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THE AFTER-EFFECT OF ONE-YEAR SET-ASIDE ON WINTER TRITICALE WEED INFESTATION

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Abstract. The paper presents the results of research concerning the influence of various methods of set-aside on the weed infestation of winter triticale on the light soil. In 2007--2010 the experiments were carried out in the Experimental Station in Bezek (east Lublin Region) on the podsolic soil, formed from heavy loamy sand. Triticale was sown after one-year land lying fallow, in which 5 various ways of its cultivation were used: bare fallow (mechanical), mechanical and herbicide fallow, herbicide fallow, hay-growing fallow and green fodder fallow. Roundup 360 SL was used in chemical cultivation. The range of research comprised the follow-up influence of set-aside on crop weed infestation. The infestation was defined by quantitative and weight method before triticale harvest. It was stated that the biggest number of weeds per 1 m^2 and their air-dry mass were observed in winter triticale sowing after hay-growing fallow. Herbicide as well as mechanical and herbicide fallow land reduced the number of perennial weeds in winter triticale canopy. The dominant species in canopy of winter triticale were monocotyledonous species, especially *Apera spica-venti*, *Setaria pumila* and *Elymus repens*.

Key words: bare fallow, green fodder fallow, hay-growing fallow, herbicide fallow, mechanical and herbicide fallow, method of set-aside

INTRODUCTION

Soils temporarily excluded from agricultural use in the form of fallows should be properly maintained and kept in agricultural tilth [Duer 1998, Hochół *et al*. 1998, Marks and Makowski 2007]. Methods of cultivation of those soils should provide the most favourable conditions possible to resume commercial production [Marks and Nowicki 2002]. According to Rola and Rola [2000], first of all particularly bothersome perennial species, such as *Artemisia vulgaris*, *Cirsium arvense*, *Solidago* sp., should be prevented from growing. Weed communities occurring in canopy of agricultural crops have some characteristic features indicating the conditions under which they are formed [Jędruszczak *et al*. 2004]. Development of weeds in agrocenoses is not only affected by

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edaphic or cultivation factors, but also by the agricultural crop itself [Stupnicka-Rodzynkiewicz *et al*. 2004]. The canopy of a field crop creates different conditions for segetal species than the unsown field, on which no cultivation practices are conducted [Majda 1997]. Similarly, different methods of fallow cultivation can have an effect on the weed infestation of the successive crop. Although the subject of cereal weed infestation is quite well documented [Woźniak 1995, Duer 1998, Wesołowski and Woźniak 2000, Pawlonka and Skrzyczyńska 2004, Buraczyńska 2010, Płaza *et al*. 2011], there is no data concerning an after-effect of set-aside on the numbers and species composition of weed communities in winter triticale growing. Such knowledge, having educational character at the moment, can be useful in relation to our farmers entering the program of planned set-aside, applied for a long time in many countries of West Europe. Making an effort to meet such a demand, a study was undertaken aiming at the assessment of weed infestation of canopy of winter triticale sown after different methods of one-year lying land fallow.

MATERIAL AND METHODS

Field research was carried out in 2007-2010 at the Experimental Station Bezek (51°19' N; 23°25' E) owned by the University of Life Sciences in Lublin, in the podsolic soil on the marly subsoil, with the granulometric composition of light and heavy loamy sand, classified as the good rye complex and the soil quality class IVb.

Characteristic of the weather conditions in the years of the study was presented in table 1. The average air temperature in all the growing seasons was higher than the long-term mean. Also the studied periods were characterized by higher precipitations than the long-term standards, and the highest precipitation was recorded in 2010.

The experiment was established in a field after spring barley with the randomised complete block design in four replications. The area of plots for harvesting was 45 m^2. The experimental scheme involved 5 methods of one-year fallow cultivation:

A – bare fallow (mechanical cultivation),
B – mechanical and herbicide fallow (mechanical + chemical cultivation, using the preparation Roundup 360 SL (3 $dm^3 \cdot ha^{-1}$)),
C – herbicide fallow, cultivated with the preparation Roundup 360 SL (3 $dm^3 \cdot ha^{-1}$),
D – hay-growing fallow (2-3-time mowing of appearing plants – volunteer plants of spring barley with weeds),
E – green fallow – mixture of oat (80 $kg \cdot ha^{-1}$) with field pea (80 $kg \cdot ha^{-1}$), without mineral fertilization intended for fodder.

The course of action was as follows: in autumn after the harvest of main crop, on bare ("A"), cultivation-herbicide ("B") and green ("E") fallows post-harvest cultivation was carried out, including grubbering (about 8 cm) + harrowing, and then the pre-winter ploughing on green fallow "E". The following year, on fallow "A" harrowing or grubbering + harrowing was made as weeds appeared, on fallows "B" and "C" after the field turning green preparation Roundup was applied (3 $dm^3 \cdot ha^{-1}$), whereas on fallow "E" a cereal-legume mixture was sown in late spring, after grubbering and harrowing.

In September next year presowing cultivation under winter triticale was carried out. Before sowing of winter triticale, the simple mineral fertilization was applied: N – 80 $kg \cdot ha^{-1}$ (ammonium nitrate), P – 39 $kg \cdot ha^{-1}$ (triple superphosphate 46%) and K – 83 $kg \cdot ha^{-1}$ (potassium salt 60%). Rates of phosphorus and potassium fertilization were

determined on the basis of soil abundance in those elements. The whole rate of phosphorus and potassium fertilization as well as 20 kg·ha^{-1} N in the form of ammonium nitrate was applied before sowing of triticale, whereas the rest of nitrogen was applied in spring, at two rates 30 kg·ha^{-1}, each, after starting the growth and at the shooting stage. Sowing winter triticale of the cultivar Todan was carried out between 21st and 27th September, depending on the year of the study, in the amount of 195 kg·ha^{-1}. During the growth (the last 10 days of April), Aminopielik Gold 530 EW (1 dm^3·ha^{-1}) was applied against weeds.

Harvest of winter triticale was conducted every year for the first 10 days of August in the phase of full grain maturity. Several days before harvest the assessment of weed infestation of the canopy was made with the quantitative and weighing method. This included the species composition, numbers and air-dry mass of weeds on two randomly selected areas of each plot, determined with a frame of 1 m x 0.5 m. The weed nomenclature was given according to Mirek *et al*. [2002]. Results of the measurements of studied features, as means from three years, were worked out statistically using the variance analysis method. Significance of differences between the mean was evaluated with Tuckey's test.

RESULTS AND DISCUSSION

Statistical analysis showed that the cultivation method of one-year fallow had a significant effect on the weed infestation of winter triticale canopy (Table 1). Both the species composition and the number of weeds per the area unit were different after various methods of set-aside.

Table 1. Air temperature and rainfall in growing periods 2008-2010 compared with long-term means (1974-2003), according to Meteorological Station in Bezek

Tabela 1. Temperatura powietrza i opady w sezonach wegetacyjnych 2008-2010 w zestawieniu ze średnimi wieloletnimi (1974-2003) według Stacji Meteorologicznej w Bezku

Year Rok	Month – Miesiąc							April-September kwiecień – wrzesień
	April kwiecień	May maj	June czerwiec	July lipiec	August sierpień	September wrzesień	October październik	
	Temperature – Temperatura, °C							Mean – Średnia
2008	9.1	12.7	17.4	18.3	19.3	12.4	9.8	14.1
2009	11.2	12.9	16.2	19.8	18.1	14.9	6.8	14.3
2010	9.0	14.5	17.6	20.8	19.7	11.7	4.8	14.0
Multi-year Wielolecie	7.6	13.6	16.2	17.9	17.5	12.9	7.8	13.4
	Rainfall – Opady, mm							Sum – Suma
2008	47.9	74.2	38.4	93.9	60.9	99.5	60.3	475.1
2009	10.1	86.8	180.5	50.8	46.9	28.8	92.1	496.0
2010	20.4	72.4	94.4	156.0	141.9	93.1	14.3	592.5
Multi-year Wielolecie	40.1	53.0	77.6	80.3	61.6	58.5	41.2	412.3

Application of the herbicide Roundup on mechanical and herbicide fallow (B) and herbicide fallow (C) as well as conducting mechanical cultivation practices on bare fallow (A) (Table 2) had a significant reducing effect on the number of perennial weeds

and the total number of weeds in winter triticale canopy. In the study by Duer [1998] the most effective method of one-year set-aside, reducing the weed infestation of winter rye, was bare fallow, which confirms the results obtained in Bezek. In the experiment under discussion, the largest total amount of weeds per 1 m^2 were found in the canopy of winter triticale sown after hay-growing fallow (215.8 no.·m^{-2}) and after green fodder fallow (212.5 no.·m^{-2}). The least weed infestation was observed after herbicide fallow ("C") and mechanical and herbicide fallow ("B"), while the significant difference was proved only in relation to the hay-growing fallow. Although the method of set-aside did not have a significant effect on the number of plants of short-lived species, they occurred in definitely largest numbers in the canopy of triticale grown after green fodder fallow, which was overgrown with a cereal-legume mixture and accompanying weeds.

Table 2. Number per 1 m^2 and air-dry mass of weeds in canopy of winter triticale (mean in 2008--2010)

Tabela 2. Liczba i powietrznie sucha masa chwastów w pszenżycie ozimym (średnio w latach 2008-2010)

Method of set-aside* Sposób ugorowania	Number of weeds, no.·m^{-2} – Liczba chwastów, szt.·m^{-2}						Air-dry mass of weeds – Powietrznie sucha masa chwastów g·m^{-2}
	short-lived krótkotrwałe		perennial wieloletnie		total ogółem		
A	124.1		45.3		169.4		67.6
B	110.7		27.6		138.3		49.6
C	109.6		25.0		134.6		49.0
D	122.2		93.6		215.8		93.2
E	154.9		57.6		212.5		75.8
Mean – Średnia	124.3		49.8		174.1		67.0
$LSD_{0.05}$ – $NIR_{0,05}$ for – dla:	ns – ni	methods sposobów	46.8	methods sposobów	75.4		ns – ni

* A – bare fallow – ugór czarny (uprawowy), B – mechanical and herbicide fallow – ugór uprawowo--herbicydowy, C – herbicide fallow – ugór herbicydowy, D – hay-growing fallow – ugór kośny, E – green fodder fallow – ugór zielony na paszę

ns – ni – non-significant differences – różnice nieistotne

Air-dry mass of weeds inhabiting the canopy of winter triticale was similar to the total number of weeds, although the difference between compared methods of set-aside was not proved statistically (Table 2). The most abundant air-dry mass was formed by weeds after hay-growing fallow (93.2 g·m^{-2}), and the least after herbicide fallow (49.0 g·m^{-2}). Different results were obtained in the study by Podstawka-Chmielewska and Kurus [2009] concerning weed infestation of winter wheat grown on rendzina soil. In that case, the most effective method for reducing the weed infestation of winter wheat appeared to be bare fallow, where only mechanical cultivation was carried out, stimulating weed seeds for germination. Young seedlings of weeds were then eliminated with the use of cultivating and harrowing.

Comparing the number of weeds per 1 m^2 in the years of the study indicates that the course of the weather was particularly favourable for the growth of weeds in the year 2010, which was characterized by heavy rainfalls, especially in summer months (2008 – 47.9 no.·m^{-2}; 2009 – 211.9 no.·m^{-2}; 2010 – 262.6 no.·m^{-2}; LSD = 49.4) (Table 1).

Species composition of the weed community in winter triticale canopy grown after different methods of set-aside was presented in Table 3.

Table 3. Species composition and number of weeds per 1 m^2 in winter triticale depending on the set-aside method (mean in 2008-2010)

Tabela 3. Skład gatunkowy i liczba chwastów w łanie pszenżyta ozimego w zależności od sposobu ugorowania, szt.·m^{-2} (średnio w latach 2008-2010)

Species – Gatunek	Method of set-aside – Sposób ugorowania*					
	A	B	C	D	E	mean średnia
1	2	3	4	5	6	7
Short-lived – Krótkotrwałe						
Apera spica-venti (L.) P. Beauv.	53.1	44.6	35.9	50.8	80.9	53.0
Setaria pumila (Poir.) Roem & Schult.	35.4	26.5	39.1	44.2	43.7	37.7
Poa annua L.	10.4	6.9	5.4	6.1	5.1	6.7
Viola arvensis Murray	3.1	4.9	5.2	4.2	4.1	4.3
Gnaphalium uliginosum L.	5.7	6.3	4.7	0.5	2.8	4.0
Anagallis arvensis L.	2.9	6.2	3.2	1.3	2.7	3.2
Stellaria media (L.) Vill.	2.4	4.4	2.9	3.1	1.8	2.9
Gypsophila muralis L.	1.9	2.3	2.6	2.2	2.8	2.3
Geranium pusillum Burm. F. Ex L.	2.3	1.8	2.2	2.7	2.3	2.2
Matricaria maritima L. ssp. *inodora* (L.) Dostàl	2.6	2.3	1.5	1.7	1.9	2.0
Veronica arvensis L.	0.6	0.8	1.5	0.6	0.7	0.8
Echinochloa crus-galli (L.) P. Beauv.	-	0.1	1.4	0.5	0.8	0.6
Myosotis arvensis (L.) Hill	0.1	0.5	0.4	1.0	0.5	0.5
Polygonum aviculare L.	0.8	0.3	0.6	0.2	0.8	0.5
Vicia hirsuta (L.) S.F. Gray	0.5	0.4	0.1	0.6	0.7	0.5
Anthemis arvensis L.	0.8	0.1	0.3	0.6	0.2	0.4
Bromus secalinus L.	0.1	0.1	0.4	0.6	0.1	0.3
Fallopia convolvulus (L.) A. Löve	0.2	0.8	0.2	0.1	0.3	0.3
Sonchus oleraceus L.	0.1	0.3	0.1	0.1	0.8	0.3
Spergula arvensis L.	0.2	–	0.7	0.1	0.3	0.3
Conyza canadensis (L.) Cronquist	0.1	0.3	–	0.5	0.3	0.2
Polygonum lapathifolium L. ssp. *lapathifolium*	0.2	0.1	0.3	–	0.4	0.2
Capsella bursa- pastoris (L.) Medik.	–	0.1	0.1	0.1	0.4	0.1
Chamomilla suaveolens (Pursh) Rydb.	0.2	0.1	0.2	0.1	0.1	0.1
Erodium cicutarium (L.) L` Hèr.	–	–	–	0.1	0.1	0.1
Galepsis tetrahit L.	0.1	0.4	–	0.1	0.1	0.1
Galinsoga parviflora Cav.	–	0.1	0.1	–	–	0.1
Galium aparine L.	0.1	–	0.1	–	0.1	0.1
Lapsana communis L.s.s.	0.1	–	–	–	–	0.1
Papaver rhoeas L.	–	–	0.1	0.1	0.1	0.1
Raphanus raphanistrum L.	0.1	–	–	–	–	0.1
Scleranthus annuus L.	–	–	0.2	–	–	0.1
Spergularia rubra (L.) J. Presl & C. Presl.	–	–	0.1	–	–	0.1
Together – Razem	124.1	110.7	109.6	122.2	154.9	124.3
Perennial – Wieloletnie						
Elymus repens (L.) Gould	38.5	18.1	19.6	79.0	49.1	40.8
Plantago media L.	4.4	5.9	2.4	6.9	6.8	5.2
Lolium perenne L.	0.4	1.8	2.1	4.2	0.1	1.7

Table 3 continued – cd tabeli 3

1	2	3	4	5	6	7
Equisetum arvense L.	0.3	0.8	0.3	0.3	0.8	0.5
Cerastium arvense L.	0.3	–	0.1	1.1	–	0.3
Cirsium arvense (L.) Scop.	0.3	0.1	0.1	0.5	–	0.2
Taraxacum officinale F.H. Wigg.	0.2	0.1	0.1	0.7	0.3	0.2
Trifolium pratense L.	–	0.3	–	0.7	–	0.2
Achillea millefolium L.s.s.	–	–	0.1	–	–	0.1
Gnaphalium sylvaticum L.	0.7	0.1	–	0.1	–	0.1
Hypericum perforatum L.	–	–	–	–	0.1	0.1
Oxalis fontana Bunge	–	0.1	0.1	–	0.3	0.1
Sonchus arvensis L.	0.1	0.3	–	–	–	0.1
Trifolium repens L.	0.1	–	0.1	–	0.1	0.1
Vicia cracca L.	–	–	–	0.1	–	0.1
Together – Razem	45.3	27.6	25.0	93.6	57.6	49.8
Total – Ogółem	169.4	138.3	134.6	215.8	212.5	174.1
Number of species – Liczba gatunków	36	35	38	36	36	

*A, B, C, D, E – for explanations see Table 1 – objaśnienia pod tabelą 1

During the three years of the study 48 taxons were recorded, with a distinct predomination of short-lived weeds (33 species) over perennial (15 species). Also the studies by Pawlonka and Skrzyczyńska [2004] and Woźniak [1995] indicate the predomination of short-lived segetal species in winter triticale growing.

Floristic composition of weed communities forming after various methods of one--year set-aside was similar. The most abundant weed community in respect of floristic composition was observed after herbicide fallow (C) – 38 taxons, and the poorest after mechanical and herbicide fallow (B) – 35 species.

Predominant weed species in winter triticale on all the tested fields were *Apera spica-venti*, *Setaria pumila* and *Elymus repens*. The most favourable conditions for growth of weeds of the family *Poaceae* were created by fallows covered with vegetation, where chemical crop-protection preparations or cultivation practices were not used. *Elymus repens* occurred in great amounts after hay-growing fallow (D), whereas *Apera spica-venti* after green fodder fallow (E). Also the study by Dąbrowska and Łabza [2010] reports a growing threat to cereals of species of the family *Poaceae*. It shows that the methods of set-aside where chemical cultivation was applied with the use of the preparation Roundup, had a reducing effect on the development of perennial weeds, particularly wheat grass.

CONCLUSIONS

1. Under conditions of the present experiment, the largest number of weeds per area unit and their air-dry mass were recorded in winter triticale sown after hay-growing fallow and green fodder fallow.

2. Maintaining the field in the form of herbicide fallow or mechanical and herbicide fallow distinctly reduced the number of perennial weeds in winter triticale canopy as compared with the other methods of one-year set-aside.

3. Predominant species of weeds in winter triticale grown after one-year leaving field fallow, irrespective of the method of its cultivation, were *Apera spica-venti*, *Setaria pumila* and *Elymus repens*.

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NASTĘPCZY WPŁYW JEDNOROCZNEGO UGOROWANIA GLEBY NA ZACHWASZCZENIE PSZENŻYTA OZIMEGO

Streszczenie. W pracy przedstawiono wyniki badań wpływu różnych sposobów ugorowania pola ornego na zachwaszczenie pszenżyta ozimego na glebie bielicowej. Badania przeprowadzono w latach 2007-2010 w Gospodarstwie Doświadczalnym Bezek (wschodnia Lubelszczyzna) na glebie bielicowej niecałkowitej na podłożu marglistym, o składzie granulometrycznym piasku gliniastego mocnego. Pszenżyto wysiewano na polu po rocznym ugorowaniu, na którym stosowano 5 różnych sposobów użytkowania gleby: ugór czarny (uprawki mechaniczne), ugór uprawowo-herbicydowy, ugór herbicydowy, ugór kośny i ugór zielony na paszę. Do chemicznej pielęgnacji stosowano preparat Roundup 360 SL (3 $dm^3 \cdot ha^{-1}$). Zakres badań obejmował ocenę następczego wpływu ugorowania pola na zachwaszczenie łanu pszenżyta ozimego. Zachwaszczenie określano metodą ilościowo-wagową przed zbiorem pszenżyta. Największą liczbę chwastów na jednostce powierzchni oraz ich powietrznie suchą masę odnotowano w pszenżycie ozimym wysiewanym w stanowisku po ugorze kośnym. Stosowanie ugoru herbicydowego lub uprawowo-herbicydowego wpłynęło ograniczająco na liczbę chwastów wieloletnich w zasiewach pszenżyta ozimego, a dominującymi gatunkami chwastów w pszenżycie ozimym uprawianym po jednorocznym ugorowaniu pola okazały się *Apera spica-venti*, *Setaria pumila* oraz *Elymus repens*.

Słowa kluczowe: sposób ugorowania, ugór czarny, ugór herbicydowy, ugór kośny, ugór uprawowo-herbicydowy, ugór zielony na paszę

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