THE EFFECT OF DIFFERENT MICROBIAL FERTILIZERS ON THE WEEDINESS OF MAIZE

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Abstract

The experiment with low-input technology of maize was conducted at the field "Radmilovac", Faculty of Agriculture Belgrade in 2022 on the luvic chernozem soil type. Cropping system included tillage with a disc harrow at 25-30 cm with the complete previous crop residues incorporation and the pre-sowing tillage with a harrow. The basic fertilization was conducted in autumn with 500 kg ha^{-1} NPK (15:15:15). For top dressing in spring, the following microbiological fertilizers were applied: biofertilizer "Slavol" with 5.0 l ha^{-1} in two treatments and Eko lame 10 l ha^{-1} in three treatments. The top dressing in the control variant was done with nitrogen fertilizer AN at the rate of 60 kg ha^{-1} N. The maize (ZP SC 666) cultivar was grown in a six-crop rotation (winter wheat-maize-spring barley+red clover-red clover-soybean-sunflower).

The weed community in maize consisted of 12 weed species, with dominating: Sorghum halepense (L.) Pers. (perennial), Solanum nigrum L. and Avena fatua L., (annual species). The obtained results show that the highest number of weeds, weeds per species, fresh and air-dry biomass were recorded in the control treatment. The statistically lowest values for the number of weed plants per species were recorded in the treatment with Eko lame, but for air-dried biomass in the treatment with Slavol. The differences in weediness in the variants with microbiological fertilizers were not statistically significant, while there were statistically very significant differences compared to the control. Application of microbiological fertilizers affected the initial faster growth of maize plants and increased competitiveness against weeds.

Key words: *competition, weed, maize, top dressing*

INTRODUCTION

Agriculture is devoting increasing attention to ecological aspects, in addition to economic considerations. The reduction of current yield losses caused by pests, pathogens and weeds are major challenges to agricultural production (Pop and Csider, 2014). Maize and winter wheat are the most important produced crops in Serbia. Their grain yield production shows significant deviations in different crop years, crop rotations and have become strongly fertilizer dependent. Sustainable optimal yielding maize production is directly connected with weed control. Good weed control in maize crop is characterized by implementation of different supportive and aimed cultural practices. The system of measures is planed according to weed community composition and species abundance at certain agroecological conditions (Simić et al 2015).

The main cultural practices in sustainable production of maize is fertilization, especially now in time with global climate change. The most adopted in Serbia is two crop maize-winter wheat rotation, even though the recommendations are to include legume crops and conduct three crop rotation (Videnović *et al*., 2013). Rotation of crops also affected rotation of herbicides and their modes of action, allowing a possible reduction in pesticide use (Liebman *et al*., 2001: Anderson, 2006). Its importance is especially highlighted because of very restrictive new EU regulations for pesticide production and use(http://www.epa.gov/pesticides/regulati ng/restricted.htm). The use of crop rotation is known to provide environmental benefits, lowering weed infestation level as well as weed seed bank richness in the soil (Spasojević *et al*., 2012).

Weed competition affects physiological processes in maize plants and modifies their morphology. This affects their light use efficiency and physiological processes relevant for productivity such are chlorophyll and carotenoids content (Spasojevic *et al*., 2014). Plant canopies can be structurally characterized by their harvest and leaf area index. Those two indices illustrate the intensity of stress and pressure present in plant stand and caused by presence of weeds and their biomass.

The aim of the research was to determine the advantages of different microbiological in comparison to mineral NPK fertilizer according to weed control effectiveness of maize.

MATERIALS AND METHODS

The experiment with low-input technology of maize was conducted at the research and study field "Radmilovac", Faculty of Agriculture, University of Belgrade (Serbia) in 2022 on the luvic chernozem soil type, in completely randomized blocks. Cropping system included tillage with a disc harrow at 25-30 cm with the complete previous crop residues incorporation and the pre-sowing tillage with a harrow. The basic fertilization was conducted in autumn with 500 kg ha^{-1} NPK (15:15:15). For top dressing in spring, the following microbial fertilizers were applied: biofertilizer ("Slavol", manufacturer "Agrounik" Serbia) with 5.0 l ha^{-1} in two treatments and Eko lame 10 l ha^{-1} in three treatments. The top dressing in the control variant was done with nitrogen fertilizer AN at the rate of 40 kg ha^{-1} N. The maize (ZPSC666) cultivars were used. The crop was grown in a six-crop rotation (winter wheat-maize-spring barley+red clover-red clover-soybean-sunflower). The sowing of maize took place on 15.04. in 2022. The size of a one crop rotation field (crop) was about 10 ar.

The application of microbial fertilizers and herbicides in maize cultivation and the evaluation of weediness followed the schedule shown in Table 1. Seeds were treated 24 hours before sowing, and the other treatments were applied over the leaves with a hand sprayer designed for this type of experiment.

Table 1. Schedule of application of microbiological preparations, time of assessment of weediness and application of herbicides

Preparation/ Date	Seed treatment	First treatment-foliar	Weediness evaulation	Herbicide	Second treatment-foliar	Third treatment-foliar
Eko lame	14.04.	17.05.	30.05.	31.05.	03.06	17.06
Slavol	14.04.	17.05.	30.05.	31.05.	03.06	-

One day before applying herbicides in maize, we conducted an evaluation of weeds and determined the following parameters: the number of weed species, the number of plants per species, their aboveground fresh and dry weights in the control and investigative treatments. The presence of weeds in maize was influenced by the fertilizers applied by the seed treatment and the first foliar treatment, while the other foliar treatments (1 or 2) had an influence on the quantity

and quality of maize grain yield. All parameters of weeds were determined by the method of random squares with an area of 1 m^2.
Obtained data were statistically processed by the analysis of variance, in which microbial fertilizers were factors, while LSD test was applied for the individual comparisons.

RESULTS AND DISCUSSIONS

The results of the influence of different types of microbiological preparations on weediness of maize crops are shown in Table 2. Statistical analysis showed that, in general, there was a statistically significant difference in the number of certain weed species between the applied microbiological preparations and the control variant. There was also a statistically significant difference in the number of weed plants per species between the treatments tested and the control, while the fresh and dry weight of weeds was highest in the control and the differences in weight between the two fertilizers tested were not statistically significant (Table 2).

Table 2. Weediness (No of weed plants m^{-2}) of soybean

Life forms	Weed species	Control	Eko lame	Slavol	Average
T	*Amaranthus retroflexus* L.	4.2	4.2	2.0	2.6
G	*Sorgh. halepense* L. Pers.	8.1	9.5	7.0	9.9
T	*Solanum nigrum* L.	9.6	7.0	9.0	9.2
T	*Ambrosia artemisiifolia* L.	7.1	6.8	6.5	
T	*Amaranthus albus* L.	1.0	1.7	2.3	4.1
T	*Hibiscus trionum* L.	2.1		0.5	1.9
G	*Convolvulus arvensis* L.	2.2	0.8	0.8	3.0
T	*Datura stramonium* L.	3.1	1.2	0.7	2.9
T	*Chenopodium hybridum* L	1.3	0.8		0.7
G	*Cirsium arvense* L. Scop.	1.3	1.0	1.9	
Total number of weed species		10^b	9^a	9^a	10.3
Total number of plants per species		41.0^c	37.0^a	39.0^b	39.7
Aboveground fresh weight of weeds (g m^{-2})		1963^b	1822^a	1874^a	1874.0
Aboveground dry weight of weeds (g m^{-2})		618.9^b	523.6^a	548.4^a	536.0

T-therophytes, G-geophytes; Values of means followed by the same letter are not significant.

As a direct consequence of the earlier application of agro-technical measures of growing most crops at this locality, it can be observed complete domination therophytes, because these forms are the easiest to resist impacts of applying these measures. Next in representation are geophytes: *Sorghum halepense* L. Pers. *Convolvulus arvensis* L. and *Cirsium arvense* L. Scop. Earlier studies of maize weed community in Radmilovac have also pointed to the dominance therophytes and geophytes, particularly in maize crops (Dolijanović et al, 2023). The dominant weed species (terophytes) in maize synusia were: *Solanum nigrum* L., *Ambrosia artemisiifolia* L., and *Amaranthus retroflexus* L.

The significantly higher weed mass on the control variant was the result of a higher incidence of perennial and annual broadleaf weeds. The application of the two microbiological fertilizers resulted in a reduction of weed emergence in the maize crops, especially in the most important parameters: the number of weed plants per species and the fresh weight of weeds per unit area. As in previous experiments at this site (Dolijanović et al., 2017), it is important to emphasize that high weed establishment was observed in the six crop rotation. The six crop rotation includes a large number of crops in frequency, which provides more favorable conditions for higher weediness. There are numerous measures that can reduce weed infestation in maize crops, such as crop rotation (Dolijanović et al., 2010; 2017), application of herbicides and mulch (Simić et al., 2012), seed rate (Mhlanga et al. 2016), cultivation of cover crops or by combining maize crops with soybean (Janošević et al, 2017;), and by reducing the tillage system (Kovačević et al, 2008), and there are fewer data on the influence of fertilizers (especially microbiological) on the occurrence of weeds in maize cultivation.

For fertilizers and fertilization of maize, the optimal application of fertilizers is the basis are important for adequate weed control. Foliar fertilizers have high efficiency in the early stages of application, which affects the accelerated growth and reduced susceptibility of maize to weeds at the beginning of the growing season. The results of Brankov et al. (2020) foliar fertilizing should be considered as a part of integrated weed management system.

CONCLUSIONS

Microbiological fertilizers are substances containing microbes and usually has impact on increase competitiveness against weeds and crop yields in an environmentally friendly way, based on the principles of sustainable agriculture, especially low input technology. As a result of this investigation, it can be said that the use of microbial fertilizer in optimal dose and timely application can be more profitable. Future studies involving additional fertilizer applications, row spacing, and planting dates under different environmental conditions will provide additional information on weediness in maize.

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