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KUZGI YUMSHOQ BUG‘ DOYNING F_5 DURAGAY AVLODLARIDA ALBUMIN OQSILLARINING IVISH HARORATI

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Annotatsiya: *Ushbu maqolada kuzgi yumshoq bug‘ doyning Chillaki va Fortuna navlari hamda ularning T-5 (Chillaki × Fortuna) kombinatsiyasidan olingan 9 ta F_5 duragay namunalarining boshoqlash davrida barg hujayra shirasidagi suvda eruvchan albumin oqsillarining ivish (koagulyatsiya) harorati P.A. Genkel uslubi yordamida o‘ rganildi. Tadqiqot natijalariga ko‘ ra, namunalar kesimida oqsillar koagulyatsiya harorati 55,3°C dan 62,5°C gacha oraliqda o‘ zgarib, eng yuqori ko‘ rsatkich T-5/4 duragayida (62,5°C) qayd etildi. Olingan natijalar duragaylarning issiqlik stressiga chidamlilik darajasi yuqori ekanligini ko‘ rsatadi.*

Kalit so‘ zlar: *Kuzgi yumshoq bug‘ doy, nav, albumin oqsili, barg hujayra shirasi, koagulyatsiya harorati.*

ТЕМПЕРАТУРА КОАГУЛЯЦИИ АЛЬБУМИНОВЫХ БЕЛКОВ У ГИБРИДНЫХ ПОКОЛЕНИЙ F_5 ОЗИМОЙ МЯГКОЙ ПШЕНИЦЫ

Аннотация: *В данной статье с использованием метода П.А. Генкеля изучена температура коагуляции водорастворимых белков альбумина в клеточном соке листьев в период колошения у сортов мягкой озимой пшеницы Chillaki и Fortuna, а также у 9 F_5 гибридных образцов (Chillaki × Fortuna). Согласно результатам исследования, температура коагуляции белков варьировала в пределах от 55,3°C до 62,5°C, при этом наивысший показатель был отмечен у гибрида T-5/4 (62,5°C). Полученные результаты свидетельствуют о высокой степени устойчивости гибридов к тепловому стрессу.*

Ключевые слова: *Озимая мягкая пшеница, сорт, белок альбумин, клеточный сок листа, температура коагуляции.*

COAGULATION TEMPERATURE OF ALBUMIN PROTEINS IN F_5 HYBRID PROGENIES OF BREAD WHEAT

Abstract: *This article investigates the coagulation temperature of water-soluble albumin proteins in the leaf cell sap during the heading period of bread wheat varieties Chillaki and Fortuna, as well as nine F_5 hybrid samples obtained from the T-5 (Chillaki × Fortuna) combination, using the P.A. Genkel method. According to the research results, the protein coagulation temperature ranged from 55.3°C to 62.5°C across the samples, with the highest value recorded in hybrid T-5/4 (62.5°C). The obtained results indicate a high level of heat stress tolerance in the studied hybrids.*

Key words: *Bread wheat, variety, albumin protein, leaf cell sap, coagulation temperature.*

Kirish

So‘ nggi yillarda global iqlim o‘ zgarishi hamda antropogen ta’sirlarning kuchayishi natijasida atrof-muhit holatining yomonlashuvi qishloq xo‘ jaligi ishlab chiqarishi va oziq-ovqat xavfsizligiga jiddiy xavf tug‘ dirmoqda. Ekinlarning o‘ sishi, rivojlanishi va hosildorligiga salbiy ta’sir etuvchi asosiy abiotik omillar qatoriga yuqori harorat, tuproq sho‘ rlanishi hamda qurg‘ oqchilik kiradi. Ushbu omillar ta’sirida o‘ simliklarda kechadigan fiziologik va biokimyoviy jarayonlar izdan chiqib, hosildorlik hamda mahsulot sifati pasayadi. Bug‘ doyning issiqlik stressiga

chidamliligini baholashda fiziologik ko‘ rsatkichlardan foydalanish muhim ahamiyatga ega. Xususan, barg hujayra shirasidagi suvda eruvchan albumin oqsillarining ivish (koagulyatsiya) harorati hujayra oqsillarining termik barqarorligini tavsiflovchi muhim ko‘ rsatkichlardan biri hisoblanadi. Ushbu ko‘ rsatkich asosida seleksiya jarayonida istiqbolli genotiplarni saralash va issiqlikka chidamli duragaylarni aniqlash imkoniyati yaratiladi. Mazkur tadqiqotda kuzgi yumshoq bug‘ doyning Chillaki va Fortuna navlari hamda ularning T-5 (Chillaki × Fortuna) kombinatsiyasidan olingan F_5 duragay avlodlarida boshoqlash davrida barg hujayra shirasidagi suvda eruvchan albumin oqsillarining ivish harorati aniqlanib, duragaylarning issiqlik stressiga chidamliligi qiyosiy baholandi.

Adabiyotlar tahlili

Issiqlik stressi o‘ simliklar o‘ zlarining optimal o‘ sish va rivojlanish haroratidan yuqori bo‘ lgan sharoitda uzoq muddat davomida qolishi natijasida yuzaga keladigan asosiy abiotik stress omillaridan biridir. Ushbu stressning kuchayishiga issiqxona gazlari va xlorftoruglerodlar emissiyasining ortishi, atmosfera tarkibida CO_2 konsentratsiyasining oshishi hamda inson faoliyati bilan bog‘ liq antropogen ta’sirlar sabab bo‘ lmoqda. Bunday o‘ zgarishlar global iqlim tizimining izchil isishiga olib kelib, qishloq xo‘ jaligi ekinlarining o‘ sishi, rivojlanishi va hosildorligiga salbiy ta’sir ko‘ rsatadi. Shu sababli iqlim o‘ zgarishining ekinlar mahsuldorligiga ta’sirini baholash, hosildorlikdagi ehtimoliy o‘ zgarishlarni oldindan prognoz qilish hamda moslashuv strategiyalarini ishlab chiqish maqsadida turli modellashtirish yondashuvlari va prognozlash modellari keng qo‘ llanilmoqda [**1**]. Yuqori harorat o‘ simliklarning generativ rivojlanish bosqichini jadallashtirib, fotosintez mahsulotlarining meva va urug‘ hosil bo‘ lishiga yo‘ naltirilishini cheklaydi. Shuningdek, tuproq haroratining me’yoridan ortishi urug‘ larning unib chiqish jarayoniga salbiy ta’sir ko‘ rsatib, maysalarning bir tekis rivojlanishiga to‘ sqinlik qilishi mumkin. Yuqori haroratning uzoq muddat davom etishi o‘ simliklarning o‘ sishi va rivojlanishini izdan chiqaradi, fiziologik jarayonlar muvozanatini buzadi hamda suv tanqisligini yanada kuchaytiradi. Natijada qurg‘ oqchilik stressi chuqurlashib, hosildorlikning keskin pasayishiga, ayrim hollarda esa o‘ simliklarning nobud bo‘ lishiga olib kelishi mumkin [**2**]. Yuqori harorat stressining salbiy ta’siri bug‘ doy, sholi, makkajo‘ xori, marvarid tariq, jo‘ xori, arpa, *Brachypodium*, *Arabidopsis*, no‘ xat va pomidor kabi ko‘ plab madaniy o‘ simliklarda kuzatiladi. Haroratning me’yoridan ortishi o‘ simliklarning o‘ sishi va rivojlanishiga salbiy ta’sir ko‘ rsatib, hosil shakllanish jarayonini izdan chiqaradi hamda hosil yig‘ imidan oldingi va keyingi yo‘ qotishlarning ortishiga sabab bo‘ ladi. Bunday o‘ zgarishlar barglarning quyosh ta’sirida kuyishi, barg, poya, novda va shoxchalarning qurishi, ildiz tizimi rivojlanishining susayishi hamda mevalar rangining o‘ zgarishi kabi morfologik belgilar bilan namoyon bo‘ ladi. Bundan tashqari, yuqori haroratning uzoq muddat davom etishi barglarning o‘ lchami, shakli va orientatsiyasiga ham ta’sir ko‘ rsatadi. Barglar fotosintezning asosiy organi bo‘ lganligi sababli, ular issiqlik stressiga eng tez javob qaytaruvchi va stressning dastlabki tashqi belgilarini namoyon etuvchi vegetativ organlardan biri hisoblanadi. Shu bois barglarda kuzatiladigan morfologik va fiziologik o‘ zgarishlar o‘ simliklarning issiqlikka chidamliligini baholashda muhim diagnostik mezon sifatida qaraladi [**3**].

Bug‘ doy dunyo miqyosida asosiy oziq-ovqat ekinlaridan biri sifatida oziq-ovqat xavfsizligi va oqsil ta’minotida muhim rol o‘ ynaydi hamda umumiy jahon don mahsulotlarining 11,1% ini va insoniyatning umumiy oqsil ehtiyojining 20,3% ini ta’minlaydi [4]. Bug‘ doy sifati, avvalo, uning oziqaviy qiymati hamda texnologik-qayta ishlash xususiyatlari bilan tavsiflanadi. Oziqaviy sifat albumin va globulin miqdori, aminokislotalar tarkibi, ayniqsa lizin kabi muhim aminokislotalar miqdori hamda boshqa oziq moddalar tarkibi bilan bog‘ liq [5]. Bug‘ doyning sifat ko‘ rsatkichlari genetik xususiyatlar, tashqi muhit omillari va ularning o‘ zaro ta’siri bilan belgilanadi [6]. Tuproqdagi namlik darajasi, yorug‘ lik intensivligi, tuproq xususiyatlari, harorat hamda atmosferadagi CO miqdorining ortishi kabi ko‘ plab ekologik omillar bug‘ doy sifatiga ta’sir ko‘ rsatishi aniqlangan [7]. Don hosil bo‘ lishi va to‘ lishi bosqichlaridagi haroratning o‘ zgaruvchanligi bug‘ doy doni sifatiga sezilarli ta’sir ko‘ rsatib, global qishloq xo‘ jaligi uchun muhim muammolardan biri hisoblanadi. 2035-yilga borib dunyo bo‘ yicha o‘ rtacha harorat taxminan 0,35-0,70°C ga oshishi taxmin qilinmoqda [8]. Issiqlik stressi don to‘ lish davrini qisqartiradi, bu bosqich oqsil va kraxmal to‘ planishi uchun muhim bo‘ lib, natijada umumiy oqsil miqdori kamayadi hamda uning tarkibi o‘ zgaradi [9]. Bug‘ doy vegetativ bosqichlarga nisbatan reproduktiv rivojlanish davrida yuqori harorat ta’siriga ko‘ proq sezgir hisoblanadi [10].

Barg haroratining oshishi natijasida issiqlik stressiga uchragan bug‘ doy o‘ simligida barglarning suv potensiali va nisbiy suv miqdori keskin kamayadi, oqibatda fotosintez samaradorligi pasayadi [11]. Don to‘ lish davrida kuzatiladigan issiqlik stressi oziq moddalarning o‘ simlik bo‘ ylab harakatlanishini susaytiradi [12]. Barg hujayralaridagi suvda eriydigan oqsillarning koagulyatsiya harorati bilan bug‘ doyning issiqlikka chidamlilik xususiyati o‘ zaro bog‘ liq hisoblanadi [13]. O‘ simliklarning yuqori haroratga moslashuvchi himoya reaksiyalaridan biri oqsillarning koagulyatsiya haroratining oshishidir [14]. Bug‘ doy barglarining suvni yuqori darajada saqlashi muhim ahamiyatga ega. Sut-mum pishish davrida barglarda suvning 60% va undan ortig‘ ining saqlanib qolishi qurg‘ oqchil hududga moslashgan navlarga xos belgi bo‘ lib, seleksiya uchun muhim ko‘ rsatkich hisoblanadi [15].

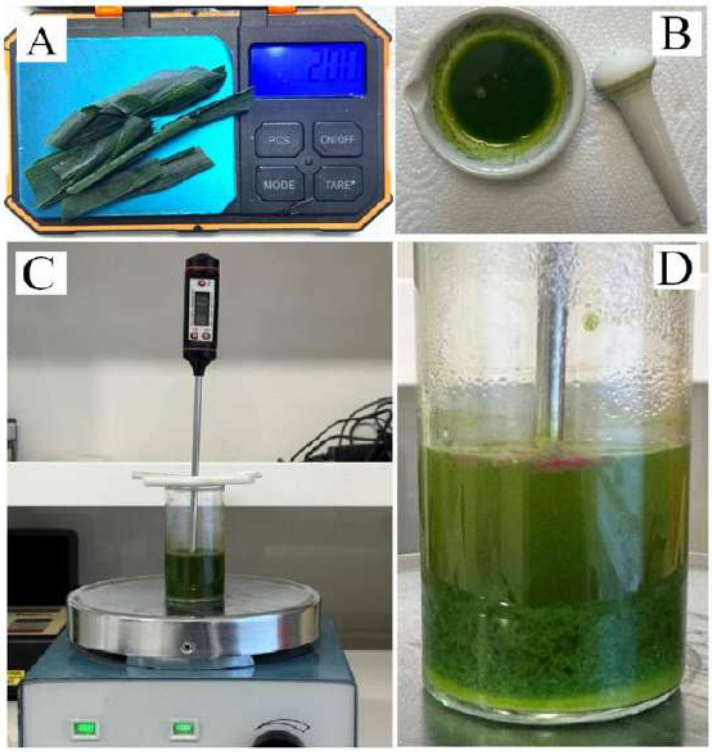
2025-2026-yillarda Xorazm viloyatida olib borilgan tadqiqotlarda ayrim navlarda bargdagi suvda eruvchan albumin oqsillarining ivish harorati aniqlangan. Unga ko‘ ra, 2025-yilda navlarning bargdagi suvda eruvchan albumin

oqsilining ivish harorati o‘ rtacha 57,9ºC dan 63,2ºC gacha oraliqda bo‘ lib, eng yuqori natija Bo‘ zqal’a (62,8ºC) va Yonbosh (63,2ºC) navlarida qayd qilingan. 2026-yilda navlarning oqsil koagulyatsiyasi aniqlanganda eng past natija Kate-A1 navida kuzatilib 56,6ºC ga teng bo‘ lgan. Qolgan navlarda Kate-A1 naviga nisbatan oqsil koagulyatsiyasi ±0,3 dan 6,9ºC gacha yuqori ko‘ rsatkichni qayd qilgan. 2026-yilda o‘ rganilgan navlar ichida eng yuqori natija Bo‘ zqal’a navida (63,5ºC) kuzatilgan [16].

Tadqiqot metodologiyasi

Tadqiqot obyekti sifatida kuzgi yumshoq bug‘ doyning Chillaki, Fortuna kabi ota-ona shakllari va T-5 (Chillaki x Fortuna) kombinatsiyasidan olingan 9 ta F_5 duragay namunalari olindi.

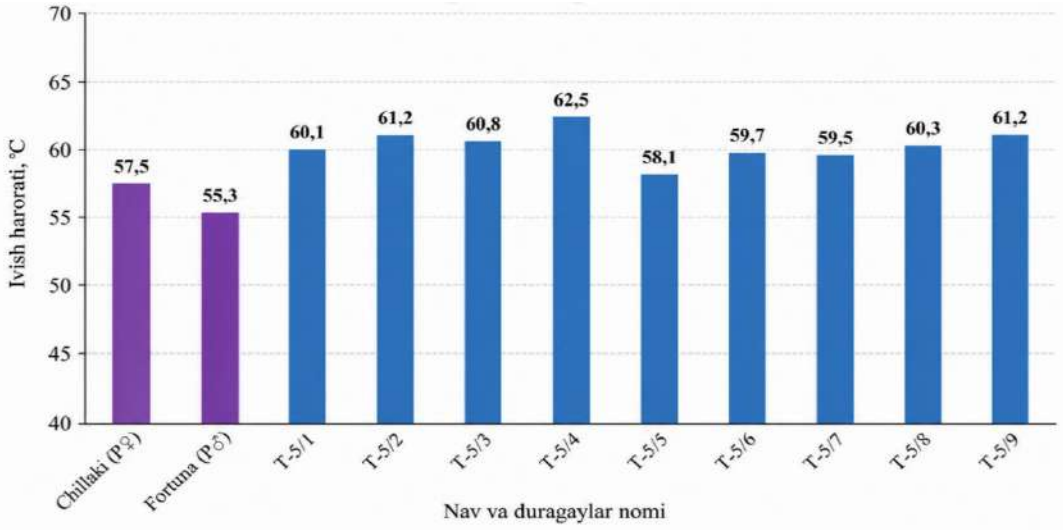
Tadqiqot uslublari. Navlar va duragaylarning boshoqlash davrida barg hujayra shirasi tarkibidagi suvda eruvchi albumin oqsillarining ivish (koagullanish) harorati P.A.Genkel uslubi yordamida o‘ rganildi. Ushbu uslub yordamida albuminlar koagulyatsiyasini aniqlash uchun 2,0 gramm barg namunasi olinib, olingan namuna ustiga 25 ml distillangan suv quyib chinni havonchada yaxshilab eziladi. Barg hujayra shirasi ajratib olinib, filtrlanadi. Filtrlangan eritma elektr plitka ustiga qo‘ yilib qizdiriladi (1-rasm). Albumin oqsillarining ivish (koagullanish) harorati aniqlanadi va natijalar qayd etiladi [17].



1-rasm. P.A.Genkel uslubi yordamida albumin oqsillarining koagullanish harorati aniqlash jarayoni. A) kerakli barg namunasini o‘ lchash, B) barg hujayra shirasi ajratib olish, C)barg shirasi ekstraktiga harorat ta’sir qildirish jarayoni, D)koagulyatsiyaga uchragan albumin oqsillari.

Natijalar va ularning tahlili

Laboratoriya sharoitida olib borilgan tadqiqotlarda Chillaki va Fortuna navlari hamda ular ishtirokida olingan duragaylarning barg hujayra shirasidagi suvda eruvchan albumin oqsillarining ivish harorati o‘ rganildi. Tadqiqot natijalariga ko‘ ra, namunalar kesimida oqsil koagulyatsiyasi harorati 55,3°C dan 62,5°C gacha oraliqda o‘ zgardi. Ota-ona shakllari orasida eng yuqori ko‘ rsatkich Chillaki navida kuzatilib, albumin oqsillarining ivish harorati 57,5°C ni tashkil etdi. Fortuna navida esa ushbu ko‘ rsatkich 55,3°C bo‘ lib, tadqiqotdagi eng past natija sifatida qayd etildi (2-rasm). Bu esa Fortuna naviga nisbatan Chillaki navining yuqori harorat ta’siriga nisbatan hujayra oqsillarini barqarorroq saqlash xususiyatiga ega ekanligini ko‘ rsatadi.



2-rasm. Navlar va duragaylar barg hujayra shirasidagi albumin oqsillarining ivish harorati, °C

Duragaylar orasida albumin oqsillarining ivish harorati ota-ona shakllariga nisbatan ancha yuqori bo‘ ldi. Eng yuqori natija T-5/4 duragayida kuzatilib, 62,5°C ni tashkil etdi. Shuningdek, T-5/2 va T-5/9 duragaylarida ham yuqori ko‘ rsatkichlar qayd etilib, bir xil ravishda 61,2°C ga teng bo‘ ldi. T-5/3 duragayida 60,8°C, T-5/8 duragayida 60,3°C va T-5/1 duragayida 60,1°C natijalar aniqlandi. Tajriba uchun olingan qolgan duragay namunalarida nisbatan pastroq ko‘ rsatkichlar kuzatilgan bo‘ lsa-da, ular ham ota-ona navlaridan yuqori natija qayd etdi.

Xulosa

Kuzgi yumshoq bug‘ doy navlari va duragaylarining barg hujayra shirasidagi albumin oqsillari koagulyatsiyasini aniqlash ularning yuqori harorat stressi hamda suv tanqisligi sharoitlariga bardoshliligini baholashda muhim fiziologik ko‘ rsatkichlardan biri hisoblanadi. Albumin oqsillarining ivish haroratining yuqori bo‘ lishi hujayra protoplazmasining termik barqarorligi yuqori ekanligini va o‘ simlikning noqulay muhit omillariga nisbatan chidamliligini tavsiflaydi.

Tadqiqot natijalariga ko‘ ra, ota-ona shakllari orasida eng yuqori ko‘ rsatkich Chillaki navida (57,5°C), eng past ko‘ rsatkich esa Fortuna navida (55,3°C) kuzatildi. Duragaylar orasida albumin oqsillarining ivish harorati 58,1–62,5°C oralig‘ ida o‘ zgarib, eng yuqori natija T-5/4 duragayida (62,5°C), undan keyingi yuqori ko‘ rsatkichlar T-5/2 va T-5/9 duragaylarida (61,2°C) qayd etildi. Mazkur duragaylarda oqsillarning yuqori haroratlarda koagulyatsiyaga uchrashi ularning issiqlik stressiga nisbatan yuqori chidamlilikka ega ekanligini ko‘ rsatadi. Shu sababli, T-5/4, T-5/2 va T-5/9 duragaylarini yuqori harorat va suv tanqisligi sharoitlariga moslashgan yangi navlarni yaratish jarayonida istiqbolli seleksiya materiali sifatida baholash mumkin.

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