

**MICROBIAL ABUNDANCE IN THE RHIZOSPHERE OF MAIZE
AND SOYBEAN: CONVENTIONAL AND ORGANIC SYSTEM PRODUCTION**

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Abstract

Soil micro-organisms and the processes that they govern are essential for long-term sustainability of agricultural systems and a major component in soil formation and nutrient cycling. Microbial processes are important in organic farming system because a lot of organic matters are used in organic systems. Soil active microbial communities are vital in synchronizing nutrient release from organic matter and nutrient demands for plant growth in organic farming system. Soil microbial activities, populations and communities are governed by environmental variables and agricultural system, as conventional and organic system.

The objective of this study was to compare the effects of conventional and organic system production on microbial number in the rhizosphere of maize and soybean crops. Soil samples were collected from plots under conventional management (CNV) and organic management (ORG) in June, 2012. Soil microbial abundance was significantly greater in ORG compared with CNV. The total number of microorganisms, number of amonifiers, azotobacter, free N₂ fixing microorganisms and fungi was higher in rhizosphere in organic production of maize then in rhizosphere of maize in conventional production. Similar results was obtained with number of microorganisms in rhizosphere of soybean in organic production in comparison with conventional. Beside the higher number of all examined groups of microorganisms, in rhizosphere of soybean, the higher number of cellulolytic actinomycetes was obtained, too. The number of nodules on root of soybean, in organic production, was 3 x higher than in conventional.

Key words: *microbial abundance, rhizosphere, maize, soybean, conventional, organic, production.*

Introduction

Soil micro-organisms and the processes that they govern are essential for long-term sustainability of agricultural systems and a major component in soil formation and nutrient cycling (Nannipieri et. al., 2003). Microbial processes are important for the management of farming system and improvement of soil quality. Soil microbial activities, populations and communities are governed by environmental variables and agricultural system, as conventional and organic system.

In recent years, multiple studies comparing conventional and organic agriculture have reported differences in soil chemical properties, higher microbial activity and diversity in organically managed soils, or distinct microbial profiles between the two systems (Shannon et al., 2002; Bending et al., 2004; Cardelli et al., 2004; Monokrousos et al., 2006; Wang et al., 2012a). More information is needed about soil microbial populations, particularly the role of microbial biodiversity in soil quality and productivity, to better interpret measurements of soil biological properties with respect to agricultural sustainability (Bastida et al., 2008).

The objective of this study was to compare the effects of conventional and organic system production on microbial abundance in the rhizosphere of maize and soybean crops.

Material and methods

The trial was set up on chernozem soil at the Bački Petrovac experiment field of the Institute of Field and Vegetable Crops. Soil samples of rhizosphere were collected under conventional management (CNV) and organic management (ORG) of maize and soybean. Samples for microbiological analyses were taken at two dates (1st June and 18th July). Soil samples were analyzed by the serial-dilution method followed by plating on different selective mediums. Total number of microorganisms was determined on agarized soil extract (10^6) and number of ammonifiers on MPA medium (10^6) (Pochon and Tardeux, 1962). For Azotobacter is used method of fertile drops, on Fjodorov medium (10^2) (Anderson, 1965). The number of fungi was determined on Czapek-Dox medium and actinomycetes on a syntetic medium (10^4). The number of cellulolytic microorganisms was done on Waksman-Carey medium (10^5). Fjodorov medium was used for determination of N-fixing microorganisms (10^6). All microbiological analyses were performed in three replications and the average number of microorganisms was calculated at 1.0 g absolutely dry soil (Jarak and Đurić, 2004).

Results and discussion

The application of organic and inorganic treatments differently affected the rhizosphere microbial population. Analyzing the response of microorganisms to different cultural practices is important because soil microbiota respond quickly to environmental changes, so they are expected to be efficient bioindicators of soil conditions (Avidano et al., 2005).

On average, the number of microorganisms was higher in plot with maize than in plot with soybean (Tab. 1, Tab. 2). On both time of sampling the total number of microorganisms, number of ammonifiers, azotobacter, free N-fixing microorganisms and fungi was higher in rhizosphere of maize in organic production than in rhizosphere in conventional. At second sampling date the number of actinomycetes and cellulolytic microorganisms was higher in organic practice in maize, too (Tab. 1).

Table 1. Number of microorganisms in rhizosphere of maize

Time of sampling		Total number $\times 10^7$	Ammonifiers $\times 10^6$	Azotobacter $\times 10^2$	N-fixing $\times 10^6$	Fungi $\times 10^4$	Actinomycetes $\times 10^4$	Cellulolytic actinomycetes $\times 10^5$	Cellulolytic bacteria $\times 10^5$	Cellulolytic fungi $\times 10^5$
I 1 st June 2012.	OP	149,43	265,45	132,44	123,24	12,37	21,75	2,95	0,59	4,72
	CP	133,06	183,31	79,36	97,06	10,04	45,60	17,55	26,49	7,02
II 18 th July 2012.	OP	270,19	175,98	84,62	384,47	6,89	41,8	7,42	25,71	6,31
	CP	174,76	92,33	52,11	133,92	13,12	30,69	4,99	8,89	3,37
Average	OP	209,81	220,72	108,53	253,86	9,63	31,78	5,19	13,15	5,52
	CP	153,91	137,82	65,74	115,49	11,58	38,15	11,27	17,69	5,2

OP – organic production

CP – conventional production

Similar results was obtained with number of microorganisms in rhizosphere of soybean in organic production in comparison with conventional. Beside the higher number of ammonifiers, azotobacter and free living N-fixing microorganisms, in rhizosphere of soybean,

the higher number of cellulolytic microorganisms and actinomycetes was obtained, too (Tab. 2).

Table 2. Number of microorganisms in rhizosphere of soybean

Time of sampling		Total number $\times 10^7$	Ammonifiers $\times 10^6$	Azotobacter $\times 10^2$	N-fixing $\times 10^6$	Fungi $\times 10^4$	Actinomycetes $\times 10^4$	Cellulolytic actinomycetes $\times 10^5$	Cellulolytic bacteria $\times 10^5$	Cellulolytic fungi $\times 10^5$
I 1 st June 2012.	OP	203,47	102,07	214,05	233,40	12,21	20,31	18,60	8,67	1,17
	CP	185,78	42,56	163,50	155,39	6,82	21,29	8,49	13,24	9,16
II 18 th July 2012.	OP	199,84	293,18	89,16	342	12,57	101,22	9,84	37,95	6,55
	CP	225,25	95,47	6,64	186,08	26,08	5,25	15,48	13,85	2,61
Average	OP	201,66	197,63	151,61	287,7	12,39	60,77	14,22	23,31	3,86
	CP	205,52	69,02	85,07	170,74	16,45	13,27	11,99	13,55	5,89

OP – organic production

CP – conventional production

In a long-term field trial in which organic and conventional agricultural systems were compared, microbial biomass was higher in soils from organic plots (Fraser et al., 1994; Hu et al., 1997; Tu et al., 2005).

Araujo et. al. (2008) concluded that the organic practices rapidly improved soil microbial characteristics and slowly increase soil organic C. Okur et al (2009) concluded that organic management positively affected microbial biomass and enzyme activity due to enhancements in organic matter content. Wang et. al. (2012a) obtained results that the abundance and diversity of N-fixing bacteria tended to increase with duration of organic management but the highest number of nifH gene copies was observed in the rhizosphere and bulk soil of 5 years organic management. Abundance and diversity of ammonia oxidizing bacteria tended to increase with duration of organic management (Wang et al., 2011).

Contrary, Buyer and Kaufman (1996) in their work on population of bacteria and fungi isolated from the rhizosphere of maize grown under both conventional and alternative agricultural systems concluded that systems had very little effect on microbial diversity. Microorganisms can be stimulated or inhibited or there may be no effect at all on the structure of the indigenous population in organic production (Dobbelaere et al., 2003).

For a better understanding of conventional and organic farming systems, therefore, needs comprehensive knowledge and monitoring of soil properties and microbes in soil under conventional and organic farming systems (Wang et al., 2012b).

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