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Efficiency of weed control in feed crops cultivation by organic technology

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Abstract. As a result of studies of field tests in 2019, it was found that corn crops lead to the stable formation of a large vegetative mass of both biennial and perennial weeds, and the cultivation of perennial grasses of the second year of use leads to a decrease in the weediness of crops by both groups of weeds. Despite the absence of pesticides and mineral fertilizers with organic technology, the number and weight of weeds was at the level of intensive technologies, which suggests the possibility of effective weed control with it method of management. Organic and extensive technology without the use of agrochemicals that contributed to a more vivid tendency to reduce the number of weeds by the end of the growing season and the smallest dynamics of their dry mass accumulation. The use of organic technology that ensures the production of crops without the use of pesticides and mineral fertilizers has contributed to the yield of annual and perennial grasses for first year of use at the level of intensive, and winter triticale, barley and corn are significantly higher than extensive, which can serve as the basis for the application of organic technology of cultivation of these crops.

1. Introduction

An Organic food production is an important part of the agricultural economy [1]. Organic farming is one environmentally viable approach to agriculture through its use of animal and green manures to provide nutrients and cultural practices to manage weeds, insects, and pathogens [2].

But organic farming systems produce lower yields compared with conventional agriculture. However, they are more profitable and environmentally friendly, and deliver equally or more nutritious foods that contain less pesticide residues, compared with conventional farming. Moreover, initial evidence indicates that organic agricultural systems deliver greater ecosystem services and social benefits [3].

Competition from weeds can reduce grain yields in both conventional and organic systems [4]. But weed management is especially difficult in organic production without the use of chemical herbicides [5].

Chemical plant protection products always violate the ecological balance, their use is associated with an increase in toxicological and ecotoxicological risk to the environment and human health [6].



Therefore, in modern conditions, the search for opportunities to introduce ecological (organic) forms of management is relevant [7].

Enhancing crop competitive ability by integrating both cultural and mechanical weed control methods is a key strategy in such instances, but the relative efficacy of different cultural and mechanical strategies and their interactions and additive effects when combined is not well known [8].

Suppression of weeds, as well as pests and pathogens should be carried out with the lowest possible risk for the environment [9].

The main tools for maintaining the phytosanitary potential of crops are tillage, crop rotation, cultivation of intermediate crops, phytocenotic suppression of weeds by cultivated plants, and the creation of an optimal nutrition for cultivated plants [10]. The optimization of the phytosanitary state in the system of organic farming is based on the formation of a heterogeneous species and varietal structure of the agroecosystem. When alternating different crops in a crop rotation, weed control measures are implemented by biological suppression using various biotypes of cultivated plants [11]. Therefore, studies the purpose of which is to establish the comparative effectiveness of weed control of forage crops agrophytocenosis using various technologies for their cultivation, including organic are very relevant and have scientific and practical significance.

2. Materials and methods

The studies were carried out in 2019 in a joint field experiment of the department of Agronomy of the FSBEI HE Yaroslavl State Agricultural Academy and Yaroslavl Research Institute of Animal Husbandry and Feed Production – branch Federal Research Center "VIK named after V.R. Vilyams" at the sod-podzolic medium loamy soil in the crop rotation: 1. Annual grasses (oats + vetch) with sowing perennial grasses (alfalfa + timothy grass meadow + meadow fescue) – 2. Perennial grasses for first year of use – 3. Perennial grasses for second year of use – 4. Perennial grasses for third year of use – 5. Winter triticale + rapeseed after harvesting – 6. Barley – 7. Corn. Cultivation technologies: Extensive (without fertilizers and pesticides + lime); Intensive (annual grasses – N60P60K90; perennial grasses – P60K90; winter triticale – N60P60K90 + plowing rapeseed into the soil + N60P60K90; barley – N60P60K90; corn – barley straw + 60 t / ha of manure + N100P100K120 + lime); High intensive (annual grasses – N90P90K135; perennial grasses – P90K135; winter triticale – N60P60K120 + plowing rapeseed into the soil + N90P90K135; barley – N90P90K135 + herbicide (Dialen super 0.5-0.7 l / ha); corn – barley straw + 60 t / ha of manure + N125P125K150 + lime + herbicide (Dialen super 1.0-1.5 l / ha); Organic (without mineral fertilizers and pesticides – perennial grasses for third year of use as a green fertilizer; rapeseed after winter triticale as a green fertilizer; corn – barley straw and 60 t / ha of manure + lime); Biological (limited use of mineral fertilizers – annual grasses – N30P30K45; perennial grasses – P30K45; winter triticale – N30P30K45 plowing rapeseed into the soil + N30P30K45; barley – N30P30K45; corn – barley straw + 60 t / ha of manure + N50P50K60 + lime).

The number of weeds was carried out by using a 1 m² frame to account for perennial weeds and 0.125 m² frame – to account for annual weeds. The counts of weeds were carried out separately for each species in 2 terms. Accounting areas were allocated by the method of randomization. The dry mass of weeds was determined by drying to a constant weight in a thermostat at a temperature of 105 °C and weighed to an accuracy of 0.1 g. Yield (productivity) accounting method – by the plot method with conversion to standard humidity; statistical method – analysis of variance (ANOVA).

3. Results and Discussion

On average, according to the studied factors, the smallest number of perennial weeds was noted in the corn – 3.8 pcs./m², which was 28.9% lower than in the annual grasses, and the maximum number was in the barley – 5.7 pcs./m², however, these differences were not significant (table 1).

A significant excess in the accumulation of dry mass by perennial weeds was noted during the cultivation of corn, which exceeded the indicator in the annual grasses by 3.9 times. It can be noted that corn with a low number of perennial weeds contributed to their accumulation of vegetative mass. The

greatest decrease in the dry mass of perennial weeds was facilitated by the cultivation of perennial grasses for second year of use: in comparison with corn by 8.7 times, with annual grasses – 2.2 times.

Table 1. Number and dry weight of weeds on average for the growing season of crops, depending on cultivation technologies (average by factors).

Variant	Number of weeds, pcs./m ²		Dry weight of weeds, g/m ²	
	perennials	annuals	perennials	annuals
Crops				
Annual grasses with sowing perennial grasses	4.9	60.0	4.74	24.51
Winter triticale	5.2	48.0	5.98	47.74
Barley	5.7	42.0	8.73	38.98
Corn	3.8	31.0	18.43	244.28
Perennial grasses for first year of use	5.2	13.0	4.88	8.07
Perennial grasses for second year of use	5.1	9.0	2.13	1.34
Cultivation technologies				
Extensive	6.0	33.0	8.10	57.65
Intensive	4.0	36.0	6.23	68.33
High intensive	5.0	31.0	7.04	58.40
Organic	5.0	34.0	7.21	48.42
Biological	5.0	34.0	8.83	71.30

Perennial grasses of the second year of use contributed not only to a decrease in the number of young weeds, but also contributed to a significant reduction in their accumulation of dry mass – up to 1.34 g/m². This value was 18.3 times lower than annual grasses. As with perennial weeds, the maximum value of dry weight accumulation by annual weeds was noted in the corn – 244.28 g / m², which was 10 times higher than in the annual grasses, and this difference was significant.

Thus, corn crops lead to the stable formation of a large vegetative mass of both perennial and annual weeds, and the cultivation of perennial grasses of the second year of use leads to a decrease in the weediness of crops by both groups of weeds.

According to the cultivation technologies of fodder crop rotation, on average, there were no significant differences in the number of weed component and their accumulation of dry mass, according to the factors studied, which generally speaks about relatively identical conditions for the spread of weed vegetation. However, the following trends deserve attention. The number of perennial weeds was maximum with extensive technology with a tendency to decrease by 20-50% in other technologies, especially intensive. A similar trend was also noted for dry weight – the indicator was lower on intensive technology by 30.0%, high intensive – by 15.1%, organic – by 12.3%, only the use of biological technology slightly increased the indicator compared to control – by 9.0%. The number of annual weeds increased by all cultivation technologies, by 3.0–9.1% in comparison with extensive, except for highintensive, where a decrease of 6.5% was observed. The dry mass of annual weeds also exceeded the control on cultivation technologies (by 1.3-23.7%), except for the organic one – in this variant a decrease of 19.1% was observed.

Thus, the biological system, despite the abundance of the weed component at the level of other technologies, gave a steady excess over other technologies in the accumulation of dry mass by the weed component in the crop rotation. The use of herbicides in high intensive technology provided only a tendency to decrease the number of annual weeds. At the same time, despite the absence of pesticides and mineral fertilizers in the organic technology, the number and weight of weeds was at the level of intensive technologies, which suggests the possibility of effective control of weeds with it method of management.

Perennial and annual grasses, as well as winter triticale, had an increasing competitive ability during the growing season in terms of the number of weeds, while barley and corn were characterized by a decrease in this ability. Moreover, the use of extensive and organic technologies has led to the greatest dynamics in reducing the number of perennial weeds, and biological technology – for annual ones.

In terms of dry weight, perennial grasses were the most competitive and the least, as in the case of number, was barley and, especially, corn. The dry mass of weeds by the time of the second count increased for the perennial group most of all on the basis of extensive technology, and for the annual – the intensive, smallest growth dynamics of dry mass was distinguished by organic technology. Thus, it was organic and extensive technology (without the use of agrochemicals) that contributed to a brighter tendency to reduce the number of weeds by the end of the growing season and the lowest dynamics of their dry mass accumulation.

The species composition of perennial weeds consisted of 15 species and was mainly represented by field sow thistle (*Sonchus arvensis* L.), dandelion (*Taraxacum officinale* L.) and butyrus field (*Cirsium arvense* L.), their total share was more than 75%. The species composition of annual weeds was very diverse – 27 species, but prevailed - white gauze (*Chenopodium album* L.) and odorless chamomile (*Matricaria inodora* L.), as well as annual bluegrass (*Poa annua* L.) with a total share of more than 50%. The resulting indicator of the cultivation technologies effectiveness is the productivity of fodder crop (table 2).

Table 2. Productivity of the feed crops.

Variant		Productivity, t / ha
Crops (product type)	Cultivation technologies	
Annual grasses with sowing perennial grasses (green mass)	Extensive	32.6
	Intensive	36.3
	High intensive	39.8
	Organic	38.1
	Biological	41.7
Winter triticale (green mass)	Extensive	11.0
	Intensive	18.1
	High intensive	21.5
	Organic	14.9
	Biological	15.9
Barley (grain)	Extensive	3.3
	Intensive	5.0
	High intensive	5.5
	Organic	3.9
	Biological	4.2
Corn (green mass)	Extensive	31.3
	Intensive	71.3
	High intensive	86.8
	Organic	62.5
	Biological	63.8
Perennial grasses for first year of use (green mass)	Extensive	17.0
	Intensive	22.6
	High intensive	23.5
	Organic	20.1
	Biological	21.8
Perennial grasses for second year of use (green mass)	Extensive	30.4
	Intensive	32.7
	High intensive	34.0
	Organic	28.2
	Biological	29.1

A significant increase in productivity was facilitated by the use of all the technologies studied in comparison with extensive technology at the winter triticale and corn with maximum values with highintensive technology. On the contrary, the cultivation of perennial grasses for second year of use did not contribute to the establishment of significant differences in the technologies for its cultivation, although the maximum was also noted at high intensive one. In other crops of fodder crop rotation, fertilizer technologies mainly significantly increased productivity compared to control, with the exception of intensive when cultivating annual grasses, organic when cultivating barley and perennial grasses for first year of use.

Thus, among the crops most responsive to intensive technologies winter triticale, barley and corn can be noted. On the other hand, the use of organic technology that ensures the production of crops without the use of pesticides and mineral fertilizers has contributed to the yield of annual grasses and perennial grasses of the first year of use at the level of intensive, and winter triticale, barley and corn are much higher than extensive, which can serve as the basis for the use of organic cultivation technologies of these crops.

4. Conclusion

The use of organic technology for feed crops cultivation did not lead to a significant increase in the weediness of their crops and the spread of malicious hard-to-eradicate species of perennial and annual weeds in comparison with intensive technologies. This served as one of the factors for obtaining a rather high yield of cultivated crops and speaks of the effective control of weeds in their crops in the absence of environmental risks due to the scientifically based crop rotation, soil tillage system and fertilizers.

References

- [1] Bhavsar V M 2002 Certified Organic Farming Principles and Practices: A Course Linking Farmers and University Students *J. Nat. Resour. Life Sci. Educ* **31** 20-4
- [2] Williams D M , Blanco - Canqui H, Francis C A and Galusha T D 2017 Organic Farming and Soil Physical Properties: An Assessment after 40 Years *Agronomy journal* **109(2)** 600-9
- [3] Reganold J and Wachter J 2016 Organic agriculture in the twenty-first century *Nature Plants* **2** 15221
- [4] Mason H E, Navabi A, Frick B L, O'Donovan J T and Spaner D M 2007 The Weed - Competitive Ability of Canada Western Red Spring Wheat Cultivars Grown under Organic Management *Crop science* **47(3)** 1167-76
- [5] Liebman M and Davis A S 2009 Managing Weeds in Organic Farming Systems: An Ecological Approach. 10.2134/agronmonogr54.c8.
- [6] Van Mansvelt Y D and Temirbekova S K 2017 Organic agriculture: principles, experience and prospects *Agricultural Biology* **52(3)** 478-86
- [7] Schukin S V and Trufanov A M 2012 Ecologization of agriculture (Conversion of traditional agriculture to organic) *A series of training manuals "RUDECO Retraining of personnel in the field of rural development and ecology"* 196
- [8] Benaragama D and Shirtliffe S J 2013 Integrating Cultural and Mechanical Methods for Additive Weed Control in Organic Systems *Organic Agriculture & Agroecology* **105(6)** 1728-34
- [9] Dudkin I V, Dudkin V M, Aidiev A Ya, Strizhkov N I and Dudkina T A 2017 Ecological aspects of the formation of agricultural systems and plant protection *Bulletin of the Kursk State Agricultural Academy* **7** 2-7
- [10] Cherkasov G N and Dudkin I V 2010 Control of weediness in crops in adaptive-landscape systems of agriculture *Agriculture* **1** 43-5
- [11] Pisarenko P V and Ponomarenko S V 2014 Optimization of the phytosanitary condition of agricultural crops in organic farming *Bulletin of Kurgan State Agricultural Academy* **3(11)** 40-4