Impact of Some Mixtures between Foliar Fertilizers and Combined Herbicides on the Sowing Properties of the Durum Wheat Sowing-Seeds

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Geliş Tarihi (Received): 01.03.2017 Kabul Tarihi (Accepted): 15.04.2017

The research was conducted during 2010 - 2012 on pellic vertisol soil type. Under investigation was Bulgarian durum wheat cultivar Predel, which belongs to var. valenciae. Factor A included no treated check and 3 foliar fertilizers - Lactofol O - 8 l/ha, Terra-sorb - 3 l/ha, Humustim - 1 l/ha. Factor B included weeded, no treated check and 3 combined herbicides – Axial one (pinoxaden + florasulam) - 1 l/ha, Hussar max OD (mesosulfuron + iodosulfuron) – 1 l/ha, Palace 75 WG (pyroxulam) - 250 g/ha. Because of the low adhesion of the herbicide Palace it was used in addition with adjuvant Dassoil - 500 ml/ha. All of foliar fertilizers, herbicides and their tank-mixtures were treated in tillering stage of the durum wheat and are applied in a working solution of 200 l/ha. Mixing was done in the tank on the sprayer.
Tank mixtures of combined herbicide Axial one with complex foliar fertilizers Lactofol and Terra-sorb decreases germination energy of the durum wheat seeds. Tank mixture Lactofol + Hussar max decreases lab seed germination. Investigated foliar fertilizers, combined herbicides and their tank mixtures increase lengths of primary roots and coleoptile and decrease waste grain quantity. Combination between herbicide Hussar max and foliar fertilizer Lactofol not influences on lengths of primary roots and coleoptile. There is antagonism of combined use by herbicide Hussar max with foliar fertilizers Lactofol and Humustim and by herbicide Palace with foliar fertilizer Lactofol. There is synergism by tank mixtures of herbicide Axial one with the three foliar fertilizers, by tank mixtures of herbicide Palace with foliar fertilizers Lactofol and Humustim, by tank mixtures of herbicide Hussar max with foliar fertilizer Terra-sorb. The highest grain yield is obtained by tank mixture Terra-sorb + Axial one.

Keywords: Durum wheat, foliar fertilizers, herbicides, grain yield, germinative energy, seed germination, roots and coleoptiles length, waste grain

Introduction

Receiving more high-quality production of durum wheat with lower cost and resource consumption, free from residues of fertilizers and pesticides requires continuous improvement of the various units of the technology of growing and connecting them in science-based system (Lalev et al., 2000). During the last years has considerably increased the the number of registered biologically active substances that are used to regulate the growth and development of plants (Rapparini et al. 1987; Radišič et al., 1997; Sharma and Kumar, 1998), the quantity and quality of the obtained production (Wu et al., 1993; Vildflush and Gurban, 1999; Taniguchi et al., 1999). They are used more and in durum wheat to increase the yield and grain quality (Yanev et al., 2008). There are still less researches concerning the effects of mixtures of preparations on seeds.

One of the important conditions for obtaining normal sown fields and a good harvest is the use of quality seeds. Furthermore, highly productive cultivar that has several conditions such as resistance to lodging, diseases and pests, the seeds must have the necessary sowing properties, the main of which are highly germinative energy and seed germination (Panayotov and Stoeva, 2000). Depending on soil and climatic conditions, lodging and seed attack from diseases and pests has been observed to obtain seeds with different germination (Bhaskara et al., 1998). In its determination should be recorded and the time when seeds in a rest after harvest. It varies depending on cultivar and condition in which the seeds were during the harvest.

These studies do not provide enough light to questions about the impact of mixtures between different pesticides on durum wheat.

Considering these achievements, we set the aim of this investigation to establish the influence of some foliar fertilizers, combined herbicides and their tank mixtures on sowing properties of the durum wheat seeds and the quantity of waste grain.

Materials and Methods

The research was conducted during 2010 - 2012 on pellic vertisol soil type. Two-factor field experiment was carried out with durum wheat cultivar Predel (*Triticum durum var. valenciae*). The experiment was conducted under the block method, in 4 repetitions; the size of the crop plot was 15 m^2.

Factor A included no treated check and 3 foliar fertilizers - Lactofol O - 8 l/ha, Terra-sorb - 3 l/ha, Humustim - 1 l/ha. Factor B included weeded, no treated check and 3 combined herbicides – Axial one (pinoxaden + florasulam) - 1 l/ha, Hussar max OD (mesosulfuron + iodosulfuron) – 1 l/ha, Palace 75 WG (pyroxulam) - 250 g/ha.
Because of the low adhesion of the herbicide Palace it was used in addition with adjuvant Dassoil - 500 ml/ha. All of foliar fertilizers, herbicides and their tank-mixtures were treated in tillering stage of the durum wheat and are applied in a working solution of 200 l/ha. Mixing was done in the tank on the sprayer.

Complex fertilizers Lactofol O and Terra-sorb contain nitrogen in amide, ammonium and nitrate forms, easily absorbable phosphorus and potassium, trace elements, amino acids, physiologically active substances, and organic fertilizer Humustim - potassium salts of humic acids and fulvia acids. Both complex foliar fertilizers differ mainly in the nature of the complexing agent – in Lactofol O it is lactic acid, and in Terra-sorb it is ethylene-diamine-tetra-acetic acid (EDTA).

The grain gained after every variant was cleaned through a sieve with holes size 2.2 mm and the quantity of the waste grain was defined (siftings). All version seeds for sowing were defined for their germination energy and lab seed germination. It was studied intensity of early growth of seeds, expressed by the length of primary roots and coleoptile definite on the eighth day after setting the samples. Each index was determined in two repetitions of the year. Averages in each of the years of experience were used as repetitions in mathematical data processing were done according to the method of analysis of variance.

Results and Discussion

One of the important conditions for obtaining a normal crop and a good harvest is the use of quality seeds. Apart from the high-yield cultivar which is resistance to diseases and pests, it 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 low germination energy is the reason for slower development of primary roots and coleoptile after seed germination and is associated with later germination in field conditions, less tempering of plants and a higher risk of frost in the winter. Its lead to lower grain yields. The obtained results show that the treatment of the durum wheat with tank mixtures of combined herbicide Axial one with complex foliar fertilizers Lactofol O and Terra-sorb during tillering stage of durum wheat lead to decrease in the germination energy (Table 1). Analysis of variance, in which the years have taken for replications, shows that these decreases are mathematically proven. Combinations of herbicide Axial one with organic foliar fertilizer Humustim do not lead to decrease in the germination energy.

Germination is the most important index who characterizing the sowing properties of the seed. At low laboratory germination sowing should be done with higher sowing rate, which increases the cost production. Laboratory germination of the seeds at all variant during the three years of study above the requirements of the standard for over 85% germination, although in different years account for some variation of its values. This is the positive effect of their use, because it is not necessary to increase the sowing rate (in kg/ha) and the cost of necessary seeds. Tank mixture Lactofol O + Hussar max decreases seed germination. Tank mixture Terra-sorb + Hussar max do not decrease proven seed germination. The durum wheat seeds germinate normally by influence of this tank mixture, although the initial rate of development is lower due to lower germination energy. Foliar fertilizers, combined herbicides and another tank mixtures increase proven the indexes germination energy and seed germination. This means that they help for joint and fast germination of the durum wheat sowing-seeds.

The obtained results for germination energy and seed germination are a prerequisite continue to investigate the effect of stimulators, herbicides and their tank mixtures on initial intensity of the growth of seeds, expressed by the length of roots and coleoptiles. It was found that the length of coleoptiles and length of primary roots of durum wheat have tendency of decrease by combinations between herbicide Hussar max with foliar fertilizer Lactofol O. This tank mixture difficult young plants developments, reduces their resistance to cold and increase risk of frost damages during winter months. Other tank mixtures between investigated foliar fertilizers and combined herbicides stimulate the growth of the length of primary roots and coleoptiles of the durum wheat and recommended for use in seed production crops of durum wheat.

Table 1. Sowing properties of the seeds (mean 2010-2012)

Variants		Germinative energy (%)	Germination (%)	Length (cm)		Waste grain (%)
Foliar fertilizers	Herbicides			Coleoptile	Root	
-	-	73	85	8.02	13.65	14.0
	Axial one	89	90	8.73	14.09	13.2
	Hussar max	82	94	8.47	14.31	13.4
	Palace	82	94	8.63	14.49	13.9
Lactofol O	-	86	96	9.83	15.04	13.8
	Axial one	80	95	9.00	14.47	10.6
	Hussar max	78	79	8.07	13.72	10.9
	Palace	84	85	9.97	14.19	10.7
Terra-sorb	-	88	96	8.50	14.72	11.3
	Axial one	87	97	8.45	14.89	10.4
	Hussar max	78	90	9.68	15.00	10.8
	Palace	83	97	8.62	15.02	10.1
Humustim	-	82	94	9.14	14.61	13.8
	Axial one	83	98	9.12	14.70	10.2
	Hussar max	84	96	8.61	14.03	10.9
	Palace	87	97	8.15	15.30	10.9
	LSD 5%	4.6	4.0	2.6	3.4	3.0
	LSD 1%	6.1	5.5	4.5	5.8	5.8
	LSD 0.1%	7.9	7.4	6.9	7.7	7.8

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. Bigger quantity screenings lead to higher cost of the seed and reduce the economic effect of seed production of durum wheat. All tank mixtures of combined herbicides Axial one, Hussar max and Palace with foliar fertilizers Lactofol O, Terra-sorb and Humustim lead to decreasing in the quantity of waste grain. Differences between them and untreated control are mathematically proven.

Decreases in the values of germination energy and laboratory seed germination, changes in the intensity of the initial growth, expressed by the length of the root and coleoptile at germination and changes in the quantity of waste grain under the influence of the combination between foliar fertilizers and combined herbicides are explained by the depressing effects on growth and development of the durum wheat during its vegetative period.

To make a full evaluation of the sowing properties needed to establish not only the quality of seeds, but also the quantity of grain which will be received this seeds. Data for the influence of foliar fertilizers, combined herbicides and their tank mixtures on grain yield (Table 2) show that the lower yield is obtained in untreated control. The alone application of herbicides Axial one, Hussar max and Palace increases grain yield because the weeds are destroyed. The differences are small, due to superior efficacy of the three combined herbicides against grassy and broadleaved weeds. Differences in mean grain yields are from 10 kg/ha to 33 kg/ha.

The alone application of complex foliar fertilizers Lactofol and Terra-sorb and organic foliar fertilizer Humustim also increases grain yields because they stimulate the growth and development of durum wheat. The increases are 3.4 – 3.9 %. The increase by alone application of foliar fertilizers is less than the increase by combined herbicides because present weeds neutralize a part of positive effect.

It is established manifestations of antagonism by combined application of herbicide Hussar max with foliar fertilizers Lactofol and Humustim and by combined application of herbicide Palace with

foliar fertilizer Lactofol. This antagonism leads to a decrease in grain yield in tank mixtures when they compared with alone application of the combined herbicides and fertilizers. Probable cause of antagonism between herbicides Hussar max and Palace by one hand and complex fertilizer Lactofol by other hand is the lactic acid, which is a complexing in this foliar fertilizer. There is not antagonism by tank mixtures of Hussar max and Palace with complex fertilizer Terra-sorb with complexing EDTA. Both complex foliar fertilizers differ mainly in the nature of the complexing agent - in Lactofol it is lactic acid, and in Terra-sorb it is ethylene-diamine-tetra-acetic acid (EDTA).

Table 2. Grain yield (2010-2012)

Variants		2010		2011		2012		Mean	
Foliar fertilizers	Herbicides	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
-	-	4444	100	3943	100	5004	100	4464	100
	Axial one	4603	103.6	4190	106.3	5262	105.2	4685	105.0
	Hussar max	4597	103.4	4180	106.0	5207	104.1	4662	104.4
	Palace	4600	103.5	4133	104.8	5223	104.4	4652	104.2
Lactofol O	-	4587	103.2	4033	102.3	5223	104.4	4614	103.4
	Axial one	4707	105.9	4343	110.1	5405	108.0	4818	107.9
	Hussar max	4377	98.5	4093	103.8	5317	106.3	4596	102.9
	Palace	4730	106.4	3487	88.3	5571	111.3	4600	103.0
Terra-sorb	-	4603	103.6	4007	101.6	5249	104.9	4620	103.5
	Axial one	4770	107.3	4460	113.1	5590	111.7	4934	110.5
	Hussar max	4623	104.0	4363	110.7	5327	106.5	4771	106.9
	Palace	4723	106.3	4444	112.7	5498	109.9	4888	109.5
Humustim	-	4593	103.4	4093	103.8	5222	104.3	4636	103.9
	Axial one	4716	106.1	4373	110.9	5502	110.0	4864	109.0
	Hussar max	4353	98.0	4003	101.5	5299	105.9	4552	101.2
	Palace	4707	105.9	4430	112.4	5557	111.1	4898	109.7
	LSD 5%	110	2.5	170	4.3	164	3.3		
	LSD 1%	148	3.3	229	5.8	221	4.4		
	LSD 0.1%	197	4.4	303	7.7	293	5.9		

There is synergism in 2011 and 2012 by combined application of herbicide Axial one with the three foliar fertilizers, by combined application of herbicide Palace with foliar fertilizers Terra-sorb and Humustim and by combined application of herbicide Hussar max with foliar fertilizer Terra-sorb. Grain yield and herbicidal efficacy by these tank mixtures are higher in comparison with the alone application of the foliar fertilizers and combined herbicides. There is additive effect in 2010 by these tank mixtures. Grain yield is approximately equal to the aggregate effect of individual preparations. The reason for these differences is large differences in the weather during the three years of the investigation.

Conclusions

Tank mixtures of combined herbicide Axial one with complex foliar fertilizers Lactofol and Terra-sorb decreases germination energy of the durum wheat seeds.

Tank mixture Lactofol + Hussar max decreases lab seed germination.

Investigated foliar fertilizers, combined herbicides and their tank mixtures increase lengths of primary roots and coleoptile and decrease waste grain quantity. Combination between herbicide Hussar max and foliar fertilizer Lactofol not influences on lengths of primary roots and coleoptile.

There is antagonism of combined use by herbicide Hussar max with foliar fertilizers Lactofol and Humustim and by herbicide Palace with foliar fertilizer Lactofol.

There is synergism by tank mixtures of herbicide Axial one with the three foliar fertilizers, by tank mixtures of herbicide Palace with foliar fertilizers Lactofol and Humustim, by tank mixtures of herbicide Hussar max with foliar fertilizer Terra-sorb. The highest grain yield is obtained by tank mixture Terra-sorb + Axial one.

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