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UNDERSOWN SERRADELLA (*Ornithopus sativus* L.) AS AN ELEMENT OF WEED CONTROL IN TRITICALE CROPS

Summary

The aim of the study was to evaluate the degree of weed infestation of spring and winter triticale harvested at different dates, depending on the method of cultivation (with or without undersown crop) in the organic farming system. The research was conducted in the Agricultural Advisory Center in Szepietowo, Poland, in the years of 2014-2016. The experiment took into account the method of cultivation of spring and winter triticale: pure sowing and sowing with undersown serradella, and the date of cereal harvest: milk-dough stage and full maturity. The studies have shown that the method of triticale cultivation significantly affected the level of weed infestation. The biggest mass of weeds was recorded in spring triticale cultivated in pure sowing, regardless of biomass use, while undersown serradella significantly reduced fresh and dry mass of weeds, both in the crops grown for green matter and for grain. A higher number of weeds were recorded in single-species crops of triticale, while the undersown crop reduced both the abundance and the number of segetal flora species in the crops. The most numerous weed species were: Chenopodium album, Erigeron candensis, Poligonum aviculare, Trifolium arvense, Setaria pumila.
***Key words**: spring triticale, winter triticale, undersown crop, serradella, organic farming, weed infestation*

WSIEWKA SERADELI (*Ornithopus sativus* L.) JAKO ELEMENT REGULACJI ZACHWASZCZENIA W ŁANIE PSZENŻYTA

Streszczenie

Celem badań była ocena stopnia zachwaszczenia pszenżyta jarego i ozimego zbieranych w różnych terminach w zależności od sposobu uprawy (z wsiewką lub bez) w ekologicznym systemie gospodarowania. Badania przeprowadzono w Podlaskim Ośrodku Doradztwa Rolniczego Szepietowo, w latach 2014-2016. W doświadczeniu dwuczynnikowym uwzględniono sposób uprawy pszenżyta jarego i ozimego: siew czysty i z wsiewką seradeli oraz termin zbioru zboża (dojrzałość mleczno-woskowa i pełna). Badania wykazały, że sposób uprawy pszenżyta istotnie wpływał na stan zachwaszczenia upraw. Największą masę chwastów wykazano w łanie pszenżyta jarego uprawianego w siewie czystym, niezależnie od przeznaczenia biomasy, natomiast wsiewka z seradeli istotnie zmniejszała świeżą i suchą masę chwastów, zarówno w uprawie na zieloną masę, jak i na ziarno. Większą liczebnością chwastów charakteryzowały się jednogatunkowe zasiewy pszenżyta, natomiast wsiewka redukowała zarówno liczebność, jak i liczbę gatunków flory segetalnej w łanach. Najliczniej występowały: Chenopodium album, Erigeron candensis, Poligonum aviculare, Trifolium arvense, Setaria pumila.
***Słowa kluczowe**: pszenżyto jare, pszenżyto ozime, wsiewka, seradela, zachwaszczenie, gospodarstwo ekologiczne*

1. Introduction

The need to use light soils for farming has caused a steady interest in serradella in Poland for more than a century. Already in 1923 it was cultivated on the area of about 24 thousand ha, while in the years 1924-1927 - it was already 62 thousand ha and this area is still growing. Out of fodder plants, it was second only to clover. In 1959 serradella was grown on the area of about 200 thousand ha and since then, there has been a regress in its cultivation, caused mainly by the intensification of nitrogenous fertilization of cereals and the mechanization of their harvest [3]. The renewed interest in this species is unquestionably linked to its many advantages, but also to the current world trends in technology, aimed at the promotion of pro-ecological agriculture.

Specific habitat requirements of serradella make it one of the most useful species for feed production on light, acidic soils which dominate in Poland. Serradella provides a valuable, easily digestible ruminant feed, and at the same time, increases milk production of cows. Moreover, it is eagerly eaten by animals due to its delicacy, palatability and lack of harmful compounds. Also, being a legume, it improves soil fertility and leaves behind a good position for the succeeding crops [1, 3]. Cultivation of seradella is hindered by the lack of moisture, especially in the early stages of growth, which affects the formation of lateral branches and pods that are responsible for the productivity of this species [7, 20]. Serradella is a species with high phenotypic variability due to high plasticity of plants resulting from the possibility of changing the direction of distribution and redistribution of assimilates during ontogenesis [18]. As a consequence, seradella cultivars may react in different ways to the cultivation and habitat conditions, as demonstrated in the studies of Sypniewski and Ignaczak [19].

Due to the strong plant lodging and difficult combine harvesting, serradella is usually grown with supporting plants, mainly cereals. Studies have confirmed that plants such as, rye, oats, barley, spring and winter triticale are useful for this purpose [10, 19, 21, 22, 23]. According to Orzechowski and Tomaszewski [11], the loss of seeds during the harvest of serradella grown in pure sowings amounts to 20-23%. Cultivation in mixed sowings is also more reliable and creates a bigger competition for weeds, which allows reducing or even abandoning the use of herbicides [4, 5, 12,

13, 14]. According to Hruszka [6], undersown serradella successfully eliminated the weeds from faba bean crops, and additionally, its ability to protect the yield was comparable to herbicides applied foliar. Such cultivation can be very useful in organic farming systems.

The working hypothesis assumed that undersown serradella would effectively limit the number of weeds among spring and winter triticale grown in organic farms. The purpose of the research was to assess the level of weed infestation of spring and winter triticale grown in pure sowings and with undersown serradella in the organic farming system.

2. Materials and methods

The research was conducted in the years of 2014-2016 in a certified organic farm in Taraskowo [53°12'N, 22°16'E], cooperating with Agricultural Advisory Center in Szepietowo, in a random block design, on the soil of good rye complex, quality class IVb. The experiment took into account the method of cultivation of spring and winter triticale (×*Triticosecale* Wittm. ex A. Camus): pure sowing and sowing with undersown serradella (*Ornithopus sativus* L.), and the date of cereal harvest: milk-dough stage and full maturity. Cereal density amounted to 500 units per 1 m^2, while serradella was sown in the amount of 60 kg·ha^{-1}. Plot size at the set-up of the experiment was 30 m^2, while at harvest - 27,6 m^2. The sowing of winter triticale was performed between 26 September and 6 October, spring triticale - between 4 and 10 April, and serradella - between 13 and 22 April. Harvesting cereals in the stage of milk-dough stage was carried out between 11 and 18 July, in full maturity stage - between 30 July and 11 August. The green matter of serradella was collected between 30 September and 3 October. The forecrop in 2013 was a legume-cereal mixture, while in 2014 and 2015 – potatoes. In terms of weed control, double ploughing was performed. An analysis of the weed infestation of the stand was performed a few days before the harvest (in milk-dough stage and full maturity), by a frame-weight method, from the area of 1 m^2, in three replications. Fresh and dry mass, species composition, and number of weeds were determined.

The impact of the tested experimental factor on the observed characteristics were assessed using the analysis of variance, setting Tukey's confidence half-intervals at significance level of $\alpha = 0.05$.

3. Results and Discussion

Test results showed that the method of triticale cultivation affected the number, fresh and dry mass, and species composition of weeds. The highest weed infestation was recorded in the crops of spring triticale grown in pure sowings, both intended for green matter and for grain, which had the biggest fresh and dry mass of weeds (Tab. 2 and 3). Undersown serradella significantly reduced the number of weeds, reducing their fresh mass, on average, by 53.3% in the triticale cultivation for green matter, and by about 25.5% in the cultivation for grain, while the dry mass of weeds was reduced by, respectively, 55.0% and 24.3%. To a less extent, serradella limited the mass of weeds in the crops of winter triticale. In the cultivation for green matter, it reduced the fresh mass of the undesirable species by 11.7%, and for grain – by 25.4%, while the dry matter by, respectively, 12.1 and 10.7%, the differences being statistically insignificant. Taking into account the following years of research, the highest weed infestation was recorded in 2016, especially in the triticale harvested at full maturity stage, whereas the lowest – in the dry 2015, which saw very small rainfalls during the summer months (June, July, August, September), accompanied by very high air temperature. These conditions adversely affected both the yields of triticale and the growth and development of weeds (Tab. 1).

In terms of weed number, the biggest amounts were recorded in the crops of winter triticale, both grown for green matter (120 units per 1 m^2) and for grain (140 units per 1 m^2). Undersown serradella increased triticale competitiveness, reducing weed numbers by 29.1% at earlier harvest and 34.4% at subsequent cuts (Tab. 4 and 5). In the crops of spring triticale, the number of undesirable species was slightly lower - 110 units per 1 m^2 at the harvest for green matter, and 127 units per 1 m^{2-} for grain. Seradella reduced weed numbers by 11.1 and 27.9%, respectively. In the earlier studies of the authors [16], undersown serradella significantly reduced fresh and dry mass and number of weeds in the crops of oats (by 64, 64 and 57%, respectively), spring barley (by 54, 36, and 73%), winter rye (by 56, 49 and 18%) and spelt wheat (by 43, 42 and 31%). Also, Jędruszczak et al. [8] showed a 61% higher weed infestation in a pure rye sowings than in a mixed sowing with serradella. The cited authors found a large variability in the number of undesirable species in the subsequent years of the study, whereas this variability was higher in the mixed crops than in pure ones.

During the three years of the study, 45 weed species were found in triticale crops for green matter, and 42 weed species in triticale harvested at a later date. The smallest species diversity was found in winter triticale grown with serradella (23 species), while the largest - in pure winter triticale (32 species) at the harvest for green matter. In the case of harvesting for grain, the least of species belonging to the segetal flora was recorded in spring triticale with undergrown serradella (27 species), while in the other treatments, species variability of weeds was similar (31-32 species).

Table 1. Course of weather conditions during the vegetation periods
Tab. 1. Przebieg warunków pogodowych w okresie wegetacji

Specification	Year	Month							Sum/ Mean (III-IX)
		III	IV	V	VI	VII	VIII	IX	
Rainfalls (mm)	2014	61.7	56.9	181.4	46.7	157.7	198.1	0.3	702.8
	2015	62.0	49.2	142.0	46.0	31.7	13.5	0.5	344.9
	2016	65.5	17.8	41.7	37.8	26.9	75.7	44.7	310.1
Temperature (°C)	2014	6.5	10.2	14.0	14.7	20.7	13.2	14.1	13.3
	2015	5.2	8.6	13.0	17.3	20.1	22.4	20.4	15.3
	2016	4.1	10.3	15.0	19.3	19.0	18.6	16.1	12.9

Source: own elaboration based on IMGW-PIB data / Źródło: opracowanie własne na podstawie danych IMGW-PIB

Table 2. Fresh and dry mass of weeds in in the crop of triticale intended for green matter depending on cultivation method
Tab. 2. Świeża i sucha masa chwastów w pszenżycie zbieranym na zielonkę w zależności od sposobu uprawy

Object	Fresh mass (g·m^{-2})				Dry mass (g·m^{-2})			
	2014	2015	2016	average	2014	2015	2016	average
Winter triticale	85.1 b	41.1 a	78.0 a	68.1 a	39.4 b	18.6 a	34.2 a	30.7 ab
Winter triticale with serradella	50.0 a	34.2 a	92.6 ab	60.1 a	27.6 ab	12.3 a	41.0 a	27.0 ab
Spring triticale	75.0 ab	66.0 a	174.1 b	105.0 b	32.8 b	25.3 a	61.8 a	40.0 b
Spring triticale with serradella	31.6 a	34.8 a	80.7 ab	49.0 a	14.2 a	10.5 a	29.3 a	18.0 a

Source: own study / Źródło: badania własne

Table 3. Fresh and dry mass of weeds in in the crop of triticale intended for grain depending on cultivation method
Tab. 3. Świeża i sucha masa chwastów w pszenżycie zbieranym na ziarno w zależności od sposobu uprawy

Object	Fresh mass (g·m^{-2})				Dry mass (g·m^{-2})			
	2014	2015	2016	average	2014	2015	2016	average
Winter triticale	90.9 a	53.7 b	137.1 a	93.9 ab	42.4 a	18.1 a	43.6 a	34.7 a
Winter triticale with serradella	64.4 a	25.9 ab	119.7 a	70.0 a	37.9 a	10.1 a	44.8 a	31.0 a
Spring triticale	99.1 a	49.6 b	169.2 a	106.0 b	36.9 a	24.4 a	73.4 a	44.9 b
Spring triticale with serradella	59.2 a	10.6 a	167.3 a	79.0 a	24.2 a	4.7 a	73.2 a	34.0 a

Source: own study / Źródło: badania własne

Table 4. Weed species composition and number of weeds (unit·m^{-2}) in the crop of triticale intended for green matter depending on cultivation method (average from the years 2014-2016)
Tab. 4. Skład gatunkowy i liczebność chwastów (szt.·m^{-2}) w pszenżycie zbieranym na zielonkę, w zależności od sposobu uprawy (średnia z lat 2014-2016)

No.	Weed species	Crop				Number of years in which the species was recorded on objects A/B/C/D
		Winter triticale A	Winter triticale with serradella B	Spring triticale C	Spring triticale with sarradella D	
1	*Amaranthus retroflexus*	0,0	0,2	0,0	0,0	0/1/0/0
2	*Anthemis arvensis*	1,8	5,8	0,2	0,2	3/2/1/1
3	*Aphanes arvensis*	3,8	1,8	0,2	3,6	1/1/1/1
4	*Artemisia vulgaris*	0,2	0,0	0,0	0,0	1/0/0/0
5	*Brassica napus*	0,0	0,0	1,3	0,2	0/0/2/1
6	*Capsella bursa-pastoris*	0,2	0,2	0,0	0,5	1/1/0/2
7	*Cerastium arvense*	3,6	0,0	0,0	0,0	1/0/0/0
8	*Chenopodium album*	6,7	12,7	20,9	17,5	2/2/3/3
9	*Cirsium arvense*	0,0	0,0	0,4	1,1	0/0/1/2
10	*Centaurea cyanus*	0,2	0,2	0,2	0,0	1/1/1/0
11	*Convolvulus arvensis*	0,0	0,0	5,6	3,3	0/0/1/1
12	*Erigeron canadensis*	24,9	4,0	6,9	6,9	3/2/2/2
13	*Fallopia convolvulus*	6,7	5,3	2,0	3,8	3/2/2/2
14	*Galeopsis tetrahit*					
15	*Geranium molle*	0,2	0,0	0,0	0,0	1/0/0/0
16	*Gnaphalium uliginosum*	0,2	0,0	0,0	0,0	1/0/0/0
17	*Matricaria maritima* subsp. *indora*	0,9	0,9	1,3	0,4	2/2/3/1
18	*Myosotis arvensis*	1,8	0,0	0,2	0,7	2/0/1/2
19	*Plantago lanceolata*	0,0	0,0	0,4	0,2	0/0/1/2
20	*Plantago major*	0,9	0,5	1,8	1,8	1/2/3/2
21	*Polygonum aviculare*	13,8	8,0	10,5	3,6	3/2/3/3
22	*Polygonum persicaria*	0,0	0,0	0,0	0,2	0/0/0/1
23	*Rumex acetosella*	3,1	1,6	2,7	1,6	2/1/2/2
24	*Scleranthus annuus*	3,3	0,7	2,4	0,0	1/1/1/0
25	*Sinapis arvensis*					
26	*Sonchus arvensis*	3,6	1,1	9,1	5,1	1/1/1/1
27	*Sonchus asper*	1,8	0,0	2,0	1,8	2/0/2/2
28	*Sonchus oleraceus*	0,0	0,0	0,0	0,2	0/0/0/1
29	*Spergula arvensis*	1,5	1,3	1,8	1,8	2/1/2/1
30	*Spergularia rubra*	0,0	0,0	0,2	0,0	0/0/1/0
31	*Stachys arvensis*					
32	*Stellaria media*	0,5	0,0	0,7	0,2	2/0/1/1
33	*Trifolium arvense*	7,8	4,7	8,9	14,7	3/2/3/3
34	*Veronica arvensis*	2,4	6,2	0,0	0,0	2/3/0/0
35	*Vicia hirsuta*	0,4	0,0	0,5	0,0	1/0/2/0
36	*Vicia sepium*	0,2	0,0	0,0	0,0	1/0/0/0
37	*Viola arvensis*	10,5	8,6	3,3	1,1	3/3/2/2
Dicotyledonous		**101,0**	**63,8**	**83,6**	**70,6**	
38	*Agrostis gigantea*	0,0	0,0	0,2	0,0	0/0/1/0
39	*Apera spica-venti*	1,1	2,0	0,0	0,0	2/2/0/0

Cont. Table 4

No.	Weed species	Crop				Number of years in which the species was recorded on objects A/B/C/D
		Winter triticale A	Winter triticale with serradella B	Spring triticale C	Spring triticale with sarradella D	
40	*Echinochloa crus-galli*	2,0	3,3	3,1	6,0	1/2/1/2
41	*Elymus repens*	1,1	0,5	0,7	0,9	3/2/2/2
42	*Juncus bufonius*	2,9	0,0	0,0	0,2	1/0/0/1
43	*Poa annua*	0,0	0,0	0,0	0,2	0/0/0/1
44	*Setaria pumila*	3,5	12,9	13,6	16,2	2/1/2/2
Monocotyledonous		**10,7**	**18,7**	**17,6**	**23,6**	
45	*Equisetum arvense*	8,0	2,4	9,3	4,0	3/2/3/2
Horsetails		**8,0**	**2,4**	**9,3**	**4,0**	
Total		**119,7**	**84,9**	**110,5**	**98,2**	
Number of species		32	23	29	29	

Source: own study / Źródło: badania własne

Table 5. Weed species composition and number of weeds (unit·m^{-2}) in the crop of triticale intended for grain depending on cultivation method (average from the years 2014-2016)

Tab. 5. Skład gatunkowy i liczebność chwastów (szt.·m^{-2}) w pszenżycie zbieranym na ziarno w zależności od sposobu uprawy (średnia z lat 2014-2016)

No	Weed species	Crop				
		Winter triticale A	Winter triticale with serradella B	Spring triticale C	Spring triticale with serradella D	Number of years in which the species was recorded on objects A/B/C/D
1	*Amaranthus retroflexus*	0,0	0,2	0,0	0,0	0/1/0/0
2	*Anthemis arvensis*	4,5	1,6	3,6	0,7	3/3/3/1
3	*Aphanes arvensis*	2,2	0,9	3,8	2,4	2/1/1/1
4	*Artemisia vulgaris*	0,0	1,6	0,0	0,4	0/1/0/1
6	*Capsella bursa-pastoris*	0,2	0,7	0,2	0,0	1/2/1/0
7	*Cerastium arvense*	1,6	0,2	0,2	0,0	1/1/1/0
8	*Chenopodium album*	24,4	10,5	24,7	20,0	3/3/3/3
9	*Cirsium arvense*	0,2	0,4	1,3	0,2	1/1/2/1
10	*Centaurea cyanus*	0,4	0,9	0,0	0,0	1/1/0/0
11	*Convolvulus arvensis*	0,4	0,0	1,3	2,5	1/0/1/2
12	*Erigeron canadensis*	18,9	11,3	13,1	1,8	3/3/2/2
13	*Fallopia convolvulus*	2,2	2,2	4,9	4,8	2/2/3/3
	Galeopsis tetrahit	0,0	0,0	0,0	0,2	0/0/0/1
15	*Gnaphalium uliginosum*	0,0	0,0	0,2	0,0	0/0/1/0
16	*Matricaria maritima* subsp. *indora*	3,3	2,4	0,2	0,7	2/1/1/2
17	*Myosotis arvensis*	0,0	0,0	0,9	0,0	0/0/1/0
18	*Plantago lanceolata*	0,9	0,2	0,2	0,2	1/1/1/1
19	*Plantago major*	2,7	0,9	1,1	0,7	2/1/2/1
20	*Polygonum aviculare*	8,2	7,6	7,1	9,8	3/2/3/2
21	*Polygonum persicaria*	0,0	0,0	0,4	0,0	0/0/1/0
22	*Rumex acetosella*	2,4	4,5	4,9	2,4	2/2/1/1
	Scleranthus annuus	2,7	0,9	0,9	0,0	1/1/1/0
	Sinapis arvensis	0,0	0,0	0,0	0,2	0/0/0/1
23	*Sonchus arvensis*	0,2	1,3	0,0	0,7	1/3/0/1
24	*Sonchus asper*	1,6	0,9	0,2	1,6	2/2/1/2
25	*Sonchus oleraceus*	2,5	0,2	5,3	0,0	2/1/1/0
26	*Spergula arvensis*	0,9	2,9	1,8	0,2	1/1/2/1
28	*Stachys arvensis*	5,1	0,4	0,0	0,0	1/1/0/0
29	*Stellaria media*	3,3	1,6	3,3	0,0	2/2/2/0
30	*Trifolium arvense*	7,1	4,7	6,7	8,9	3/2/2/3
31	*Veronica arvensis*	3,6	4,0	4,7	4,4	3/1/1/1
32	*Vicia hirsuta*	0,4	0,0	0,0	0,4	1/0/0/1
33	*Vicia sepium*	0,0	0,2	0,0	0,0	0/1/0/0
34	*Viola arvensis*	14,0	2,0	4,2	2,7	3/2/3/2
Dicotyledonous		**114,1**	**65,3**	**95,5**	**65,9**	
35	*Agrostis gigantea*	0,0	0,4	0,0	0,0	0/1/0/0
36	*Apera spica-venti*	0,0	0,0	0,4	1,1	0/0/1/1
37	*Echinochloa crus-galli*	7,3	4,0	10,0	1,6	2/1/1/1
38	*Elymus repens*	2,0	0,7	1,3	2,7	1/1/2/2
39	*Juncus bufonius*	1,3	0,0	0,9	0,0	1/0/1/0
40	*Poa annua*	0,0	0,0	0,4	0,0	0/0/1/0
41	*Setaria pumila*	6,0	12,4	5,8	12,5	2/1/2/2
Monocotyledonous		**16,7**	**17,5**	**18,9**	**17,8**	
42	*Equisetum arvense*	9,8	9,3	12,3	7,6	2/3/3/3
Horsetails		**9,8**	**9,3**	**12,2**	**7,6**	
Total		**140,5**	**92,1**	**126,6**	**91,3**	
Number of species		31	32	32	27	

Source: own study / Źródło: badania własne

The number of recorded weed species was similar to that obtained by other authors. Jędruszczak et al. [8] noted 28 taxa in the rye with seradella. In contrast, Skrzyczyńska and Rzymowska [15] recorded from 15 to 33, while Kapeluszny and Haliniarz [9] - 36 species in the organically grown spring cereals. In turn, Staniak et al. [16] showed more weed species in pure cereal crops than in mixed sowings with serradella. In the case of oats, the authors identified a total of 22 species of weeds, barley - 25, rye - 24, and spelt wheat - 26. The presence of seradella reduced the number of undesirable species, mainly in spring crops. When it was undersown into oats, it completely eliminated 10 taxa, while in the mixture with barley - 17.

The most abundant weed species, regardless of the method of cultivation and the date of cereal harvest, were (dicotyledonous): *Chenopodium album*, *Erigeron canadensis*, *Polygonum aviculare*, *Trifolium arvense*, and monocotyledonous *Setaria pumila*. There was also a large number of *Equisetum arvense*. All these species appeared at least in two years of the studies (Tab. 4 and 5). In winter triticale harvested for grains, undersown seradella significantly reduced the number of the most aggressive weeds (on average in 3 year period of research) such as: *Ch. album* by 57%, *E. canadensis* by 40%, *Viola arvensis* by 86%, *Echinochloa crus-galli* by 45%, and *T. arvense* by 34%. In contrast, in the case of winter triticale harvested for green matter, undersown serradella reduced the number of: *E. canadensis* by 86%, *V. arvensis* by 36%, *E. crus-galli* by 84%, and *E. arvense* by 38%.

Many authors consider perennial weeds as particularly troublesome in organic farms. According to Skrzyczyńska and Rzymowska [15], big problems among spring crops were caused by, among others: *E. arvense*, *Elymus repens* and *Cirsum arvense*; according to Kapeluszny and Haliniarz [9] – *Sonchus arvensis*, *Ch. album*, *E. crus-galli* and *E. arvense*; while according to Feledyn-Szewczyk [2] – *Ch. album* and *Stellaria media*. In the earlier studies, the authors identified the following species, as the most troublesome and most severe in organic farms: *Ch. album*, *E. crus-galli*, *Stellaria media* and *Capsella bursa-pastoris*) [16, 17]. Jędruszczak et al. [8], Feledyn-Szewczyk [2] and Hauggaard-Nielsen in. [4] report of a significant reduction the number of weeds after the use of undersown crops.

4. Conclusions

1. The method of triticale cultivation significantly affected the amount of weeds. The highest fresh and dry mass of weeds were recorded in spring triticale cultivated in pure sowing, regardless of the biomass destination. Undersown serradella significantly reduced fresh and dry mass of weeds in spring triticale, both cultivated for green matter (by 53 and 55%, respectively) and for grain (by 26 and 24% respectively).
2. The largest number of weeds was recorded in the single-species crops of winter triticale, regardless of the harvest date. Undersown seradella reduced number of weeds, slightly more in the case of winter triticale (on average by 32%) than spring triticale (on average by 20%).
3. The number of segetal flora species was lower in triticale cultivated with undersown serradella (23-27), than in pure cereal sowings (31-32).
4. The most abundant weed species, regardless of the date of triticale harvest, were: *Chenopodium album*, *Erigeron candensis*, *Poligonum aviculare*, *Trifolium arvense* and *Setaria pumila*. Undersown serradella limited the number of weeds by 34 to 86%.

5. References

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