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ORIGINAL RESEARCH PAPER

Weed infestations of winter wheat depend on the forecrop and the tillage system

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Abstract

In-crop weed infestation is affected by both habitat conditions and agronomic practices, including the forecrop and tillage treatments used. This study evaluated the effect of the forecrop and the tillage system on species composition, number and dry weight of weeds in a winter wheat 'Astoria'. A field study was carried out over the period 2014–2017 at the Uhrusk Experimental Farm (SE Poland), on a mixed rendzina soil with a grain-size distribution of sandy loam. Wheat was grown in a four-course crop rotation: soybean – winter wheat – rapeseed – winter wheat. The experimental factors were as follows: a forecrop of winter wheat (soybean and winter rapeseed) and a tillage system (ploughing and no-tillage). *Avena fatua* was the most frequently occurring weed in the wheat crop sown after soybean, whereas after winter rapeseed it was *Viola arvensis*. *Viola arvensis* was the dominant weed under both tillage systems. In all experimental treatments, the species *Viola arvensis* and *Cirsium arvense* were characterized by the highest constancy (Constancy Class V and IV), and also *Veronica arvensis* after the previous winter rapeseed crop. In the wheat crop sown after winter rapeseed, the number of weeds was found to be higher by 62.1% and the weed dry weight higher by 27.3% compared to these parameters after the previous soybean crop. A richer floristic composition of weeds was also observed in the stand after winter rapeseed. Under conventional tillage conditions, compared to no-tillage, the number of weeds was found to be lower by 39.7% and their dry weight by 50.0%. An increase in the numbers of the dominant weed species was also noted in the untilled plots.

Keywords

crop rotation; tillage; number and dry weight of weeds; constancy of weeds

Introduction

Weed competitiveness in a wheat crop is determined by the number and diversity of weed species occurring in the crop. It is estimated that about 150 species occur in cereal crops, out of which 50 can be considered as common [1]. In-crop weed infestation is affected by both habitat conditions and agronomic practices, including the forecrop and tillage treatments used [2–5].

Tillage carried out appropriately and timely is the basic method for reducing the number of weeds threatening crops. In agriculture in which integrated protection is used, an important role is assigned to the soil's natural fertility and its biological activity. The number of ploughings and their depth should therefore be reduced by using other implements, instead of ploughing, which deeply loosens the soil without turning it over, e.g., grubbers [1]. The reason for the abandonment of conventional ploughing is the destruction of the topsoil structure and reduced soil biological diversity [6,7].

The basis for an integrated protection system of winter wheat is a well-designed crop rotation under which this species will be grown in good stands. According to the assumptions of this system, wheat should be sown after leafy crops, such as rapeseed, which shades the soil well and produces a lot of crop residue whilst at the same time vacating the field early and thus enabling full cultivation and timely sowing of the succeeding crop. Early harvested crops, such as potatoes (manured) as well as legumes [1], are also appropriate forecrops for wheat. The beneficial effect of legumes in reducing weed infestation of a winter wheat crop was observed by Buczek et al. [8], among others.

The aim of the present study was to evaluate the effect of a previous crop (soybean and winter rapeseed) and the tillage system (ploughing and no-tillage) on species composition, number, and dry weight of weeds in a winter wheat crop.

Material and methods

Plant material and growth conditions

A field experiment was conducted over the period 2014–2017 at the Uhrusk Experimental Farm (51°18′11″ N, 23°36′50″ E), on a mixed rendzina soil with a grain-size distribution of a sandy loam and classified as a very good rye soil complex. The soil was characterized by an alkaline pH (in 1 M KCl = 7.7), very high availability of phosphorus (229.8 mg P kg^{-1} soil), high potassium availability (150.2 mg K kg^{-1} soil), and very low magnesium availability (16 mg Mg kg^{-1} soil). The humus content was at a level of 1.5%, whereas the content of fine particles (<0.02 mm) in the 0–30 cm layer was 20.7%.

The experiment on winter wheat (*Triticum aestivum* 'Astoria') was set up in a randomized block design with three replicates in 32-m^2 plots. Wheat was grown in a four-course crop rotation: soybean – winter wheat – rapeseed – winter wheat, with all rotated crops grown in the four fields simultaneously. The results relate to the harvest years 2014, 2015, 2016, and 2017 and to both wheat treatments (after soybean and after rapeseed) under either of the tillage systems. The experimental factors were as follows: (***i***) forecrop of winter wheat: soybean and winter rapeseed, and (***ii***) tillage system: ploughing and no-inversion tillage.

Under ploughing, the following operations were carried out after the previous soybean crop had been harvested: application of NPK fertilizers, presowing ploughing, harrowing, seeding, and postsowing harrowing; in the spring: harrowing, application of N at the beginning of the growing season, harrowing, application of N at the stem elongation stage. Under no-tillage, the following operations were carried out after the previous soybean crop had been harvested: harrowing, application of NPK fertilizers, instead of ploughing tilling with a stubble cultivator: grubber + cage roller, seeding, and postsowing harrowing; in the spring, the same operations were carried out as in the ploughing treatment. After harvest of the winter rapeseed, skimming was additionally carried out in the ploughing treatment, whereas under no-tillage, a stubble cultivator (grubber + cage roller) was used instead of skimming. Further treatments were the same as in the stand after soybean.

Mineral fertilization of wheat was applied at the following amounts: N – 120 kg ha^{-1}, P – 60 kg ha^{-1}, and K – 90 kg ha^{-1}. Fertilizer rates were determined based on the nutritional requirements of the crop plant and the soil nutrient availabilities. Phosphorus and potassium fertilizers were added in one application before sowing. The nitrogen application was divided into three portions: the first portion of 60 kg ha^{-1} was applied before sowing wheat, whereas the other two portions of 30 kg ha^{-1} were applied in the spring at the beginning of the growing season and at the stem elongation stage (BBCH 32).

Winter wheat was sown in the last 10 days of September 2016, at a rate of 5.5 million grains per ha. Before sowing, the seed dressing Sarfun T 65 DS (a.i. thiuram, carbendazim) was applied at a rate of 200 g per 100 kg of grain with addition of water (800 mL).

In the spring at the beginning of the growing season (BBCH 23), the herbicide Lancet Plus 125 WG (a.i. aminopyralid, pyroxsulam, florasulam) was sprayed at a rate of 0.2 kg ha^{-1} in order to control mono- and dicotyledonous weeds. To control diseases at the first node stage (BBCH 31), the fungicide Alert 375 SE (a.i. carbendazim, flusilazole) was applied at a rate of 1 L ha^{-1}, and at the beginning of heading (BBCH 51) Tilt Turbo 575 EC (a.i. fenpropidin, propiconazole) at a rate of 1 L ha^{-1}. When a threat from aphids occurred, Decis 2.5 EC (a.i. deltamethrin) was applied (0.25 L ha^{-1}) at full heading (BBCH 55).

Winter wheat was harvested in the first 10 days of August.

Weed infestation of the winter wheat crop was evaluated by the dry-weight-rank method [2] at the beginning of stem elongation (BBCH 31). This evaluation involved the determination of the botanical composition, number, and dry weight of weeds. Sampling areas were delineated by a rectangular frame (1 × 0.25 m) in two randomly selected positions in each plot. Constancy classes followed the Braun-Blanquet method [9] and were calculated based on the 4-year analysis of weed infestation of wheat.

Statistical analysis

Data were statistically analyzed by analysis of variance (ANOVA) and the means were compared by Tukey's test using least significant differences at a significance level of α = 0.05.

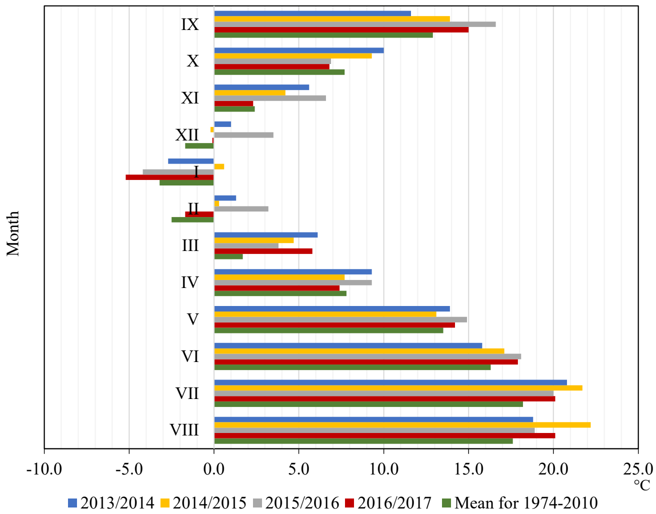

Fig. 1 Mean monthly air temperature (°C) at the Bezek Meteorological Station in 2013–2017.

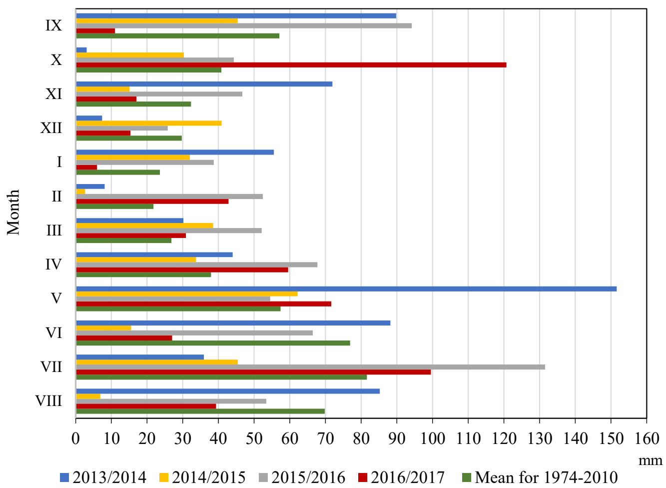

Fig. 2 Total rainfall and rainfall distribution (mm) at the Bezek Meteorological Station in 2013–2017.

Weather conditions in the study area

During the growing season of winter wheat (September–August), the average air temperature in all study years was higher than the long-term average (1974–2010). In the month when winter wheat was sown (September), a temperature lower than the long-term average was recorded only in the first growing season (2013/2014). In all experimental years, the temperature values in the months from March to August were very favorable during the period of intensive wheat growth and grain ripening (Fig. 1). Throughout the duration of the experiment, the highest total precipitation (727.7 mm) was recorded in the third growing season (2015/2016) of winter wheat cultivation. Nevertheless, the precipitation in this season was not distributed evenly. Its highest values were recorded during the time of wheat sowing (September) and grain ripening (July). A greater amount of precipitation than the long-term average was also recorded in the first growing period of wheat (2013/2014). The lowest precipitation level occurred in the 2014/2015 season, when the total was lower by 187 mm than the long-term average for this period (Fig. 2).

Results

The number of weeds per m^2 in the winter wheat crop was significantly modified by both experimental factors (Tab. 1). The average value for the 4-year study period was higher after the previous winter rapeseed crop by 62.1% relative to that found after soybean, whereas under no-tillage conditions it was higher by 65.9% compared to conventional tillage. The number of weeds in the stand after soybean was observed to be significantly lower in first and fourth experimental year. In the treatment with ploughing, the number of weeds per m^2 was proven to be lower compared to the untilled plots in the first, second, and fourth year.

Tab. 1 Number of weeds per m² in the winter wheat crop depending on forecrop and tillage system.

	Previous soybean crop			Previous winter rapeseed crop			Mean	
Year	Plough system	No-tillage system	Mean	Plough system	No-tillage system	Mean	Plough system	No-tillage system
2014	15.3	23.3	19.3	29.3	36.3	32.8	22.3	29.8
2015	7.7	10.0	8.9	7.7	21.3	14.5	7.7	15.7
2016	11.3	12.3	11.8	13.7	16.0	14.9	12.5	14.2
2017	13.0	19.3	16.2	12.3	44.7	28.5	12.7	32.0
Mean	11.8	16.2	14.0	15.8	29.6	22.7	13.8	22.9
$LSD_{0.05}$	* Forecrop – 2.06, tillage system – 2.06, Forecrop × Tillage System – 3.87, Forecrop × Years – 6.54, Tillage System × Years – 6.54, Forecrop × Tillage System × Years – 10.60							

* $p \leq 0.05$.

Tab. 2 Dry weight of weeds in the winter wheat crop depending on forecrop and tillage system (g m^{-2}).

Year	Previous soybean crop			Previous winter rapeseed crop			Mean	
	Plough system	No-tillage system	Mean	Plough system	No-tillage system	Mean	Plough system	No-tillage system
2014	4.2	5.2	4.7	7.3	10.3	8.8	5.8	7.8
2015	3.0	4.8	3.9	2.4	12.5	7.5	2.7	8.7
2016	4.4	4.8	4.6	5.4	7.2	6.3	4.9	6.0
2017	8.3	18.3	13.3	5.0	16.7	10.9	6.7	17.5
Mean	5.0	8.3	6.6	5.0	11.7	8.4	5.0	10.0
$LSD_{0.05}$	* Forecrop – 1.03, tillage system – 1.03, Forecrop × Tillage System – 1.93, Forecrop × Years – 3.27, Tillage System × Years – 3.27, Forecrop × Tillage System × Years – 5.29							

* $p \leq 0.05$.

The interaction of the experimental factors also had a significant effect on the number of weeds in the wheat crop (Tab. 1). After both forecrops used, a lower number of weeds was found under ploughing conditions relative to no-tillage, respectively by 46.6% in wheat sown after rapeseed and by 27.2% in the stand after the leguminous crop. The highest number of weeds was found in wheat sown after winter rapeseed under no-tillage conditions, whereas the lowest one was in the stand after the leguminous crop in the ploughing treatment.

On average for the 4-year study period, a significantly higher (by 27.3%) weed dry weight was recorded in the wheat crop after the previous winter rapeseed crop compared to soybean (Tab. 2). A lower weed weight in the stand after soybean, relative to that observed after winter rapeseed, was recorded in the first and second year of the study. Under ploughing conditions, the value was as much as 2 times lower compared to that found under no-tillage during the study period. In the untilled plots, a significantly higher weed dry weight was noted in the second and last year of the experiment; in the other years, these differences were not statistically significant.

The statistical analysis showed that after both forecrops used the weed dry weight was lower under conventional tillage conditions compared to no-tillage, respectively by 57.3% in wheat sown after rapeseed and by 39.8% after soybean (Tab. 2). The highest weed weight was found in the stand after winter rapeseed in the no-tillage treatment, whereas the lowest one after the previous soybean crop under ploughing conditions.

Throughout the duration of the experiment, the winter wheat crop was inhibited by 23 weed species in total, out of which 20 were annuals; the others were perennials (Tab. 3). In the wheat crop sown in the stand after soybean, the dominant weed was *A. fatua*, whereas in the stand after winter rapeseed, the species *Viola arvensis* occurred

Tab. 3 Species composition, number per 1 m^2, and constancy of weeds in the winter wheat crop depending on forecrop and tillage system (mean for 2014–2017).

Species		Previous soybean crop	Previous winter rapeseed crop	Plough system	No-tillage system
I. Annual weeds					
Avena fatua L.		3.4 II	3.4 II	1.8 II	5.0 II
Viola arvensis Murr.		2.7 V	6.8 V	3.5 V	6.0 V
Veronica arvensis L.		2.0 II	2.9 IV	2.0 III	2.8 III
Anagallis arvensis L.		1.4 II	1.5 II	1.3 II	1.5 II
Consolida regalis S. F. Gray		0.6 II	0.3 I	0.4 II	0.4 II
Capsella bursa-pastoris (L.) Medik.		0.5 III	0.5 III	0.3 II	0.7 III
Stellaria media (L.) Vill.		0.4 II	0.5 II	0.4 II	0.6 II
Melandrium album (Mill.) Garcke		0.4 II	-	0.3 I	0.2 I
Matricaria maritima ssp. *inodora* (L.) Dostál		0.3 II	1.6 III	0.7 II	1.1 III
Lamium amplexicaule L.		0.2 II	0.4 III	0.3 II	0.3 II
Sonchus asper (L.) Hill		0.2 II	0.4 II	0.2 II	0.4 II
Galium aparine L.		0.1 I	1.2 III	0.2 I	1.2 III
Euphorbia helioscopia L.		0.1 I	0.3 II	0.2 I	0.2 II
Polygonum aviculare L.		0.1 I	0.2 I	0.2 I	0.1 I
Papaver rhoeas L.		-	0.3 II	0.2 I	0.2 I
Apera spica-venti (L.) P. Beauv		-	0.1 I	0.1 I	-
Geranium pusillum L.		-	0.1 I	0.1 I	-
Anthemis arvensis L.		-	0.1 I	-	0.1 I
Chenopodium album L.		-	0.1 I	-	0.1 I
Conyza canadensis (L.) Cronquist		-	0.1 I	-	0.1 I
Total of annual weeds		12.4	20.8	12.2	21.0
II. Perennial weeds					
Cirsium arvense (L.) Scop.		1.2 IV	1.4 IV	1.2 IV	1.4 IV
Sonchus arvensis L.		0.2 I	0.4 II	0.4 II	0.2 II
Convolvulus arvensis L.		0.2 I	0.1 I	-	0.3 II
Total of perennial weeds		1.6	1.9	1.6	1.9
Total number of species		17	22	19	21
Number of species in constancy classes	V	1	1	1	1
	IV	1	2	1	1
	III	1	4	1	4
	II	9	7	9	9
	I	5	8	7	6

in greatest numbers. Apart from the above-mentioned weeds, *Veronica arvensis* and *Anagallis arvensis* as well as *C. arvense*, which are all perennial weeds, were found in quite large numbers. Twenty-two weed species were found in the winter wheat crop sown after rapeseed and 17 after soybean. In the stand after the leguminous crop, the numbers of most weed species were also observed to be reduced, in particular the following: *Viola arvensis*, *Veronica arvensis*, *Matricaria maritima* ssp. *inodora*, and *Galium aparine*.

In both tillage systems, the dominant weed species was *Viola arvensis*, whereas among perennial weeds it was *C. arvense* (Tab. 3). *Avena fatua*, *Veronica arvensis* and *Anagallis arvensis* also occurred in quite large numbers under both tillage systems. The number of weed species was similar in both tillage treatments since under the ploughing system

Tab. 4 Species composition, number per m², and constancy of weeds in the winter wheat crop depending on the interaction of forecrop and tillage system (mean for 2014–2017).

Species		Previous soybean crop		Previous winter rapeseed crop	
		Plough system	No-tillage system	Plough system	No-tillage system
I. Annual weeds					
Avena fatua L.		3.1 II	3.7 II	0.6 II	6.3 II
Viola arvensis Murr.		2.3 V	3.1 V	4.7 V	9.0 V
Veronica arvensis L.		1.6 II	2.4 II	2.5 IV	3.3 III
Anagallis arvensis L.		1.1 II	1.6 II	1.6 II	1.4 II
Melandrium album (Mill.) Garcke		0.6 II	0.3 II	-	-
Stellaria media (L.) Vill.		0.4 II	0.5 II	0.4 II	0.6 II
Consolida regalis S. F. Gray		0.3 II	0.8 II	0.5 I	0.1 I
Matricaria maritima ssp. *inodora* (L.) Dostál		0.3 II	0.3 II	1.2 II	1.9 III
Capsella bursa-pastoris (L.) Medik.		0.2 II	0.8 III	0.4 II	0.6 III
Sonchus asper (L.) Hill		0.2 I	0.3 II	0.3 II	0.5 II
Lamium amplexicaule L.		0.2 I	0.2 II	0.4 III	0.4 II
Polygonum aviculare L.		0.2 I	-	0.2 I	0.2 I
Galium aparine L.		-	0.2 I	0.3 II	2.2 IV
Euphorbia helioscopia L.		-	0.2 I	0.3 II	0.3 II
Papaver rhoeas L.		-	-	0.3 II	0.3 I
Apera spica-venti (L.) P. Beauv		-	-	0.2 I	-
Geranium pusillum L.		-	-	0.1 I	-
Anthemis arvensis L.		-	-	-	0.2 I
Chenopodium album L.		-	-	-	0.2 I
Conyza canadensis (L.) Cronquist		-	-	-	0.2 I
Total of annual weeds		10.5	14.4	14.0	27.7
II. Perennial weeds					
Cirsium arvense (L.) Scop.		1.1 IV	1.3 IV	1.3 IV	1.4 IV
Sonchus arvensis L.		0.2 I	0.1 I	0.5 II	0.3 II
Convolvulus arvensis L.		-	0.4 II	-	0.2 II
Total of perennial weeds		1.3	1.8	1.8	1.9
Total number of species		14	16	18	20
Number of species in constancy classes	V	1	1	1	1
	IV	1	1	2	2
	III	-	1	1	3
	II	8	10	10	8
	I	4	3	4	6

only two species less were found than in the no-tillage treatment. Under conventional tillage conditions, however, a lower number of individuals were observed for most of the weed species, in particular as regard to the following dominant species in the wheat crop: *A. fatua*, *Viola arvensis*, and *Veronica arvensis*.

Compared to ploughing, under a no-tillage system a higher number of dominant weeds was recorded in the wheat crop after both forecrops (Tab. 4). In the no-tillage treatment, after the previous rapeseed crop, the numbers of *A. fatua* and *Viola arvensis* individuals were more than 10 times higher and almost 2 times higher, respectively, compared to that found under ploughing. The differences in the numbers of weeds were significantly smaller in both tillage systems after the soybean forecrop,. Two more weed species occurred in the untilled plots compared to ploughing after both forecrops.

Throughout the duration of the experiment, *Viola arvensis* and *C. arvense* were characterized by the highest constancy (Class V and IV) after all forecrops and tillage systems used, and in the case of *Veronica arvensis* also after the winter rapeseed crop (Tab. 3). In the stand after rapeseed (Tab. 3) and also in the no-tillage treatment, four weed species classified in Constancy Class III were found, whereas only one such species was noted after the previous soybean crop and in the ploughed plots. The interaction of the experimental factors did not cause large differences in the constancy of occurrence of weeds in this winter wheat crop.

Discussion

In the opinion of some authors, selection of an appropriate stand in crop rotation can effectively reduce weed infestation of crop fields [1]. In our study, the effect of a previous soybean crop in reducing weed infestation of the winter wheat crop was evident compared to the stand after winter rapeseed. The studies by Piekarczyk [10] and Buczek et al. [8] both suggest that a previous leguminous crop reduces the number and weight of weeds in a winter wheat crop also relative to stands after cereal crops. The results of our study also prove that after both forecrops used, the effect of no-tillage is a greater weed infestation of the wheat crop compared to conventional tillage. In his research, Smagacz [11] obtained similar results when he used a cultivator and postharvest field preparation with a disk harrow instead of ploughing. He found the number of weeds in a winter wheat crop to be twice higher compared to the conventional tillage treatment. In the opinion of Małecka et al. [12], such a phenomenon can generally be observed in the first crop rotation, whereas during the later period, weed infestation stabilizes and even positive aspects of no-till field preparation for sowing are noticeable.

The opinions on the influence of tillage system on weed infestation of crops are not unambiguous. In a study by Shrestha et al. [13], ploughing and no-tillage systems did not cause differences in weed infestation of a winter wheat crop. According to Tørresen and Skuterud [14], on the other hand, under no-tillage conditions there is an increased supply of diaspores to the topsoil layer where seeds germinate, and hence weed infestation of the succeeding crop increases. Davis et al. [15] and Peigné et al. [16] also report that no-till increases weed infestation and, as a consequence, reduces yields. Unlike the latter authors, Tuesca et al. [17] showed that ploughing increases weed infestation, whereas replacing ploughing with other implements reduces it because weed diaspores are not transferred to the deeper soil layers. The tillage system does not affect the size of the weed seed bank but it changes both its composition and seed distribution in the soil profile [18].

Weed infestation of a plantation can also be greatly dependent on no-tillage intensity, as the number of weeds is often higher as a result of the use of active machines (e.g., a power harrow, rototiller) compared to passive tillage tools with a disk or spike-tooth harrow [19].

Bilalis et al. [20] demonstrated that conventional ploughing has an effect on reducing weed infestation of crops with perennial weeds but it increases the number and weight of annual weeds, in particular in the case of the species *Sinapis arvensis* and *Solanum nigrum* because they reproduce from seed and conventional tillage creates more favorable conditions for their growth. Tuesca et al. [17] also showed an increase in the number of annual weeds under conventional tillage. We can also find papers reporting that tillage systems have no impact on changes in weed communities (e.g., [21]).

In a study by Kwiatkowski et al. [22], conventional tillage with ploughing resulted in reduced biological diversity of weed species relative to conservation tillage (without ploughing). However, the study presented in this paper showed that the tillage system did not cause significant differences in the number of weed species in the wheat crop since only two species less were found under the ploughing system compared to no-tillage. Similar to the experiment in question, in a study by Weber et al. [23] *Viola arvensis* was the dominant weed species in a wheat crop under both tillage systems used. These authors also demonstrated that under no-tillage conditions there was a significant increase in weed infestation of a plantation, especially in the first years after the introduction of this tillage system.

Conclusions

It was found that the number of weeds in a wheat crop sown after winter rapeseed was higher by 62.1% and the weed dry weight higher by 27.3% compared to those found in the stand after soybean. In the wheat crop sown after soybean, *A. fatua* was the weed that occurred in greatest numbers, whereas it was *Viola arvensis* in the crop after winter rapeseed. In the stand after the leguminous crop, the numbers of most of the dominant species were also observed to be reduced. The wheat crop grown under a ploughing system, compared to no-till, was characterized by lower weed infestation, as expressed by number and dry weight of weeds, respectively by 39.7% and 50.0%. The highest number and dry weight of weeds were found in wheat sown after winter rapeseed under no-tillage conditions, whilst the lowest were in the stand after the leguminous crop in the ploughing treatment. In both tillage systems, the dominant species was *Viola arvensis*, whereas among perennial weeds it was *C. arvense*. Under conventional tillage, however, a lower number of individuals was observed for most of the weed species, in particular among the dominant species in the wheat crop. In all experimental treatments, *Viola arvensis* and *C. arvense* were characterized by the highest constancy (Constancy Class V and IV), whereas after the previous winter rapeseed crop it was also *Veronica arvensis*.

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Zachwaszczenie pszenicy ozimej w zależności od przedplonu i systemu uprawy roli

Streszczenie

Zachwaszczenie łanu roślin uprawnych kształtują zarówno czynniki siedliska, jak i zabiegi agrotechniczne, w tym zastosowany przedplon i zabiegi uprawowe. W pracy oceniano wpływ przedplonu i sytemu uprawy roli na skład gatunkowy, liczbę oraz powietrznie suchą masę chwastów w łanie pszenicy ozimej (*Triticum aestivum* 'Astoria'). Badania polowe przeprowadzono w Gospodarstwie Doświadczalnym w Uhrusku w latach 2014–2017, na rędzinie mieszanej o składzie granulometrycznym gliny piaszczystej. Pszenica uprawiana była w czteropolowym płodozmianie: soja – pszenica ozima – rzepak – pszenica ozima. Czynnikami badawczym były: przedplon pszenicy ozimej (soja i rzepak ozimy) oraz system uprawy roli (płużny i bezpłużny). W łanie pszenicy wysiewanej po soi najliczniej występującym chwastem był *Avena fatua*, natomiast po rzepaku ozimym *Viola arvensis*. W obu systemach uprawy dominującym gatunkiem chwastów był *Viola arvensis*. Na wszystkich obiektach doświadczenia największą stałością występowania (V i IV stopień stałości fitosocjologicznej) charakteryzowały się gatunki *Viola arvensis* i *Cirsium arvense*, a po przedplonie rzepaku ozimym również *Veronica arvensis*. W łanie pszenicy wysiewanej po rzepaku ozimym stwierdzono większą o 62,1% liczebność i o 27,3% powietrznie suchą masę chwastów w porównaniu do występujących po przedplonie soi. W stanowisku po rzepaku ozimym zaobserwowano również bogatszy skład florystyczny chwastów. W warunkach tradycyjnej uprawy płużnej względem obiektu z uprawą bezpłużną stwierdzono mniejszą o 39,7% liczebność chwastów i o 50,0% ich powietrznie suchą masę. Na poletkach z uprawą bezorkową zanotowano również wzrost liczebności dominujących gatunków chwastów.