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Influence of Treatment with Post-Emergence Herbicides on Productivity of Barley Emon, Lardeya and Orfey

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Abstract

Field trial with two-row barley varieties Emon, Lardeya and Orfej is conducted in the Institute of Agriculture – Karnobat during the period 2011-2013. The influence of broadleaf (dicotyledonous) herbicides alone and on their combination with wild oat (monocotyledonous) herbicides, applied in tillering stage of the crop in optimal and double doses, is investigated. The treatment with various herbicides and herbicide combinations had an effect on the yield of the studied barley varieties. In case of broadleaf weed infestation in the Lardeya crops they can be treated with almost any studied herbicide and they do not have a negative effect on the variety productivity. In the Orfey and Emon crops the broadleaf weed infestation is best treated with Sekator OD and Granstar Super. In case of mixed weed infestation in the three varieties, it is best to treat the crops with the combination Puma Super 7.5 EW + Sekator OD. The Lardeya and Orfej varieties appeared more resistant to all studied herbicide preparations, and the Emon variety was more susceptible.

Keywords: barley, productivity, herbicides

Introduction

The use of herbicides takes into account that not only the weed, but the crop species as well are variously susceptible to them.

Reduction of the yield of winter wheat crops as consequence of the phytotoxic effect of certain herbicides was pointed out by Wicks (1987), Clay, et.al., 1988, Heering and Peeper (1989), Господинов (1984), Orr Jack, et. al. (1996), Georgieva T., M. Dimitrova. (2000), Тонев и др. (2001), Georgieva, T., M. Dimitrova (2001). Делчев (2003). It was proved that there is a varietal difference in yield and response to some of the herbicides applied to barley Господинов, 1990[a], 1990[b]; Димитрова, Димова и Кузманов, 2003, Atanasova, D. 2007, Атанасова, Д. 2008). Studies on various types of malting barley also reported the negative effect of wild oat herbicides, especially in increased doses or when the preparation is used in combination with broadleaf herbicides (Mesban, Miller, 2005; Michael, Mickelson, 2001, Makhan, et.all, 2013).

The aim of this study was to establish the effect of treatment with broadleaf herbicides applied alone and in combination with wild oat herbicides on the productivity of new varieties of malting barley.

Materials and Methods

The study was conducted during 2011-2013 as a field experiment of The Institute of Agriculture - Karnobat, Bulgaria, in soil type - Leached smolnitza.

To study the effect of herbicides on three varieties of malting barley (Emon, Lardeya and Orfej varieties) was set a field experiment by randomized block design in four replications in a plot size of 10 m^2. It was harvested within the optimal term – 20-30 October, after a sunflower predecessor and N_{10} fertilization. The herbicides were applied during tillering stage, in optimal and double doses with knapsack sprayers (Table 1).

Table 1. Variants in field experiment

Variants	*Dose kg (l).ha^{-1}*	
	optimal	***double***
1. K - untreated and without weeds	-	-
2. SEKATOR OD (iodosulfuron + amidosulfuron)	0.10	0.20
3. ARAT(tritosulfuron + dicamba)	0.10	0.20
4. DERBY Super (florasulam + aminopyralid acid)	0.03	0.06
5. GRANSTAR SUPER (tribenuron methyl + thifensulfuron methyl)	0.04	0.08
6. AKSIAL PLUS (pinoxaden + florasulam)	1.00	2.00
7. GRASP 25 SK + AKURAT 60 WP (tralkoxydim + metsulfuron-metil)	1.20+0.01	2.40+0.02
8. PUMA SUPER 7.5 EW+ SEKATOR WG (fenoxaprop-P-ethyl + iodosulfuron + amidosulfuron)	1.0+0.10	2.00+0.20

The most common herbicides were used against broadleaf weeds (2-5) and combinations – against broadleaf + wild oat weeds (6-8).

Crop tolerance was evaluated by the scale of the European Weed Research Society (*EWRS)* (1 – no effect on crop, 9 – complete crop death).

Characteristics of the studied barley varieties:

Emon is a winter two-row barley variety created at the Institute of Agriculture, Karnobat. It was acknowledged as original in 1998. Botanical description: (*H. vulgare, subsp. distichon (L.) Koern*.) stem – average height 88 *cm*, with very good lodging resistance. Spike – two-row, var. erectum, average length 6.8 *cm* resistant to grain shattering and sprouting. Grain – big (about 50 *g*), uniform, suitable for brewing, covered, protein content of approximately 11-12 % and extract content 77.0 – 79.5% (Мерсинков, 2003).

Lardeya is a winter two-row barley variety created at the Institute of Agriculture, Karnobat. It was acknowledged as original in 2007. Botanical description: (*H. vulgare, subsp. distichon (L.) Koern*.) stem – average height 94 *cm*, with good lodging resistance. Spike – two-row, var. nutans, average length 10.9 *cm*. Grain – weight of 1000 grains – 40-43 *g*, protein content of approximately 11.7% and extract content 78.2% (Вълчева, Вълчев, 2009).

Orfej is a winter two-row barley variety created at the Institute of Agriculture, Karnobat. It was acknowledged as original in 2007. Botanical description: (*H. vulgare, subsp. distichon (L.) Koern*.) stem – average height 92 *cm*, with good lodging resistance. Spike – two-row, var. nutans, average length 10.5 *cm*. Grain – weight of 1000 grains – 41-42 *g*, protein content of approximately 10.9% and extract content 78.6% (Вълчев, Вълчева, 2010).

Results and Discussion

The agrometeorological conditions over the years of study and particularly the amount of rainfall differed significantly, which determined the specific crop development and the differences in yield by year. Year 2010/2011 was characterized as the driest, as the amount of rainfall during the vegetation period was 345 *mm,* i.e. 20% less than the annual multi-annual values for the same period (425 *mm*). The other two years – 2011/2012 and 2012/2013 had substantial rainfall, which was distributed very unevenly among the months. The most climatically favorable year for growing winter barley was 2012/2013 (Figure 1).

The phonological observations in the experiment, performed on the 7th and 14th day after treatment, did not indicate any visible signs of phytotoxicity (by the EWERS scale) for the three varieties.

Yield grain varied significantly by years, depending on the meteorological conditions and the studied variants. In the first year of study, the yields were the lowest as the year had rather unfavorable climatic conditions. In the second year the yields were higher than the first one. In the last year of 2012/2013 the crops were dense and well developed and managed to realize its productive potential very well – the yields were highest out of the three studied years. Under unfavorable climatic conditions for the year, the highest yield was realized by the Lardeya variety 4.89 t.ha^{-1} – in 2011, and under favorable conditions – the Orfej variety - 7.12 t.ha^{-1} – in 2013.

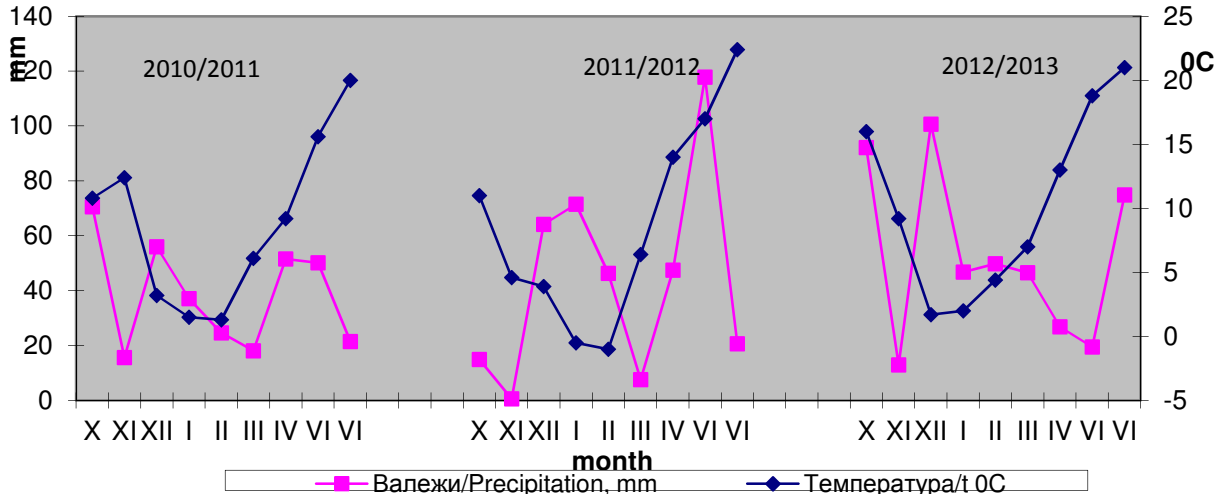
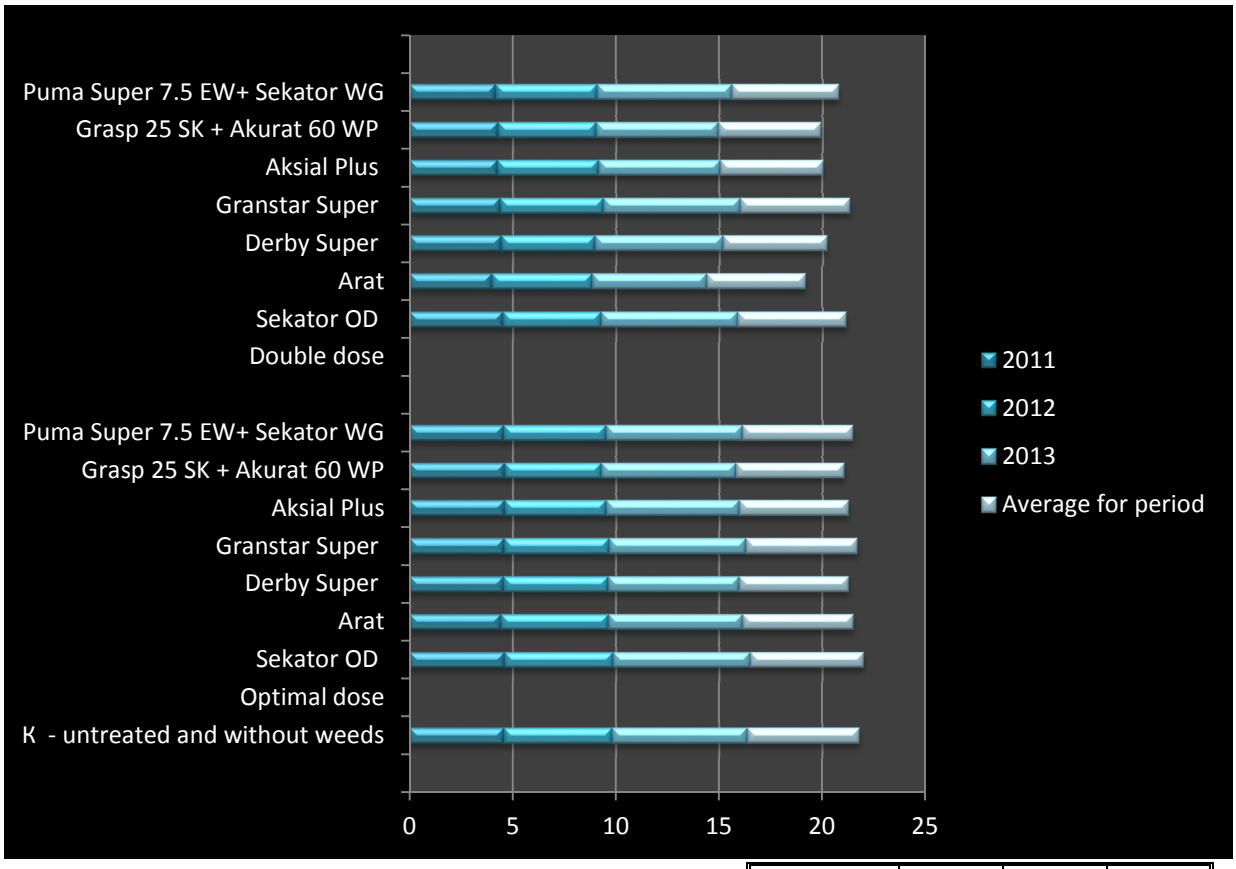


Figure 1. Rainfall and temperature distribution during the growth period (2010-2013)

Average for the period, the herbicides applied to the Emon variety in optimal doses did not reduce yield (Figure 2). The variety realized the highest yield after treatment with the anti-broadleaf herbicides Sekator OD (5.50 t.ha^{-1}) and Granstar Super (5.43 t.ha^{-1}).



	2011	2012	2013
GD 5 %	0.225	0.339	0.300
GD 1 %	0.301	0.471	0.416
GD 0.01 %	0.396	0.554	0.517

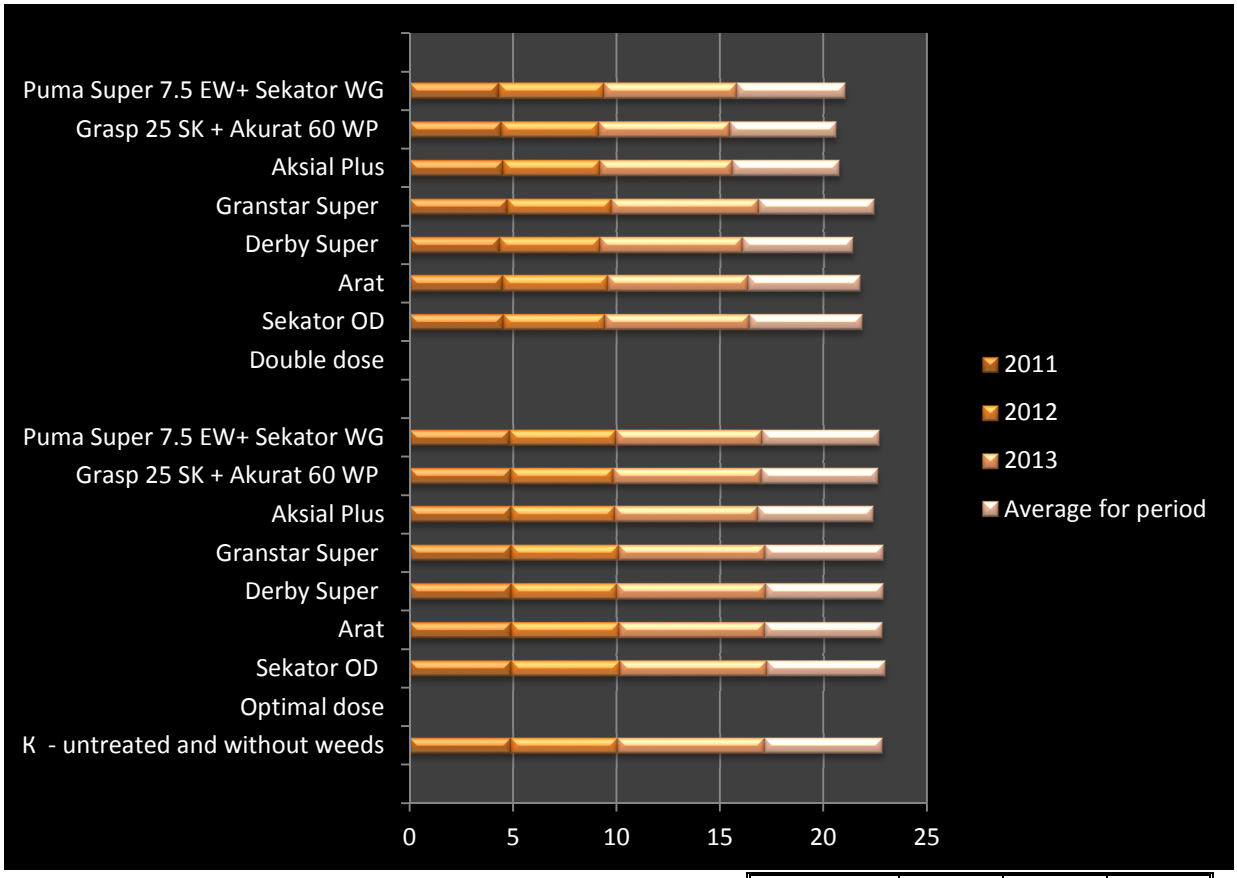
Figure 2. The grain yield at malting barley variety Emon, t.ha^{-1}

After treatment with Derby Super and Arat the reduction of yield compared to the check was minimal. After application of combined preparations, the yield again decreased quite insignificantly – Puma Super 7.5 EW + Sekator OD (5,37 t.ha^{-1}), Aksial Plus (5.31 t.ha^{-1}) and Grasp 25 SP + Akurat 60 WP (5,26 t.ha^{-1}).

The increase of doses as a whole reduced the yields (from 0.12 to 0.65 t.ha^{-1} compared to the weeded out check). Only Granstar Super did not show negative effect (5.33 t.ha^{-1}). The highest reduction of yield was observed for the variant treated with Arat in a double dose (4.80 t.ha^{-1}), followed by the combination Grasp 25 SK + Akurat 60 WP (4.98 t.ha^{-1}).

In case of broadleaf weed infestation the Emon variety can be treated with Sekator OD and Granstar Super, which hardly affect the variety productivity, and when the weed infestation is mixed – with the combination Puma Super 7.5 EW + Sekator OD.

The herbicides effect on grain yield for Lardeya is presented in Table 3. The yield varied greatly under the influence of the meteorological conditions, seen in the differences in the checks in the different years with about 2.20 t.ha^{-1}. After treatment with an optimal dose, the deviation was insignificant compared to the check. Against broadleaf weeds – Sekator OD - 5.74 t.ha^{-1}, Granstar Super - 5.72 t.ha^{-1}, Derby Super - 5.71 t.ha^{-1} and Arat - 5.70 t.ha^{-1}, and in the combinations against broadleaf and wild oat weeds – Puma Super 7.5 EW + Sekator OD - 5,67 t.ha^{-1}.



	2011	2012	2013
GD 5 %	0.119	0.272	0.287
GD 1 %	0.160	0.377	0.399
GD 0.01 %	0.210	0.424	0.504

Figure 3. The grain yield at malting barley variety Lardeya, t.ha^{-1}

After the double dose, yield decreased significantly for almost all the herbicides, except for the application of Granstar Super (5.61 t.ha^{-1}). The most greatly reduced productivity was observed in the variants treated with Grasp 25 SK + Akurat 60 WP (5.15 t.ha^{-1}) and Aksial Plus (5.19t.ha^{-1}).

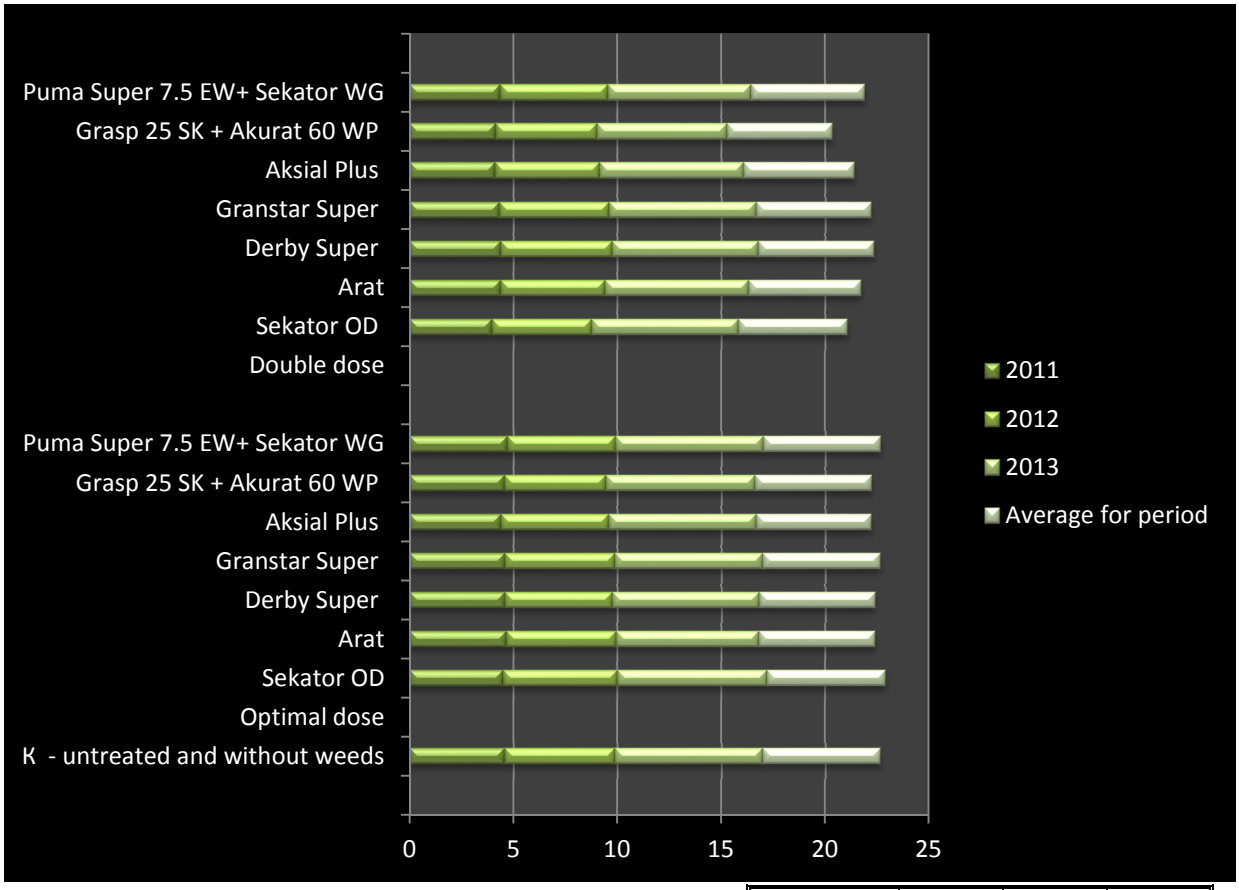
In case of broadleaf weed infestation in the Lardeya crops they can be treated with almost any studied herbicide, which do not affect the variety productivity, and in case of mixed weed infestation – with the combination Puma Super 7.5 EW + Sekator OD.

The results presented in Figure 4 show that the yield also varied significantly over the years in the Orfej variety. Tendencies to increase the yield were observed after treatment with Sekator OD, especially in 2012 and 2013, which were more favorable for barley. Unfavorable effect on the yield had the preparation of combined action - Aksial Plus. The reduction of yield was with 0.11 t.ha^{-1} at the optimal dose and with 0.31 t.ha^{-1} at the double dose.

The other herbicides, applied in optimal doses, did not have a negative effect.

The treatment with double doses do not have negative effect Derby Super and Granstar Super. The productivity of the Orfej variety remained at a good level. The other herbicides in double doses had oppressing effect.

In the Orfej crops the broadleaf weed infestation was best treated with Sekator OD and Granstar Super, and the mixed weed infestation – with the combination Puma Super 7.5 EW + Sekator OD.



	2011	2012	2013
GD 5 %	0.179	0.208	0.218
GD 1 %	0.240	0.287	0.301
GD 0.01 %	0.316	0.335	0.376

Figure 4. The grain yield at malting barley variety Orfej, t.ha^{-1}

The analysis of variance showed that in herbicide treatment the greatest role for yield formation was played by the meteorological conditions of the year (Table 2). Over the studied period there was quite a big variability in yield by years. It had greater significance compared to the herbicide effect. The Emon variety was more affected by the herbicides compared to the other two varieties.

Table 5. Results of dispersion analysis on grain yield data

Surse of variability	Variety								
	Emon			Lardeya			Orfej		
	SQ	DF	η2 (%)	SQ	DF	η2 (%)	SQ	DF	η2 (%)
Main effects	32.9250	44		44.7358	44		54.7387	44	
Years	30.3209	2	92.09	42.4339	2	94.85	52.8312	2	96.52
Herbicides	1.6532	14	5.02	1.7788	14	3.98	1.2324	14	2.25
Accidental	0.9508	28	2.89	0.5230	28	1.17	0.6751	28	1.23

Conclusion

On the grounds of the obtained results we can draw the following conclusions:

The treatment with various herbicides and herbicide combinations had an effect on the yield of the studied barley varieties. In case of broadleaf weed infestation in the Lardeya crops they can be treated with almost any studied herbicide and they do not have a negative effect on the variety productivity. In the Orfej and Emon crops the broadleaf weed infestation is best treated with Sekator OD and Granstar Super. In case of mixed weed infestation in the three varieties, it is best to treat the crops with the combination Puma Super 7.5 EW + Sekator OD.

The Lardeya and Orfej varieties appeared more resistant to all studied herbicide preparations, and the Emon variety was more susceptible.

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