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WINTER HARDINESS AS A GUARANTEE OF HIGH YIELD IN WINTER WHEAT

Fayzullayev Abdulla Zohidjon o‘g‘li
PhD, Researcher
https://orcid.org/0000-0002-0543-2334
uz.abdulin@gmail.com

Nurbekov Ulmas Asatullayevich
PhD, Researcher
nurbekovolmas@gmail.com

Ziyadullayev Zohidjon Fayzullayevich
DSc, Professor
Southern Research Institute of Agriculture
https://orcid.org/0009-0007-6889-1793,

ABSTRACT
The study evaluated the effect of winter hardiness on grain yield in winter wheat germplasm grown in Karakalpakstan in 2025. The final Uzhydromet assessment of the winter of 2024–2025 was taken into account: the overall temperature regime was close to the long-term average; however, severe cold spells in northern Karakalpakstan reached 15–18°C below zero, while precipitation amounted to 40–70% of the long-term norm. Vegetation duration ranged from 231 to 237 days, grain yield from 61.6 to 89.1 c/ha, and winter hardiness from 61.7 to 92.2%.

Keywords: Winter wheat; winter hardiness; grain yield; vegetation duration; Karakalpakstan.

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INTRODUCTION

Winter hardiness is one of the main adaptive traits of autumn-sown wheat. The survival of tillers during winter creates the conditions for spring recovery and subsequent yield formation. Scientific experiments have shown that freezing temperature and its duration jointly affect winter survival and grain yield, while severe and prolonged freezing can increase plant mortality and reduce yield, primarily through a decrease in the number of spikes [3].

According to the final Uzhydromet assessment, the overall temperature regime during the winter of 2024–2025 was close to the long-term average. However, temperatures in December were 1–2.5°C below normal, while in January they were 2–3°C above normal in northern Uzbekistan. The strongest cold spells in Karakalpakstan and northern Navoi Region reached 15–18°C below zero. During the winter season, precipitation across much of the country amounted to 40–70% of the long-term norm. This indicates that wintering conditions in Karakalpakstan should be assessed against a background of strong but relatively short cold spells combined with moisture deficiency [2].

This climatic background indicates that the winter-hardiness level of the 2025 material reflects not only varietal productivity potential but also adaptation under actual wintering conditions. In the study, winter hardiness was evaluated by comparing the number of plants before and after winter, demonstrating that substantial differences may occur among genotypes. Therefore, the aim of the study was to assess the relationship between winter hardiness, grain yield and vegetation duration in ten germplasm entries and to determine the extent to which high winter hardiness was associated with grain yield.

RESEARCH RESULTS

According to the experimental results, the mean vegetation duration was 234 days, ranging from 231 to 237 days. Mean grain yield was 76.0 c/ha, while mean winter hardiness was 74.3%. The correlation between winter hardiness and grain yield was positive (r=0.612). This indicates that, within the present dataset, genotypes with better winter survival generally produced higher yields.

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KR21-28FAWIR-106 combined the highest grain yield (89.1 c/ha) with winter hardiness of 83.9% and a vegetation duration of 234 days. KR22-BWF6-208 had the highest winter-hardiness value (88.2%), together with a yield of 87.2 c/ha and a relatively short vegetation duration of 232 days. In KR21-27FAWIR-60, winter hardiness was 81.3%, grain yield was 87.3 c/ha, and vegetation duration was the shortest in the group, at 231 days.

The Turon variety had a high grain yield (88.1 c/ha) and winter hardiness of 92.1%. This result indicates that high yield was accompanied by high winter hardiness in this variety. At the same time, KR22-BWF6-067 had winter hardiness of 77.4% but a yield of 66.5 c/ha, showing that winter hardiness alone does not fully determine final grain yield.

Table 1. Vegetation duration, grain yield and winter hardiness of winter wheat germplasm studied in Karakalpakstan.

No.	Germplasm	Vegetation, days	Yield, c/ha	Winter hardiness, %
1	Yaksart (check)	233	62.1	75.0
2	Turon (check)	235	88.1	92.1
3	KR20-BWF51R-3150	237	70.1	72.0
4	KR21-28FAWIR-106	234	89.1	83.9
5	KR22-24IWWYTIR-9833	235	70.1	65.0
6	KR21-27FAWIR-99	236	61.6	61.7
7	KR21-27FAWIR-60	231	87.3	81.3
8	KR22-BWF6-067	237	66.5	77.4
9	KR22-BWF6-101	237	78.3	66.9
10	KR22-BWF6-208	232	87.2	88.2
	Mean	**234.7**	**76.0**	**74.3**

The value of r=-0.641 between winter hardiness and vegetation duration is also noteworthy. Among the ten lines, genotypes with higher winter hardiness tended to mature somewhat earlier. Such a combination may be advantageous under

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conditions where high temperatures occur toward the end of the growing season [1].

Overall, winter-hardiness percentage is a directly measured trait, whereas grain yield represents the final production outcome of the entire growing season. The simultaneous occurrence of high winter hardiness and high yield in KR21-28FAWIR-106, KR21-27FAWIR-60 and KR22-BWF6-208 strengthens the possibility that adaptation to winter conditions contributed to yield formation in 2025. The performance of KR22-BWF6-067, however, indicates that other factors also affected yield.

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