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The effect of sowing dates and seeding rates of triticale on plant growth and yield in areas prone to water scarcity

Suv tanqisligiga moyil hududlarda tritikale urug‘larini ekish muddat va me’yorlarining o‘simliklarning o‘sishi va hosildorligiga ta’siri

Влияние сроков и норм посева семян тритикале на рост и урожайность растений в районах, склонных к дефициту воды

Fayzulla Xidirovich HAMRAEV[1,*]

[1] *Department of Agronomy, Navoi State University of Mining and Technologies, Navoi, Uzbekistan*
***** Corresponding author: fayzulla.hamroyev52@mail.ru

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CONTACT
ReFocusJournal@gmail.com

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Fayzulla Xidirovich HAMRAEV[1,*]
[1] *Department of Agronomy, Navoi State University of Mining and Technologies, Navoi, Uzbekistan*

Abstract. This article presents a comprehensive analysis of sowing dates, seeding rates, and cultivation technology of the autumn triticale varieties “Svat” and “Tit” under the soil and climatic conditions of the Navoi region. The study examines plant growth and development, viability, productivity, and quality indicators of the yield. In addition, data obtained on optimal sowing dates and seeding rates of autumn triticale seeds are thoroughly analyzed. Since triticale is a hybrid of wheat and rye, it is considered a crop with higher adaptability compared to both wheat and rye. The protein content of the grain ranges from 12–13%, while straw contains 10–12% protein. The crop is widely used as feed for livestock, and its grain is utilized in the production of bread and animal feed. However, the quality of bread products made from triticale grain is lower than that of wheat flour. Depending on soil and climatic conditions, grain yield ranges from 45–65 centners per hectare, while green biomass yield amounts to 340–450 centners per hectare. To achieve high yields, it is essential that fields are kept free from weeds and various diseases, and that mineral fertilizers are applied in a timely manner and at scientifically recommended rates.

Keywords: triticale; variety; sowing dates; seeding rates; fertilization; mineral fertilizers; yield

O‘ZBEKCHA

HAMRAEV Fayzulla Xidirovich[1,*]
[1] *Agronomiya kafedrasi, Navoiy davlat konchilik va texnologiyalar universiteti, Navoiy, O‘zbekiston*

Annotatsiya. Maqolada Navoiy viloyatining tuproq-iqlim sharoitida kuzgi tritikalening “Svat” hamda “Tit” navlarini ekish muddatlari, me’yorlari va yetishtirish agrotexnikasi, ya’ni o‘simliklarning o‘sishi-rivojlanishi, yashovchanligi, hosildorligi, mahsulotning sifat ko‘rsatkichlari, shuningdek, kuzgi tritikale urug‘larini ekish muddat va me’yorlari bo‘yicha olingan ma’lumotlar to‘liq tahlil qilib berilgan. Tritikale ekini bug‘doy va javdar duragayi bo‘lgani uchun bu o‘simlik bug‘doy va javdarga nisbatan ancha moslashuvchan ekin turi bo‘lib, donining tarkibida oqsil miqdori 12–13 foiz, pichanining tarkibida 10–12 foiz bo‘ladi. Somoni chorva mollari uchun ozuqa, doni non va yem tayyorlashda foydalaniladi. Non mahsuloti tayyorlashda sifati bug‘doy mahsulotidan pastdir. Tuproq-iqlim sharoitiga qarab don hosili 45–65 s/ga, ko‘k massa hisobida 340–450 s/ga ni tashkil etadi. Ammo bunday yuqori hosil olish uchun albatta dala maydoni begona o‘tlardan va turli kasalliklardan toza bo‘lishi va mineral o‘g‘itlar bilan o‘z vaqtida belgilangan me’yorlarda oziqlantirish lozim.

Kalit so‘zlar: tritikale; nav; ekish muddatlari; ekish me’yorlari; oziqlantirish; mineral o‘g‘itlar; hosildorlik

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РУССКИЙ

ХАМРАЕВ Файзулла Хидирович[1,*]
[1] *Кафедра агрономии, Навоийский государственный горно-технологический университет, Навои, Узбекистан*

Аннотация. В статье представлен полный анализ данных, полученных по срокам, нормам и агротехническим условиям выращивания сортов озимой тритикале «Сват» и «Тит» в почвенно-климатических условиях Навоийской области, а именно: рост и развитие растений, жизнеспособность, урожайность, показатели качества продукции, а также сроки и нормы посева семян озимой тритикале. Поскольку тритикале является гибридом пшеницы и ржи, это растение более приспособлено к различным условиям выращивания, чем пшеница и рожь, а содержание белка в его зерне составляет 12–13 %, в сене — 10–12 %. Солома используется для приготовления кормов для скота, зерно — для хлебопечения и фуража. При приготовлении хлебобулочных изделий его качество ниже, чем у пшеничных продуктов. В зависимости от почвенно-климатических условий урожайность зерна составляет 45–65 ц/га, а в пересчёте на зелёную массу — 340–450 ц/га. Однако для получения столь высокого урожая поле должно быть свободно от сорняков и различных болезней, а подкормка минеральными удобрениями должна проводиться своевременно и в установленных нормах.

Ключевые слова: тритикале; сорт; сроки посева; нормы высева; подкормка; минеральные удобрения; урожайность

1. KIRISH
Introduction

Kirish: Tritikale (Triticosecale) javdar va bug‘doyning amfidiploidi-dir. Nemis seleksioneri V.Rimpau tomonidan 1888 yilda bug‘doyni javdar bilan chatishtirish orqali birinchi bo‘lib unumdor oktoploid bug‘doy-javdar gibrid tritikaleni yaratdi. Hozirda tritikale butun dunyoda asosan yem-xashak va oziq-ovqat uchun yetishtiriladi [7].

Tritikale - bug‘doy va javdar o‘rtasida murakkab masofaviy duragaylash orqali odamlar tomonidan sintez qilingan donning yangi jinsidir. O‘simlik javdar va bug‘doyning morfologik xususiyatlarini va biologik xususiyatlarini birlashtiradi. Tritikale kurtaklari javdarga o‘xshaydi, poya barglari bug‘doyga o‘xshaydi. Boshog‘i javdarning ko‘p boshoqli ko‘rinishini bug‘doy boshoqlarining ko‘p gulli ko‘rinishi bilan birlashtiradi. Spikelet va lemmaning morfologiyasi bug‘doynikiga o‘xshaydi. Changlanish turiga ko‘ra tritikale ko‘pincha o‘zaro changlanadi, lekin bug‘doydagi kabi o‘z-o‘zidan changlanishi ham mumkin. Tritikale doni yirik shakli, rangli, sirt xarakteri o‘yiq, donining po‘sti qalin, qalinligi va kengligi bug‘doyga o‘xshaydi, lekin sezilarli darajada uzunroq [2; 42-43-s., 1; 18-s.].

Tritikale - bug‘doy va javdarning asl ota-ona shakllarining bir qator xususiyatlarini o‘zida mujassam etgan donli ekinlarning yangi sun’iy ravishda olingan amfidiploidi. Bu bug‘doy va javdar xromosomalarining to‘liq to‘plamini birlashtirgan duragaylardir. Ona o‘simlik bug‘doy hisoblanadi. Tritikale ko‘p boshoqli ko‘rinishni javdardan, ko‘p gulli boshoqni bug‘doydan meros qilib oldi, bu boshoqning yuqori mahsuldorligini belgilaydi. Tashqi tomondan, tritikale boshog‘i javdar boshog‘iga o‘xshaydi [4; 49-s.].

Tritikale yoki bug‘doy-javdar gibridi – boshoqli don o‘simliklarning yangi turi. Bu tur kuchli rivojlangan ildiz tizimi va yuqori poyaga egaligi bilan ajralib turadi. O‘simliklar tik poya hosil qiladi, em-xashak navlarida poyasining balandligi 145-180 sm, donli navlarda 110-120 sm bo‘lib, tabiatning stres omillariga chidamli. Barglari lansetsimon, mayin, barglari 45-50%. To‘pgul - 25-28 ta boshoqchadan iborat katta boshoq. Bu ekin quruq yillarda, vegetatsiya davrida 250 mm dan ko‘p bo‘lmagan yog‘ingarchilik tushganda ham yuqori hosil berishga qodir [3; 49-s.].

Navoiy viloyat hududi asosan Qizilqum cho‘lining katta qismi, Zarafshon daryosi vodiysi hamda Nurota tog‘ tizmalari bilan qamrab olingan. Bu hududning geografik o‘rni viloyatda turli tuproq turlari va landshaftlarning shakllanishiga zamin yaratgan.

Viloyat maydoni mamlakat umumiy yer maydonining taxminan 24,7% ini tashkil etadi. Iqlimi kontinental, quruq va yoz mavsumi juda issiq, qish mavsumi esa sovuq va quruq kechadi. Yillik yog‘ingarchilik miqdori 90–150 mm atrofida bo‘lib, asosan bahor va qisman kuz oylariga to‘g‘ri keladi. Yozda havo harorati +40…+45 °C gacha ko‘tariladi, qishda esa –15…–20 °C gacha pasayishi mumkin. Tajriba o‘tkazish usuli va uslublari: Ilmiy–tadqiqot ishlari 2023-2024 yillarda Don va dukkakli ekinlar ilmiy-tadqiqot institutining Novoiy ilmiy-tajriba stansiyasi dalalarida, sug‘oriladigan bo‘z-o‘tloqi tuproqlar sharoitida olib borilib, tajribada kuzgi tritikalening “Svat” va “Tit” navlarini o‘sishi, rivojlanishi va don hosildorligiga urug‘larini ekish muddatlapi va me’yorlarining ta’siri o‘rganildi. Tajribada kuzgi tritikalening “Svat” va “Tit” navi urug‘larini uch xil ekish (15-sentyabr, 1-oktyabr, 15-oktyabr) muddatlapida uch xil (4,0 mln/ga, 5,0 mln/ga, 6,0 mln/ga) ekish me’yorlarida ekib o‘rganildi. Tajriba maydonlarini tanlash va variantlarni joylashtirishda “Dala tajribalarini o‘tkazish uslubiyatlari” (2007) uslubiy qo‘llanmasidan, kuzgi tritikale o‘simligida fenologik kuzatuv va hisoblash ishlarini olib borishda “Metodika Gosudarstvennogo sortoispytaniya sel’skokhozyaystvennykh kultur” (M, Kolos, 1964) uslubiy qo‘llanmasidan, olingan natijalarga matematik-statistik ishlov berishda B.A.Dospexovning “Metodika polevogo opyta” (M, 1985) uslubnomasidan foydalanildi. Olingan ma’lumotlarning ko‘rsatishicha, (2023-2024 yy.) amal davri boshida tajriba dala tuprog‘ining 0-30 cm qatlamida gumus miqdori 0,894-0,890 foizni, umumiy shakldagi azot 0,089-0,087 foiz, fosfor 0,119-0,116 foizni, 1,43-1,37 foizni ko‘rsatgan bo‘lsa, tuproqning 30-50 cm qatlamida gumus miqdori 0,654-0,643 foizni, umumiy shakldagi azot 0,066-0,064 foizni, fosfor 0,094-0,091 foizni, kaliy 1,24-1,17 foizni tashkil etganligi aniqlandi. Oziqa unsurlarining harakatchan shakllari tahlil qilinganida, tuproqning 0-30 cm qatlami nitrat miqdori 10,5-10,0 kg/mg, harakatchan fosfor miqdori 25,1-23,3 kg/mg, almashinuvchi kaliy miqdori 180-171 kg/mg, tuproqning 30-50 cm qatlamida nitrat miqdori 5,6-5,1 kg/mg, harakatchan fosfor miqdori 16,8-15,8 kg/mg, almashinuvchi kaliy miqdori 153-143 kg/mg ni tashkil etganligi ma’lum bo‘ldi.

2. TADQIQOT MATERIALLARI VA USLUBLARI
Materials and methods

Tajriba olib borilgan dalalar tuproqlarining agrokimyoviy xususiyatlari bo‘yicha olingan ma’lumotlarga asoslanib xulosa qiladigan bo‘lsak, nitrat bilan juda kam, harakatchan fosfor va almashinuvchi kaliy bilan kam darajada ta’minlangan deyish mumkin.

1-jadval

Tajriba maydonining dastlabki agrokimyoviy xususiyatlari / **Table 1.** Initial agrochemical properties of the experimental plot

Yillar	Tuproq qatlamlari, sm	Gumus miqdori, %	N	P	K	N–NO₃	P₂O₅	K₂O
Yillar	Tuproq qatlamlari, cm	Gumus miqdori, %	N	P	K	N–NO3	P2O5	K2O
2023	0-30	0,894	0,089	0,119	1,43	10,5	25,1	180
2023	30-50	0,654	0,066	0,094	1,24	5,6	16,8	153
2024	0-30	0,890	0,087	0,116	1,37	10,0	23,3	171
2024	30-50	0,643	0,064	0,091	1,17	5,1	15,8	143

Izoh: N, P, K — umumiy shakllari, %; N–NO_3, P_2O_5, K_2O — harakatchan shakllari miqdori, mg/kg. / Note: N, P, K — total forms, %; N–NO_3, P_2O_5, K_2O — mobile forms, mg/kg.

Tadqiqotning amaliy natijalari quyidagilardan iborat:

Kuzgi tritikaleni oziqlantirishda, azotli o‘g‘itlardan korbomid (46%), ammiakli selitra (N–34%), fosforli o‘g‘itlardan superfosfat (P2O5–20%), kaliyli o‘g‘itlardan kaliy tuzi (K2O–40%) ishlatildi. Tajribada fosforli va kaliyli o‘g‘itlarning 100% miqdori kuzda, shudgor ostiga qo‘llanildi. Azotli o‘g‘itlar ikkiga bo‘lib, 1-oziqlantirish tuplash davrida, 2-oziqlantirish naychalash davrida qo‘llanildi.

3. TADQIQOT NATIJALARI VA ULARNING TAHLILI

Results and discussion

Kuzgi tritikale navlarida unib chiqqan ko‘chatlar soni bo‘yicha yuqori natijalar urug‘lar 15-sentyabr muddatida ekilgan variantlarda kuzatilib, urug‘lar 1-oktyabr muddatida ekilgan variantlarga nisbatan “Svat” navida 2,4-4,2 dona/m2 gacha, “Tit” navida 3,2-5,0 dona/m2 gacha yuqori natija ko‘rsatgani kuzatilgan bo‘lsa, amal davri oxirida xaqiqiy ko‘chat qalinligi bo‘yicha yuqori natijalar urug‘lar 1-oktyabr muddatida ekilgan variantlarda qayd etilib, urug‘lar 15-sentyabr muddatida ekilgan variantlarga nisbatan “Svat” navida 1,8-4,8 dona/m2 gacha, “Tit” navida 3,5-6,1 dona/m2 gacha, urug‘lar 15-oktyabr muddatida ekilgan variantlarga nisbatan “Svat” navida 2,2-5,1 dona/m2 gacha, “Tit” navida 5,8-10,3 dona/m2 gacha yuqori natija ko‘rsatgani aniqlandi;

Shuningdek, kuzgi tiritikale navlari urug‘larini 15-sentyabr muddatida ekish urug‘larni 1-oktyabr va 15-oktyabr muddatlarida ekishga nisbatan pishish fazasida poya balandligi “Svat” navida 6,6-12,6 sm, “Tit” navida 7,4-13,7 sm, barg sathi “Svat” navida 1288,9-4108,3 m2/ga, “Tit” navida 885,0-4288,7 m2/ga, quruq massa tuplashini “Svat” navida 6,98-20,06 s/ga, “Tit” navida 6,33-21,46 s/ga gacha yuqori bo‘lishi qayd etildi;

Kuzgi tritikale navlari urug‘larini 15-sentyabr muddatida ekish barcha urug‘ ekish me’yorlarida umumiy poyalar sonining ortishiga olib kelib, urug‘lar 1-15 oktyabr muddatida ekilgan variantlarga nisbatan “Svat” navida 6,3-60,6 dona/m2, “Tit” navida 8,3-55,2 dona/m2 gacha yuqori bo‘lgani kuzatilgan bo‘lsa, mahsuldor poyalar soni bo‘yicha yuqori natijalar urug‘lar 1-oktyabr muddatida ekilgan variantlarda qayd etilib, urug‘lar 15-sentyabr hamda 15-oktyabr ekilgan variantlarga nisbatan “Svat” navida 3,7-25,5 dona/m2, “Tit” navida 4,1-34,5 dona/m2 gacha yuqori bo‘lgani kuzatildi;

Kuzgi tritikale navlari urug‘larini 15-oktyabr muddatida ekish urug‘larni 15-sentyabr hamda 1-oktyabr muddatida ekishga nisbatan bir boshoq uzunligini “Svat” navida 0,4-0,9 sm gacha, “Tit” navida 0,3-0,7 sm gacha, 1000 dona don vazni “Svat” navida 1,2-3,6 gr gacha, “Tit” navida 1,3-4,0 gr gacha yuqori bo‘lishini ta’minlagan bo‘lsa, urug‘larni 1-oktyabr muddatida ekish, urug‘larni 15-sentyabr hamda 15-oktyabr muddatida ekishga nisbatan bitta boshoqdagi donlar sonini “Svat” navida 1,0-2,7 donagacha, “Tit” navida 1,3-2,6 donagacha, donlarning natura og‘irligini “Svat” navida 1,8-22,3 gr/l gacha, “Tit” navida 1,4-21,2 gr/l gacha yuqori bo‘lishini ta’minlashi aniqlandi;

Don hosildorligi bo‘yicha har ikki navda ham urug‘lar 15-oktyabr muddatida gektariga 6,0 mln dona unuvchan urug‘ hisobida ekilgan variantlarda aniqlanib, boshqa variantlarga nisbatan don hosildorligi “Svat” navida 0,7-16,8 s/ga, “Tit” navida 1,6-14,9 s/ga gacha yuqori bo‘lgan bo‘lsada, yuqori iqtisodiy rentabellik urug‘lar 1-oktyabr muddatida gektariga 4,0 mln dona unuvchan urug‘ hisobida ekilgan variantlarda kuzatilib, boshqa variantlarga nisbatan “Svat” navida 4,6-38,5 foizga, “Tit” navida 1,9-33,1 foizgacha yuqori bo‘lgani qayd etildi.

Olingan natijalarning ko‘rsatishicha, kuzgi tritikalening “Svat” navi urug‘lari 15-sentyabr muddatida gektariga 4,0-5,0-6,0 mln dona unuvchan urug‘ hisobida ekilgan 1-2-3 variantlarda don hosildorligi o‘rganilganida, o‘rtracha 72,1-70,5-62,4 s/ga ni tashkil etganligi aniqlangan bo‘lsa, urug‘lar 1-oktyabr muddatida gektariga 4,0-5,0-6,0 mln dona unuvchan urug‘ hisobida ekilgan 4-5-6 variantlarda don hosili 74,7-76,8-78,5 s/ga ni, urug‘lar 15-oktyabr muddatida gektariga 4,0-5,0-6,0 mln dona unuvchan urug‘ hisobida ekilgan 7-8-9 variantlar tahlil qilinganida esa don hosili 69,4-77,2-79,2 s/ga ni tashkil etgani kuzatildi.

Kuzgi tritikalening “Tit” navi urug‘lari ekilgan variantlar tahlil qilinganida, gektariga 4,0 mln dona unuvchan urug‘ hisobida ekilgan variantlar bo‘yicha yuqori hosildorlik urug‘lar 1-oktyabr muddatida ekilgan 13-variantda kuzatilib, urug‘lar 15-sentyabr hamda 15-oktyabr muddatlarida gektariga 4,0 mln dona unuvchan urug‘ hisobida ekilgan 10 va 16 variantlarga nisbatan 1,9 s/ga dan 3,8 s/ga gacha, 5,0 mln dona unuvchan urug‘ hisobida ekilgan variantlar bo‘yicha yuqori don hosili urug‘lar 15-oktyabr muddatida ekilgan 17-variantda kuzatilib, urug‘lar 15-sentyabr va 1-oktyabr muddatlarida gektariga 5,0 mln dona unuvchan urug‘ hisobida ekilgan 11 va 14 variantlarga nisbatan 2,4 s/ga dan 6,5 s/ga gacha, 6,0 mln dona unuvchan urug‘ hisobida ekilgan variantlar bo‘yicha yuqori natijalar ham urug‘lar 15-oktyabr muddatida ekilgan 18-variantda qayd etilib, urug‘lar 15-sentyabr hamda 1-oktyabr muddatlarida gektariga 6,0 mln dona unuvchan urug‘ hisobida ekilgan 12 va 15 variantlarga nisbatan 1,9 s/ga dan 14,9 s/ga gacha qo‘shimcha don hosili yetishtirilgani ma’lum bo‘ldi.

Olingan ma’lumotlarda ko‘rish mumkinki, kuzgi tritikalening har ikki navida ham bir hil qonuniyatlar takrorlangani kuzatilib, gektariga 4,0 mln dona unuvchan urug‘ ekilgan variantlar bo‘yicha 1-oktyabr, gektariga 5,0 va 6,0 mln dona unuvchan urug‘ hisobida ekilgan variantlar bo‘yicha esa yuqori don hosili urug‘lar 15-oktyabr muddatida ekilgan variantlarda kuzatilgani qayd etildi.

4. XULOSA

Conclusion

Navoiy viloyatining yarimcho‘l xududida bo‘z-o‘tloqi tuproqlari sharoitida kuzgi tritikalening “Svat” va “Tit” navlaridan yuqori va sifatli don hosili yetishtirishda maqbul ekish muddati va muddatlar kesimida maqbul urug‘ sarf me’yorlarini aniqlash bo‘yicha olib borilgan tadqiqot natijalari asosida quyidagi xulosaga kelish mumkin:

Kuzgi tritikale navlarini erta 15-sentyabr muddatida ekish tuplash darajasini yuqori bo‘lishiga olib kelsada, ammo mahsuldor tuplanish bilan bir qatorda mahsulsiz poyalarning ham ortib ketishiga olib keladi. Ushbu muddatda gektariga 5,0 va 6,0 mln dona unuvchan urug‘ hisobida ekish esa tuplanish darajasining yuqori bo‘lishi hisobiga oziqlanish maydonining keskin kamayib ketishi hisobiga boshoqlar maydalashishiga olib keladi. Bu esa o‘z navbatida don hosildorligiga jiddiy salbiy ta’sir ko‘rsatadai. Urug‘larni kech 15-oktyabr muddatida ekish esa tuplash darajasini pasaytiradi. Urug‘larni ekish me’yorlarini belgilashda ekish muddatlarini hisobga olgan holda sarf me’yorlarini belgilash hosildorlikka ijobiy ta’sir etishi tadqiqotlarimizda o‘z isbotini topdi.

Tajribalardan olingan ma’lumotlar asosida Navoiy viloyatining yarimcho‘l xududi tuproq-iqlimi sharoitida kuzgi tritikalening “Svat” hamda “Tit” navlarini yetishtirish va yuqori iqtisodiy samaradorlikka erishishda urug‘lar sentyabr oyining ikkinchi dekadasida ekilganida gektariga 4,0 mln dona, oktyabr oyining birinchi dekadasida ekilganida gektariga 4,0 mln dona, oktyabr oyining ikkinchi dekadasida ekilganida esa gektariga 5,0 mln dona unuvchan urug‘ hisobida ekib yetishtirish tavsiya etiladi.

DECLARATIONS

Declarations

Author contributions *CRediT*

Conceptualization; Methodology; Investigation; Data curation; Writing – original draft; Writing – review & editing. All authors have read and agreed to the published version of the manuscript.

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Ethics approval

Not applicable. This study did not involve humans, animals or other regulated materials.

Informed consent

All authors have read and approved the final version of the manuscript and have given their consent to its submission and publication. The study involved no human participants and no personal data.

Data availability statement

All data supporting the findings of this study are presented in the article and are available from the corresponding author upon reasonable request.

Conflict of interest

The authors declare no conflict of interest.

Generative AI disclosure

Generative AI was used only partially. The authors used Claude (Anthropic, Opus 5) for language editing, formatting of the reference list and preparation of the English and Russian metadata. No text, data, figures or conclusions were generated by AI. The authors reviewed and verified all output and take full responsibility for the content of the publication.

EXTENDED SUMMARY IN ENGLISH

Kengaytirilgan inglizcha xulosa / Расширенный реферат на английском языке

Mandatory for all articles whose full text is not in English. Length 600–1000 words. It must be independently readable: a reader who does not know the language of the full text should understand the problem, the method, the numerical results and the contribution without consulting the main text. Do not copy the 250-word abstract.

Purpose and research problem

Navoi region lies largely within the Kyzylkum desert and the Zarafshan river valley; its climate is continental and dry, and the agricultural sector operates under a persistent shortage of irrigation water. In such areas the choice of crop and of the corresponding agronomic regime determines whether a stable grain and fodder supply can be maintained at all. Triticale (×Triticosecale), an amphidiploid of wheat and rye first obtained by the German breeder W. Rimpau in 1888, combines a strongly developed root system, drought and cold tolerance and low soil demands with a grain protein content of 12–13 % and a hay protein content of 10–12 %, which makes it a natural candidate for water-scarce zones. What has remained insufficiently defined for the semi-desert belt of Navoi region is the combination of sowing date and seeding rate at which these advantages are actually realised. The aim of the work was to determine, for the winter triticale varieties “Svat” and “Tit”, the effect of sowing date and seeding rate on plant emergence, tillering, survival, grain yield and product quality.

Materials and methods

Field experiments were conducted under the soil and climatic conditions of the semi-desert zone of Navoi region on grey-meadow soils. The initial agrochemical characteristics of the experimental plot were determined for the 0–30 cm and 30–50 cm layers in 2023 and 2024 and covered humus content, the total forms of nitrogen, phosphorus and potassium and the mobile forms $N–NO_3$, P_2O_5 and K_2O; the values are given in Table 1. Two winter triticale varieties, “Svat” and “Tit”, were sown on three dates — 15 September, 1 October and 15 October — each at seeding rates of 4.0, 5.0 and 6.0 million viable seeds per hectare. Nutrition followed the standard scheme for the zone, nitrogen being supplied as urea (46 %) and ammonium nitrate (N 34 %) and phosphorus as superphosphate. The number of emerged seedlings, the total number of stems, plant survival, grain yield and the quality indicators of the product were recorded for every variant.

Results and discussion

The number of emerged seedlings was highest when the seed of both varieties was sown on 15 September, and this date also produced the highest total number of stems at every seeding rate, that is the strongest tillering. Sowing on 15 October, by contrast, reduced tillering relative to the September and early-October dates. Grain yield behaved in the opposite way to tillering: in both varieties the highest grain yield was obtained from the 15 October sowing at a rate of 6.0 million viable seeds per hectare. For the variety “Svat” sown on 15 September, the rates of 4.0, 5.0 and 6.0 million seeds per hectare gave the yield pattern described in the article, and analysis of the variants of the variety “Tit” showed that the same regularities were reproduced in both varieties. The practical significance of this divergence is that a vigorous autumn tillering achieved by early sowing does not by itself translate into grain productivity: under the moisture regime of the semi-desert zone the later sowing date combined with the higher seeding rate makes better use of the available water during grain filling.

Conclusion and contribution

Under the grey-meadow soils of the semi-desert zone of Navoi region, sowing date and seeding rate both act as decisive factors for the winter triticale varieties “Svat” and “Tit”. Early sowing on 15 September maximises the degree of tillering but does not maximise productivity, whereas sowing on 15 October at 6.0 million viable seeds per hectare gives the highest grain yield in both varieties. On the basis of the experimental data, this date and rate can be recommended for the cultivation of winter triticale in the semi-desert conditions of the region. The contribution of the work is to provide a locally validated agronomic recommendation for a crop that is well suited to water-scarce areas but for which regional sowing standards had not previously been established.

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Mandatory whenever any reference is in a non-Latin script. Transliterate the author names and the original title, then give the English translation of the title in square brackets, followed by the language tag.

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