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SUBMITTED 31 July 2025

ACCEPTED 28 August 2025

PUBLISHED 30 September 2025

VOLUME Vol.07 Issue09 2025

CITATION

G'ulom Tajibayev, Tanjarbay Allambergenov, Gulayim Kauyenderova, & Saidmurat Baboev. (2025). Analysis Of Ecological Variability In Grain Yield Of Bread Wheat (*Triticum Aestivum* L.) Varieties Under The Conditions Of Karakalpakstan. The American Journal of Agriculture and Biomedical Engineering, 7(09), 30–33.

<https://doi.org/10.37547/tajabe/Volume07Issue09-05>

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Analysis Of Ecological Variability In Grain Yield Of Bread Wheat (*Triticum Aestivum* L.) Varieties Under The Conditions Of Karakalpakstan

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Abstract: In our article, the arid climate and ecological variability of Karakalpakstan are examined. The grain yield of bread wheat varieties was analyzed in close relation to weather factors, particularly air and soil temperature, as well as the level of precipitation. In this study, we analyzed the variability of grain yield indicators of bread wheat cultivated in Beruniy, Nukus, and Kungrad districts during 2017–2019. The dispersion and correlation between ecological factors such as soil and air temperature and precipitation were evaluated. As a result, high-yielding varieties with stability and adaptability to these regions were identified.

Keywords: Arid, Variable, Yield, Ecological factors, Correlation analysis.

Introduction: Wheat is one of the three most important food crops globally, cultivated on more than 215 million hectares with an annual production exceeding 735 million tons of grain. However, in recent years, grain

yield has been declining as a consequence of climate change. This situation necessitates the identification of ecological factors influencing yield, the determination of bread wheat varieties tolerant to climatic stresses, and their utilization as initial breeding material for the development of new, high-yielding cultivars.

Under the conditions of Karakalpakstan, the soil-climatic environment is sharply continental, and the irrigation system together with agrotechnical measures has a significant impact on crop yield [1]. Climate change directly affects agriculture. Scientific studies have shown that an increase in air temperature may shorten the growing period of cereal crops and consequently lead to a reduction in yield [2]. Soil temperature directly influences the development of the root system. Higher soil temperatures enhance root activity and accelerate the absorption of nutrients [4]. In non-irrigated areas, precipitation has a considerable impact on yield. Under arid climatic conditions, insufficient rainfall can result in a drastic decline in productivity [3].

Under the conditions of Karakalpakstan, the yield of bread wheat depends on various factors, with the biological characteristics of the varieties playing a major role. It has been observed that grain yield tends to decline at different stages of growth and development. During 2017–2019, several wheat varieties were cultivated in the Beruniy, Nukus, and Qo'ng'iro' districts of the Republic of Karakalpakstan, and their yield indicators were recorded. This article analyzes the changes in yield over the years, the differences across districts, and the influence of

ecological factors.

Methods

In this study, biological material consisted of bread wheat varieties cultivated in the Beruniy, Nukus, and Kungrad districts of Karakalpakstan during 2017–2019, with grain yield data and ecological factor indicators recorded.

For statistical analysis, variance and correlation analyses of mean values were conducted to determine the relationships between yield and meteorological factors. Mathematical analyses were carried out based on ANOVA and the methodology of Dospekhov B.A. (1985) [5]. Climatic factors (air temperature, soil temperature, precipitation) were statistically examined for their association with yield.

Results And Discussion

For the study, grain yield data were collected from varieties cultivated in the Beruniy, Nukus, and Kungrad districts during 2017–2019. Throughout the research, grain yield data of bread wheat varieties grown under the conditions of Karakalpakstan, including Krasnadar-99, Alikseyevich, Asr, Tanya, Antonina, Grut, Grom, and Zimnitsa, were analyzed.

During the analysis, differences in the average grain yield across districts for the period 2017–2019 were identified. In Beruniy district, yield levels were observed to be higher and more stable, while in Nukus district a declining trend in yield was recorded.

In Kungrad district, however, grain yield showed considerable fluctuations (Figure 1).

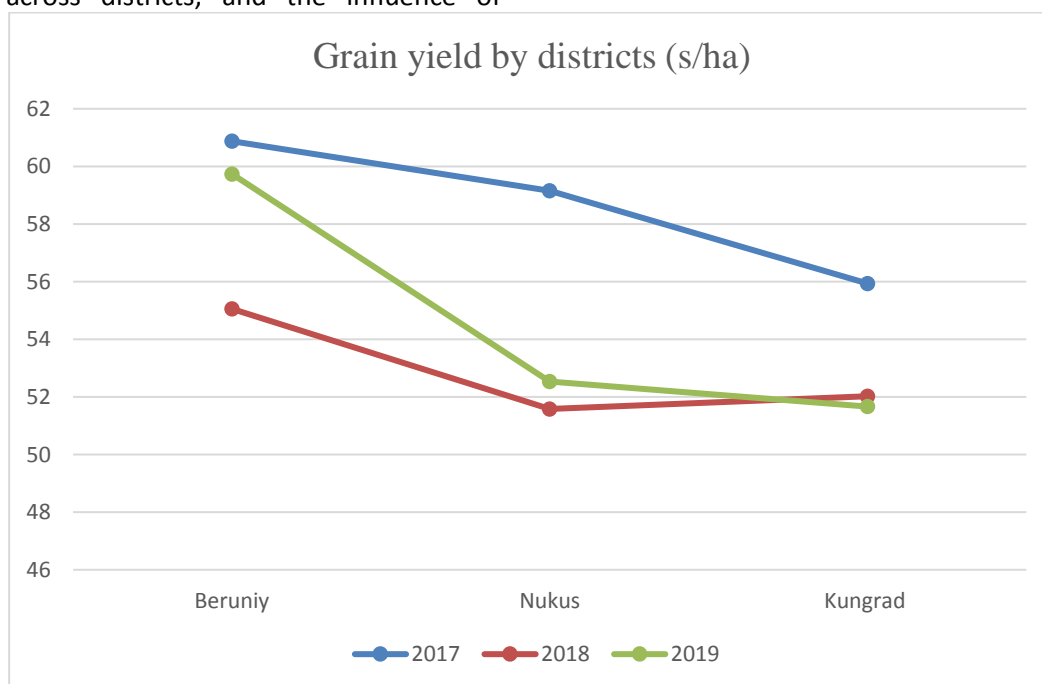


Figure 1. Changes in grain yield across districts over the years.

In different regions of Karakalpakstan, grain yield has varied over the years. The yield indicators for the period 2017–2019 were analyzed in the Beruniy, Nukus, and Kungrad districts.

Yield trends:

- **Beruniy district:** The highest yield was recorded in 2017 (60.88 s/ha), followed by a decline in 2018 (55.05 s/ha). In 2019, the yield increased again (59.73 s/ha), approaching the previous level.
- **Nukus district:** Yield was 59.15 s/ha in 2017, but sharply decreased to 51.58 s/ha in 2018. In 2019, a slight increase was observed (52.54 s/ha).

- **Kungrad district:** Yield was 55.94 s/ha in 2017, decreased to 52.02 s/ha in 2018, and remained almost unchanged in 2019 (51.66 s/ha).

The data indicated that ecological factors influenced grain yield. In Beruniy district, the highest yields were associated with optimal temperature conditions and lower levels of soil salinity. In contrast, lower yields in Kungrad and Nukus districts were attributed to lower temperatures and higher soil salinity.

In our study, yield trends of bread wheat varieties across the years were evaluated (Figure 2).

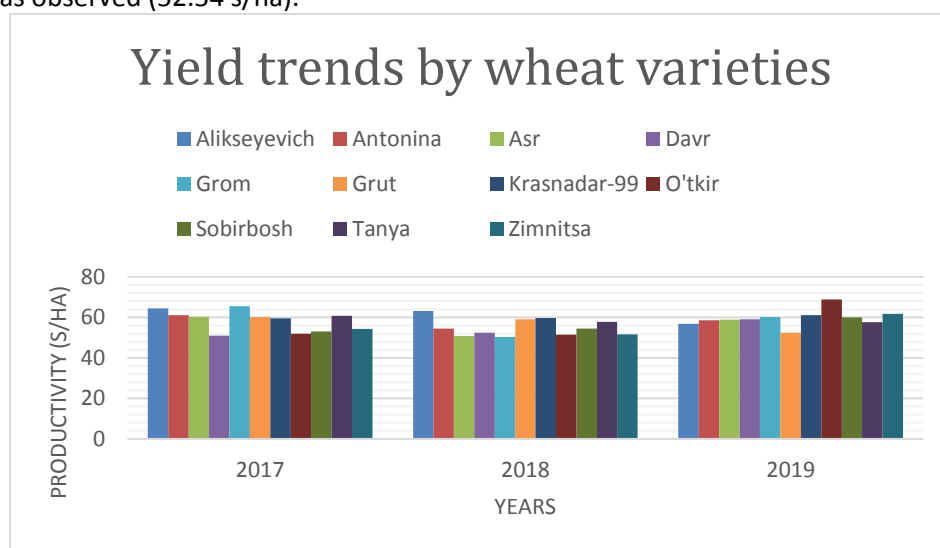


Figure 2. Yield trends of bread wheat varieties.

Under the conditions of Karakalpakstan, the grain yield of bread wheat varieties varied across the years. The variety Alikseyevich had the highest yield in 2017 (64.44 s/ha), but significantly decreased by 2019 (56.79 s/ha). The variety Antonina produced 61.15 s/ha in 2017, dropped to 54.43 s/ha in 2018, and then increased again in 2019 (58.63 s/ha). The variety Asr showed the lowest yield in 2018 (50.92 s/ha), but recovered to 58.95 s/ha in 2019. The variety Davr

yielded 51.00 s/ha in 2017, slightly increased to 52.46 s/ha in 2018, and then rose markedly to 59.05 s/ha in 2019. The variety O'tkir yielded 52.00 s/ha in 2017, slightly decreased in 2018, but reached as high as 68.87 s/ha in 2019.

Under the conditions of Karakalpakstan, the yield performance of different grain varieties of bread wheat was analyzed for the period 2017–2019 (Table 1).

Table 1

Yield dynamics of bread wheat varieties during 2017–2019

Varieties	Productivity (s/ha)			Productivity change
	2017	2018	2019	
Alikseyevich	64.44	63.15	56.79	-7.65
Antonina	61.15	54.43	58.63	-2.52
Asr	60.41	50.92	58.95	-1.46
Davr	51.00	52.47	59.05	+8.05
Grom	65.52	50.31	60.12	-5.40

Grut	60.14	58.99	52.37	-7.77
Krasnadar-99	59.59	59.63	61.04	+1.45
O'tkir	52.00	51.47	68.87	+16.87
Sobirbosh	53.00	54.43	60.07	+7.07
Tanya	60.85	57.73	57.70	-3.15
Zimnitsa	54.35	51.59	61.78	+7.43

Analysis of the above table showed that the highest increase was observed in the variety O'tkir, which rose from 52.00 s/ha in 2017 to 68.87 s/ha in 2019 (+16.87 s/ha). Significant yield increases were also recorded in the varieties Davr, Sobirbosh, and Zimnitsa. The greatest yield decline was found in the variety Grut, which decreased by -7.77 s/ha. Decreases were also observed in the varieties Alikseyevich and Grom. Among the stable varieties, Krasnadar-99 was identified as relatively stable compared to the others, with yield remaining almost unchanged over the years.

The variety O'tkir demonstrated the highest yield, indicating its strong adaptability to ecological conditions. Some varieties showed a decline in 2018 but recovered in 2019. In contrast, yield reductions were observed in the varieties Grut and Alikseyevich, suggesting their lower adaptability to climatic conditions.

Conclusion

The results of the study showed that in Karakalpakstan, grain yield is mainly associated with soil temperature and air temperature. Correlation analysis revealed a strong relationship between soil temperature and yield, as evidenced by the high-yielding variety O'tkir, which increased from 52.00 s/ha in 2017 to 68.87 s/ha in 2019 (+16.87 s/ha). The variety Krasnadar-99 was found to be relatively stable compared to other varieties. Selection of such varieties and the planning of appropriate agrotechnical measures are among the key factors in improving productivity. The findings of this study provide a scientific basis for increasing wheat yield in the conditions of Karakalpakstan, and for using high-yielding varieties as initial material in the development of salt-tolerant varieties through the application of MAS (Marker-Assisted Selection) technology.

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