



INFLUENCE OF ABIOTIC FACTORS ON WHEAT VARIETIES AND YIELD VARIABILITY IN THE CONDITIONS OF KARAKALPAKSTAN

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Abstract. *This study analyzes the effects of abiotic factors on the yield variability of bread wheat (*Triticum aestivum* L.) grown in three districts of Karakalpakstan — Nukus, Beruniy, and Kungrad. The response of the Asr, Davr, and Gurt varieties to climatic conditions, particularly to temperature fluctuations and cold stress, was investigated. The results showed that prolonged winter cold significantly reduces yield, while shortened warm seasons affect grain quality. The study highlights the necessity of selecting regionally adapted and climate-resilient wheat varieties for sustainable production.*

Keywords: *wheat, abiotic stress, yield, genetic variability, Karakalpakstan, climate conditions.*

Introduction. Wheat (*Triticum aestivum* L.) is one of the most important cereal crops ensuring global food security, providing about 23% of the world's caloric intake and 21% of protein requirements [1]. In recent decades, climate change — particularly temperature extremes and reduced water availability — has negatively impacted wheat productivity. Karakalpakstan, located in the Aral Sea basin, is characterized by cold winters, dry summers, and strong winds, making it a challenging agroecological zone. Therefore, identifying wheat genotypes that are tolerant to abiotic stresses such as cold and drought is crucial [4].

The main objective of this research is to assess the influence of environmental factors on the yield performance of different wheat varieties under the climatic conditions of Karakalpakstan.

Materials and Methods. The research was conducted in 2023 across three districts — Nukus, Beruniy, and Kungrad — of Karakalpakstan. The wheat varieties Asr, Davr, and Gurt were cultivated on irrigated lands. Climatic data, including average temperature, precipitation, and cold duration, were obtained from the Karakalpak Hydrometeorological Service. Yield (t/ha) was measured for each site. Statistical analysis included calculation of means and variance (ANOVA) to determine the significance of environmental effects.

Results. In 2023, the total wheat cultivation area in Karakalpakstan was 53,000 ha, producing 253,120 tons of grain.



Beruniy district – 4,950 ha, total yield 28,880 t, average productivity 52.3 c/ha;

Nukus district – 5,200 ha, 23,685 t, 45.5 c/ha;

Kungrad district – 3,050 ha, 12,985 t, 42.6 c/ha.

In Kungrad, average temperatures dropped to -27°C in January, lasting until April, which reduced yield by 10–15%. Many plants were damaged by frost. In contrast, Beruniy district had milder winters and a more favorable spring, resulting in the highest yield levels.

Discussion. The obtained results confirm that abiotic stress — especially cold temperature — has a strong influence on the physiological and genetic mechanisms controlling wheat yield. According to Wang et al. (2019) [2], cold-tolerant genotypes activate *CBF* and *COR* genes to enhance their stress response. The yield reduction observed in Kungrad supports these findings.

Karimov (2021) [3], reported that a 1°C increase in temperature reduces wheat yield by 3–5% in southern Uzbekistan, which aligns with our results for the Karakalpakstan region. Therefore, the selection of genotypes resistant to cold, drought, and thermal fluctuations, as well as the development of adaptive agrotechnologies, are vital for stable and sustainable wheat production [4].

Conclusion. Under the climatic conditions of Karakalpakstan, abiotic factors — particularly prolonged winter cold and temperature fluctuations - significantly affect wheat yield. The highest average yield (52.3 c/ha) was recorded in Beruniy district, where milder winter and sufficient soil moisture contributed to stable yield formation. It is recommended to select cold-tolerant genetic lines, improve adaptive agrotechnologies, and establish continuous environmental-yield monitoring systems for sustainable wheat production in this region.

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