

THE EFFECT OF MINERAL FERTILIZERS AND RETARDANTS ON THE YIELD OF WINTER WHEAT

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Abstract. The article presents the experimental results on the effect of applying mineral fertilizers and growth retardants at different rates, in combination, on the yield of the winter wheat varieties Krasnodar-99 and Chillaki.

Keywords: Krasnodar-99, Chillaki, fertilizer, retardant, winter wheat, variety, plant lodging, yield.

In recent years, the intensive technologies of winter wheat cultivation in our country have been improved through the application of biologically active substances in order to obtain high and high-quality grain yields. Scientific sources indicate that the combined use of mineral fertilizers and retardants helps to more fully realize the potential productivity of wheat varieties and to increase the efficiency of fertilizers (1, 2, 3).

The application of nitrogen fertilizers to produce high-quality grain increases both the yield and the quality indicators of the grain; however, in many cases it may also cause plant lodging, which leads to a decrease in yield and grain quality. Therefore, the use of retardants that prevent excessive stem elongation and ensure shorter plant height as a result of high nitrogen fertilizer application is recommended. Lodging in wheat plants is more frequently observed in early-maturing varieties with relatively tall stems. To prevent such negative effects, scientific sources emphasize the expediency of using retardants that slow down plant growth and increase stem resistance to lodging (2, 3, 4)

Lodging in wheat varieties mainly occurs under the influence of the following factors:

- varietal characteristics (stem length and thickness, root system, etc.);
- weather conditions (rainfall, temperature, wind, hail, insufficient light);
- pests and fungal diseases;
- agronomic practices (excessive plant density, high nitrogen fertilizer rates, excess moisture).

At present, the application of nitrogen fertilizers at high rates may cause even short-stemmed wheat varieties to grow taller to some extent. As a result, the susceptibility of plants to lodging increases. The use of retardants can prevent yield losses caused by lodging by 15–50%. When retardants are applied, the shortening of the lower internodes and the thickening of the stem ensure resistance to lodging (5, 6, 7, 8).

The purpose of our experiments was to determine the effectiveness of retardants used to prevent lodging in early-maturing, relatively tall winter wheat varieties and to ensure fuller utilization of their potential productivity.

Materials and Methods.

Field experiments were conducted at the experimental site of the Research Institute of Plant Genetic Resources in Tashkent Region. The experiment was laid out in four replications, with each plot area measuring 50 m². The soil type is typical grey soil. The objects of the study were the winter wheat varieties *Krasnodarskaya-99* and the hybrid variety *Chillaki*, both registered in the State Register.

Observations and biometric measurements were carried out on model plants in odd-numbered replications. Phenological observations were conducted according to the methodology of the State Variety Testing Inspection for Agricultural Crops (1985; 1989).

Lodging resistance was evaluated using the visual estimation method on a five-point scale during the heading and soft-dough grain maturity phases.

The seeding rate was 5 million seeds per hectare, with the sowing date set at October 20. The retardant Moddus (trinexapac-ethyl) was applied at a rate of 0.2–0.4 L/ha. Three fertilizer rates were used: N180P90K60, N210P105K70, and N240P120K80. From mineral fertilizers, ammophos (N 11%, P₂O₅ 46%) and potassium chloride (60%) were applied before plowing. Nitrogen fertilizer in the form of ammonium nitrate (34%) was applied as top-dressing during the tillering stage, the beginning of stem elongation, and heading stages, before rainfall or irrigation.

Results of the Study.

Depending on the sowing dates of winter wheat, the retardant was applied in early spring at the end of the tillering stage and the beginning of stem elongation. The retardant was applied at temperatures of 18–20°C. Application is not recommended when the temperature exceeds 30°C, as the product may produce adverse effects.

During the research, it was observed that in the plots treated with retardants, the tillering of winter wheat increased due to the shortening of internodes, the development of additional roots, and the stronger formation of the root system. This, in turn, improved nutrient uptake and had a positive effect on the efficiency of fertilizers. Additionally, we found that retardants positively influenced the yield structure of winter wheat by increasing spike length, thousand-grain weight, grain weight per spike, and the number of productive stems per square meter.

The dependence of winter wheat yield on various factors and the changes influenced by different agronomic or climatic indicators have been thoroughly analyzed in the literature.

In our study, we analyzed that the increase in winter wheat yield was formed both due to varietal characteristics and the applied mineral fertilizer rates and retardants.

In the variety *Krasnodarskaya 99*, increasing fertilizer rates from N180P90K60 kg/ha to N210P105K70 kg/ha resulted in an additional yield of 5.5 c/ha, and increasing the rate to N240P120K80 kg/ha produced an additional yield of 7.6 c/ha. When the fertilizer rate was increased from N180P90K60 kg/ha to N210P105K70 kg/ha, applying the retardant at 0.2 L/ha

did not increase the yield due to the retardant. However, at the same fertilizer rates, applying the retardant at 0.4 L/ha resulted in a yield increase of 2.0–2.7 c/ha attributable to the retardant.

In the early-maturing and relatively tall variety *Chillaki*, increasing fertilizer rates –similar to the variety *Krasnodarskaya 99* – resulted in an increase in average yield from 73.9 to 75.7 c/ha. It was found that the yield increased by 9.6 to 10.1 c/ha due to fertilizers, and by 3.9-4.6 c/ha due to the application of retardants.

In the *Chillaki* variety, the effectiveness of retardant application was found to be higher compared to *Krasnodarskaya 99*, and it also positively influenced the efficiency of fertilizers.

Table 1.

Effect of fertilizers and retardants on the yield of winter wheat, c/ha (2021–2023 y.)

Retardant, L/ha	Fertilizer rate, kg/ha	Replications				Average	Additional yield, c/ha	
		1	2	3	4		from fertilizer s	from retardan ts
Krasnodarskaya-99 (st)								
0.2(st)	N ₁₈₀ P ₉₀ K ₆₀ (st)	65,1	65,4	66,4	63,9	65,2	-	-
	N ₂₁₀ P ₁₀₅ K ₇₀	70,2	73,3	71,2	72,0	70,7	5.5	
	N ₂₄₀ P ₁₂₀ K ₈₀	77,3	76,5	75,8	77,8	72,8	7.6	
0,4	N ₁₈₀ P ₉₀ K ₆₀ (st)	65,6	65,8	66,4	66,9	66.1	-	-
	N ₂₁₀ P ₁₀₅ K ₇₀	73,1	74,2	73,2	74,1	73.4	7.3	2.7
	N ₂₄₀ P ₁₂₀ K ₈₀	74,9	74,8	73,8	73,6	74.8	7.7	2.0
Chillaki								
0.2(st)	N ₁₈₀ P ₉₀ K ₆₀ (st)	68,6	72,1	69,3	70,1	63.4	-	-
	N ₂₁₀ P ₁₀₅ K ₇₀	77,2	78,4	74,5	76,2	69,3	5.9	-
	N ₂₄₀ P ₁₂₀ K ₈₀	71,9	71,4	71,8	71,9	71.8	8.4	-
0,4	N ₁₈₀ P ₉₀ K ₆₀ (st)	64,2	63,8	63,9	64,2	64.2	-	-0.8
	N ₂₁₀ P ₁₀₅ K ₇₀	73,5	73,9	73,7	73,8	73.9	9.6	4.6
	N ₂₄₀ P ₁₂₀ K ₈₀	75,6	75,9	74,8	74,9	75.7	10.1	3.9

Conclusion. In the variety *Krasnodarskaya 99*, increasing fertilizer rates from N₁₈₀P₉₀K₆₀ kg/ha to N₂₁₀P₁₀₅K₇₀ kg/ha significantly increased yield. However, further increasing the rate

from N210P105K70 kg/ha to N240P120K80 kg/ha did not result in a significant additional yield from fertilizers, indicating a decrease in fertilizer efficiency. The application of retardants contributed an additional yield of 2.0–2.7 c/ha.

In the early-maturing and relatively tall variety *Chillaki*, applying the retardant at 0.2 L/ha did not produce additional yield, but increasing the dose to 0.4 L/ha doubled the additional yield compared to *Krasnodarskaya 99*, reaching 3.9–4.6 c/ha. The effectiveness of retardant application in the tall *Chillaki* variety was higher, and it also improved the efficiency of fertilizers.

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