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EFFICIENCY AND SELECTIVITY OF HERBICIDES IN SPRING RAPE (*BRASSICA NAPUS*)

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Abstract

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During 2009–2011 at the Experimental field of IASS "Obraztsov Chiflik" – Rousse a field experiment was conducted with three herbicides in spring rape, including "JURA" and "PACHA" hybrids. The objective of the study was the efficiency and selectivity of herbicides tested to be determined, being applied at optimal, reduced and duel high doses. It was found out that herbicides pendimethalin at dose of 264 gda^{-1} a.s. and quizalaphop-P-ethyl at dose of 20 $g.da^{-1}$ a.s., caused plant damages. Pendymethalin, applied post sowing, before emergence, and tetraloxidim – methyloleat and quizalaphop-P-ethyl in phase 3–5 eaf of weeds and phase "leaf rosette" of the crop, reduced density of annual cereal and broad-leaved weeds up to 100%. The herbicides showed insignificant effects on perennial weeds – up to 57%.

Key words: spring rape, weeds, herbicides, efficiency, selectivity
Abbreviations: a.s. – active substance; EWRS – European Weed Research Society

Introduction

Multilateral use of rape led to rapid and steady increase of areas in Bulgaria. Rape is one of the best predecessors of wheat – improves the phytosanitary soil condition, reduces root rot damages, and as a result grain yield increases by 20–30%, and gluten content – by 2–3%. Rape is eco-culture that improves recultivation of contaminated land, and is one of the best honey plants and early source of pollen and nectar. In order desired yield to be achieved, it needs intensive care (Ivanova et al., 1999).

Plant protection is a significant factor for the successful production. Cultural preservation throughout the vegetation of weeds, diseases and pests is essential to achieve higher yield.

Weed infestation of stands effects on growth, development and formation of rape yield. Weeds strongly compete with rape and along with yield reduction they lower its winter resistance. Weed seed presence increases the moisture content and hampers the storage of production. The implementation of the biological potential of the crop is closely related to the removal of the harmful effects of weeds (Martin et al., 2001; Primot et al., 2006). Weed control in spring rape is chemically, i.e. the application of herbicides (soil or vegetation), which creates favorable conditions for germination, growth and development of the crop, with good density and high-yield stands.

In rape the number of registered rape herbicides is very small, and chemical control of certain weed species is practically impossible. There are a lot of publications in Bulgaria, connected with the use of different herbicides and herbicide combinations, doses and time of treatment (Tityanov et al., 2009; Tonev et al., 2007; Dimitrova et al., 2007; Dimitrova et al., 1991; Wlutman et al., 2008; Ivanova et al., 2006). The data obtained are valid for the relevant soil and climatic conditions, types and quantities of weeding.

These circumstances gave us reason to test pendimethalin (Stomp 330 EC), tepraloxydim and metiloleat (Aramo 50) and quizalofop-P-ethyl (Taurus) herbicides.

The objective of that study was to determine the efficiency and selectivity of the soil and vegetation herbicides tested, applied at optimal, reduced and double high doses of weed control in spring rape.

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Materials and Methods

During the period 2009–2011 at IASS "Obraztsov chiflik" a field experiment was conducted with herbicides in spring rape, including „JURA" and „PACHA" hybrids. The experiment was started after the Block method in four replications, the harvesting plot being 10 m^2 and randomized location of the variants. Hybrids: pendimethalin 330 g/l (Stomp 330 EC), tepraloxydim 50 g/l – metiloleat 500 g/l (Aram 50), quizalofop-P-ethyl 50 g/l (Taurus) were tested, applied at reduced, optimal and dual high doses.

Table 1
Variants description

Herbicid's substance	Name of herbicide	Rate, g.da^{-1} a.s.
330g.l^{-1} pendimethalin	Stomp 330 EC	66
		132
		264
50 g.l^{-1} tepraloxydim + 500 g.l^{-1} Metiloleat	Aramo 50	27.5
		55
		110
50 g.l^{-1} Quizalofop-P-ethyl	Taurus	5
		10
		20

Pendimethalin (Stomp 330 EC) herbicide was applied after sowing before emergence of rape at doses of 66, 132, 264 g.da^{-1} a.s. and the other herbicides – tepraloxydim – metiloleat (Aramo 50) at doses of 27.5, 55, 110 g.da^{-1} a.s. and quizalofop-P-ethyl (Taurus) at doses of 5, 10, 20 g.da^{-1} a.s. at phase third – fifth leaf of weeds and phase leaf rosette of rape (Table 1).

Soil tillage involved 20–25 cm plowing, disking and milling. Crop sowing was carried out in the optimal period for the region, following the adopted technology.

Rape was grown after predecessor Aglika wheat variety, fertilized by N – 14 kg.da^{-1} a.s., P_2O_5 – 8 kg.da^{-1} a.s. and K_2O – 4 kg.da^{-1} a.s. The soil type of the experiment was strongly leached chernozem with low humus content (1.98%), low N and P_2O_5 and good K_2O stock. The soil reaction was slightly acidic (pH – 5.2).

Herbicides were applied via knapsack sprayer, dose of working solution being:

Table 2
Efficiency and selectivity of some leaf and soil herbicides in hybrid "JURA"

Variants	Weeds number per m^2 25 days after treatment									Selectivity by EWRS
	Annual						Perennial		Efficiency, %	
	Grass		Efficiency, %	Broad-leaved		Efficiency, %				
	before treatment	after treatment		before treatment	after treatment		before treatment	after treatment		
Control – untreated	30**	64***	–	42**	67***	–	24**	57***	–	–
Control tilling	0	0	–	0	0	–	0	0	–	–
Pendimethalin – 66 g.da^{-1}	0	2	93	0	5	88	0	11	54	1
Tepraloxydim + Metiloleat – 27.5 g.da^{-1}	30	2	93	44	11	75	18	14	22	1
Quizalofop-P-ethyl – 5 g.da^{-1}	40	2	95	54	12	78	11	8	27	1
Pendimethalin – 132 g.da^{-1}	0	2	93	0	5	88	0	9	63	1
Tepraloxydim + Metiloleat – 55 g.da^{-1}	24	1	96	80	8	90	11	7	36	1
Quizalofop-P-ethyl – 10 g.da^{-1}	25	1	96	41	6	85	21	9	57	1
Pendimethalin – 264 g.da^{-1}	0	0	100	0	6	86	0	7	71	6
Tepraloxydim + Metiloleat – 110 g.da^{-1}	34	1	97	63	5	92	12	6	50	1
Quizalofop-P-ethyl – 20 g.da^{-1}	30	2	93	107	6	94	9	7	22	4

** The weeds are encountered before introducing the herbicides
*** The weeds are encountered 25 days after introducing the herbicides

• 30 l.da^{-1} for soil herbicides (applied after sowing before crop emergence);

• 20 l.da^{-1} for vegetation herbicides (applied at 3-5 weed leaf phase and leaf rosette phase of rape).

Efficacy of herbicides was registered on the 25th day after spraying, in constant sampling plot for yield estimation of 1m^2, and the selectivity of the preparation – according to the Scale of EWRS (where grade 1 – no damage, and grade 9 – the crop is completely destroyed). The species composition of weeds was recorded after the Method of visual estimation and the registration of weeds – after the Quantitative-weighting method.

Results and Discussion

Meteorological conditions over the years were favorable for the development of rape. Precipitation and temperatures varied within optimal range, enabling the timely crop emergence and the effects of soil and vegetation herbicides.

The area, where the tests were conducted was with a natural background of weed infestation with prevailing participation of: large crab-grass – *Digitaria sanguinalis* (L.), green bristlegrass – *Setaria viridis* (L.), green amaranth – *Amaranthus retroflexus* (L.), white goosefoot – *Chenopodium album* (L.), deady nightshade – Solanum nigrum (L.), common purslane – *Portulaca oleracea* (L.), scarlet pimpernel – *Anagallis arvensis* (L.), black bindweed – *Polygonum convolvulus* (L)., field chamomile – *Anthemis arvensis* (L.), field bindweed – *Convolvulus arvensis* (L.), Canada thistle – *Cirsium arvense* (L.), johnsongrass – *Sorghum halepensis* (L.) and field sow thistle – *Sonchus arvensis* (L.).

Soil herbicide pendimethalin (Stomp 330 EC) was applied after sowing, pre-emergence of crop, at three doses – reduced, optimal and double high. Applied at a dose of 264 g.da^{-1} a.s. in „JURA“ and „PACHA“ hybrids, caused serious damages (grade 6–7 according to EWRS scale), expressed in chlorosis, developing into necrosis (Tables 2 and 3). On the 30th day after treatment somewhat overcome of the phytotoxicity to moderate damage was registered (grade 4–5 according to EWRS scale), and at doses of 66 and 132 g.da^{-1} a.s. high selectivity to rape was shown (grade 1 according to EWRS scale).

Table 3
Efficiency and selectivity of some leaf and soil herbicides in hybrid “PACHA”

Variants	Weeds number per m^2 25 days after treatment									Selectivity by EWRS
	Annual						Perennial		Efficiency, %	
	Grass		Efficiency, %	Broad-leaved		Efficiency, %				
	before treatment	after treatment		before treatment	after treatment		before treatment	after treatment		
Control tilling	29**	53***	–	41**	63***	–	23**	23***	–	–
Pendimethalin – 66 g.da^{-1}	0	0	–	0	0	–	0	0	–	–
Tepraloxydim end Metiloleat – 27.5 g.da^{-1}	0	0	100	0	7	83	0	4	83	1
Quizalofop-P-ethyl – 20 g.da^{-1}	33	3	91	34	9	74	10	9	10	1
Pendimethalin – 132 g.da-1	36	2	94	50	9	82	16	13	19	1
Tepraloxydim end Metiloleat – 55g.da^{-1}	0	0	100	0	3	93	0	3	87	1
Quizalofop-P-ethyl – 20 g.da^{-1}	28	0	100	41	9	78	7	5	29	1
Pendimethalin – 264 g.da-1	29	0	100	58	9	84	10	8	20	1
Tepraloxydim end Metiloleat – 110 g.da^{-1}	0	0	100	0	2	95	0	10	57	6
Quizalofop-P-ethyl – 20 g.da^{-1}	35	0	100	65	10	85	8	4	50	1
Quizalofop-P-ethyl – 20 g.da^{-1}	20	0	100	101	8	92	12		33	4

** The weeds are encountered before introducing the herbicides
*** The weeds are encountered 25 days after introducing the herbicides

The effect on annual cereal and broad-leaved weeds in „JURA“ hybrid varied from 88% to 100%, and in „PACHA“ hybrid – from 83% to 100%, and the initial weeding was prevented. Because of the unilateral spectrum of influence of the herbicide, the following weeds showed higher resistance: field bindweed – *Convolvulus arvensis* (L.), Canada thistle – *Cirsium arvense* (L.) and deady nightshade – *Solanum nigrum* (L.) – up to 87%. That enabled the rape in testing by pendimethalin (Stomp 330 EC) soil herbicide applied, to develop faster in their growth infancy and themselves to suppress the weed plants.

Tepraloxydim – metiloleat (Aramo 50) herbicide was selective to rape, when applied at the three doses.

Quizalofop-P-ethyl (Taurus) vegetation herbicide applied at a dose of 20 g.da^{-1} a.s. showed slight to moderate chlorosis only in „JURA“ hybrid (grade 4 according to EWRS scale), that on the 14^{-th} day was overcome, and at doses of 5 and 10 g.da^{-1} a.s. showed high selectivity (grade 1 according to EWRS scale).

In tepraloxydim – metiloleat (Aramo 50) and quizalofop-P-ethyl (Taurus) herbicides in both hybrids very good effects were registered on annual cereals weeds 91–100%, and a lower one – on annual broad-leaved weeds – 74–94%. As regards to perennial weeds: johnsongrass – *Sorgum halepense* (L.), Canada thistle – *Cirsium arvense* (L.) and bindweed – *Convolvulus arvensis* (L.), the herbicides showed unsatisfactory effect to 57%. The slight effect of herbicides on those weeds was influenced by their advanced phase of development (after 2nd leaf).

Conclusions

Pendimethalin (Stomp 330 EC) applied at dose of 264 g.da^{-1} a.s. caused serious crop damages (grade 6–7 according to EWRS scale), expressed in chlorosis and passing in necrosis.

Quizalofop-P-ethyl (Taurus) applied at a dose of 20 g.da^{-1} a.s. showed slight to moderate chlorosis only in “JURA” hybrid (grade 4 according to EWRS scale).

Pendimethalin (Stomp 330 EC) applied at doses of 66, 132 g.da^{-1} a.s., tepraloxydim – metiloleat (Aramo 50) – 27.5, 55, 110 g.da^{-1} a.s. and quizalofop-P-ethyl (Taurus) – 5, 10, 20 g.da^{-1} a.s. were selective to spring rape hybrids.

Pendimethalin (Stomp 330 EC) applied after sowing before crop emergence at doses of 66; 132 and 264 g.da^{-1} a.s. reduced the density of the annual cereal and broad-leaved weeds up to 100%, and the density of perennial ones – up to 57%.

Tepraloxydim – metiloleat (Aramo 50) and quizalofop-P-ethyl (Taurus) successfully controlled cereal weeds at 3–5 weed leaf phase and at leaf rosette phase of the crop from 91–100%, a slighter effect was observed on annual broad-leaved weeds – 74–94%. Herbicides showed a slight effect on perennial weeds – up to 57%.

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