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EFFECT OF LEAF TREATMENT PRODUCTS ON SOME STRUCTURAL COMPONENTS IN THE YIELD OF COMMON WHEAT

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Abstract

In a field experiment conducted at the Training Experimental and Implementation Base of the Agricultural University of Plovdiv in 2015-2017, the effect of leaf treatment products on some structural components in the yield of common wheat varieties: Enola, Annapurna, Ginra and Biliana was studied. The following products have been tested: alone - Plantafol (mineral leaf fertilizer) at a dose of 250 g/da and Bombardier (organic biostimulator) at a dose of 400 ml/da, as well as a combination of the two products. The treatment was carried out in the wheat tillering phase (22-25 on the Zadoks scale). The experiment has been set by the fractional parcel method in 4 repetitions with crop plot size of 15 m^2.
It has been found that the independent and combined application of the tested products had a positive effect on the values of the structural components in the yield (spike length, spikelet number, grain number and grain mass in the spike of common wheat).

Key words*: foliar treatment products, structural components of yield, common wheat*.

INTRODUCTION

In recent years the use of foliar treatment products has been increasing when growing common wheat. They help to solve the issues related to accelerating the growth and development of plants (Delchev et al., 2004; Delchev et al., 2007; Delchev, 2009), their resistance to stress factors (Fujita et al., 2006), as well as enhancing the productivity and quality of the grain obtained from the wheat (Gallie, 2013). According to the research of a number of authors, treatment of plants with foliar treatment products during the vegetation of common wheat contributes to increasing the number of grains and their mass, resulting in increased productivity (Sevov & Delibaltova, 2013; Wasternack & Hause, 2013; Delchev et al., 2015).
The objective of the conducted research is to establish the effect of foliar treatment products on some structural components of yield in common wheat varieties Enola, Annapurna, Ginra and Biliana.

MATERIALS AND METHODS

The experiment was cconducted at the Training Experimental Field of the Department of Plant Production at the Agricultural University of Plovdiv in the period 2016-2018. The field experiment was laid out in a block method in four replications and crop plot size of 15 m^2 on carbonate alluvial meadow Mollic Fluvisols (FAO - UNESCO, 1990) soil characterized by medium sand-clayey mechanical composition, 1-2% humus content, pH 7.7, presence of carbonates up to 7.4% and lack of salts. In the soil layer 0-20 cm the content of the main nutrients was as follows: N - 20.8 mg/1000 g, P_2O_5 - 7.01 mg/100 g, K_2O - 32.8 mg/100 g.
The following products were tested: separately - Plantafol (mineral foliar fertilizer) at a dose of 250 g/da and Bombardier (organic biostimulator) at a dose of 400 ml/da, as well as a combination of both products. Treatment was carried out in the wheat tillering phase (22-25 on the Zadoks scale). The tested wheat varieties were grown by the approved technology after predecessor sunflower. Sowing was made within the optimum time (01-20.XI). The experiment was fertilized with N_{16} P_{14}, and the entire amount of phosphorous fertilizer was introduced prior to the main cultivation, whereas the nitrogen 1/3 before sowing and 2/3 in early spring as supplemental nutrition.
The following biometric measurements were taken: spikelet number per spike, grain number per spike, grain weight per spike (g) and grain yield (t/ha).

The amount of precipitation during the vegetation period of common wheat (X-VI) was as follows: 2016/2017 - 264.2 mm and in 2017/2018 - 457.2 mm at 419.6 mm over a multiannual time period (Figure 1).

RESULTS AND DISCUSSIONS

A favourable year for the growth and development of common wheat with a relatively good distribution of precipitation was 2016-2017 and then the values of the structural components of yield were higher for the tested varieties. Unfavourable for plant development was the 2017-2018 harvest year due to a significant amount of precipitation that prevented harvesting, which had negative effect on common wheat productivity (Figure 2).

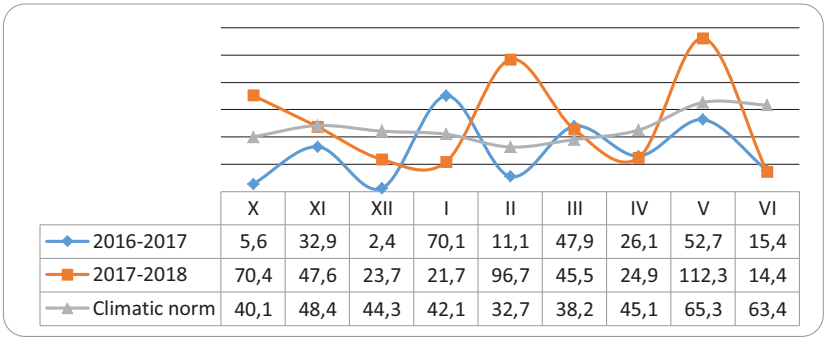
The data from the biometric measurements of the variants with the tested foliar treatment products are presented in Table 1.

The number of spikelets and the favourable conditions during flowering and fertilization are a guarantee of the formation of well-grained spikes.

The extremely favourable meteorological conditions at that time were a good prerequisite for the formation of a great number of spikelets in the different varieties with the greatest numberproduced by the Enola variety.

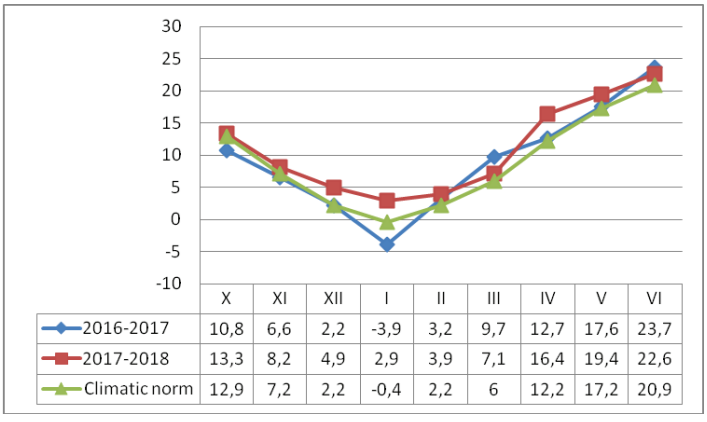
During the study period it was found out that the foliar treatment products had stronger effect on the spike length in the Enola variety, which increased by 2.4 cm (29.8%) with individual treatment with Bombardier, and with Plantafol by 2.2 cm (18.3%), and in the Plantafol + Bombardier variant 2.36 cm (29.3%).

When using the foliar treatment products for Annapurna wheat variety, the greatest number of spikelets per spike are formed 21.6 pcs. (14.0%) with individual treatment with Plantafol, followed by treatment with Bombardier 20.8 pcs. (11.8%), followed by Biliana and Enola varieties, and the lowest number of spikelets were observed in the Ginra variety.



	X	XI	XII	I	II	III	IV	V	VI
2016-2017	5,6	32,9	2,4	70,1	11,1	47,9	26,1	52,7	15,4
2017-2018	70,4	47,6	23,7	21,7	96,7	45,5	24,9	112,3	14,4
Climatic norm	40,1	48,4	44,3	42,1	32,7	38,2	45,1	65,3	63,4

Figure 1. Precipitation by months (sum mm/m^2)



	X	XI	XII	I	II	III	IV	V	VI
2016-2017	10,8	6,6	2,2	-3,9	3,2	9,7	12,7	17,6	23,7
2017-2018	13,3	8,2	4,9	2,9	3,9	7,1	16,4	19,4	22,6
Climatic norm	12,9	7,2	2,2	-0,4	2,2	6	12,2	17,2	20,9

Figure 2. Monthly temperatures (average)

Number of germinate plant

The germinate plants in Annapurna variety is higher from 398.4 counts (79%) to 409.9 counts (81.9%), Biliana variety is following from 369.2 counts (73.8%) to 387.9 counts (77.6%), next is Enola variety from 354.2 counts (70.8%) to 367.3 counts (73.5%) and the last is Ginra variety from 342.5 counts (68.5%) to 358.2 counts (71.6%) (Table 1).

Number of surviving plants the winter/cold temperatures plants Into the technological development one of the most important componens is the winter surviving plants quality the the variety. According the characteristic of the varieties coming from their inventors, the minimum healthy plants surviving the winter period should be 80%

One of the reason of lower yield is a destroyed plants after the winter period. The varieties should have a cold resisting element. Otherwise there is a possibilities cold temperature to stress the plants, or even to destroy them. In our case the surviving winter plants were less than the emerged ones.

The survaiving winter plants were satisfied. It vary in Biliana variety from 80.9% to 84.6%, Ginra variety from 88.1% to 90.3%, Annapurna variety from 94.9% to 96.6% and Enola variety from 95.9% to 96.3% (Table 1).

Tillering plants

The tillering vary in Enola variety from 60.08% to 63.11%, in Annapurna variety from 65.08% to 68.62%, Ginra from 60.02% to 61.17%, and Biliana from 64.67% to 66.28% (Table 2).

On average for the study period treatment of plants in wheat varieties with the tested products resulted in an increase in the grain weight per spike, being the highest in treatment of plants from the Biliana variety in the combination of Plantafol + Bombardier 2.99 g (15.0%) and individual treatment with Bombardier 2.89 g (11.1%) (Table 3).

The number of grains per spike as a result of the effect of the studied foliar treatment products varies in the Annapurna variety from 59.7 pcs. in the Bombardier variant (12.0%) and with Plantafol 58.3 pcs. (9.4%), whereas in treatment with Plantafol + Bombardier 58.9 pcs. (10.5%). In the Biliana Enola and Ginra wheat varieties fewer number of grains per spike were reported.

Variety Annapurna follows treated with Plantafol + Bombardier 2.79 g (18.7%), individual treatment with Plantafol 2.71 g (15.3%), with Bombardier 2.68 g (14.0%) more than the untreated control (Table 3).

Table 1. Number of germinated and wintering plants (average 2016-2018)

Variety	Foliar treatment products	Number of germinated plants	% relative to the sowing rate	Number of wintering plants	% of emerging plants
A_1 - Enola	B_0 Control - not fertilized	354.2	70.8	340.5	96.1
	B_1 Plantafol	359.1	71.8	345.7	96.3
	B_2 Bombardier	361.3	72.3	347.5	96.2
	B_3 Plantafol + Bombardier	357.4	71.5	342.8	95.9
A_2- Annapurna	B_0 Control - not fertilized	398.4	79.7	379.6	95.3
	B_1 Plantafol	406.7	81.3	389.1	94.9
	B_2 Bombardier	403.2	80.6	387.7	96.1
	B_3 Plantafol + Bombardier	405.4	81.1	384.8	94.9
A_3 - Ginra	B_0 Control - not fertilized	342.5	68.5	301.8	88.1
	B_1 Plantafol	345.7	69.1	312.1	90.3
	B_2 Bombardier	348.4	69.7	308.7	88.6
	B_3 Plantafol + Bombardier	344.6	68.9	304.2	88.2
A_3 - Biliana	B_0 Control - not fertilized	369.2	73.8	300.5	81.3
	B_1 Plantafol	379.2	75.8	317.2	81.8
	B_2 Bombardier	384.6	76.9	311.7	81.0
	B_3 Plantafol + Bombardier	381.5	76.3	309.0	80.9

Table 2. Common tillering and yield tillers plants (average 2016-2018)

Variety	Foliar treatment products	Number of brothers/m^2	Number of classical stems/m^2	Common tillering, %
A_1 - Enola	B_0 Control - not fertilized	544.8	331.2	60.08
	B_1 Plantafol	553.1	339.3	61.34
	B_2 Bombardier	556.0	340.2	61.18
	B_3 Plantafol + Bombardier	548.5	346.2	63.11
A_2 - Annapurna	B_0 Control - not fertilized	607.4	395.3	65.08
	B_1 Plantafol	622.6	424.2	68.13
	B_2 Bombardier	620.3	429.3	69.21
	B_3 Plantafol + Bombardier	615.7	422.5	68.62
A_3 - Ginra	B_0 Control – not fertilized	482.9	290.9	60.02
	B_1 Plantafol	499.4	308.4	61.18
	B_2 Bombardier	492.9	303.8	61.16
	B_3 Plantafol + Bombardier	486.7	300.5	61.17
A_3 - Biliana	B_0 Control – not fertilized	480.8	312.3	64.67
	B_1 Plantafol	507.5	335.3	66.07
	B_2 Bombardier	498.7	330.4	66.25
	B_3 Plantafol + Bombardier	494.4	327.7	66.28

Table 3. Biometrics data (average 2016-2018)

Variety	Foliar treatment products	Length of spike, cm	Number of spikelets per spike	Number of grains per spike	Weight of grains per spike, g
A_1 - Enola	B_0 Control - not fertilized	8.05	17.3	44.8	2.00
	B_1 Plantafol	10.25	18.9	51.9	2.39
	B_2 Bombardier	10.45	19.8	50.5	2.26
	B_3 Plantafol + Bombardier	10.41	19.7	52.6	2.34
A_2-Annapurna	B_0 Control - not fertilized	8.45	18.6	53.3	2.35
	B_1 Plantafol	9.45	21.2	58.3	2.71
	B_2 Bombardier	9.73	20.8	59.7	2.68
	B_3 Plantafol + Bombardier	9.56	20.5	58.9	2.79
A_3 - Ginra	B_0 Control – not fertilized	7.65	17.1	36.5	2.00
	B_1 Plantafol	9.05	18.9	44.7	2.38
	B_2 Bombardier	9.17	19.4	43.9	2.41
	B_3 Plantafol + Bombardier	9.23	19.1	45.1	2.49
A_3 - Biliana	B_0 Control – not fertilized	9.70	19.0	52.2	2.60
	B_1 Plantafol	9.92	19.7	55.5	2.72
	B_2 Bombardier	9.89	19.9	55.2	2.89
	B_3 Plantafol + Bombardier	9.98	20.2	55.9	2.99
	GD 5%	0.47	1.35	4.85	0.34

Photo 1. Photos from the field January mount

CONCLUSIONS

The values of the structural components of yield in common wheat varieties Enola, Annapurna, Ginra and Biliana, when treated with the tested foliar treatment products exceed those of the non-treated controls.

Spike length in the Enola variety increases in individual treatment with Bombardier and in the Plantafol + Bombardier variant, and is the weakest with Plantafol.

When using the foliar treatment products for the Annapurna wheat variety, the greatest number of spikelets per spike are formed in individual treatment with Plantafol, followed

by treatment with Bombardier, followed by Biliana and Enola varieties, and the smallest number of spikelets was observed in the Ginra variety.

Treating plants from wheat varieties with the tested products results in an increase in the grain weight per spike, it being the highest in treatment of plants from the Biliana variety in the combination Plantafol + Bombardier combination and the individual treatment with Bombardier. Annapurna variety follows treated by Plantafol + Bombardier and individual treatment with Plantafol or Bombardier.

Photo 2. Ripening period – June

Photo 3. Tillering stage of development

Photo 4. Photos from mount June. Ear comparison. Ripening period - June

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