

EFFECT OF STIMULATORS AND PROTECTIVE TOOLS ON THE COLLECTION INDICATORS IN WHEAT PLANTS (Field experiment results as of February 16, 2024)

Q. Davronov

Fargana State University, PhD, Associate Professor

Z. Sadikova

Fargana State University, Independent Researcher

Abstract

This study investigated the effect of various biostimulants, fungicides, insecticides, and humic fertilizers on the tillering capacity of wheat at the early stages of growth. Experiments were conducted across 11 variants with three repetitions each, and the number of seedlings and tillers were recorded for each variant. Based on the average values, the most effective treatment combinations were identified. The results have practical significance for selecting optimal treatments and scientifically substantiating agronomic practices aimed at increasing wheat productivity.

Keywords: Wheat (*Triticum aestivum* L.), field experiment, tillering, seedling density, biostimulant, humic substances, potassium humate, phytohormone, fungicide, insecticide, Novogumin, Impakt, Karat, integrated treatment, early growth stage, productivity.

Introduction

Wheat (*Triticum aestivum* L.) is one of the most important staple crops worldwide and a strategic commodity for food security. Achieving a uniform and productive wheat stand depends strongly on early growth processes, particularly seedling establishment and tillering (the formation of secondary shoots). Tillering is a key yield-forming trait because it determines the potential number of fertile stems and, ultimately, the number of spikes per unit area. Strong early tillering improves canopy development, enhances photosynthetic capacity, increases nutrient uptake efficiency, and strengthens crop resilience to abiotic stresses such as cold events, water deficit, and temporary nutrient limitations.

In modern cereal production systems, farmers increasingly combine growth-promoting inputs (biostimulants, phytohormones, and humic substances) with protective tools (fungicides and insecticides) to stabilize crop development and reduce early-season losses. Biostimulants and humic fertilizers can enhance root growth, activate physiological metabolism, and support nutrient assimilation, while fungicides and insecticides protect seedlings from pathogens and pests that can suppress establishment and weaken plants during the most sensitive stages. However, the response of wheat to these products is often dose-dependent and influenced by environmental conditions



and application strategies (single vs. combined use). Therefore, evidence-based selection of effective combinations is essential to avoid unnecessary costs and to maximize agronomic benefits.

Against this background, evaluating the comparative effectiveness of biostimulants, protective agents, and humic–hormonal mixtures under field conditions is highly relevant. The present study addresses this practical and scientific need by testing multiple treatment variants and quantifying their effects on early wheat stand indicators. Identifying the most effective options provides a scientifically grounded basis for optimizing agronomic management and improving wheat productivity potential under real field conditions.

The Main Part

Wheat (*Triticum aestivum* L.) is one of the world's major food crops, and its yield depends on many agrotechnical, biological and environmental factors. The tillering (in other words, the emergence of multiple shoots from the seedling) that develops during the early growing season of wheat is one of the main indicators determining its future yield. Strong and stable tillering enhances the plant's photosynthesis process, ensures efficient absorption of nutrients, and increases its resistance to winter stress or other adverse factors. In recent years, biologically active preparations such as biostimulants, phytohormones and humic substances have been recognized as important tools for accelerating the growth process of wheat and increasing its yield. At the same time, fungicides and insecticides protect crops from diseases and pests and help improve the general physiological condition of the plant. Studies have shown that various preparations and their combinations have a significant effect on the number of seedlings and the ability to establish a plant. Therefore, the selection of optimal stimulants in wheat and their use in combination with agrotechnical measures enhances plant development and maximizes yield. The purpose of this study is to determine the effect of various biostimulants, fungicides, insecticides and humic fertilizers on the establishment process in wheat plants, to identify the most effective options and recommend them for practice. This, in turn, is of great importance in ensuring high-quality and high-yield wheat crops.

Table 1. Observations on wheat accumulation as of February 16, 2024 Average

No	Experience options	1st return		2nd return		3rd return		average	
		number of seedlings	accumulation	number of seedlings	accumulation	number of seedlings	accumulation	number of seedlings	accumulation
1	Control	196	157	195	152	194	171	195	160
2	Template (Universal) (2.0-2.0)	205	174	204	176	205	170	204	173
3	Biostimulant (Novogumin) + fungicide (Inpakt) (2.0-0.02/2.0-0.02)	198	159	200	161	199	162	199	160
4	Biostimulant (Novogumin) + insecticide (Karat) (2.0-0.15/2.0-0.15)	203	168	203	171	202	173	202	170
5	Biostimulant (Novogumin) + fungicide (Inpakt) + insecticide (Karat) combined treatment (2.0-0.02-0.15/2.0-0.02-0.15)	199	161	200	165	202	162	200	162
6	Biostimulant (Novogumin) + fungicide (Inpakt) + insecticide (Karat) separate treatment (2.0-0.02-0.15/2.0-0.02-0.15)	198	168	205	167	202	166	201	167
7	Potassium humate + phytohormon (1.0+0.250-1.0+0.250)	198	158	198	157	197	157	197	157
8	Potassium humate + phytohormon (1.0+0.5-1.0+0.5)	204	176	202	176	202	171	202	174
9	Potassium humate (1.0)	193	154	193	155	194	157	193	155
10	Potassium humate (2.0)	197	161	198	162	199	160	198	161
11	Novogumin (2.0)	197	159	194	164	196	164	195	162



The study investigated the germination capacity and number of seedlings of wheat in 11 experimental variants. Each variant was repeated three times and the average results were calculated. The control (no drug was used) had an average number of seedlings of 195, and an average germination of 160. These indicators are used as a baseline and serve as a basis for comparison with other drugs. Andoz (Universal) drug: the average number of seedlings was the highest - 205, and the average germination was 173. The result shows that the universal drug enhances the initial growth process of wheat and improves germination indicators. Biostimulant (Novogumin) + fungicide (Impact): the average number of seedlings was 199, and germination was 161. The indicators of this combination are slightly higher than the control, which helps to improve germination. Biostimulant (Novogumin) + insecticide (Karat): number of seedlings 203, germination 171. This combination, due to the addition of insecticide, protects the plant from pests and enhances the germination process. Novogumin + Impakt + Karat (together): number of seedlings 200, germination 163. The result of joint treatment is good, but germination is slightly lower compared to separate treatment. Novogumin + Impakt + Karat (separately): number of seedlings 202, germination 167. The separate use of the drugs helped to further improve germination. Potassium humate + phytoharmon (1.0+0.25): number of seedlings 198, germination 157. This combination gives a slightly higher indicator than the control, but the germination is not high. Potassium humate + phytoharmon (1.0 + 0.5): the number of seedlings is 203, the highest germination is 174. Thus, it stands out as the most effective combination in terms of wheat germination and the number of seedlings. Potassium humate (1.0): the number of seedlings is 193, the germination is 155. When used alone, the efficiency is lower. Potassium humate (2.0): The number of seedlings was 198, the number of clusters was 161. Increasing the amount of the drug slightly improved the indicators. Novogumin (2.0): the number of seedlings was 196, the number of clusters was 162. When used alone, the effect on clustering was moderate. The general conclusion shows that the highest germination: Potassium humate + phytoharmon (1.0+0.5) – 174 units, the highest number of seedlings: Andozha (Universal) – 205 units. The control option is used as a base with low indicators. These results show that the addition of biostimulants, phytohormones and humic substances significantly improves the initial growth and germination of wheat, especially the selection of optimal combinations is important for increasing yield. The most effective option is Potassium humate + phytohormon (1.0+0.5). The template also showed high results. The complex use of components ensured stable growth. The control recorded a low indicator.

Conclusion

Field experiment results recorded on 16 February 2024 confirm that biostimulants, crop-protection products (fungicides and insecticides), and humic fertilizers can noticeably influence wheat establishment at early growth stages, particularly seedling density and tillering. In the untreated control, the mean values were 195 seedlings and 160 tillers, which served as the baseline for comparison.

The highest tillering was obtained with potassium humate + phytohormone (1.0 + 0.5), reaching an average of 174 tillers (i.e., +14 compared with the control, approximately +8–9%). The highest seedling number was recorded in the Andoz (Universal) treatment, with an average of 205 seedlings (+10 relative to the control, ~+5%). The Novogumin + Karat combination also



performed well, producing 203 seedlings and 171 tillers, indicating that the inclusion of insecticidal protection may contribute to stronger early establishment.

Among the complex treatments, applying Novogumin + Impakt + Karat separately resulted in better tillering (167) than applying them as a combined treatment (162). This suggests that the application sequence and mixture compatibility (tank-mix effects) may influence the physiological response of wheat during establishment. In contrast, potassium humate used alone (1.0 or 2.0) did not provide a clear advantage over the control and, in some cases, performed slightly lower.

Overall, the findings indicate that selecting optimal combinations, especially potassium humate + phytohormone (1.0 + 0.5) for maximizing tillering and Andoz (Universal) for increasing seedling density, has practical value for improving early wheat stand development and supporting higher productivity potential under field conditions.

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