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EVALUATION OF IODOSULFURON AND AMIDOSULFURON MIXTURE TO CONTROL BROAD-LEAVED WEEDS IN WINTER AND SPRING CEREALS

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Abstract. The aim of the experiments was to evaluate the effect of Sekator 6,25 WG used for broad leaved weeds control in winter and spring cereals. Sekator 6.25 WG herbicide is composed of iodosulfuron 1.25%, amidosulfuron 5% and mephenpyr diethyl 12.5%. The field trials were conducted over the period 1997-1999 at experimental station, which belonged to the Institute of Plant Protection. The results showed that Sekator 6,25 WG effectively controled *Galium aparine, Anthemis arvensis, Myosotis arvensis, Chenopodium album, Polygonum* sp., *Sinapis arvensis*, *Stellaria media, Capsela bursa-pastoris, Thlaspi arvense* and *Lamium purpureum*. The obtained yield of winter and spring cereals was increased by Sekator 6,25 WG application. Sekator 6,25 WG herbicide used in all experiments was safe for both winter and spring cereals.

Key words: sulfonylurea, herbicide, broad-leaved weeds, winter cereals, spring cereals, weed control

I. INTRODUCTION

In 1980 the new chemical sulfonylurea class was discovered and presented and it was the beginning of development of the new herbicides generation (Palm and Allison 1980). Using only few to hundred grams per hectare of those herbicides provides very high level of weed control. Herbicides from sulfonylurea group are very selective to cereals and other crops, except sugar beet and oilseed rape (Adamczewski et al.1988; Adamczewski et al.1996; Amerin and Gerber 1985; Ferguson et al.1980; Sidonis et al.1985).

Some active ingredients from sulfonylurea group, as e.g. chlorsulfuron, need longer time for degradation in soil. Cultivation of sugar beet and oilseed rape in crop rotation after using this compound can be difficult or impossible (Paradowski 1994).

Iodosulfuron is a new active ingredient patented by Aventis, previously – AgrEvo (Hacker et al.1995). The mixture of iodosulfuron with mephenpyr diethyl as a safener (in ratio 1:3) reveals high selectivity to winter and spring cereals and gives excellent monocotyledonous and dicotyledonous weed control. Iodosulfuron methyl-sodium is already registered in Poland under trade name Huzar 05 WG. Another product containing 1.25% iodosulfuron methyl-sodium, 5% amidosulfuron and 12.5% mephenpyr diethyl is also registered in Poland under trade name Sekator 6,25 WG. Co-formulation of iodosulfuron and amidosulfuron is able to control the wider spectrum of weed species. It has favourable toxicological and environmental profiles with low potential risk for the following crops (Adamczewski et al.1998). The producer informs that rapid soil degradation and limited bioavailability of the herbicide induce no carry-over risks when used under normal agricultural and environmental conditions. Sekator 6,25 WG is a post-emergence herbicide recommened for using until the end of tillering of cereals. Weeds are the most sensitive at the stage

of 2-4 leaves. First data from field trials on the effectiveness of this compound in Polish conditions were published by Adamczewski and Miklaszewska (2000). The active ingredients are taken up by roots and leaves and translocated in weed plants causing retardation of their growth and development. Iodosulfuron blockades AHAS enzyme responsible for amino acids biosynthesis. The full weed killing effects occur 14-18 days after treatment. Sekator 6,25 WG controls the wide spectrum of broad-leafed weeds.

The objective of field trials was to evaluate Sekator 6,25 WG efficacy in winter and spring wheat, winter and spring triticale, rye and spring barley to dicotyledonous weed control.

II. MATERIALS AND METHODS

The experiments were carried out at Experimental Station of the Plant Protection Institute in Winna Góra, Sośnicowice and Trzebnica over the period 1997-1999. All field experiments were designed in the randomised block design, on pods soil based on loamy sand. Cultivation and fertilisation were performed according to the best agronomic practices for these commercial crops. The sowing rate was right typical for region and species of cereals. The plot area was 20 m^2. Sekator 6,25 WG was applied at four rates: 0.15; 0.2; 0.25 and 0.3 kg/ha. As a standard Granstar 75 WG was used at dose rates 15 and 20 g/ha. The products were applied post-emergence at full tillering of cereals. Treatment timings were as follows: first half of April for rye, second half of April for winter wheat and winter triticale. Spring cereals were sprayed in the middle of May. The herbicides were applied with a small plot sprayer of Gloria type, using the XR 1103 nozzles, a spray volume 300 l/ha and pressure of 3 bar.

The efficacy assessments were made 3 weeks after treatment. On the control plots weed counting was performed 4 times on 0.25 m^2. On the treated plots weed control was rated using the scale 0 to 100%, where 0 = no control and 100 = complete control. Crop phytotoxicity was assessed visually 2 weeks after treatment. Number of ears was counted (4 x 0.25 m^2) on each plot before harvest. Number of grains was estimated on the basis of 25 ears from one plot (100 ears from one treatment). Weight of 1,000 grains was determined. The cereals were harvested at maturity using a plot combine. The LSD method was used to process data statistically. Standard error P = 0.05. The tables consolidated the average data from 3 years experiments.

III. RESULTS

Galium aparine, Viola arvensis, Anthemis arvensis, Papaver rhoeas, Myosotis arvensis, Veronica sp. and *Fumaria oficinalis* were the most numerous weed species in winter wheat, winter triticale and rye (Tabs. 1, 2, 3). Spring cereals – wheat, barley and triticale were mostly infested by: *Chenopodium album, Viola arvensis, Anthemis arvensis, Sinapis arvensis, Stellaria media, Capsella bursa-pastoris, Thlaspi arvense* and *Polygonum* sp. (Tabs. 4, 5, 6).

Table 1

Influence of Sekator 6,25 WG herbicide on weed control and yield in winter wheat

	Dose per ha	Percent of weed control					Weight of 1,000 grains g	No of grains in ear	No of ears per sq. m	Yield t/ha
		Galap	Antar	Vioar	Lampu	Verpe				
Sekator 6,25 WG	0.15	89	88	64	82	56	39.9	40.5	440	6.95
Sekator 6,25 WG	0.2	90	94	68	88	74	41.9	41.4	455	7.07
Sekator 6,25 WG	0.25	93	99	70	95	79	42.2	41.6	482	7.18
Sekator 6,25 WG	0.3	98	100	83	98	86	41.8	42.2	494	7.25
Granstar 75 WG	0.015	75	96	72	98	67	40.6	41.2	462	6.91
Granstar 75 WG	0.02	79	99	75	100	89	41.8	42.7	486	7.27
Kontrola	–	(38)	(18)	(15)	(14)	(12)	38.2	37.1	391	5.81

LSD (0.05%)=0.199=

Table 2

Influence of Sekator 6,25 WG herbicide on weed control and yield in winter triticale

	Dose per ha	Percent of weed control					Weight of 1,000 grains g	No of grains in ear	No of ears per sq. m	Yield t/ha
		Vioar	Galap	Verpe	Fumof	Paprh				
Sekator 6,25 WG	0.15	30	72	67	88	45	39.8	48.6	422	6.83
Sekator 6,25 WG	0.2	33	84	69	89	55	39.7	47.9	442	6.93
Sekator 6,25 WG	0.25	37	90	72	96	74	40.2	51.3	456	7.01
Sekator 6,25 WG	0.3	40	95	84	100	85	40.7	51.8	446	7.05
Granstar 75 WG	0.015	55	65	74	71	52	40.2	51.3	438	6.86
Granstar 75 WG	0.02	65	70	85	80	65	40.9	50.0	461	6.95
Kontrola	–	(36)	(16)	(13)	(10)	(8)	36.2	48.7	411	6.01

LSD (0.05%) =0.121=

Table 3

Influence of Sekator 6,25 WG herbicide on weed control and yield in winter rye

	Dose per ha	Percent of weed control						Weight of 1,000 grains g	No of grains in ear	No of ears per sq. m	Yield t/ha
		Vioar	Antar	Myoar	Galap	Verer	Paprh				
Sekator 6,25 WG	0.15	20	78	70	81	59	92	30.8	45.8	469	6.16
Sekator 6,25 WG	0.2	45	90	91	95	67	98	33.0	47.1	489	6.34
Sekator 6,25 WG	0.25	55	99	95	95	82	100	33.4	50.1	517	6.37
Sekator 6,25 WG	0.3	68	100	100	100	90	100	32.9	54.3	520	6.38
Granstar 75 WG	0.015	54	87	72	69	72	98	31.1	45.7	472	6.03
Granstar 75 WG	0.02	78	98	87	87	80	100	32.7	49.6	526	6.37
Kontrola	–	(32)	(26)	(22)	(9)	(8)	(8)	29.5	43.3	451	5.51

LSD (0.05%) =0.145=

Table 4

Influence of Sekator 6,25 WG herbicide on weed control and yield in spring wheat

	Dose per ha	Percent of weed control						Weight of 1,000 grains g	No of grains in ear	No of ears per sq. m	Yield t/ha
		Cheal	Vioar	Antar	Capbp	Polco	Sinar				
Sekator 6,25 WG	0.15	79	81	89	91	90	94	42.3	29.0	548	5.64
Sekator 6,25 WG	0.2	92	88	94	96	95	98	43.3	32.4	579	5.77
Sekator 6,25 WG	0.25	96	91	98	100	100	100	44.0	32.8	623	5.87
Sekator 6,25 WG	0.3	97	90	98	100	100	99	43.7	32.6	643	5.85
Granstar 75 WG	0.015	82	80	98	99	100	99	41.9	30.7	560	5.57
Granstar 75 WG	0.02	89	86	99	100	99	100	43.7	31.8	632	5.81
Kontrola	–	(67)	(22)	(21)	(20)	(18)	(13)	41.2	29.2	521	4.79

LSD (0.05%) =0.178=

Table 5

Influence of Sekator 6,25 WG herbicide on weed control and yield in spring triticale

	Dose per ha	Percent of weed control					Weight of 1,000 grains g	No of grains in ear	No of ears per sq. m	Yield t/ha
		Cheal	Vioar	Polav	Antar	Thlar				
Sekator 6,25 WG	0.15	85	90	90	97	95	47.8	42.2	534	5.60
Sekator 6,25 WG	0.2	90	98	96	100	100	48.0	43.2	544	5.69
Sekator 6,25 WG	0.25	95	97	99	100	100	48.6	43.4	551	5.78
Sekator 6,25 WG	0.3	98	100	100	100	100	49.1	42.9	562	5.89
Granstar 75 WG	0.015	97	75	74	100	98	48.0	41.8	540	5.57
Granstar 75 WG	0.02	99	78	80	100	100	49.6	43.7	565	5.76
Kontrola	–	(36)	(16)	(15)	(13)	(8)	45.5	39.8	451	5.01

LSD (0.05%) =0.167=

Table 6

Influence of Sekator 6,25 WG herbicide on weed control and yield in spring barley

	Dose per ha	Percent of weed control					Weight of 1,000 grains g	No of grains in ear	No of ears per sq. m	Yield t/ha
		Cheal	Vioar	Polco	Steme	Verar				
Sekator 6,25 WG	0.15	86	98	93	97	62	43.5	21.6	707	5.19
Sekator 6,25 WG	0.2	98	100	96	100	70	43.9	22.4	710	5.37
Sekator 6,25 WG	0.25	97	100	96	100	80	43.7	22.5	724	5.53
Sekator 6,25 WG	0.3	100	100	100	100	90	44.6	23.0	731	5.60
Granstar 75 WG	0.015	91	83	92	96	84	44.1	22.3	698	5.18
Granstar 75 WG	0.02	98	88	99	100	87	43.9	23.4	731	5.53
Kontrola	–	(39)	(31)	(24)	(12)	(10)	43.1	21.9	659	4.71

LSD (0.05%) =0.265=

The efficacy of Sekator 6,25 WG was correlated with dose rates, weed species and their development stage at the time of treatment. The lowest dose rate of Sekator 6,25 WG was not efficacious to control most of weed species occurred in the experimental fields. Control level of *Galium aparine* was high: from 89 to 98% in winter wheat (Tab. 1), 81–100% in rye (Tab. 3) and in winter triticale from 72 to 95% (Tab. 2). In winter triticale crop, *G.aparine* was treated at older stage of development therefore the dose 0.15 kg/ha of Sekator 6,25 WG was insufficient to control this species.

Sekator 6,25 WG showed very high activity against *Anthemis arvensis* (78-100%), *Capsella bursa-pastoris, Sinapis arvensis* and *Thlaspi arvense* (91-100%), *Polygonum* sp. (90-100%) and *Stellaria media* (97-100%).

Spring cereals were mostly infested with *Chenopodium album*. The control level of this species with Sekator 6,25 WG was very high. Only in spring wheat crops, where *Chenopodium* was at older stage of development, the lowest dose of the compound gave not satisfactory effect. Efficacy of Sekator 6,25 WG used against *Viola arvensis* and *Papaver rhoeas* was correlated with the stage of weed development. In rye, *Papaver rhoeas* was at older stage and that was the reason why the control level was not satisfactory.

Viola arvensis was very abundant weed in winter and spring cereals (Tabs. 1, 2, 3). During spring treatment in winter cereals this species, which germinated in autumn, was at very advanced stage. The control of *V. arvensis* was as follows: 64-83% in winter wheat, 30--40% in winter triticale and from 20 to 68% in rye. Sekator 6,25 WG used for *Viola arvensis* control in spring cereals provided much better effect, because the weeds were at early stage of development at the time of treatment. This species was controlled from 81-to100%.

Tabele 7

Influence of dose rates of Sekator 6,25 WG on weed control (%)

Weeds species	Dose rate kg/ha			
	0.15	0.2	0.25	0.3
Anthemis arvensis	88	94	99	100
Capsela bursa-pastoris	91	96	100	100
Chenopodium album	83	93	96	98
Fumaria oficinalis	88	89	96	100
Galium aparine	81	90	93	98
Lamium purpureum	82	88	95	98
Myosotis arvensis	70	91	95	100
Papaver rhoeas	69	72	87	93
Polygonum convolvulus	92	95	98	100
Polygonum aviculare	90	96	99	100
Sinapis arvensis	94	98	100	99
Stellaria media	97	100	100	100
Thlaspi arvense	95	100	100	100
Veronica arvensis	61	69	81	90
Veronica persica	62	72	76	85
Viola arvensis	64	72	75	80

Granstar 75 WG used as a standard controlled weeds also in a very high percent. Especially the dose 20 g/ha provided good results. Table 7 contains data from average weed control with different dose rates of Sekator 6,25 WG. The data show that *Veronica arvensis*, *Veronica persicaria* and *Viola arvensis* are not very sensitive to Sekator 6,25 WG.

No phytotoxic effects of the used herbicide were observed in winter and spring cereals. Sekator 6,25 WG used at higher dose was tolerant for the crops.

The yield of cereals was determined (Tabs. 1, 2, 3, 4, 5, 6). Statistically processed data

showed that after using Sekator 6,25 WG yield of all species of cereals was higher than on untreated plots. Higher dose rate of the compound and higher weed control was correlated with yielding in each experiment. Higher yield was also correlated with the weight of 1,000 grains, the average number of grains in the ear and the number of ears per square mete IV.

VI. CONCLUSION

The yield of winter cereals was increased by Sekator 6,25 WG application. In winter wheat the yield was higher from 20 to 25% in comparison to untreated plots. In winter triticale the yield was increased from 14 to 17% and in winter rye from 12 to 16% in comparison to untreated plots. Also in spring cereals higher yield, than on untreated plots, was observed: 18--23% in spring wheat, 12-18% in spring triticale and 10-19% in spring barley. The efficacy of weed control was increased with the dose compound. Very good control of *Galium aparine, Anthemis arvensis, Myosotis arvensis, Chenopodium album, Polygonum* sp., *Sinapis arvensis, Stelleria media, Capsela bursa-pastoris, Thlaspi arvense* and *Lamium purpureum* was observed. Lower activity of the herbicide against *Papaver rhoeas* (in winter triticale) and *Veronica* sp. was noted. The control of *Viola arvensis* was good in spring cereals but in winter crops the control of this species was not satisfactory. Sekator 6,25 WG used in all experiments was safe for both winter and spring cereals.

The presented results of Sekator 6,25 WG were used for registration of the herbicide in Poland.

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OCENA PRZYDATNOŚCI JODOSULFURONU W MIESZANCE Z AMIDOSULFURONEM DO ZWALCZANIA CHWASTÓW DWULIŚCIENNYCH W ZBOŻACH OZIMYCH I JARYCH

STRESZCZENIE

Badania polowe nad biologiczną oceną herbicydu Sekator 6,25 WG przeprowadzono w latach 1997-1999 w Rolniczym Zakładzie Doświadczalnym w Winnej Górze, Terenowej Stacji Doświadczalnej w Trzebnicy i Sośnicowicach.

Herbicyd Sekator 6,25 WG jako substancję biologicznie czynną zawiera 1,25% jodosulfuronu, 5% amidosulfuronu i 12,5% mefenpyr diethylu jako sejfnera. Herbicyd stosowano wiosną w pełni krzewienia zbóż w dawkach: 0,15; 0,2; 0,25 i 0,3 kg/ha.

Uzyskane wyniki wskazują, że Sekator 6,25 WG skutecznie zwalczał: *Galium aparine, Anthemis arvensis, Myosotis arvensis, Chenopodium album, Polygonum* sp., *Sinapis arvensis, Stellaria media, Capsela bursa-pastoris, Thlaspi arvense* i *Lamium purpureum*. Nieco słabiej był zwalczany *Papaver rhoeas* (w pszenżycie) i *Veronica* sp. *Viola arvensis* był dobrze zwalczany w zbożach jarych, ale znacznie słabiej w zbożach ozimych.

Plony ziarna, zarówno zbóż ozimych jak i jarych, były wyższe na poletkach, gdzie zastosowano Sekator 6,25 WG. W pszenicy ozimej przyrost plonu wynosił 20-25%, w pszenżycie 14-17%, a w życie od 12 do 16%. Również w pszenicy jarej wzrost plonu ziarna wynosił 18-23%, w pszenżycie jarym 12-18%, a w jęczmieniu jarym od 10 do 19%.

Herbicyd Sekator 6,25 WG we wszystkich doświadczeniach okazał się selektywny dla zbóż.