

UDC: 631.11; 631.455;56/5 (575.192)

## THE EFFECT OF DIFFERENT SOWING PERIODS AND FERTILIZER RATES ON THE GRAIN QUALITY OF WINTER SOFT WHEAT VARIETIES

Karshi State Technical University

PhD in Agricultural Sciences, Associate Professor **Mukhayyo Azimova**

Assistant **Nilufar Khimatova**

### Annotation

This article examines the relationship between sowing rates, sowing periods, and the amount of mineral fertilizers with the grain quality indicators of the winter soft wheat varieties *Yaksart*, *Ghozg'on*, *Bunyodkor*, and *Krasnodarskaya-99* under the irrigated light gray soil conditions of the Kashkadarya region. According to the results of the experiments, it was observed that as the sowing period was delayed and the seeding rate increased, the amount of protein and gluten in the grain gradually decreased. Conversely, an increase in fertilizer rates led to an improvement in grain quality.

**Keywords:** variety, period, rate, fertilizer, protein, gluten, grain, soil, intensive, natural weight.

At present, as the world's population continues to grow and the demand for food, grain, and grain products steadily increases while energy resources are diminishing, enhancing the efficiency of the cereal-growing sector in agriculture has become an urgent issue. Under such circumstances, the improvement of grain production systems must not only focus on yield enhancement but also ensure grain quality and stability. Global changes in weather and climate are leading to a decline in both the quantity and quality of crop yields, including cereal crops. Taking this into account, and considering the diversity of soil and climatic conditions within our republic, it becomes essential to develop highly productive, early-maturing, drought- and heat-resistant varieties with superior grain quality. Moreover, it is necessary to improve the agricultural technologies for cultivating these varieties in accordance with the specific soil and climatic conditions of each region [5;4].

Taking into consideration the soil and climatic conditions of the irrigated lands in our republic, several researchers have carried out scientific studies to determine the most optimal sowing periods, sowing densities, and fertilizer application norms for winter soft wheat varieties [3].

Field experiments were conducted on the light gray soils of the experimental plots of the Kashkadarya branch of the Grain and Leguminous Crops Research Institute during 2014–2016, and production trials were performed in 2016–2017.

To study the effect of sowing period, sowing density, and fertilizer rate on the yield and yield components of winter soft wheat, the new soft wheat varieties recommended for the southern regions — *Yaksart*, *Bunyodkor*, *Ghozg'on*, and the widely cultivated *Krasnodarskaya-99* — were selected for the experiment.

Each experimental plot had an area of 100 m<sup>2</sup> (furrow length — 41.7 m, width — 2.4 m), of which 50 m<sup>2</sup> was taken for measurement. The total number of variants was 36, arranged in three replications on three tiers. The research was conducted in accordance with generally accepted scientific recommendations and methodological guidelines. Under the light gray soil conditions of the Kashkadarya region, the optimal sowing period, sowing rate, and mineral fertilizer norms for winter soft wheat varieties were determined, taking into account their biological characteristics. The results revealed that under these conditions, when the varieties *Yaksart*, *Bunyodkor*, and *Ghozg'on* were sown early (October 1) at a seeding rate of 4.0 million viable seeds per hectare with mineral fertilizers applied at N<sub>180</sub>P<sub>108</sub>K<sub>54</sub> kg/ha, or at the optimal period (October 20) with 5.0 million seeds and N<sub>210</sub>P<sub>147</sub>K<sub>105</sub> kg/ha, or at the late period (November 10) with 6.0 million seeds and N<sub>210</sub>P<sub>147</sub>K<sub>105</sub> kg/ha — the highest grain yield and economic efficiency were achieved.

**Results on Grain Protein Content.** In the control plots (without fertilizers), when the winter soft wheat varieties were sown early (October 1) at a rate of 4.0 million viable seeds per hectare, the protein content in the grain was recorded as follows: **13.7%** in the variety *Krasnodarskaya-99*, **13.4%** in *Yaksart*, **13.5%** in *Bunyodkor*, and **13.9%** in *Ghozg'on*. When the seeding rate was increased to 5–6 million viable seeds per hectare, the protein content in the respective varieties changed to **13.9–13.8%**, **13.5–13.9%**, **13.6–13.7%**, and **13.8–14.1%**. For the control variants (without fertilizer) sown at the **optimal time (October 20)**, the protein content was observed to be **13.7–14.0%** in *Krasnodarskaya-99*, **13.8–14.3%** in *Yaksart*, **14.2–14.4%** in *Bunyodkor*, and **14.3–14.5%** in *Ghozg'on*. However, in the plots fertilized with N<sub>180</sub>P<sub>108</sub>K<sub>54</sub> kg/ha, the protein content in the wheat grain was higher — specifically, **14.3–15.1%** in *Krasnodarskaya-99*, **14.5–15.3%** in *Yaksart*, **14.6–15.4%** in *Bunyodkor*, and **14.7–15.6%** in *Ghozg'on*. When the fertilizer rate was increased to N<sub>210</sub>P<sub>147</sub>K<sub>105</sub> kg/ha, the protein content of the grain grown in the respective varieties and at different sowing rates reached **15.2–15.8%**, **15.3–16.1%**, **15.6–16.3%**, and **15.7–16.8%**, respectively. When the wheat was sown at the **late period (November 10)** at rates of 4.0, 5.0, and 6.0 million viable seeds per hectare in control plots (without fertilizer), the protein content in the grain was found to be **13.5–13.4%** for *Krasnodarskaya-99*, **13.5–15.6%** for *Yaksart*, **13.7–13.5%** for *Bunyodkor*, and **13.8–13.9%** for *Ghozg'on*. When fertilizers were applied at N<sub>180</sub>P<sub>108</sub>K<sub>54</sub> kg/ha, the corresponding protein content rose to **13.6–14.4%**, **13.5–14.5%**, **14.0–14.5%**, and **14.2–14.7%**. Under conditions where fertilizers were applied at the higher rate of N<sub>210</sub>P<sub>147</sub>K<sub>105</sub> kg/ha, the protein content increased further, reaching **14.6–15.6%**, **14.6–16.1%**, **14.8–16.3%**, and **14.9–16.8%** for the respective varieties.

**The Effect of Sowing Dates and Rates on the Gluten Content of the Grain.** In our experiments, the influence of sowing dates and seeding rates on the gluten content of the grain revealed a pattern similar to that observed for protein. In the winter soft wheat varieties *Krasnodarskaya-99*, *Yaksart*, *Bunyodkor*, and *Ghozg'on*, the gluten content in the grain varied significantly depending on the sowing time and seeding rate. For example, under **early sowing conditions**

(October 1) at seeding rates of 4.0, 5.0, and 6.0 million viable seeds per hectare in control plots (without fertilizer), the gluten content was as follows: 21.9–22.3% in *Krasnodarskaya-99*, 20.7–22.6% in *Yaksart*, 20.9–22.4% in *Bunyodkor*, and 22.4–23.7% in *Ghozg'on*. When fertilizers were applied at  $N_{180}P_{108}K_{54}$  kg/ha, the gluten content increased to 23.5–25.2% in *Krasnodarskaya-99*, 24.0–25.6% in *Yaksart*, 24.6–26.1% in *Bunyodkor*, and 25.2–26.4% in *Ghozg'on*. At a higher fertilizer rate of  $N_{210}P_{147}K_{105}$  kg/ha, the gluten content reached 26.3–28.0%, 27.2–28.3%, 27.5–28.6%, and 27.9–29.2%, respectively. Under optimal sowing periods (October 20) with 4.0, 5.0, and 6.0 million viable seeds per hectare and without fertilization (control variants), the gluten content ranged between 21.2–23.5% in *Krasnodarskaya-99*, 21.7–23.8% in *Yaksart*, 22.0–23.4% in *Bunyodkor*, and 23.8–24.9% in *Ghozg'on*. When fertilized with  $N_{180}P_{108}K_{54}$  kg/ha, the gluten content increased noticeably — 24.8–27.0% in *Krasnodarskaya-99*, 25.1–26.8% in *Yaksart*, 26.1–26.9% in *Bunyodkor*, and 26.8–28.0% in *Ghozg'on*. Further increasing the fertilizer rate to  $N_{210}P_{147}K_{105}$  kg/ha resulted in even higher gluten content across all variants: 26.5–29.2% in *Krasnodarskaya-99*, 27.4–29.5% in *Yaksart*, 27.7–29.8% in *Bunyodkor*, and 28.6–30.2% in *Ghozg'on*. The experiments showed that both sowing time and sowing density jointly affected the gluten content in the grain. For instance, when winter soft wheat varieties were sown late (November 10) at rates of 4.0, 5.0, and 6.0 million viable seeds per hectare without fertilizer (control), the gluten content was 20.7–20.5% in *Krasnodarskaya-99*, 21.6–21.2% in *Yaksart*, 21.8–21.6% in *Bunyodkor*, and 21.9–22.2% in *Ghozg'on*. It was observed that with an increase in sowing rate, the gluten content tended to decrease. However, when fertilization was applied, the opposite trend appeared — the gluten content increased regardless of the sowing density. When the fertilization rate of  $N_{210}P_{147}K_{105}$  kg/ha was applied, the gluten content reached 25.0–27.1% in *Krasnodarskaya-99*, 25.4–27.0% in *Yaksart*, 26.6–27.4% in *Bunyodkor*, and 26.5–27.5% in *Ghozg'on*. It is well known that the vitreousness (glassiness) of the grain is closely related to the amount of protein and gluten it contains, making it one of the most important quality indicators. In our research, under optimal sowing dates (October 20) and rates of 5.0 million viable seeds per hectare, when fertilized with  $N_{210}P_{147}K_{105}$  kg/ha, the vitreousness of the grain reached 69% in *Krasnodarskaya-99*, 72% in *Yaksart*, 75% in *Bunyodkor*, and 77% in *Ghozg'on*.

#### Analysis of Gluten Quality Based on IDK Indicators.

In our study, when analyzing the IDK (Instrumental Dough Quality) indicators of the winter soft wheat varieties *Krasnodarskaya-99*, *Yaksart*, *Bunyodkor*, and *Ghozg'on*, it was found that when sown on October 1 and November 10, the grain did not meet the requirements of Class III (ranging from 0 to 15 — “poorly unsatisfactory”) or Class II (ranging from 20 to 40 — “moderately satisfactory”) in terms of gluten quality. In other words, at these sowing times, the gluten quality was categorized as weak or unsatisfactory. However, in the early sowing period (October 1) at seeding rates of 4.0, 5.0, and 6.0 million viable seeds per hectare, the grain quality indicators for the varieties *Krasnodarskaya-99*,

*Yaksart*, *Bunyodkor*, and *Ghozg'on* corresponded to the requirements of Class II (80–100 units), meaning they were considered to be of moderate quality. It is important to emphasize that under the fertilization condition of  $N_{210}P_{147}K_{105}$  kg/ha, in the varieties *Yaksart*, *Ghozg'on*, and *Bunyodkor*, the grain obtained from plots sown at 5.0–6.0 million viable seeds per hectare met the requirements of Class I (40–75 units), which is classified as “good” in gluten quality. This result indicates that these varieties can be safely sown at early periods, achieving both high yield and high-quality grain. When these winter soft wheat varieties were sown late (November 10) at the above-mentioned seeding rates, the resulting grain quality corresponded to Class II, meaning it met the “satisfactory” standard. However, it was also observed that when the varieties were sown early, the grain quality indicators tended to decrease gradually. When the varieties *Krasnodarskaya-99*, *Yaksart*, *Bunyodkor*, and *Ghozg'on* were sown at the optimal period (October 20) with seeding rates of 4.0, 5.0, and 6.0 million viable seeds per hectare — both in control plots (without fertilizer) and in those fertilized with  $N_{180}P_{108}K_{54}$  kg/ha — the grain quality corresponded to the requirements of Class II (80–100 units), or “weakly satisfactory.” When the same sowing period and a seeding rate of 5.0 million viable seeds per hectare were combined with fertilization at  $N_{210}P_{147}K_{105}$  kg/ha, the resulting grain quality indicators met the standards of Class I (40–75 units) — meaning the gluten quality was evaluated as “good.” This demonstrates that taking into account the biological characteristics of each variety, and correctly managing the agrotechnical practices, including sowing time, seeding density, and fertilization, plays a crucial role in achieving both high productivity and excellent grain quality. Among the key indicators determining the quality of winter soft wheat grown under various soil and climatic conditions across the republic is its test weight (grain nature), which reflects the grain’s fullness and milling suitability. For this reason, test weight is officially included among the state standard indicators for assessing grain quality.

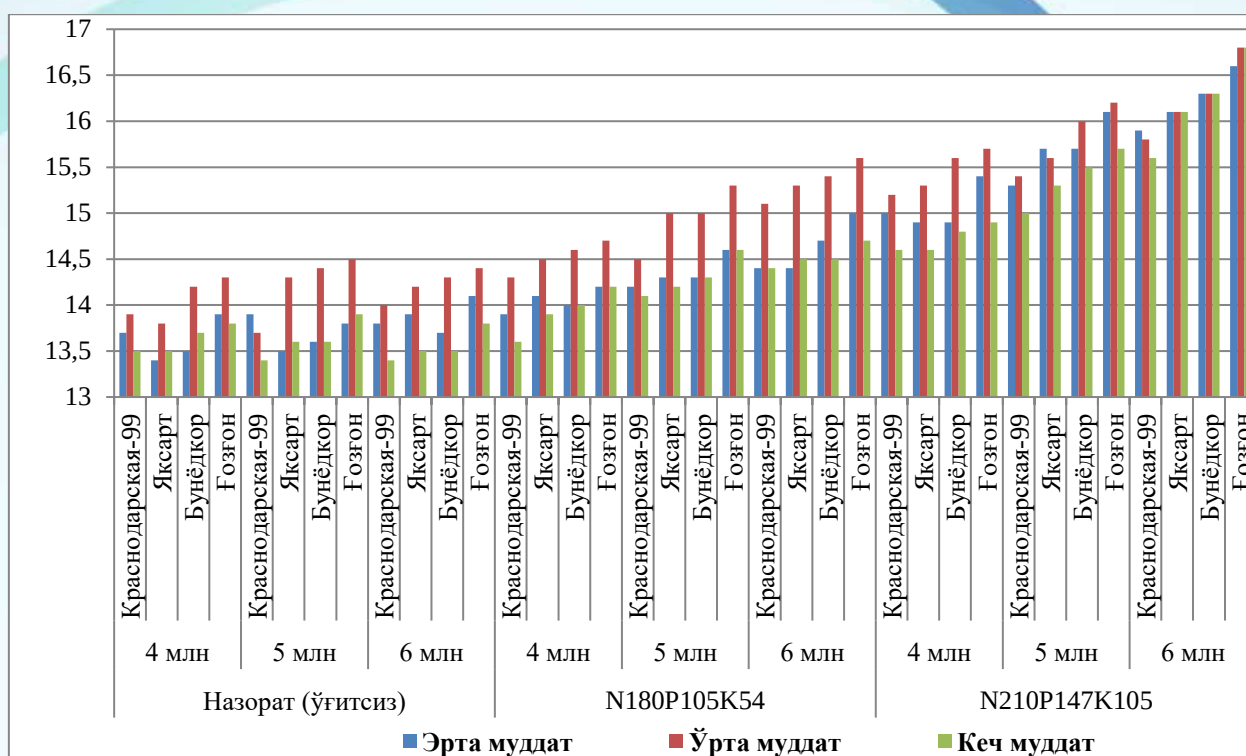


Figure 1.

*The effect of sowing period, seeding rate, and fertilization on the protein content of winter wheat grain (2014–2016).*

In our experiments, when fertilizers were not applied and the winter wheat was sown early (October 1) at seeding rates of 4.0, 5.0, and 6.0 million viable seeds per hectare, the test weight (grain nature) of the harvested wheat was as follows: 766–773 g/L for *Krasnodarskaya-99*, 769–777 g/L for *Yaksart*, 771–779 g/L for *Bunyodkor*, and 775–782 g/L for *Ghozg'on*.

When fertilizers were applied at  $N_{180}P_{108}K_{54}$  kg/ha, these indicators increased respectively to 784–787 g/L for *Krasnodarskaya-99*, 787–790 g/L for *Yaksart*, 786–791 g/L for *Bunyodkor*, and 790–795 g/L for *Ghozg'on*. When the fertilizer rate was further increased to  $N_{210}P_{147}K_{105}$  kg/ha, the grain test weight rose even higher — 795–797 g/L for *Krasnodarskaya-99*, 798–802 g/L for *Yaksart*, 801–806 g/L for *Bunyodkor*, and 805–811 g/L for *Ghozg'on*.

According to the results obtained from the field trials, when wheat varieties were sown at the optimal time (October 20), the test weight of grain produced without fertilizer (control) was noticeably lower than that of fertilized plots. In the control variants, the test weight ranged between 759–764 g/L for *Krasnodarskaya-99*, 762–766 g/L for *Yaksart*, 765–769 g/L for *Bunyodkor*, and 770–771 g/L for *Ghozg'on*. When fertilization was carried out at  $N_{180}P_{108}K_{54}$  kg/ha, the test weight increased to 776–783 g/L in *Krasnodarskaya-99*, 776–784 g/L in *Yaksart*, 780–786 g/L in *Bunyodkor*, and 784–790 g/L in *Ghozg'on*. When the fertilizer rate was raised to  $N_{210}P_{147}K_{105}$  kg/ha, the test weight increased even further, reaching 789–800 g/L in *Krasnodarskaya-99*, 790–794 g/L in *Yaksart*,

793–798 g/L in *Bunyodkor*, and 797–800 g/L in *Ghozg'on*. These findings confirm that fertilization and sowing management significantly influence the technological properties of winter soft wheat grain. In particular, applying fertilizers at optimal rates in combination with appropriate sowing times and densities enhances the grain fullness and milling suitability, leading to improved overall quality and economic efficiency.

## Conclusion

To summarize, under the conditions of the irrigated light gray soils of the Kashkadarya region, the most suitable sowing period for the winter soft wheat varieties *Krasnodarskaya-99*, *Yaksart*, *Bunyodkor*, and *Ghozg'on* was determined to be October 20, with a seeding rate of 5.0 million viable seeds per hectare. When mineral fertilizers were applied at  $N_{210}P_{147}K_{105}$  kg/ha, the highest yield and best grain quality were achieved, characterized by:

- Protein content: 15.4–16.2%
- Gluten content: 28.3–29.7%
- Grain vitreousness: 69–77%
- Test weight: 744–805 g/L
- IDK index: 78–75 units (corresponding to Class I — “good” quality).

It was also determined that when wheat was sown earlier (October 1) or later (November 10) than the optimal period, the grain quality indicators mentioned above decreased significantly.

Hence, the correct selection of sowing time, seeding rate, and fertilizer dosage ensures high and stable yields of high-quality grain. These results underline the importance of adjusting agricultural practices according to the biological characteristics of each variety and the specific soil-climatic conditions of the region.

## References

1. Abdurakhmonov S. *Fertilization rates and irrigation regime of the “Sanzar-8” winter wheat variety*. Bulletin of Agricultural Science of Uzbekistan, 2003, No. 3, p. 11.
2. Amanov A.A., Nurbekov A.I. *Winter wheat breeding for resistance to rust diseases under irrigated conditions in Uzbekistan*. Abstracts of the First Regional Wheat Yellow Rust Conference for Central and West Asia and North Africa. Karaj, Iran, May 8–14, 2001, p. 30.
3. Kodanov I.M. *Improving Grain Quality*. Moscow: Kolos, 1976, p. 87.
4. Siddikov R. *If You Want Quality Bread*. Uzbekistan Agriculture, No. 4, 2004, pp. 14–15.
5. Khalimov I., Sattorov M., Ismoilov A. *It Is Better to Sow at the Proper Rate*. Uzbekistan Agriculture, No. 8, 2004, p. 16.

6. Ahmatovich R. A. et al. In biocenosis the degree of appearing entomophagous types of vermins which suck tomatoey sowings //Austrian Journal of Technical and Natural Sciences. – 2018. – №. 9-10. – С. 3-5.
7. Сулаймонов Б. А. и др. Фитофаги и виды энтомофагов, встречающиеся в лесном биоценозе //Актуальные проблемы современной науки. – 2021. – №. 1. – С. 64-69.
8. Кимсанбаев Х. Х., Жумаев Р. А. К вопросу размножения *Trichogramma evanescens* для биологической защиты растений //Международна научна школа" Парадигма". Лято-2015. – 2015. – С. 34-41.
9. Жумаев Р. А. Биолaborаторияда трихограммани in vitro усулида ўстириш технологияси. Трихограммани сунъий озикада ўстириш курси (1)(Hymenoptera: Trichogrammatidae). – 2016.
10. Sulaymonov B. A. et al. Effectiveness of Application of Parasitic Entomophages against Plant Bits in Vegetable Agrobiotensensis //Solid State Technology. – 2020. – Т. 63. – №. 4. – С. 355-363.
11. Kimsanbaev X. X., Jumaev R. A., Abduvosiqova L. A. Determination Of Effective Parasite-Entomofag Species In The Management Of The Number Of Family Representatives In Pieridae //The American Journal of Agriculture and Biomedical Engineering. – 2021. – Т. 3. – №. 06. – С. 135-143.
12. Jumaev R. Invitro rearing of parasitoids //E3S Web of Conferences. – EDP Sciences, 2023. – Т. 371.
13. Кимсанбаев Х. Х. и др. Биоценозда ўсимлик зараркунандалари паразит энтомофаглари ривожланиши. « //O'zbekiston» НМИУ,–Тошкент. – 2016.
14. Сулаймонов Б. А. и др. Ўрмон биоценозида фитофаг турлари ва улар микдори бошқариш //O'zbekiston» НМИУ,–Тошкент. – 2018.
15. Jumaev R., Rakhimova A. Analysis of scientific research on reproduction of species of Trichograms in Biolaboratory //The American Journal of Agriculture and Biomedical Engineering. – 2020. – Т. 2. – №. 08. – С. 148-152.
16. Axmatovich J. R. In vitro rearing of trichogramma (Hymenoptera: Trichogrammatidae) //European science review. – 2016. – №. 9-10. – С. 11-13.
17. Jumaev R. A. et al. The technology of rearing Braconidae in vitro in biolaboratory //European Science Review. – 2017. – №. 3-4. – С. 3-5.
18. Жумаев Р. А. Массовое размножение трихограммы на яйцах хлопковой совки в условиях биолaborатории и ее применение в агробиоценозах //Халқаро илмий-амалий конференция “Ўзбекистон мева-сабзавот маҳсулотларининг устунлиги” мақолалар тўплами. Тошкент. – 2016. – С. 193-196.
19. Жумаев Р. А. Значение представителей семейства BRACONIDAE в регулировании численности совок в агробиоценозах //ЎЗМУ Хабарлари. – 2017. – Т. 3. – №. 1.

20. Жумаев Р. А. РАЗМНОЖЕНИЯ ИИ ВИТРО ВАСОН НАВЕТОР САУ И ВАСОН ГРЕНИ АШМЕД //Актуальные проблемы современной науки. – 2017. – №. 3. – С. 215-218.
21. Axmatovich J. R. In Vitro Rearing of Parasitoids (Hymenoptera: Trichogrammatidae and Braconidae) //Texas Journal of Agriculture and Biological Sciences. – 2022. – Т. 4. – С. 33-37.
22. Suleymanov B. A., Jumaev R. A., Abduvosiqova L. A. Lepidoptera Found In Cabbage Agrobiocenosis The Dominant Types Of Representatives Of The Category Are Bioecology //The American Journal of Agriculture and Biomedical Engineering. – 2021. – Т. 3. – №. 06. – С. 125-134