

JOURNAL OF AGRICULTURAL, CHEMICAL AND BIOLOGICAL RESEARCH

QISHLOQ XO'JALIGI, KIMYO VA BIOLOGIYA TADQIQOTLARI JURNALI



- ✓ Qishloq xo'jaligi va agrotexnologiyalar
- ✓ Kimyo fanlari va amaliy kimyo tadqiqotlari
- ✓ Biologiya fanlari va hayotiy tizimlar
- ✓ Biotexnologiya va molekulyar fanlar
- ✓ Atrof-muhit, ekologiya va barqaror rivojlanish
- ✓ Oziq-ovqat, tuproq va bioresurslar tadqiqotlari



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QISHLOQ XO'JALIGI, KIMYO VA BIOLOGIYA TADQIQOTLARI JURNALI -
ilmiy-uslubiy jurnali

VOLUME-1, ISSUE-9, 2026

Ushbu to'plamda **“QISHLOQ XO'JALIGI, KIMYO VA BIOLOGIYA
TADQIQOTLARI JURNALI”** ilmiy-uslubiy jurnalining 2026-yil 9-soniga qabul
qilingan maqolalar nashr etilgan.

Bosh muharrir: Qirgizov Fazliddin Baxtiyorovich - Andijon davlat pedagogika instituti
kimyo o'qitish metodikasi kafedrasida dotsenti k.f.f.d (PhD)

Jurnal quyidagi sohalarda maqolalar qabul qiladi: Qishloq xo'jaligi va
agrotexnologiyalar, kimyo fanlari va amaliy kimyo tadqiqotlari, biologiya fanlari va
hayotiy tizimlar, biotexnologiya va molekulyar fanlar, atrof-muhit, ekologiya va
barqaror rivojlanish, oziq-ovqat, tuproq va bioresurslar tadqiqotlari

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“INNOVATIVE PUBLICATION” MAS'ULIYATI CHEKLANGAN JAMIYATI





The relationship between overwintering and phenological adaptation in winter soft wheat

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Abstract

The study evaluated post-winter survival and phenological development of winter bread wheat accessions under the sharply continental conditions of Karakalpakstan. More than 150 accessions were screened in 2025–2026, and 50 were subjected to detailed observations. Post-winter survival ranged from 93.1 to 94.4%. Early developmental stages were relatively synchronized, whereas the main differences occurred at heading and full maturity. D-197 (D-205) D-196 and D-50 (D-77) D-21 D-133×Avoset (2) showed comparatively early generative development. D-50 (D-77) D-21 D-133×Avoset (2) combined 94.4% survival with heading on 29 April and full maturity on 9 June. The findings provide preliminary evidence for further breeding evaluation; replicated and multi-year testing is required for definitive conclusions.

Keywords

Triticum aestivum L., winter wheat, wintering, preservation, phenology, early maturity, adaptability, salinization.

Introduction. The adaptability of winter wheat is related to its viability during the wintering period and the adaptation of development periods to environmental conditions during the growing season. In the sharply continental conditions of Karakalpakstan, low temperatures, dry cold winds, unstable snow cover, high temperatures at the end of the growing season, and water scarcity can increase the stress load. Cold acclimatization



and winter hardiness in wheat are complex genetic-physiological characteristics, the manifestation of which depends on the interaction of genotype and environment [1,2]. Phenological development is also an important component of adaptation. The developmental periods of wheat are regulated by the vernalization, photoperiod, and genetic early stages systems. In conditions where there is a threat of extreme heat or drought, relatively early generative development can help avoid a period of stress, but there is a possibility that too early development will shorten the time for biomass accumulation [3].

Salinization in Karakalpakstan is also an important agro-ecological factor. The response of wheat genotypes to salinization varies, but tolerance cannot be judged by post-wintering retention or phenological timing alone; this requires standardized salinity tests [4].

Purpose of the study. Joint assessment of the preservation after wintering and the main phenological development periods of collection samples of winter soft wheat in the conditions of Karakalpakstan, as well as the selection of preliminary promising materials for further breeding trials.

Materials and methods. The study was conducted in 2025–2026 at the experimental plots of the Grain and Rice Research and Production Association. Out of more than 150 collection samples, 50 were evaluated in detail. The varieties Utkir, ASR, Karakalpakstan-100, and Soberbash were used as standards; The acute was adopted as the main standard. Sowing was carried out on October 12, 2025.

The number of plants before and after wintering was calculated. The conservation level was determined by the formula $S = (N1/N2) \times 100$; where N1 is the number of plants before wintering and N2 is the number of plants after wintering.

Phenological observations recorded dates of germination, clustering, restoration of spring vegetation, heading, and full ripening. Observations were conducted in



accordance with the methodology for conducting field experiments and state variety testing [5, 6]. The available material does not provide individual values for the number of independent repetitions, the delynka, the counting area, or repetitions. Therefore, ANOVA, LSD/NSR, and R-values were not calculated.

Results. The number of plants before wintering was 360–448 units, and after wintering, 335–423 units. Preservation was recorded in the range of 93.1–94.4%. Preservation in standards was 93.1–93.2%, with three collection samples showing a high value of 94.4%.

Table 1.

Number of plants and storage of collection samples before and after wintering.

Sample	Before wintering, pcs.	After wintering, pcs.	Retention, %
O'tkir st	360	335	93,1
ASR	362	337	93,1
Qaraqalpaqstan-100	365	340	93,2
Soberbosh	368	343	93,2
D-203 (D-4) D-25 D-256×Alekseeich	370	345	93,2
D-67 (D-46) D-144×Avoset	378	353	93,4
D-175 (D-93) D-168	440	415	94,3
D-188 (D-110) K-53235	442	417	94,4
D-128 (D-60) D-100	445	420	94,4
D-50 (D-77) D-21 D-133×Avoset (2)	448	423	94,4

As seen from the table above, the retention rate in the O'tkir standard was 93.1%. In samples D-188 (D-110) K-53235, D-128 (D-60) D-100 and D-50 (D-77) D-21 D-133×Avoset (2), the indicator reached 94.4%, which is 1.3 percentage points higher than the standard. Since the absolute number after wintering depends on the initial number,



the survival rate was taken as the main indicator when comparing genotypes. In phenological observations, the initial phases were relatively synchronous: germination was recorded on October 21-22, clustering on November 13, and the restoration of spring vegetation on February 22. The main differences were observed at the stage of ear formation and full ripening.

Table 2.

Main phases of phenological development of collected specimens.

Sample	Germi- nation	Accumu- lation	Reco- very	Collo- cation	Full ripening
O'tkir st	22.10	13.11	22.02	02.05	12.06
Qaraqalpaqstan-100	22.10	13.11	22.02	03.05	13.06
Soberbosh	22.10	13.11	22.02	29.04	08.06
D-203 (D-4) D-25 D-256×Alekseeich	21.10	13.11	22.02	02.05	12.06
D-65 (D-13) D-167	22.10	13.11	22.02	01.05	11.06
D-197 (D-205) D-196	22.10	13.11	22.02	28.04	08.06
D-175 (D-93) D-168	22.10	13.11	22.02	04.05	14.06
D-188 (D-110) K-53235	22.10	13.11	22.02	03.05	13.06
D-128 (D-60) D-100	22.10	13.11	22.02	03.05	13.06
D-50 (D-77) D-21 D-133×Avoset (2)	22.10	13.11	22.02	29.04	09.06

The data in the table show that in the O'tkir standard, heading occurred on May 2 and full ripening on June 12. D-197 (D-205) D-196 germinated on April 28 and ripened on June 8, i.e., completed both phases 4 days earlier than the standard. D-50 (D-77) D-21 D-133×Avoset (2) sprouted on April 29, ripened on June 9, and reached maturity 3 days earlier than the standard. Soberbash became a head on April 29 and fully ripened on June 8. These results indicate an increase in differentiation between genotypes during the stage of generative development. Relatively early development can shorten the



period at the end of the growing season when the risk of heat and moisture deficiency increases [3]. However, early maturity cannot be evaluated independently as a sign of high yield or general adaptability.

Discussion. A combined analysis of the two tables shows that the survival and phenological development periods after wintering are complementary characteristics during the initial selection screening. D-50 (D-77) D-21 D-133×Avoset (2) combined 94.4% retention, heading on April 29, and full ripening on June 9. Therefore, it is an interesting material for evaluation as a complex combination of traits in subsequent breeding trials.

D-197 (D-205) D-196 was one of the earliest generatively developed forms; however, the conservation values after wintering for this specimen are not presented in Table 1. Therefore, it is impossible to draw a complete conclusion about its complex adaptability. The maximum difference with the preservation standard was 1.3 percentage points. Since there are no duplicates, this difference cannot be interpreted as a statistically confirmed advantage. Due to the environmental dependence of winter hardiness, the results must be verified through repeated and long-term testing [1,2]. Quantitative laboratory or field indicators of salinity are not provided in this study. Therefore, high wintering resistance cannot be equated with salinity resistance. Salinity tolerance should be assessed through separate standardized experiments [4].

Conclusion. In the collection samples of winter soft wheat studied under the conditions of Karakalpakstan, the retention rate after wintering was 93.1–94.4%. D-188 (D-110) K-53235, D-128 (D-60) D-100 and D-50 (D-77) D-21 D-133×Avoset (2) showed a high retention rate of 94.4%.

The initial phases of phenological development were relatively synchronous, with the main differences occurring during the heading and full ripening stages. D-197 (D-205) D-196 - on April 28, ripened on June 8; D-50 (D-77) D-21 D-133×Avoset (2)



became a head on April 29 and fully ripened on June 9. D-50 (D-77) D-21 D-133×Avoset (2) combines the characteristics of high preservation and relatively early maturity, so it can be isolated for further evaluation in breeding trials. To determine the final breeding value, it is necessary to conduct a combined assessment of yield, grain quality, wintering resistance, and salinity response indicators during repeated and long-term trials.

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