

## WEED CONTROL IN SPRING CEREALS BY LOWER DOSES OF HERBICIDES

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**Abstract:** In the years 2000–2002 the evaluation of herbicides' efficacy used in lowered doses was conducted. Six herbicides recommended for weed control in spring cereals were used for investigation. The majority of species of weeds occurring in spring wheat and spring barley reacted with a strong (above 90%) decrease of the fresh weight to the treatment with the herbicides applied in the doses reduced by 25%–50% in relation to the recommended ones. *Polygonum convolvulus* L., *Polygonum persicaria* L. and *Thlaspi arvense* L. were very sensitive species as they were very good controlled by tested herbicides in the doses decreased by 50%–75%. *Veronica hederifolia* L. and *Viola arvensis* Murr. were characterised by a low level of sensitivity and were controlled only by full recommended doses of tested herbicides.

The significant statistical decrease on yield of spring wheat on the objects treated with the herbicides Aurora Super 61,5 SG (mecoprop-P+carfentrazone-ethyl), Granstar 75 DF (tribenuron-methyl) and Grodyl 75 WG (amidosulfuron) in the doses lowered by 50% in relation to the recommended ones and Starane 250 EC (fluroxypyr) and Chwastox Trio 540 SL (mecoprop+MCPA+dicamba) in the dose lowered by 50%–75% was not observed. In the case of the herbicide Aminopielik D 450 SL (2,4-D+dicamba) the reduction of the dose by 25%–50% also did not cause decrease on yield of spring wheat.

In the spring barley, the significant statistical decrease of yielding was not observed on all treatments with tested herbicides applied in the doses reduced by 50%–75%.

**Key words:** herbicides, reduced doses, cereals, regulation of weed infestation

### INTRODUCTION

More than half of the chemical substances used in plant protection are reckoned among herbicides (Torstenson 1996). In the Western Europe and Scandinavian countries for the last several years the use of reduced herbicide doses by farmers has been widely observed (Gauvrit 1991; Thonke 1991). It is a result of the ten-

dency to use herbicides more rationally (Proven et al. 1991; Whiting et al. 1991). It is connected with aiming at limiting the amounts of biologically active substances applied to the fields under cultivation during phytosanitary treatments (Rola et al. 1998). The major object of this activity is the regulation of weeding to the level not endangering the crop and weakening the condition of the weeds (Domaradzki and Rola 2000). This mechanism is strictly connected with the change of viewing the problem of human interference with the environment of segetal weeds occurring in a corn-field of cultivated plant (Domaradzki and Rola 2001).

The aim of the research conducted in the Department of Ecology and Weed Control in Wrocław was the assessment of effectiveness of the influence of changing doses of herbicides and their influence on yielding of spring cereals.

## MATERIAL AND METHODS

In the years 2000–2002 in the Institute of Soil Science and Plant Cultivation, Department of Ecology and Weed Control in Wrocław, 15 field experiments were conducted (9 in spring wheat and 6 in spring barely). The experiments were carried out with the use of the method of randomly chosen blocks, in three replications, on the 20 m<sup>2</sup> fields. All trials were localised in the production fields of spring cereals, in the south-west part of Poland (brown soil of class II–IIIb, podsolc soil of class IIIa–IVb, and chernozem of class II–IIIa). Six herbicides commonly used in practice to control weeds in spring wheat and in spring barely were taken into account in the experiments (Tab. 1).

Herbicides were applied in four doses – maximum recommended one (1/1) and three reduced ones (by 25% – 3/4, by 50% – 1/2 and by 75% – 1/4). The herbicides were applied with the use of the rucksack sprayer “Gloria”, with the constant pressure of 0.25 MPa and the expenditure of the spray liquid of 250 l/ha. The application was performed in spring at the tillering growth stage of cereals, in the recommended terms for each herbicide.

The assessment of the herbicides effectiveness was based on a calculation of the reduction of the fresh weight of weeds compared to the untreated plots. Aiming at this, 4–5 weeks after the application of the herbicide the weight and the number of

Table 1. Characteristic of tested herbicides

Herbicide	Active ingredient	Producer	Dose per ha (l, kg, g)			
			full (1/1)	3/4	1/2	1/4
Aminopielik D 450 SL	2,4-D = 417.5 g/l, dicamba = 32.5 g/l	Zakłady Chemiczne “Rokita” S.A.	3	2.25	1.5	0.75
Aurora Super 61,5 SG	mecoprop-P = 60%, karfentrazon ethyl = 1.5%	FMC Corporation	0.8	0.6	0.4	0.2
Chwastox Trio 540 SL	mecoprop = 300 g/l, MCPA = 200 g/l, dicamba = 40 g/l	Zakłady Chemiczne „Organika – Sarzyna”	2	1.5	1.0	0.5
Granstar 75 DF	tribenuron-methyl = 75%	Du Pont de Nemours	20	15	10	5
Grodyl 75 WG	amidosulphuron = 75%	Bayer CropSciences	20	15	10	5
Starane 250 EC	fluroxypyr = 250 g/l	DOW AgroScience	0.8	0.6	0.4	0.2

particular species of weeds growing in three randomly chosen places of each field ( $3 \times 0.25 \text{ m}^2$ ) were assessed. The weeds were cut just above the surface of the ground, on the level of root crown and weighed. Based on the outcome, the decrease in the weight of weeds as a result of herbicide treatment was assessed. The trials were harvested by the field mini-combine nurserymaster Elite Z 035 at the stage of full ripeness.

## RESULTS

Reduction of the fresh weight of weeds caused by the herbicides (Tab. 2).

Generally, during the three years of investigations, 30 species of weeds were observed in the experiments, among which only 10 of them occurred as dominating ones in at least 5 experiments. These were: *Anthemis arvensis* L. (ANTAR), *Chenopodium album* L. (CHEAL), *Galium aparine* L. (GALAP), *Lamium purpureum* L. (LAMPU), *Polygonum concolculus* L. (POLCO), *Polygonum persicaria* L. (POLPE), *Stellaria media* (L.) Vill. (STEME), *Thlaspi arvense* L. (THLAR), *Veronica hedirifolia* L. (VERHE) and *Viola arvensis* Murr. (VIOAR),

Table 2. Reduction of fresh weight of weeds treated with herbicides used in full and reduced doses

Herbicide	Dose	Average for all weeds	Reduction of weeds' fresh weights (%)									
			for predominant weed species:									
			ANTAR	CHEAL	GALAP	LAMPU	POLCO	POLPE	STEME	THLAR	VERHE	VIOAR
Aminopielik D 450 SL	0.75	68.9	49	81	56	73	99	85	70	90	48	34
	1.5	84.6	68	93	73	84	100	100	84	97	65	53
	2.25	91.5	76	99	78	88	100	100	93	99	88	66
	3.0	94.9	95	99	91	96	100	100	98	99	96	80
Chwastox Trio 540 SL	0.5	61.3	53	78	61	45	83	92	78	87	26	24
	1.0	79.7	73	91	79	68	100	100	89	94	52	63
	1.5	92.1	81	99	89	84	100	100	97	98	79	78
	2.0	95.9	97	99	96	96	100	100	100	98	90	90
Starane 250 EC	0.2	61.0	41	46	84	66	90	59	88	86	32	21
	0.4	78.8	66	61	95	92	95	89	96	94	53	43
	0.6	88.9	75	80	97	95	100	98	100	100	74	72
	0.8	94.7	92	89	99	99	100	100	100	100	96	87
Aurora Super 61,5 SG	0.2	52.0	45	60	67	63	62	58	47	77	59	42
	0.4	72.5	61	84	87	83	74	87	60	90	79	63
	0.6	87.9	79	92	97	91	94	97	72	99	89	79
	0.8	96.0	85	96	99	98	95	99	89	100	95	86
Grodyl 75 WG	5	53.6	86	41	64	47	50	78	42	70	29	26
	10	73.3	96	59	84	75	79	86	75	89	43	50
	15	86.4	98	70	95	79	93	99	87	95	77	72
	20	94.4	99	88	98	82	97	99	94	99	96	85
Granstar 75 DF	5	56.4	73	37	35	58	58	84	82	86	40	56
	10	76.1	93	64	57	83	82	97	96	92	55	80
	15	89.8	99	77	73	96	93	100	100	93	88	94
	20	97.3	100	90	81	99	99	100	100	99	95	97

The average reduction of weeding, taking into account all species occurring in the experiments, in the case of the full recommended dose was high and amounted to 94.4% (Gro-dyl 75 WG) up to 97.3% (Granstar 75 DF). Herbicides applied in the dose reduced by 25% worked about 5–8% weaker. The most effective were Chwastox Trio 540 SL (reduced the fresh weight of weeds by 92.1%) and Aminopielik D 450 SL (reduced the fresh weight of weeds by 91%), and the weakest ones were Gro-dyl 75 WG and Aurora Super 61,5 SG (reduced the fresh weight of weeds by 86.4%–87.9%). Together with continuous reduction of the dose of the examined herbicides, their effectiveness decreased. The half of the recommended dose reduced the amount of the fresh weight of weeds from 72.5% (Aurora Super 61,5 SG) up to 84.6% (Aminopielik D 450 SL). The herbicides applied in the doses reduced by 75% were characterized by the lowest effectiveness. In this case the reduction of the fresh weight of weeds amounted to 52.0% (Aurora Super 61,5 SG) up to 69.9% (Aminopielik D 450 SL).

Analyzing the reaction of the chosen weeds to the herbicides, the large diversity resulting from the different sensitivity of each species and the height of the used dose can be noticed.

#### ***Anthemis arvensis* L.**

This species was controlled very effectively (in 93%–96%) by the herbicides Gro-dyl 75 WG and Granstar 75 DF used in the dose reduced even by 50%. The remaining herbicides, excluding the herbicide Aurora Super 61,5 SG were effective only when used in the full dose. Their application ensured the reduction of the fresh weight of weeds by 92%–97%.

#### ***Chenopodium album* L.**

The herbicides Aminopielik D 450 SL and Chwastox Trio 540 SL enabled effective (in 91%–93%) control of this weed with the use of only the half of the recommended dose. The similar effects were obtained when the herbicide Aurora Super 61,5 SG in the dose reduced by 25% was used. The remaining examined herbicides allowed destroying *C. album* L. on the level of 88%–90% only when the full recommended dose was used.

#### ***Galium aparine* L.**

The effective control of this species was possible with the use of Starane 250 EC in the dose reduced by 50% in comparison to the full recommended one, with the use of Aurora Super 61,5 SG and Gro-dyl 75 WG in the doses reduced by 25% and the full doses of the herbicides Aminopielik D 450 SL and Chwastox Trio 540 SL. Only Granstar 75 DF did not ensure the required effectiveness even when used in the full recommended dose.

#### ***Lamium purpureum* L.**

The high effectiveness of weed control (91%–96%) was observed after the use of Starane 250 EC in the dose reduced by 50% and the herbicides Aurora Super 61,5 SG and Gro-dyl 75 WG in the doses reduced by 25% in comparison to the full recommended doses. The remaining of the examined herbicides (excluding the herbicide Gro-dyl 75 WG) ensured similar effectiveness only when used in the full dose.

***Polygonum convolvulus* L.**

This species showed the large sensitivity to all of the examined herbicides. Aminopielik D 450 SL was very effective even when used in the dose lowered by 75%, Chwastox Trio 540 SL and Starane 250 EC were effective when used in the doses reduced by 50% and Aurora Super 61,5 SG, Grodyl 75 WG and Granstar 75 DF – in the doses reduced by 25%.

***Polygonum persicaria* L.**

The similar situation was observed in the case of *P. persicaria* L. This weed was very sensitive to Chwastox Trio 540 SL in the dose reduced by 75%, Aminopielik D 450 SL in the dose reduced by 50% and the herbicides Starane 250 EC, Aurora Super 61,5 SG, Grodyl 75 WG and Granstar 75 DF used in the doses reduced by 25%.

***Stellaria media* (L.) Vill.**

The conducted experiments showed the possibility of effective control of this species with the use of the reduced (by 50%) dose of the herbicides Starane 250 EC and Granstar 75 DF and the herbicides Aminopielik D 450 SL and Chwastox Trio 540 SL in the doses reduced by 25% in comparison to the full recommended dose. The same effects were obtained when using Grodyl 75 WG in the full dose. Only the herbicide Aurora Super 61,5 SG did not ensure the satisfactory effectiveness.

***Thlaspi arvense* L.**

Also *T. arvense* L. was one of the weeds which reacted very visibly even to the reduced doses of the examined herbicides. The reduction of the fresh weight of this species on the level of at least 90% was ensured by the use of 25% of the recommended dose of Aminopielik D 450 SL, 50% of the herbicides Chwastox Trio 540 SL, Starane 250 EC, Aurora Super 61,5 SG and Granstar 75 DF or the 75% of the full dose of the herbicide Grodyl 75 WG.

***Veronica hedirifolia* L.**

Based on the results of the conducted experiments it may be stated that *V. hedirifolia* L. was effectively controlled only by the full doses of the examined herbicides. Reducing the dose even by 25% resulted in the decrease of effectiveness by 6% to 22%.

***Viola arvensis* Murr.**

Also in the case of *V. arvensis* Murr. the poor influence of the herbicides on this species was observed. Only the herbicides Chwastox Trio 540 SL in its full recommended dose and Granstar 75 DF in the recommended dose and in the one reduced by 25% were effective, whereas the remaining examined herbicides even in their full doses were less effective.

The influence of the level of the herbicide doses on yielding of the spring crops is presented in table 3. The significant decrease of yielding of spring wheat treated with the herbicides Chwastox Trio 540 SL and Starane 250 EC in the doses reduced by 75%, by the herbicides Aurora Super 61,5 SG, Grodyl 75 WG and Granstar 75 DF in the doses reduced by 50% and the herbicide Aminopielik D 450 SL in the dose reduced by 25% in comparison to the recommended one was not observed.

Table 3. Yielding of spring cereals treated with herbicides used in full and reduced doses

Herbicide	Dose per ha	Yield t per ha	
		spring wheat	spring barley
Untreated	–	4.13	3.09
Aminopielik D 450 SL	0.75	4.30	3.50
	1.5	4.33	3.49
	2.25	4.50	3.54
	3.0	4.66	3.61
Chwastox Trio 540 SL	0.5	4.56	3.52
	1.0	4.61	3.49
	1.5	4.68	3.54
	2.0	4.79	3.68
Starane 250 EC	0.2	4.61	3.55
	0.4	4.70	3.57
	0.6	4.74	3.60
	0.8	4.80	3.59
	LSD (0.05)	0.273	0.213
Untreated	–	3.63	3.30
Aurora Super 61,5 SG	0.2	4.20	3.55
	0.4	4.26	3.58
	0.6	4.31	3.66
	0.8	4.49	3.68
Grodyl 75 WG	5	4.13	3.52
	10	4.29	3.63
	15	4.37	3.67
	20	4.50	3.66
Granstar 75 DF	5	4.14	3.58
	10	4.35	3.68
	15	4.29	3.70
	20	4.44	3.72
	LSD (0.05)	0.245	0.143

In the case of the spring barely, the use of the herbicides Aminopielik D 450 SL, Chwastox Trio 540 SL, Starane 250 EC, Aurora Super 61,5 SG, Grodyl 75 WG and Granstar 75 DF in the doses reduced even by 75% in comparison to the full recommended one did not influence significantly the level of the cultivated crop.

## CONCLUSION

Based on the conducted investigation it may be stated that:

1. The effectiveness of the herbicide weed control, when used in the reduced doses, was dependent on particular weed species and its sensitivity to particular herbicide.
2. The weed species very sensitive to the most of the examined herbicides were *P. convolvulus* L., *P. persicaria* L. and *T. arvense* L. and could be controlled with the use of the doses reduced by 50%–75%.
3. *V. hederifolia* and *V. arvensis* Murr. occurred to be difficult to control and they reacted only to the full recommended doses. The remaining species of weeds could

be eliminated with the use of examined herbicides in the doses reduced by 25%–50%.

4. The significant decrease of yielding of spring wheat treated with the herbicides Chwastox Trio 540 SL and Starane 250 EC in the doses reduced by 75%, the herbicides Aurora Super 61,5 SG, Grodyl 75 WG and Granstar 75 DF in the doses reduced by 50% and the herbicide Aminopielik D 450 SL in the dose reduced by 25% in comparison to the recommended one was not observed.
5. In the spring barely, all the examined herbicides may be used in the doses reduced by 75% in comparison to the full recommended dose without the significant influence on the yielding.

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## POLISH SUMMARY

### REGULACJA ZACHWASZCZENIA ZBÓŻ JARYCH PRZEZ HERBICYDY W NIŻSZYCH DAWKACH

W latach 2000–2002 badano możliwość regulacji zachwaszczenia zbóż za pomocą herbicydów stosowanych w dawkach niższych od zalecanych. W badaniach uwzględniono sześć herbicydów zalecanych do odchwaszczania zbóż jarych.

Na ich podstawie można stwierdzić, że większość chwastów występujących w pszenicy jarej i jęczmieniu jarym reagowała silną (powyżej 90%) obniżką świeżej masy pod wpływem traktowania ich badanymi herbicydami w dawkach obniżonych o 25%–50% w porównaniu z zalecanymi. Bardzo wrażliwymi gatunkami okazały się *Polygonum convolvulus* L., *Polygonum persicaria* L. i *Thlaspi arvense* L. Były one skutecznie niszczone herbicydami w dawkach niższych o 50%–75%. Słabą reakcją na badane herbicydy wykazały się *Veronica hederifolia* L. i *Viola arvensis* Murr., które były dobrze niszczone jedynie przez pełne zalecane dawki badanych herbicydów.

Nie obserwowano statystycznie istotnych różnic w plonowaniu pszenicy jarej traktowanej herbicydami Aurora Super 61,5 SG (mekoprop-P+karfentrazon etylu), Granstar 75 DF (tribenuron metylu) i Grodyl 75 WG (amidosulfuron) w dawce niższej o 50% w porównaniu do zalecanej oraz Starane 250 EC (fluroksypyr) i Chwastox Trio 540 SL (mekoprop+MCPA+dikamba) w dawce niższej o 50%-75%. W przypadku herbicydu Aminopielik D 450 SL zawierającego 2,4-D+dikambę ograniczenie dawki może dochodzić do 25%-50%.

W jęczmieniu jarym nie obserwowano istotnych różnic w plonowaniu pomiędzy obiektami traktowanymi dawką pełną oraz zredukowanymi o 50%-75%.