

Mechanical and chemical weeding effects on the weed structure in durum wheat

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Abstract

A three-year field experiment was performed to study weed infestation of durum wheat at the stage of emergence and full maturity. Two weeding systems (WS) were used in the post-harvest period: i) mechanical weeding (MW); and ii) chemical weeding (CW). In the MW system, soil underwent shallow ploughing at a depth of 10-12 cm and double harrowing (after ploughing and 3 weeks later), whereas glyphosate only was used in the CW system. In the springtime, in both MW and CW systems, a tillage set consisting in a cultivator, a string roller and harrowing was used. Overall, the number of weeds m², the number of weed species and the value of weed diversity indices were always higher in MW than in the CW systems in each study year at both the emergence and full maturity stage of durum wheat. The study demonstrated that at the stage of durum wheat emergence, more weeds per m² occurred in the MW than in the CW system in each study year. Moreover, the MW systems was characterized by a higher number of weed species as well as by a higher value of weed diversity index compared to the CW system.

Introduction

Glyphosate herbicides are the most commonly used plant protection agents in crop stands (Dill, 2005; Heap and Duke, 2018).

They are used to eradicate weeds on stubble fields and barren lands, and in stands of genetically modified organism (GMO) plants resistant to glyphosate (Duke, 2005; Young *et al.*, 2013; Koning *et al.*, 2019). Glyphosate-resistant crops are grown primarily in the USA, Argentina, Brazil, and China (Nandula *et al.*, 2005; Reddy and Koger, 2005). In the European Union, where no such crops are cultivated, this herbicide is used on stubble fields, usually in the direct sowing and strip-till systems (Santín-Montanyá *et al.*, 2016; Koning *et al.*, 2019). Weed control with herbicides, particularly with the non-selective glyphosate, is highly effective and efficient (Haliniarz *et al.*, 2018; Woźniak and Rachoń, 2019), but unfortunately contributes to the development of herbicide-resistant weed biotypes (Van Gessel, 2001; Yuan *et al.*, 2002; Perez *et al.*, 2004; Koger and Reddy, 2005; Owen and Zelaya, 2005; Collavo and Sattin, 2014). This is due to the use of reduced doses of herbicides (compared to the recommended ones) that may selectively affect little-sensitive weeds and induce their resistance to plant protection agents (Koning *et al.*, 2019). As reported by Heap and Duke (2018), thirty-eight weed species have now evolved resistance to glyphosate, distributed across 37 countries and in 34 different crops and six non-crop situations.

Weed infestation of crops is a resultant of the co-occurrence of multiple factors, such as the: weed seed bank in the soil (Swanton *et al.*, 2000; Vanasse and Leroux, 2000; Woźniak, 2007; Restuccia *et al.*, 2019), tillage systems (Chauhan *et al.*, 2012; Gawęda *et al.*, 2018; Woźniak and Soroka, 2018), plant succession in crop rotation (Moyer *et al.*, 1994; Woźniak and Soroka, 2015), and weeding systems (Rasmussen *et al.*, 2006; Peigné *et al.*, 2007; Pardo *et al.*, 2008). Cultivation tools destroy annual weeds mechanically, but at the same time increase the number of vegetative species which reproduce through rhizomes, runners, bulbs or roots. During ploughing, seeds are being ploughed out onto soil surface, afterwards they sprout and emerge under convenient conditions. In turn, seeds which have just fallen on soil surface are in the ploughing process mixed into the deeper soil layers from where only a few of them are capable to emerge (Yenish *et al.*, 1992; Riemens *et al.*, 2007). As demonstrated in our previous study (Woźniak, 2007), in the conventional tillage system, the highest number of weed seeds may be found in the soil layer at 1-10 cm, then a lower number in the soil layer at 10-25 cm, whilst the lower number on soil surface (0-1 cm). In contrast, the no-till system increases weed seed bank in the topsoil (Tørresen and Skuterud, 2002; Mohler *et al.*, 2006). In turn, an experiment performed by Bärberi *et al.* (2001) has demonstrated that up to 90% of the seed bank may be present on soil surface and that, when emerged, these seedlings may be destroyed by chemical or mechanical treatments.

The use of various solutions in soil tillage affects the extent of weed infestation and weed biodiversity (Peigné *et al.*, 2007; Woźniak and Rachoń, 2019). Glyphosate herbicides used in the direct sowing system reduce the number of weed species compared to the conventional and reduced tillage, as well as contribute to the vertical distribution of weeds in the crop stand (Woźniak and Soroka, 2017; Woźniak, 2018).

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Key words: Species composition; Shannon-Wiener's diversity index; Jaccard's similarity index; degrees of phytosociological constancy.

Acknowledgements: Research supported by Poland's Ministry of Science and Higher Education as part of the statutory activities of the Department of Herbology and Plant Cultivation Techniques, University of Life Sciences in Lublin.

Received for publication: 24 October 2019.

Revision received: 28 March 2020.

Accepted for publication: 28 March 2020.

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Italian Journal of Agronomy 2020; 15:1559

doi:10.4081/ija.2020.1559

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This study aimed to evaluate the effect of weeding systems the extent of weed infestation and weed biodiversity at the stage of emergence and full maturity of durum wheat.

Materials and methods

Habitat localization and climatic conditions

A field experiment was performed in the years 2016-2018 at the Uhrusk Experimental Station of the University of Life Sciences in Lublin (south-eastern Poland; 51°18'12" N, 23°36'48"E). It was set up in a randomized sub-block design in 3 replicates having the size of 6×25 m. The soil under experiment contained 24.1% of the silty fraction and 13.2% of the dust fraction and was classified as Rendzic Phaeozem (IUSS Working Group WRB 2015). It was characterized by alkaline pH (pH_{KCL}=7.3), high contents of available phosphorus (140 mg P kg⁻¹) and potassium (300 mg K kg⁻¹), and by a moderate content of magnesium (61 mg Mg kg⁻¹). Organic carbon content in the soil accounted for 8.20 g kg⁻¹ and that of total nitrogen – for 0.90 g N kg⁻¹. In the period 1990-2015, the average annual sum of atmospheric precipitation at the study area reached 607 mm, but from durum wheat sowing (April) until harvest (August) the rainfalls accounted for 339 mm. In the study period (2016-2018), the sums of monthly precipitations from April to August were highly diversified - the lowest ones occurred in 2018 (220 mm), higher in 2017 (297 mm), and the highest in 2016 (374 mm). Considering air temperature, the warmest turned out to be the year 2018 (18.2°C on average), colder was 2016 (16.2 °C), and the coldest appeared to be 2017 (15.9°C).

Crop management

Two weeding systems (WS) were used in the post-harvest period: i) mechanical weeding (MW); and ii) chemical weeding (CW). In the MW system, soil underwent shallow ploughing at a depth of 10-12 cm and double harrowing (immediately after ploughing and 3 weeks later), whereas glyphosate (360 g L⁻¹, 4 L ha⁻¹) only was used in the CW system. In both weeding systems, pea (*Pisum sativum* L.) was used as the previous crop to spring durum wheat (*Triticum durum* Desf., Duromax cultivar). In the MW system, pre-winter ploughing at a depth of 20-25 cm was performed at the beginning of November. In the springtime, in both MW and CW systems a tillage set was used which consisted of a cultivator, a string roller, and a harrow. Nitrogen, phosphorus, and potassium were administered at doses of: N - 120 kg ha⁻¹, P - 35 kg ha⁻¹, and K - 80 kg ha⁻¹. Fertilization was calculated according soil chemical analysis. The phosphorus-based and potassium-based fertilizers were used once before durum wheat sowing, whereas the nitrogen-based ones were applied in the three following terms: i) before sowing - 50 kg ha⁻¹; ii) at the tillering stage (22-23 BBCH) - 40 kg ha⁻¹; and ;) at the flag leaf emergence stage (39 BBCH) - 30 kg ha⁻¹ (BBCH Working Group 2001). In all study years, durum wheat was sown in the first decade of April at the sowing density of 450 seeds per m².

Performance traits and statistical analysis

The number and species composition of weeds were evaluated in two terms: i) at the emergence stage (12-13 BBCH); and ii) at the full maturity stage (89 BBCH) of durum wheat. The number of weeds and their species composition were determined on the area of m² of each plot using the frame twice having the size of 1x0.5 m. At the 89 BBCH stage, analyses were also conducted to determine the air-dry weight of weeds. Weeds picked at this stage from

the designated areas were placed in a ventilated room until dry matter has been obtained. Then, the following biodiversity indices and degrees were determined: Shannon-Wiener's diversity index (H'), Jaccard's similarity index (Kj), and degrees of phytosociological consistency (Woźniak and Soroka, 2015; Woźniak, 2018).

Values of the Shannon-Wiener's index (H') were computed from the following formula:

$$H' = -S \left(\frac{ni}{N} \right) \log \left(\frac{ni}{N} \right),$$

where: ni – number of individuals of species, and N – total number of individuals of all species.

Values of the Jaccard's similarity index were computed using the following formula:

$$Kj = \frac{c}{a+b-c},$$

where a – number of species in sample a; b – number of species in sample b; c – number of common species in both samples.

The frequency of weeds occurrence was evaluated using five classes: V (80-100%), IV (60-80%), III (40-60%), II (20-40%), and I (<20%).

Results were elaborated statistically with the analysis of variance (ANOVA) method, whereas the significance of differences between the compared mean values (years x weeding systems) was estimated with the Tukey's *HSD* test, $P < 0.05$.

Results

Weed infestation of durum wheat at the stage of emergence (12-13 BBCH)

The number of weeds per m² at durum wheat emergence stage was found to depend on both: weeding systems (WS), study year (Y), and their interaction WS x Y (Tables 1 and 2). In each study

Table 1. Number of weeds per m² at the emergence stage of durum wheat (12-13 BBCH).

Years (Y)	Weeding systems (WS)		Mean
	Mechanical weeding (MW)	Chemical weeding (CW)	
2016	20.1	2.5	11.3
2017	35.3	3.4	19.4
2018	34.5	11.6	23.1
Mean	29.9	5.8	-
<i>HSD</i> _{0.05} for WS = 5.1; Y = 6.3; WS x Y = 9.7			

Table 2. Number of weed species at the emergence stage of durum wheat (12-13 BBCH).

Years (Y)	Weeding systems (WS)		Mean
	Mechanical weeding (MW)	Chemical weeding (CW)	
2016	14.0	6.0	10.0
2017	17.0	5.0	11.0
2018	14.0	6.0	10.0
Mean	15.0	5.7	-
<i>HSD</i> _{0.05} for WS = 4.5; Y = ns; WS x Y = 11.0			

ns, not significant.

year, a significantly higher number of weeds was recorded on plots cultivated in the MW system than CW system. The higher weed number per m² was also determined in the years 2017 and 2018 compared to 2016. The MW plots were also characterized by a higher number of weed species than the CW plots. The weeding systems and study years affected also the species composition of weeds. In 2016, the prevailing species on MW plots included: *Stellaria media*, *Galium aparine*, *Consolida regalis*, and *Polygonum persicaria*; whereas these on CW plots included: *S. media*, *Viola arvensis*, *Capsella bursa-pastoris*, and *Apera spica-venti* (Figure 1). In 2017, *S. media*, *Papaver rhoeas*, and *G. aparine* prevailed on MW plots; whereas *S. media*, *Sonchus asper*, and *V. arvensis* on CW plots (Figure 2). In 2018, the most abundant species on MW plots were: *S. media*, *P. rhoeas*, and *G. aparine*; and on CW plots: *S. media*, *S. asper*, and *V. arvensis* (Figure 3).

The weeding systems and study years affected also values of Shannon-Wiener's diversity index (H') and Jaccard's similarity index (K_j) (Table 3). Significantly greater species diversity of weeds (H') was observed on MW than on CW plots. Differences were also observed among study years, with greater diversity reported in 2017 and 2018 than in 2016. In contrast, higher values of the similarity index (K_j) were determined for the weed community from the CW system than for the community from the MW system as well as in the year 2016 compared to 2017 and 2018.

The variance component analysis demonstrated that the number of weeds per m² depended to a greater extent on the weeding system (WS) than on study year (Y) and their co-effect (WS x Y); and that the number of weed species was affected to a greater extent by WS x Y co-effect and WS. In addition, it showed that the values of the Shannon-Wiener's diversity index (H') were equally influenced by WS, WS x Y and Y; whereas these of the Jaccard's similarity index (K_j) were affected more by the WS x Y co-effect and similarly influenced by WS and Y (Table 4).

Weed infestation of durum wheat at the stage of full maturity (89 BBCH)

At the full maturity stage of durum wheat, in each study year, a significantly higher number of weeds per m² (by 74.3-79.5%) was found on plots cultivated in the MW than in the CW system (Table 5). Also the air-dry weight of weeds was higher in the MW

Table 3. Values of Shannon-Wiener's diversity index (H') and Jaccard's similarity index (K_j) at the emergence stage of durum wheat (12-13 BBCH).

Years (Y)	Weeding systems (WS)		Mean
	Mechanical weeding (MW)	Chemical weeding (CW)	
Shannon-Wiener diversity index			
2016	1.03	0.53	0.78
2017	1.17	0.60	0.88
2018	1.03	0.74	0.89
Mean	1.07	0.62	-
<i>HSD</i> _{0.05} for WS = 0.07; Y = 0.09; WS x Y = 0.12			
Jaccard's index of similarity			
2016	0.23	0.49	0.36
2017	0.18	0.36	0.27
2018	0.24	0.31	0.28
Mean	0.22	0.39	-
<i>HSD</i> _{0.05} for WS = 0.04; Y = 0.06; WS x Y = 0.10			

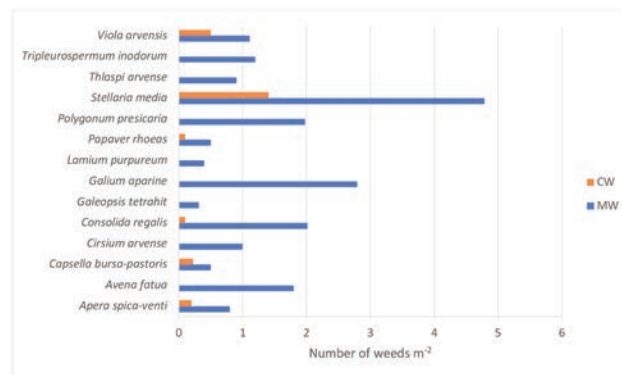


Figure 1. Species composition of weeds at the emergence stage of durum wheat (12-13 BBCH) in 2016, CW – Chemical weeding; MW – Mechanical weeding.

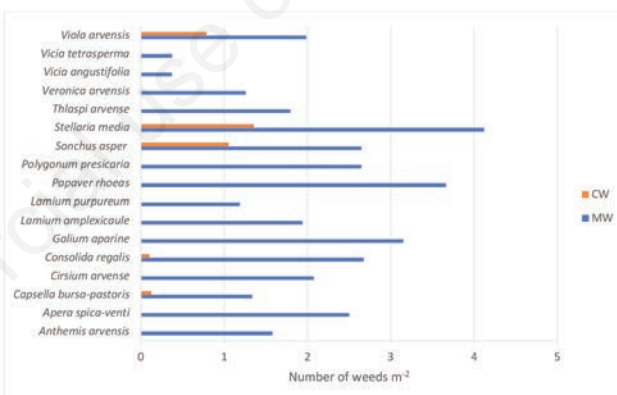


Figure 2. Species composition of weeds at the emergence stage of durum wheat (12-13 BBCH) in 2017, CW - Chemical weeding; MW – Mechanical weeding.

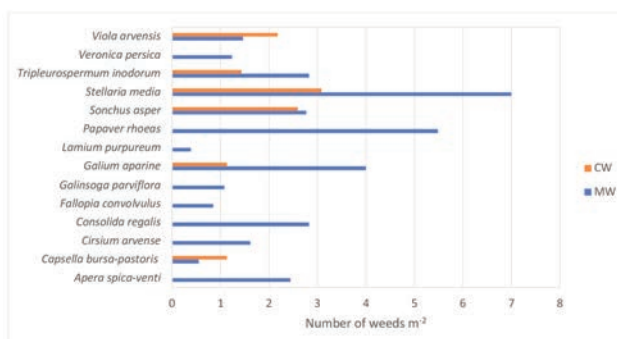


Figure 3. Species composition of weeds at the emergence stage of durum wheat (12-13 BBCH) in 2018, CW - Chemical weeding; MW – Mechanical weeding.

than in the CW system (by 52.1-65.1%). The MW plots were also characterized by a higher number of weed species (from 10 to 16 species) compared to the CW plots (Table 6). The number of weed species on MW and CW plots was found to depend on study year, with a higher species number identified in 2018 than in 2016. In 2016, the prevailing species on MW plots included: *P. rhoeas*, *Avena fatua*, *S. media*, and *A. spica-venti*; whereas these prevailing on CW plots included: *Vicia angustifolia*, *V. arvensis*, and *Fumaria officinalis* (Figure 4). In 2017, *A. fatua*, *P. rhoeas*, *S. media*, and *G. aparine* prevailed on MW plots; whereas *A. spica-venti*, *A. fatua*,

and *S. media* on CW plots (Figure 5). In 2018, the most abundant species on MW plots were: *A. fatua*, *S. media*, *Chenopodium album*, and *P. rhoeas*; whereas on CW plots: *A. fatua*, *A. spica-venti*, *S. media*, and *P. aviculare* (Figure 6).

The weeding systems and study years affected also values of the diversity and similarity indices (Table 7). A higher value of the Shannon-Wiener's diversity index (H') was computed for the MW than for the CW system as well as in the year 2018 than in the year 2016. Opposite observations were made for the Jaccard's similarity index (K_j), the values of which were higher in the CW than in the MW system, and in 2016 than in 2018.

The variance component analysis showed that the number of weeds per m^2 depended to a greater extent on WS than on WS x Y co-effect (Table 8), and that the number of weed species was similarly affected by WS and Y, and less affected by their co-effect. Values of the Shannon-Wiener's diversity index (H') were influ-

Table 4. Variance analysis of indicators of weed infestation of durum wheat stand at the emergence stage (12-13 BBCH).

Specification	Value	WS	Y	WS x Y
Number of weeds m^{-2}	F	198.5	92.3	134.6
	P	**	*	*
Number of species	F	12.9	2.3	14.9
	P	*	ns	*
Shannon-Wiener diversity index (H')	F	63.0	12.3	29.6
	P	*	*	*
Jaccard's similarity index (K_j)	F	12.1	13.3	21.9
	P	*	*	*

WS, Weeding systems; Y, Years, * P<0.05; **P<0.05; ns, not significant.

Table 5. Number and air-dry weight of weeds per m^2 at the full maturity stage of durum wheat (89 BBCH).

Years (Y)	Weeding systems (WS)		Mean
	Mechanical weeding (MW)	Chemical weeding (CW)	
	Number of weeds m^{-2}		
22016	82.5	16.9	49.7
2017	71.6	17.4	44.5
2018	81.6	21.0	51.3
Mean	78.6	18.4	-

HSD_{0.05} for WS = 9.3; Y = ns; WS x Y = 13.2

Years (Y)	Weeding systems (WS)		Mean
	Mechanical weeding (MW)	Chemical weeding (CW)	
	Air-dry weight of weeds in $g m^{-2}$		
2016	61.1	21.3	41.2
2017	57.8	22.9	40.4
2018	65.3	26.2	45.8
Mean	61.4	23.5	-

HSD_{0.05} for WS = 7.5; Y = ns; WS x Y = 12.1

ns, not significant.

Table 6. Number of weed species at the full maturity stage of durum wheat (89 BBCH).

Years (Y)	Weeding systems (WS)		Mean
	Mechanical weeding (MW)	Chemical weeding (CW)	
2016	18.0	8.0	13.0
2017	23.0	11.0	17.0
2018	28.0	12.0	20.0
Mean	23.0	10.3	-

HSD_{0.05} for WS = 4.1; Y = 6.0; WS x Y = 9.8

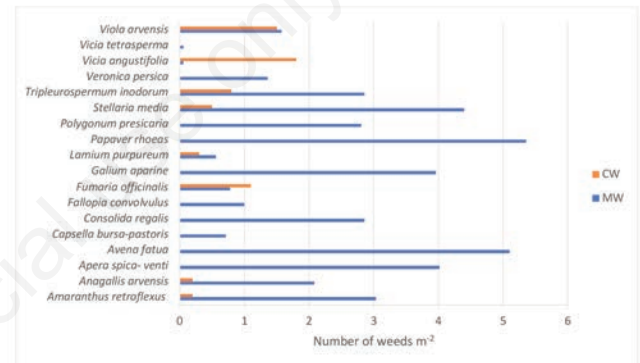


Figure 4. Species composition of weeds at the full maturity stage of durum wheat (89 BBCH) in 2016, CW – Chemical weeding; MW – Mechanical weeding.

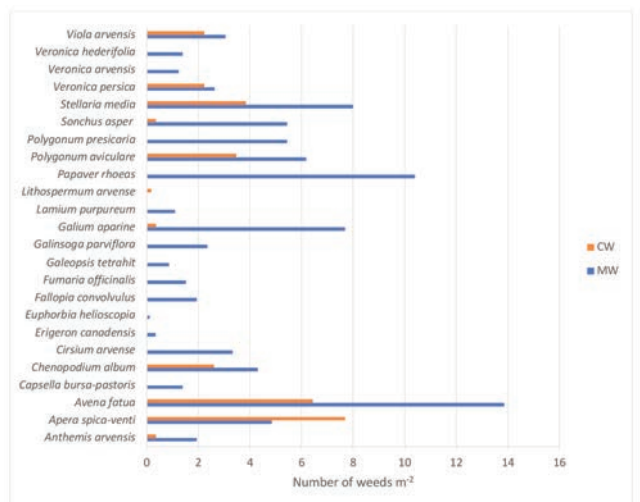


Figure 5. Species composition of weeds at the full maturity stage of durum wheat (89 BBCH) in 2017, CW – Chemical weeding; MW – Mechanical weeding.

enced to a greater extent by WS and WS x Y co-effect, and to a lesser extent by Y; whereas values of the Jaccard's similarity index (K_j) were similarly affected by WS and Y, and less affected by WS x Y co-effect. In the MW system, 29 species of dicotyledonous weeds and 3 species of monocotyledonous weeds were identified in durum wheat stand (Table 9). *P. aviculare*, *S. asper*, *S. media*, *Tripleurospermum inodorum*, *Veronica persica*, *V. arvensis*, and *A. fatua* occurred in the durum wheat crop in the highest V class of phytosociological consistency, whereas *C. regalis*, *Lamium amplexicaule*, *L. purpureum*, *P. rhoeas*, and *Echinochloa crus-galli* in the IV degree. The number of dicotyledonous and monocotyledonous weed species identified on CW plots accounted for 11 and 2, respectively. This highest V class of phytosociological constancy was ascribed to: *P. aviculare*, *S. media*, *V. arvensis*, and *A. fatua*, whereas the IV degree to: *L. amplexicaule*, *T. inodorum* and *V. persica*.

Discussion

Weeds are companion species to crops that strongly respond to agrotechnical treatments (Gunton *et al.*, 2011; Pinke *et al.*, 2012; Fried *et al.*, 2012). As shown in our study and in investigations conducted by Hernández Plaza *et al.* (2015), Woźniak and Rachoń (2019), and Woźniak (2018), the conventional tillage system increases the species diversity of weed communities compared to the no-till system with the use of glyphosate. In our previous experiment Woźniak and Soroka (2017), on plots treated with glyphosate herbicide, the weed community was shown to include only short-term species, whereas on plots cultivated in the conventional and reduced systems it included both short-term and perennial species (*Convolvulus arvensis*, *Cirsium arvense*, *Elymus repens* and *S. arvensis*). According to Hernández Plaza *et al.* (2015), weeds produce more seeds (but with a lower mass) in the direct sowing system with glyphosate than in the conventional and

reduced systems. In turn, seeds from the conventional system were characterized by highly variable size and mass, which caused a greater diversity and, consequently, higher germination capability, growth dynamics of seedlings, competitiveness, and diversity of the weed community (Hernández Plaza *et al.*, 2015). Our previous study (Woźniak and Soroka, 2017) demonstrated that tillage systems affected also the species composition and vertical distribution of weeds in cereal stands. *A. spica-venti* was found to prevail on the plots treated with glyphosate, whereas *Avena fatua* on plots cultivated in the conventional and reduced systems without the herbicide. Another research of ours (Woźniak and Rachoń, 2019) showed an increased contribution of the biomass of monocotyledonous weeds in the total weed biomass on plots treated with glyphosate compared to the plots cultivated with the conventional tillage system. In the presented experiment, the weeding systems and study years affected also values of the Shannon-Wiener' diversity index (H') and Jaccard's similarity index (K_j). Greater diversity of the weed community was found in the MW system than in the CW system. Similar dependencies were reported by Van Gessel (2001), Koger and Reddy (2005), Hernández Plaza *et al.* (2015), Woźniak (2018), and Koning *et al.* (2019). Also the number of weed species was higher in the MW system (32 species) than in the CW system (13 species). In our previous study (Woźniak and Soroka, 2015), cereals were accompanied by communities of sege-

Table 7. Values of Shannon-Wiener's diversity index (H') and Jaccard's similarity index (K_j) at the full maturity stage of durum wheat (89 BBCH).

Years (Y)	Weeding systems (WS)		Mean
	Mechanical weeding (MW)	Chemical weeding (CW)	
Shannon-Wiener diversity index			
2016	1.13	0.79	0.96
2017	1.21	0.86	1.03
2018	1.30	0.97	1.13
Mean	1.21	0.87	-
<i>HSD</i> _{0.05} for WS = 0.08; Y = 0.10; WS x Y = 0.15			
Jaccard's index of similarity			
2016	0.21	0.49	0.35
2017	0.19	0.42	0.30
2018	0.17	0.33	0.25
Mean	0.19	0.41	-
<i>HSD</i> _{0.05} for WS = 0.05; Y = 0.07; WS x Y = 0.12			

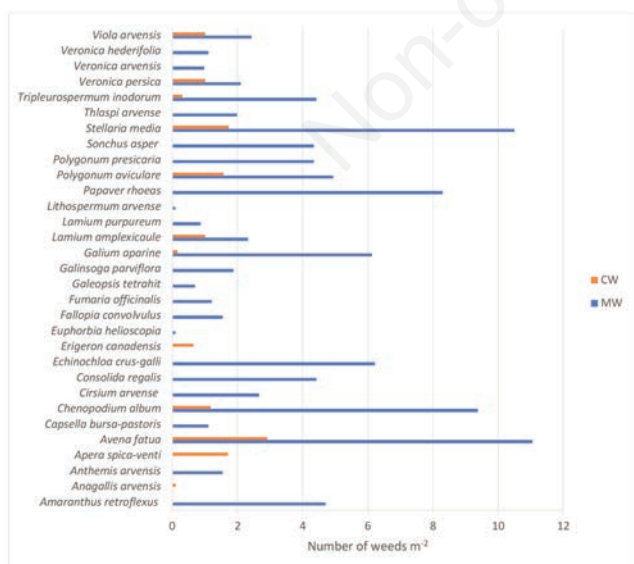


Figure 6. Species composition of weeds at the full maturity stage of durum wheat (89 BBCH) in 2018, CW – Chemical weeding; MW – Mechanical weeding.

Table 8. Variance analysis of indicators of weed infestation of durum wheat stand at the full maturity stage (89 BBCH).

Specification	Value	WS	Y	WS x Y
Number of weeds m ⁻²	F	121.3	32.8	89.4
	P	**	ns	*
Number of species	F	24.2	29.6	16.3
	P	*	*	*
Shannon-Wiener diversity index (H')	F	72.3	31.9	69.4
	P	**	*	*
Jaccard's similarity index (K_j)	F	13.3	14.8	13.9
	P	*	*	*

WS, Weeding systems; Y, Years, * P<0.05; **P<0.05; ns, not significant.

tal weeds, mainly representatives of the class *Stellarietea mediae* R.Tx, Lohm. et Prsg 1950. These communities were composed of one-year or two-year segetal species, and on fields with low agrotechnical ingenerence also of perennial ruderal and even meadow species. Their development is influenced by the type and properties of soil, water-air balance, crop species, plant succession in crop rotation, and intensity of agrotechnical measures. These findings were also confirmed in our field experiment.

Table 9. Degrees of phytosociological constancy of weed species at the full maturity stage of durum wheat (89 BBCH).

Species composition	Mechanical weeding (MW)	Chemical weeding (CW)
Dicotyledonous species		
<i>Amaranthus retroflexus</i> L.	III	-
<i>Anagallis arvensis</i> L.	II	-
<i>Anthemis arvensis</i> L.	III	-
<i>Capsella bursa-pastoris</i> (L.) Medicus	III	II
<i>Chenopodium album</i> (L.)	III	III
<i>Cirsium arvense</i> (L.) Scopoli	I	-
<i>Consolida regalis</i> Gray	IV	-
<i>Erigeron canadensis</i> L.	-	I
<i>Euphorbia helioscopia</i> L.	I	-
<i>Fallopia convolvulus</i> (L.) Löve	II	-
<i>Fumaria officinalis</i> L.	I	-
<i>Galeopsis tetrahit</i> L.	I	-
<i>Galinsoga parviflora</i> Cav.	II	-
<i>Galium aparine</i> L.	V	V
<i>Lamium amplexicaule</i> L.	IV	IV
<i>Lamium purpureum</i> L.	IV	-
<i>Lithospermum arvense</i> L.	I	-
<i>Papaver rhoeas</i> L.	IV	-
<i>Polygonum aviculare</i> L.	V	V
<i>Polygonum persicaria</i> L.	I	-
<i>Sonchus asper</i> (L.) Hill	V	III
<i>Stellaria media</i> (L.) Villars	V	V
<i>Thlaspi arvense</i> L.	III	-
<i>Tripleurospermum inodorum</i> (L.) Schultz.Bip.	V	IV
<i>Veronica persica</i> Poir.	V	IV
<i>Veronica arvensis</i> L.	I	-
<i>Veronica hederifolia</i> L.	I	-
<i>Vicia angustifolia</i> Reichard	I	-
<i>Vicia tetrasperma</i> (L.) Schreb.	II	-
<i>Viola arvensis</i> Murray	V	V
Number of species	29	11
Monocotyledonous species		
<i>Apera spica-venti</i> L.	I	II
<i>Avena fatua</i> L.	V	V
<i>Echinochloa crus-galli</i> (L.) P.B.	IV	-
Number of species	3	2

Conclusions

Chemical weeding (CW) used after harvest of the previous crop (pea) caused a decrease the number and biomass of weeds in durum wheat compared to the mechanical weeding (MW). In addition, it contributed to the less diverse species composition and a lower number of weed species in durum wheat. On plots cultivated with both weeding systems, there prevailed short-term species, most of which were representants of the class of dicotyledonous weeds. In turn, a representative of monocotyledonous weeds - *Avena fatua* - was found in each study year and in each weeding system. In the MW system, we identified also a perennial species - *Cirsium arvense* - occurring in the I degree of phytosociological constancy.

The choice of the weed control method should be adapted to the number and species composition of the weeds.

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