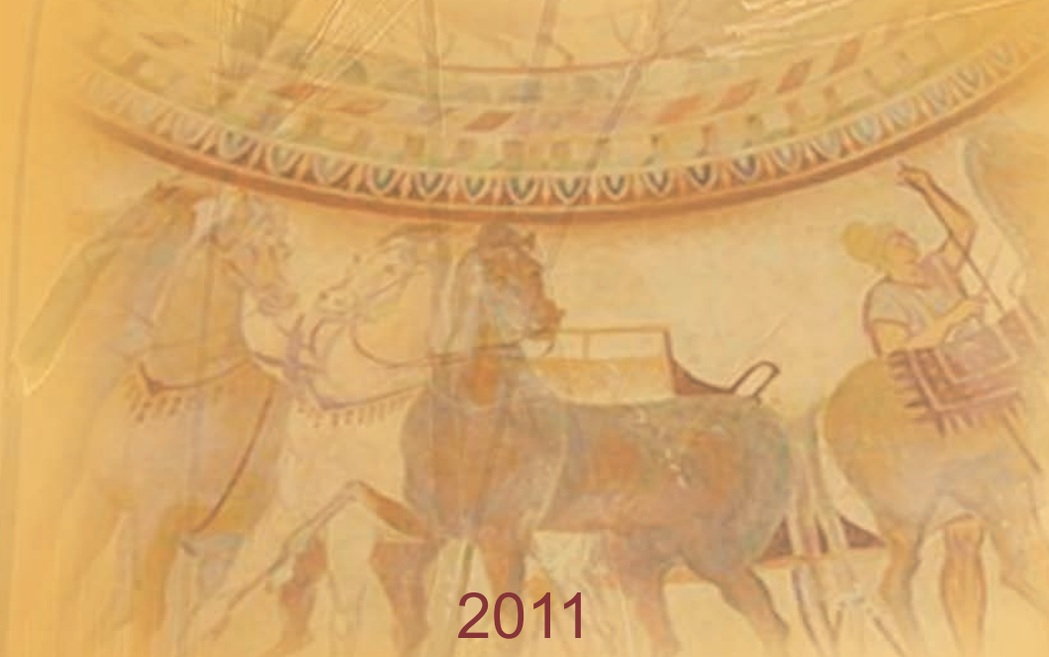
ISSN 1313 - 8820
Volume 3, Number 2
June, 2011

AGRICULTURAL SCIENCE AND TECHNOLOGY



2011

An International Journal Published by Faculty of Agriculture,
Trakia University, Stara Zagora, Bulgaria

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AGRICULTURAL SCIENCE AND TECHNOLOGY, VOL. 3, No 2, pp 117 - 120, 2011

Impact of mixtures between retardants and combined herbicides on the sowing properties of the durum wheat

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Abstract. *The research was conducted in 2007-2009 on the experimental field of the Field Crops Institute, Chirpan, Bulgaria, on pellic vertisol soil type. Factor A included no treated check and 5 retardants – Stabilan (chlormequat) - 2 l/ha, Flordimex extra (ethephon) – 750 ml/ha, Vivax (chlormequat + ethephon) – 1.7 l/ha, Cycocel extra (chlormequat + cholinechloride) – 1.5 l/ha, Terpal (ethephon + mepiquat) – 3 l/ha. Factor B included weeded no treated check and 3 herbicides - Hussar max (mesomax + iodosulfuron) – 250 g/ha, Logran extra (terbutrin + triasulfuron) – 500 g/ha, Glean (chlorsulfuron) – 15 g/ha. All retardants, herbicides and their tank-mixtures were treated in tillering stage of the durum wheat. The weak adhesion of Hussar max required its application with adjuvant Genapol in dose 500 ml/ha. Under investigation was Bulgarian durum wheat cultivar Progress, which belongs to var. leucurum. Tank mixtures of herbicide Logran extra with retardants Stabilan, Vivax and Cycocel extra, of herbicide Glean with retardant Flordimex extra and of herbicide Granstar with retardant Terpal have decreased the germinative energy of durum wheat sowing seeds. Investigated retardants, combined herbicides and their tank mixtures do not influence seed germination and waste grain quantity. Tank mixtures Flordimex extra + Hussar max and Flordimex extra + Logran extra have decreased root and coleoptile length. Mixtures of Glean with the investigated retardants have increased root and coleoptile length. Herbicide Logran extra cannot be mixed with retardants containing chlormequat - Stabilan, Vivax and Cycocel extra. There is antagonism in mixtures of Hussar max with Flordimex extra and Glean with Terpal.*

Keywords: durum wheat, retardants, herbicides, germinative energy, seed germination, root and coleoptile length, waste grain

Introduction

One of the important conditions for obtaining normal sown fields and a good harvest is the use of quality seeds. Furthermore, for a 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 the condition in which the seeds were during the harvest.

In recent years biologically active substances are used that increase plant resistance to lodging and contribute more fully to realize the productive potential of durum wheat cultivars (Sharma and Kumar, 1998; Delchev, 2004). In modern agriculture herbicides are an effective instrument of weed control in wheat. Since their entry in agriculture till now the terms, doses, treatment methods, and their influence on grain yield and grain quality are recommended in their self-use (Orth, 1965; O'Sullivan, 1980; Ahmed et al., 1993; Kudsk and Streibig, 2003; Delchev, 2008). These studies do not provide enough light to questions about the impact of mixtures between different pesticides on durum wheat.

The aim of this investigation is to establish the influence of some retardants, combined herbicides and their tank mixtures on the sowing properties of durum wheat seeds and the quantity of waste grain.

Material and methods

The research was conducted in 2007-2009 on the experimental field of the Field Crops Institute, Chirpan, Bulgaria, on pellic vertisol soil type. A two-factor experiment was carried out as a block method in 4 repetitions, on a 20 m2 harvesting area, after sunflower predecessor. Factor A included no treated check and 5 retardants, which are shown in Table 1. Factor B included weeded no treated check and 3 herbicides, which are shown in Table 2. All retardants, herbicides and their tank mixtures were treated in tillering stage of the durum wheat and are applied in a working solution of 300 l/ha. Mixing was done in the tank on the sprayer. The weak adhesion of Hussar max required its application with adjuvant Genapol in dose 500 ml/ha. Under investigation was Bulgarian durum wheat cultivar Progress, which belongs to var. leucurum.

The grain gained after every variant was cleaned through a sieve with hole size 2x2 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. The intensity of early growth of seeds expressed by the length of primary roots and coleoptile definite on the eighth day after setting the samples was studied. 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 according to the method of variance analysis.

Results and discussion

One of the important conditions for obtaining a normal crop and

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Table 1. Investigated retardants - Factor A

Retardants	Active substance	Doses, l/ha
Check – no treated	-	-
Stabilan	chlormequat	2
Flordimex extra	ethephon	0.75
Vivax	chlormequat + ethephon	1.7
Cycocel extra	chlormequat + cholinechloride	1.5
Terpal	ethephon + mepiquat	3

Table 2. Investigated herbicides - Factor B

Herbicides	Active substance	Doses, g/ha
Check – weeded	-	-
Hussar max	mesomax + iodosufuron	250
Logran extra 62VG	terbutrin + triasulfuron	500
Glean 75DF	chlorsulfuron	15

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. It leads to lower grain yields. The obtained results show that the treatment of durum wheat with tank mixtures of herbicide Logran extra with retardants Stabilan, Vivax and Cycocel extra, of herbicide Glean with retardant Flordimex extra and of herbicide Granstar with retardant Terpal leads to proven changes in germination energy (Table 3). Analysis of variance, in which the years have taken for replications, shows that these decreases are mathematically

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

Variants		Germinative energy, %	Germination, %	Length, cm		Waste grain, %
Retardants	Herbicides			Coleoptile	Root	
-	-	94.0	97.0	9.2	12.8	11.1
	Hussar max	94.0	95.0	8.9	12.3	12.1
	Logran extra	92.5	93.0	8.0	11.9	13.0
	Glean	92.0	95.0	10.3	14.6	10.7
Stabilan	-	94.5	96.0	8.8	12.1	11.0
	Hussar max	94.0	95.0	7.7	10.7	10.2
	Logran extra	90.5	92.0	7.2	10.8	10.4
	Glean	95.0	95.0	10.0	14.0	10.1
Flordimex extra	-	95.5	97.0	9.2	12.6	13.3
	Hussar max	92.5	94.5	5.0	8.0	11.3
	Logran extra	93.5	94.5	4.8	7.6	11.1
	Glean	90.0	92.0	10.4	14.5	11.6
Vivax	-	94.5	97.0	9.6	12.6	10.6
	Hussar max	96.0	99.0	9.6	16.0	12.1
	Logran extra	89.0	92.5	9.3	14.4	11.4
	Glean	96.0	97.5	11.3	16.3	11.7
Cycocel extra	-	94.5	95.5	9.0	12.0	10.9
	Hussar max	95.0	96.0	8.8	13.0	10.1
	Logran extra	90.0	92.0	9.6	14.2	10.4
	Glean	92.0	93.5	10.7	18.8	10.5
Terpal	-	92.5	94.0	8.5	14.2	10.6
	Hussar max	96.0	97.0	10.5	14.8	12.1
	Logran extra	94.0	96.0	9.4	12.6	12.0
	Glean	90.5	91.0	11.6	17.0	11.8
	LSD 5%	3.2	4.1	3.3	4.0	2.5
	LSD 1%	5.1	6.3	4.9	5.6	4.3
	LSD 0.1%	7.4	8.8	6.7	7.9	6.2

proven.

Germination is the most important index which characterizes 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 of all variants during the three years of study were above the requirements of the standard for over 85% germination, although in the different years there was some variation of the 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. Durum wheat seeds germinate normally by influence of the tank mixtures of Logran extra with Stabilan, Vivax and Cycocel extra, of Glean with Flordimex extra and of Granstar with Terpal, although the initial rate of development is lower due to lower germination energy. Other retardants, combined herbicides and their mixtures did not affect the indices of germination energy and seed germination. This means that they do not impede the joint and fast germination of durum wheat sowing-seeds.

The obtained results for germination energy and seed germination are a prerequisite to continue to investigate the effect of stimulators, herbicides and their tank mixtures on the initial intensity of the growth of seeds, expressed by the length of roots and coleoptiles. It was found that mathematically proven decrease in the length of primary roots and coleoptiles of durum wheat are established in combinations between retardant Flordimex extra with combined herbicides Hussar max and Logran extra. This means that this tank mixture hinders the development of young plants, reducing their resistance to cold and increased the risk of frost during winter months. Coleoptile length also increases in the combination of retardant Stabilan with herbicides Hussar max and Logran extra, but it is not mathematically proved. Mixed use of herbicide Glean with the five investigated retardants stimulates the growth of the length of primary roots and coleoptiles of the durum wheat and is recommended for use in seed production crops of durum wheat.

At the evaluation of the sowing characteristics we have to consider not only the characteristics of the sowing seeds but also the quantity of waste grain (siftings) which are gained at the preparation of these seeds. Greater quantity screenings lead to higher cost of the seed and reduce the economic effect of seed production of durum wheat. Investigated retardants, combined herbicides and their tank mixtures do not lead to mathematically proven changes in the quantity of waste grain. Differences between them and untreated check are small and unproven; although in different years some mixtures tend to increase the received screenings.

Decreases in the values of germination energy and laboratory seed germination, decrease the intensity of the initial growth, expressed by the length of the root and coleoptile at germination and the increase in the quantity of waste grain under the influence of the herbicides is explained by the depressing effects on growth and development of durum wheat during its vegetative period.

To make a full evaluation of the sowing properties it is necessary to establish not only the quality of seeds, but also the quantity of grain which will be received from these seeds. Data for the influence of stimulators, antigrass herbicides and their tank mixtures on grain yield (Table 4) show that the lower yield is obtained in untreated and weeded check. The separate uses of herbicides Hussar max,

Table 4. Grain yield (2007-2009)

Variants		2007		2008		2009		Mean	
Retardants	Herbicides	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
-	-	2233	100	4560	100	3050	100	3281	100
	Hussar max	2500	112.0	4867	106.7	3467	113.7	3611	110.1
	Logran extra	2433	108.9	4833	106.0	3367	110.4	3544	108.0
	Glean	2517	112.7	4800	105.3	3367	110.4	3561	108.5
Stabilan	-	2533	113.4	4733	103.8	3200	104.9	3489	106.3
	Hussar max	2667	119.4	4800	105.3	3300	108.2	3589	109.4
	Logran extra	2083	93.3	4300	94.3	3167	103.8	3183	97.0
	Glean	2500	112.0	5233	114.8	3417	112.0	3717	113.4
Flordimex extra	-	2300	103.0	4700	103.1	3100	101.6	3367	102.6
	Hussar max	2250	100.8	4367	95.8	3450	113.1	3356	102.3
	Logran extra	2550	114.2	4100	89.9	3500	114.8	3383	103.1
	Glean	2800	125.4	5100	111.8	3533	115.8	3811	116.2
Vivax	-	2533	113.4	4833	106.0	3333	109.3	3566	108.7
	Hussar max	2850	127.6	4867	106.7	3567	117.0	3761	114.6
	Logran extra	2133	95.5	5333	117.0	3100	101.6	3522	107.3
	Glean	2633	117.9	4933	108.2	3483	114.2	3683	112.3
Cycocel extra	-	2467	110.5	4800	105.3	3267	107.1	3511	107.0
	Hussar max	2600	116.4	4967	108.9	3517	115.3	3695	112.6
	Logran extra	2217	99.3	4500	98.7	2917	95.6	3211	97.9
	Glean	2617	117.2	5300	116.2	3700	121.3	3872	118.0
Terpal	-	2467	110.5	4700	103.1	3267	107.1	3478	106.0
	Hussar max	2600	116.4	4800	105.3	3617	118.6	3672	111.9
	Logran extra	2567	115.0	4700	103.1	3606	118.2	3624	110.5
	Glean	2233	100.0	4733	103.8	2966	97.2	3311	100.9
	LSD 5%	137	6.1	249	5.5	162	5.3		
	LSD 1%	183	8.2	332	7.3	216	7.1		
	LSD 0.1%	239	10.7	432	9.4	283	9.3		

Logran extra and Glean increase grain yield, because they destroy existing weeds. The separate uses of retardants Stabilan, Flordimex extra, Vivax, Cycocel extra and Terpal also increase yields because they stimulate the growth and development of durum wheat. The increase was less than in mixtures with herbicides because the available weeds neutralize part of their positive effect. In variants treated with retardant Flordimex extra a small increase in grain yield is obtained in comparison with other retardants included in the investigation. It has been established that herbicide Logran extra cannot be mixed with retardants containing chlormequat. Its mixtures with Stabilan, Vivax and Cycocel extra decreased grain yield, which is not the case with the separate use. Mixtures Logran extra + Stabilan and Logran extra + Cycocel extra decrease grain yield. It is even lower than the yield of untreated check. At tank mixture between Logran extra and Vivax the yield is higher than the yield of the non-treated check but lower than yields of the separate use of these two pesticides. Antagonism exists by mixing the herbicide Hussar max with retardant Flordimex extra and by mixing the herbicide Glean with retardant Terpal. In cool and wet weather in the period after treatment as in 2008, antagonism was observed at mixtures between herbicide Logran extra and retardant Flordimex extra. In drought weather as in 2007 and 2009 there was no antagonism between Logran extra and Flordimex extra. This antagonism is expressed mainly in the reduction of grain yield and less reduction in the herbicide effect.

Conclusion

Tank mixtures of herbicide Logran extra with retardants Stabilan, Vivax and Cycocel extra, of herbicide Glean with retardant Flordimex extra and of herbicide Granstar with retardant Terpal decreased the germinative energy of durum wheat sowing-seeds. Investigated retardants, combined herbicides and their tank mixtures do not influence seed germination and waste grain quantity. Tank mixtures Flordimex extra + Hussar max and Flordimex extra + Logran extra decreased root and coleoptile length. Mixtures of Glean with the investigated retardants increased root and coleoptile length. Herbicide Logran extra cannot be mixed with retardants containing chlormequat - Stabilan, Vivax and Cycocel extra. There is antagonism in mixtures of Hussar max with Flordimex extra and Glean with Terpal.

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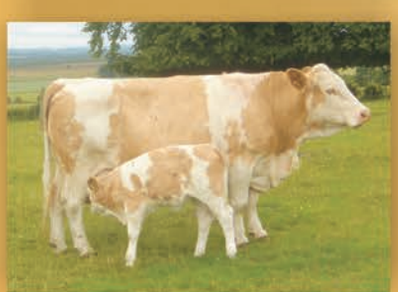

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