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BIOLOGICAL DIVERSITY OF WEEDS IN A WINTER TRITICALE (*Triticum rimpaui* Wittm.) CROP DEPENDING ON DIFFERENT DOSES OF HERBICIDES AND FOLIAR FERTILIZATION

Sylwia Andruszczak, Piotr Kraska, Ewa Kwiecińska-Poppe, Edward Pałys

Department of Agricultural Ecology, University of Life Sciences in Lublin, Akademicka 13, 20-950 Lublin, Poland
e-mail: sylwia.andruszczak@up.lublin.pl

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Abstract

A field experiment was conducted in the period 2006-2008 on incomplete podzolic soil. The present study investigated the effect of different doses of the herbicides Mustang 306 SE and Attribut 70 WG as well as of the foliar fertilizers Insol 3 and FoliCare 18:18:18 on the biodiversity of weeds in a winter triticale crop, 'Todan'. The segetal flora was assessed 6 weeks after the application of the herbicides and before the harvest of the triticale crop. The herbicides were applied together at labelled doses as well as at doses reduced to 75% and by half. Spraying with the foliar fertilizers was done twice during the growing period. Plots in which no herbicides or foliar fertilizers were used were the control treatment.

Matricaria maritima and *Viola arvensis* from the dicotyledonous class were predominant in the winter triticale crop, whereas *Apera spica-venti* was the dominant species among the monocotyledons. The weed control efficacy of the reduced herbicide doses was weaker compared to the labelled rates by, respectively, from 6% to 9% at the first time of weed infestation assessment and from 4% to 8% at the second assessment time. Simultaneously, air-dry weight of weeds in the herbicide-treated plots did not differ significantly. This indicates that it is possible to reduce herbicide doses in a winter triticale crop without a risk of increased weed infestation.

Key words: winter triticale, weed biodiversity, herbicide doses, foliar fertilization

INTRODUCTION

The currently observed biodiversity of segetal communities has been shaped under the influence of long-term human activity, in particular weed management methods (Rola et al. 1999). The weed control concept has been modified in recent years, since it has been concluded that the complete removal of weeds is not always necessary. Taking into account yields obtained, it is possible to reduce weed infestation to a level that does not pose any threat to crop plants (Dobrzański and Adamczewski, 2009). This changed perception of weed management entails the application of reduced herbicide doses (Blackshaw et al. 2006). Numerous studies show that reducing herbicide doses clearly decreases the occurrence of weeds and effectively weakens their form. At the same time, this does not cause any significant decrease in yields of crop plants and is beneficial not only from the point of view of environmental protection, but also for economic reasons (Davies and Whiting, 1989; Romek and Dzienia, 2000; Zhang et al. 2000; Domaradzki and Sadowski, 2002; Kraska et al. 2009).

The level and type of fertilization applied can be a factor that modifies the structure of agrophytocenoses. Studies of many authors show that an adequate supply of all necessary macro- and micronutrients to plants, through the beneficial effect on the crop content, reduces the weed infestation level and differentiates the species composition of weeds (Stępień, 2004; Blecharczyk et al. 2009).

The aim of the present study was to determine the biodiversity of weeds in a winter triticale crop grown under the conditions of application of reduced herbicide doses and foliar fertilization.

MATERIALS AND METHODS

The present field experiment was conducted in the period 2006–2008 in the Bezek Experimental Farm, belonging to the University of Life Sciences in Lublin. The experimental field was located on incomplete podzolic soil lying on marl substrate with the granulometric composition of loamy sand. This soil is classified as soil class IVb and good rye complex. It was characterized by slightly acidic pH (pH in 1 mol KCl 6.0), high phosphorus content (74.6 mg×kg^{-1}), average potassium content (99.6 mg×kg^{-1}), and low magnesium content (22.0 mg×kg^{-1}). The humus content was 1.2%.

The two-factor experiment, set up in a randomized block design with three replicates, investigated and compared the effects of three herbicide doses and two foliar fertilizers in a winter triticale *Triticum rimpaui* Wittm. crop, cv. Todan. Spraying with the herbicides Mustang 306 SE (florasulam – 6.25 g×l^{-1}; 2,4 D – 300 g×l^{-1}) and Attribut 70 WG (propoxycarbazone-sodium – 70%) was done in the spring at the full tillering stage of winter triticale (phase 23/25 in the BBCH scale that is used to identify phytophenological phases of crop plants). The herbicides were applied together at full labelled doses (respectively, 400 ml×ha^{-1} and 60 g×ha^{-1}) as well as at doses reduced to 75% and by half. Foliar fertilization was done twice during the growing season at the tillering and stem elongation stages (BBCH 23/25 and 33/35), using the foliar fertilizers Insol 3 at a rate of 1l×ha^{-1} and FoliCare 18:18:18 at 20 kg×ha^{-1}. The chemical composition of these fertilizers is presented in Table 1. Plots in which no herbicides or foliar fertilizers were used were the control treatment. Additionally, the following fungicides were used: Alert 375 SC at a rate of 1 l×ha^{-1} (BBCH 26-29) and Tango 500 SC at 0.8 l×ha^{-1} (BBCH 51-56), as well as the growth retardant Tergal C 460 SL at a rate of 2.5 l×ha^{-1} (32-39 BBCH). Tillage was performed following generally accepted agricultural practice recommendations. Seeds, dressed with the seed dresser Panoctine 300 LS (300 g×l^{-1} – guazatine in the form of acetate), were sown at an amount of 500 grains per 1 m^2. Mineral fertilizer rates were as follows: N – 120 kg×ha^{-1}; P – 43.6 kg×ha^{-1}; K – 99.6 kg×ha^{-1}.

Weed infestation of the crop was determined twice using the quantitative gravimetric method; the first time 6 weeks after the herbicide treatment, while the second time before the harvest of winter triticale. Number of weeds, weed species composition and air-dry weight of the above-ground parts of weeds were determined based on the sampling sites marked out by a 1m x 0.25m frame, in four randomly selected places in each plot. The obtained results were statistically processed using analysis of variance and least significant differences were calculated using Tukey's confidence half-intervals with a 5% risk of error.

RESULTS AND DISCUSSION

A winter triticale crop meets the essential conditions for good competitiveness against weeds thanks to relatively wide leaf blades of this plant, high crop density, and good tillering ability. At the same time, triticale, as an interspecific hybrid, exhibits higher sensitivity to weed infestation than rye, which results primarily from its slow growth rate at the initial stage of plant development and from the sensitivity of cultivated cultivars to climatic conditions (Hruszka, 2005). Irrespective of the experimental factors, during the first assessment of weed infestation a total of 29 weed species were identified, among which *Equisetum arvense* and 4 species from the group of monocotyledones weeds were found, while the remaining species belonged to the dicotyledonous class (Tables 2 and 4). The character of this agrophytocenosis was formed by two dominant species, i.e. *Matricaria maritima subsp. inodora* and *Viola arvensis*, which accounted respectively for 30.2% and 26.0% of the total number of weeds. *Veronica arvensis, Galium aparine, Stellaria media* and *Geranium pusillum* from the dicotyledons (comprising from 4.3% to 9.8%) as well as *Apera spica-venti* and *Poa annua* from the monocotyledones class (accounting respectively for 8.6% and 2.4%) were found in much smaller numbers. The remaining taxa occurred sporadically, with each of them constituting 2% or less in the community.

Before the harvest of the winter triticale crop, 33 weed species were identified, out of which 6 belonged to the monocotyledones class (Tables 3 and 5). It should be stressed that at the second assessment time 12 species appeared that had not been found during the previous assessment. The following belonged to them, among others: *Cerastium arvense, Plantago major, Anagallis arvensis, Setaria viridis,* and *Echinochloa crus-galli*. One should suppose that this was attributable to diaspores found in the soil seed bank, whose emergence occurred during the later part of the growing season. *Apera spica-venti*, whose percentage in the total number of weeds was 44.6%, was an absolute dominant at this assessment time. Among the dicotyledons species, *Viola arvensis* and *Matricaria maritima* were represented in greatest numbers (respectively, 15.9% and 10.3%). Analysing the species composition of the weeds colonizing the winter triticale crops, it can be said that, in the light of the literature data, it was typical for this cereal crop (Klikocka, 2000; Rychcik and Sadowski, 2007; Kraska, 2008).

The applied herbicides Mustang 306 SE and Attribut 70 WG differentiated the number and species composition of weeds in the winter triticale crops. At the first time of weed infestation assessment (Table 2), the weed control efficacy of the above-mentioned weed killers averaged from 38% to 52%. Kraska (2008), when applying Atlantis 04 WG and Factor 365 EC in a winter triticale crop, achieved higher effectiveness of herbicide action. Among the herbicide treatments, the plots treated with the herbicides applied at half doses were characterized by the greatest species diversity. The study of K r a s k a (2008) shows a similar correlation in a winter triticale crop. The herbicide treatments clearly reduced the numbers in the case of most of the weed species. Regardless of the herbicide dose used, the following weed species, *inter alia*, were found in smaller numbers compared to the control treatment: *Matricaria maritima* (from 51% to 75%), *Galium aparine* (from 67% to 74%), *Stellaria media* (from 62% to 92%), and *Anthemis arvensis* (from 77% to 96%). Moreover, the application of the herbicides at the full recommended dose and at a dose reduced to 75% eliminated 6 weed species from the crop in each case. At the same time, taxa such as *Conyza canadensis, Lamium amplexicaule, Setaria pumila,* and *Equisetum arvense* appeared sporadically. D o m a r a d z k i (2006) draws attention to the varied species-specific sensitivity of weeds to the active substances of herbicides. According to this author, some taxa exhibit a strong response to weed control agents applied at rates reduced from 50% to 75%, whereas some other ones can be eliminated only when herbicides are applied at recommended amounts.

During the estimation of weed infestation of the winter triticale crop before harvest (Table 3), on average 1 to 2 weed species more were found in the herbicide treatments than in the control plots. The herbicides Mustang 306 SE and Attribut 70 WG, depending on the applied dose, clearly reduced the number of *Conyza canadensis* (from 65 to 75%), *Chenopodium album* (from 59 to 77%), and *Matricaria maritima* (from 24 to 49%), but these herbicides were found to show the highest weed control effectiveness against *Apera spica-venti* (70–76%). R o m e k and D z i e n i a (2000) report that reduction of the doses of the herbicides Protugan 500 SC, Lentipur 80 WP, and Chisel 75 DF by half decreased the weed control efficacy against *Apera spica-venti* by 15% to 31%, on average. In the experiment under discussion, the effect of the below-labelled rates of the weed control agents Mustang 306 SE and Attribut 70 WG against this species was weaker by only 2% to 6% than that of the full labelled rates.

It is characteristic that the proportion of *Viola arvensis*, both during the first and second assessment time, in the herbicide treatments was higher than that under the control conditions, which was probably attributable to low sensitivity of this species to the active substances of the herbicides applied. According to Romek and D z i e n i a (2000), increased weed infestation of crop fields caused by *Viola arvensis* and other resistant species results from the common application of active substances that are not very effective in killing some dicotyledons weed species. In effect, *Viola arvensis* can reach the height of a mature cereal crop and cause substantial crop losses (M i k l a s z e w s k a et al. 1996).

Foliar feeding of the plants changed weed biodiversity in the winter triticale crop. Irrespective of the herbicide dose, during the first assessment of weed infestation the weed communities averaged from 50.5 to 58.6 pieces per 1 m^2, with dicotyledons species accounting for 85% to 90% (Table 4). The effect of the application of the fertilizer Insol 3, as a result of better nutrition of the triticale plants and their increased competitive ability, was the elimination of 6 weed species from the crop, with the simultaneous appearance of single individuals of *Cirsium arvense*. The numbers of most taxa in this treatment generally decreased under the influence of the fertilizer applied, except for *Capsella bursa-pastoris*, *Vicia hirsuta, Polygonum aviculare, Lamium amplexicaule,* and *Apera spica-venti*. In the treatments sprayed with the fertilizer FoliCare 18:18:18, six weed species, including *Matricaria maritima* and *Veronica arvensis*, exhibited greater numbers relative to the treatment without foliar fertilizers. Three taxa (*Galinsoga parviflora, Polygonum aviculare,* and *Sonchus arvensis*) were eliminated from the crop, while *Cirsium arvense, Conyza canadensis, Setaria pumila*, and *Equisetum arvense* appeared additionally.

Before the harvest of the winter triticale crop (Table 5), a total of 27 taxa were found in the control treatments without foliar fertilizers, including 21 from the dicotyledons class. Under the influence of the foliar fertilizers Insol 3 and FoliCare 18:18:18, the number of weed species decreased to 24 and 25, respectively.

An important measure in weed infestation assessment is air-dry weight of the above-ground mass produced by weeds. In the present experiment, the value of this trait was significantly affected only by the herbicide treatments applied (Table 6). During the first assessment of weed infestation, the weed control efficacy of the herbicides Mustang 306 SE and Attribut 70 WG averaged from 73% to 81%, whereas at the second assessment time it was from 61% to 69%. It is worth noting that a significant decrease in air-dry weight of weeds was obtained, relative to the control treatment, after the application of the herbicides both at labelled and below-labelled rates. At the same time, the differences between the herbicide treatments were within the margin of statistical error. S t a r c z e w s k i and Ż ą d e ł e k (2000) showed that reduction of the rates of the herbicides Arelon 75 WP and Puma Super 069 EC by half decreased the effectiveness of their action by 8%, while in the study of R o m e k and D z i e n i a (2000) the efficacy of the weed control agents Protugan 500 SC, Lentipur 80 WP, and Chisel 75 DF was reduced by 12% up to 17%.

Table 1.
Chemical composition of foliar fertilizers (%)

Foliar fertilizer	N	P	K	Mg	S	B	Cu	Fe	Mn	Mo	Zn
Insol 3	11.5	-	-	2.84	-	0.28	0.56	1.20	1.68	0.01	1.12
FoliCare 18:18:18	18.0	18.1	18.0	1.5	7.2	0.02	0.10	0.20	0.10	0.01	0.02

Table 2.
Species composition and number of weeds per 1 m^2 in the winter triticale crop at the first time of weed infestation assessment depending on the herbicide dose, mean for 2006-2008

No.	Weed species	Herbicide dose			
		Control treatment	100%	75%	50%
	Dicotyledons				
1	*Matricaria maritima subsp. inodora*(L.)	31.9	7.9	12.2	15.6
2	*Viola arvensis* Murray	13.7	15.4	14.5	14.3
3	*Galium aparine* L.	7.0	1.8	2.0	2.3
4	*Stellaria media* (L.) Vill.	6.5	0.5	1.2	2.5
5	*Veronica arvensis* L.	4.4	4.9	4.8	7.7
6	*Geranium pusillum* L.	2.6	1.6	2.8	2.7
7	*Anthemis arvensis* L.	2.6	0.6	0.2	0.1
8	*Capsella bursa-pastoris* L.	2.0	0.1	0.1	0.3
9	*Chenopodium album* L.	1.6	0.1	0.3	0.2
10	*Myosotis arvensis* L.	1.2	0.2	0.4	0.7
11	*Vicia hirsuta* (L.) Gray	0.4	0.0	0.1	0.0
12	*Melandrium album* (Mill.)	0.4	-	0.0	0.0
13	*Centaurea cyanus* L.	0.3	0.1	-	-
14	*Convolvulus arvensis* L.	0.2	0.2	0.2	0.0
15	*Stachys palustris* L.	0.2	0.2	-	0.0
16	*Fallopia convolvulus* L.	0.2	0.1	-	0.0
17	*Papaver rhoeas* L.	0.2	-	-	0.0
18	*Cirsium arvense* L.	0.1	-	0.1	0.0
19	*Galinsoga parviflora* Cav.	0.1	-	-	-
20	*Sonchus arvensis* L.	0.0	-	0.0	0.0
21	*Veronica persica* Poir.	0.0	-	-	0.0
22	*Conyza canadensis* L.	-	0.1	0.2	-
23	*Lamium amplexicaule* L.	-	0.0	0.1	0.1
24	*Polygonum aviculare* L.	-	-	-	0.3
	Total dicotyledons weeds	75.6	33.8	39.2	46.8
	Number of dicotyledons species	21	17	17	21
	Monocotyledones				
25	*Apera spica-venti* L.	5.8	3.7	5.8	3.9
26	*Elymus repens* L.	1.6	0.6	0.4	0.7
27	*Poa annua* L.	0.9	1.5	2.1	0.8
28	*Setaria pumila* (Poir.) Roem. & Schult	-	0.3	-	-
29	*Equisetum arvense* L.	-	-	0.0	-
	Total monocotyledones weeds	8.3	6.1	8.3	5.4
	Number of monocotyledones species	3	4	4	3
	Total number of weeds	83.9	39.9	47.5	52.2

0.0 – species numbering less than 0.1 pcs. per 1 m^2

Table 3.
Species composition and number of weeds per 1 m^2 in the winter triticale crop
at the second time of weed infestation assessment depending on the herbicide dose, mean for 2006-2008

No.	Weed species	Herbicide dose			
		Control treatment	100%	75%	50%
	Dicotyledons				
1	*Matricaria maritima subsp. inodora*(L.)	3.7	1.9	2.8	2.7
2	*Viola arvensis* Murray	2.2	5.2	5.6	4.3
3	*Chenopodium album* L.	2.2	0.9	0.5	0.7
4	*Conyza canadensis* L.	2.0	0.5	0.5	0.7
5	*Geranium pusillum* L.	0.6	1.1	0.5	1.0
6	*Fallopia convolvulus* L.	0.6	0.6	0.4	0.4
7	*Myosotis arvensis* L.	0.4	1.0	0.2	0.3
8	Cerastium arvense L.	0.4	0.2	0.5	0.2
9	*Centaurea cyanus* L.	0.4	0.2	0.1	0.1
10	*Stellaria media* (L.) Vill.	0.3	0.3	-	0.6
11	*Polygonum aviculare* L.	0.2	0.3	0.3	0.0
12	*Plantago major* L.	0.2	0.2	-	-
13	*Capsella bursa-pastoris* L.	0.2	0.1	0.2	-
14	*Vicia hirsuta* (L.) Gray	0.2	-	0.2	0.1
15	*Anagallis* arvensis L.	0.1	0.2	-	-
16	*Veronica arvensis* L.	0.1	0.2	-	-
17	*Papaver rhoeas* L.	0.1	-	-	0.0
18	*Galium aparine* L.	-	0.3	0.6	0.4
19	*Stachys palustris* L.	-	0.2	0.0	-
20	*Hypericum perforatum* L.	-	0.1	-	0.2
21	*Gypsophila muralis* L.	-	0.1	-	0.0
22	*Amaranthus retroflexus* L.	-	-	0.2	-
23	*Cirsium arvense* L.	-	-	0.1	-
24	*Medicago lupulina* L.	-	-	0.1	-
25	*Gnaphalium uliginosum* L.	-	-	0.0	-
26	*Sonchus arvensis* L.	-	-	-	0.0
27	*Urtica dioica* L.	-	-	-	0.0
	Total dicotyledons weeds	13.9	13.6	12.8	11.7
	Number of dicotyledons species	17	19	18	18
	Monocotyledons				
28	*Apera spica-venti* L.	27.0	6.4	6.9	8.1
29	*Elymus repens* L.	1.5	1.0	1.3	1.4
30	*Setaria viridis* (L.) P. Beauv.	0.4	0.1	0.1	0.6
31	*Poa annua* L.	0.0	0.1	0.3	0.2
32	*Bromus secalinus* L.	0.0	-	-	-
33	*Echinochloa crus-galli* (L.) P. Beauv.	-	0.4	0.4	0.2
	Total monocotyledones weeds	28.9	8.0	9.0	10.5
	Number of monocotyledones species	5	5	5	5
	Total number of weeds	42.8	21.6	21.8	22.2

0.0 – species numbering less than 0.1 pcs. per 1 m^2

Table 4.
Species composition and number of weeds per 1 m^2 in the winter triticale crop at the first time of weed infestation assessment depending on foliar fertilization, mean for 2006-2008

No.	Weed species	Control treatment	Insol 3	Foli Care 18:18:18
	Dicotyledons			
1	*Matricaria maritima subsp. inodora*(L.)	16.4	16.2	18.0
2	*Viola arvensis* Murray	15.0	13.6	14.9
3	*Veronica arvensis* L.	6.0	4.1	6.3
4	*Galium aparine* L.	3.7	2.5	3.6
5	*Stellaria media* (L.) Vill.	3.4	1.5	3.1
6	*Geranium pusillum* L.	2.6	2.4	2.2
7	*Anthemis arvensis* L.	0.9	0.3	1.4
8	*Chenopodium album* L.	0.8	0.3	0.5
9	*Myosotis arvensis* L.	0.7	0.5	0.6
10	*Capsella bursa-pastoris* L.	0.4	0.6	0.9
11	*Convolvulus arvensis* L.	0.3	0.1	0.1
12	*Melandrium album* (Mill.)	0.2	-	0.1
13	*Vicia hirsuta* (L.) Gray	0.1	0.2	0.1
14	*Fallopia convolvulus* L.	0.1	0.1	0.1
15	*Centaurea cyanus* L.	0.1	-	0.2
16	*Stachys palustris* L.	0.1	-	0.2
17	*Papaver rhoeas* L.	0.1	-	0.1
18	*Galinsoga parviflora* Cav.	0.1	-	-
19	*Polygonum aviculare* L.	0.0	0.2	-
20	*Lamium amplexicaule* L.	0.0	0.1	0.0
21	*Sonchus arvensis* L.	0.0	0.0	-
22	*Veronica persica* Poir.	0.0	-	0.0
23	*Cirsium arvense* L.	-	0.1	0.1
24	*Conyza canadensis* L.	-	-	0.2
	Total dicotyledons weeds	51.0	42.8	52.7
	Number of dicotyledons species	22	17	21
	Monocotyledones			
25	*Apera spica-venti* L.	5.0	6.0	3.4
26	*Poa annua* L.	1.6	1.1	1.3
27	*Elymus repens* L.	0.8	0.6	1.0
28	*Setaria pumila* (Poir.) Roem. & Schult	-	-	0.2
29	*Equisetum arvense* L.	-	-	0.0
	Total monocotyledones weeds	7.4	7.7	5.9
	Number of monocotyledones species	3	3	5
	Total number of weeds	58.4	50.5	58.6

0.0 – species numbering less than 0.1 pcs. per 1 m^2

Table 5.
Species composition and number of weeds per 1 m^2 in the winter triticale crop at the second time of weed infestation assessment depending on foliar fertilization, mean for 2006-2008

No.	Weed species	Control treatment	Insol 3	Foli Care 18:18:18
	Dicotyledons			
1	*Viola arvensis* Murray	4.8	5.0	3.2
2	*Matricaria maritima subsp. inodora*(L.)	2.9	2.9	2.6
3	*Chenopodium album* L.	1.2	0.9	1.1
4	*Geranium pusillum* L.	1.2	0.6	0.5
5	*Conyza canadensis* L.	1.1	1.0	0.7
6	*Myosotis arvensis* L.	0.7	0.3	0.4
7	*Fallopia convolvulus* L.	0.6	0.4	0.4
8	Cerastium arvense L.	0.2	0.4	0.4
9	*Stellaria media* (L.) Vill.	0.2	0.4	0.3
10	*Centaurea cyanus* L.	0.2	0.3	0.1
11	*Polygonum aviculare* L.	0.2	0.1	0.3
12	*Vicia hirsuta* (L.) Gray	0.2	0.1	0.1
13	*Plantago major* L.	0.2	0.1	-
14	*Stachys palustris* L.	0.2	-	-
15	*Galium aparine* L.	0.1	0.4	0.5
16	*Capsella bursa-pastoris* L.	0.1	0.1	0.1
17	*Anagallis* arvensis L.	0.1	-	0.1
18	*Veronica arvensis* L.	0.1	-	0.1
19	*Cirsium arvense* L.	0.1	-	-
20	*Gypsophila muralis* L.	0.0	0.1	-
21	*Papaver rhoeas* L.	0.0	-	0.0
22	*Hypericum perforatum* L.	-	0.1	0.1
23	*Gnaphalium uliginosum* L.	-	0.0	-
24	*Urtica dioica* L.	-	0.0	-
25	*Amaranthus retroflexus* L.	-	-	0.2
26	*Medicago lupulina* L.	-	-	0.1
27	*Sonchus arvensis* L.	-	-	0.0
	Total dicotyledons weeds	14.4	13.2	11.4
	Number of dicotyledons species	21	19	21
	Monocotyledones			
28	*Apera spica-venti* L.	11.1	10.8	14.4
29	*Echinochloa crus-galli* (L.) P. Beauv.	0.3	0.2	0.3
30	*Setaria viridis* (L.) P. Beauv.	0.3	0.2	0.3
31	*Elymus repens* L.	1.2	1.5	1.3
32	*Poa annua* L.	0.0	0.4	-
33	*Bromus secalinus* L.	0.0	-	-
	Total monocotyledones weeds	12.9	13.1	16.3
	Number of monocotyledones species	6	5	4
	Total number of weeds	27.3	26.3	27.7

0.0 – species numbering less than 0.1 pcs. per 1 m^2

Table 6.
Air-dry weight of weeds per 1 m^2 in the winter triticale crop (mean for 2006-2008)

Foliar fertilizer	Herbicide dose				Mean
	Control treatment	100%	75%	50%	
	First time of weed infestation assessment				
Control treatment	103.1	12.6	24.7	26.0	41.6
Insol 3	85.8	19.0	21.5	25.6	38.0
Foli Care 18:18:18	124.4	27.1	31.0	34.2	54.2
Mean	104.4	19.6	25.7	28.6	–
$LSD_{0.05}$	Between herbicide doses 28.02				
	Second time of weed infestation assessment				
Control treatment	64.7	29.8	28.4	22.7	36.4
Insol 3	53.7	14.8	23.0	33.6	31.3
Foli Care 18:18:18	80.5	16.9	17.7	20.8	34.0
Mean	66.3	20.5	23.0	25.7	–
$LSD_{0.05}$	Between herbicide doses 24.79				

CONCLUSIONS

Matricaria maritima, Viola arvensis, and *Apera spica-venti* were the species that occurred in greatest numbers in the winter triticale crop at both assessment times.

The species composition and numbers of weeds depended primarily on the applied doses of the herbicides Mustang 306 SE and Attribut 70 WG. Foliar fertilization did not have a significant effect on both weed species diversity and weed density.

At the first assessment time, the applied herbicides reduced to the greatest extent the occurrence of *Matricaria maritima, Galium aparine, Stellaria media,* and *Anthemis arvensis*. Before the harvest of the winter triticale crop, a substantial decrease in the number of individuals of *Apera spica-venti, Chenopodium album, Conyza canadensis* and *Matricaria maritime* was found.

Air-dry weight of weeds in the herbicide treatments did not differ significantly. This indicates that it is possible to reduce herbicide doses in a winter triticale crop without a risk of increased weed infestation

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Różnorodność biologiczna chwastów w łanie pszenżyta ozimego (*Triticum rimpaui* Wittn.) w zależności od zróżnicowanych dawek herbicydów oraz nawożenia dolistnego

Streszczenie

Doświadczenie polowe przeprowadzono w latach 2006-2008 na glebie bielicowej niecałkowitej. Badano wpływ zróżnicowanych dawek herbicydów Mustang 306 SE i Attribut 70 WG oraz nawozów dolistnych Insol 3 i FoliCare 18:18:18 na bioróżnorodność chwastów w łanie pszenżyta ozimego ‘Todan’. Florę segetalną oceniano 6 tygodni po zastosowaniu herbicydów oraz przed zbiorem pszenżyta. Herbicydy stosowano łącznie w pełnych zalecanych dawkach, zredukowanych do 75% oraz w dawkach zmniejszonych o połowę. Opryskiwanie nawozami dolistnymi wykonano dwukrotnie w okresie wegetacji. Obiekt kontrolny stanowiły poletka, na których nie stosowano zarówno herbicydów, jak i nawozów dolistnych.

W łanie pszenżyta ozimego dominowały *Matricaria maritima* i *Viola arvensis* z klasy dwuliściennych, z jednoliściennych zaś *Apera spica-venti*. Skuteczność chwastobójcza obniżonych dawek herbicydów była słabsza niż pełnych zalecanych dawek odpowiednio od 6 do 9% w pierwszym terminie oceny zachwaszczenia i od 4 do 8% w drugim. Jednocześnie powietrznie sucha masa chwastów na obiektach herbicydowych nie różniła się istotnie. Wskazuje to na możliwość obniżenia dawek herbicydów w łanie pszenżyta ozimego bez ryzyka zwiększenia poziomu zachwaszczenia.