Soil Fertility: Organic vs. Conventional Farming Systems in Vojvodina, northern Serbia

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Abstract

The aim of this study was to examine on-farm the influence of organic farming systems on soil fertility, in order to recommend agrotechnical practices that will contribute to increase soil fertility, thus the yield and quality of cultivated plants. The survey was conducted at 7 representative farms in the system of control and certification in Vojvodina, northern Serbia, and within them, 55 production fields with different history of farming practices. Optimal to high soil fertility found in average in all investigated sites indicates that there are necessary natural preconditions for successful organic farming. The results showed high variability in soil fertility, both, between organic farming systems and between different sites. Significant differences in soil fertility between organic and conventional production, have not been found.

Introduction

In Vojvodina, main agriculture region in Serbia, number of organic producers and the area under organic farming systems are constantly increasing due to growing market demands for healthy and safe food. It is estimated that approximately 8,000 ha are under organic systems although precise data is still lacking. Healthy fertile soil is a key prerequisite for organic production. Many studies have shown that organic farming positively affects the quality and soil biological activity (Carpenter-Boggs *et al*. 2000). However, there is insufficient on-farm research data on the effects of organic production systems on soil fertility (Jarecki *et al*. 2004). For this reason, we wanted that on production farms in the conversion period examine the impact of organic production systems on soil fertility, due to recommend agronomic practices that will contribute to increase soil fertility, and thus the crop yield and quality.

Materials and methods

Study was conducted during 2005 and 2006, at 7 representative farms and within them 55 plots with different history of the applied agro-technical practices. Soil on the all farms belongs to loam/clay loam Chernozem, and for each investigated farm we selected plots in organic production (3-5 per site) and conventional production (1-2 per site). If there were no plots with conventional production system on the organic farm

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for comparison, samples were taken from the nearest neighboring farms. Soil samples were taken from the surface layer of soil (0-20 cm), and for NO_3-N determination to a depth of 60 cm. Soil analyses were done in the laboratories of the Department of Field and Vegetable Crops, Faculty of Agriculture in Novi Sad. We used the following methods: humus content was determined by Tjurin, content of total N by autoanalyzator Elementar; contents of available phosphorus and pottasium by AL method (Enger *et al*., 1960); nitrate N, N -min method; Dehydrogenase activity (DHA), and modified method of (Thalmann 1968). Statistical data was performed using analysis of variance using Statistica7.

Results

In order to obtain economically justified yields, farmers used different fertilizers (Tab. 1), which are in accordance with the EU and national regulations. Most farms used manure, different origins, which quantities are often inadequate, due to imbalances between crop and livestock production. A large number of farms engaged only in crop production. While visiting these sites, it was found that the process of collecting, preserving and fostering the manure can significantly improved, which would increase the quality of manure. Some organic producers regularly use commercial preparations to increase soil fertility and plant nutrition (Baktofil, Slavol, Bioplasm, Bioaktiv, Humisin etc.), but not always in accordance with the recommended dosage.

Tab. 1: Fertilization treatments at investigated organic farms

Fertilizers	Organic farms						
	Ljutovo	Čenej	Kelebija	Tavankut	Bajmok	Orom	Kisač
Organic	FYM[1], C[2]	FYM, C	FYM, C	FYM, C	FYM	FYM	FYM
Purchased	UE[3], H[4], B[5]	-	UE, H	-	BP[6]	BA[7]	H
Microbial	B, N[8]	B, N	B, N	B	B	EM[9]	B
Green manure	MS[10], SC[1], PT[12]	MS,	MS,PT, VR[13]	MS	-	-	BR[14]

[1] FYM, farmyard manure; [2] C, compost; [3] UE, urtrica extract; [4] H, humisin; [5] B, Bactofil; [6] BP, Bio-phlasma; [7] BA, Bio-activ; [8] N, Nitragin; [9] EM, Effective microorganisms; [10] MS, *Medicago sativa;* [11] SC*, Secale cereal;* [12] PT*, Phacelia tanacetifolia;* [13] VR*, Vegetable residues;* [14] BR*, Brassicea spp residues.*

Discussion

Results of soil analysis indicate a high variability in soil fertility, both between individual organic production systems, and between individual (Tab. 2). Significant differences in soil fertility between organic and conventional production, in average for all sites were not determined. A short period of time (2-4 years) from switching to organic production was not long enough, that the positive effects of organic production are reflected in soil fertility. At all locations in organic production, readily available P_2O_5 and K_2O are at the optimum level. However, in some localities in conventional production (Čenej and Kelebija), too high content of these elements was measured. Significantly lower content of nitrate N was measured in soils under organic production systems, which reduces the risk of nitrate leaching, out of the growing season. High activity of dehydrogenase enzymes (DHA), indicators of general soil biogenity, was measured at all sites regardless of the production system. However, as a result of lower organic matter content on farms Ljutovo and Kelebija, lower activity of this enzyme was measured.

Tab. 2: Selected soil characteristics for the organic and conventional farming systems at investigated sites (mean±SD)

Site/FS[1]		pH	Humus[2]	Total N[3]	P_2O_5[4]	K_2O[5]	NO_3-N[6]	DHA[7]
L[8]	O[16]	8,3±0,1	2,5±0,7	0,14±0,02	16±7	16±6	52±35 b	712±93
L[8]	C[17]	8,4±0,14	2,8±0,38	0,17±0,01	15±2,2	17±0,1	98±6,7	867±17
Č[9]	O	8,1±0,25	3,7±0,49	0,26±0,04	15±7,1 b	34±16	38±38 b	690±232
Č[9]	C	8,1±0,03	3,2±0,21	0,23±0,01	35±0,3	37±0,5	101±70	467±72
K[10]	O	8,4±0,04	2,2±0,13	0,13±0,01	67±20	30±5,0	42±23	654±157
K[10]	C	8,3±0,01	3,1±0,03	0,19±0,01	86±0,3	53±4,8	133±12	1246±67
T[11]	O	8,2±0,02	3,0±0,35	0,18±0,03	39±25	26±13	57±10	788±121
T[11]	C	8,2±0,03	3,9±0,03	0,23±0,01	29±1,8	19±0,4	12±17	700±222
O[12]	O	8,1±0,13	4,8±1,75	0,32±0,11	29±18	28±17	20±16	800±400
O[12]	C	8,2±0,05	3,8±0,50	0,24±0,01	21±2,7	21±0,6	5,0±3,2	602±82
B[13]	O	8,2±0,03	3,5±0,14	0,25±0,01	18±4,6	15±1,1	24±6,3	401±68
B[13]	C	8,2±0,04	3,5±0,04	0,23±0,01	10±1,7	20±0,9	8,3±3,2	580±62
K[14]	O	8,4±0,02	3,5±0,40	0,23±0,02	19±3,0	25±6,5	7,4±4,3	264±45
K[14]	C	8,2±0,16	3,8±0,31	0,24±0,03	12±2,6	19±7,3	8,9±6,3	393±120
A[15]	O	8,3±0,17	3,16±0,8	0,21±0,07	27±22	26±13	39±31	650±218
A[15]	C	8,2±0,13	3,37±0,5	0,22±0,03	29±24	28±13	64±60	665±297

[1]FS, Farming Systems; [2,3] %; [4] mg P_2O_5 $100g^{-1}$; [5] mg K_2O $100g^{-1}$; [6] kg N ha^{-1}; [7] µg TPF; [8] Ljutovo; [9] Čenej, [10] Kelebija; [11] Tavankut; [12] Orom; [13] Bajmok; [14] Kisač; [15] Average; [16] Organic; [17] Conventional.

Conclusions

Optimum to high soil fertility, determined in average for all tested sites in organic production, indicating that there are natural conditions necessary for successful organic farming. Significant differences in soil fertility between organic and conventional production in average for all sites were not determined. A short period of transition to organic production (2-4 years), it was not long enough that the positive impacts of organic production are reflected in soil fertility.

References

Carpenter-Boggs L., Kennedy A.C., Reganolt J.P. (2000): Organic and biodynamic management: effects on soil biology. Soil Sci. Soc. Am.J. 64:1651-1659.

Jarecki M.K., Lal R., James R.(1969): Crop management effects on soil carbon sequestration on selected farmers' fields in northeastern Ohio. Soil & Tillage Research 81(2):265-276.

Thalmann, A.: Landw. Forsch., 21: 249 – 258, 1968.

Enger H, Riehm H, Domingo WR (1960) Untersuchungen uber die shemische Bodenanalyse als Grundlage fur die Beurteilung des Nahrstoffzustandes der Boden. II Chemische Extrationsmethoden zur Phosphur-und Kaliumbestimmung. Kungl Lantbr Hogsk Ann. 26:199-215.