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Influence of some stimulators on the grain yield and sowing-seed properties of two durum wheat cultivars

G. Delchev^{1*}, D. Nenkova², D. Stoychev¹

¹Cotton and Durum Wheat Research Institute, 6200, Chirpan Bulgaria

²Cryobiology and Food Technologies Institute, 65 Cherni vrah, 1407 Sofia, Bulgaria

Abstract. A two-factor experiment was carried out on pellic vertisol soil type in 2007-2009 on the experimental field of the Cotton and Durum Wheat Research Institute, Chirpan, Bulgaria. Factor A included 2 Bulgarian durum wheat cultivars - Vuzhod and Saturn, which belong to var. valenciae. Factor B included 6 rates – non-treated control and 3 stimulators: Tritimil - 300 ml/ha, Napsil - 300 and 500 ml/ha, Cemofol - 500 and 700 ml/ha. All stimulators were treated in the tillering stage of the durum wheat. Stimulators Tritimil, Napsil and Cemofol decreased less the 1st and 2nd overgrown internode length of cultivar Saturn compared with cultivar Vuzhod. Napsil and Cemofol increased grain yield by 9.0 % and 10.9 % in cultivar Vuzhod and by 10.3 % in cultivar Saturn. Both stimulators have equal or increased effectiveness compared with the standard Tritimil. The studied stimulators increased the vitreousness, protein content, wet and dry gluten contents. Stimulators Tritimil, Napsil and Cemofol increased germination energy and seed germination and decreased the waste grain quantity.

Keywords: durum wheat, stimulators, cultivars, grain yield, grain quality, sowing-seed properties

Introduction

Growth regulators properly selected and used of appropriate level of mineral fertilization, increase grain yield and grain quality in cases where traditional methods and tools are little effective or nearly exhausted their opportunities (Taniguchi et al., 1999; Vildflush and Gurban, 1999; Delchev, 2003). In literature, there is evidence that common and durum wheat respond differently to treatment with the same preparations (Rapparini et al., 1984; Pomati, 1987; Pestryakov et al., 1991). According to some authors (Jürgens and Knittel, 1985; Rapparini et al., 1987) in their reaction to some retardants durum wheat is closer to barley than to common wheat.

Based on these data, we set ourselves the aim to determine the influence of some stimulators on grain yield, grain quality and sowing-seeds properties of two durum wheat cultivars.

Material and methods

The investigation was conducted in the period 2007-2009 in the experimental field of the Cotton and Durum Wheat Research Institute - Chirpan on pellic vertisol soil type. A two-factor field experiment was carried out embedded in the block method in 4 replications with the 15 m² crop plot size. Factor A included 2 Bulgarian durum wheat cultivars - Vuzhod and Saturn, which belong to var. valenciae. Factor B included 6 rates – non-treated control and 3 stimulators: Tritimil (derived phytalamine acids, chlorofenoxyc acids, quaternary ammonium salts) at a dose of 300 ml/ha, Napsil (derived chlorofenoxycetic acid, naftilacetic acid, phtalamine acid, chlorochlorine chloride, folic acid, trace elements) in doses of 300 and 500 ml/ha, Cemofol (derived methylphtalamine acid, chlorochlorine chloride, folic acid, salicylic acid, trace elements, surface active substance) in doses of 500 and 700 ml/ha.

All stimulators were treated in tillering stage of the durum wheat with consumption of working solution 20h l/ha. Mixing was done in a

sprinkler tank. Early spring feeding was carried out with 120 kg N/ha, in the form of ammonium nitrate. All other cultivation practices are carried out according to accepted technology for cultivation of durum wheat.

The effect of foliar fertilizers on the grain yield of durum wheat has been studied. The changes occurring in the physical properties of the grain - 1000 grains weight, test weight, vitreousness - and biochemical properties of the grain - protein content, wet and dry gluten contents have been investigated. Received from each variant grain was cleaned through a sieve with mesh width of 2.2 mm and was the quantity of waste grain (screenings). Received by each variant seeds were determined a germination energy and laboratory germination. The intensity of initial growth of seeds was studied expressed by the length of primary roots and coleoptile. They determine on the eighth day after setting the samples. Mathematical data processing is done by the method of analysis of variance.

Results and discussion

Lodging of the crops of durum wheat may become a problem in its cultivation at higher farming practices. It is due to the discrepancy between the weight of the overgrown part of the plant and the size of the 1st and 2nd overgrown internodes that can withstand greater loads. Therefore, in assessing the effectiveness of stimulators, it is important to establish what its impact on those internodes is. Results obtained showed that the tested stimulators Tritimil, Napsil and Cemofol have small affect on the diameter of the 1st and 2nd overgrown internodes in both durum wheat cultivars (Table 1). Three stimulators give little influence on the length of these two internodes in cultivar Saturn. But Saturn is a very low cultivar and the lodging risk is minimum. In the variety Vuzhod reduction of internode length is significantly greater. The greatest reduction in the length is obtained at the 2nd internode of cultivar Vuzhod. This is an important feature of the three stimulators because Vuzhod is higher and the

* e-mail: delchevgrd@dir.bg

Table 1. Sizes of 1st and 2nd overgrown internodes. Grain yield (mean 2007-2009)

Variants		1 st internode		2 nd internode		Grain yield	
Cultivars	Stimulators	Diameter, mm	Length, cm	Diameter, mm	Length, cm	kg/ha	%
Vuzhod	Control – non-treated	3.10	4.95	3.50	10.67	3711	100
	Tritimil - 300 ml/ha	3.14	3.21	3.57	10.20	3983	107.3
	Napsil -300 ml/ha	3.23	3.46	4.00	9.98	3928	105.8
	Napsil - 500 ml/ha	3.43	3.23	3.92	8.63	4044	109.0
	Cemofol - 500 ml/ha	3.42	3.45	4.08	9.41	3922	105.7
	Cemofol - 700 ml/ha	3.46	3.31	3.95	8.27	4117	110.9
Saturn	Control – non-treated	3.40	4.70	3.71	3.96	3900	100
	Tritimil - 300 ml/ha	3.62	4.20	3.78	3.68	4261	109.3
	Napsil -300 ml/ha	3.59	4.51	3.88	3.91	4200	107.7
	Napsil - 500 ml/ha	3.65	4.32	3.91	3.88	4300	110.3
	Cemofol - 500 ml/ha	3.62	4.55	3.72	3.72	4178	107.1
	Cemofol - 700 ml/ha	3.67	4.44	3.79	3.75	4300	110.3
LSD 5 %						285	7.7
LSD 1 %						378	10.2
LSD 0.1 %						491	13.2

risk of lodging it is greater.

Average for the period of study stimulator Napsil leads to mathematically proven to increase grain yield of 333 kg/ha - 9.0 % in cultivar Vuzhod and of 400 kg/ha - 10.3 % in cultivar Saturn. Stimulator Cemofol increased grain yield by 406 kg/ha - 10.9 % in Vuzhod and by 400 kg/ha - 10.3 % in Saturn. Throughout the investigated period both stimulators have equal or increased effectiveness compared with the standard Tritimil. In two durum wheat cultivars Vuzhod and Saturn observed slight, but unproved

trend of increase in mass of 1000 grains has been observed with the use of the test stimulators (Table 2). However, with all options the value of this indicator is above the requirements of standards.

Test weight characterizes grain consistence and it is one of the most important technological parameters. It does not change under the influence of Tritimil, Napsil Cemofol in both cultivars, although some increase is reported in relation to non-treated control and there is some variation during different years. Test weight retained its high values typical of durum wheat - in all variants it is over 80 kg in

Table 2. Physical and biochemical properties of the grain (mean 2007-2009)

Variants		1000 grain weight, g	Test weight, kg	Vitreous-ness, %	Protein, %	Gluten	
Cultivars	Stimulators					Wet, %	Dry, %
Vuzhod	Control – non-treated	45.6	80.3	85.2	12.48	21.5	8.0
	Tritimil - 300 ml/ha	46.8	80.7	88.4	13.11	23.5	8.9
	Napsil -300 ml/ha	46.6	80.0	88.4	12.95	23.0	8.7
	Napsil - 500 ml/ha	46.8	80.5	88.8	13.44	24.2	9.2
	Cemofol - 500 ml/ha	46.2	80.1	88.8	12.92	23.2	8.8
	Cemofol - 700 ml/ha	46.4	80.8	89.0	13.54	24.3	9.4
Saturn	Control – non-treated	40.8	82.7	77.4	11.14	16.5	6.1
	Tritimil - 300 ml/ha	42.2	83.4	80.3	12.17	19.7	7.5
	Napsil -300 ml/ha	42.2	82.8	80.2	12.03	19.5	7.2
	Napsil - 500 ml/ha	42.2	82.7	81.2	12.11	20.2	7.9
	Cemofol - 500 ml/ha	42.6	82.6	80.3	11.80	19.1	7.1
	Cemofol - 700 ml/ha	42.8	82.8	81.0	11.96	19.3	7.2
LSD 5 %		4.8	6.3	3.0	0.41	1.7	0.8
LSD 1 %		6.4	8.5	5.1	0.57	2.8	1.7
LSD 0.1 %		8.2	10.7	7.2	0.84	4.9	2.2

cultivar Vuzhod and over 82 kg in cultivar Saturn. Vitreousness of the grain is increase proved in the treatment with the three stimulators, although some variation is obtained over the years. In all cases it is with values above the requirements of international standards for over 75 % vitreousness. Under all variants vitreousness is high - more than 85 % in cultivar Vuzhod and more than 77 % in cultivar Saturn.

The protein content was determined by cultivar, but very much depending on weather conditions and farming practices. Treatment with the three stimulators increases the protein content, most pronounced by the use of Napsil in dose of 500 ml/ha. Wet and dry gluten contents are very important elements of the qualitative characteristics of the grain. The data show that all stimulators increase the gluten content. The increase was the greatest for treatment with Napsil at a dose of 500 ml/ha.

One of the important conditions for obtaining normal crop and

good harvest is the use of quality seeds. Seeds must have the necessary sowing properties, the main of which are high germination energy and seed germination. Germination energy is one of the most important characteristics of the sowing properties of the seed. The high germination energy is the reason for faster development of primary roots and coleoptile after seed germination and is associated with earlier germination in field conditions, bigger tempering of plants and a lower risk of frost in the winter. Germination is the most important index characterizing the sowing properties of the seed. At high laboratory germination sowing should be done with lower sowing rate, which decreases the production cost. It was found that stimulators Tritimil, Napsil and Cemofol increased germination energy and seed germination in both durum wheat cultivars - Vuzhod and Saturn (Table 3). This led to higher grain yields. The obtained results for germination energy and seed germination are a prerequisite to continue to investigate the effect of

Table 3. Sowing properties of the seeds (mean 2007-2009)

Variants		Germinative energy, %	Germination %	Length, cm		Waste grain, %
Cultivars	Stimulators			Coleoptile	Root	
Vuzhod	Control – non-treated	92.0	93.5	10.6	12.9	14.3
	Tritimil - 300 ml/ha	95.0	96.5	11.2	15.4	11.4
	Napsil -300 ml/ha	93.5	96.0	11.1	14.4	11.1
	Napsil - 500 ml/ha	96.0	98.0	11.2	15.1	10.4
	Cemofol - 500 ml/ha	94.0	95.5	11.2	16.0	10.1
	Cemofol - 700 ml/ha	95.0	96.5	11.7	16.1	9.4
Saturn	Control – non-treated	89.5	91.5	10.2	12.2	14.4
	Tritimil - 300 ml/ha	94.0	96.0	12.4	13.8	11.3
	Napsil -300 ml/ha	93.0	95.5	11.1	15.1	13.8
	Napsil - 500 ml/ha	93.5	97.5	11.7	15.6	13.7
	Cemofol - 500 ml/ha	94.5	97.0	10.2	14.3	14.0
	Cemofol - 700 ml/ha	96.5	98.0	10.6	15.7	13.8
LSD 5 %		1.4	1.8	0.43	1.38	2.0
LSD 1 %		2.9	3.3	0.61	1.54	3.6
LSD 0.1 %		4.3	4.6	0.78	1.78	5.2

stimulators on the initial intensity of the growth of seeds, expressed by the length of roots and coleoptiles. It was found that the influence of the three stimulators on the length of the primary root is stronger than their effect on the length of the coleoptile. Their positive effect on early growth of seeds leads to better rooting of young plants, less damage by frost and prevents plant withdrawal during winter months.

At the evaluation of the sowing characteristics we have to consider not only the characteristics of the sowing seeds but also the quantity of the waste grain (siftings) which are gained at the preparation of these seeds. The treatment with stimulators Tritimil, Napsil and Cemofol of cultivars Vuzhod and Saturn in tillering stage of durum wheat decreases the amount of screenings received. Less amount of screenings leads to lower cost of the seed and increases the economic effect of seed production of durum wheat. Increases in the values of germination energy and laboratory seed germination,

increase the intensity of the initial growth, expressed by the length of the root and coleoptile at germination and the decrease in the quantity of waste grain under the influence of the herbicides are explained by the positive effects on growth and development of durum wheat during its vegetation period.

Conclusion

Stimulators Tritimil, Napsil and Cemofol decreased less the 1st and 2nd overgrown internode length of cultivar Saturn compared to cultivar Vuzhod. Napsil and Cemofol increased grain yield by 9.0 % and 10.9 % in cultivar Vuzhod and by 10.3 % in cultivar Saturn. Both stimulators have equal or increased effectiveness compared to the standard Tritimil. Investigated stimulators increased the

vitreousness, protein content, wet and dry gluten contents. Stimulators Tritimil, Napsil and Cemofol increased germination energy and seed germination and decreased the quantity of waste grain.

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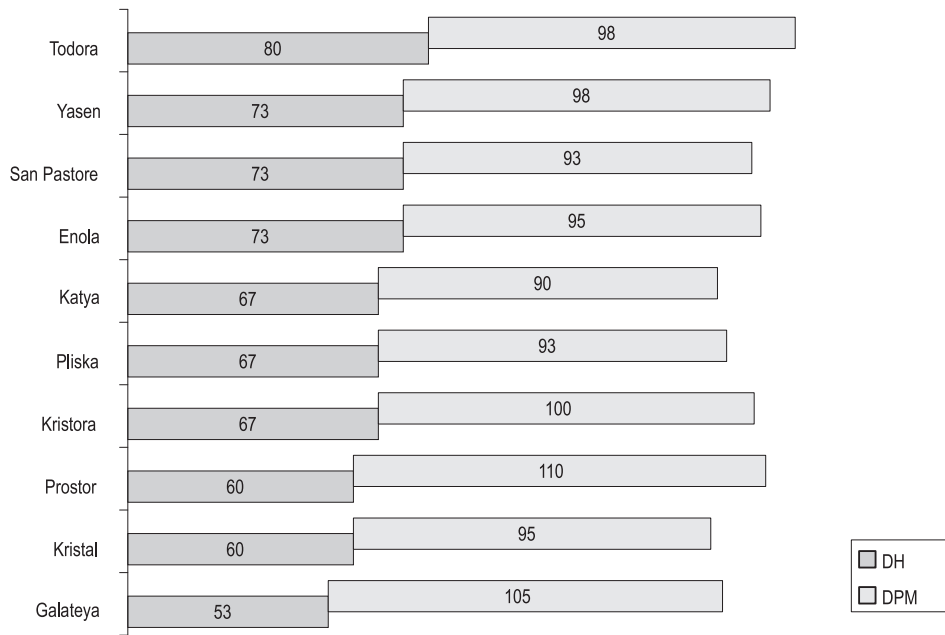
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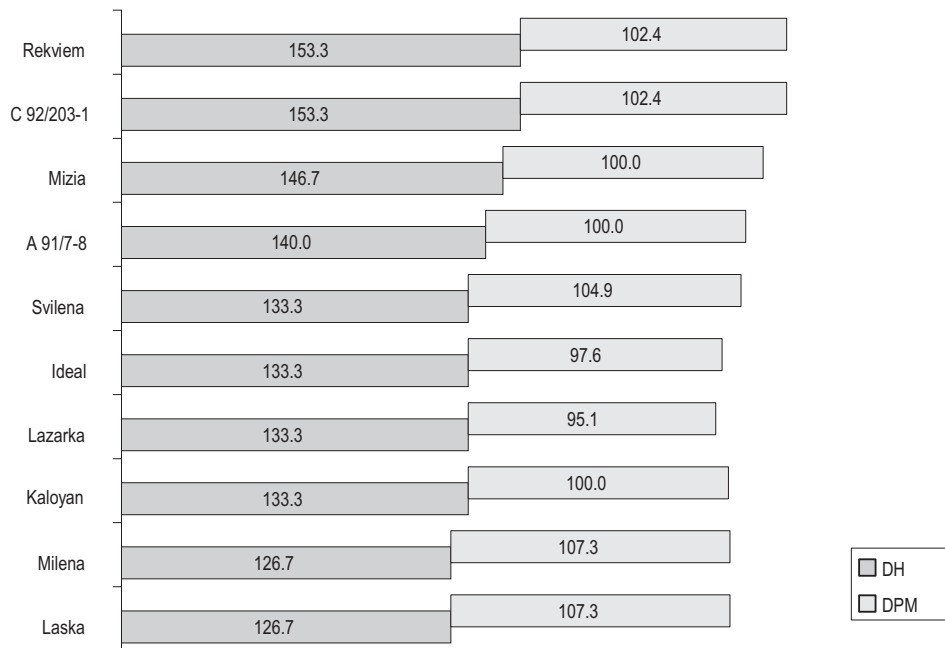


Figure 4. Duration of the period to heading and maturity in the group of late varieties expressed as relative value from the standard

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CONTENTS

Genetics and Breeding

- Synchronization of estrous in gilts with Altrenogest** 3
S. Dimitrov, G. Bonev, Hr. Taseva

- Phenotypic stability of new cotton varieties with improved fiber quality** 6
A. Stoilova

- Effect of age upon the reproductive performance of Japanese quails** 9
A. Genchev

Nutrition and Physiology

- Ethological evaluation of a building for free housing of dairy cows.** 14
II. Behavioural activities in the winter
I. Varlyakov, T. Slavov, N. Grigorova

- Effect of the addition of VemoZim F (phytase) to diets with decreased content of phosphorus on the microstructure of tibia in broiler chickens** 22
V. Georgieva, D. Yovchev, A. Atanasov

Production Systems

- Quantitative changes in major components of lavender oil during the distillation process** 26
G. Zhekova, N. Nedkov

- Influence of some stimulators on the grain yield and sowing-seed properties of two durum wheat cultivars** 29
G. Delchev, D. Nenkova, D. Stoychev

Agriculture and Environment

- Anthropogenically disturbed soils and methods for thier reclamation** 33
M. Banov, V. Tsoleva, P. Ivanov, M. Hristova

- Using microwave mineralization in order to determine heavy metal concentration in samples of herbs used for pharmaceutical purposes** 40
L. Dospatljev

- Tolerance of lucerne varieties to Apion seniculus Kirby (Coleoptera: Curculionidae)** 44
I. Nikolova, N. Georgieva

Quality and Safety

- Probiotic characteristics of lactic acid bacteria isolated from feces of breast-fed infant** 48
S. Boycheva

- Heat-induced changes in organic compounds characteristics and properties of sandy soils** 52
I. Atanassova, S. Doerr