GOSSYPIUM HIRSUTUM POPULYATSIYASIGA ZARARKUNANDA HASHARAT G`O`ZA TUNLAMI (*HELICOVERPA ARMIGERA*) NING TA'SIRI VA KURASHISH CHORALARI.

Erkaboeva Dilrabo Oybek qizi stajor-tatqiqotchi, Usmonov Dilshod Erkinboevich PhD,
Bo'riyev Zabardast Tojiboevich b.f.d .
O'z RFA Genomika va bioinfarmatika markazi,
e-mail: dilraboerkaboeva@gmail.com

Annotatsiya. Mazkur maqolada g'o'za tunlami (*Helicoverpa armigera*) ning G.*hirsutum* turiga ta'sir mexanizmi, tarqalgan areallari, zararlanishdan keyingi oqibatlari va kurashish chora-tadbirlari haqida ma'lumotlar keltirilgan. Bundan tashqari dunyoda keng qo'llanilayotgan hasharotlarga qarshi tura oladigan *Cry (parasporal kristal), HMGR (3-gidroksi-3-metilglutaril koenzim-A reduktaza) , HaHR3 (Helecoverpa armigera HR3), GNA (Galanthus nivalis agglutinin), Cry5Aa, CYP6AE14 (Cytochrome P-450)* genlari hamda ular asosida ishlab chiqilgan transgen liniyalar haqida ham ma'lumotlar keltirib o'tilgan.

Kalit so'zlar: G'o'za tunlami (*Helicoverpa armigera*), *Gossypium hirsutum*, *Bacillus thuringiensis (Bt*),*Cry, Cty, HMGR, HaHR3, GNA, Cry5Aa, P450.*

THE IMPACT OF THE COTTON BOLL WEEVIL *(HELICOVERPA ARMIGERA*) ON THE POPULATION OF *GOSSYPIUM HIRSUTUM* AND ITS CONTROL MEASURES.

Erkaboeva Dilrabo Oybek's daughter is a trainee-researcher, Usmonov Dilshod Erkinboevich PhD, Boriyev Zabardast Todjiboevich Doctor of Biological Scienes.
Center for Genomics and Bioinformatics of the Republic of Uzbekistan,
e-mail: dilraboerkaboeva@gmail.com

Abstract. The article presents information about the mechanism of action of the cotton bollworm (*Helicoverpa armigera*) on *G. hirsutum* species, its distribution areas, consequences of damage and control measures. In addition, the genes Cry (*parasporal crystal), HMGR (3-hydroxy-3-methylglutarylcoenzyme-A reductase), HaHR3* (*Helicoverpa armigera HR3), GNA (Galanthus nivalis agglutinin),Cry5Aa*, *CYP6AE14 (cytochrome P-450) and reports on transgenic lines created on their basis are given.*

Key words: Cotton weevil (*Helicoverpa armigera*), *Gossypium hirsutum, Bacillus thuringiensis (Bt), Cry, Cty, HMGR, HaHR3, GNA, Cry5Aa, P450.*

ВЛИЯНИЕ ХЛОПКОВОГО ДОЛГОНОСИКА (*HELICOVERPA ARMIGERA*) НА ПОПУЛЯЦИЮ *GOSSYPIUM HIRSUTUM* И МЕРЫ БОРЬБЫ.

Эркабоева Дилрабо Ойбек кизи стажер-исследователь, Усманов Дилшод Эркинбаевич PhD., Бориев Забардаст Тоджибаевич д.б.н..
Центр геномики и биоинформатики Академии наук Республики Узбекистан,
e-mail: dilraboerkaboeva@gmail.com

Абстракт. В статье представлены сведения о механизме действия хлопкового совки (*Helicoverpa armigera)* на виды *G. hirsutum*, ареалах его распространения, последствиях повреждений и мерах борьбы. Кроме того, гены *Cry (параспоральный кристалл), HMGR (3-гидрокси-3-метилглутарилкоэнзим-А редуктаза), HaHR3 (Helecoverpa armigera HR3), GNA (агглютинин Galanthus nivalis), Cry5Aa, CYP6AE14 (цитохром P-450)* и также приведены сообщения о созданных на их основе трансгенных линиях.

Ключевые слова: *Хлопковый совки (Helicoverpa armigera), Gossypium hirsutum, Bacillus thuringiensis (Bt), Cry, Cty, HMGR, HaHR3, GNA, Cry5Aa, P450.*

Kirish, Hozirgi kundagi g\`o\`za yetishtiruvchi mamlakatlarning diqqat markazidagi asosiy muamalardan biri, g’o’zaning turli abiotik va biotik omillarga chidamli, hosildor va tola sifati yuqori bo’lgan yangi navlarni olishdir. Texnik o’simlik - paxta eng daromadli o’simligi hisoblanadi. G’o’za o’simligidan nafaqat tola olish maqsadida, balki uning chigit va poyasidan ham keng foydalaniladi. Mamlakatimizda 1440,8 millon gektardan ortiqroq yer maydonlarida g\`o\`za o\`simligining *G.hirsutum* turiga mansub navlar yetishtiriladi. Bu yer maydonlaridan olinadigan umumiy hiosildorlik yiliga 3,5 mln tonnani tashkil etadi. Biroq yetishtirilayotgan navlarning hosildorlik hamda sifat ko\`rsatkichlarining oshib borsada, ularning abiotik va biotik omillarga chidamlilik darajasini pasayib borishi kuzatilmoqda [11,12]. Xususan, ko\`sak qurti g`o`za o`simligining asosiy kushandaklaridan hisoblanib, hosildorlikni va tola sifatini keskin tushib ketishiga olib keladi.

Adabiyotlar tahlili. Ushbu hasharat g`o`zadan tashqari oraliq o`simliklarga ham zarar yetkazadi. So’ngi o’n yil ichida Hindistonda pomidor mevasining ushbu zararkunanda bilan zararlanishi natijasida hosilning 20% dan 70% gacha yo’qotilgani aniqlangan [17]. O’zbekistonda sabzavot maydonlarida mazkur tunlamning zarari o’rtacha 15-20% ni ba’zi yillari esa 50-60% ni tashkil etadi [16]. G’o’za tunlami nafaqat paxtada, balki 68 tadan ortiq oiladan 172 ta o’simlik turining zararkunandasi ekanligi aniqlangan [6,7]. *Helicoverpa armigera* lichinkalarining yashovchanligi g’o’zada 46,1% , tariqda 39,5% , soyada 24,2% makkajo’xorida 21,1% ligi aniqlangan [15]. G’o’za tunlami asosan tropik va subtropik mintaqalarda ayniqsa Afrika, Avstralya, Osiyo, Evropa da ko’plab qayd etilgan. Mazkur tur haqida birinchi marta Brazilya olimlar tomonidan aniqlangan [4,5]. Ommoviy zararlanishlar Albaniya, Jazoir, Bolgariya, Misr, Ispaniya, Portugaliya, Germaniya, Gretsiya, Isroil, Eron, Ukraina, Moldaviya, Sis-Kavkaz, Transkavkaz, Qozog‘iston, O‘rta Osiyo va Rossiyaning janubida kuzatilgan. U quyidagicha polisiklik tur hisoblanadi: Shimoliy Kavkazda 2-3 tagacha, Ozarbayjon va O‘rta Osiyoda 3-4 tagacha, Tojikiston janubida esa 5 tagacha avlod rivojlanadi. Ushbu tur havo xarorati o`rtacha +18-20°C bo`lganda rivojlanishni boshlaydi. Bu rivojlanishning boshlanishi mamlakatimizda aprel oylariga to’g`ri keladi. G`o`za tunlamining birinchi avlodalari oraliq ho`jayin o’simliklar hisoblangan pomidor, makkajo‘xori, no‘xat, beda va tamaki kabi ekinlar bilan oziqlanadi. G`o`za o`simligiga esa ko`saklash fazasida katta zarar yetkazadi. O‘rta Osiyoda uning zararli bo‘lishining iqtisodiy chegarasi 100 ta o’simlik namunasida o’rganilganda, uzun poyali g‘o‘zada 3 tadan 5 tagacha lichinka, o‘rtacha poyali g’o’zada esa 8 tadan 12 tagacha lichinka bo‘lishi aniqlangan [2,3]. G’o’za tunlamining bitta qurti 10 tadan 24 tagach ko’sakni zararlashi mumkin [18].

Mazkur tur bilan kurashishda an’anaaviy seleksiya va zamonaviy texnologiya usullaridan foydalanilmoqda. Zamonaviy texnologiya va metodlarning kashf qilinishi natijasida gen muhandisligi asosida ko’plab yutuqlarga erishilmoqda [19]. Xususan, *Bacillus thuringiensis* (Bt) bakteriyalari tomonidan ishlab chiqarilgan parasporal kristal (*Cry*) pestitsid sifatida ishlatiladi. Ushbu kristallar asosan hasharotlarning o'rta ichaklariga ta’sir qiladigan *Cry* va *Cyt* oqsillaridan iborat. *Cry* oqsillari *Bt* biopestitsidlarining muhim tarkibiy qismi bo'lib, transgen o'simliklarida ekspressiya orqali hasharotlarga ta’sir qilish uchun muhim vositadir. Ba'zi *Cry* toksinlari uchun *Cyt* o'rta ichak membranasiga ulanish uchun retseptor bo'lib xizmat qiladi. *Cry* toksinlarning aksaryati 130-140 kDa gacha bo’lgan protoksinlar bo’lib, ular 60-70 kDa gacha faollashadi [8,9,10]. Umuman olganda, so’ngi yillarda *Cry* toksinlarining yaratilishi hamda *Cry* va *Cty* toksinlari ta'sirining murakkab mexanizmlarini tushuntirish ko’plab yutuqlarga olib keldi [20]. *Cry* oqsillaridan ekinlarga zarar etkazuvchi va inson kasalliklarni tashuvchi hasharotlarga qarshi kurashishda foydalanilmoqda [1] . *Bt* asosida yaratilgan transgen g’o’zalar, Xitoyda 15 milliondan ortiq kichik fermerlar tomonidan ishlatiladi. Hindiston va boshqa rivojlangan mamlakatlarda ham ushbu transgen paxtadan keng foydalanib kelinmoqda [13,14].

Funksional genomikani tadbiq qilish va zararkunanda hashoratlarga kurashishda RNK interferensiya texnologiyasi asosida ham ko’plab tatqiqotlar olib borilmoqda. Ushbu texnologiya asosida g`o`za tunlami *HMGR (3-gidroksi-3-metilglutaril koenzim A reduktaza)* geni agrobakterya orqali o’simlikga transfarmatsiya qilingan. *Ha_HMGR* geni kiritilgan transgen g’o’zaning barglarini istemol qilgan ko’sak qurtlari lichinkalari sezilarli darajada pasaygan. Bundan tashqari hashorat lichinkalari transgen barglar bilan oziqlanganda lichinkalarda *vitellogenin* (Vg, emrion rivojlanishi uchun muhim oziqlanish manbai) genining ekspressiya darajasi ham 76,86% ga kamaygan. *Ha_HMGR* geni nafaqat vazn ortishiga to’sqinlik qiladi, balki ko’sak qurti lichinkalarni o’sishini ham kechiktiradi [21, 22, 23].

Helecoverpa armegera ga qarshi kurashishda *Cytochrome-P450* genlar oilasi asosida yaratilgan genetik konstruksiyalardan ham samarali foydalaniladi.

Ha_Cytochrome-P450 (CYPs) monooksigenaza vazifasini bajaradigan kofaktor sifatida genlarni o'z ichiga olgan ko’p funksiyali fermentlarning yuqori oilasidir. G`o`za tunlami genomida mavjud *CYP332A1*, *CYP4L11*, *CYP4L5*, *CYP4M6*, *CYP4M7*, *CYP6B7*, *CYP9A12*, *CYP9A14* genlar asosida oligan genetik konstruksiyalar ham ushbu hasharotga qarshi kurashishdfa samarali ekanligini ko`rsatdi [21,22]. Bundan tashqari *CRISPR-Cas9* texnalogiyasi asosida (*CYP6AE)* ishlab chiqilgan konstruksiya ham g’o’za tunlamiga qarshi samarali vosita ekanligi adabiyotlarda keltirib o’tilgan [23,24].

Yuqorida keltirib o’tilgan *Bt* genlari bilan *GNA* genlari birgalikda qo’llash orqali ham transgen o’simliklar ishlab chiqilgan. Tatqiqotlar shuni ko’rsatdiki ushbu genlarning integratsiyasi va molekulyar biologiya texnikasi hasharotlar lichinkalari uchun o’ta zaharli shu bilan birga populyatsiya rivojlanishini sezilarli darajada pasaytiradi. Ota-ona ajdodlarning o’z o’zini chatishtirish orqali olingan keyingi avlodlarda ham ushbu genlar ajratib olingan [25,26,27]. Tadqiqotlarda tanlangan maqsadli genlar asosida sun'iy ravishda ko’sak qurtlariga chidamli yangi *Cry5Aa* geni sintez qilindi. Yangi gen asosida tuzilgan genetik konstruksiya yordamida transgen g`o`za o`simliklari olindi. Transgen o`simlik barglari bilan ko’sak qurtini oziqlantirish orqali nazorat ekspremеntlari o`tkazilgan. Tatqiqot natijasida *T1*,*T2*,*T3* o`simlik avlodlarida chidamlilik ko`rstkichi 2,35%, 55,8% va 94,5% tashkil qilgan. G‘o‘za tunlamining chidamlilik tahlili shuni ko‘rsatdiki, ikkinchi, uchinchi va to‘rtinchi bosqichli lichinkalar transgen g‘o‘za barglari bilan nobud bo‘lish darajasi mos ravishda 85,42%, 73,35% va 62,79% ni tashkil etdi. Ikkita gen asosida olingan ushbu konstruksiya *Helecoverpa armigeraga* nisbatan yuqori darajada samaradorlikni bergan va *Cry5Aa* geni orqali keyingi avlodlarga uzatilishi sezilarli darajada barqarorligi aniqlangan. Bundan tashqari *Cry5Aa* genini nafaqat g’o’zada balki makkajo'xori va kartoshka o’simliklarga transfarmatsiya qilib nematodalarga chidamliligini oshirishi mumkin ko`rsatilgan [28,29,30].

RNKi texnologiyasi asosida *HaHR3* genini o'chirish uchun *dsRNA-HaHR3* fragmenti tanlangan. Bunda o’chirilgan *HaHR3* genini ifodalovchi jami 19 ta transgen g’o’za liniyalari muvaffaqiyatli yetishtirilgan va tekshirish maqsadida suniy oziqlantirish uchun 7 ta hosilga kirgan liniyalari tanlab olingan. Transgen o’simlikni tekshirish uchun yangi chiqqan ko’sak qurtining lichinkalari hamda 3-5- avlod lichinkalari bilan zararlantirilgan. Olingan natijalar shuni ko’rsatdiki yosh lichinkalarning nobud bo`lish darajasi yuqori bo’lgan, populyatsiyaning yetuk rivojlangan vakillari esa deformatsiyaga uchragan. Bundan tashqari transgen g’o’za nazorat maqsadida solishtirganda nafaqat qurtga chidamlilik ba’lki hosildorlikning ham oshiganligi aniqlangan [31,32,33].

Xulosa. Mamlakatimizda paxta yetishtirish va undan yuqori mo’l-hosil olish maqsadida yangi, raqobatbardosh, chidamli navlar olish ustida ilmiy markazlarda doimiy ravishda tatqiqotlar olib boriladi. Ma’lumki, O’zbekistonda ham sanoat miqyosida paxtadan keng foydalaniladi va shu sababdan ko’plab yer maydonlariga ekiladi. Butun dunyoda bo’lgani singari yurtimizda ham paxta tolasining sifat va miqdor ko’rsatkichlarini yaxshilash borasida ilmiy-tatqiqot ishlari olib boriladi. Biz yuqorida keltirib o’tkan tur *Helicoverpa armigera* esa aynan shu muhim ko’satkichlarning keskin tushib ketishiga olib keladi. Buning natijasida esa kutilgan samaradorlikga erishish uchun to`siq bo`lmoqda. Ushbu biotik cheklovchi omilni bartaraf qilish uchun gen muhandisligi texnologiyalari asosida g`o`zaning chidamli liniyalarini ishlab chiqishni maqsad qildik.

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