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EFECT OF BIOSTIMULANT FERTIGRAIN ON BREAD WHEAT (*Triticum aestivum*) PRODUCTIVITY ELEMENTS AND GRAIN YIELD

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Abstract

The field experiment was held on selected areas in the production field in Zhrebino village (South-east Bulgaria) during the 2007 – 2010 period. The test was performed by means of a block method with four repetitions; experimental field area - 15m^2 after sunflower predecessor.
Four variants i.e seed treatment whit fertigrain start in rate 50 ml/100 kg seeds, leaf treatment whit fertigrain foliar in rate 1l/ha at tillering phase, seed treatment +leaf treatment and untreated control were considered for this study.
The aim of the study was to determine the influence of the biostimulants Fertigrain on the elements of productivity and the yield of bread wheatvariety Sadovo 772.
The results show: the biostimulant fertigrain have positive effect on the productivity of bread wheat Sadovo 772 variety. The Fertigrain contributes to higher values of structural elements of the yield, such as; length of the spike, number of the spikeletts per spike, number of the grains per spike, weightof the grains per spikeand thousand grain weight. The highest increase in the grain yield was found at variant seed treatment in rate 50 ml + leaf treatment leaf treatment in rate 1l/ha – 18% of the crop grain for the investigated period compared to the untreated control.

Key words: *biostimulant fertigrainr, bread wheat, elements of productivity, grain yield.*

INTRODUCTION

In modern cereal crops growing technologies increasingly becomes important the usage of bio-stimulators and growth regulators.
These chemicals affect plant productivity, increasing metabolism, accelerate the absorption of nutrients and contribute to their redistribution in the plant body (Nickel, 1982).
Different studies in the country and abroad have shown that the application of various bio-stimulators and growth regulators in cereal crops increased grain yield and has a positive impact on productivity and the elements of the physical properties of grain (Atanasova et al., 2001; Kolev et al., 2007; Peter 2005; Wolber and Seemann, 2006).
In other research has found that there are products that increase plant resistance to various stressors (Delchev and Kolev, 1998).
There are studies in Bulgaria about usage of a bio-stimulators and growth regulators in durum wheat (*Triticum durum*) growing, while those in ordinary (*Triticum aestivum*) are very limited (Delchev and Kolev, 2001; Kolev et al., 2006).
Therefore the aim of this study is to determine the influence of the bio-stimulant Ffertigrain on the productivity elements and the yield of bread wheat variety Sadovo 772.

MATERIALS AND METHODS

Research activities were conducted in the period of 2007-2010 at the experimental field of Jhrebino village, South-East Bulgaria. The experiment was performed on carbonate vertisols soil type whit sandy-clayed texture, by means of a block method with four repetitions; experimental field area - 15 m^2, after the predecessor sunflower. The contents of the basic nutrient elements in the 0-20 cm layer were as follows: N-26.6 mg/1000 g, P_2O_5-11.2 mg/100 g, K_2O-38.1 mg/100 g, humus-3.31 %.
Four variants - seed treatment whit fertigrain start in rate 50 ml/100 kg seeds (1), leaf treatment whit fertigrain foliar in rate 1l/ha at tillering phase (2), seed treatment + leaf treatment (3) and untreated control were considered for this study.
All the stages of the established technology for wheat growing were followed.
Soil tillage included single disking (10-12 cm) after harvesting of the previous crop, and double disking after the main fertilization has been made. The area was treated by $N_{120}P_{80}$ and

the whole quantity of the phosphorous fertilizer and 1/3 of the nitrogenous fertilizer were applied before main soil tillage. The remaining amount from the nitrogen norm was applied before permanent spring vegetation beginning. Triple super phosphate and ammonia nitrate were used. Sadovo 772 sowing was completed within the optimal for this region agrotechnical term at sowing rate 550 germinating seeds/m^2. Weeds and diseases control was done with suitable pesticides when necessary. Harvesting was done at full maturity. The grain yield is determined with standard grain moisture of 13%.

The indices; height of plants (cm), length of the spike (cm), number of the spikeletts per spike, number of the grains per spike, weight of the grains per spike (g), thousand grain weight (g), test weight (kg) and grain yield (kg ha^{-1}) were determined.

For determining the quantity dependence between the studied indicators, the experimental data was processed according to Anova Method of dispersion analysis, and the differences between the variants were determined by means of Dunkan's Multiple Range Test (Dunkan, 1995).

The research period (2007-2010) is characterized with variety of temperature and rainfall conditions which enables to evaluate the reaction of the studied varieties in accordance with their yields and quality characteristics under different climatic conditions (Figure 1).

The chart on Figure 1 showed that the temperatures during the vegetation of bread wheat cultivation were higher compared to the long-term period in all years of the research. According to the meteorological conditions data, three years of the study could be considered suitable for the bread wheat cultivation Rainfalls in autumn and during the critical spring period are decisive for the development of the wheat plants. The mean annual precipitation sums during October – March, which formed the autumn-and-winter moisture reserves in soil during the experimental years 2007-2008, 2008-2009 and 2009-2010 were 67.7, 5.9 and 59.2 mm higher than the mean sums of the long - term period.

In April-May when plants were at booting and heading stages, the mean annual precipitation sum in 2008-2009 and 2009-2010 was lower than the mean long - term value, while in 2007-2008 this sum was higher with 4.7 mm.

In June (during grain filling-maturation) rainfalls in harvest year 2008-2009 was 8.2 mm lower than the long - term period, while in 2007-2008 and 2009-2010 they were with 21.5 and 23.0 mm, respectively higher.

The most favourable for plant growth and development was the first experimental year (2007-2008), followed by the third (2009-2010), and unfavourable was the second year (2008-2009), of the experiment, having an effect on yield and grain quality of bread wheat.

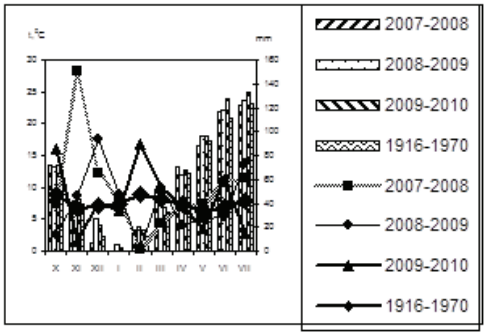

Figure 1. Temperature and rainfall distribution during the period 2007-2010

RESULTS AND DISCUSSIONS

Because of same trend in the data in all three years of the study there are presented averaged values of the structural elements of yield in table 1. The results showed that the treated with bio-stimulant Fertigrain plants are up to 6.4 cm higher than the untreated control.

The spike analysis show that when bio-stimulant Fertigrain is used the spikes are longer, compared to the control. As a result of the bio-stimulant usage there are 1.6 to 3.5 cm longer spikes in treated variant, compared to the control.

The highest values of this parameter are given in options with seed treatment in rate 50 ml + leaf treatment leaf treatment in rate 1 l/ha (12.5 cm), followed by leaf treatment whit Fertigrain foliar in rate 1 l/ha at tillering phase (11.3 cm) and the variant where the seeds are treated whit Fertigrain start in rate 50 ml/100 kg - 10.6 cm. Statistically proven the spike

length has lowest values at the untreated control (9.0 cm).

Table 1. Height of plants and structural elements of the yield, average during the period 2007-2010

Variants	Height of plants (cm)	Length of spike (cm)	Number of spikeletts per spike	Number of the grains per spike	Weight of the grains per spike (g)	Thousand kernel (grain) weight (g)	Test weight (kg)
1	94.1 [b]	10.6 [b]	17.0 [a]	40.6 [b]	1.86 [b]	48.9 [b]	78.2 [a]
2	93.7 [b]	11.3 [b]	17.8 [a]	43.0 [c]	1.94 [b]	50.2 [c]	78.0 [a]
3	96.6 [c]	12.5 [c]	20.5 [b]	46.7 [d]	2.18 [c]	51.4 [d]	80.1 [b]
Control	90.2 [a]	9.0 [a]	16.5 [a]	40.0 [a]	1.51 [a]	46.5 [a]	77.5 [a]
LSD 5%	*2.4*	*1.1*	*2.5*	*1.2*	*0.21*	*1.0*	*2.1*

The number of spikeletts per spike increases under the bio-stimulant Fertigrain influence. All the treated variants exceed the untreated one up to 24.2 %. Statistically proven the highest number of spikeletts per spike differs variant with the seed treatment in rate 50 mlleaf treatment leaf treatment in rate 1 l/ha – 20.5.

The grains number per spike vary from 41.0 to 46.7 compared to 40.0 at the untreated control. Statistically proven the largest increase in values of this index 16.8% was recorded at the variant with seed treatment in rate 50 mlleaf treatment in rate 1 l/ha, compared to the untreated one. In all other variants

Applying Fertigrain leads to increasing the grain number from 3 to 7.5% at all treated variants compared to the untreated one. The grain weight per spike in all treated variants also exceed the control. The excess is 0.35 – 0.67 g, which is statistically proven. Highest increase of this indicator is reported at seed treatment in rate 50 mlleaf treatment in rate 1 l/ha – 2.18 g compared to 1.51 g, obtained to the control. Thousand kernel (grain) weight increases uder the influence of the bio-stimulant Fertigrain up to 10.5 % compared to the control. Highest values are reported at seed treatment in rate 50 mlleaf treatment leaf treatment in rate 1 l/ha – 51.4 g, followed by leaf treatment whit fertigrain foliar in rate 1l/ha at tillering phase - 50.2 g and the variant where the seeds are treated with fertigrain start in rate 50 ml/100 kg - 48.9 g.

The Fertigrain variant (seed treatment in rate 50 ml + leaf treatment leaf treatment in rate 1 l/ha) – 80.1 kg statistically proven exceed the control – 77.5 kg. In all other variants the value increasing compared to the control is not statistically proven.

The favorable combination between the the temperature and the moisture during the wheat vegetation is a prerequisite for obtaining higher yields in 2007-2008 compared to 2008-2009 and 2009-2010 year.

In the first year of the experiment the grain yield vary from 5710 kg/ha at the control to 6854 kg/ha at the variant seed treatment in rate 50 ml + leaf treatment leaf treatment in rate 1 l/ha. All other Fertigrain treated variants exceed the control from 632 up to 955 kg/ha which is also statistically proven (Table 2).

Table 2. Grain yield, kg/ha

Variants	Years of study			Average for the period (kg/ha)
	2007-2008 kg/ha	2008-2009 kg/ha	2009-2010 kg/ha	
1	6342 [b]	5500 [b]	5620 [b]	5821
2	6665 [c]	5673 [c]	6100 [c]	6146
3	6854 [d]	5955 [d]	6290 [d]	6366
Control	5710 [a]	5148 [a]	5325 [a]	5394
LSD 5 %	*165.1*	*170.4*	*132.4*	

The lowest garin yield are reported in the second experimental year. At the Fertigrain treated variants they are in range from 5500 to 5955 kg/ha compared to 5148 kg/ha at the control.

In all treated variants the grain yield statistically proven exceed the control from 6,8 to 15.7%.

During the last experimental year (2009-2010) the grain yield vary from 5325 kg/ha at the control to 6290 kg/ha at the variant seed treatment in rate 50 ml + leaf treatment leaf treatment in rate 1 l/ha. Fertigrain treated variants statistically proven exceed from 295 to 965 kg/ha the untreated variant.

In average for the researched period (2007-2010), the highest yield was obtained from the variant seed treatment in rate 50 mlleaf treatment leaf treatment in rate 1l/ha-6366 kg/ha, followed by the leaf treatment whit Fertigrain foliar in rate 1 l/ha at tillering phase – 6146 kg/ha and the variant seed treatment whit Fertigrain start in rate 50 ml/100 kg seeds where the yield is 5821 kg/ha. Statistically proven the Fertigrain application

increase the grain yield from 427 to 972 kg/ha, compared to the control.

The results from the multifactor analysis of variances showed the independent effect of the investigated factors, as well as their interaction (Table 3). The variants had highest statistic influence on the seeds yield – η 97, followed by years with their climatic conditions - η 96.

Table 3. Analysis of variance for grain yield for the period 2007-2010

Source of Variation	Sum of Square	DF	Mean Square	Sig of F	η^2
Variants	6302118.92	3	2100706.3	.000	97
Years	5689763.17	2	2844881.6	.000	96
2- Way Interactions	289134.83	6	48189.14	.000	61
Residual	187001.00	36	5194.47		

Interaction - Variants x Years - η 61 was also significant for grain yield.

CONCLUSIONS

The biostimulant Fertigrain have positive effect on the bread wheat Sadovo 772 productivity. The Fertigrainr contribute to higher values of the yield structural elements, such as; length of the spike, number of the spikeletts per spike, number of the grains per spike, weight of the grains per spike and thousand grain weight.

The grain yield increasing vary from 7.9 to 18% compared to the control.

The highest grain yield increase in the grain yield was found at seed treatment in rate 50 ml + leaf treatment leaf treatment in rate 1 l/ha variant – 18.0% for the all investigated period compared to the untreated control.

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