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INFLUENCE OF GROWTH REGULATORS ON THE DURUM WHEAT YIELD

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Abstract

In a field experiment carried out in the Experimental and Implementation Base of the Department of Plant Growing at the Agricultural University, in non-irrigated conditions, the influence of following growth regulators was tested: Madex Top (600 ml/ha), Flordimex T Extra (750 ml/ha), Seron 480 SL (1000 ml/ha) and Trimax 175 EK (400 g/ha) on the yield of durum wheat varieties Deyana and Zvezditsa. The tested growth regulators have influenced to varying degrees the yield gains of the investigated durum wheat varieties. The treatment of Deyana durum wheat variety with the growth regulator Seron 480 SL (1000 ml/ha) results in an increase of the yield with 450 kg/ha (11.5%) on average over the three-year study period compared to the control. The higher grain yield of the durum wheat variety Zvezditsa with the same growth regulator is 350 kg/ha (9.8%). With second results, for both tested varieties is the variant treated with Medax Top (600 ml/ha), where the average increase of grain yield is respectively: for Deyana variety 280 kg/ha (8.7%) and for Zvezditsa variety 260 kg/ha more than the untreated control. When spraying durum wheat with Trimax 175 EC, the yield gain for Deyana is 280 kg/ha, and 250 kg/ha for Zvezditsa variety. The studied growth regulators have helped to increase the grain mass in one ear for the Deyana variety, while for the Zvezditsa variety - to increase the number of grains in one ear.

Key words*: growth regulators, durum wheat, yield productivity.*

INTRODUCTION

A key area of cereal crop technology is the use of growth regulators (Delchev et al., 2011; Kolev et al., 2006). A number of scientific publications abroad (Pirasteh Anosheh et al., 2012; Nabti et al., 2010) and in Bulgaria (Mangova et al., 2013; Kolev et al., 2015) also present research results on this issue. A number of leading companies producing agricultural products present new products every year.

The need to investigate the impact of new growth regulators on grain yield and quality of durum wheat has led to the present experiment.

MATERIALS AND METHODS

During the period 2014-2017, a field experiment was conducted in the Training, Experimental and Implementation Centre of the Department of Plant Growing at Agricultural University under non-irrigated conditions, where the influence of some growth regulators on the productivity of durum wheat varieties Deyana and Zvezditsa (selection of the Field Cultures Institute in the town of Chirpan) was tested.

Growth regulators against layering of durum wheat were tested: **Madex Top** (active substance 300 g/l mepiquat chloride + 50 g/l prohexadione calcium) at a dose of 600 ml/ha is administered in BBCH phase 30-39 (start of stem elongation - the flange leaf is completely unfolded); **Floridimex T Extra** (active substance 660 g/l ethephon) at a dose of 750 ml/ha introduced into the BHCH phase 26-30 (end of tillering - start of shooting up); **Seron 480 SL** (active substance 480 g/l ethephon) at a dose of 1000 ml/ha applied in phase BBCH 32-39 (from the phase the second node is at least 2 cm above the first to phase the flange leaf is completely unfolded); **Trimax 175 EK** (active substance 175 g/l trinexapac-ethyl) at a dose of 400 g/ha and phase of administration BBCH 30-39 (beginning of stem elongation to a fully unfolded flange leaf). There was also an untreated control. The experiment is based on the fractional plot method in four iterations

with a plot size of 10 m^2. Durum wheat is grown according to established technology (Yanev et al., 2008). The sowing is carried out in the optimal for Bulgaria period from 20th October to 10th November with a sowing rate of 500 germinating seeds per m^2. The field experiment is carried out on alluvial-meadow soil (Molic Fluvisols by FAO), which is characterized by a medium sand-clayey mechanic composition, a humus content of 1-2% and a pH of 7.7. The nutrient content in the soil layer 0-20 cm is as follows: N - 15.6 mg/1000 g; P_2O_5 - 32 mg/100 g; K_2O - 47 mg/100 g of soil; $CaCO_3$ - 7.4% (Popova et al., 2010).

The area subjected to the experiment was fertilized with 120 kg/ha NH_4NO_3 (ammonium nitrate) and 80 kg/ha P_2O_5 (triple superphosphate - 46% diphosphorus pentoxide) in the active substance. In order to determine the differences between the tested growth regulators and the specific varietal response to them, the following indicators were taken into account: plant height (cm), length of spike (cm), number of spikelets in one spike (pcs), grain yield (t/ha), number of grains in one spike (pcs), grain mass in one spike (g), mass of 1000 grains (g) and specific weight (kg/hl).

The statistical processing of the data obtained on the surveyed indicators was carried out with the BIOSTAT software (Penchev, 1998).

The aim of the experiment carried out is to study the impact of the growth regulators Madex Top, Floridimex T Extra, Seron 480 SL, and Trimax 175 EK on the productivity of the varieties durum wheat Deyana and Zvezditsa in the climatic and soil conditions of Southern Bulgaria.

RESULTS AND DISCUSSIONS

The sum of rainfall during durum wheat vegetation was as follows: 2014/2015 - 655.8 mm/m^2, 2015/2016 - 388.5 mm/m^2, and 2016/2017 - 278.3 mm/m^2 compared to 419.0 mm/m^2 for a thirty year period time (Figures 1, 2).

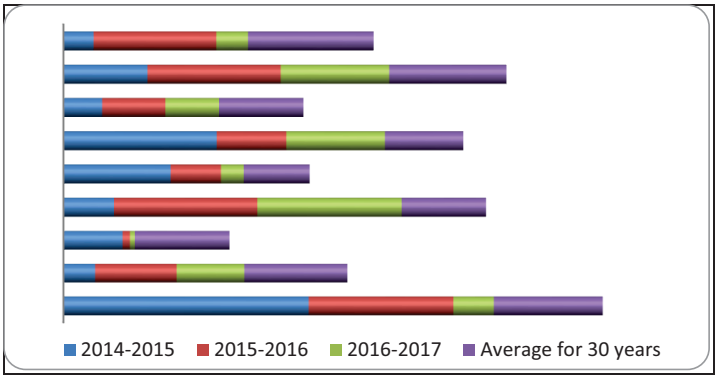
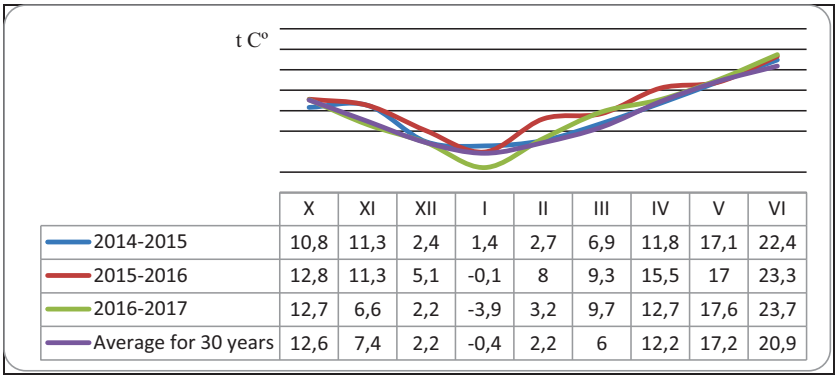


Figure 1. Precipitation by months (sum mm/m^2)



	X	XI	XII	I	II	III	IV	V	VI
2014-2015	10,8	11,3	2,4	1,4	2,7	6,9	11,8	17,1	22,4
2015-2016	12,8	11,3	5,1	-0,1	8	9,3	15,5	17	23,3
2016-2017	12,7	6,6	2,2	-3,9	3,2	9,7	12,7	17,6	23,7
Average for 30 years	12,6	7,4	2,2	-0,4	2,2	6	12,2	17,2	20,9

Figure 2. Monthly temperatures (average)

In the years of the experiment, favourable for the growth and development of durum wheat with a good distribution of rainfall is the harvest year 2017, then higher grain yields were obtained for all tested variants. Despite the large amount of precipitation during vegetation unfavourable for the plant growth is the first year, i.e. 2014/2015 due to a drought in the spring, when in the phases of the end of tillering - the beginning of shooting up, the stages of organogenesis happen, during which the length of the spike, the number of spikelets and blossoms are determined.

Grain yield is the indicator that reflects the effects of growth regulators and other factors studied (Table 1).

From the data presented in the table it is evident that both varieties react differently depending both on the studied growth regulators and on the weather conditions of the year.

In durum wheat of Deyana, the highest increase in grain yield was observed under the effect of the growth regulator Seron 480 SL (1000 ml/ha). In the experimental years, the increase was from 360.0 kg/ha to 530 kg/ha or an average of 450 kg/ha (11.5%) over the three-year study period, compared to the untreated control. In the case of durum wheat variety Zvezditsa with the same growth regulator, the increase in productivity is also high, but compared to the Deyana variety, the values obtained are lower in the range from 350 kg/ha to 380 kg/ha or on average 350 kg/ha (9.8%).

In the second place in both tested varieties is the variant treated with Medax Top (600 ml/ha), where the average increase of grain yield is respectively: for Deyana 280 kg/ha (8.7%) and for Zvezditsa variety 260 kg/ha more than untreated control. The use of the growth regulator Trimax 175 EK results in an increase in productivity for Deyana with 280 kg/ha and 250 kg/ha for the Zvezditsa variety.

The growth regulator Floridimex T Extra (750 ml/ha) affected to the least degree the grain yield increase for both tested varieties, as in both experimental varieties of durum wheat 100 kg/ha of grain more were harvested versus the untreated control.

The productivity of the studied durum wheat varieties results from the effect of the tested growth regulators on some of the structural elements of the yield (Table 2). Plant height decrease was observed in all studied controls compared to untreated control. In the variant treated with the growth regulator Seron 480 SL (1000 ml/ha), the plant height measured for the three-year period of Deyana variety is 4 cm, and of the Zvezditsa variety is 5 cm smaller than that of the control.

Table 1. Grain yield t/ha

Variety	Growth regulators	2015	2016	2017	Average	
		t/ha	t/ha	t/ha	t/ha	%
Deyana	Control untreated	3.70	3.94	4.06	3.90	100,0
	Seron 480 SL	4.17	4.30	4.59	4.35	111,5
	Medaks Top	4.05	4.23	4.45	4.24	108,7
	Flordimeks T Extra	3.86	3.97	4.18	4.00	102,6
	Trimax 175 EK	4.04	4.15	4.35	4.18	107.2
Zvezditsa	Control untreated	3.29	3.57	3.83	3.56	100,0
	Seron 480 SL	3.65	3.92	4.21	3.91	109.8
	Medaks Top	3.51	3.80	4.14	3.82	107,3
	Flordimeks T Extra	3.34	3.68	3.95	3.66	102,8
	Trimax 175 EK	3.45	3.78	4.20	3.81	107,0
		A B AxB	A B AxB		A B AxB	
GD 5%		20.2 21.8 24.5	16.3 17.5 19.7		10.1 15.3 18.4	

In the spike length indicator, more significant changes were observed when the plants were sprayed with Seron 480 SL (1000 ml/ha), where the decrease in the length of the spike of Deyana variety was by 0.8 cm and for the Zvezditsa variety by 0.5 cm.

The tested growth regulators have helped to increase the grain mass in one spike of Deyana variety, and in the Zvezditsa variety - to increase the number of grains in one spike.

In Deyana variety of durum wheat yield is higher because of the higher grain mass in one

spike, by 0.38 g more than the untreated control in the Seron 480 SL (1000 ml/ha) variant, whereas in the Zvezditsa variety there is an increase in the number of grains in one spike with 3.9 pcs. in plants treated with the same growth regulator.

This trend is preserved in the other studied growth regulators. Lower values for the number of grains in a spike, i.e. 34.4 pcs. for Deyana variety, and grain mass of 1.07 g in a spike for Zvezditsa variety were obtained by treatment with Floridimex T Extra (750 ml/ha), but the results obtained were higher than the untreated control, respectively, by 0.9 and 0.03 g.

Table 2 Biometrical data (2015-2017)

Variety	Growth regulators	Height of plants, cm	Length of the spike, cm	Number of the grains per spike	Mass of the grains per spike, g
Deyana	Control untreated	90	7.6	33.5	1.23
	Seron 480 SL	86	6.8	39.7	1.61
	Medaks Top	89	7.2	37.5	1.53
	Flordimeks T Extra	87	7.0	34.4	1.31
	Trimax 175 EK	88	7.1	36.1	1.40
Zvezditsa	Control untreated	94	7.4	38.2	1.04
	Seron 480 SL	89	6.9	42.1	1.26
	Medaks Top	92	7.2	40.5	1.21
	Flordimeks T Extra	93	7.0	39.4	1.07
	Trimax 175 EK	90	7.1	39.8	1.18

CONCLUSIONS

The tested growth regulators have influenced to varying degrees the increase in productivity in the investigated durum wheat varieties.

The treatment of Deyana durum wheat with the growth regulator Seron 480 SL (1000 ml/ha) resulted in an increase in the yield by 450 kg/ha (11.5%) on average over the three-year study period compared to the control.

Higher grain yields of durum wheat variety Zvezditsa treated with the same growth regulator is 350 kg/ha (9.8%).

In the second place, in both tested varieties is the variant treated with Medax Top (600 ml/ha), where the average increase of grain yield is respectively: for Deyana - 280 kg/ha (8.7%), and for Zvezditsa variety 260 kg/ha more than untreated control. When spraying durum wheat with Trimax 175 EK, the yield increase for Deyana is 280 kg/ha, and 250 kg/ha for Zvezditsa variety.

The studied growth regulators have helped to increase the grain mass in one spike in the Deyana variety, while in the Zvezdica variety to increase the number of grains in one spike.

The studied growth regulators improve the physical properties of the grain, mass per 1000 grains, hectolitre mass, and glassiness. For durum wheat varieties, Deyana and Zvezditsa, the highest increase in the values of the physical properties of the grain was observed in the treatment with Seron 480 SL and Medaks Top.

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