Kurbanbayevna

[1]Abu Rayhon Beruniy universiteti dotsenti

[2]Sanakulov Akmal Lapasovich

[2]Samarqand davlat universiteti professori

937093939

maftunakurbanbayevna@gmail.com

Annotatsiya: *Ushbu maqolada Samarqand viloyati o‘tloqi-bo‘z tuproqlari sharoitida loviyaning Ravot va Mahsuldor navlariga biofaol moddalarni qo‘llanilib ularning rivojlanish fazalarida variantlar kesimida plastid pigmentlarining miqdori o‘rganilganda Uzgumi, Edagum SM, Gumel Lyuks preparatlari orasida pigmentlar miqdori bo‘yicha eng yuqori ta’sir Gumel Lyuks preparati qo‘llanilishi natijasida bo‘lganligi aniqlandi. O‘simlikda pigmentlar miqdori shonalash fazasidan gullash fazasigacha oshib boradi va keying fazalarga qarab ushbu ko ‘rsatkichning pasayishi haqida ma’lumotlar keltirilgan.*

Kalit so‘zlar: *Loviya, Ravot, Mahsuldor, xlorofill, biofaol modda, shona, gul.*

Abstract: *This article investigates the effects of bioactive substances on plastid pigment content during different developmental stages of the Ravot and Mahsuldor bean varieties grown under meadow-gray soil conditions in the Samarkand Region. Among the preparations tested—Uzgumi, Edagum SM, and Gumel Lux—the highest effect on pigment content was observed following the application of Gumel Lux. The article also presents findings showing that the pigment content in plants increases from the budding stage to the flowering stage and subsequently decreases during the later developmental stages.*

Keywords: *bean, Ravot, Mahsuldor, chlorophyll, bioactive substance, bud, flower.*

Loviya muhim ijtimoiy va iqtisodiy ahamiyatga ega bo‘lgan inson iste’moli uchun eng muhim dukkakli-don ekini bo‘lib, butun dunyoda iste’mol qilinadigan dukkakli-don ekinlarning yarmini tashkil qiladi. Loviya insoniyatning barqaror hayot kechirishida muhim rol o‘ynaydi, u oziq-ovqat xavfsizligini ta’minlash orqali fermerlarning daromad manbai va kambag‘al oilalarda to‘yib ovqatlanmaslikni kamaytirishda muhim manba bo‘lib hisoblanadi.

Xlorofill yer yuzida hayotning mavjudligini ta'minlovchi eng asosiy omildir. Busiz sayyoramizda organik hayot, kislorod va oziq-ovqat zanjiri bo'lmas edi.

Xlorofill yashil o‘simliklarda organik moddalar hosil bo‘lishining dastlabki jarayoni – fotosintezda fotokimyoviy reaksiyalarni amalga oshiradi. Darhaqiqat, oddiy loviya navlari hayotida plastid pigmentlar, nuklein kislota va boshqa muhim organik moddalar miqdori oziqlanish sharoiti va yetishtirish agrotexnologiyasiga bog‘liq holda o‘zgaradi.

Ko‘pchilik yuksak o‘simliklarda xlorofill “a” ning miqdori xlorofill “b” ga nisbatan ortiq bo‘lib, ularning umumiy miqdori o‘simlik turi, biologik xususiyatlari va yashash sharoitlariga bog‘liq holda turlicha bo‘ladi. M.A. Rahmonov, A.L. Sanakulov tajribalarida, loviyaning Ravot navida shoxlanish davrida xlorofill “a” miqdori 2,42 mg/g, xlorofill “b” – 1,60 mg/g, karotinoidlar – 0,47 mg/g, Mahsuldor navida tegishlicha 2,36; 1,54 va 0,23 mg/g ni tashkil etgan bo‘lsa, gullash davriga kelib, ko‘rsatkichlar Ravot navida 2,44; 1,65; 0,53 mg/g, Mahsuldor navida esa 2,40; 1,61 va 0,37 mg/g bo‘lganligi aniqlangan. N.M.Tursunova va boshqalarning tadqiqotlarida Baby Lima, F_2 Solnishko x Ravot, Vir, F_1 Baby Lima x Calipso krasnaya, F_1 Baby Lima x Vir, F_2 Baby Lima x Calipso krasnaya navi va namunalarida umumiy suv va xlorofill “b” miqdori bo‘yicha yuqori natijalar qayd etilgan. Ushbu nav va namunalarda umumiy suv miqdori 84,45%, xlorofill “a” miqdori 2,34 mg/g, xlorofill “b” esa 1,05 mg/g, karotinoidlar esa 0,78 mg/g ga tengligi aniqlangan.

Biz tomonimizdan o‘tkazilgan tadqiqot natijalari shuni ko‘rsatdiki, Ravot va Mahsuldor navlarida plastid pigmentlar – xlorofill “a”, xlorofill “b” va karotinoidlar (K) miqdori o‘sish, gullash, dukkaklash va pishish fazalarida sezilarli darajada farq qilganligi aniqlandi. Shu bilan birga, o‘simliklarning rivojlanish davrida qo‘llanilgan biofaol moddalarning ta’siri pigmentlarning kontsentratsiyasiga ijobiy ta’sir ko‘rsatganligi qayd etildi (1-jadvalga qarang).

Shonalash davrida Ravot navida xlorofill “a” 1,20 mg/g dan 1,63 mg/g gacha, xlorofill “b” 0,91-1,31 mg/g, karotinoidlar 0,52-0,76 mg/g oraliqda o‘zgarib, eng yuqori ko‘rsatkich Gumel Lyuks preparati qo‘llanilganda qayd etildi. Mahsuldor navida esa xlorofill “a” 1,23-1,74 mg/g, xlorofill “b” 0,91-1,43 mg/g va karotinoidlar 0,55-0,78 mg/g ni tashkil etdi. Shuni ta’kidlash lozimki, Biofaol moddalar qo‘llanishi xlorofill va karotinoidlar miqdorini oshirishga xizmat qilganligi aniqlandi.

Xususan, Ravot navining Fon + Gumel Lyuks variantida gullash davrida xlorofill “a” 2,49 mg/g, xlorofill “b” 1,82 mg/g va karotinoidlar 0,55 mg/g ga yetgan bo‘lsa, Mahsuldor navida shunga o‘xshash tendensiya kuzatilib, xlorofill “a” 2,55 mg/g, xlorofill “b” 2,12 mg/g va karotinoidlar 0,58 mg/g gacha oshganligi aniqlandi. Bu o‘sish fotosintetik apparatning faollashuvini va o‘simlikning fotosintez qobiliyati oshishi bilan bog‘liq.

Ravot navining dukkaklash davrida xlorofill “a” 2,10 mg/g, xlorofill “b” 1,45 mg/g va karotinoidlar 0,70 mg/g ni tashkil etgan bo‘lsa, pishish davrida esa xlorofill “a” 1,37 mg/g, xlorofill “b” 0,99 mg/g va karotinoidlar 0,72 mg/g gacha pasayganligi aniqlandi. Mahsuldor navida esa dukkaklash davrida xlorofill “a” 2,14 mg/g, xlorofill “b” 1,58 mg/g va karotinoidlar 0,68 mg/g bo‘lsa, pishish davrida xlorofill “a” 1,57 mg/g, xlorofill “b” 1,12 mg/g va karotinoidlar 0,69 mg/g ni tashkil etdi. Shu bilan Mahsuldor navi o‘zining pigment tarkibi bo‘yicha Ravot naviga nisbatan yuqori darajada saqlanib qolganligi qayd etildi.

Uzgumi, Edagum SM va Gumel Lyuks preparatlari Ravot va Mahsuldor navlarida xlorofill, karotinoidlar miqdorini oshirdi, bu esa o‘sish va gullash davrlarida fotosintetik samaradorlikni yaxshilashga xizmat qildi. Eng yuqori pigment miqdori Gumel Lyuks preparati qo‘llanilganda qayd etildi, bu preparat fotosintetik apparatni stimulyatsiya qilishi, xlorofill biosintezini rag‘batlantirishi va karotinoidlar miqdorini oshirishi bilan izohlanadi.

Mahsuldor navining Ravot naviga nisbatan yuqori pigment miqdori uning fotosintetik qobiliyati va potensial hosil berish imkoniyatining yuqoriligini ko‘rsatadi.

Xulosa qilib aytganda, olingan natijalar shuni ko‘rsatadiki, biofaol moddalarning qo‘llanilishi loviya navlarida plastid pigmentlarining ko‘p to‘planishiga erishishga yordam berdi. Shonalashdan pishishgacha bo‘lgan rivojlanish davrlarida biofaol moddalar Ravot, Mahsuldor navlarining fotosintetik faoliyati va quruq modda to‘plash imkoniyatini oshirdi. Mahsuldor navi barcha fazalarda Ravot naviga nisbatan plastid pigmentlar miqdori yuqori bo‘lib, fotosintez jarayonida ustunlikka egaligi aniqlandi.

1-jadval

***Phaseolus vulgaris* L. navlarida pigmentlar miqdori, mg/g (2023-2025 yy.).**

Navlar	Biofaol moddalar	Xl "a"	Xl "b"	K	Xl "a"	Xl "b"	K	Xl "a"	Xl "b"	K	Xl "a"	Xl "b"	K
		Shonalash			Gullash			Dukkaklash			Pishish		
Ravot	$N_{35}P_{60}K_{30}$ (Fon) Biofaol moddalarsiz	1,20	0,91	0,52	2,49	1,82	0,55	2,10	1,45	0,70	1,37	0,99	0,72
	Fon+Uzgumi	1,52	1,13	0,66	2,66	2,14	0,65	2,16	1,57	0,72	1,43	1,03	0,74
	Fon+Edagum SM	1,58	1,29	0,69	2,76	2,24	0,73	2,28	1,66	0,75	1,54	1,12	0,76
	Fon+Gumel Lyuks	1,63	1,31	0,76	2,87	2,48	0,84	2,44	1,76	0,78	1,66	1.26	0,78
Mahsuldor	$N_{35}P_{60}K_{30}$ (Fon) Biofaol moddalarsiz	1,23	0,91	0,55	2,55	2,12	0,58	2,14	1,58	0,68	1,57	1,12	0,69
	Fon+Uzgumi	1,54	1,25	0,69	2,79	2,29	0,69	2,29	1,59	0,70	1,65	1,28	0,71
	Fon+Edagum SM	1,66	1,39	0,73	2,91	2,33	0,77	2,39	1,70	0,73	1,74	1,29	0,73
	Fon+Gumel Lyuks	1,74	1,43	0,78	2,99	2,43	0,88	2,46	1,73	0,76	1,86	1,36	0,75

Adabiyotlar ro‘yxati

1. Rahmonov M.A Sanakulov A.L Loviya navlarining suv saqlash qobiliyati va barglaridagi pigmentlar miqdori. Agrobiotexnologiya va veterinariya tibbiyoti. Ilmiy jurnali 3-jild, 11-nashr 2024-yil.
2. Tursunova N.M *Phaseolus vulgaris* L. turiga mansub duragaylarining fiziologik xususiyatlari va morfoxo‘jalik belgilarining irsiylanishi mavzusidagi dissertatsiyasi avtoreferati. Chirchiq – 2025
3. Saimnazarov Y.B. va boshqalar. O‘zbekistonda dukkakli-don ekinlari yetishtirish bo‘yicha tavsiyalar. Toshkent.2009 y. 21-45
4. Bansal, P.; Rawal, V.; Bansal, V. Pulses of *Phaseolus* and *Vigna* genera. In *The Global Economy of Pulses*; Rawal, V., Navarro, D.K., Eds.; FAO: Rome, Italy, 2019; pp. 39–70.
5. Hayat, I.; Ahmad, A.; Masud, T.; Ahmed, A.; Bashir, S. Nutritional and health perspectives of beans (*Phaseolus vulgaris* L.): An overview. *Crit. Rev. Food Sci.* **2014**, *54*, 580–592.
6. Messina, V. Nutritional and health benefits of dried beans. *Am. J. Clin. Nutr.* **2014**, *100*, 437S–442S.

7. Ganesan, K.; Xu, B. Polyphenol-rich dry common beans (*Phaseolus vulgaris* L.) and their health benefits. *Int. J. Mol. Sci.* **2017**, *18*, 2331.
8. Chen, P.X.; Bozzo, G.G.; Freixas-Coutin, J.A.; Marcone, M.F.; Pauls, P.K.; Tang, Y.; Zhang, B.; Liu, R.; Tsao, R. Free and conjugated phenolic compounds and their antioxidant activities in regular and non-darkening cranberry bean (*Phaseolus vulgaris* L.) seed coats. *J. Funct. Foods* **2015**, *18*, 1047–1056.
9. Pitura, K.; Arntfield, S.D. Characteristics of flavonol glycosides in bean (*Phaseolus vulgaris* L.) seed coats. *Food Chem.* **2019**, *272*, 26–32.
10. Rodríguez Madrera, R.; Campa Negrillo, A.; Suárez Valles, B.; Ferreira Fernández, J.J. Characterization of extractable phenolic profile of common bean seeds (*Phaseolus vulgaris* L.) in a Spanish diversity panel. *Food Res. Int.* **2020**, *20*, 138.
11. Capistrán-Carabarin, A.; Aquimo-Bolaños, E.N.; García-Díaz, Y.D.; Chávez-Servia, J.L.; Vera-Guzmán, A.M.; Carrillo-Rodríguez, J.C. Complementarity in phenolic compounds and the antioxidant activities of *Phaseolus coccineus* L. and *P. vulgaris* L. Landraces. *Foods* **2019**, *8*, 295.
12. Gan, R.Y.; Wang, M.F.; Lui, W.Y.; Wu, K.; Dai, S.H.; Sui, Z.Q.; Corke, H. Diversity in antioxidant capacity, phenolic contents, and flavonoid contents of 42 edible beans from China. *Cereal Chem.* **2017**, *94*, 291–297.
13. Fan, G.; Beta, T. Discrimination of geographical origin of Napirira bean (*Phaseolus vulgaris* L.) based on phenolic profiles and antioxidant activity. *J. Food Compos. Anal.* **2017**, *62*, 217–222.

SURXONDARYO VILOYATI ISSIQXONALARIDA LIMON NEMATODOFAUNASINING TARKIBI VA BIOEKOLOGIK XUSUSIYATLARI

Raimova Feruza Jumanazar Qizi

Termiz davlat muhandislik va agrotexnologiyalar universiteti, tayanch doktoranti

E-mail: feruzar470@gmail.com

Annotatsiya: *Ushbu maqolada Surxondaryo viloyati issiqxonalarida yetishtirilayotgan limon (Citrus limon (L.) Osbeck) o‘simligining nematodafaunasini o‘rganish masalalari yoritilgan. Limonning issiqxona sharoitida ko‘p yillik ekin sifatida yetishtirilishi uning ildiz tizimi va rizosfera tuprog‘ida turli ekologik guruhlarga mansub nematodalarning shakllanishi uchun qulay sharoit yaratishi mumkin. Tadqiqot davomida limon o‘simligining ildiz tizimi va ildiz atrofi tuprog‘idan namunalar olish, nematodalarni ajratib olish, ularni mikroskop yordamida morfologik belgilar asosida aniqlash hamda tarqalishi va zichligini baholash ko‘zda tutilgan.*

Kalit so‘zlar: *limon, Citrus limon, nematoda, nematodafauna, fitoparazit nematodalar, Tylenchulus semipenetrans, issiqxona, rizosfera, tuproq, ildiz tizimi, bioekologiya, fitosanitar nazorat.*

Abstract:*This article examines the nematode fauna associated with lemon plants (Citrus limon (L.) Osbeck) grown in greenhouses in the Surkhandarya region. Since lemon is cultivated as a perennial crop under greenhouse conditions, its root system and rhizosphere soil may provide suitable conditions for the development of different ecological groups of nematodes. The study includes the collection of lemon root and rhizosphere soil samples, extraction of nematodes, their identification based on morphological characteristics using microscopy, and assessment of their distribution and population density. Particular attention is paid to the identification of plant-parasitic nematodes and their association with the lemon root system.*

Keywords: *lemon, Citrus limon, nematodes, nematode fauna, plant-parasitic nematodes, Tylenchulus semipenetrans, greenhouse, rhizosphere, soil, root system, bioecology, phytosanitary control.*

Kirish: So‘nggi yillarda O‘zbekistonda issiqxona xo‘jaliklarini rivojlantirish va subtropik mevali ekinlarni, jumladan limonni yetishtirishga bo‘lgan e’tibor ortib bormoqda. Limon (*Citrus limon* (L.) Osbeck) issiqxona sharoitida ko‘p yillik ekin sifatida yetishtirilishi bilan boshqa sabzavot ekinlaridan farq qiladi. O‘simlikning bir joyda uzoq muddat davomida yetishtirilishi tuproqning biologik holati, ildiz tizimi va rizosfera muhitida turli organizmlarning shakllanishiga ta’sir ko‘rsatadi.

Tuproqda uchraydigan nematodalar ekologik jihatdan xilma-xil bo‘lib, ular oziqlanish xususiyatlariga ko‘ra turli guruhlarga ajratiladi. Ularning ayrimlari bakteriyalar va zamburug‘lar bilan oziqlansa, boshqalari yirtqich yoki o‘simlik-parazit hayot tarziga ega. O‘simlik-parazit nematodalar o‘simliklarning ildiz tizimidan oziqlanishi natijasida ildizlarning normal rivojlanishiga salbiy ta’sir ko‘rsatishi va o‘simlikning suv hamda oziq moddalarni o‘zlashtirish jarayonini susaytirishi mumkin. Issiqxona sharoitida harorat va namlikning nisbatan barqaror bo‘lishi, o‘simliklarning uzoq muddat davomida bir joyda yetishtirilishi hamda tuproqning doimiy ravishda sug‘orilishi ayrim nematoda guruhlarining rivojlanishi uchun qulay sharoit yaratishi mumkin. Shu sababli limon o‘simligining ildiz tizimi va rizosfera tuprog‘idagi nematodalar tarkibini o‘rganish muhim ilmiy-amaliy ahamiyatga ega. Sitrus ekinlari bilan bog‘liq fitoparazit nematodalar orasida sitrus nematodasi – *Tylenchulus semipenetrans* (Cobb, 1913) alohida ahamiyatga ega. Ushbu tur sitrus o‘simliklarining ildiz tizimi bilan bog‘liq holda rivojlanadigan parazit nematodalardan biri bo‘lib, uning yuqori zichlikda uchrashi o‘simliklarning o‘sishi va rivojlanishiga salbiy ta’sir ko‘rsatishi mumkin. Mazkur nematoda sitrus yetishtiriladigan ko‘plab hududlarda qayd etilgan. *T. semipenetrans* ning urg‘ochilari limon va boshqa sitrus o‘simliklarining ildizlarida oziqlanadi. Nematodaning oziqlanishi ildizning funksional faoliyatiga ta’sir etishi va kuchli zararlanish sharoitida o‘simlikning umumiy rivojlanishini susaytirishi mumkin. Shu bilan birga, nematodaning populyatsiya zichligi tuproq xususiyatlari, namlik, harorat va xo‘jayin o‘simlikning holati kabi omillar bilan bog‘liq. Nematodalarni o‘rganishda faqat bitta zararli turga e’tibor qaratish yetarli emas. Chunki limonning ildiz tizimi va rizosfera tuprog‘ida turli ekologik guruhlarga mansub nematodalar birgalikda uchrashi mumkin. Ularning umumiy tarkibini o‘rganish orqali issiqxona agroekotizimining biologik xususiyatlari haqida ma’lumot olish, o‘simlik-parazit turlarni ajratish va ularning tarqalish darajasini baholash imkoniyati yaratiladi. Shuningdek, nematodalarni aniqlashda tuproq va ildiz namunalarini to‘g‘ri yig‘ish, laboratoriyada nematodalarni ajratib olish hamda mikroskopik morfologik belgilar asosida aniqlash muhim hisoblanadi. Ayniqsa, *Tylenchulus* avlodiga mansub nematodalarni boshqa tuproq nematodalaridan farqlashda tana shakli, stilet, qizilo‘ngach, dum va jinsiy tizim kabi diagnostik belgilarni hisobga olish talab etiladi. Surxondaryo viloyatining issiq iqlimi va issiqxona xo‘jaliklarining rivojlanganligi ushbu hududda limon yetishtirish uchun muayyan imkoniyatlar yaratadi. Biroq issiqxonalarda limonning ko‘p yillar davomida bir joyda yetishtirilishi natijasida tuproqdagi fitoparazit nematodalar monitoringini muntazam olib borish zarur. Shu jihatdan Surxondaryo viloyati issiqxonalarida limon nematodafaunasining tur tarkibi, tarqalishi va bioekologik xususiyatlarini o‘rganish dolzarb masalalardan biri hisoblanadi.Shu asosda mazkur tadqiqotning asosiy yo‘nalishi Surxondaryo viloyati issiqxonalarida yetishtirilayotgan limon o‘simliklari bilan bog‘liq nematodalar faunasini

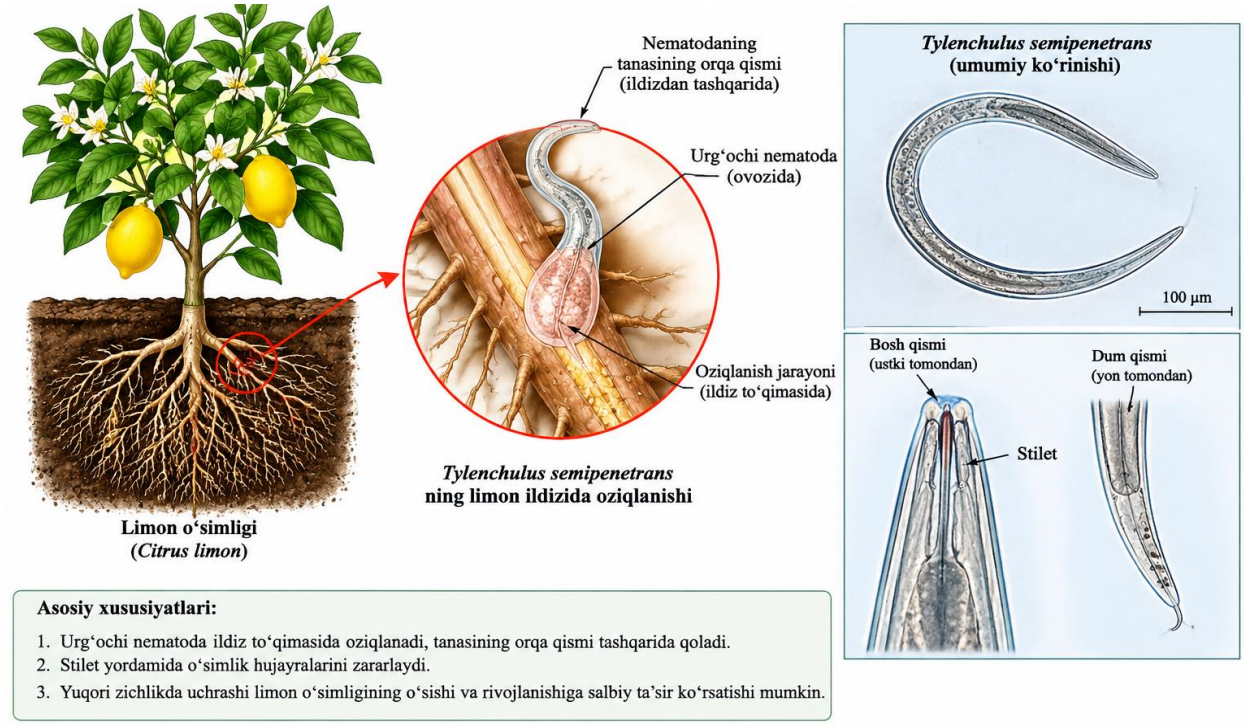
o‘rganish, fitoparazit nematodalarni aniqlash, ularning tarqalish xususiyatlarini baholash hamda issiqxona sharoitida nematodalar sonini nazorat qilishga qaratilgan ilmiy-amaliy tavsiyalar ishlab chiqishdan iborat.

Tadqiqot usullari: Tadqiqot jarayonida limon o‘simliklarining ildiz tizimi va ildiz atrofi tuprog‘idan namunalar olish, nematodalarni ajratib olish, mikroskopik tekshirish va aniqlash usullaridan foydalanish rejalashtirilgan.Tuproq namunalari limon o‘simliklarining ildiz atrofi, ya’ni rizosfera qismidan olinadi. Bunda ildiz tukchalari va zararlanish belgilari mavjud bo‘lgan qismlaridan ajratib olinadi. Har bir namuna yorliqlanib, olingan joyi, sana va o‘simlikning holati qayd etiladi.Tuproq va ildiz namunalaridan nematodalarni ajratib olishda nematodalarni tuproqdan suvli muhitga ajratishga asoslangan laboratoriya usullaridan foydalaniladi. Ajratib olingan nematodalar vaqtinchalik preparatlar yordamida mikroskopda kuzatiladi. Nematodalarni aniqlashda ularning tana shakli, uzunligi, bosh qismi, qizilo‘ngach tuzilishi, dum qismi va boshqa diagnostik morfologik belgilariga e’tibor beriladi. O‘simlik-parazit nematodalarni aniqlashda stiletning mavjudligi va tuzilishi muhim belgilardan biri sifatida baholanadi. Aniqlangan nematodalar imkon qadar avlod va tur darajasigacha aniqlanadi. Sitrus nematodasi - *Tylenchulus semipenetrans* (Cobb, 1913)ni aniqlashda uning o‘ziga xos morfologik belgilariga alohida e’tibor qaratiladi. Nematodalar soni olingan namuna hajmiga nisbatan hisoblanib, ularning populyatsiya zichligi baholanadi. Olingan ma’lumotlar asosida nematodalarning issiqxona sharoitida tarqalishi va limon o‘simliklari bilan bog‘liqligi tahlil qilinadi.

Nematodalarning bioekologik xususiyatlarini o‘rganish: Issiqxona sharoitida nematodalar tarkibi va tarqalishi tashqi muhit omillari bilan chambarchas bog‘liq. Ayniqsa, tuproq namligi, harorat, mexanik tarkib, organik moddalar miqdori va limon ildiz tizimining holati nematodalar uchun muhim ekologik omillar hisoblanadi. Tadqiqot davomida nematodalarning tur tarkibi bilan bir qatorda, ularning turli issiqxonalarda va limon o‘simliklarining turli rivojlanish bosqichlarida uchrashi ham baholanadi. Bunda nematodalarning uchrash chastotasi va populyatsiya zichligidagi farqlar aniqlanadi. O‘simlik-parazit nematodalar orasida *Tylenchulus semipenetrans* (Cobb, 1913) alohida ahamiyatga ega. Ushbu tur sitrus o‘simliklarining ildiz tizimi bilan bog‘liq bo‘lib, ildizning oziqlanish faoliyatiga salbiy ta’sir ko‘rsatishi mumkin. Sitrus nematodasining urg‘ochisi ildiz to‘qimasiga qisman kirib oziqlanadi, tanasining orqa qismi esa ildizdan tashqarida qoladi. Nematodalar sonining ortishi limon ildiz tizimining zaiflashishi, o‘simlikning o‘sishi va rivojlanishining susayishi bilan bog‘liq bo‘lishi mumkin. Shu sababli nematodalar miqdorini muntazam kuzatib borish issiqxonalarda fitosanitar holatni baholashning muhim yo‘nalishlaridan biri hisoblanadi.

Tadqiqot natijasida Surxondaryo viloyati issiqxonalarida yetishtirilayotgan limon o‘simliklari bilan bog‘liq nematodafaunaning tur tarkibini aniqlash rejalashtirilgan. Bunda ildiz tizimi va rizosfera tuprog‘ida uchraydigan nematodalar ekologik guruhlarga ajratilib, ularning uchrash darajasi baholanadi.

Alohida e’tibor o‘simlik-parazit nematodalarga qaratiladi. Ularning orasida sitrus nematodasi – *Tylenchulus semipenetrans* (Cobb, 1913)ning mavjudligi, tarqalishi va populyatsiya zichligini aniqlash muhim hisoblanadi.

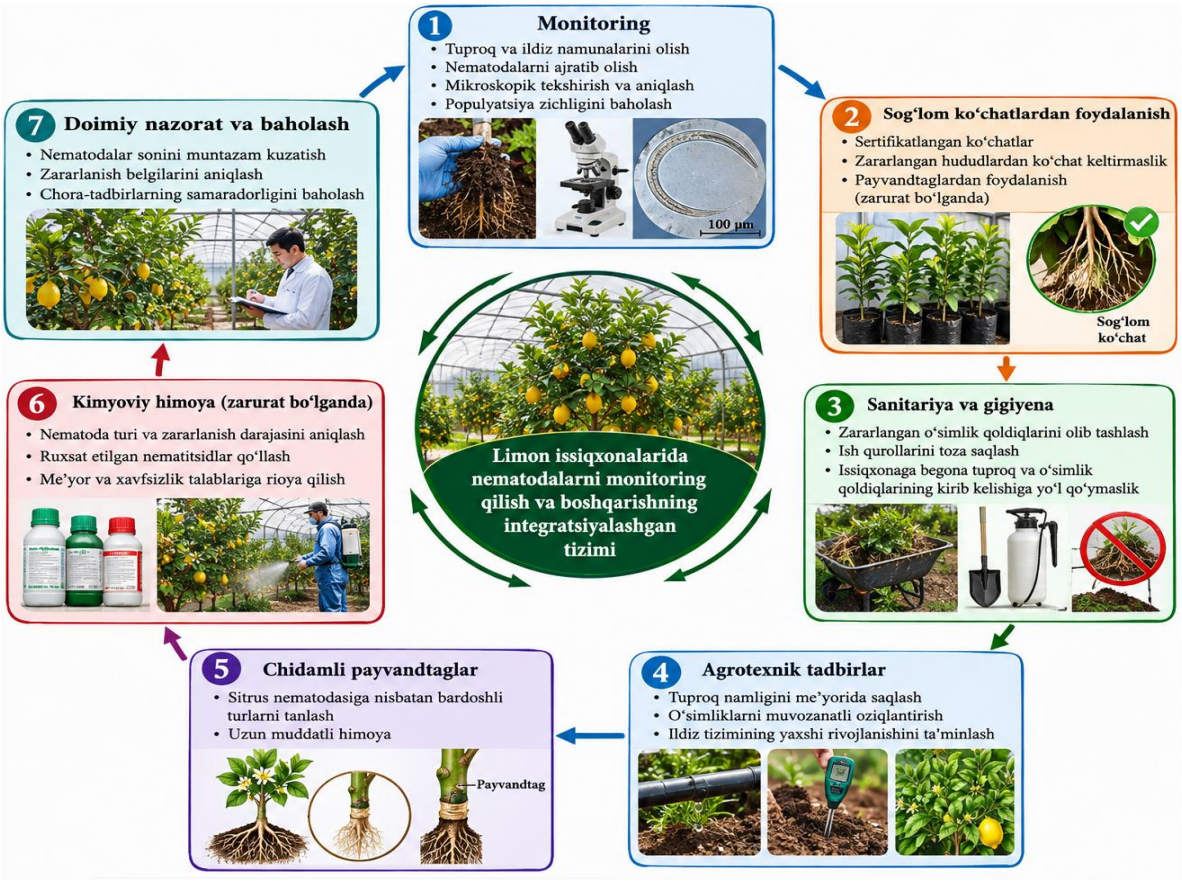


1-rasm. *Tylenchulus* semipenetransning limon ildiz tizimi bilan bog‘liqligi va oziqlanish jarayonining sistematik ko‘rinishi.

Mazkur tur limon va boshqa sitrus o‘simliklarining ildiz tizimi bilan bog‘liq bo‘lib, yuqori zichlikda uchraganda o‘simlikning ildiz faoliyatiga salbiy ta’sir ko‘rsatishi mumkin.

Tadqiqot davomida nematodalar soni bilan tuproqning namligi, harorati, mexanik tarkibi va ildiz tizimining holati o‘rtasidagi bog‘liqlikni aniqlashga harakat qilinadi. Bu ma’lumotlar issiqxona sharoitida nematodalarning tarqalishiga qulay bo‘lgan omillarni aniqlash imkonini beradi. Olingan natijalar asosida limon ekilgan issiqxonalarda nematodalarni muntazam monitoring qilish, zararlangan o‘simliklarni aniqlash va fitosanitar holatni baholash bo‘yicha tavsiyalar ishlab chiqiladi. Tadqiqotning yakuniy natijalari Surxondaryo viloyati issiqxonalarida limon yetishtirishda nematodalar bilan bog‘liq muammolarni aniqlash va ularni boshqarish choralarini takomillashtirishga xizmat qilishi kutiladi. Issiqxona sharoitida limon o‘simliklarida nematodalarni

nazorat qilishda, avvalo, ularning turi va populyatsiya zichligini aniqlash muhim hisoblanadi. Nematodalar aniqlanmasdan turib kurash choralarini qo‘llash maqsadga muvofiq emas. Shu sababli muntazam tuproq va ildiz monitoringini tashkil etish zarur. Nematodalarning tarqalishini kamaytirishda kasallikdan holi va sifatli ko‘chatlardan foydalanish muhim agrotexnik tadbirlardan biridir. Shuningdek, issiqxonaga boshqa hududlardan tuproq, o‘simlik qoldiqlari yoki zararlangan ko‘chatlarning kirib kelishiga yo‘l qo‘ymaslik kerak.



2-rasm. Limon issiqxonalarida nematodalarni monitoring qilish va boshqarishning integratsiyalashgan sxemasi

Issiqxonada sanitariya-gigiyena qoidalariga rioya qilish, zararlangan o‘simlik qoldiqlarini o‘z vaqtida olib tashlash va ish qurollarini toza saqlash nematodalarning tarqalishini cheklashga yordam beradi. Tuproq namligini me’yorida saqlash, o‘simliklarni oziqa elementlari bilan muvozanatli ta’minlash va ildiz tizimining yaxshi rivojlanishi uchun qulay sharoit yaratish ham muhim hisoblanadi. Nematodalar soni yuqori bo‘lgan hollarda chidamli yoki nisbatan bardoshli payvandtaglardan foydalanish imkoniyatlari ham ko‘rib chiqilishi mumkin. Bunday usul, ayniqsa, sitrus nematodasiga qarshi uzoq muddatli kurashish choralaridan biri sifatida baholanadi.

Kimyoviy nematitsidlardan foydalanish masalasi esa faqat nematoda turi va zararlanish darajasi aniqlangandan keyin ko‘rib chiqilishi lozim. Bunda issiqxona ekinlari uchun amaldagi tartibda ruxsat etilgan preparatlar, ularning qo‘llash me’yorlari va xavfsizlik talablari asosida ish olib borilishi kerak. Umuman olganda, limon issiqxonalarida nematodalarga qarshi kurashda bitta usulga tayanishdan ko‘ra, **monitoring, sog‘lom ko‘chatlardan foydalanish, sanitariya, agrotexnik tadbirlar va zarurat bo‘lganda boshqa ruxsat etilgan himoya choralarini birgalikda qo‘llash** maqsadga muvofiqdir.

Xulosa. Surxondaryo viloyati issiqxonalarida yetishtirilayotgan limon o‘simliklari bilan bog‘liq nematodafaunani o‘rganish o‘simliklarning fitosanitar holatini baholashda muhim ahamiyatga ega. Tadqiqot davomida limonning ildiz tizimi va rizosfera tuprog‘ida uchraydigan nematodalarning tur tarkibi, ekologik guruhlari va tarqalish xususiyatlarini aniqlash rejalashtirilgan.

Alohida e’tibor o‘simlik-parazit nematodalarga, xususan, sitrus nematodasi – *Tylenchulus semipenetrans* (Cobb, 1913)ga qaratiladi. Ushbu tur sitrus o‘simliklari ildiz tizimi bilan bog‘liq bo‘lib, yuqori populyatsiya zichligida limon o‘simliklarining o‘sishi va hosildorligiga salbiy ta’sir ko‘rsatishi mumkin. Tadqiqotda nematodalar tarqalishining tuproq namligi, harorati, mexanik tarkibi va ildiz tizimining holati bilan bog‘liqligini baholash ko‘zda tutiladi. Olingan ma’lumotlar asosida issiqxonalarda nematodalarni erta aniqlash, ularning populyatsiya zichligini kuzatish va zarur fitosanitar tadbirlarni belgilash bo‘yicha tavsiyalar ishlab chiqiladi. Nematodalarni boshqarishda sog‘lom ko‘chatlardan foydalanish, sanitariya-gigiyena tadbirlariga rioya qilish, agrotexnik usullar va monitoringni muntazam olib borish muhim hisoblanadi. Sitrus nematodasiga nisbatan chidamli payvandtaglardan foydalanish ham ilmiy adabiyotlarda samarali boshqaruv yo‘nalishlaridan biri sifatida ko‘rsatilgan.

Foydalanilgan adabiyotlar

1 Тулаганов А.Т. Растениеядные и почвенные нематоды Узбекистана. – Ташкент: Издательство Института ботаники и зоологии АН УзССР, 1949. – 227 с.

2 Тулаганов А.Т. Нематоды растений и почвы Узбекистана (по материалам Голодной степи). – Ташкент: Фан, 1972.

3 Тулаганов А.Т., Усманова А.З. Фитонематоды Узбекистана. Часть 1. – Ташкент: Фан, 1975. – 371 с.

4 Тулаганов А.Т., Усманова А.З. Фитонематоды Узбекистана. Часть 2. – Ташкент: Фан, 1978. – 442 с.

5 Хуррамов Ш.Х. Нематоды субтропических плодовых культур Средней Азии и меры борьбы с ними. – Ташкент: Фан, 2003. – 215 с.

6 Сиддиков Ж.Т. Фитонематоды семейств Heteroderidae и Meloidogynidae различных ландшафтов Узбекистана и сопредельных районов (систематика, биология, экология и меры борьбы): автореф. дисс. … канд. биол. наук. – Ташкент, 1993. – 15 с.

7 Кирьянова Е.С., Кралль Э.Л. Паразитические нематоды растений и борьба с ними. Т. 1. – Ленинград: Наука, 1969. – 447 с.

8 Кирьянова Е.С., Кралль Э.Л. Паразитические нематоды растений и борьба с ними. Т. 2. – Ленинград: Наука, 1971. – 521 с.

9 Парамонов А.А. Основы фитогельминтологии. Т. III. – Москва: Издательство АН СССР, 1970. – 255 с.

10 Bekmurodov A., Voxidova D., Ergasheva M. Surxondaryo viloyati mevali bog‘larining fitonematodalari // O‘zMU xabarlari. Tabiiy fanlar. – 2023. – № 3.1.1. – B. 25–27

11 Duncan L.W. Nematode parasites of citrus // Plant Parasitic Nematodes in Subtropical and Tropical Agriculture / Eds. M. Luc, R.A. Sikora, J. Bridge. 2nd ed. – Wallingford: CABI Publishing, 2005. – P. 437–466. DOI: 10.1079/9780851997278.0437.

12 Duncan L.W., Cohn E. Nematode parasites of citrus // Plant Parasitic Nematodes in Subtropical and Tropical Agriculture. – Wallingford: CABI, 1990. – P. 321-346.

13 Galeano M., Verdejo-Lucas S., Sorribas F.J., Ornat C., Forner J.B., Alcaide A. New citrus selections from Cleopatra mandarin × *Poncirus trifoliata* with resistance to *Tylenchulus semipenetrans* Cobb //

O‘ZBEKISTON SHAROITIDA XANTAL (SINAPIS ALBA L.) O‘SIMLIGINI YETISHTIRISHNING AGROBIOLOGIK XUSUSIYATLARI.

D.S. Esanqulova Jizzax davlat pedagogika universiteti o’qituvchisi
desankulova5@gmail.com. +998882950046.
G.B. Raxmatullayeva Jizzax davlat pedagogika universiteti magistranti.
+998882955797

Annotatsiya: *Ushbu maqolada oq xantal (Sinapis alba L.) o‘simligining biologik, ekologik va agrobiologik xususiyatlari tahlil qilingan. O‘simlikning sistematik o‘rni, morfologik tuzilishi, rivojlanish bosqichlari hamda xalq xo‘jaligidagi ahamiyati yoritilgan. O‘zbekiston tuproq-iqlim sharoitida xantalni yetishtirish imkoniyatlari, uning moyli va siderat ekin sifatidagi afzalliklari ilmiy adabiyotlar asosida baholangan. Xantalning qishloq xo‘jaligida ekinlar diversifikatsiyasini ta’minlash, tuproq unumdorligini oshirish va ekologik barqaror agroekotizimlarni shakllantirishdagi o‘rni ko‘rsatib berilgan.*

Kalit so‘zlar: *oq xantal, Sinapis alba L., agrobiologik xususiyatlar, moyli ekin, siderat, hosildorlik, agroekotizim, introduksiya.*

Abstract: *This article analyzes the biological, ecological and agrobiological characteristics of white mustard (Sinapis alba L.). The systematic position, morphological structure, growth stages and economic importance of the plant are described. Based on scientific literature, the prospects for cultivating white mustard under the soil and climatic conditions of Uzbekistan are evaluated. The role of this crop as an oilseed and green manure plant in improving soil fertility and ensuring sustainable agroecosystems is highlighted.*

Keywords: *White mustard, Sinapis alba L., agrobiological characteristics, oilseed crop, green manure, productivity, agroecosystem, introduction.*

Bugungi kunda dunyo qishloq xo‘jaligida moyli ekinlar yetishtirish hajmini oshirish, oziq-ovqat xavfsizligini ta’minlash va tuproq unumdorligini saqlab qolish dolzarb masalalardan biri hisoblanadi [1;2]. Moyli ekinlar orasida oq xantal (Sinapis alba L.) o‘zining biologik xususiyatlari, qisqa vegetatsiya davri va ko‘p qirrali foydalanish imkoniyatlari bilan alohida ahamiyat kasb etadi [3].

Oq xantal Brassicaceae oilasiga mansub bir yillik o‘simlik bo‘lib, qadim zamonlardan beri oziq-ovqat, farmatsevtika va chorvachilikda foydalanib kelinadi [4]. Urug‘lari tarkibida 25–35 % moy va 20–30 % gacha oqsil mavjudligi uning iqtisodiy ahamiyatini oshiradi [5].

So‘nggi yillarda xantal nafaqat moyli ekin, balki siderat o‘simlik sifatida ham keng qo‘llanilmoqda. Yashil massasining tuproqqa haydalishi natijasida organik modda miqdori ortadi,

tuproqning fizik-kimyoviy xususiyatlari yaxshilanadi va ayrim kasallik qo‘zg‘atuvchilari rivojlanishi cheklanadi [6].

O‘zbekiston sharoitida xantal yetishtirish bo‘yicha tadqiqotlar hali yetarli darajada olib borilmaganligi sababli ushbu o‘simlikning agrobiologik xususiyatlarini o‘rganish muhim ilmiy va amaliy ahamiyatga ega [7].

Tadqiqotning maqsadi: Oq xantal (Sinapis alba L.) o‘simligining biologik va agrobiologik xususiyatlarini tahlil qilish hamda O‘zbekiston tuproq-iqlim sharoitida yetishtirish istiqbollarini ilmiy asoslash.

Tadqiqot materiallari va metodlari: Tadqiqot davomida oq xantal biologiyasi, ekologiyasi va agrotexnologiyasiga oid mahalliy hamda xorijiy ilmiy manbalar tahlil qilindi. Olingan ma’lumotlar qiyosiy tahlil, umumlashtirish va ilmiy mushohada usullaridan foydalangan holda baholandi [8].

Natijalar va muhokama:

Xantalning sistematik o‘rni; Oq xantal (Sinapis alba L.) Brassicales tartibi, Brassicaceae oilasi va Sinapis turkumiga mansub o‘simlik hisoblanadi [4]. Uning vatani O‘rta Yer dengizi havzasi bo‘lib, bugungi kunda Yevropa, Osiyo va Shimoliy Amerikaning ko‘plab hududlarida yetishtiriladi [3].

Morfologik xususiyatlari; O‘simlikning ildiz tizimi o‘q ildiz tipida bo‘lib, tuproqning chuqur qatlamlariga kirib boradi. Poyasi tik o‘suvchi va kuchli shoxlangan bo‘lib, balandligi 50–120 sm ga yetadi [5].

Pastki barglari patsimon bo‘lingan, yuqori barglari esa maydaroq va oddiy tuzilishga ega. Gullari sariq rangli bo‘lib, shingilsimon to‘pgullar hosil qiladi [4].

Mevasi qo‘zoqcha bo‘lib, har bir mevasi bir nechta urug‘ hosil qiladi. Urug‘lari yumaloq shaklda va och sariq rangga ega [3].

Biologik xususiyatlari; Oq xantal sovuqqa chidamli ekinlardan biri hisoblanadi. Uning urug‘lari 2–3°C haroratda unib chiqishi mumkin. Nihollar qisqa muddatli sovuqlarga bardosh bera oladi [6].

Vegetatsiya davri odatda 80–120 kunni tashkil etadi va quyidagi bosqichlardan iborat: urug‘ning unishi, nihollanish, barg hosil bo‘lishi, poyalanish, g‘unchalash, gullash, meva hosil qilish, urug‘larning ishishi [7]

.**Ekologik talablari:** Xantal yorug‘sevar o‘simlik hisoblanadi. Quyosh nuri yetarli bo‘lgan maydonlarda yaxshi rivojlanadi va yuqori hosil beradi [2]. Tuproqqa nisbatan talabchan emas, biroq unumdor bo‘z tuproqlar va mexanik tarkibi yengil hamda o‘rtacha tuproqlarda yaxshi natija

ko‘rsatadi [5]. Gullash va urug‘ hosil qilish davrida namlik yetarli bo‘lishi hosildorlikka ijobiy ta’sir ko‘rsatadi. Namlik tanqisligi urug‘ hosildorligining pasayishiga olib keladi [6].

Xantalning xalq xo‘jaligidagi ahamiyati: Oq xantal oziq-ovqat sanoatida ziravor va moy olish uchun keng foydalaniladi [3]. Urug‘laridan olinadigan moy oziq-ovqat, kosmetika va farmatsevtika sanoatida qo‘llaniladi. Shuningdek, kunjarasi chorvachilikda oqsilga boy yem sifatida ishlatiladi [4]. Xantal yashil o‘g‘it sifatida ham muhim ahamiyatga ega. U tuproqdagi organik moddalar miqdorini oshiradi, strukturasini yaxshilaydi va agroekotizimlarning biologik barqarorligini ta’minlaydi [6].

O‘zbekiston sharoitida yetishtirish istiqbollari: Respublikaning ko‘plab hududlarida bahorgi namlik zaxiralari mavjud bo‘lib, ular xantal yetishtirish uchun qulay sharoit yaratadi [7]. Xantalning qisqa vegetatsiya davri uni asosiy va takroriy ekin sifatida yetishtirish imkonini beradi. Bundan tashqari, ushbu ekin almashlab ekish tizimlarida tuproq unumdorligini saqlash va kasalliklar tarqalishini kamaytirishda muhim rol o‘ynaydi [8]. Kelgusida O‘zbekiston sharoitida xantalning ekish muddati, ekish me’yori va agrotexnik tadbirlarini o‘rganish orqali yuqori hosildorlikka erishish mumkin.

Xulosa Oq xantal (Sinapis alba L.) biologik va xo‘jalik jihatdan qimmatli moyli ekin hisoblanadi. O‘simlik sovuqqa chidamliligi, qisqa vegetatsiya davri va ekologik moslashuvchanligi bilan ajralib turadi. Xantal oziq-ovqat, farmatsevtika, chorvachilik va siderat ekin sifatida muhim ahamiyatga ega.

O‘zbekiston tuproq-iqlim sharoiti ushbu ekinni yetishtirish uchun qulay hisoblanadi. Xantalning agrobiologik xususiyatlarini chuqur o‘rganish kelgusida yuqori hosildor texnologiyalarni ishlab chiqish uchun ilmiy asos bo‘lib xizmat qiladi.

FOYDALANILGAN ADABIYOTLAR RUYXATI

1. Atabayeva X.N. O‘simlikshunoslik. – Toshkent: Fan, 2021.
2. Tojimuhamedov B. Qishloq xo‘jaligi ekinlari biologiyasi. – Toshkent, 2020.
3. Gupta S.K. Biology and Breeding of Cruciferous Crops. – New Delhi, 2018.
4. Rakow G. Brassica and Mustard Crops. – London, 2019.
5. Jumaev A.J. Moyli ekinlar agrobiologiyasi. – Toshkent, 2022.
6. Kirkegaard J.A. Biofumigation and Green Manure Crops. – Australia, 2017.
7. Vavilov N.I. Madaniy o‘simliklarning kelib chiqish markazlari. – Moskva, 1987.
8. Dospexov B.A. Dala tajribasi metodikasi. – Moskva, 1985.

KUZGI BUG'DOY NAVLARINING EKISH ME'YORLARINI BAHOLASH

Raxmanqulov Bektosh Ilashovich, q.x.f.f.d., (PhD)

Ismoilov Voxid Isropilovich, q.x.f.f.d., PhD

Don va dukkakli ekinlar ilmiy tadqiqot instituti Samarqand ilmiy-tajriba stansiyasi

Annotatsiya. *Maqolada kuzgi yumshoq bug'doyning navlarini boshoq uzunligi, boshoqdagi donlar soni, 1000 ta don massasi va don hosildorligiga ekish me'yorlarining ta'siri natijasi olingan natijalar bayon qilingan.*

Kalit so'zlar: *Bug'doy, nav, ekish me'yori, boshoq, don, hosil, kuzgi yumshoq.*

Annotation. *The article presents the results of the study of the influence of planting standards on ear length, number of grains per ear, 1000-grain weight, and grain yield of soft winter wheat varieties.*

Key words: *Wheat, Variety, Sowing rate, Spike, Grain, Yield, Winter soft.*

Kirish. Bugungi kunda respublikamizda qishloq xo'jaligini kompleks rivojlantirish, sohaga innovatsion texnologiyalarni keng joriy etish, jumladan, aholini non va non mahsulotlari bilan ta'minlash hamda bug'doyni xorijga eksport qilish maqsadida kuzgi bug'doy yetishtirishda, ayniqsa, ekish va oziqlantirish masalalari bo'yicha zarur chora-tadbirlar amalga oshirilmoqda. Bu borada har bir tuproq-iqlim mintaqasi sharoitida kuzgi bug'doyning har bir navini ekish muddatlari, oziqlantirish me'yor, muddat hamda ekish me'yorlarini ilmiy, amaliy ahamiyatini asoslab berish, ishlab chiqarishga muhim tavsiyalar berish g'allachilik sohasining dolzarb vazifalaridan hisoblanadi.

Dunyoning bug'doy yetishtiruvchi mamlakatlarida kuzgi bug'doyning maqbul ekish va oziqlantirish muddat va me'yorlari hamda sug'orish tartiblarini ishlab chiqish bo'yicha izlanishlarga alohida e'tibor qaratilmoqda. Iqlimning global o'zgarishida bug'doyning stress omillarga chidamli yangi nav va tizmalarini yaratish hamda o'ziga xos yetishtirish agrotadbirlarini takomillashtirish talab etilmoqda. Kuzgi bug'doy don hosilini va uning sifatini, ya'ni shishasimonligi, makaronbopligini oshirishga resurstejovchi, yuqori samarali texnologiyalarni qo'llash orqali erishish mumkin.

Kuzgi yumshoq bug'doyning ekish muddatlari bo'yicha K.Aliqulov [2], A.M.Mo'minov va boshqalar [4], K.M.Mo'minov va M.E.Azimovalar [5], I.Najmiddinov [6], A.Raximov va boshqalar [7], R.I.Siddiqov va boshqalar [8], N.Xalilov [10] kabi olimlar ilmiy-tadqiqot ishlari olib borishgan va ekinlardan mo'l va sifatli hosil yetishtirish tabiiy omillar bilan bog'liq bo'lib, har bir ekin va uning navini aniq tuproq va iqlim sharoitida maqbul ekish muddatini aniqlashdan maqsad

agrometeorologik sharoitlardan ekinlarning maksimal darajada foydalanishni tashkil etishdan iborat degan xulosaga kelishgan

B.Abdalniyozov, I.Ibragimov [1] ma’lumotlarida keltirilishicha, Xorazm viloyati uchun kuzgi bug‘doyni maqbul ekish muddati 1-15 sentabr bo‘lib, bu holatda o‘simlik yaxshi tuplab, qishga chiniqqan holda kiradi va muhimi hosil yetilishi 10-12 kunga tezlashadi. Ekish me’yori erta muddatda gektariga 4,5-5,0 mln., maqbul muddatlarda 5,0-6,0 mln. va kech muddatlarda 6.0 mln dona/ga hisoblanadi.

T.Jalolov va A.Mansurov [3] larning izlanishlarida kuzgi urug‘lik bug‘doy yetishtirishda 4-5 mln. dona/ga me’yorda ekish samarali va unda bosh poyalar 90-91 %gacha bo‘lishi aniqlangan bo‘lsa, Z.Sultonovaning [9] Qoraqolpog‘iston Respublikasining sho‘rlangan yerlarida olib borgan tadqiqotlarida kuzgi bug‘doyni optimal ekish me’yori 6 mln. dona/ga. unuvchan urug‘ hisobida ekilishi maqbul ekanligi ta’kidlangan.

Material va uslublar. Tadqiqotlarda barcha kuzatuvlar tuproq va o‘simlik namunalari tahlillari hamda hisob kitoblar “Dala tajribalarini o‘tkazish uslublari” (2014) [11] qo‘llanmasi asosida o‘tkazildi. Dala tajribalari Don va dukkakli ekinlar ilmiy tadqiqot instituti Samarqand ilmiy-tajriba stansiyasida o‘tkazildi.

Tajriba o‘tkazilgan maydonning tuprog‘i o‘tloqi bo‘z tuproqlardan iborat. Tajriba ob’ekti yumshoq bug‘doyning Davlat reyestriga kiritilgan Краснодар-99 (nazorat), Вехa va Улътра navlari olingan. Tajriba tizimi 9 ta variantdan iborat bo‘lib, 4 qaytariq, bir yarusda joylashtirildi. Bitta paykalning uzunligi – 37 m, eni 3,6 m bo‘lib, umumiy maydon 134,0 m^2 ni tashkil qildi. Hisobga olingan maydon 67 m^2.

Tadqiqot natijalari va ularning tahlili. Bizning tajribalarimizda, kuzgi yumshoq bug‘doy navlari boshog‘ining uzunligi, boshoqdagi donlar soni va 1000 ta don massasi ekish me’yorlariga bog‘liq holda o‘zgardi (1-jadval).

Kuzgi yumshoq bug’doy navlarining boshoq strukturasiga va don hosildorligiga ekish me’yorlarining ta’siri (2025-2026 yy)

Nav	Ekish me’yori	Boshoq uzunligi, sm	Bohoqdagi donlar soni, dona	1000 ta don massasi, g	Don hosildorligi, s/ga
Краснодарская 99 (nazorat)	4,5 mln.dona/ga (nazorat)	9,6	59,6	43,1	58,5
	5,5	9,1	55,4	41,2	56,2

	mln.dona/ga				
	6,5 mln.dona/ga	8,5	53,1	39,4	53,1
Bexo	4,5 mln.dona/ga (nazorat)	11,3	67,5	45,1	68,4
	5,5 mln.dona/ga	11,0	65,4	44,2	71,4
	6,5 mln.dona/ga	10,4	63,8	40,2	66,4
Улътра	4,5 mln.dona/ga (nazorat)	10,5	64,5	44,8	64,8
	5,5 mln.dona/ga	10,2	62,4	42,1	67,8
	6,5 mln.dona/ga	9,7	60,5	40,0	64,1

Tajribada o’rganilgan kuzgi yumshoq bug’doy navlarining boshoq uzunligi, boshoqdagi donlar soni va 1000 ta don massasi ekish me’yorlarining oshib borishi bilan kamayib borganligi aniqlandi. Kuzgi bug’doyning Краснодарская 99 nazorat navining boshoq uzunligi ekish me’yorlariga bog’liq ravishda 8,5 sm dan 9,6 sm gacha bo’lgan bo’lsa, Bexo navida ushbu ko’rsatkich 10,4 sm dan 11,3 sm gacha va Улътра navida esa 9,7 sm dan 10,5 sm gacha bo’lganligi qayd etildi.

Boshoqdagi donlar soni nazorat Краснодарская 99 navida 4,5 mln.dona/ga nazorat variantida eng yuqori 59,6 dona bo’ldi. ekish me’yori 5,5 va 6,5 mln.dona/ga bo’lgan variantlarda nazorat variantga nisbatan mos ravishda 4,2 va 6,5 donaga kam bo’lganligi kuzatildi. Bexo va Улътра navlarida ham yuqoridagi qonuniyat qayd etildi.

Kuzgi yumshoq bug’doy navlarini 1000 ta don massasiga ekish me’yorlarining oshirib borilishi salbiy ta’sir ko’rsatdi. Eng kam ko’rsatkich barcha navlarda gaktariga 6,5 mln.dona urug’ ekilgan variantlarda aniqlandi. Bunda Краснодарская 99 navida 39,4 g, Bexo navida 40,2 g va Улътра navida esa 40,0 g bo’lganligi aniqladi. Eng yuqori ko’rsatkich esa gektariga 4,5 mln.dona urug’ ekilgan variantlarda (Краснодарская 99-43,1 g, Bexo-45,1 g, Улътра-44,8 g) kuzatildi.

Kuzgi bug’doy navlarining don hosildorligiga ekish me’yorlari sezilarli darajada ta’sir ko’rsatdi. Bexo va Улътра navlarida eng yuqori don hosili gektariga 5,5 mln dona urug’ ekilgan variantlarda aniqlandi. Краснодарская 99 navida don hosili ekish me’yori 4,5 mln.dona/ga nazorat variantida eng yuqori bo’ldi. O’rganilgan navlar orasida eng yuqori don hosili Bexo navidan olindi. Ushbu navda ekish me’yorlariga bog’liq ravishda don hosili 68,4 s/ga, 71,4 s/ga va 66,4 s/ga bo’lganligi qayd etilgan bo’lsa, Краснодарская 99 nazorat naviga nisbatan Bexo navida don hosili variantlarga mos ravishda 9,9 s/ga, 15,2 s/ga va 13,3 s/ga yuqori bo’ldi.

Xulosa qilib aytganda, Samarqand viloyatining sug’oriladigan o’tloqi bo’z tuproqlari sharoitida kuzgi yumshoq bug‘doyning Bexo va Улътра navlarini gektariga ekish me’yori 5,5 mln.dona (220 kg/ga) ekish tavsiya etiladi.

FOYDALANILGAN ADABIYOTLAR

1. Абдалниёзов Б., Ибрагимов И. Хоразм вилояти шароитида кузги буғдой ва такрорий экинларни етиштиришга доир тавсиялар. Хива: Хоразм Маъмун Академияси, 2002. Б. 13-34

2. Аликулов К. Вақтида экилмаган буғдойдан сифатли ва мўл ҳосил кутманг. // Фермер. – Тошкент, №2, 2015. – Б.14

3. Жалолов Т., Мансуров А. Кузги буғдой экиш меъёрларининг уруғлик сифати ва ҳосилдорлигига таъсири // Агро илм. -Тошкент, 2010. -№1 (13). Б. 8

4. Мўминов А.М., Адашев И., Рахмонов Ш. Кузги буғдой навларини экиш муддатлари ва экиш меъёрларининг дон ҳосилдорлигига таъсири. // Агроилм – Ўзбекистон қишлоқ хўжалиги журнали илмий иловаси. – Тошкент, №1(51), 2018. – Б.23-24

5. Мўминов К.М., Азимова М.Э. Кузги юмшоқ буғдой навлари уруғларининг унувчанлигига экиш меъёри ва муддатларининг таъсири. “Ўзбекистоннинг жанубий ҳудудларида бошоқли дон экинлари селекцияси, уруғчилиги ва етиштириш агротехнологияларининг ҳолати ва ривожлантириш истиқболлари” мавзудаги халқаро илмий-амалий конференция материаллари тўплами. Қарши, 2018. – Б.249-252

6. Нажмиддинов И. Экиш муддатлари ва меъёрлари. // Ўзбекистон қишлоқ хўжалиги. – Тошкент, №8, 2004. – Б.14-15

7. Рахимов А., Бобоев З., Бобомирзаева С., Хурсандов С. Суғориладиган ерларда қаттиқ буғдой ҳосили ва сифатининг экиш муддатлари ва ўғитлаш меъёрларига боғлиқлиги. “Ўзбекистоннинг жанубий ҳудудларида бошоқли дон экинлари селекцияси, уруғчилиги ва етиштириш агротехнологияларининг ҳолати ва ривожлантириш истиқболлари” мавзудаги халқаро илмий-амалий конференция материаллари тўплами. Қарши, 2018. – Б.275-277

8. Сиддиқов Р.И., Мўминов А.А., Рахмонов Ш.Х. Кузги юмшоқ буғдой навларини экиш муддати ва меъёрларининг ҳосилдорлик ҳамда технологик сифат кўрсаткичларига таъсири. “Ўзбекистоннинг жанубий ҳудудларида бошоқли дон экинлари селекцияси, уруғчилиги ва етиштириш агротехнологияларининг ҳолати ва ривожлантириш истиқболлари” мавзудаги халқаро илмий-амалий конференция материаллари тўплами. Қарши, 2018. – Б.158-161

9. Султанова З. Изучение продуктивности и соленаколления сортов яровой пшеницы при различных нормах высева в условиях приаралья // Агро илм. -Тошкент, 2010. -№2(14). -Б. 25

10. Халилов Н. Научные основы возделывания пщеницы осеннего посева на орошаемых землях Узбекистана: Автор. дисс. доктора с/х наук. – Самарканд: СамСХИ, 1994. – 41 с

11. Nurmatov Sh., Mirzajonov Q., Avliyoqulov A., Bezborodov G., Ahmedov J., Teshaev Sh., Holiqov B., Niyozaliev B., Hasanova F., Mallabaev N., Tillabekov B., Ibragimov N.,.Abdualimov Sh, Shamsiev A., Isaev S. Dala tajribalarini o‘tkazish uslublari. Toshkent 2014. – Б. 175.

“JUNCUS GERARDII LOISEL” O’SIMLIGINING BOTANIK TAVSIFI, GEOGRAFIK TARQALISHI

Ro’ziyeva Dilso’z Bahriddin qizi

Samarqand davlat pedagogika instituti talabasi

e-mail: dilsozroziyeva0905@gmail.com

Annotatsiya: *Ushbu maqolada Juncus gerardi o’simligining botanik tavsifi, ekologik tarqalishi, dunyo bo’ylab geografik tarqalishi, ahamiyati va taksonomik belgilari keltirilgan. Juncus gerardi Yakondoshlar oilasiga mansub bo’lib, asosan botqoqliklarda, ochiq qirg’oqbo’yi o’tloqlarida sernam joylarda keng tarqalgan o’simlik turi hisoblanadi. Amaliy ahamiyati yetarli darajada tahlillarni kutmoqda.*

Kalit so’zlar*: Juncus gerardi, morfologiyasi, taksonomiyasi, yem -xashak.*

Abstract: *This article presents the botanical description of the plant* Juncus gerardi*, its ecological distribution, global geographical distribution, significance, and taxonomic characteristics.* Juncus gerardi *belongs to the Juncaceae family and is mainly widely distributed in marshlands, open coastal meadows, and moist habitats. Its practical importance still requires further analysis and research.*

Keywords: Juncus gerardi*, morphology, taxonomy, forage plant.*

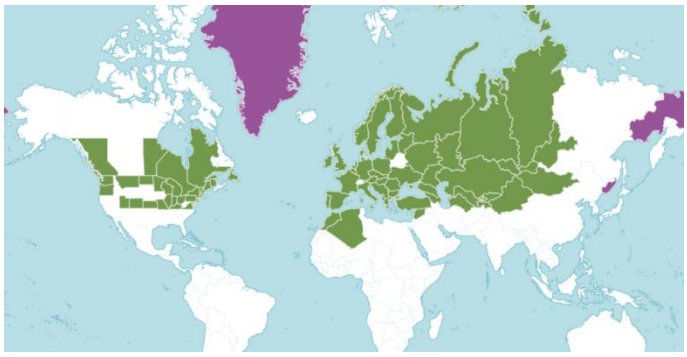
Botanik tavsifi: Gerardii Lois. *Journ. de Bot. tomonidan* 1809-yil taklif qilingan [1]. *Juncus gerardii Loisel-Jerar* yakoni yakondoshlar (*Juncaceae*) oilasiga mansub ko’p yillik gulli o’simlik [2]. Poyalari ingichka va ipsimon bo'lib, navbatma navbat joylashgan balandligi 30-50 sm gacha o'sadi . Kulrang-yashil, bir yillik, ildizi yo‘g‘onlashgan. Poyasi dumaloq, asosida va yuqori qismida keng, shoxlangan barg qo‘ltiqchalari bor. Barglari silliq, yaltiroq, eni 2 mm gacha, poyaga nisbatan 2 marta qisqaroq, qisqa, qalin bandli. To‘pguli pishiq, zich, notekis, yuqoriga qarab yo‘nalgan shoxchalardan iborat; pastki barglar to‘pgul asosida deyarli o‘tirib turadi yoki bandi teng bo‘ladi. Har bir tugunda novdaning uchigacha bitta gul joylashgan. [1]. Gullar shoxlarning uchlariga qarab qisqa, birlamchi bargli bo'ladi. Tepalari to‘q jigarrang tusda, novsimon va qora kapsulalar atrofida joylashgan bo'lib, bu kapsulalarga chiziqli ko'rinish berishi mumkin . Gullar va mevalar tugishi bahorning oxiridan yozgacha davom etadi . Ko'chatlarning ko'payishi yorug'lik raqobati kam bo'lgan ochiq joylarda sodir bo'ladi [1]. Biroq, bu tur asosan jinssiz ko'payish orqali tarqaladi va yoyilgan **ildizpoyalardan** klonal populyatsiyalarni hosil qiladi [6]. Gul to‘plami gullashning so‘nggi bosqichida rivojlanib, uzunligi 3–15 sm ni tashkil etadi, u siyrak shoxlangan, shoxchalari yuqoriga ko‘tarilgan. Har bir gul ikkita qo‘shilgan shoxcha bilan tavsiflanadi. Mevalari kashtan jigarrang yoki jigarrang tuxumsimon (keng ellipsoid), gulqo‘rg‘on segmentlari teng yoki biroz ustunroq; urug'lari to'q jigarrang, ellipsoiddan oysimongacha (nok shaklida), uzunligi taxminan 0,5-

0,6 mm.ga yetadi [1] **. *Juncus gerardi* sinonimlari:** 1.*Juncsus bulbosus var gerardi (Loisel.)* A.Gray in Manual, ed.2.: 483:34 (1856). 2.*Tenageia gerardi (Loisel.)* Fourr.in Ann.Soc.Linn.Lyon,n.s, 17; 172 (1869) *3.Juncus compressus var.gerardi (Loisel.)* Corb. In Nouv.FI.Normandie:583 (1894) [4].

Klassifikatsiyasi:

T/r	*Sistematik birlik*	*Lotincha*	*O'zbekcha*
1	*Bo'lim*	*Magnoliophyta*	*Gulli o'simliklar*
2	*Sinf*	*Liliopsida*	*Bir urug'palalilar*
3	*Qabila*	*Juncuales*	*Yakonomalar*
4	*Oila*	*Juncaceae*	*Yakondoshlilar*
5	*Tur*	*Juncus*	*Yakondosh*
6	*Turkum*	*Juncus Gerardi*	*Jerar yakoni*

(1-jadval)



Geografik tarqalishi:

Bu tur 18-asrda yashagan fransuz botanigi *Lui Jerar* (1733–1819) sharafiga nomlangan [6]. Juncus gerardii. Yevropa (O'rta yer dengizidan Mo'g'ulistongacha) va Shimoliy Amerikaga xos [5].

2-rasm**. (www.powo.com).**

Shimoliy Amerikada u Buyuk ko'llar mintaqasi kabi ba'zi istalmagan joylarga tarqaldi. Juncus gerardii Grenlandiya , Yangi Zelandiya, Avstraliya (Tasmaniya va Viktoriya) va Osiyo (Primorye va Magadan kabi bir qator mamlakatlarda tanishtirilgan . *Juncus gerardii* tasodifan Yangi Zelandiyaga olib kelingan va 1891-yilda naturalizatsiya qilingan [6]. Undan tashqari O'rta Osiyoda ham uchraydi. Zarafshon, Urgut hamda Zarafshon, Toshkent, Farg'ona, Samarqand, Buxoro va Xorazm viloyatlari; Qoraqalpog'iston ASSR [1].

Ekologiyasi*: Juncus gerardii* botqoqliklarda, ochiq qirg'oqbo'yi o'tloqlarida, suv toshqini chizig'idan biroz yuqoriroqda sho'r botqoqliklarda va hatto tabiiy yaylovlar kabi ba'zi ichki muhitlarda keng koloniyalar hosil qiladi [7]. Bu tur odatda muntazam o'tlatishga moyil bo'lgan yashash joylarida uchraydi. *Juncus gerardii* sho'r bo'lmagan, botqoqlangan tuproqlarni afzal ko'radi, ammo suv toshqinlariga chidamsiz. U sho'r ekotizimlarga bardosh bera oladi, ammo sho'rlanish darajasining oshishi urug'larning unib chiqishini, ko'chatlarning omon qolishini kamaytiradi va

mavjud o'simliklarning vegetativ o'sishini kamaytiradi [5]. Bu tur sho'r botqoqni sho'rsizlantirgandan keyin 15 yilgacha yashashga qodir. *Juncus gerardii* temir va marganetsning yuqori konsentratsiyasiga ega tuproqlarda ham o'sishi mumkin, ammo har ikkala elementning yuqori konsentratsiyasiga alohida sezgir. Ko'chatlarning paydo bo'lishi quruq, ochiq joylarda, yorug'lik uchun raqobat kam bo'lgan joylarda sodir bo'ladi. Nihollarning paydo bo'lishi odatda mart oyida boshlanadi va iyun oyida, suv cheklovchi omilga aylanganda tugaydi [6]. Hosildor novdalar vegetativ novdalarga qaraganda balandroq o'sishga moyil. *Juncus gerardii* odatda maydan avgustgacha gullaydi va meva beradi. *J.gerardii* jamoalari vegetativ ildizpoyalar o'sishi orqali kengayib, klon populyatsiyalarini hosil qiladi.



3-rasm**. (planetarium.ru).**



4-rasm**. (planetarium.ru).**

Ahamiyati: Dorivor va texnik ahamiyatga ega [1]. Botqoq ekotizimining barqarorligini saqlashda muhim rol o’ynaydi va qirg’oq eroziyasini kamaytiradi [7].Tuprpqni mustahkamlaydi, qushlar va hayvonlar uchun yashash joy yaratadi. Sho’r va nam muhitlarga moslashgan galofit tur hisoblanadi [3].Ozuqabop yem-xashak sifatida ishlatiladi [4].

Foydalanilgan adabiyotlar:

1. Sh T. K. et al. Kadastr flory Uzbekistana: Samarkandskaya oblast [Cadaster of the flora of Uzbekistan: Samarkand region] //Tashkent: Publ. house" FAN" of the Academy of Sciences of the Republic of Uzbekistan. – 2018.
2. WCVP. 2021. World Checklist of Vascular Plants, version 2.0. Facilitated by the Royal Botanic Gardens, Kew. Available at: http://wcvp.science.kew.org/.

3. Candargy, P.C. 1897. Flore de l'île de Lesbos. Bulletin de la Société Botanique de France 44(1): 140–144, (2): 145–162, (4): 369–373, (5): 449–462. DOI: 10.1080/00378941.1897.10830751
4. Кадастр флоры Узбекистана: Бухарская область. К.Ш. Тожибаев, Н.Ю. Бешко, Х.Ф. Шомуродов с участием О.С. Абдураимова, Б.А. Адилова, Т. Рахимовой, Н.К. Рахи мовой, Ф.И. Полвонова, Ш.У Сарибаевой, Б.Ш. Хабибуллаева, Р.Ш. Хайитова, В.К. Шариповой, Х.К. Эсанова - Ташкент: ИПТД «O'qituvchi», 2020. - 128 с.: (+40 с. вкл.)
5. “Juncus gerardii-saltmarsh rush” - Native Plant Trust GO BOTANY https://gobotany.nativeplanttrust.org/species/juncus/gerardii/
6. *Edgar, E; Healy, A. J. (1980). Flora of New Zealand Adventive Cyperaceous, Petalous & Spathaceous Monocotyledons. Vol. 3. Wellington, New Zealand: P. D. HASSELBERG. ISBN 0-477-01041-5*
7. . Кадастр флоры Узбекистана: Навоийская область. К. Ш. Тожибаев, Н. Ю. Бешко, Х. Ф. Шомуродов с участием Абдураимова О. С., Адилова Б. А., Ахмедова А. К., Рахимовой Т., Рахимовой Н. К., Сарибаевой Ш. У., Хайитова Р. Ш., Шариповой В. К. – Ташкент: Издательство «Фан»

TRITIKALE URUG‘LARINING UNUVCHANLIGIGA SHO‘RLIKNING TA’SIRI

S.Uroqov, F.Z.Toshpulatova

Sharof Rashidov nomidagi Samarqand davlat universiteti, Samarqand shahri, O‘zbekiston

e-mail:toshpulatovaf26@gmail.com

Annotatsiya. *O‘simliklardan yuqori hosil olish hamda sho‘rlanishga chidamli navlarni yaratish muhim ahamiyatga ega. Seleksiya jarayoni uchun boshlang‘ich manbalarni har tomonlama chuqur o‘rganish va to‘g‘ri tanlash tadqiqotlar samaradorligini oshirishda muhim ahamiyat kasb etadi. Tadqiqotlarimizda tritikale navlari “Prag serebristiy”, “Do‘stlik”o‘rganildi. Maqolada tritikale urug‘larining laboratoriya sharoitida sho‘rlikka ta’siri NaCl eritmasida o‘rganildi.*

Kalit so‘zlar: *Tritikale, urug‘lar, distirlangan suv, sho‘rlik, NaCl eritmsi.*

Abstract. *Achieving high crop yields and developing salt-tolerant varieties are of great importance in agriculture. A comprehensive study and proper selection of initial genetic material for breeding programs play a crucial role in improving research effectiveness. In this study, the triticale varieties “Prag Serebristiy” and “Do‘stlik” were investigated. The article examines the effects of*

salinity on triticale seed germination under laboratory conditions using sodium chloride (NaCl) solutions.

Keywords: *triticale, seeds, distilled water, salinity, NaCl solution.*

Tritikale (*Triticosecale* Wittmack) donli ekini ilk bor 1875-yilda bug‘doy o‘simligini (ona shakl sifatida) javdar changi (ota shakl sifatida) bilan duragaylash orqali sun’iy ravishda yaratilgan. Dunyo miqyosida tritikale yetishtirish hajmi so‘nggi o‘n yilliklarda barqaror o‘sib bordi va xalqaro statistikaga ko‘ra global ishlab chiqarish ko‘rsatkichi 17 million tonnadan ortdi [1].

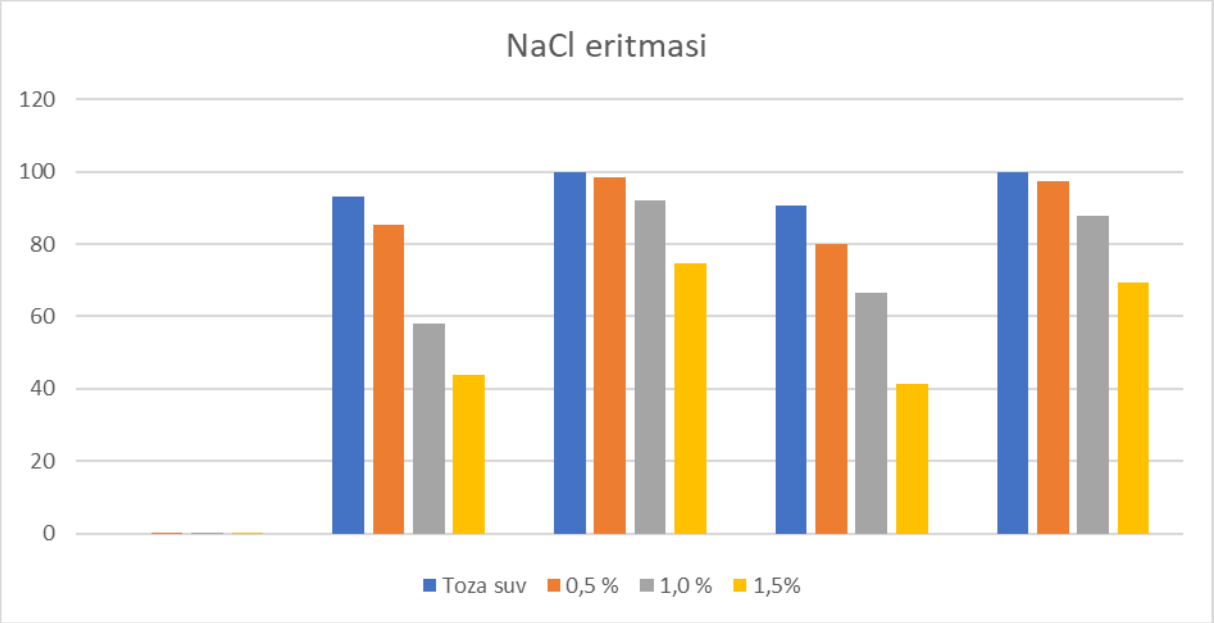
Yumshoq non bug‘doyi (*Triticum aestivum* L.) bugungi kunda sayyoramiz bo‘ylab taxminan 216,7 million gektar maydonda yetishtiriladigan eng yetakchi va strategik ekin turi hisoblanadi. Global miqyosda insoniyat iste'mol qiladigan umumiy kaloriyaning 20 foizini aynan ushbu don ekini qoplaydi va u yer yuzi aholisining qariyb 30 foizini oziq-ovqat bilan ta'minlashga yetarli quvvatga ega. Tarkibida oqsildan tashqari (E, B_1, B_2 va B_3) vitaminlari hamda inson salomatligi uchun zarur bo‘lgan minerallar (Mn, P, Cu, Se) kompleksi mavjud bo‘lgan asosiy ekin hisoblanadi [2].

Ushbu ikki turning eng yaxshi jihatlarini birlashtirish maqsadida XX asr boshlariga kelib (xususan 1913-yillardan boshlab) bug‘doy va javdar duragaylarini olish bo‘yicha keng qamrovli seleksiya ishlari olib borildi. Keyinchalik, *Triticum* va *Secale* lotincha nomlarining o‘zaro birikmasidan hosil bo‘lgan hamda fanga taklif etilgan "Tritikale" donli ekini 1931-yilga kelib mustaqil va istiqbolli gibrid turi sifatida ilmiy doiralarda to‘liq e'tirof etildi [5].1975-yilning o‘zidayoq tritikale navlarini global miqyosda sinovdan o‘tkazish dasturi doirasida 5 ta qit’adagi 75 ta davlatning 338 ta hududida amaliy tajribalar bajarilgan. Ushbu sinovlar geografik jihatdan quyidagicha taqsimlangan edi: Shimoliy Amerikada 41 ta, Yevropa hududida 64 ta, Afrika qit’asida 60 ta, Lotin Amerikasida 71 ta, Yaqin Sharq mamlakatlarida 23 ta hamda Janubi-Sharqiy Osiyo va Okeaniya mintaqasida 79 ta obyekt [4].

O‘zbekiston sharoitida tritikalening tez o‘sadigan navlarini yaratish respublika seleksionerlari oldida turgan asosiy muammolardan biridir. Tez o‘sadigan navlar qurg‘oqchilik va jazirama boshlanishidan oldin кераkli hosilni olishga qodir bo‘lib, tuproqning tez bo‘shashishi tufayli yiliga 2-3 marta hosil olish mumkin [3].

Biz tadqiqot uchun tritikalening navlarini NaCl tuzining 0,5%, 1,0% hamda 1,5% kontsentratsiyali eritmalarida termostatda undirildi. Olingan natijalar 1-rasmlarda keltirilgan.

1-rasm. Tritikale nav urug'lari unuvchanligiga sho'rlikning ta'siri.



Tadqiqotlarimizda nazorat (toza suv) variantda urug'larning unish quvvati Do'stlik navida 90,6% hamda Prag serebristiy navida 93,3% bo'ldi, unuvchanlik esa ikkala navda ham 100,0% bo'lganligi aniqlandi.

Tadqiqotimizda tritikale navlarining sho'r muhitga chidamligini aniqlash natijalari shuni ko'rsatadiki, urug'larning unuvchanligi nazoratga nisbatan natriy xlor tuzning 0,5% li eritmasida - 97,3-98,6% ni tashkil etib nazoratga nisbatan 1,4-2,7 % ga kam bo'ldi. Eritma kontsentratsiya 1,0 % li eritmada 88,0-92,0% ni tashkil etib nazoratga nisbatan - 8-12 % va 1,5 % li eritmada 69,3-74,6% ni tashkil etib nazoratga nisbatan - 25,4-30,7 % ga kam bo'ldi.

Olib borilgan tadqiqot natijalariga ko'ra, 0,5% (NaCl) variantda tritikale urug'larning unish quvvati Prag serebristiy navi chidamli ekanligi kuzatilgan bo'lsa, NaCl tuzining 1,0% li eritmasida Do'stlik navi nisbatan chidamsiz ekanligi kuzatilgan. 1,5% li NaCl eritmasida ham Prag serebristiy navi ancha chidamli ekanligi ma'lum bo'ldi.

FOYDALANILGAN ADABIYOTLAR:

1. Birlashgan Millatlar Tashkilotining Oziq-ovqat va qishloq xo'jaligi tashkiloti. (2003). O'zbekistondagi agroekologik zonalar va yer resurslari.
2. Chumikina L.V., Arabova L.I., Toptunov A.F. Bioximicheskie osobennosti izmeneniya belkovogo kompleksa zerna tritikale. Izvestiya vuzov, 2009.
3. Eshmurodova A.A., Bo'ronov A.Q. Tritikale morfologiyasi va uning kelib chiqishi. Academic research in educational sciences. 2022. №2.

4. Mirzayev O.F., Xudoyberdiyev T.S. Yemxashak yetishtirish. Andijon, 2003.
5. Sechnyak L.K., Sulima Yu.G. Tritikale. Moskva: Kolos, 1984.

NA’MATAK (*ROSA CANINA* L.) O‘SIMLIGIDA *SPHAERULINA REHMIANA* JAAP ZAMBURUG‘I KELTIRIB CHIQARUVCHI DOG‘LANISH KASALLIGINING MORFOLOGIK VA FITOPATOLOGIK XUSUSIYATLARI

Xo‘jaqulova Durdona Sadriddin qizi
Shahrisabz davlat pedogogika instituti kata o’qituvchi v.b. dotsent
+998901131395 durdonaxojaquulova@gmail.com

ANNOTATSIYA. *Ushbu maqolada respublikamiz florasining muhim dorivor o‘simliklaridan biri na’matak (Rosa canina L.) ning biologik xususiyatlari, kimyoviy tarkibi, ekologik va iqtisodiy ahamiyati hamda ushbu o‘simlikda so‘nggi yillarda qayd etilgan mikologik kasallik, xususan, Sphaerulina rehmiana Jaap zamburug‘i keltirib chiqaradigan barg dog‘lanish kasalligi tahlil qilingan.*

Kalit so‘zlar: *Rosaceae, Rosa canina L., Ascomycetes, Mycosphaerellaceae, Sphaerulina rehmiana.*

ABSTRACT. *This article analyzes the biological characteristics, chemical composition, ecological and economic importance of dog rose (*Rosa canina *L.), one of the important medicinal plants in the flora of Uzbekistan. It also examines a mycological disease recently reported in this plant, specifically leaf spot disease caused by the fungus* Sphaerulina rehmiana *Jaap.*

Keywords: *Rosaceae,* Rosa canina *L., Ascomycetes, Mycosphaerellaceae,* Sphaerulina rehmiana.

Dunyoda va respublikamizda tabiiy dorivor xomashyoga bo‘lgan talabning ortib borishi o‘rmon xo‘jaliklari va ixtisoslashtirilgan o‘simlikshunoslik xo‘jaliklarida dorivor o‘simliklarni sun’iy ravishda yetishtirish va ularning maydonlarini kengaytirish zaruriyatini tug‘dirmoqda. O‘zbekiston Respublikasi o‘rmon xo‘jaligi tizimida bugungi kunda na’matak (*Rosa canina* L.) plantatsiyalari 500 gektardan ortiq maydonni tashkil etib, respublika farmatsevtika sanoatini sifatli biologik faol moddalar bilan ta’minlashda muhim o‘rin tutadi.

Biroq, so‘nggi yillarda global iqlim o‘zgarishlari, havo haroratining keskin tebranishlari, atmosferaning texnogen ifloslanishi hamda tuproq degradatsiyasi kabi salbiy ekologik omillar o‘simliklarning immun tizimini zaiflashtirib, ularda turli epizootik va epifitotik kasalliklarning

rivojlanishiga zamin yaratmoqda. Zararli fitopatogen zamburug‘lar o‘simlikning asimilatsion a’zolarini (barg, poya va meva) zararlab, fotosintez jarayonining susayishiga, biomassaning kamayishiga hamda meva tarkibidagi biologik faol moddalar va vitaminlar miqdorining keskin pasayishiga olib keladi. Shu sababli, dorivor na’matak plantatsiyalarida fitopatologik monitoring ishlarini muntazam olib borish, kasallik qo‘zg‘atuvchilarining taksonomik tarkibini aniqlash va ularga qarshi kurash choralarini ishlab chiqish fitopatologiya hamda mikologiya fanining dolzarb vazifalaridan biri hisoblanadi.

Na’matak (*Rosa* L.) – ra’noguldoshlar (*Rosaceae*) oilasiga, Rosales tartibiga mansub ko‘p yillik o‘tsimon va poyali butasimon o‘simlikdir. Rosaceae oilasi dunyo bo‘yicha 120 ta turkum va 3000 dan ortiq turini o‘z ichiga oladi. O‘zbekiston florasida ushbu oilaning ko‘plab vakillari uchraydi, xususan na’matakning 17 ta tabiiy va madaniylashtirilgan turi tarqalgan. Dunyo miqyosida esa *Rosa* turkumining 135 dan ortiq turi ma’lum va ilmiy o‘rganilgan[1][6].

O‘zbekiston sharoitida na’matak o‘simliklari asosan qir-adir zonalarda, tog‘ va tog‘oldi hududlarida, dengiz sathidan 800 metrdan 2800 metrgacha bo‘lgan balandliklarda yaxshi rivojlanadi. O‘simlikning adaptiv imkoniyatlari yuqori bo‘lib, turli tuproq-iqlim sharoitlariga moslasha oladi[4].

Na’matak mevalari o‘zining unikal va boy kimyoviy tarkibi bilan dorivorlik xususiyatini namoyon etadi. Uning mevalari tarkibida quyidagi hayotiy muhim moddalar mavjud[1]:

- **Vitaminlar:** Askorbin kislotasi (S vitamini), riboflavin (B2), K vitamini, P vitamini, E vitamini va provitamin A (karotin);
- **Organik kislotalar va birikmalar:** Limon va olma kislotalari, pektin moddalari, flavonoidlar va efir moylari;
- **Uglevodlar hamda oshlovchi moddalar:** Yengil o‘zlashtiriluvchi qandlar, tenninlar.

Modda / Birikma turi	Tarkibiy miqdori (%)	Biologik va amaliy ahamiyati
P, K va E vitaminlari birikmasi	12 – 27 %	Antioksidantlik va tomirlarni mustahkamlash xususiyati
Karotin va organik kislotalar	29 % gacha	Immunomodulyator hamda metabolizmni yaxshilovchi
Qand quvvati (uglevodlar)	18 % gacha	Energetik manba va tatlilik darajasi
Oshlovchi moddalar	4,5 % ni tashkil etadi	Bakterid va biriktiruvchi ta’sir

Modda / Birikma turi	Tarkibiy miqdori (%)	Biologik va amaliy ahamiyati
(taninlar)		ko‘rsatuvchi

Tadqiqot ishlari O‘zbekiston Respublikasi Fanlar Akademiyasi Botanika institutining Mikologiya va Algologiya laboratoriyasi, .N. Rusanov nomidagi Toshkent Botanika bog‘i va Buxoro viloyati Buxoro tumani "So‘fikor" MFY hududlarida olib borildi. Tadqiqot obyekti sifatida zararlangan na’matak (*Rosa canina* L.) barglari va undan tayyorlangan gerbariy namunalari olindi.

Laboratoriya va mikroskopik tahlil usullari:

1. *Gerbariy va namunalarni yig‘ish:* Toshkent Botanika bog‘idan (28-05-2023 DXS-032) va Buxoro viloyatidan (12-06-2023 DXS-066) kasallik belgilari aniqlangan na’matak barglaridan gerbariy namunalar yig‘ildi.

2. *Mikroskopiya:* Zamburug‘ namunalaridan vaqtinchalik preparatlar tayyorlandi hamda zamonaviy N-300V (HDCE-XN) raqamli mikroskopida morfologik tahlillar va o‘lchovlar o‘tkazildi. Zamburug‘ning konidiyalari, sporalari va boshqa generativ a’zolarining o‘lchamlari aniqlandi.

3. *Taksonomik aniqlash:* Zamburug‘ turini aniqlash va sistematik o‘rnini belgilash uchun xalqaro mikologik ma’lumotlar bazalari — **Index Fungorum**[7] va **POWO** [8]ma’lumotlaridan keng foydalanildi.

4. *Fitopatologik va ekologik monitoring:* Kasallikning paydo bo‘lish va rivojlanish dinamikasi, harorat hamda havoning nisbiy namligi kabi ekologik omillarning patogen faolligiga ta’siri yillar davomida kuzatib borildi.

NATIJALAR VA ULARNING TAHLILI. Ilmiy adabiyotlar tahliliga ko‘ra, *Sphaerulina* turkumiga mansub zamburug‘ turi dastlab Yevropa va Shimoliy Amerika hududlarida botanik va fitopatolog olim Desmazieres (1847) tomonidan *Cytisus laburnum* (= *Laburnum anagyroides*) o‘simligida *Sphaerulina rehmiana* Jaap zamburug‘i kasallik keltirib chiqarishi qayd etilgan [3][5].

O‘zbekiston mikobiotasida *Sphaerulina* turkumiga mansub turlar ilgari 104 avlod va 40 oilaga mansub 163 ta o‘simlik turida uchrashi ma’lum edi. Ayniqsa Poaceae, Lamiaceae, Fabaceae, Rubiaceae, Asteraceae, Apiaceae va Rosaceae oilalari vakillarida mazkur turkum zamburug‘lari keng tarqalgani qayd etilgan[2].

Tadqiqotlar natijasida O‘zbekistonda *Sphaerulina* turkumiga mansub turlar soni yana bittaga ortdi, ya’ni respublikamizda birinchi marotaba na’matak (*Rosa canina* L.) o‘simligida yangi patogen zamburug‘ *Sphaerulina rehmiana* Jaap turi aniqlandi.

Kuzatuvlar shuni ko‘rsatdiki, *Sphaerulina rehmiana* keltirib chiqaradigan barg dog‘lanish kasalligi juda barvaqt namoyon bo‘ladi. 2021–2023 yillardagi dinamik kuzatuvlarda, ayniqsa 2023 yil bahor va yoz oylarida kasallik ko‘rsatkichi na’matakning yosh barglarini juda kuchli zararlagani qayd etildi. Kasallikning asosiy bosqichma-bosqich belgilari quyidagicha kechadi:

- **Boshlang‘ich bosqich:** Barg plastinkasida mayda, aylanasimon sarg‘ish tusdagi dog‘lar paydo bo‘ladi;
- **Rivojlanish bosqichi:** Vaqt o‘tishi bilan dog‘lar kengayib, ularning chetlari to‘q jigarrang tus oladi, markaziy qismi esa och jigarrang yoki kulrang-jigarrang ko‘rinishga keladi;
- **Terminal bosqich:** Kuchli zararlangan barglar muddatidan oldin qriydi, fotosintez yuzasi keskin qisqaradi va o‘simlikning umumi rivojlanishi sekinlashadi.

5. XULOSA VA TAVSIYALAR

O‘tkazilgan kompleks mikologik va fitopatologik tadqiqotlar natijasida quyidagi muhim xulosalarga kelindi:

1. O‘zbekiston mikobiotasida *Sphaerulina* turkumiga mansub fitopatogen zamburug‘larning doirasi na’matak (*Rosa canina* L.) o‘simligi hisobiga kengaydi va uning qo‘zg‘atuvchisi *Sphaerulina rehmiana* Jaap ekanligi birinchi bor aniqlandi.

2. Kasallik na’matakning yosh barglarida barvaqt namoyon bo‘lib, barg sathining zararlanishi va fotosintez funksiyasining izdan chiqishiga olib keladi.

3. Respublikamizdagi na’matak plantatsiyalarida (500 gektardan ortiq) hosildorlik va dorivor xomashyo sifatini saqlab qolish uchun bahor oylaridan boshlab *Sphaerulina rehmiana* zamburug‘iga qarshi o‘z vaqtida fitopatologik monitoring va profilaktik himoya choralarini o‘tkazish tavsiya etiladi.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI

1. Berdiyev E. T. Na’matak tabiiy vitaminlar xazinasi. Toshkent – 2018
2. Islomiddinov Z. Sh., Teshaboyeva Sh. A., Mustafaev I. M. Checklist of genus Septoria (Mycosphaerellaceae) in Uzbekistan // Asian Journal of Mycology. 20. 5(1), 91–106. Doi: 10.5943/ajom/5/1/8
3. Mabberley D.J. Mabberley’s Plant-Book: A Portable Dictionary of Plants, Their Classification and Uses. – Cambridge: Cambridge University Press, 2017.
4. O‘zbekiston florasi. 1–6-jildlar. – Toshkent: Fan, 1953–1962.
5. Verkley G.J.M., Priest M.J. Septoria and similar coelomycetous fungi on Rosaceae // Studies in Mycology. – 2000.
6. Xolmatov X.X., Ahmedov U.X. Dorivor o‘simliklar. – Toshkent: Ibn Sino, 1995.
7. http://www.indexfungorum.org
8. https://powo.science.kew.org

MARJUMAKNING DORIVORLIK XUSUSIYATILARI VA AHAMIYATI

Artikova Gulnoza Xasanovna

Samarqand davlat Pedagogika insituti

Tabiiy fanlar fakulteti Biologiya kafedrasi assistenti, +998 91 595 34 45, E-mail:

artikova@gmail.com

Annotatsiya. *Ushbu maqolada marjumak (Fagopyrum esculentum Moench) donining kimyoviy tarkibi, asosiy biologik faol birikmalari, dorivorlik xususiyatlari, inson salomatligi uchun ahamiyati, O‘zbekiston sharoitida olib borilgan ilmiy tadqiqotlar hamda undan oziq-ovqat va dorivor preparatlar yaratish istiqbollari tahlil qilingan.*

Kalit so‘zlar: *Marjumak, oziq-ovqat, kimyoviy tarkibi, dorivor o‘simlik, ahamiyati.*

Abstract. *This article analyzes the chemical composition of buckwheat (Fagopyrum esculentum Moench) grain, its main biologically active compounds, medicinal properties, importance for human health, scientific research conducted in Uzbekistan, and the prospects for creating food and medicinal products from it.*

Keywords: *Buckwheat, nutritional value, chemical composition, medicinal plant, importance.*

Marjumak yoki grechixa (*Fagopyrum esculentum* Moench) Polygonaceae — torondoshlar oilasiga mansub bir yillik, qadimdan oziq-ovqat, parhezbop va dorivor ahamiyatga ega bo‘lgan donli ekinlardan biri hisoblanadi. Keyingi yillarda donining tarkibidagi rutin, kversetin, fenol kislotalari, fagopiritollar, oqsillar, aminokislotalar, oziq tolalari, vitaminlar va mineral elementlarning biologik faolligi tufayli marjumakka bo‘lgan ilmiy qiziqish yanada ortmoqda. Xorijda olib borilgan tadqiqotlar marjumakning antioksidant, yallig‘lanishga qarshi, gipoglikemik, gipolipidemik, gipertenziv holatlarni yumshatuvchi, neyroprotektiv va ayrim parxezbop xususiyatlarga ega bo‘lishi mumkinligini ko‘rsatgan. Ammo ushbu ta’sirlarning katta qismi in vitro sharoitida yoki hayvonlar ustuda olib borilgan tajribalarda aniqlangan bo‘lib, odamlar ishtirokidagi klinik tadqiqotlar yetarli emas [1, 2262–2267-b.].

O‘zbekiston sharoitida marjumak asosan bug‘doydan bo‘shagan maydonlarda takroriy ekin sifatida yetishtirish, mineral oziqlantirish, fotosintez mahsuldorligi, hosildorlik va urug‘larning fiziologik xususiyatlari nuqtayi nazaridan o‘rganilgan. Zarafshon vodiysida olib borilgan tadqiqotlar marjumakning Samarqand viloyati agroiqlim sharoitlarida yetishtirish imkoniyatlari va biologik xususiyatlarini aniqlashga qaratilgan [4, 30–32-b.; 5, 81–84-b.].

Marjumak donining oziqaviy qiymati tarkibidagi oqsilning sifati, oziq tolalari, mineral elementlar va fenolli birikmalarga boyligi bilan bog‘liq. Marjumak oqsili ozuqaviy jihatdan yuqori

qiymatli bo‘lib, lizin va arginin kabi aminokislotalarga nisbatan boyligi bilan ajralib turadi. Bu jihat marjumakni boshqa don mahsulotlarida yetishmasligi mumkin bo‘lgan muhim aminokislotalarning qo‘shimcha manbai sifatida baholash imkonini beradi. Bundan tashqari, marjumak tabiiy ravishda glyutensiz bo‘lgani sababli glyutensiz parhez uchun muhim xomashyo hisoblanadi [1, 2262–2267-b.].

Marjumakning dorivor ahamiyati, avvalo, uning ikkilamchi metabolitlari –flavonoidlar va boshqa fenolik moddalarning mavjudligi bilan izohlanadi. Xususan, rutin, kversetin, orientin, izoorientin, viteksin va izoviteksin kabi flavonoidlar marjumakning biologik faol komponentlari hisoblanadi [2, 192–198-b.]. Marjumakning eng muhim biologik faol moddalaridan biri **rutin** hisoblanadi. Rutin flavonol glikozid bo‘lib, ayniqsa o‘simlikning bargi, guli, urug‘ po‘stlog‘i va boshqa tashqi qismlarida to‘planishi mumkin. Kversetin esa rutin gidrolizi yoki fermentativ parchalanishi natijasida hosil bo‘lishi mumkin [5, 4–6-b.]. Tatar marjumagida rutin miqdori oddiy marjumakka nisbatan ko‘pincha yuqoriroq bo‘lishi qayd etilgan [6, 1–4-b.]. Rutin kapillyarlarni mustahkamlash, oksidlovchi stressni kamaytirish va qon-tomir tizimini himoya qilish bilan bog‘liq biologik ta’sirlari sababli alohida qiziqish uyg‘otadi [3, 31–34-b.].

Jing va hammualliflar Fagopyrum turkumiga mansub o‘simliklarda 100 dan ortiq biologik faol birikmalarni tavsiflab, ularni flavonoidlar, fenolik moddalar, fagopiritollar, triterpenoidlar, steroidlar va yog‘ kislotalari kabi guruhlarga ajratgan [2, 590–594-b.]. Mazkur birikmalar marjumakning antioksidant, yallig‘lanishga qarshi, gepatoprotektiv va antidiabetik faolligining ehtimoliy asosini tashkil qiladi.

Sytar va hammualliflar marjumak genotiplarida rutin, xlorogen kislota, fagopirin, oqsil va aminokislotalar miqdori genotip, o‘sish sharoiti va o‘simlikning organiga qarab o‘zgarishini ko‘rsatgan [7, 194–199-b.]. Demak, marjumakning dorivor qiymatini baholashda faqat tur nomiga emas, balki nav, genotip, yetishtirish sharoiti va qayta ishlash texnologiyasiga ham e’tibor berish lozim.

Marjumakning antioksidant xususiyatlari oksidlovchi stress hujayralarda reaktiv kislorod shakllarining ortiqcha hosil bo‘lishi bilan tavsiflanadi va yurak-qon tomir kasalliklari, metabolik buzilishlar, yallig‘lanish va qarish jarayonlari bilan bog‘liq. Marjumak tarkibidagi rutin, kversetin, xlorogen kislota, gall kislota, kofein kislota, ferul kislota va boshqa fenolik moddalar erkin radikallarni neytrallashda ishtirok etishi mumkin [8, 1–7-b.]. Kreftning sharh maqolasida marjumak fenolik metabolitlarining antioksidant faolligi, yurak-qon tomir tizimi, yallig‘lanish, diabet va boshqa patologik holatlarga potensial ta’siri tahlil qilingan. Muallif marjumak tarkibidagi rutin va kversetinning antioksidant xususiyatlari alohida ahamiyatga ega ekanini qayd etgan [3, 30–34-b.].

Marjumakning yurak-qon tomir tizimiga ta’siri yurak-qon tomir tizimi uchun potensial foydasi bir necha mexanizm bilan izohlanadi. Birinchidan, uning tarkibidagi polifenollar oksidlovchi stressni kamaytirishi mumkin. Ikkinchidan, rutin qon tomir devorlarining mustahkamligini qo‘llab-quvvatlovchi biologik faollikka ega. Uchinchidan, oziq tolalari va ayrim oqsil komponentlari lipid almashinuviga ta’sir ko‘rsatishi mumkin [3, 34–36-b.]. Xorijiy sharhlarda marjumak iste’moli qon bosimi, plazmadagi xolesterin miqdori va yurak-qon tomir xavf omillariga ijobiy ta’sir ko‘rsatishi mumkinligi qayd etilgan, biroq bunday xulosalarning bir qismi preklinik tadqiqotlarga asoslangan [9, 110–116-b.]. Shu sababli marjumakni gipertoniya yoki yurak-qon tomir kasalliklarini davolovchi dori vositasi sifatida emas, balki sog‘lom ratsionning funksional komponenti sifatida baholash to‘g‘riroqdir.

Marjumakning antidiabetik potensiali uning oqsillari, polifenollari, oziq tolalari, rezistent kraxmal, D-chiro-inozitol va fagopiritollar bilan bog‘lanadi [2, 595–599-b.]. Ushbu komponentlar uglevodlarning hazm bo‘lishi va glyukozaning so‘rilish tezligini o‘zgartirishi, insulin sezgirligiga ta’sir ko‘rsatishi mumkin. Stringer va hammualliflar 2-tip qandli diabetga ega shaxslar ishtirokidagi tadqiqotda guruch asosidagi mahsulot bilan taqqoslaganda, butun donli marjumak unidan tayyorlangan mahsulot iste’moli ovqatdan keyingi ayrim glyukozaga bog‘liq gormonal javoblarni o‘zgartirganini aniqlagan [10, 1021–1027-b.]. Ushbu natija marjumakning glyukemik nazorat nuqtayi nazaridan qiziqarli ekanini ko‘rsatadi. Biroq marjumakning qandli diabetni davolashdagi klinik samaradorligi haqida qat’iy xulosa chiqarish uchun katta hajmdagi, uzoq muddatli, randomizatsiyalangan klinik tadqiqotlar zarur. Hozirgi ma’lumotlar marjumakni **diabetga qarshi dori o‘rnini bosuvchi vosita emas, balki ratsionning foydali komponenti** sifatida ko‘rsatishga yetarlidir.

Hozirda bu qimmatbaho don mahsuloti asosan xorijdan valyutaga xarid qilinmoqda. Mamlakatimizda marjumakning biologik xususiyatlari, mahalliy sharoitga mos serhosil, sifatli don beradigan navlari va ularning ilmiy asoslangan yetishtirish texnologiyasini o‘rganish hamda tegishli tavsiyalarni ishlab chiqish marjumak yetishtirishda yechimini kutayotgan juda dolzarb muammolardir. Shunung uchun ham marjumakning ishlab chiqarish texnologiyasini o‘rganib qishloq xo‘jaligiga tatbiq etish eng dolzarb muammolardan biri hosoblanadi. Bunda grechixa yetishtirish mumkin bo‘lgan hududlarni aniqlash, tuproq va iqlim sharoitiga mos keladigan serhosil navlarni tanlash biologik xususiyatlarni o‘rganish muhimdir. Shu jihatdan marjumakni oddiy oziq-ovqat mahsuloti emas, balki **har kuni iste’mol qilinishi zarur bo‘lgan oziq-ovqat va nutrasevtik xomashyo** sifatida baholash maqsadga muvofiqdir.

FOYDALANILGAN ADABIYOTLAR

1. Sofi, S. A., Ahmed, N., Farooq, A., Rafiq, S., Zargar, S. M., Kamran, F., Dar, T. A., Mir, S. A., Dar, B. N., & Mousavi Khaneghah, A. (2023). Nutritional and bioactive characteristics of buckwheat, and its potential for developing gluten-free products: An updated overview. *Food Science & Nutrition, 11*(5), 2256–2276. https://doi.org/10.1002/fsn3.3166

2. Jing, R., Li, H.-Q., Hu, C.-L., Jiang, Y.-P., Qin, L.-P., & Zheng, C.-J. (2016). Phytochemical and pharmacological profiles of three *Fagopyrum* buckwheats. *International Journal of Molecular Sciences, 17*(4), 589. https://doi.org/10.3390/ijms17040589

3. Kreft, M. **(**2016). Buckwheat phenolic metabolites in health and disease. *Nutrition Research Reviews, 29*(1), 30–39. https://doi.org/10.1017/S0954422415000190

4. O‘roqov, S. X., Xo‘jayev, J. X., Jo‘rayeva, Z. J., & Atayeva, Sh. S. (2015). G‘alladan bo‘shagan maydonlarda yetishtirilgan marjumakning hosildorlik darajasiga mineral o‘g‘itlarning ta’siri. *Guliston davlat universiteti axborotnomasi*, (4), 30–33.

5. Huda, M. N., Lu, S., Jahan, T., Ding, M., Jha, R., Zhang, K., Zhang, W., Georgiev, M. I., Park, S. U., & Zhou, M. (2021). Treasure from garden: Bioactive compounds of buckwheat. *Food Chemistry, 335*, 127653. https://doi.org/10.1016/j.foodchem.2020.127653

6. Luthar, Z., Golob, A., Germ, M., Vombergar, B., & Kreft, I. (2021). Tartary buckwheat in human nutrition. *Plants, 10*(4), 700. https://doi.org/10.3390/plants10040700

7. Sytar, O., Brestic, M., Zivcak, M., & Tran, L.-S. P. (2016). The contribution of buckwheat genetic resources to health and dietary diversity. *Current Genomics, 17*(3), 193–206. https://doi.org/10.2174/1389202917666160202215425

8. Singh, B., Oberoi, S., & Kaur, A**.** (2024). Phenolic composition, antioxidant activity and health benefits of Tartary (*Fagopyrum tataricum* Gaerth) and common (*F. esculentum* Moench) buckwheat grains: A review. *Food Chemistry Advances, 5*, 100820. https://doi.org/10.1016/j.focha.2024.100820

9. Tufail, T., Ul Ain, H. B., Noreen, S., Tufail, S., Ajaz, N., Sultan, H., & Aja, P. M. (2026). Therapeutic and health-promoting perspectives of the functional pseudocereal buckwheat (*Fagopyrum esculentum*). *Discover Food, 6*, 138. https://doi.org/10.1007/s44187-026-00812-4

10. Stringer, D. M., Taylor, C. G., Appah, P., Blewett, H., & Zahradka, P**.** (2013). Consumption of buckwheat modulates the post-prandial response of selected gastrointestinal satiety hormones in individuals with type 2 diabetes mellitus. *Metabolism, 62*(7), 1021–1031. https://doi.org/10.1016/j.metabol.2013.01.021

ВЛИЯНИЕ ЭПИБРАССИНОЛИДА И ЕГО КОМПОЗИЦИЙ С ФЕРУЛОВОЙ КИСЛОТОЙ НА МОРФОМЕТРИЧЕСКИЕ ПОКАЗАТЕЛИ РАПСА ЯРОВОГО

Кароза С.Э., Республика Беларусь, УО «Брестский государственный университет имени А.С. Пушкина, к.б.н., доцент, (+375 162) 21-69-49, karoza01@yandex.by

Аннотация: *В статье приведены результаты лабораторного эксперимента по оценке влияния 24-эпибрассинолида, феруловой кислоты и их композиций на начальные этапы роста и развития рапса ярового. Установлено отрицательное влияние наиболее высокой дозы и разнонаправленное влияние более низких концентраций, что позволило выбрать варианты для вегетационного эксперимента.*

Ключевые слова*: рапс яровой, 24-эпибрассинолид, феруловая кислота, рострегулирующая активность, энергия прорастания, всхожесть.*

Обеспечение продовольственной безопасности Республики Беларусь опирается на повышение продуктивности сельскохозяйственных культур и их устойчивости к неблагоприятным воздействиям с сохранением качества продукции растениеводства. В идеальном варианте должно происходить улучшение характеристик этой продукции с одновременным снижением количества потенциально опасных веществ. Стандартный интенсивный путь увеличения урожайности основан на улучшении агротехники, увеличении количества и расширении спектра применяемых удобрений и средств защиты растений. Но это направление часто приводит к неблагоприятным экологическим последствиям. Вторым очень перспективным направлением является селекция новых более продуктивных и устойчивых сортов, но их создание, даже с учетом современных технологий, требует много времени, в том числе за счет длительного периода сортоиспытания. «Зеленые» для получения «чистой» продукции предлагают использовать «органическое» земледелие, но полностью перейти к нему в промышленном масштабе невозможно из-за снижения урожайности. Альтернативным путем является применение препаратов фитогормональной природы с рострегулирующими и протекторными и свойствами. Ими являются брассиностероиды (БС), сравнительно недавно выделенные в отдельный класс растительных гормонов после их обнаружен во многих видах растений. Скйчас их биологическая активность изучена уже достаточно хорошо, но последняя русскоязычная монография опубликована еще в 1993 г. [1]. За 20 лет исследований было выяснено, что они в очень невысоких концентрациях влияют на многие физиолого-биохимические процессы, изменяя при этом активность других фитогормонов [2, С. 442]. Также установлено, в том числе и в исследованиях, проведенных в

Брестском государственном университете имени А.С. Пушкина, что БС в низких дозах (10^{-10}–10^{-8} М), не оказывающих отрицательного влияния на растения и биосферу, способны активизировать процессы развития и роста сельскохозяйственных культур, повышать их устойчивость к неблагоприятным факторам среды и урожайность [3]. Но в Государственном реестре средств защиты растений и удобрений, разрешенных к применению в Республике Беларусь, в настоящее время находится всего 1 препарат брассиностероидной природы: эпин (действующее вещество – эпибрассинолид в концентрации 0,25 г/л) [4].

Одной из важных сельскохозяйственных культур, необходимых для производства высококачественного растительного масла и высокобелковых кормов для животноводства, является рапс. Рапсовое масло потребляется не только внутри страны, но и идет на экспорт, что вносит значимый вклад в экономику Республики Беларусь. В основном в Республике Беларусь возделывают рапс озимый. Но при неблагоприятных погодных условиях происходит его вымокание или вымерзание. Тогда на пострадавших участках, в том числе и взамен других погибших озимых культур, высевают рапс яровой (*Brassica napus* L. *ssp. oleifera* (Metzg.) Sinsk). Но как мелкосемянная культура он уязвим на начальных этапах развития из-за дефицита влаги, температурных колебаний и конкуренции с сорняками. Экологически безопасным способом стимуляции прорастания семян и защиты всходов от неблагоприятных условий среды является применение новых биостимуляторов стероидной природы. К ним может относиться композиция входящего в состав разрешенного к применению эпина 24-эпибрассинолида (ЭБ) и феруловой кислоты (ФК). ФК (3-метокси-4-гидроксикоричная кислота) – ароматическая непредельная карбоновая кислота, представитель оксикоричных кислот. Она не является фитогормоном, но проявляет рострегулирующую и стимулирующую активность и используется как компонент биостимуляторов роста, так как является антиоксидантом, регулирующим ауксиновый обмен и растяжение клеток [5, С. 170]. Положительное влияние ее композиции с брассиностероидами уже было установлено на примере яровой пшеницы [6].

Целью исследования являлась оценка влияния ЭБ, ФК с концентрациями 10^{-10}, 10^{-9}, 10^{-8} и 10^{-7} М и их эквимолярной смеси (ЭС) на начальные ростовые процессы и морфометрические параметры проростков рапса ярового сорта Вихрь, включённого в Государственный реестр сортов Республики Беларусь в 2020 году и районированного для всех областей [7]. Семена замачивали в исследуемых растворах на 5 часов. Оценку всхожести и энергии прорастания осуществляли согласно ГОСТ 12038–84. Дополнительно определяли высоту побегов и массу 10 растений.

Результаты эксперимента показали, что исследуемые соединения оказали неоднозначное влияние на разные показатели, в зависимости от используемой концентрации. Так, ЭБ повышал энергию прорастания только в двух вариантах: 10^{-9} и 10^{-8} М (+3,1 и 1,7 % к контролю соответственно). Самая высокая доза препарата (10^{-7} М) вызывала понижение этого показателя на 2,8 % по отношению к контролю, а самая низкая (10^{-10} М) – на 0,6 %. ФК при использовании растворов с концентрациями 10^{-10} и 10^{-7} М понизила энергию прорастания на 4,5 и 0,8 % соответственно, а 10^{-9} и 10^{-8} М, наоборот, повысила на 1,5 и 0,9 %.

Всхожесть семян незначительно повысили только две минимальные дозы ЭБ (10^{-10} и 10^{-9} М) – на 0,5 и 0,2 % соответственно. Более высокие дозы (10^{-10} и 10^{-9} М) привели к понижению всхожести на 1,0 и 3,9 % соответственно. Незначительное отрицательное влияние ФК проявилось только при в самой низкой дозе 10^{-10} М (–0,8 %), а в остальных вариантах наблюдались отличия от контроля в положительную сторону. Применение смеси дало небольшие положительные результаты при использовании растворов в минимальной и максимальной концентрациях (+0,2 и 0,7 % соответственно). Дозы 10^{-9} и 10^{-8} М вызвали понижение данного показателя на 2,6 и 1,3 % соответственно.

Влияние ЭБ на высоту побега было отличалось от влияния и на энергию прорастания, и на всхожесть. Он повышал высоту побегов только в самой низкой применяемой дозе 10^{-10} М (+9,7 % к контролю). Его самая высокая доза (10^{-7} М) вызывала очень сильное понижение этого показателя (–20,1 %). В остальных вариантах (концентрации 10^{-9} и 10^{-8} М) высота побегов снижалась на 6,3 и 5,0 % по отношению к контролю. ФК вызвала увеличение высоты побегов на 4,2 % только при использовании минимальной дозы (10^{-10} М). Растворы с концентрациями 10^{-9}, 10^{-8} и 10^{-7} М вызвали уменьшение этого показателя на 4,1, 9,0 и 12,1 % соответственно. Применение ЭС оказало положительный эффект только при использовании концентрации 10^{-8} М (+5,2 %).

Растворы с концентрациями 10^{-10}, 10^{-9} и 10^{-7} М вызвали снижение этого показателя на 4,7, 10,7 и 5,0 % соответственно.

Массу растений ЭБ повышал только в самой низкой концентрации 10^{-10} М (+15,1 % к контролю). Самая высокая доза (10^{-7} М) вызывала очень сильное понижение этого показателя (–16,4 % к контролю). В остальных вариантах энергия прорастания также была ниже контроля, но разница была менее значительной. ФК, наоборот, оказала максимальное положительное влияние на массу растений в максимальной дозе 10^{-7} М (+13,1 % к контролю), а максимальное отрицательное – в минимальной дозе 10^{-10} М (–14,0 %

к контролю). Влияние растворов в двух промежуточных концентрациях было положительным, но выраженным слабо. ЭС оказала положительное, но слабое влияние при применении растворов во всех 4 концентрациях, при этом масса растений была максимальной при использовании минимальной дозы препаратов (10^{-10} М), где превышение составило 5,1 %.

Заключение. Таким образом, анализ полученных данных лабораторного эксперимента показал, что на большинство морфометрических показателей роста и развития рапса ярового сорта Вихрь наиболее высокая используемая концентрация ЭБ и ЭС 10^{-7} М оказала отрицательное влияние. Влияние остальных доз было разнонаправленным, поэтому не удалось выявить одну оптимальную концентрацию для эпибрассинолида, феруловой кислоты и их эквимолярной смеси, и для дальнейших этапов исследования в почвогрунте решено использовать растворы с концентраицмями 10^{-10}, 10^{-9} и 10^{-8} М.

СПИСОК ИСПОЛЬЗОВАННОЙ ЛИТЕРАТУРЫ

1. Хрипач, В. А. Брассиностероиды / В. А. Хрипач, Ф. А. Лахвич, В. Н. Жабинский. – Минск : Наука и техника, 1993. – 287 с.

2. Kripach, V. Twenty years of brassinosteroids: steroidal plants hormones warrant better crops for the XXI century / V. Kripach, V. Zhabinskii, A. de Groot // Annals Bot. – 2000. – Vol. 86. – P. 441–447.

3. Кароза С.Э. [и др.] Биологическая активность брассиностероидов и стероидных гликозидов / под общ. ред. С.Э. Карозы. – Брест : БрГУ, 2020. – 260 с.

4. Государственный реестр средств защиты растений и удобрений. – URL: https://ggiskzr.by/documents/reestr/5.%20Перечень%20зарегистрирован-ных%20СЗР.pdf (дата обращения: 03.10.2026).

5. Antioxidative potential of ferulic acid phenoxyl radical / A. Amić, Z. Marković, J. M. D. / Marković [et al.] // Phytochemistry. – 2020. – Vol. 170. – Art. 112218.

6. Росторегулирующая активность брассиностероидов при совместном использовании их с феруловой кислотой на растениях яровой пшеницы / Р. П. Литвиновская, Н. Е. Манжелесова [и др.] // Прикладная биохимия и микробиология. – 2025. – Т. 61, № 2. – С. 172–184.

7. Продукция: Корма // Брестская областная сельскохозяйственная опытная станция НАН Беларуси : [сайт]. – Брест, 2026. – URL: https://agronauka.brest.by/produkcziya/korma (дата обращения: 26.05.2026).

OZUQA TARKIBIDAGI KLETCHATKANING QUYONLAR QONINING GUMORAL IMMUN TIZIMIGA TA’SIRI

[1]Normurodova M.A., [2]Bazarov B.M., [3]Hayitov D.G‘.

[1]Zarmed univeristeti (Samarqand kompusi), assistent

[2,3]Sharof Rashidov nomidagi Samarqand davlat universiteti, dotsentlari

Abstract. *This article demonstrates that dietary fiber content directly influences local intestinal immunity and the synthesis of general immunoglobulins (antibodies) in the blood of rabbits. The comparative numerical indicators of primary immunoglobulins in the blood of rabbits fed with diets containing 10%, 22.8%, 30%, and 40% fiber are presented below.*

Keywords. *Rabbit, diet, immunoglobulin, fiber, antibody, intestines, physiological limit.*

Аннотация. *В данной статье рассматривается прямое влияние содержания клетчатки в рационе на местный иммунитет кишечника и синтез общих иммуноглобулинов (антител) в крови кроликов. Ниже приведены сравнительные числовые показатели основных иммуноглобулинов в крови кроликов, получавших рационы с содержанием клетчатки 10%, 22,8%, 30% и 40% .*

Ключевые слова. *Кролик, рацион, иммуноглобулин, клетчатка, антитело, кишечник, физиологический предел.*

Quyonlardan olinadigan mahsulotlarini ishlab chiqarishni ko‘paytirish uchun eng muhim omillardan biri bu yuqori adaptatsion xususiyatga ega hayvonlarni tanlash, ko‘paytirish va baholash muhimdir. Shu tufayli quyonlarning moslanuvchanlik imkoniyatlarini o‘rganish muhim ilmiy va amaliy ahamiyatga ega.

Tabiiy chidamlilik darajasi hayvonlarning yoshi, yil vaqti, oziqlantirish va parvarish qilish sharoitlari kabi omillar ta’sirida organizmning kasalliklarga qarshilik darajasini tavsiflaydi [5; 186-189 b].

Quyonlarning stressga, ayniqsa noqulay atrof-muhit sharoitlariga sezgir ekanligini bildiradi. Ko‘pgina ekzogen va texnologik omillar, masalan, emlash, populyatsiyani yaratish, ozuqa tarkibidagi o‘zgarishlar bu hayvonlarning organlari va tizimlarining ichki funksiyasini buzadi. Organizmning qarshiligi pasayganda, konsentrlangan o‘choqlarda patogen bakteriyalar va mikroorganizmlar majburiy mikroflorani almashtirib, oshqozon-ichak traktida dominantlik qiladi, bu esa quyonlarda turli kasalliklarga olib keladi.

Ayyat M.S., Al-Saghir A.A. va boshqalar o‘z ishlarida jismoniy qarshilik darajasi organizmning patogen bakteriyalar va viruslar kabi tashqi omillarning salbiy ta’siridan o‘zini himoya qilishga tayyorligini ko‘rsatishini tasdiqlaydi va neytrofillarning fagotsitik faolligi, qon

zardobining bakteritsid faolligi va qon zardobidagi lizozim faolligi kabi ko‘rsatkichlar bilan tavsiflanadi, bu asosan oziqlanish va yashash sharoitlariga bog‘liqdir [1; 162-173].

Odam va hayvonlar organizmida noqulay omillar ta’sirida paydo bo‘ladigan begona antigenlarni farqlash jarayonida ikki turga oid molekulalar ishtirok etadi. Bulardan biri immunoglobulinlar bo‘lsa, ikkinchisi T-hujayralarning antigen retseptorlaridir. Immunoglobulinlar yoki antitanalar glikoproteinlar bo‘lib, barcha sut emizuvchilarning zardob va to‘qima suyuqliklarida uchraydi. Immunoglobulin molekulalarini plazmatik hujayralar ko‘p miqdorda ishlab chiqaradi.

O‘ziga xos bo‘lmagan immunitetni oshirish, ozuqaning hazm bo‘lishini va assimilyatsiyasini yaxshilash, hayvonlarning o‘sishi va rivojlanishini rag‘batlantirish uchun fitokomponentlar bilan boyitilgan turli xil fermentlar, probiyotiklar, prebiyotiklar va murakkab probiyotik preparatlar qo‘llaniladi [2; 789-795 b., 3; 376-386 b].

Hozirgi vaqtda chorvachilik amaliyotida biologik faol preparatlar, vitaminlar, minerallar, antioksidantlar, immunomodulyatorlar va turli probiyotik ozuqa qo‘shimchalaridan foydalangan holda hayvonlarning go‘sht mahsuldorligini oshirish usullari keng qo‘llanilmoqda [4; 45-49 b].

Tadqiqot obe’ktlari va usullari. Tadqiqot uchun 3 oylik hikol zotiga mansub quyonlarda olob borildi. Ozuqa ratsioni 1000 gramm (1 kg) ozuqa ratsionining (200 g makkajo‘xori so‘tasi po‘stlog‘i, 200 g uzum po‘stlog‘i, 200 g olma po‘stlog‘i, 100 g somon, 100 g beda, 100 g arpa va 100 g kombikorm) da kletchatkani turli konsentsrtsiyasi inobatga olindi.

Kletchatka –Gravimetrik usulida tekshirildi (GOST-31675-2012).Xom kletchatka aniqlash usuli barcha turdagi o‘simlik ozuqalari, omuxta yem va ozuqa xomashyosi uchun qo‘llaniladi va xom kletchatka tarkibini aniqlash usulini belgilaydi. Usul mahsulotdan kislota-asosda eruvchan moddalarni olib tashlash va an’anaviy ravishda kletchatka sifatida qabul qilinadigan qoldiq massasini aniqlashga asoslangan.

Tadqiqot natijalari tahlili. Immunoglobulin G (IgG) ko‘proq to‘qima suyuqliklarida uchrab bakteriya zaharlarini neytrallashtirish va mikroorganizmlarni o‘ziga bog‘lashda muhim ahamiyatga ega. Bundan tashqari IgG, bakteriyalar bilan kompleks birikmalar hosil qilib, komplement tizimini kuchaytiradi va leykotsitlarni xemotaksisga olib keladi. Kletchatka miqdori 10 % bo’lganda infeksiyalar kirish xavfi ortgani uchun kompensator reksiya kuzatiladi. IgG 22,8% kletchatkada eng yuqori ko‘rsatkich (9,2 mg/ml) qayd etiladi. Organizmning umumiy himoya qobiliyati eng yuqori nuqtada. Bu quyonning surunkali va yuqumli kasalliklarga qarshi kuchli antitelo zaxirasiga ega ekanligini anglatadi. Kletchatka miqdori 30 % bo’lganda ozuqa hazm bo‘lishi qiyinlashgani sari sintez sekinlashadi. 40% kletchatkada ko‘rsatkich ikki barobardan ko‘proqqa tushib ketadi, bu esa

oqsil ochligi sababli himoya oqsillari sintezi to‘xtaganidan dalolat beradi. Kuchli disterioz va anemiya fonida oqsil sintezi va immunitet susayadi.

Immunoglobulin A (IgA) qon zardobi tarkibidagi umumiy immunoglobulinlar miqdorining 10-15 foizni tashkil etadi. Bu molekulalar ko‘pincha shilliq pardalarning sekretlarida, masalan, so‘lak, ko‘z yoshi va burun suyuqligi, teri hamda o‘pka sekretlarida uchrab, uning shilliq pardasini tashqi muhitdan tushayotgan mikroorganizmlar ta’siridan himoya qiladi. Bu ko‘rsatkich ichak shilliq qavatini himoya qiladi. Kletchatka miqdori 10 % bo’lganda ichak shilliq qavati atrofiyasi tufayli sintez kamayadi. Kletchatka kamligida (10%) IgA pasayadi, natijada ichak devorlari patogen bakteriyalar uchun ochiq bo‘lib qoladi. Kletchatka me’yorda bo‘lganda (22,8%) Ichak bariyeri mustahkam ichak mikroflorasi IgA ishlab chiqarilishini rag‘batlantiradi. Kletchatka miqdori 30 % bo’lganda normaga yaqin yoki biroz pasayish tendensiyasiga ega. Kletchatka miqdori 40 % bo’lganda kuchli disterioz va anemiya fonida oqsil sintezi va immunitet susayadi.

1-jadval

Quyonlar qonidagi immunoglobulinlar miqdorini klechatkaga bog‘liqligi (mg/ml), n=10

Ko‘rsatkichlar	10% Kletchatka	22,8% Kletchatka	30% Kletchatka	40% Kletchatka
IgG	6,5 ± 0.4	9,2 ± 0.6	7,1 ± 0.5	4,2 ± 0.3
IgA	0,18 ± 0.02	0,35 ± 0.04	0,25 ± 0.03	0,12 ± 0.01
IgM	0,45 ± 0.05	0,68 ± 0.08	0,52 ± 0.06	0,30 ± 0.04
IgE	0,08 ± 0.01	0,04 ± 0.01	0,06 ± 0.01	0,09 ± 0.02

Organizmning immunologik javob reaksiyasi sifatida birinchi bo‘lib immunoglobulin M (IgM) namoyon bo‘ladi. IgM agglyutinatsiya va hujayralar lizisini juda oson keltirib chiqaradi. Ular B-limfotsitlarning membrana tarkibidagi antigen aniqlovchi retseptorlari hisoblanadi. Organizmga infeksiya tushganda birinchi bo‘lib IgM javob beradi. Kletchatka miqdori 30 % bo’lganda ichak orqali patogenlar o‘tishi (translokatsiya) hisobiga birlamchi reaksiya. Uning 22,8% li ratsionda barqaror bo‘lishi organizmning tezkor himoya reaksiyasiga tayyorligini bildiradi. Antigenik yuklama yo‘q, tizim tinch holatda. Kletchatka miqdori 30 % bo’lganda fiziologik chegaralarda saqlanadi. Kletchatka miqdori 40 % bo’lganda suyak ko‘migi va limfoid a’zolar faoliyati susayishi (leykopeniya) hisobiga.

Immunoglobulin E (IgE) immunoglobulinlar sinfiga kiradi, ular asosan shilliq-nafas olish va oshqozon-ichak traktida, shuningdek, mintaqaviy limfa tugunlarida sintezlanadi. Qon zardobida IgE faqat juda past konsentratsiyalarda bo‘ladi. Ushbu immunoglobulinning muhim qismi bazofillarning hujayralari bilan bog‘liq. IgE ning asosiy vazifasi allergik hodisalarda gistaminning chiqarilishini rag‘batlantirishdan iborat deb taxmin qilinadi. IgE molekulalari bir-biri bilan disulfid bog‘lari bilan bog‘langan ikkita L va ikkita H zanjiridan iborat. Bu ko‘rsatkichning 10% va 40% kletchatkada yuqori bo‘lishi (0,08-0,09 mg/ml) ichakdagi yallig‘lanish jarayonlari yoki disbakterioz oqibatidagi allergik stressdan dalolat beradi. Kletchatka miqdori 10 % bo’lganda ichak to‘siq funksiyasi buzilishi ozuqa allergenlariga sezuvchanlikni oshiradi. 22,8% kletchatkada esa IgE eng past darajada bo‘lib, ichak tizimi tinch va sog‘lom ekanligini ko‘rsatadi. Allergiya yoki immunologik asabbiylik kuzatilmaydi. Kletchatka miqdori 30 % bo’lganda ozuqa komponentlariga nisbatan xavfsiz neytrallik. Kletchatka miqdori 40 % bo’lganda toksik/allergik va o‘tkir alimentar stress reaksiyasi tufayli kechadi (1-jadval).

Xulosa. Ozuqa tarkibida 10% kletchatka bo’lganda yetishmovchilik holati yuzaga keladi. Quyonlar ko‘r ichagida (sekum) ozuqa massasining harakati sekinlashadi, pH muvozanati buziladi (ishqoriy tomonga siljiydi) va patogen mikroflora ko‘payadi. Bu holat ichak devorida yallig‘lanishni chaqirgani sababli, qonda IgM va IgE miqdori ko‘tarilishi, lekin tizimli himoya qiluvchi IgA va IgG guruhlari kamayishi kuzatiladi. Ratsiondagi 22,8% kletchatka optimal doza hisoblanadi. Ko‘r ichakda erkin yog‘ kislotalari (sirka, moy, propion kislotalar) sintezi stimullanadi. erkin yog‘ kislotalari esa ichak limfotsitlarini faollashtirib, IgA (shilliq qavat himoyachisi) va IgG (qon antitelolari) sintezini eng yuqori samarali darajaga olib chiqadi.

Kletchatkaning 30% ga oshirilishi mo‘tadil yuklama bo’lib ozuqa hazm qilish tizimi jiddiy ishlay boshlaydi. Ko‘rsatkichlar me’yor atrofida bo‘lsa-da, ozuqaviy moddalarning so‘rilish samaradorligi biroz tushgani sababli immun tizimi oqsillar (immunoglobulinlar) sintezi uchun yetarlicha qurilish materiallari (aminokislotalar) ololmaydi, natijada barcha immunoglobulinlar biroz pasayish tendensiyasini ko‘rsatadi. 40% Kletchatka o‘tkir alimentar va oksidativ stressni keltirib chiqaradi. Ratsionning deyarli yarmi kletchatkadan iborat bo‘lishi ichak mexanik jarohatlanishiga, ozuqa moddalari to‘liq so‘rilmasdan chiqib ketishiga (gipotrofiya) olib keladi. Leykotsitlar miqdori tushib ketishi fonida qonda IgA, IgG va IgM keskin kamayadi (immunodefitsit holati). Ayni paytda, organizmda kechayotgan tizimli alimentar stress va yallig‘lanish javobi sifatida IgE miqdori patologik darajada yuqorilashi mumkin

FOYDALANILGAN ADABIYOTLAR

1. Ayyat M.S. Organic selenium, probiotics, and prebiotics effects on growth, blood biochemistry, and carcass traits of growing rabbits during summer and winter seasons / M.S. Ayyat, A.A. Al-Sagheer, K.M. Abd El-Latif, B.A. Khalil Organic Selenium // Biological Trace Element Research. 2018;186 (1):162-173.
2. Marcin A. Comparison of the effect of Enterococcus faecium and aromatic oils from sage and oregano on growth performance and diarrhoeal diseases of weaned pigs. / A. Marcin, A. Laukova, R. Mati // In Biologia Bratislava. – 2006. – Vol. 61 (6). – P. 789-795.
3. Pogany Simonova, M. Enterococcus faecium CCM7420, bacteriocin PPB CCM7420 and their effect in the digestive tract of rabbits / M. Pogany Simonova, A. Laukova, L. Chrastinova, V. Strompfova, S. Faix, Z. Vasilkova, L. Ondruska, R. Jurcík, J. Rafay // In Czech Journal of Animal Science. – 2009. – Vol. 54. – № 8. – P. 376-386.
4. Ноздрин, Г.А. Влияние пробиотиков на количественные и качественные показатели мясной продуктивности животных / Г.А. Ноздрин // Мат. 2-го международного конгресса по пробиотикам. – 2009. – С. 45-49
5. Селиванова И.Р. Новый пробиотик Бифилак для лечения и профилактики расстройств пищеварения у поросят / И.Р. Селиванова // Ветеринарная патология. – 2007. – № 2. – С. 186-189.

“LUZULA CAMPESTRIS” O’SIMLIGINING BOTANIK TAVSIFI, GEOGRAFIK TARQALISHI

K.I.Sharifmurodov. *Samarqand davlat pedagogika instituti o’qituvchisi*

D. B. Ro’ziyeva. *Samarqand davlat pedagogika instituti talabasi*

Annotatsiya: *Ushbu maqolada Luzula campestris o’simligining botanik tavsifi, ekologik tarqalishi, ahamiyati va taksonomik belgilari keltirilgan. Luzula cmpestris Yakondoshlar oilasiga mansub bo’lib, asosan botqoqliklarda, ochiq qirg’oqbo’yi o’tloqlarida sernam joylarda keng tarqalgan o’simlik turi hisoblanadi. Amaliy ahamiyati yetarli darajada tahlillarni kutmoqda.*

Kalit so’zlar*:Luzula campestris, morfologiyasi, taksonomiyasi, yem -xashak.*

Abstract: *This article presents the botanical description of the plant* Juncus gerardi*, its ecological distribution, global geographical distribution, significance, and taxonomic characteristics.* Luzula compstris *belongs to the Juncaceae family and is mainly widely distributed in marshlands, open coastal meadows, and moist habitats. Its practical importance still requires further analysis and research.*

Keywords:Luzula campestris*, morphology, taxonomy, forage plant.*

KIRISH: Juncaceae Juss. — Yakandoshlar oilasi bir pallali o‘simliklar qatoriga mansub bo‘lib, uning vakillari morfologik tuzilishi, ekologik xususiyatlari va geografik tarqalishi bilan ajralib turadi. Mazkur oila tarkibidagi Luzula DC. turkumi o‘simliklar sistematikasi va floristik tadqiqotlarda muhim o‘rin tutadi. Turkum vakillari asosan mo‘tadil va sovuq iqlimli mintaqalarda, tog‘li hududlarda, o‘rmonlar, o‘tloqlar hamda namligi turlicha bo‘lgan yashash muhitlarida tarqalgan. So‘nggi yillarda Luzula DC. turkumining taksonomik tarkibi, morfologik belgilari va filogenetik munosabatlarini o‘rganishga qaratilgan tadqiqotlar olib borilmoqda. Xususan, morfologik tahlillarni molekulyar-genetik ma’lumotlar bilan uyg‘unlashtirish turlar o‘rtasidagi qarindoshlik munosabatlarini aniqlash, taksonomik muammolarni hal etish va turkumning evolyutsion tarixini chuqurroq anglash imkonini beradi.

Dolzarbligi: *Luzula* turkumining dolzarbligi, avvalo, uning turlarini morfologik va sistematik jihatdan tavsiflash, tarqalish hududlarini aniqlash hamda turli ekologik sharoitlarga moslanish xususiyatlarini o‘rganish bilan belgilanadi. Ushbu turkum vakillari ko‘p yillik o‘simliklar bo‘lib, barglarining chetida mayda tuklarning mavjudligi ularning muhim morfologik belgilaridan biri hisoblanadi.

Ahamiyati: Dorivor va texnik ahamiyatga ega . Botqoq ekotizimining barqarorligini saqlashda muhim rol o’ynaydi va qirg’oq eroziyasini kamaytiradi. Tuprpqni mustahkamlaydi, qushlar va hayvonlar uchun yashash joy yaratadi. Sho’r va nam muhitlarga moslashgan galofit tur hisoblanadi .Ozuqabop yem-xashak sifatida ishlatiladi (4)

Botanik tavsifi: lk bor J.B.A.M. de Lamark va A.P. de Kandollning *Flore Française* asarining 3-nashri, 3-jildi, 158-betida (1805-yil) ma’lumot berilgan. Luzula turkumida hozirgi kunda125 tur borligi aniqlangan [1]. Gulqo‘rg‘on bargchalari asosida o‘zaro qo‘shilgan, yupqa pardasimon. Tugunchasi bir uyali. Changchilari 3 ta. Mevasi uch qirrali, bir uyali ko‘sakcha. Urug‘lari 3 ta bo‘lib, bir uchida etli o‘simtasi bor. To‘pguli ro‘vaksimon, soyabonsimon yoki boshchasimon. Gullari oq, pardasimon qo‘shimchalarga ega.O‘simliklar ko‘p yillik. Poyasi yuqori qismigacha bargli. Barg qinlari yopiq. Barglari yassi, chetlari ozmi-ko‘pmi oq kiprikchalar bilan qoplangan [2].(flora uzbekistana).Hozirgi kunda luzula turkumini O’zbekistonda 2turi uchraydi.Ular Luzula pallescens Sw va Luzula spicata. (flora uzbekistana jizakh) [3]. uzula pallescens Sw. — oqish luzula. Ko‘p yillik o‘simlik. Daryo qirg‘oqlarida, botqoqlashgan nam yerlarda va alp o‘tloqlarida o‘sadi. Tog‘larning o‘rta va yuqori mintaqalarida tarqalgan. Shimoliy Turkiston hududida uchraydi. Yem-xashak o‘simligi.. Luzula spicata (L.) DC. — boshoqli luzula. Ko‘p yillik o‘simlik. Morenalar, qoyalar, nam toshloq yonbag‘irlar, botqoqlashgan nam yerlar, daryo va soy qirg‘oqlarida o‘sadi. Tog‘larning yuqori mintaqasida tarqalgan. Shimoliy Turkiston hududida uchraydi. Yem-xashak o‘simligi [3].

1-rasm**. (planetarium.ru).**



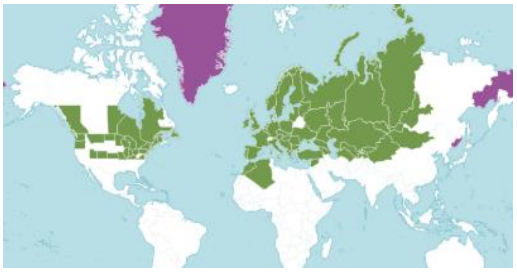
Luzula bermudiana Luzula divigulats Luzula multiflora

Luzula Campestris(L) ning **Klassifikatsiyasi:**

T/r	Sistematik birlik	Lotincha	O’zbekcha
1	Bo’lim	Magnoliyophyta	Gulli o’simliklar
2	Sinf	Liliopsida	Bir urug’palallliar
3	Qabila	Juncalec	Yakonomalar

4	Oila	Juncaceae	Yakondoshlilar
5	Turkum	Luzula	Luzula
6	Tur	Campestris(L)	Campestris(L)

(2-jadval)



2 rasm.

Luzula DC. turkumining tarqalishi: Yevropa, Osiyo, Afrika, Shimoliy va Janubiy Amerika, Avstraliya hamda Okeaniya hududlarida tarqalgan. Jumladan, Rossiya, Qozog‘iston, O‘zbekiston, Tojikiston, Qirg‘iziston, Xitoy, Hindiston, Yaponiya, Turkiya, Eron, Kavkaz, G‘arbiy va Sharqiy Sibir, Himolay tog‘lari, Shimoliy Amerika va Yangi Zelandiyada uchraydi.[1]

Xulosa:

Luzula campestris — o‘ziga xos ingichka barglari, tukchali barg chetlari va qizg‘ish-jigarrang gul to‘plamlari bilan ajralib turadigan ko‘p yillik o‘simlik. U Juncaceae oilasiga mansub bo‘lib, asosan Yevropa va Shimoliy-G‘arbiy Afrikada tabiiy tarqalgan. Turning morfologik belgilari, geografik areali va o‘sish muhiti uni boshqa Luzula turlaridan farqlashda muhimdir. O‘zbekiston florasidagi mavjudligi va xo‘jalik ahamiyatini aniqlash uchun mahalliy gerbariy namunalari hamda mintaqaviy floristik manbalar bilan solishtirish lozim

Adabiyotlari:

1. POWO. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet: https://powo.science.kew.org/. Accessed 19 October 2026.
2. Тожибаев К.Ш., Бешко Н.Ю., Эсанкулов А.С., Батошов А.Р., Азимова Д.Э. Кадастр флоры Узбекистана: Джизакская область. — Ташкент: Zamin nashr, 2021. — 368 с. Ташкент:
3. Флора Узбекистана. В 6 т. — Ташкент: Издательство Академии наук Узбекской ССР, 1941–1962.

4. *Edgar, E; Healy, A. J. (1980). Flora of New Zealand Adventive Cyperaceous, Petalous & Spathaceous Monocotyledons. Vol. 3. Wellington, New Zealand: P. D. HASSELBERG. ISBN 0-477-01041-5.*

FITONEMATODALAR VA ULARNING QISHLOQ XO‘JALIGI EKINLARIGA TA’SIRI

Vaydullayeva Ziyoda Shaxob qizi

Otamurodova Sevinch Mansurovna

Samarqand davlat pedagogika instituti talabalari

Spitamen shox 166

Annotatsiya.*Ushbu tezisda fitonematodalarning biologik xususiyatlari, tashqi tuzilishi, oziqlanishi, ko‘payishi va rivojlanishi hamda qishloq xo‘jaligi ekinlariga yetkazadigan zarari izchil yoritiladi. Shuningdek, ildiz bo‘rtma nematodalari (Meloidogyne), sista hosil qiluvchi nematodalar (Heterodera), ildiz to‘qimalarini zararlovchi nematodalar (Pratylenchus) va poya nematodalari (Ditylenchus)ning ayrim xususiyatlari bayon etiladi. O‘zbekistonda fitonematodalarni o‘rganishga oid ilmiy ishlar hamda ularga qarshi kurashning asosiy yo‘llari ko‘rib chiqiladi.*

Kalit so‘zlar*: fitonematodalar, fitogelmintologiya, parazitizm, stilet, ildiz bo‘rtmasi, sista, g‘o‘za, sabzavot ekinlari, almashlab ekish, biologik kurash.*

Abstract. *This thesis systematically examines the biological characteristics, structure, feeding habits, reproduction, and development of plant-parasitic nematodes, as well as their harmful effects on agricultural crops. Certain characteristics of nematodes belonging to the genera Meloidogyne, Heterodera, Pratylenchus, and Ditylenchus are described. The thesis also reviews research on plant-parasitic nematodes in Uzbekistan and the main methods for reducing their harmful effects.*

Keywords: *plant-parasitic nematodes, phytohelminthology, parasitism, stylet, cotton, vegetable crops, crop rotation, biological control.*

Kirish. Qishloq xo‘jaligida yuqori va sifatli hosil yetishtirish o‘simliklarning sog‘lom o‘sishi hamda rivojlanishini ta’minlash bilan chambarchas bog‘liq. Ekinlarga zarar yetkazuvchi organizmlarni o‘rganish, ularni o‘z vaqtida aniqlash va qarshi kurash choralarini to‘g‘ri tanlash dehqonchilikning muhim vazifalaridan biridir. Ana shunday organizmlar qatoriga fitonematodalar ham kiradi.

Fitonematodalar — o‘simliklarda parazitlik qiladigan, odatda juda mayda, ipsimon tanali yumaloq chuvalchanglardir. Ularning ko‘pchiligi tuproqda va o‘simlik ildizlarida uchraydi, ayrim turlari esa poya, barg, piyozbosh yoki urug‘larni zararlashi mumkin. O‘simlik paraziti nematodalar stilet deb

ataladigan sanchib-so‘ruvchi organ yordamida hujayralarga ta’sir ko‘rsatib, oziq moddalar bilan oziqlanadi.

Fitonematodalarning zarari dastlab aniq ko‘rinmasligi mumkin. Zararlangan o‘simliklarda o‘sish sekinlashadi, barglar sarg‘ayadi, ildizlar shikastlanadi va suv hamda mineral moddalarni o‘zlashtirish jarayoni buziladi. Kuchli zararlanish hosildorlikning pasayishiga, ayrim hollarda esa o‘simlikning nobud bo‘lishiga olib keladi. Shu bois fitonematodalarning tuzilishi, hayot faoliyati va ekinlarga ta’sirini o‘rganish ilmiy hamda amaliy ahamiyatga ega [2].

Fitonematodalarning umumiy tavsifi va morfologik tuzilishi.

Fitonematodalar Nematoda tipiga mansub bo‘lib, ularning o‘simliklarda parazitlik qiladigan ko‘plab turlari mavjud. Tanasi cho‘zinchoq va ipsimon, ikki uchi ingichkalashgan bo‘lib, tashqi tomondan kutikula bilan qoplangan. Kutikula tanani tashqi ta’sirlardan himoya qilishga yordam beradi. Nematodalarning o‘lchami va tana shakli turiga, rivojlanish bosqichiga hamda yashash muhitiga qarab farqlanadi.

Fitonematodalarni oziqlanish xususiyati va zararlaydigan o‘simlik organiga qarab farqlash mumkin. Ayrim turlari ildiz to‘qimalari ichida yashaydi, boshqalari ildiz yuzasida yoki tuproqda turib oziqlanadi. Stilet o‘simlik hujayrasini teshib, oziq moddalarni olish imkonini beradi. Ushbu organ orqali oziqlanish hujayralarning shikastlanishiga va o‘simlik to‘qimalarida turli o‘zgarishlar yuzaga kelishiga sabab bo‘lishi mumkin [4].

Fitonematodalar bilan zararlanish belgilari har doim ham faqat nematodaga xos bo‘lmaydi. O‘sishning sustlashishi, barglarning sarg‘ayishi va ildizning zararlanishi boshqa kasalliklar yoki noqulay sharoitlarda ham kuzatiladi. Shuning uchun nematodalar mavjudligini aniq belgilashda o‘simlik alomatlarini kuzatish bilan birga tuproq va ildiz namunalarini laboratoriyada tekshirish zarur. Fitonematodalarning oziqlanishi, ko‘payishi va rivojlanishi.

Fitonematodalar o‘simlik hujayralaridagi moddalar bilan oziqlanadi. Ularning oziqlanishi o‘simlik to‘qimalariga bevosita ta’sir qilib, ildizning suv va mineral moddalarni o‘zlashtirish qobiliyatini susaytirishi mumkin. Natijada o‘simlikning oziqlanish muvozanati buziladi, o‘sishi sekinlashadi va hosil miqdori kamayishi ehtimoli ortadi.

Turli fitonematodalar o‘simlikda turlicha shikastlanishlarni keltirib chiqaradi. Masalan, Meloidogyne avlodiga mansub ildiz bo‘rtma nematodalari ildizlarda bo‘rtmalar hosil qiladi. Heterodera avlodining ayrim vakillari rivojlanish jarayonida sista hosil qilishi bilan ajralib turadi. Pratylenchus nematodalari ildiz to‘qimalarini zararlab, nekrotik o‘zgarishlarga sabab bo‘lishi mumkin. Ditylenchus avlodining ayrim turlari esa poya va boshqa o‘simlik organlarida parazitlik qiladi.

Ko‘pchilik fitonematodalarning rivojlanish sikli tuxum, lichinkalik bosqichlari va voyaga yetgan individ davrlarini o‘z ichiga oladi. Tuxumdan chiqqan yosh nematoda bir necha rivojlanish bosqichidan o‘tib voyaga yetadi. Rivojlanish davomiyligi, oziqlanish joyi va o‘simlikka kirish bosqichi nematoda turiga qarab farqlanadi [2].

Rivojlanish tezligiga tuproq harorati va namligi, tuproqning mexanik tarkibi, oziq o‘simlik turi, o‘simlikning fiziologik holati hamda nematoda turining biologik xususiyatlari ta’sir ko‘rsatadi. Qulay sharoitda ayrim turlar tez ko‘payib, populyatsiya sonini oshiradi. Boshqa turlar esa tuxum yoki chidamli bosqichlarda noqulay sharoitni o‘tkazishi mumkin. Shu sababli zararlanishni kamaytirish uchun tuproq va ildiz namunalarini tekshirish, shuningdek, ekin maydonlarini muntazam kuzatib borish muhim.

O‘zbekistonda fitonematodalar faunasi, ularning o‘simliklar bilan munosabati va qishloq xo‘jaligidagi ahamiyatini o‘rganish bo‘yicha ilmiy izlanishlar olib borilgan. Bunday tadqiqotlar mamlakat hududida uchraydigan nematodalar turlarini aniqlash, ularning tarqalishini o‘rganish va ekinlarga ta’sirini tushunishda muhim o‘rin tutadi.

A. T. To‘laganov va A. Z. Usmanova O‘zbekiston fitonematodalarini o‘rganish bilan bog‘liq ilmiy ishlari bilan tanilgan. Ularning «Фитонематоды Узбекистана» asari respublikada fitonematodalar faunasini o‘rganishga oid muhim bibliografik manbalardan biri hisoblanadi. Mazkur yo‘nalishdagi ishlar o‘simliklarda uchraydigan nematodalar tarkibi va ularning xo‘jalik ekinlari bilan bog‘liqligini yoritishga xizmat qiladi [1].

E.S. Kiryanova va T. S. Ivanovaning ishlari ham fitogelmintologiya va parazit nematodalarni o‘rganish bilan bog‘liq adabiyotlarda keltiriladi. Sh. X. Xurramovning Janubiy O‘zbekiston o‘simliklarining parazit nematodalariga oid tadqiqotlari hududiy faunani o‘rganish nuqtayi nazaridan ahamiyatlidir. Olimlarning aniq ilmiy natijalarini bayon qilishda ularning asarlari va bibliografik ma’lumotlariga tayanish lozim [4].

Fitonematodalar o‘simlik ildizi va boshqa organlarini zararlab, o‘sish hamda rivojlanish jarayonlariga salbiy ta’sir ko‘rsatishi mumkin. Ildizning shikastlanishi suv va mineral moddalarning o‘zlashtirilishini qiyinlashtiradi. O‘simlik zaiflashganda uning noqulay muhit omillariga chidamliligi ham pasayishi mumkin. Zararlanish darajasi nematoda turi, uning soni, o‘simlik turi va tashqi muhit sharoitlariga bog‘liq.

Fitonematodalarga qarshi kurashda, avvalo, zararlanishni to‘g‘ri aniqlash kerak. Tuproq va ildiz namunalarini laboratoriyada tekshirish nematoda turini aniqlash va samarali choralarni tanlashga yordam beradi. Agrotexnik tadbirlar qatoriga almashlab ekish, sog‘lom ekish materialidan foydalanish, chidamli navlarni tanlash va ekin maydonlarini muntazam kuzatish kiradi [2].

Biologik kurash usullaridan foydalanish ham ayrim sharoitlarda foyda berishi mumkin, biroq samaradorlik nematoda turi v a muhit sharoitlariga bog‘liq. Kimyoviy vositalar esa zarurat tug‘ilganda, amaldagi tavsiyalar va xavfsizlik qoidalariga muvofiq qo‘llanishi lozim. Turli usullarni birgalikda qo‘llash fitonematodalar sonini kamaytirish va hosil yo‘qotishlarining oldini olishga ko‘maklashadi [3].

Xulosa

Fitonematodalar qishloq xo‘jaligi ekinlarining o‘sishi, rivojlanishi va hosildorligiga salbiy ta’sir ko‘rsatishi mumkin bo‘lgan muhim biologik omillardandir. Ularning zarar yetkazish xususiyati oziqlanish usuli, rivojlanish sikli va o‘simlik bilan munosabatiga bog‘liq. Meloidogyne avlodi ildizlarda bo‘rtmalar hosil qilishi, Heterodera ayrim turlari sista shakllantirishi, Pratylenchus ildiz to‘qimalarini zararlashi, Ditylenchusning ayrim turlari esa poya va boshqa organlarda parazitlik qilishi bilan tavsiflanadi.

Fitonematodalar zararini kamaytirish uchun muntazam kuzatuv, laboratoriya diagnostikasi, sog‘lom ekish materialidan foydalanish, almashlab ekish va chidamli navlarni tanlash muhimdir. Zaruratga qarab biologik, agrotexnik va kimyoviy usullarni uyg‘unlashtirish lozim. O‘zbekiston sharoitida fitonematodalarning tur tarkibi, tarqalishi va ekinlarga ta’sirini chuqur o‘rganish hamda ekologik xavfsiz kurash usullarini takomillashtirish dolzarb vazifa bo‘lib qoladi.

FOYDALANILGAN ADABIYOTLAR

1. Кирьянова Е. С., Шагалина Л. М., Иванова Т. С. Природная очаговость фитонематод. — 1979.

2. Иванова Т. С. Паразитические корневые нематоды. Семейство Criconematidae. — 1976.

3. Тўлаганов А. Т., Усманова А. З. Фитонематоды Узбекистана. — Ташкент: Фан, 1975.

4. Тўлаганов А. Т., Усманова А. З. Фитонематоды Узбекистана. — Ташкент: Фан, 1978.

UO‘K: 633.2/.4:633.361(575.1)

ONOBRYCHIS CHOROSSANICA ILDIZ TIZIMI KO‘RSATKICHLARIGA EKISH CHUQURLIGINING TA‘SIRI

Xujaqulov Davlat Davronqulzoda

Qorako‘lchilik va cho‘l ekologiyasi ilmiy-tadqiqot instituti, doktaranti

https://orcid.org/0009-0002-4826-2408

xujaqulov.davlat@mail.ru

Haydarov Xislat Qudratovich

Samarqand davlat universiteti botanika kafedrasi professori

https://orcid.org/0000-0002-4516-8101

haydarov@rambler.ru

Annotatsiya. *Maqolada Onobrychis chorossanica o‘simligining Qashqadaryo viloyati adirlari sharoitida ildiz tizimi ko‘rsatkichlariga ekish chuqurligining ta‘sirini o‘rganish natijasida olingan natijalar bayon qilingan. Aniqlanganki Onobrychis chorossanica ildiz uzunligi, ildiz massasi, ildiz bo‘g‘zi diametri hamda ildizning yer ustki massasiga nisbati bo‘yicha eng yuqori qiymatlar 2,6-3,5 sm ekilgan variantda, eng past ko‘rsatkichlar esa 1,-1,5 ekilgan variantda qayd etildi.*

Kalit so‘zlar*. Xuroson esparseti, adir, ozuqabop o‘simlik, ildiz uzunligi, ildiz massasi, ildiz bo‘g‘zi, urug‘.*

Abstract. *The article presents the results of a study on the effect of sowing depth on the root system characteristics of Onobrychis chorossanica in the foothill conditions of the Kashkadarya region. It was determined that the highest values for root length, root mass, root collar diameter, and the root-to-shoot mass ratio were observed in the variant sown at a depth of 2.6–3.5 cm, while the lowest values were recorded in the variant sown at 1.0–1.5 cm.*

Key words*. Onobrychis chorossanica foothills, forage plant, root length, root mass, root collar, seed.*

Kirish. Xuroson esparsetini madaniylashtirish bo‘yicha tadqiqot ishlari Qashqadaryo viloyatining Kitob tumani adirlari sharoitida “Kitob” o‘rmon xo‘jaligi dalalarida olib borilmoqda. Xududning tabiiy iqlim sharoitida mazkur o‘simlik yovvoyi holda uchraydi. Uning qimmatli ozuqaboplik xususiyati va nisbatan yuqori pichan hosilini to‘plash qobiliyati mahalliy sharoitlarda chorva qishlovi uchun to‘yimli ozuqa jamg‘arish imkonini beradi. O‘simlikning yana bir qimmatli xususiyatlaridan biri- ildizida azot to‘plovchi bakteriyalarning hosil bo‘lishi va tuproqni tabiiy azot bilan boyitishidir. Adirlar iqlim sharoitida o‘sib, yuqori pichan hosilini to‘plash imkonini beruvchi o‘simlik turlaridan biri Xuroson esparsetidir. Ma‘lumotlarga qaraganda [1,2] Xuroson esparsetining hosildorligi adir sharoitida gektaridan 163,7 sentner ko‘k massani yoki 41,64 sentner pichanni tashkil qilishi mumkin. Esparsetlar burchoqdoshlar oilasiga mansub qimmatli ozuqabop o‘simliklar qatoriga kiritiladi. Ularning pichani barcha chorva hayvonlari tomonidan barcha mavsumlarda yaxshi yeyilib, tarkibida 10-25% gacha protien, 1,6-5,6% gacha yog, 20,9-34,5%gacha kletchatka mavjudligi aniqlangan [3,4,5]. Beda o‘simligidan farqli o‘laroq, chorva hayvonlarida timpanit kasalligini qo‘zg‘amaydi. Esparsetlarning yana bir muhim qimmatli biologik xususiyati shundaki, ular azot to‘plovchi ildiz tuganakchalarini hosil qiladi va tuproqni tabiiy azot bilan boyitadi, tuproq unumdorligini oshiradi. Bunday tugunaklar esparsetlarda boshqa tur dukkakli o‘simliklar, jumladan bedaga nisbatan ko‘proq xosil bo‘ladi. Xuroson esparsetining yuqorida qayd etib o‘tilgan qimmatli xo‘jalikbop xususiyatlarini, shuningdek, Kitob tumani adirlari sharoitida yovvoyi holda tarqalganligini, mazkurtuproq-iqlim sharoitida o‘sishga yaxshi moslashganligini hisobga olib uni madaniylashtirishning samarali agrotexnik tadbirlarini ishlab chiqish maqsadida tadqiqot ishlarini olib bordik.

Materiallar va uslublar. Tadqiqotlar Qashqadaryo viloyati Kitob tumanidagi “Kitob davlat o‘rmon xo‘jaligi” hududida joylashgan tajriba dalasida olib borildi. Tadqiqot materiallari bo‘lib ekin sharoitida parvarishlanayotgan 1 va 3 yoshdagi Xuroson esparseti o‘simliklari xizmat qildi. O‘simliklarning ildiz tizimining

shakllanish xususiyatlarini o‘rganishda M.S. Shalitning [6] “o‘ra kovlash” uslubidan foydalanildi. Dala tajribalari B.A. Dospexov metodikasi bo‘yicha [7] qo‘yildi. Tajriba variantlari: urug‘larni ekish chuqurligi – 1-1,5; 1,6-2,0; 2,1-2,5; 2,6-3,0 va 3,1-3,5 sm. Takrorlanish 3 karra, har bir takrorlanishda 100 dona urug‘.

Natijalar va munozara. *Onobrychis chorossanica* o‘simligining ildiz tizimi ko‘rsatkichlarini tahlil qilish shuni ko‘rsatdiki, ekish chuqurligi ortib borishi bilan ildiz uzunligi, ildiz massasi, ildiz bo‘g‘zi diametri hamda ildiz va yer ustki massasi nisbati bosqichma-bosqich oshdi. Biroq 3,1-3,5 sm chuqurlikda mazkur ko‘rsatkichlarning ayrimlarida 2,6-3,0 sm variantiga nisbatan biroz pasayish kuzatildi. Bu holat urug‘larning juda chuqur joylashtirilishi natijasida unib chiqish va dastlabki ildiz tizimi shakllanishi uchun sarflanadigan energiyaning ortishi bilan izohlanadi.

Eng kam ko‘rsatkichlar 1-1,5 sm chuqurlikda qayd etildi. Bu variantda ildiz uzunligi 18,6 sm, bir o‘simlikdagi ildiz massasi 5,8 g, ildiz bo‘g‘zi diametri 4,1 mm, ildiz/yer ustki massa nisbati esa 0,184 ni tashkil qildi. Urug‘larning tuproqning nisbatan yuza qatlamiga joylashtirilishi dastlabki davrda namlikning tez yo‘qolishi, ildizning tuproq qatlamiga chuqur kirib borish imkoniyatining cheklanishi va ildizning kuchli tarmoqlanishi uchun sharoitning nisbatan yomon bo‘lishiga olib kelgan. Shu sababli ushbu variantda ildiz tizimi ham uzunligi, ham quruq/ho‘l massa to‘plashi bo‘yicha past natija ko‘rsatdi.

Ekish chuqurligini 1,6-2,0 sm gacha oshirish ildiz tizimining rivojlanishini sezilarli darajada yaxshiladi. Bunda ildiz uzunligi 20,4 sm ga yetdi va 1-1,5 sm variantiga nisbatan 1,8 sm yoki 9,7% ga oshdi. Bir o‘simlikka to‘g‘ri keladigan ildiz massasi 6,7 g ni tashkil qilib, dastlabki variantga nisbatan 0,9 g yoki 15,5% ga ko‘paydi. Ildiz bo‘g‘zi diametri 4,5 mm bo‘lib, 1-1,5 sm variantiga nisbatan 0,4 mm yoki 9,8% ga yuqori bo‘ldi. Ildiz/yer ustki massa nisbati ham 0,193 gacha ko‘tarilib, o‘simlik assimilyatlarning ma’lum qismini ildiz tizimiga yo‘naltirish qobiliyati oshganini ko‘rsatdi.

Ekish chuqurligi 2,1-2,5 sm ga yetkazilganda ildiz tizimining rivojlanish ko‘rsatkichlari yanada yuqori darajaga ko‘tarildi. Ushbu variantda ildiz uzunligi 22,7 sm ni tashkil qildi va 1-1,5 sm nazorat variantiga nisbatan 4,1 sm yoki 22,0% ga oshdi. Ildiz massasi 7,8 g/o‘simlik bo‘lib, dastlabki variantdan 2,0 g yoki 34,5% ga yuqori bo‘ldi. Ildiz bo‘g‘zi diametri 4,9 mm ga yetdi, bu nazoratga nisbatan 0,8 mm yoki 19,5% yuqori ko‘rsatkichdir. Ildiz/yer ustki massa nisbati 0,202 ni tashkil qildi. Bu davrda o‘simlikning ildiz va yer ustki organlari o‘rtasidagi moddalar taqsimoti nisbatan muvozanatli shakllanganini ko‘rsatdi.

1-jadval

Onobrychis chorossanica ildiz tizimi ko‘rsatkichlariga ekish chuqurligining ta‘siri (2022-2024 yy.)

Ekish chuqurligi, sm	Ildiz uzunligi, sm	Ildiz massasi, g/o‘simlik	Ildiz bo‘g‘zi diametri, mm	Ildiz/yer ustki massa nisbati
1–1,5	18,6	5,8	4,1	0,184
1,6–2,0	20,4	6,7	4,5	0,193
2,1–2,5	22,7	7,8	4,9	0,202
2,6–3,0	24,9	9,1	5,3	0,208
3,1–3,5	24,2	8,7	5,2	0,207

Ildiz tizimining eng yaxshi rivojlanishi 2,6-3,0 sm chuqurlikda kuzatildi. Mazkur variantda ildiz uzunligi 24,9 sm ga, bir o‘simlikdagi ildiz massasi 9,1 g ga, ildiz bo‘g‘zi diametri 5,3 mm ga va ildiz/yer ustki massa nisbati 0,208 ga yetdi. 1-1,5 sm varianti bilan solishtirilganda ildiz uzunligi 6,3 sm yoki 33,9%, ildiz massasi 3,3 g yoki 56,9%, ildiz bo‘g‘zi diametri 1,2 mm yoki 29,3%, ildiz/yer ustki massa nisbati esa 0,024 birlik yoki 13,0% ga oshdi (3.11-jadvalga qarang).

Ayniqsa, ildiz massasining 5,8 g dan 9,1 g gacha oshishi mazkur ekish chuqurligida o‘simlikning tuproqdagi suv va mineral oziq elementlaridan foydalanish imkoniyati yaxshilanganini ko‘rsatadi. Ildiz massasining ko‘payishi nafaqat asosiy ildizning o‘sishi, balki yon ildizlar va ildiz tukchalarining rivojlanishi bilan ham bog‘liq bo‘lishi mumkin. Bunday ildiz tizimi *Onobrychis chorossanica* kabi ko‘p yillik dukkakli o‘simlik uchun ayniqsa muhim bo‘lib, keyingi vegetatsiya davrida suv tanqisligiga chidamlilik va mineral oziqlanish samaradorligini oshirishga xizmat qiladi.

3,1-3,5 sm chuqurlikda ham ildiz tizimi yaxshi rivojlangan bo‘lsa-da, 2,6-3,0 sm variantidagi maksimal natijalarga nisbatan biroz pasayish qayd etildi. Bu variantda ildiz uzunligi 24,2 sm, ildiz massasi 8,7 g/o‘simlik, ildiz bo‘g‘zi diametri 5,2 mm, ildiz/yer ustki massa nisbati 0,207 ni tashkil qildi. 2,6-3,0 sm variantiga nisbatan ildiz uzunligi 0,7 sm, ildiz massasi 0,4 g, ildiz bo‘g‘zi diametri 0,1 mm, nisbat ko‘rsatkichi esa 0,001 birlikka kamaydi.

Xulosa. Olingan natijalarga ko‘ra, *Onobrychis chorossanica* uchun ekish chuqurligi 2,6-3,0 sm bo‘lganda ildiz tizimining shakllanishi eng qulay kechdi. Mazkur variantda ildiz uzunligi, ildiz massasi, ildiz bo‘g‘zi diametri va ildiz/yer ustki massa nisbati bo‘yicha maksimal natijalar qayd etildi.

Shuning uchun tadqiqot sharoitida 2,6-3,0 sm ekish chuqurligi o‘simlikning nafaqat yer ustki vegetativ massasini shakllantirish, balki kuchli va yaxshi rivojlangan ildiz tizimini hosil qilish nuqtai nazaridan ham eng maqbul variant sifatida baholandi.

FOYDALANILGAN ADABIYOTLAR RO‘YXATI

1. Мустафаев С.М.Дикорастущие бобовые растения-источник кормовых ресурсов//«Наука», Ленинградское отделение, 1982. -280 с.

2. Мустафаев С.М. Растительные ресурсы бассейна реки Кашкадарья. Автореф. дис. канд. биол. наук.Ташкент ,1966,-31с.

3. Сулейманов М. Сельская Америка .“Кайнар”, 1994.-105с.

4. Таджиев С.Ф. Эколого-биологичиские особенности дикорастущих кормовых бобовых, перспективных для введения в культуру на адырах Ферганской долины. Автореф. дисс… канд. биол. наук, Ташкент: Тош ГУ,1980.-20с.

5. Хасанов. О.Х., Таджиев С.Ф. Хозяйственная характеристика эспарцета хоросанского. В кн.: Адаптатсия кормовых растений к условиям аридной зоны Узбекистана, Ташкент, изд-во «ФАН»., 1983. 236-245 б.

6. Шалыт М.С. Методика изучения морфологии подземной части отделных растений в растителных сообществ. В кн.: Полевая геоботаника, Т.2М-Л.; Изд-во АНСССР, 1960. –С.369-447.

7. Доспехов Б.А. Методика полевого опыта. – М.: Колос, 1985. – 351 с.

UO‘K:633.2/.4:633.361(575.1)

XUROSON ESPARSETI URUG‘LARNI EKISH CHUQURLIGINING HOSILDORLIKKA TA‘SIRI

Xujaqulov Davlat Davronqulzoda

Qorako‘lchilik va cho‘l ekologiyasi ilmiy-tadqiqot instituti tayanch doktaranti

https://orcid.org/0009-0002-4826-2408

xujaqulov.davlat@mail.ru

Haydarov Xislat Qudratovich

Samarqand davlat universiteti botanika kafedrasi professori

https://orcid.org/0000-0002-4516-8101

haydarov@rambler.ru

Annotatsiya. *Maqolada Xuroson esparseti urug‘larini ekish chuqurligining o‘simliklar hosildorlik faoliyatiga ta’sirini o‘rganish tajribalaridan olingan natijalar bayon qilingan. Aniqlanganki, eng yuqori hosildorlik* 2,6–3,0 sm chuqurlikka *ekilgan variantda kuzatildi.*

Kalit so‘zlar: *Xuroson esparseti, urug‘, ekish chuqurligi, hosildorlik, pichan.*

Abstract. *The article presents the results of experiments investigating the effect of sowing depth on the productivity of Khorasan sainfoin. It was determined that the highest yield was observed in the variant sown at a depth of 2.6–3.0 cm.*

Keywords: *Onobrychis chorossanica, seed, sowing depth, productivity, hay.*

Kirish. Qashqadaryo viloyati O‘zbekistonda yaylov chorvachiligi rivojlangan yirik xudud hisoblanadi. Ayniqsa cho‘l-yaylov chorvachiligi (qorako‘lchilik, qo‘ychilik, echkichilik, yaylov yilqichiligi) viloyat chorvachiligining asosiy tarmoqlaridir va ularning asosiy ozuqa manbai sifatida adir (tog‘ oldi yarim cho‘l) va cho‘l yaylovlaridan foydalanib kelinmoqda. Chorvachilikni rivojlantirishning asosiy shartlaridan biri-mustaxkam ozuqa zahiralarini yaratishdir. Qashqadaryo viloyati yaylovlarining katta qismini tog‘ oldi yarim cho‘l yaylovlari tashkil qiladi. Bunday yaylovlarining o‘ziga xos xususiyatlaridan biri -o‘simlik qoplamining asosan efemer va efemeroid turlardan tashkil topganligidir. Yaylovlarining hosildorligi turli yillarda yuzaga keladigan iqlim xususiyatlari bilan uzviy bog‘liq holda keskin o‘zgaruvchanligi bilan ham ajralib turadi. Shu bois, mintaqa yaylovlarida ozuqa tanqisligining keskinlashuvi tez-tez takrorlanib turadi. Hozirgi kunda O‘zbekistonning tog‘ oldi yarim cho‘l mintaqasida ozuqa ishlab chiqarishni intensivlashtirish o‘ta muhim va dolzarb vazifalardan biri hisoblanadi. Ushbu muammoni hal qilishda tabiiy floradan qurg‘oqchilikka bardoshli, qimmatli ozuqaboplik xususiyatlariga ega o‘simlik turlarini izlab topish, ularning biologik, ekologik xususiyatlarini chuqur o‘rganish asosida madaniy holda yetishtirishning samarali yo‘llarini ishlab chiqish ilmiy va amaliy jihatlardan dolzarb hisoblanadi.

Xuroson esparseti- *Onobrychis chorossanica Bunge.* ozuqaboplik xususiyatlari bo‘yicha beda- *Medicago sativa* o‘simligidan qolishmaydigan, ko‘p yillik o‘tchil o‘simlik bo‘lib, tabiatda Qashqadaryo viloyatining tog‘ oldi yarim cho‘l mintaqasida yovvoyi holda tarqalgan [2;3].Esparset turlarining ozuqa ishlab chiqarishda muhim ahamiyatga ega ekanligi ko‘pchilik tadqiqotchilar tomonidan isbotlangan. Adirlar iqlim sharoitida o‘sib, yuqori pichan hosilini to‘plash imkonini beruvchi o‘simlik

turlaridan biri Xuroson esparsetidir. Ma‘lumotlarga qaraganda Xuroson esparsetining hosildorligi adir sharoitida gektaridan 163,7 sentner ko‘k massani yoki 41,64 sentner pichanni tashkil qilishi mumkin. [4;5;6;7;8].

Materiallar va uslublar. Tadqiqot Qashqadaryo viloyati Kitob tumanidagi “Kitob davlat o‘rmon xo‘jaligi” tajriba dalasida olib borildi. Dala tajribalari B.A. Dospexov metodikasi bo‘yicha [1] qo‘yildi. Tajriba variantlari: urug‘larni ekish chuqurligi – 1-1,5; 1,6-2,0; 2,1-2,5; 2,6-3,0;va 3,1-3,5 sm. Takrorlanish 3 karra, har bir takrorlanishda 100 dona urug‘.Statistik ishlovda o‘rtacha qiymat ($\overline{x}$) hisoblandi.

Natijalar va munozara. Tadqiqot natijalari *Onobrychis chorossanica* o‘simligida ekish chuqurligi hosildorlikning shakllanishiga sezilarli ta’sir ko‘rsatganini ko‘rsatdi. Ekish chuqurligi 1-1,5 sm dan 2,6-3,0 sm gacha oshirilganda yashil massa, quruq massa, pichan va urug‘ hosili muttasil ravishda oshdi. 3,1-3,5 sm chuqurlikda esa mazkur ko‘rsatkichlar 2,6-3,0 sm variantiga nisbatan biroz pasaydi. Bu holat ekish uchun eng qulay chuqurlik ma‘lum bir optimal oraliqda shakllanganini ko‘rsatdi. 1-1,5 sm chuqurlikda eng past hosildorlik qayd etildi. Ushbu variantda yashil massa hosili 124,6 s/ga, quruq massa hosili 30,8 s/ga, pichan hosili 27,4 s/ga, urug‘ hosili esa 1,86 s/ga ni tashkil qildi. Urug‘larning yuzaga yaqin joylashishi natijasida dastlabki davrda tuproq namligidan foydalanish imkoniyati cheklanishi va ildiz tizimining chuqurroq qatlamlarni egallashi nisbatan sekin kechishi o‘simliklarning keyingi o‘sish sur‘ati va biomassa to‘plashiga ta’sir ko‘rsatdi.

Ekish chuqurligi 1,6-2,0 sm gacha oshirilganda yashil massa hosili 137,8 s/ga ga yetdi. Bu 1-1,5 sm variantiga nisbatan 13,2 s/ga yoki 10,6% ko‘pdir. Quruq massa hosili 34,2 s/ga bo‘lib, 3,4 s/ga yoki 11,0% ga oshdi. Pichan hosili 30,5 s/ga ni tashkil qilib, dastlabki variantga nisbatan 3,1 s/ga yoki 11,3% yuqori bo‘ldi. Urug‘ hosili ham 2,04 s/ga ga yetib, 0,18 s/ga yoki 9,7% ga ko‘paydi.

2,1-2,5 sm chuqurlikda hosildorlikning yanada yuqori darajaga ko‘tarilishi qayd etildi. Bu variantda yashil massa hosili 151,6 s/ga ni tashkil qildi. 1-1,5 sm varianti bilan solishtirganda qo‘shimcha hosil 27,0 s/ga, ya’ni 21,7% ni tashkil qildi. Quruq

massa hosili 37,8 s/ga bo‘lib, nazoratga nisbatan 7,0 s/ga yoki 22,7% ga oshdi. Pichan hosili 33,7 s/ga ga yetdi va 6,3 s/ga yoki 23,0% qo‘shimcha hosil olindi. Urug‘ hosili esa 2,25 s/ga ni tashkil qilib, birinchi variantdan 0,39 s/ga yoki 21,0% yuqori bo‘ldi.

Eng yuqori hosildorlik 2,6-3,0 sm chuqurlikda ekish variantida qayd etildi. Ushbu variantda yashil massa hosili 164,9 s/ga, quruq massa hosili 41,2 s/ga, pichan hosili 36,8 s/ga, urug‘ hosili esa 2,48 s/ga ni tashkil qildi.

1-1,5 sm variantiga nisbatan 2,6-3,0 sm chuqurlikda yashil massa hosili 40,3 s/ga yoki 32,3% ga oshdi. Quruq massa hosili 10,4 s/ga yoki 33,8%, pichan hosili 9,4 s/ga yoki 34,3%, urug‘ hosili esa 0,62 s/ga yoki 33,3% ga ko‘paydi. Demak, ekish chuqurligini 1-1,5 sm dan 2,6-3,0 sm gacha oshirish natijasida ham vegetativ, ham generativ mahsuldorlik sezilarli darajada oshdi. Ayniqsa, yashil massa hosilining 124,6 s/ga dan 164,9 s/ga gacha, ya’ni 40,3 s/ga ga oshishi o‘simliklarning vegetativ massasi shakllanishi uchun 2,6-3,0 sm chuqurlikda eng qulay sharoit yuzaga kelganini ko‘rsatdi.

3,1-3,5 sm chuqurlikda ham hosildorlik yuqori darajada saqlandi. Yashil massa hosili 160,7 s/ga, quruq massa 40,1 s/ga, pichan hosili 35,8 s/ga, urug‘ hosili 2,39 s/ga ni tashkil qildi. Biroq 2,6-3,0 sm variantiga nisbatan yashil massa 4,2 s/ga, quruq massa 1,1 s/ga, pichan 1,0 s/ga, urug‘ hosili esa 0,09 s/ga kamaydi. Bu pasayish miqdor jihatidan katta bo‘lmasa-da, ekish chuqurligini yanada oshirish 2,6-3,0 sm da erishilgan maksimal natijani yaxshilamaganini ko‘rsatdi

1-jadval

***Onobrychis chorossanica* hosildorligiga ekish chuqurligining ta‘siri (2022-2024 yy.)**

Ekish chuqurligi, sm	Yashil massa hosili, s/ga	Quruq massa hosili, s/ga	Pichan hosili, s/ga	Urug‘ hosili, s/ga
1–1,5	124,6	30,8	27,4	1,86
1,6–2,0	137,8	34,2	30,5	2,04
2,1–2,5	151,6	37,8	33,7	2,25
2,6–3,0	164,9	41,2	36,8	2,48
3,1–3,5	160,7	40,1	35,8	2,39

Olingan ma‘lumotlarga ko‘ra, ekish chuqurligi 1-1,5 sm dan 2,6-3,0 sm gacha oshirilganda yashil massa hosili har bir keyingi variantda izchil ravishda ortib bordi. 3,1-3,5 sm da esa yashil massa hosili 2,6-3,0 sm ga nisbatan 2,5% ga kamaydi. Quruq massada bu farq 2,7%, pichan hosilida 2,7%, urug‘ hosilida esa 3,6% ni tashkil qildi.

Xulosa. Shunday qilib, tadqiqot natijalari *Onobrychis chorossanica* uchun ekish chuqurligining 2,6-3,0 sm oralig‘i hosildorlikni shakllantirish nuqtai nazaridan eng maqbul ekanini ko‘rsatdi. Mazkur chuqurlikda yashil massa, quruq modda, pichan va urug‘ hosilining maksimal qiymatlari qayd etildi. Bunga 2,6-3,0 sm chuqurlikda urug‘larning namlik bilan yaxshiroq ta‘minlanishi, ildiz tizimining kuchli rivojlanishi, ildiz bo‘g‘zining yaxshi shakllanishi, poya va yon shoxlar sonining ko‘payishi hamda barg apparatining yaxshi rivojlanishi kompleks ta‘sir ko‘rsatgan deb baholash mumkin.

Foydalanilgan adabiyotlar:

1. Доспехов Б.А. Методика полевого опыта. М.: Колос, 1979.- 416 с.

2.Люцинский В.В., Прижуков Ф.Б. Семеноводство многолетних трав. М.: Колос,1973. -248 с.-С.87-100.

3.Матаис Л.Н., Козлова З.В. Влияние эспарцета песчаного на продуктивност кормовых севооборотов при различных уровнях минералного питания. Сборник трудов иркутского государственного Университета, 2021. – С.100-107.

4. Матолинес Н.,Волошин В. Сравнителная отсенка сортов эспарцета песчаного (*Onobrychis arenaria Kit.*) при позделывании на зеленую массу в Среднем Предурале.Вестник Пермского федералного исследователского сентра, 2018. №4.-С.27-32.

5.Матолинес Н.,Волошин В. Целесообразность интродукции эспарцета песчаного (*Onobrychis arenaria*)-новой многолетней бобовой культуры. Ж.Аграрный вестник Урала,2016.№7(149), Биология и биотехнология..-С.28-33.

6.Морозов Н.А., Хрипунов А.И., Обшия Е.Н. Влияние агрометеорологических условий на урожайност эспарцета на зелёный корм в засушливой зоне Ставрополского края. Ж. Аграрная наука. 2020; (11-12):-С.76-78.

7. Мустафаев С. М. Дикорастущие бобовые растения-источник кормовых ресурсов// «Наука», Ленинградское отделение, 1982. -280 с.

8. Мустафаев С.М. Растительные ресурсы бассейна реки Кашкадарья. Автореф. дис. канд. биол. наук.Ташкент ,1966,-31с

M U N D A R I J A

I-SHU'BA

MOLEKULYAR BIOLOGIYA VA GENETIKANING ZAMONAVIY RIVOJLANISH TENDENSIYALARI

Teri leyshmaniozini laborator diagnostikasida molekulyar-genetik usullarni qo‘llash samaradorligi. ***Sattarova X.G‘.***	6
Izoprenalin bilan chaqirilgan yurak ishemiyasida kalamushlar qon ko‘rsatkichlarining o‘zgarishlari. ***Mirzayeva M.X., Qo‘chqorov Sh.Ya., Tojikulova O.J.***	10
Peroxidase enzyme activity in bean seeds stored under various conditions. ***Abdusalomova Z.R., Sanakulov A.L.***	13
Samarqand viloyatida OIV infeksiyasini xolatini epidemiologik baxolash. ***Murodkosimov S., Elmirzayeva S.***	18
Патофизиологические механизмы нарушения выделительной функции почек задержки азотистых метаболитов под влиянием раас у домашних животных. ***Хасанов Гасан., Салахова Эмилия., Улдуз Сафарова.***	21
Development rhythm, seed productivity and reproductive characteristics of wormwood (*Artemisia diffusa* krasch. ex poljak.) under the conditions of karnabchul. ***Abdulloyeva M.Sh., Rabbimov A.***	25
Molekular biologiya va genetikaning zamonaviy rivojlanish tendensiyalari. ***Hayitov F.I.***	31
Генетический полиморфизм в диагностике токсокароза и его роль в эффективном лечении и профилактике. ***Саттарова Х.Г.***	35
Scutellaria baicalensis georgi flavonoidlarining kimyoviy tarkibi va farmakologik faolligi: ilmiy adabiyotlar tahlili. ***Iroda Saydullayeva.***	38
Moyli zig‘ir o‘simligining qurg‘oqchilikka chidamlilik genlarini dnk markerlar yordamida aniqlash. ***M.A. Turdimurodova.***	44
«Современные тенденции развития молекулярной биологии и генетики» ***Давлатова Н.О., Сафарова З.Х., Абдусаматова М.Б.***	48
Gidroponika tizimlarida o‘simliklar patogenlariga qarshi ekspress biotest-diagnostikasi va mikrobial antagonistlarni qo‘llash texnologiyasi. ***N.Rashidov.***	53
Seleksiya: nazariya asoslar , usullar va zamonaviy rivojlanish yo‘nalishlari. ***Anvaraova M.R.***	58
Alopecurus pratensis **l.** turining xloroplast genom xususiyatlari. ***D.E. Azimova D.S. Esanqulova.***	62

II-SHU’BA

EKOLOGIYA VA BARQAROR RIVOJLANISH: BIOLOGIK TIZIMLAR MONITORINGI VA TA’LIMI.

Экологическая грамотность учащихся 11 класса: организация учебной дискуссии по проблемам промышленных предприятий и их воздействия на экосистемы. ***Конопацкая Оксана Александровна, Ступень Нонна Степановна.***	70
Очистка шахтных вод в Казахстане. ***Мухамбеткалиева Б.Ж., Бергенева Н.С.***	74
Экологизация содержания курса химии: диагностика уровня сформированности экологических представлений и методические решения. ***Ступень Нонна Степановна, Коваленко Виктор Викторович.***	77
Анализ вариации морфометрических показателей вида *pseudotaphoxenus juvencus*. ***Яковлев Роман Викторовичб, Зокирова Дилноза Фазлиддиновна.***	88
Tog‘ biotsenozlari namatak o‘simligi nematodafaunasining taksonomik tarkibi. ***Xo‘jamov Sh., Mavlyanov O.***	87
Organik, mineral o‘g‘itlar va “glitsbut” fitostimulyator preparatidan foydalanishning tuproq tarkibiga ta’siri. ***Ergasheva F.Sh., Djurayev T.A., Kushiyev X.X., Xushmatov Sh.S.***	93
Atrof-muhitning og‘ir metallar bilan ifloslanish darajasi monitoringida fitoindikatorlardan foydalanish. ***M.U.Mamadiyarov, X.Q.Xaydarov.***	98
Lalmi sharoitda *sorghum almum* parodi yetishtirishning ahamiyati. ***Avutxonov B.S.***	102
Sorghum bicolor l. navlarining barglarida suv saqlash qobiliyati dinamikasi va tuproq sho‘rlanishiga fiziologik moslashuvchanligi. ***Abdimurotov D.V, Ibragimov A.J.***	105
Zomin davlat qo‘riqxonasida miqqiy (falco tinnunculus)ning bioekologiyasi va populyatsiya holati. ***Abduazimova M.A.***	108
“Qozon” marjumak navi urug‘larining unuvchanligiga haroratning ta’siri. ***Artikova G.X.***	111
Dorivor gulxayri (*althaea officinalis* l.) o‘simligining bioekologik xususiyatlari, fitokimyoviy tarkibi va yetishtirish istiqbollari. ***Boratova O‘.Q., Baratova M.R.***	115
In northwestern kyzylkum eco-biological features of certain species belonging to the order *delphinium* l. ***Bekbergenova G.S.***	120
Ekologiya va barqaror rivojlanish ta’limi - zamon talabi. ***Ziyadilla S.B., Jamolova M.U.***	129
Yashil iqtisodiyot va ekologik barqarorlik. ***Djalilov F.S., Muxammedova S.A.***	132
Iqlim o‘zgarishi ekologik muammoalarni keltirib chiqarishi va oqibatlari. ***Djalilov F.S., Mirzamurodov O.X., To‘xtayev A.O.***	135
Предварительный опыт выращивания азотфиксирующих растений для улучшения плодородия почв в каракалпакстане. ***Ещанова Г.А., Матжанова Х.К., Орел М.М.***	137
Atrof-muhitga yo‘naltirilgan iqtisodiyot. ***Ishankulova K.K., Qurbonov I.F.***	141
Shahar hududlarining kengayishi sharoitida biologik xilma-xillikning o‘zgarish xususiyatlari. ***Ishmo‘minov B.B., Po‘latova F.A.***	145
Toshkent shahrida yashil rivojlanish jarayonlari va shahar ekologik holati. ***Ishmo‘minov B.B., Raxmatova D.A.***	148
Biologik tizimlar monitoringida zamonaviy yondashuvlar va ularning barqaror rivojlanishdagi ahamiyati.	152

Jumanova G.T.	
Использование солеустойчивых кормовых растений для повышения продуктивности пустынных пастбищ на территории центрального устюрта. ***Матжанова Х.К., Орёл М.М.***	156
Zarafshon vohasida chakanda pashshasi (*rhagoletis batava* hering) xavf zonalarini maxent va qgis yordamida baholash. ***Malikov D.B.***	160
Kampirchopon (*Trichodesma incanum*) ning nematodafaunasi, uning tahlili va ekologik guruhlari. ***U.N.Mirzayev, S.N.Narzullayev, N.X.Xakimov.***	164
Og‘ir metallar bilan turli darajada ifloslangan sharoitda *paulownia tomentosa*, *chitalpa tashkentensis*, *vinca minor* o‘simliklarida suv rejimi ko‘rsatkichlari miqdoriy tahlili. ***M.U.Mamadiyarov, Elmirzayeva S.B.***	172
O‘zbekistonning turli biotsenozlarida kovrak nematodasi (heteroanguina ferulae)ning tarqalish monitoring ***Narzullayev S.B, Mo‘minov Sh.A.***	176
Quyonlarning gumoral immun tizimiga fotoperiod stressor omillarning ta’siri. ***Narzullayeva M., Hayitov D,G‘., Haydarov D.Ya.***	180
Yomg‘ir chuvalchanglarining tuproq unumdorligini oshirish va ekotizim barqarorligini ta’minlashdagi ahamiyati. ***S.N.Narzullayev, D.A.Sulaymonova.***	185
Og'ir metallarning tuproq-o'simlik tizimida migratsiyasini baholash. ***Normamatova K.Sh.***	190
Pulsoksimetriya usuli yordamida organizmni funksional imkoniyatlarini aniqlash va unga yuqori haroratni ta’siri. ***Norxo‘jayeva M.S.***	199
Pollen micromorphology of medicinal asteraceae species in the samarkand region: baseline data for ecological monitoring. ***Nozimova A.B.***	203
Reproductive biology and adaptive phenology of rare relict taxa in the aral sea basin. ***Orazbaev T.J, Ajiev A.B.***	209
Ekologiya va barqaror rivojlanish: biologik tizimlar monitoring. ***Raximjonova D.R.***	213
Qora andiz (Inula helenium l.) o'simligining bioekologiyasi va dorivor xususiyati. ***Ro‘ziqulova M.R.***	217
O‘zbekiston florasida lythrum l. (lythraceae) turkumi turlarining asliy integratsiyasi va fitosenotik strukturasi. ***Saydullayeva D.S.***	220
O‘zbekistonda lythrum l. turkumi turlarining tarqalish dinamikasi va zamonaviy fitosenotik xususiyatlari. ***Saydullayeva D.S.***	226
Ekologik omillarning odam anatomiyasi va fiziologik jarayonlariga ta’siri. ***Sadiqova G.E.***	232
Oziq moddalar yetishmovchiligining odam organizmidagi anatomik va fiziologik o‘zgarishlarga ta’siri. ***Sadiqova G.E.***	239
O‘rta Zarafshon hududida Lymnaea urug‘i va Pontastacus leptodactylus ning bioiqlimiy modellashtirish asosida potensial tarqalishini baholash. ***Suyarov S.A.***	245
Zarafshon milliy tabiat bog'i ekotizimlariga antropogen omillarning ta'sirini baholash ***Toshmurodova M.***	249
Urbanizatsiya sharoitida gidrobiontlar tarqalishining ekologik aspektlari. ***N.R.Turniyozova.***	260
Zangori sachratqi (*Cichorium intybus* L.) nematodafaunasining bioekologik xususiyatlari. ***Tursunova Sh.Sh.***	264
A new record for the agelenidae (araneae) fauna of Uzbekistan. **Shodmonov F.A.**	270

Maxent-based prediction of the potential distribution of *glycyrrhiza glabra* l. in Uzbekistan. ***Islamov B., Khurramov O.***	273
Tashqi muhit yuqori haroratining yurak-qon tomir tizimi faoliyatiga ta’siri: fiziologik moslashuv va biologik monitoringi. ***Xolm’minova L.A.***	280
Tog‘ biotsenozlarida o‘suvchi namatak (*rosa* spp.) o‘simligi nematodafaunasining bioekologik xususiyatlari. ***Xakimov N.X., Xo‘jamov Sh.***	283
Shaxsning ruhiy va jismoniy rivojlanishida ekologiyaning ta’siri. ***Zaripov O.M.***	288
Zabrus morio morfometrik ko‘rsatkichlarining balandlik gradiyenti bo‘ylab o‘zgarishi. ***Zokirova D.F.***	291
Og‘ir metallar intoksikatsiyasini korreksiyalashda biofaol moddalardan foydalanish. ***Shakarova Sh.A., Tojikulova O.J., Abdullayeva G.T.***	296
Urbanization acts as an environmental filter reshaping soil nematode traits, functional diversity, and food-web structure. ***Shahid Afzal, Arash Noshadi.***	299

III-SHU’BA

BIOTEXNOLOGIYA VA BIOMEDITSINANING YANGI ISTIQBOLLARI

Biologically active plant compounds as promising antitumor agents: kegg-based analysis of molecular mechanisms of berberis heteropoda schrenk and juniperus communis. ***Assan Gulmira Kudaibergenkyzy, Zhumash Akzhunis Sagatbekkyzy, Ablaikhanova Nurzhanyat Tatukhanovna.***	301
Перспективы применения экстрактов полисциаса для блокировки свободныхрадикалов. ***ГрицукД.П.***	304
Analysis of the anticancer potential of bioactive compounds associated with *berberis heteropoda* schrenk. ***Zhumash Akzhunis Sagatbekkyzy, Asan Gulmira Kudaibergenkyzy, Ablaikhanova Nurzhanyat Tatukhanova.***	309
Морфологические изменения поджелудочной железы, печени и почек при аллоксан-индуцированном сахарном диабете: обзор экспериментальных исследований. ***МолбосынД.С., ЖаманбаеваГ.Т., АманкелдіА.Н., ЖапаркуловаН.И.***	313
Специфическая профилактика клостридиозов сельскохозяйственных животных. ***Пулотзода Фаридун Хайтали, Самиева Суман Зохидовна, Пирова Мавджуда Комилджоновна.***	317
Патофизиологические механизмы нарушения выделительной функции почек и задержки азотистых метаболитов под влиянием раас у домашних животных. ***Хасанов Гасан Салахова., Эмилия Улдуз Сафарова.***	319
Bo‘z tipik tuproqlarda yetishtiriladigan tok navlarini rizosfera mikroorganizmlari asosida skrining qilish. ***Jahongir Esanboyevich Obloqulov, Iskandarova Nazira Feruzovna.***	322
Vegetativ nerv tizimi faolligi va vo2 max o‘rtasidagi bog‘liqlikni yurak ritmi o‘zgaruvchanligi parametrlari asosida baholash. ***K.U.Rozumbetov.***	327
Temirtikan o‘simligining xalq xo‘jaligidagi ahamiyati. ***Perdebayeva Gulasal Asqar qizi., Ajiev Alisher Baxtibayevich.***	333
Aloe vera ekstraktining farmakologik va toksikologik xususiyatlarini o‘rganish. ***Adirbekova Lalagul Muratbekovna.***	335
Biologically active plant compounds as promising antitumor agents: kegg-based analysis of molecular mechanisms of berberis heteropoda schrenk and juniperus communis l. ***Assan Gulmira Kudaibergenkyzy, Zhumash Akzhunis Sagatbekkyzy, Ablaikhanova Nurzhanyat Tatukhanovna.***	341
Irsiy kasalliklarni davolashda zamonaviy biotexnologik yondashuvlar gen terapiyasi va gen tahrirlash	344

texnologiyalarining istiqbollari. ***Abdusayitov Jonibek Sadullayevich, Erkinov Otabek Anvarovich, Abdullayeva Yulduz Ulug‘murodovna.***	
Накопление тяжелых металлов из почвы в организме растений и их токсическое воздействие. ***Каипбекова Наргиза Марат кызы.***	350
Dorivor gulxayri (althaea officinalis l.) O‘simligining uchinchi vegetatsiya yilida ildiz hosildorligining ekish muddatlariga bog‘liqligi. ***Boratova O‘g‘iloy Qodirjon qizi., Baratova Mohidil Raximovna.***	354
Дирофиляриоз собак в условиях изменения климата: биология паразита, роль переносчиков и новые эпидемиологические риски. ***Аиша Кязымлы, Кушвар Мамедова.***	358
Ensuring Animal Welfare in Organic Livestock Farming and Its Impact on Animal Health. ***Ayla Mammadzada, Kushvar Mammadova.***	367
Modern biotechnological approaches to the diagnosis of infectious diseases in animals. ***Elshad Alizada, Nuraddin Imanov, Sevda Osmanova, Kushvar Mammadova.***	375
Aflatoxin B1- Aflatoxin M1: carry-over of Mycotoxins from feed to milk and risks to human health. ***Gulnar Rustamli, Kushvar Mammadova.***	390
Veterinary medicine, environmental health and food security: One Health approaches to sustainable agriculture. ***Kushvar Mammadova, Yegane Behbudova.***	403
Микробиологическая безопасность органических продовольственных систем: от почвенных микробиомов до агропродовольственной цепи. ***Кушвар Мамедова Егяна Бехбудова.***	416
Molecular Epidemiology and Genetic Evolution of Canine Distemper Virus: Transmission, Adaptation and Emerging Strains. ***Nigar Adigozalova, Kushvar Mammadova.***	429
Накопление тяжелых металлов из почвы в организме растений и их токсическое воздействие. ***Каипбекова Наргиза Марат кызы.***	437
Dorivor *polyporus tuberaster* (jacq. Ex pers.) Fr. Zamburug‘ining biotexnologik ahamiyati. ***Nurullayeva Iroda Uktam Qizi.***	441
Cassia tora l. Urug‘larini aseptik sharoitda in vitro kulturaga introduksiya qilish texnologiyasi. ***Eshmuratova Aygul Arepbayeva, Esimbetov Adilbay Tlepovich.***	444
Soya (*glycine max (l.) Merr.*) Navlari tarkibidagi flavonoidlar tahlili. ***Sa`dullayeva Sitora O‘ktamjon qizi.***	448
Probiotik qo‘shimchali ratsionning quyonlar qon zardobidagi AST va ALT fermentlari dinamikasiga ta’siri. ***Raxmatova Nigora Boturovna.***	451
Turli ozuqa ratsionlarining quyonlarda oqsil va lipid almashinuvi ko‘rsatkichlariga ta’siri. ***M.A.Ismayilova., N.B.Dovronova.***	455
Qandli diabetda lipidlarning peroksid oksidlanishi va antioksidant himoya ko‘rsatkichlariga e vitamini ta’sirining biokimyoviy baholanishi. ***G.Sh Normurodova.***	457
Qandli diabetda e vitaminining lipidlar peroksid oksidlanishi va antioksidant himoya ko‘rsatkichlariga ta’siri. ***G.Sh.Normurodova.***	460
Parrandalar oziqlanishini takomillashtirishda sut zardobining ahamiyati. ***M.M. Sa’dullayeva, M.S. Kuziyev, D.U. Ergashe[1], Huang.***	462
Eksperimental diabetda gepatositar oksidativ stressining qonning ayrim biokimyoviy ko‘rsatkichlariga ta’siri. ***Asqarova V.A., Hayitov D.G‘., Zhumaboeva T.T.***	466
Tokda uchraydigan fitopatogen zamburug‘lardan himoya qilishda zamonaviy biotexnologik yondashuvlarning istiqbollari.	470

Maxmudov Davron Kamol o‘g‘li.	
Molekular biologiya va genetikaning zamonaviy rivojlanish tendensiyalari. ***Hayitov Feruz Ilxomovich.***	473
Development rhythm, seed productivity and reproductive characteristics of wormwood (*artemisia diffusa* krasch. Ex poljak.) Under the conditions of karnabchul. ***Abdulloyeva Mohinur Shavkatjonovna., Rabbimov Abdullo.***	477
Estrogen va progesteron miqdorining yosh davrlariga bog‘liq holda o‘zgaruvchanligi. ***Shodmonova E.A., Nasrullayeva G.A., Hayitov D.G‘.***	482
Begona o’t niqobi ostidagi dorivor xazina. ***Egamberdiyeva Oyjamol Abdurauf qizi.***	486
Qora sedananing *(Nigella sativa L.)* xalq xo’jaligidagi ahamiyati. ***Baltabayeva Ayman Seytmurat qizi., Qarshiboyeva N.H.***	489
Dorivor moychechak (matricaria chamomilla l.) Ning biologik xususiyatlari va dorivor ahamiyati. ***Nasrullayeva Farangiz.***	492
Capparis spinosa l. o‘simligining biotexnologiya va tibbiyotdagi o‘rni. ***Eshboyeva S.R., Jumayeva Z.***	496

IV-SHU’BA

BIOLOGIYA TA’LIMIDA INNOVATSION PEDAGOGIK YONDASHUVLAR.

Developing students’ higher-order thinking skills in biology education in the era of artificial intelligence: conceptual foundations of the «bestik ai» technology. ***Aidana Berikkyzy Aidarova.***	500
Biologiya darslarida gul morfologiyasi va changlanish jarayonlarini o‘qitishda palinologik preparatlarga asoslangan innovatsion yondashuv. ***Axrorova Sarvinoz Alisher qizi.***	503
Developing pre-service biology teachers’ STEM and digital competence through the integration of virtual laboratories and generative artificial intelligence. ***Boranbayeva L., Kuralbayevna Z.K.***	511
Развитие исследовательских навыков шестиклассников на уроках биологии через сценарное обучение. ***Воробьева О.А.***	521
Development of ecological competence in the course of general and inorganic chemistry. ***Kovalenko Viktor.***	525
O‘simlik nematodalarini aniqlash va anal-vulvar qismidan vaqtinchalik va doimiy preparat tayyorlash metodikasi. ***Mirzayev U.N., Atajanov B.A.***	527
Talabalarga xalq tabobati va etnobotanika atamalarini tushuntirish. ***Murodov Sirojiddin Ahmatovich.***	531
Biologiya fanini o‘qitishda zamonaviy pedagogik texnologiyalardan foydalanishning samaradorligi. ***Berdimurodova R.Sh, Pardayeva D.S, Ibodullayeva B.X.***	535
Qurg‘oqchilik va sho‘rlanish mavzusini o‘qitishda interaktiv raqamli usullardan foydalanish. ***Usmonova M.I, Arzimurodova M.J.***	539
Raqamli ta’lim muhitida o‘quvchilarning faol ishtirokini oshirish usullari. ***Usmonova M.I, Arzimurodova M.J.***	544
Mutaxassislik fanlarini o‘qitishda bugungi kundagi axborot-kommunikatsiya texnologiyalari imkoniyatlari.	549

Gulboyev D.T.	
Pedagogning kasbiy mahoratini oshirishda vaqtni samarali boshqarish va kasbiy ko‘nikmalarning o‘rni. ***Gulboyev D.T., Munojidinova G.M.***	553
Oliy ta’limda zoologiya fanini o‘qitishda generativ sun’iy intellekt va raqamli identifikatsiya vositalarini integratsiyalashning metodik imkoniyatlari. ***Mirzayev. U.N, Narzullayev .S.N, Xakimov.N.X.***	558
Экологический образование и воспитание в школах Республика Таджикистан. ***Каримзода А.И.***	565
Biologiya ta’limida innovatsion pedagogik yondashuvlar. ***Jo‘raqulova B.S.***	569
Maktab botanika darslarida mahalliy o‘simliklar changining raqamli atlasi va QR-kodli o‘quv kartochkalaridan foydalanish metodikasi. ***Djumayeva Z.U, Jo‘raqulova B.S.***	574
Botanika fanidan amaliy mashg‘ulotlarni o‘tkazishda innovatsion texnologiyalarni qo‘llash metodikasi. ***Ro‘ziyeva M.K.***	577
Biologiya fanini o‘qitishda ilg‘or pedagogik texnologiyalardan foydalanish. ***Turniyozova N.R.***	583
Gul changi namunalarini shaffof smolada saqlash orqali maktab biologiya darslarini amaliy va interaktiv tashkil etish. ***Xamidullayeva Nodira.***	587
Palinologiyaning fanlararo bog‘liqligi va biologik tizimlar monitoringidagi o‘rni. ***Djumayeva Z.U.***	591
Talabalarda yurak-qon tomir tizimi funksional ko‘rsatkichlarini kompleks tahlil qilish va ularni o‘qitishning innovatsion metodikasi. ***Elmirzayeva S.B.***	597
Issiqxona sharoitidagi sabzi va uning rizosferasi nematodalari jamoasining taksonomik tahlili. ***G‘ofirjonova G.G‘., Narzullayev S.B.***	600
Bo‘lajak tabiiy fanlar o‘qituvchilarining kasbiy kompetentligini shakllantirishda innovatsion texnologiyalarning o‘rni va ahamiyati. ***Karimova.J.G‘ .***	604
Shaxs salomatligida biogenetik va pedagogik yondashuvlar. ***Zaripov O.M.***	609
Biologiya darslarida interfaol metodlardan foydalanish va ularning o‘quvchilar faolligiga. ***Abdushukurova M, Ibodullayeva B.X.***	612
Biologiya fanini o‘qitishda STEAM yondashuvidan foydalanish imkoniyatlari. ***Muzaffarova M.X, Ibodullayeva B.X.***	615
Методика формирования и развития биологических понятий, умений и навыков учащихся. ***Ражамурадова Н.З.***	619
Tirik tizimlarning raqamli egizagi: odam anatomiyasi va fiziologiyasida vegetativ organlar ishini imitatsion texnologiyalar vositasida vizuallashtirish. ***Pardayeva M.O.***	628
Тематические разработки в преподавании дисциплин ботанического цикла. ***Шкуратова Н.В., Левковская М.В.***	634
Oliy ta’limda tadqiqotga yo‘naltirilgan o‘qitish (RBL) va mantiqiy fikrlashni rivojlantirishning pedagogik-psixologik asoslarini botanika fani xususiyatlaridan kelib chiqqan holda ochib berish. ***Obloqulov Jahongir.***	637
Методика преподавания кроветворения в красном костном мозге студентам биомедицинских специальностей. ***Ибрагимова Наиля Ахтамовна.***	641

Zoologiya fanini o‘qitishda muammoli ta’lim texnologiyalari asosida pedagogik kompetensiyalarni rivojlantirish. ***Ismoilova D.D.***	646
Talabalarning jismoniy yuklamaga funksional moslashuvini baholashda pulsoksimetriyadan foydalanish metodikasi. ***Xolmo‘minova L.A.***	650
Aqlli anatomiya: Vegetativ organlar fiziologiyasini o‘qitishta sun’iy intellekt va interaktiv simulyatsiyalarning o‘rni. ***Pardayeva M.O.***	652
Biologiya ta’limida raqamli transformatsiya va fanlararo integratsiyaga innovatsion yondashuvlar. ***Abdujabborova M.I.***	659

V-SHU’BA
OZIQ-OVQAT MAHSULOTLARI BILAN BOG‘LIQ MAHALLIY VA GLOBAL MUAMMOLARNI HAL ETISH.

Накопление фенольных соединений в винограде сен пепин и алешенькин, культивируемых в условиях г. бреста республики Беларусь. ***Колбас Н.Ю., Левый А.В.***	663
Некоторые сведения о биоразнообразии бассейна реки ширкент. ***Сатторов Р.Б., Мирзоев Н.М.***	667
Raps sideratidan foydalanish orqali sabzavot ekinlarida fitoparazit nematodalarni kamaytirish va hosildorlikni oshirish. ***Xakimov N.X., Mirzayev U.N.***	671
Zarafshon vodiysi sabzavot agrotsenozlarida fitoparazit nematodalarning tarqalishi va ularning oziq-ovqat ta’minotidagi ahamiyati. ***Mavlyanov O.M., Mirzayev U.N.***	677
Surxondaryo viloyatining o‘rtacha sho‘rlangan tuproqlari sharoitida kinoa rivojlanish davrlari davomiyligiga ekish muddati va me’yorining ta’siri. ***Ko‘chkeldiyeva Sh.Ch., Jumayev Sh.M., Abduxalimova S.A.***	683
Grek shambalasi (*trigonella foenum-graecum* l.) ni funksional oziq-ovqat xomashyosi sifatida yetishtirishning maqbul ekish muddati va sxemasi. ***Normaxmatov S.Sh., Jumayev Sh.M., Safarova N.S.***	689
Marjumakning tarqalishi, morfologik va fiziologik xususiyatlari. ***Usmanova M.I., Eshmurodova M., O’roqov S.X.***	695
Kamalak foreli (Oncorhynchus mykiss), balig'ining jahon miqyosidagi ahamiyati. ***Buvrayev N.R., Jabborov A.R., Yuldashov M.A.***	699
Kamalak foreli (Oncorhynchus mykiss), balig'ining yoshga bog'liq xususiyatlari. ***Buvrayev N.R., Jabborov A.R., Yuldashov M.A.***	703
Определение содержания флаволигнанов (комплекс силимарина) в семенах расторопши, выращенной при различных агротехнических факторах. ***Алавдинов М.Х., Камолова Д.Х.***	707
Интродукция расторопши пятнистой (silybum marianum l.) в условиях культурного агроценоза и биология всхожести семян. ***Алавдинов М.Х., Намозова С.Ш.***	712
Хозяйственное значение рода *ferula* l. во флоре Узбекистана. ***Мукумов И.У., Шодиева З.Ш., Расулова З.А., Курбанова Ф.Н.***	716
Samarqand viloyati florasida juncus bufonius l. turining taksonomik va ekologik xususiyatlari.	721

Sharifmurodov K.I., Abdumanonova S.S.	
Ixiolirion tataricum — tatar chuchmomosining sistematik o‘rni, biologik xususiyatlari va amaliy ahamiyati: adabiyotlar tahlili. ***Aktamova K.Z.***	725
O‘simliklar karantinining oziq-ovqat mahsulotlari xavfsizligini ta’minlashdagi ahamiyati, xorijiy tajribalar va ulardan foydalanish. ***Alimov M.A.***	730
Loviya (Phaseolus vulgaris) o‘simligining biologik va fiziologik xususiyatlari. ***Boliqulova F.G'., Usmanova M.I.***	737
Sut zardobi oqsillari asosida yeyiladigan bionano-qoplamalar olish va ularning oziq-ovqat xavfsizligidagi ahamiyati. ***Erkinov O.A., Umarova P.M., Abdusayitov J.S., Baysariyeva Ch.U.***	740
Mosh navlarining dala unuvchanlilgiga ekish muddatlari hamda ekish sxemalarining ta’sirini baholash. ***Ismailova F.E., Ismoilov V.I., Raxmanqulov B.I.***	744
Sustainability of rangeland utilization in kyzylkum desert, Uzbekistan. ***Kushbokov A.U., Khushbekova M.S.***	748
Glycyrrhiza triphlla o‘simligining ayrim xususiyatlari. ***Mamarasulova N.T.***	752
Ratsion tarkibidagi ozuqaviy moddalarning quyonlar tomonidan o‘zlashtirilish dinamikasi. ***Namazova D.I.***	757
Phaseolus vulgaris l. ning ravot va mahsuldor navlarida pigmentlar miqdori. ***Nasimova M.K., Sanakulov A.L.***	763
Surxondaryo viloyati issiqxonalarida limon nematodofaunasining tarkibi va bioekologik xususiyatlari. ***Raimova F.J.***	768
O‘zbekiston sharoitida xantal (sinapis alba l.) o‘simligini yetishtirishning agrobiologik xususiyatlari. ***Esanqulova D.S., Raxmatullayeva G.B.***	775
Kuzgi bug’doy navlarining ekish me’yorlarini baholash. ***Raxmanqulov B.I., Ismoilov V.I.***	778
“Juncus gerardii loisel” o’simligining botanik tavsifi, geografik tarqalishi. ***Ro’ziyeva D.B.***	783
Tritikale urug‘larining unuvchanligiga sho‘rlikning ta’siri. ***O‘roqov S.X., Toshpulatova F.Z.***	786
Na’matak (*rosa canina* l.) o‘simligida *sphaerulina rehmiana* jaap zamburug‘i keltirib chiqaruvchi dog‘lanish kasalligining morfologik va fitopatologik xususiyatlari. ***Xo‘jaqulova D.S.***	789
Marjumakning dorivorlik xususiyatilari va ahamiyati. ***Artikova G.X.***	793
Влияние эпибрассинолида и его композиций с феруловой кислотой на морфометрические показатели рапса ярового. ***Кароза С.Э.***	797
Ozuqa tarkibidagi kletchatkaning quyonlar qonining gumoral immun tizimiga ta’siri. ***Normurodova M.A., Bazarov B.M., Hayitov D.G‘.***	801
“Luzula campestris” o’simligining botanik tavsifi, geografik tarqalishi. ***Sharifmurodov K.I., Ro’ziyeva D.B.***	806
Fitonematodalar va ularning qishloq xo‘jaligi ekinlariga ta’siri. ***Vaydullayeva Z.Sh., Otamurodova S.M.***	809
Onobrychis chorossanica ildiz tizimi ko‘rsatkichlariga ekish chuqurligining ta‘siri. ***Xujaqulov D.D., Haydarov X.Q.***	813

Xuroson esparseti urug‘larni ekish chuqurligining hosildorlikka ta‘siri. ***Xujaqulov D.D., Haydarov X.Q.***	818

O‘ZBEKISTON RESPUBLIKASI TA’LIM VA ILM-FAN VAZIRLIGI

SAMARQAND DAVLAT PEDAGOGIKA INSTITUTI

“Biologiya fanining zamonaviy rivojlanishi va uni o‘qitish metodikasining innovatsion yondashuvlari: fanlararo integratsiya va raqamli transformatsiya sari”

mavzusida xalqaro ilmiy-amaliy anjuman

23-24-Oktabr 2026-yil

Samarqand – 2026. 834-bet.