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ELYMUS REPENS CONTROL BY GRAMINICIDE QUIZALOFOP-P-TEFURYL (PANTERA 040 EC) AT CROP ROTATION PEAS–SPRING CEREALS

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Abstract: Field experiments were conducted to determine quizalofop-P-tefuryl (Pantera 040 EC) efficacy for control of couchgrass (*E. repens*) at crop rotation peas-spring cereals. The results showed that herbicides applied at 4–8 leaf stage of *E. repens* enhanced weed control effect. Subsequent treatments i.e. at 10–12 leaf stage of *E. repens* were less effective. In the following years, the yield of spring cereals depended on efficacy of *E. repens* control in forecrop i.e. pea. Spring cereals (wheat and barley) gave better yield when higher level of *E. repens* control was observed.

Key words: quizalofop-P-tefuryl, couchgrass (*E. repens*), weed control, grass weeds, peas, crop rotation

I. INTRODUCTION

Couchgrass (*E. repens*) is an important grass weed that infests especially cereals, tuber crop and pod crop in most European countries. During the past decades in many sites of Poland a significant increase of couchgrass infestation was observed. Couchgrass has caused a considerable decrease of yield of cultivated plants, and complicates agronomical practices, postemergence and cultivation treatments. Although, many herbicides give a good efficacy against this weed, in next vegetation season on treated plantations there is often observed a regrowth of couchgrass shoots from rhizomes (Adamczewski and Praczyk 1988; Piskorz and Leska 1999). In the last years the wide use of graminicides against couchgrass and other grass weeds is frequently observed (Anyszka et al 1999; Anyszka and Dobrzański 1999; Rola et al. 1996; McIntire et al. 1990). The use of these herbicides apart from reduction of grass population in many broad-leaved crop plants shows an advantageous influence on next cultivated crop. For grass weeds control the following graminicides are used: quizalofop-P-tefuryl or quizalofop-P-ethyl. Quizalofop-P-tefuryl in quantities 40 g l^{-1} establishes active ingredient of graminicide Pantera 040 EC. It is a systemic herbicide applied on weeds after emergence. Graminicide is uptaken by plants through the leaves and is quickly translocated to the target places (Wilson 1997).

The aim of investigations was to determine the influence of graminicide quizalofop-P-tefuryl (Pantera 040 EC) on *E. repens* control, crop yielding at crop rotation peas-spring cereals.

II. METHODS

In 1996 and 1997 the efficacy of graminicides in the *E. repens* control in peas was investigated. In the next years i.e. in 1997 and 1998 residual effect of herbicide activity in spring cereals was determined. The experiments were carried out in Winna Góra Experimental Station of Institute of Plant Protection in Poznań. The field trials were conducted on grey brown podsolic soil.

Commercial formulation of quizalofop-P-tefuryl (Pantera 040 EC containing 40 g a. i. l^{-1} quizalofop-P-tefuryl, product Uniroyal Chemical) and quizalofop-P-ethyl as standard (Targa Super 5 EC containing 5% a. i. l^{-1} quizalofop-P-ethyl, product Nissan Chemicals Industries) were used in peas. Graminicides were applied at two times of application and different rates. The following treatments were applied: Pantera 040 EC at application rate 1.5; 1.75 and 2.0 l/ha and Targa Super 5 EC at 2.0 l/ha. The first application was done at 4–8 leaf growth stage of *E. repens* and the second took place at 10–12 leaf growth stage of *E. repens*. Broad-leaved weeds were treated with herbicide Basagran 480 SL (containing 480 g a. i. l^{-1} bentazon, product BASF) at application rate 3.0 l/ha.

In cereals (spring barley and spring wheat) the broad-leaved weeds were controlled with Chwastox Trio 540 SL (300 g a. i. l^{-1} mecoprop, 200 g a. i. l^{-1} MCPA and 40 g a. i. l^{-1} dicamba, product Z.CH. Organika-Sarzyna) at application rate 1.5 l/ha. The treatments were performed using backsprayer "Gloria" type with flat fan TeeJet 11003 XR nozzles at spray volume of 300 l ha^{-1} and spray pressure of 300 kPa. The experiments were arranged as a randomised complete block design with 4 replications and a plot size of 16.5 m^2.

The selectivity of herbicides was determined using a 1–9 scale, where 1 meant a complete resistance. Visual evaluation of phytotoxicity of graminicides was done 1and 3 weeks after each treatment.

Assessments in peas were performed visually 3–4 weeks after treatments as percent of *E. repens* control (evaluation of % green biomass compared to the untreated control, where 0% meant no difference to untreated and 100% meant the complete absence of living plants in the plot). Last evaluation was done after ear emergence of the peas. The data of successive observations were shown in the tables as a result of average destruction of *E. repens* plants.

Residual effect of graminicides in cereals was estimated from *E. repens* counts (weight of rhizomes before crop sowing, number of shoots before earing) and visual assessments of infestation after harvest in 1–9 scale.

The seed yield, weight of 1000 pea seeds and yielding of cereals i.e. grain yield, weight of 1000 grains and number of ears per sq.m were estimated. The yield results were statistically worked out with analysis of variance and Student's test.

III. RESULTS

The results are presented in tables 1, 2, 3 and 4. Tables 1 and 2 show the influence of quizalofop-P-tefuryl on *E. repens* control in peas (in 1996 and 1997, respectively). Tables 3

Table 1

The influence of quizalofop-P-tefuryl (Pantera 040 EC) on *Elymus repens* control in peas (1996 and 1997)

Time of application	Treatment	Rate (l ha^{-1})	Control of Elymus repens in %		
			Year		Mean for year
			1996	1997	
	Untreated (density – no. m^{-2})	–	(58.6)	(52.3)	
Elymus repens at 4–8 leaf stage	Pantera 040 EC	1.5	91	96	93.5
	Pantera 040 EC	1.75	94	98	96.0
	Pantera 040 EC	2.0	96	99	97.5
	Targa Super 5 EC	2.0	98	98	98.0
Elymus repens at 10–12 leaf stage	Pantera 040 EC	1.5	72	76	74.0
	Pantera 040 EC	1.75	80	82	81.0
	Pantera 040 EC	2.0	85	84	84.5
	Targa Super 5 EC	2.0	81	79	80.0

and 4 give the results of experiments in which residual effects of graminicides in spring barley (1997) and spring wheat (1998) were investigated.

In 1996 the effectiveness of quizalofop-P-tefuryl in peas was generally good, although high density of *E. repens* was noted (58.6 no. per sq.m). Major differences occur in the susceptibility of the weed to the herbicides as related to the time of application at the different growth stages of *E. repens.* The best results of biological activity of quizalofop-P-tefuryl were recorded when the treatment was performed at 4–8 leaf stage of *E. repens*. In 1996 the

Table 2

Response of peas to graminicide quizalofop-P-tefuryl (Pantera 040 EC) (1997 and 1997)

Time of application	Treatment	Rate (l ha^{-1})	Phytotoxicity to peas	Weight of 1000 seeds (g)		Yield (t ha^{-1})	
			Average in 1996 and 1997 (1–9 scale)	1996	1997	1996	1997
	Untreated	–	1	202	206	0.45	0.45
Elymus repens at 4–8 leaf stage	Pantera 040 EC	1.5	1	208	215	1.03	1.17
	Pantera 040 EC	1.75	1	215	224	1.47	1.67
	Pantera 040 EC	2.0	1	217	227	2.05	2.28
	Targa Super 5 EC	2.0	1	220	230	2.04	2.24
Elymus repens at 10–12 leaf stage	Pantera 040 EC	1.5	1	203	211	0.92	1.02
	Pantera 040 EC	1.75	1	205	215	1.22	1.52
	Pantera 040 EC	2.0	1	212	216	1.83	2.13
	Targa Super 5 EC	2.0	1	211	214	1.90	2.13
				$LSD_{0.05}$=		0.162	0.156

Table 3

Residual effect of quizalofop-P-tefuryl – Pantera 040 EC (applied in 1996) in spring barley (1997)

Time of application	Treatment	Rate (l ha^{-1})	Residual effect in spring barley (1997)						
			Weight of rhizomes before crop sowing (g m^{-2})	Number of shoots before earing (no. m^{-2})	Infestation after harvest (1–9 scale)	Weight of 1000 grains (g)	Number of grains in ear (no.)	Number of ears per sq. m	Yield (t ha^{-1})
Elymus repens at 4–8 leaf stage	Untreated	–	2125	58.6	9	45.3	22.1	443	1.86
	Pantera 040 EC	1.5	182	15.8	3	49.2	23.0	468	3.22
	Pantera 040 EC	1.75	65	10.6	2	50.6	23.9	472	4.13
	Pantera 040 EC	2.0	25	5.7	1–2	50.5	24.5	483	4.85
	Targa Super 5 EC	2.0	24	5.8	1–2	50.4	24.3	481	4.86
Elymus repens at 10–12 leaf stage	Pantera 040 EC	1.5	689	36.5	5–6	46.8	22.1	452	2.97
	Pantera 040 EC	1.75	367	22.4	5	48.6	23.2	463	3.83
	Pantera 040 EC	2.0	289	16.2	4–5	48.9	23.1	474	4.31
	Targa Super 5 EC	2.0	293	17.0	4–5	49.1	23.4	469	4.33
								$LSD_{0.05}$=	0.207

optimum efficiency (91%, 94% and 96%) was obtained with the rate 1.5; 1.75 and 2.0 l /ha, respectively. In the next year the similar results in controlling couchgrass were recorded (efficacy from 96 to 98% respectively).

No phytotoxicity effects with graminicides applied at different application rates on pea plants were observed (1 in 1–9 scale).

The residual effect of graminicides applied at two growth stages of peas showed that the early application (at 4–8 leaf stage of *E. repens*) resulted in considerably greater reduction in weight of rhizomes than the late application. As those trends were observed in both experiments it is most likely that the differences in growth stages account for the observed differences in herbicide activity. Besides, number of shoots of *E. repens* before earing and also the infestation after harvest of cereals were correlated with efficacy of control of *E. repens* in peas. The results emphasize the importance of the time of herbicide application.

The pea yield in 1996 and 1997 was usually correlated with the degree of couchgrass control (Tab. 2). The yields from the herbicide treated plots were significantly higher than from untreated plots. Yield was increased when higher level of *E. repens* control was ob-

Table 4

Residual effect of quizalofop-P-tefuryl – Pantera 040 EC (applied in 1997) in spring wheat (1998)

Time of application	Treatment	Rate (l ha^{-1})	Residual effect in spring barley (1997)						
			Weight of rhizomes before crop sowing (g m^{-2})	Number of shoots before earing (no. m^{-2})	Infestation after harvest (1–9 scale)	Weight of 1000 grains (g)	Number of grains in ear (no.)	Number of ears per sq. m	Yield (t ha^{-1})
Elymus repens at 4–8 leaf stage	Untreated	-	2912	63.6	9	38.9	28.1	357	1.37
	Pantera 040 EC	1.5	282	18.8	3–4	45.2	35.0	448	3.25
	Pantera 040 EC	1.75	165	14.6	3	47.6	37.9	462	3.83
	Pantera 040 EC	2.0	86	8.7	2	48.4	43.8	473	4.34
	Targa Super 5 EC	2.0	93	8.8	2	48.5	44.3	478	4.28
Elymus repens at 10–12 leaf stage	Pantera 040 EC	1.5	659	49.3	6–7	44.6	33.1	418	2.33
	Pantera 040 EC	1.75	417	32.4	6	45.6	34.2	433	3.74
	Pantera 040 EC	2.0	489	26.2	5	46.9	36.1	444	3.97
	Targa Super 5 EC	2.0	493	27.0	5	46.6	35.4	448	3.93
								$LSD_{0.05}$=	0.187

served. In both years 1996 and 1997 the highest yield of pea stood with the best activity of quizalofop-P-tefuryl applied at 2.0 l/ha (2.05 t/ha and 1.83 t/ha in 1996 and 2.28 t/ha and 2.13 t/ha in 1997, respectively). The influence of graminicides on weight of 1000 seeds was slightly differentiated and mostly insignificant.

Yield of residual crops i.e. spring barley and spring wheat depended on the herbicides efficacy in pea and thereby depended on the density of couchgrass shoots in cereals (Tabs 3 and 4). The highest *E. repens* infestation in cereals was stated in the technology of the lowest efficacy of weed control in peas. The highest yield of spring barley was (4.85 t/ha) correlated with the lowest infestation of couchgrass (5.7 plants m^{-2}). The similar trend in spring wheat crop was observed. The application of graminicides at 10–12 leaf *E. repens* stage in forecrop (pea) reduced yields of cereals when compared to the treatments applied earlier. The differences between the yield were statistically significant. The considerable yield losses have been measured on the untreated plots. The yield of spring barley and spring wheat was increased by 73–160 % and 137–217 % when compared to the untreated plots, respectively due to the application rate of graminicides. All the components of yield (weight

of 1000 grains, number of grains in ear, number of ears per sq. m) were affected by couchgrass competition in both cereals

IV. DISCUSSION

A reduction in the number of treatments can be obtain either by the reduction the number of rides through the crop, which are treated with herbicide or by applying reduced doses. The reduction in the number of herbicide treatments can be achieved at different ways. It can be an introduction of economic thresholds, using non-chemical methods of weed control or the influence of decreased number of couchgrass shoots resulting from the good weed control in the forecrop.

Field experiments with graminicides applied in peas and their residual effect in cereals (spring wheat and spring barley) confirm the possibility of reduction in the number of herbicide treatments with satisfactory efficacy of couchgrass control and increase of yield of cereals. The results showed that biological activity of quizalofop-P-tefuryl depended on the growth stage of *E. repens* and the application rate. The best efficacy was obtained when the gramicicide was applied at earlier growth stage of *E. repens*, at 4–8 leaf regardless of application rate. Subsequent treatment at 10–12 leaf growth stage of *E. repens* reduced the efficacy of couchgrass control in pea and in the consequence influenced the increase of infestation and significant loss of yield in the following crops cultivated in crop rotation. Those results have been confirmed in the other research (Rola and Badowski 1998). The yield of spring cereals (barley and wheat) depended on the efficacy of couchgrass control in forecrop i.e. pea.

V. REFERENCES

1. Adamczewski K., Praczyk T. 1988. Efektywność chemicznych metod zwalczania *Elymus repens*. Materiały Kraj. Symp., Bielsko-Biała, 29–30 IX: 202–210.
2. Anyszka Z., Dobrzański A. 1999. The response of snap bean and barnyardgrass (*Echinichloa crus-galli*) on quizalofop-P-tefuryl. Vegetatable Crops Research Bulletin vol. 51: 95–102.
3. Anyszka Z., Dobrzański A., Pałczyński J. 1999. Zastosowanie chizalofop-P-tefurylu do zwalczania chwastów jednoliściennych w uprawie marchwi (*Daucus carota* L.). Materiały XVII Spot. Zesp. Herb. Kom. Nauk Ogr. PAN, Skierniewice–Olsztyn, 25 V 1999: 58–61.
4. McIntire W.S., Bell A.R., Ams R.B. 1990. UBI C4874 PANTERA, a new postemergence herbicide for control of grassy weeds. Proceedings of the 43rd Annual meeting of the Southern Weed Society: 384–388.
5. Rola J., Badowski M., Sadowski J. 1996. Pantera 040 EC – nowy graminicyd do zwalczania rocznych i wieloletnich chwastów jednoliściennych w roślinach uprawnych. Prog. Plant Protection/ Post. Ochr. Roślin 36(2): 290–292.
6. Rola J., Badowski M. 1998. Żywotność rozłogów *Elymus repens* po zastosowaniu różnych herbicydów. Prog. Plant Protection/ Post. Ochr. Roślin 38(1): 64–72.
7. Piskorz B., Leska L. 1999. Odrastanie perzu właściwego (*Agropyron repens* L.) po zastosowaniu herbicydów. Rocz. Nauk Roln., Seria A, T. 114, Z. 1–2: 165–171.
8. Wilson J. 1997. Quizalofop-P-tefuryl – a new post emergence herbicide for control of annual and perennial grass weeds in broad-leaved crops. 10th EWRS Symp., p.162.

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STRESZCZENIE

Graminicyd quizalofop-P-tefuryl (Pantera 040 EC) stosowany w uprawie grochu, we wcześniejszym terminie, tj. w fazie 4–8 liści perzu właściwego, skutecznie zwalczył ten groźny gatunek chwastu. Późniejszy zabieg środkiem Pantera 040 EC w fazie 10–12 liści perzu właściwego odznaczał się znacznie gorszym efektem działania. Wyraźne zróżnicowanie w skuteczności chwastobójczej uzyskane dla różnych faz rozwojowych perzu obserwowano w każdym roku badań i było ono uzależnione od zastosowanej dawki graminicydu. Poziom zachwaszczenia perzem właściwym w roślinach następczych (jęczmień jary i pszenica jara) był ściśle związany ze skutecznością zniszczenia tego gatunku w przedplonie, tj. w grochu. Przyrost plonu jęczmienia jarego i pszenicy jarej był na ogół ściśle skorelowany z efektem chwastobójczym działania graminicydu Pantera 040 EC w przedplonie. Plon zbóż jarych uprawianych po grochu był istotnie wyższy na obiektach, na których efektywność zniszczenia perzu właściwego była wysoka.