WEEDS IN SPRING BARLEY AND RESULTS OF WEED LIMITING

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Abstract

Field trials were carried out on organic farming fields at the Skriveri Research center of the Latvia University of Agriculture (LLU). The influence of previous plants (red clover, bare fallow, winter rye for green manure, winter rye), use of stable manure (60 t ha^{-1} or without) and harrowing (without harrowing, before first leaf emergence, at the stage of tillering, before first leaf emergence and at the stage of tillering) on the yield and weediness of spring barley 'Sencis' were tested. Data show that previous plants and stable manure influenced barley grain yields. Harrowing increased the yields of barley only after winter rye for green manure and using stable manure, but the time of harrowing had no influence on the yield of barley. The highest weed infestation in barley was obtained after red clover. Use of stable manure increased the number of annual weeds.

Key words: organic farming, spring barley, weeds, harrowing, previous plants, yields.

Introduction

The main preconditions for organic farming are use of organic fertilizers and crop rotation that maintain soil fertility [1]. One of factors limiting barley grain yields is weeds. In Latvia, during the last 10 years, weeds have been freely propagating in large areas, especially perennial weeds. From 1946, every year in Latvia expeditions are regularly organized to record weeds in different plant sowings. In 1999, in the eastern part of Latvia, 47 species of weeds were ascertained in barley sowings. The most spread annual weeds were *Chenopodium* album L., *Stellaria media* (L.) Will., *Galium aparine* L., *Convolvulus arvensis* L., *Matricaria inodorum* L., and perennial weeds *Elytrigia repens* (L.) Nevski., *Sonchus arvense* L., *Cirsium arvense* L., *Artemisia vulgaris*, and *Tussilago farfara* L. The weed infestation in of barley sowings increased from 79.0 pieces m^{-2} in 1996 to 165.1 pieces m^{-2} in 1999 [2, 3].

The aim of the article is to present the research results on productivity of barley and weed infestation in sowings depending on different agrotechnical elements in organic farming trials at the Skriveri Research centre.

Materials and Methods

The object of research: spring barley 'Sencis'.

The field trials were carried out on turf podsolic soil: pH_{KCl} — 6,75, P_2O_5 — 162 mg kg^{-1}, K_2O — 15,8 mg kg^{-1}, organic matter content — 3,25%, N_{total} — 0,11%.

After bare fallow + winter rye for green manure, 17 t ha^{-1} of biomass of winter rye were cultivated. Winter rye was at the stage of stemelongation (GS 32 after Zadoks). The number of plants — 335 plants m^{-2}. In the trial, variants with stable manure were included (doses of 60 t ha^{-1}). Before sowing, grains were treated with 1,5 kg of ashes of foliage trees and 1,5 l of water per 100 kg of grain.

The variants in the trial:

factor A — previous plants with graduation:
- A_1 — red clover,
- A_2 — bare fallow,
- A_3 — winter rye,
- A_4 — winter rye for green manure;

factor B — time of harrowing with graduation:
- B_1 — without harrowing,
- B_2 — before first leaf emergence,
- B_3 — at the stage of tillering,
- B_4 — before first leaf emergence and at the stage of clustering;

factor C — use of stable manure with graduation:
- C_1 — without stable manure,
- C_2 — stable manure 60 t ha^{-1}.

Weed assessment was established by the method of number and weight of weeds using a 0.25 m^{-2} by frame.

Results and Discussion

The year 2003 was very favorable for growth and development of spring barley. April was rainy and cold, which hampered the time of sowing. In May, the air was getting warmer gradually, at nights the temperature was under 10 °C, and frosts were frequent on the soil surface. Barley germinated and clustered quickly. In June, the average air temperature was 0,7 degrees lower than the norm, but the amount of precipitation made 75% of the norm. July with average air temperature 19 °C was the second warmest middle-summer month during the last 80 years in Latvia. Barley grew and developed well and produced good and qualitative grain yields. Depending on the variants, the yields in the field trial varied from 2,18 to 3,56 t ha^{-1} (Table 1).

Table 1

The spring barley 'Sencis' grain yields depending on the previous plant, use of stable manure and time of harrowing, t ha^{-1}, 2003

Previous plant* Factor A	Time of harrowing (factor B)	Stable manure** (Factor C)		
		without	60 t ha^{-1}	on average
A_1	1. without	3,03	3,37	3,20
	2. at GS 7	2,72	3,26	2,99
	3. at GS 23	2,94	3,38	3,16
	4. at GS 7 and GS 23	3,00	3,56	3,28
	$\gamma_{0,05}$ = 0,46 t ha^{-1}	$\gamma_{0,05}B$ =0,33 t ha^{-1}	$\gamma_{0,05}C$ = 0,23 t ha^{-1}	
A_2	1. without	2,24	2,96	2,60
	2. at GS 7	2,23	2,73	2,48
	3. at GS 23	2,20	2,71	2,46
	4. at GS 7 and GS 23	2,46	2,79	2,62
	$\gamma_{0,05}$ = 0,52 t ha^{-1}	$\gamma_{0,05}B$ =0,37 t ha^{-1}	$\gamma_{0,05}C$ = 0,26 t ha^{-1}	
A_3	1. without	3,30	3,16	3,23
	2. at GS 7	3,16	3,58	3,37
	3. at GS 23	3,13	3,46	3,29
	4. at GS 7 and GS 23	3,08	3,51	3,30
	$\gamma_{0,05}$ = 0,52 t ha^{-1}	$\gamma_{0,05}B$ =0,36 t ha^{-1}	$\gamma_{0,05}C$ = 0,26 t ha^{-1}	
A_4	1. without	2,43	3,31	2,87
	2. at GS 7	2,23	3,30	2,76
	3. at GS 23	2,19	3,24	2,71
	4. at GS 7 and GS 23	2,31	3,28	2,80
	$\gamma_{0,05}$ = 0,34 t ha^{-1}	$\gamma_{0,05}B$ =0,24 t ha^{-1}	$\gamma_{0,05}C$ = 0,17 t ha^{-1}	

* A_1 — bare fallow; A_2 — red clover; A_3 — bare fallow and winter rye for green manure; A_4 — bare fallow and winter rye for grain.

The data in Table 1 demonstrate the influence of stable manure on spring barley — grain yields have increased by 0,47—0,99 t ha^{-1} on average. Use of stable manure for barley after winter rye provided the highest yield increase. It is known that winter rye impoverishes the soil; use of stable manure provided increase in yields by 0,99 t ha^{-1} on average.

After different previous plants the highest yields were obtained after winter rye for green manure and after bare fallow in both variants, with stable manure and without it. Increase in grain yields after winter rye for green manure can be explained by the activity of microorganisms. After decomposition of winter rye biomass, plants can use nitrogen and CO_2 for development.

1000 kernel weight was medium — 33,5—38,4 g, medium was also specific weight — 609,0—633,5 g. The content of total protein in grain after bare fallow and winter rye for green manure was good — 11,7—11,5%, but after red clover and winter rye for grain — unsatisfactory (9,7—9,5%).

Excess precipitation and warm weather in most part of the vegetation period favored fast development of barley and suppression of weeds. Harrowing increased the grain yields essentially only after winter rye for green manure with stable manure, whereas time of harrowing had no significant influence on the grain yield. The microorganisms, carried into the soil by stable manure, provided fast decomposition of green manure.

At the stage of heading (3 weeks after harrowing) 18 species of weeds were established in the sowings. The number and weight of annual and perennial weeds are presented in Table 2.

Table 2

Weed infestation in spring barley 'Sencis' sowings in 2003

Previous plant (factor A)*	Stable manure (factor C)**	Harrowing (factor B)	Number of weeds, pieces m^{-2}			Biomass of weeds, g m^{-2}		
			total	annual	perennial	total	annual	perennial
A_1	0	without	108	108	0	370,0	370,0	0,0
		GS 7	90	80	10	113,6	93,6	20,0
		GS 23	78	78	0	170,7	170,7	0,0
		GS 7, GS 23	62	62	0	55,1	55,1	0,0
	60	without	134	134	0	138,3	138,3	0,0
		GS 7	104	104	0	107,8	107,8	0,0
		GS 23	72	72	0	51,1	51,1	0,0
		GS 7, GS 23	50	48	2	47,4	46,1	0,0
A_2	0	without	148	64	50	50,0	50,0	0,0
		GS 7	84	54	16	16,0	16,0	0,0
		GS 23	88	46	42	42,0	42,0	0,0
		GS 7, GS 23	94	50	44	44,0	44,0	0,0
	60	without	215	163	52	52,0	52,0	0,0
		GS 7	147	105	42	42,0	42,0	0,0
		GS 23	165	117	48	48,0	48,0	0,0
		GS 7, GS 23	150	114	36	36,0	36,0	0,0
A_3	0	without	120	120	0	104,9	104,9	0,0
		GS 7	74	74	0	98,8	98,8	0,0
		GS 23	62	60	2	93,2	91,2	2,0
		GS 7, GS 23	46	42	4	134,2	126,1	8,2
	60	without	161	161	0	190,6	190,6	0,0
		GS 7	97	97	0	110,7	110,7	0,0
		GS 23	118	112	6	198,4	190,0	8,4
		GS 7, GS 23	82	82	0	139,4	139,4	0.0
A_4	0	without	120	120	0	86,0	86,0	0,0
		GS 7	46	44	2	58,8	46,1	12,7
		GS 23	90	82	8	114,5	97,3	17,3
		GS 7, GS 23	70	70	0	64,8	64,8	0,0
	60	without	108	106	2	137,6	87,6	50,0
		GS 7	102	102	0	108,8	108,8	0,0
		GS 23	80	78	2	131,3	129,3	2,0
		GS 7, GS 23	76	76	0	205,1	205,1	0,0

* A_1 — bare fallow; A_2 — red clover; A_3 — bare fallow and winter rye for green manure; A_4 — bare fallow and winter rye for grain;
** 0 — without stable manure; 60—60 t ha^{-1}.

In variants without stable manure, the previous plant did not influence the total number of weeds. In variants with stable manure, the number of weeds was higher after red clover. After use of stable manure the number of weeds increased essentially when barley was grown after red clover (+ 65 pieces m^{-2}) and after winter rye for green manure (+ 39 pieces m^{-2}).

The total number of weeds influenced barley grain yields without use of stable manure only after winter rye for green manure ($r = 0,81$), but in variants with stable manure — when barley was grown after bare fallow ($r = -0,91$) and after winter rye for green manure ($r = -0,80$). Total biomass of weeds influenced the grain yield significantly only after winter rye with stable manure ($r = 0,96$).

From annual weeds, *Chenopodium album* L, *Stellaria media* L., *Capsella bursa-pastoris* L., *Polygonum* spp. and *Matricaria inodorum* L. were ascertained in all variants. In some variants, *Spergula arvensis* L., *Viola* spp., *Galeopsis speciosa* Mill., *Raphanus raphanistrum* L. and *Thlaspi arvense* L. were established, though the number of these weeds was negligible.

The number of annual weeds influenced the yields of barley significantly only after red clover without stable manure ($r = 0,86$). Whereas biomass of these weeds influenced the grain yield only after winter rye without stable manure ($r = -0,93$).

In barley sowings, six perennial weed species were established, the most widespread of which were *Elytrigia repens* (L.) Nevski and *Sonchus arvense* L. After red clover a higher number of weeds were established compared to

other previous plants, though neither the number nor biomass of weeds influenced the yields of grain. Sowings of previous plant red clover were sparse, which favored fast spread of perennial weeds.

Table 3

The influence of harrowing time and use of stable manure, after different previous plants, on the number of weeds in spring barley 'Sencis' in 2003

Time of harrowing (factor B)	Stable manure (factor C)		On average
	0	60	
1. after bare fallow			
1. without	108	134	121
2. at GS 7	92	104	113
3. at GS 23	78	72	75
4. at GS 7 and GS 23	62	50	56
$\gamma_{0,05}$ = 58 pieces m^{-2}	$\gamma_{0,05}$ B = 41 pieces m^{-2}		$\gamma_{0,05}$ C = 29 pieces m^{-2}
2. after red clover			
1. without	148	215	182
2. at GS 7	84	147	116
3. at GS 23	88	165	127
4. at GS 7 and GS 23	94	150	122
$\gamma_{0,05}$ = 79 pieces m^{-2}	$\gamma_{0,05}$ B = 56 pieces m^{-2}		$\gamma_{0,05}$ C = 39 pieces m^{-2}
3. after winter rye for green manure			
1. without	120	161	141
2. at GS 7	74	97	86
3. at GS 23	62	88	90
4. at GS 7 and GS 23	46	82	64
$\gamma_{0,05}$ = 47 pieces m^{-2}	$\gamma_{0,05}$ B = 33 pieces m^{-2}		$\gamma_{0,05}$ C = 23 pieces m^{-2}
4. after winter rye for grain			
1. without	120	118	114
2. at GS 7	90	102	74
3. at GS 23	70	80	85
4. at GS 7 and GS 23	46	76	73
$\gamma_{0,05}$ = 42 pieces m^{-2}	$\gamma_{0,05}$ B = 30 pieces m^{-2}		$\gamma_{0,05}$ C = 21 pieces m^{-2}

Table 3 shows that harrowing significantly decreased the number of weeds after all previous plants.

After bare fallow without stable manure, double harrowing decreased the number of weeds essentially but only in variants without harrowing. In variants with stable manure, harrowing decreased the number of weeds significantly at growth stage 23 and, if barley was harrowed twice, at GS 7 and GS 23. After winter rye for green manure the time of harrowing had no influence on the number of weeds. After winter rye without stable manure harrowing at growth stage 23 and double harrowing decreased the number of weeds, but in variants with stable manure the time of harrowing did not influence the number of weeds.

Conclusions

1. In the field trial, grain yields varied within the range of 2,18—3,56 t ha^{-1}. Use of stable manure increased the grain yield by 0,47—0,99 t ha^{-1}. The highest yields after different previous plants were obtained after winter rye for green manure and after bare fallow in both variants, with stable manure and without. Harrowing increased grain yields essentially only after winter rye for green manure with stable manure, though the time of harrowing had no essential influence on the yield of grain.
2. At the stage of heading (3 weeks after harrowing), 18 species of weeds were ascertained in barley sowings. Use of stable manure increased the number of weeds significantly when barley was grown after red clover and after winter rye for green manure.
3. The number of annual weeds had a significant influence on barley grain yield only after red clover without stable manure. Whereas biomass of these weeds influenced grain yields only after winter rye without stable manure.
4. Harrowing essentially decreased the number of weeds after all previous plants.

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