J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 4 (11): 1273 - 1288, 2013

CHEMICAL AND BIOLOGICAL INDICATORS OF SOIL QUALITY IN ORGANIC AND CONVENTIONAL FARMING SYSTEMS

Daif, M. A.*; H. A. Khater*; M. Abdul Aleem; and Mai M. Rehan***

***Soil Science Department, Faculty of Agriculture, Cairo University, Giza, Egypt**

****Soil microbiology Department, Faculty of Agriculture, Cairo University, Giza, Egypt**

ABSTRACT

Organic farming has gained ground worldwide and has expanded in recent years due to environmental, economic, and social concerns. In Egypt, up to 1.10 % of the agricultural area is managed organically. The transition from conventional to organic farming is accompanied by changes in an array of soil properties and processes that affect soil fertility. These changes in soil properties under Egyptian condition are not well documented. Therefore, the present study was carried out to study the comparative effects of organic and conventional farming systems on some soil chemical and biological indicators under Egyptian conditions. Surface soil samples (0-30 cm) were collected from eight field pairs (one organic field ant its conventional counterpart) to represent three organic farms in three governorates. Three organic fields which were in organic practice for four; six, and ten years since certification and three adjacent conventional fields were chosen from Fayoum Organic Farm, Tubhar city, Fayoum Governorate. Two organic fields which were in organic practice for twenty and thirty years since certification and two adjacent conventional fields were chosen from SEKEM Organic Farm, Bilbeis city, Sharkyia Governorate. Three organic fields which were in organic practice for eight, ten and twelve years since certification and three adjacent conventional fields were chosen from a private organic farm located in Salhyia city, Ismailia Governorate. The studied soil chemical indicators include soil organic carbon, T-N, pH, EC, Ex-Cations, and Available N, P, K, Fe, Mn, Zn, Cu while the biological indicators include population of bacteria, actinomycetes, azotobacter and fungi as well as dehydrogenase, alkaline phosphatase and Urease activities. Organically managed soils showed significantly better soil nutritional and microbiological conditions regardless of periods of organic farming practice. Soil organic carbon, T-N, and available N, P, K, Fe, and Mn contents were significantly higher in the organic system than in the conventional system. Soil pH, EC, available Cu and Zn were higher in the conventional system than in the organic system. The microbial communities (bacteria, actinomycetes, azotobacter & fungi) and enzyme activities (dehydrogenase, alkaline phosphataes & urease) were also greater in soils from organic system.

Keywords: Conventional and organic farming, soil quality indicators, soil microbial population, soil enzyme activity

INTRODUCTION

Organic farming has gained ground worldwide and has expanded in recent years due to environmental, economic, and social concerns (Gasparatos *et al*, 2011). It has been proposed as an alternative agricultural system to help solve the environmental problems arising from conventional farming management, such as pesticide application, excessive inputs of synthetic chemical fertilizers, soil degradation, and the presence of pesticide residues in food (Stockdale *et al.,* 2001). In Egypt, up to 1.10 % (40000 ha) of the agricultural area is managed organically according to European Union Regulation (Willer and kilcher, 2010).

The transition from conventional to organic farming is accompanied by changes in an array of soil properties and processes that affect soil fertility (Clark *et al*., 1998; Herencia *et al.,* 2008). A growing number of studies show that organic farming leads to higher quality soil and more soil biological activity than conventional farming. Given that soil quality depends on the physical, biological, and biochemical properties of the soil, changes in these properties must be taken into account in assessing changes in soil quality.

Studies that compare the impact of organic and conventional farming systems on soil show that the organically managed soils contained higher levels of organic carbon (Shu Wang *et al.,* 2012, Admir *et al.,* 2009; Herencia *et al.,* 2008), pH, total nitrogen, CEC (Reganold, 1988; Wander, *et al.,* 1994; Melero *et al.,* 2006), soluble phosphorus and potassium (Clark *et al.,* 1998), and soil microbial growth and enzyme activities (Carpenter-Boggs *et al.,* 2000; Marinari *et al.,* 2005; Okur *et al.,* 2009; Shu Wang *et al.,* 2012). However, some authors reported some different trends (Sheppered *et al.,* 2002; Gosling and 2005; Marinari *et al.,* 2005; Gasparatos *et al.,* 2011).

Comparison of organic with conventional systems is complex and difficult. The literature consists of studies with differences in soil type, crops, and climatic conditions, type of amendments and the amount applied, so it is very difficult to compare one study with another (Herencia *et al.,* 2008). The object of the present study was to compare the impacts of conventional and organic farming systems on some chemical and biological indicators of soil under Egyptian conditions.

MATERIALS AND METHODS

Surface soil samples (0-30 cm) were collected from eight field pairs (one organic field ant its conventional counterpart) to represent three organic farms in three governorates. Three organic fields which were in organic practice for four; six, and ten years since certification and three adjacent conventional fields were chosen from Fayoum Organic Farm, Tubhar city, Fayoum Governorate. Two organic fields which were in organic practice for twenty and thirty years since certification and two adjacent conventional fields were chosen from SEKEM Organic Farm, Bilbeis city, Sharkyia Governorate. Soils were sampled first at 10/3/2012 and second at 13/4/2013 except those of Fayoum location which were sampled once, at 1/8/2011. Five soil sample replicates were taken per field, each replicate was a composite sample of three soil samples taken at random using an auger to a depth of 30 cm. Soil samples were air dried and ground using a wooden hammer and sieved through a 2 mm-mesh screen prior to the following chemical analyses.

Organic carbon was measured according to Walkley and Black, total nitrogen (T-N) by the Kjeldahl method (Black, 1965b). Soil pH was measured in 1: 2.5 soil water suspensions, electrical conductivity (EC) was determined in 1:2.5 soil water ratio extract (USSL, 1954). Available phosphorus was extracted with 0.50 M $NaHCO_3$ solution according to Olsen et al. (Black. 1965) and determined according to Watanabe and Olsen (1965) procedure. Available potassium was extracted with ammonium acetate solution and determined photometrically (USSL, 1954). Available micronutrients (Fe, Mn, Zn, and Cu) were extracted according to Lindsay and Norvel (1978) method and determined using atomic absorption spectrophotometry.

Three rhizosphere replicate soil samples from some of the studied fields were collected for microbiological analyses. Samples were placed in plastic bags and stored in a refrigerator. Enzyme activities were estimated within 24h after sampling. Dehydrogenase activity was measured using the modified method of Thalman (1968). Soil samples were suspended in a triphenyl tetrazolium chloride solution and incubated for 16h at 25°c. The triphenyl formazan (TPF) produced was extracted with acetone and measured photometrically at 546 nm. Alkaline phosphatase activity was measured using the method of Eivazi and Tabatabai (1977)using a buffered P-nitro phenyl phosphate solution (pH=11) and incubated for1h at 37°C and measured photometrically at 400 nm. Urease activity was measured according to Kandeler and Gerber(1988)method and incubated for2h at 37°C.

Statistical analysis:

Data were analyzed using a completely randomized design using Costat (Costat Statistical Software, 2003), and analysis of variance was used to determine significant differences among sampling time, period of organic certification, and farming system after transformation to normalize data and equalize variance as required. Significance level was set at ($P<0.05$). Comparison between means was made with the Duncan's multiple range (DMR) test. When treatment x year interactions was not significant, data were combined across years. Statistical analysis was made for each location separately.

RESULTS AND DISCUSSION

Soil Organic Carbon, SOC

Analysis of variance indicated that SOC was significantly affected by farming system as well as the period of organic farming practice in the three studied locations (Table 1). In Fayoum location, the SOC content increased significantly from 10.89 g/kg in conventionally managed soils to 11.77 g/kg in soils that organically managed for 4 years (8.08% increase), from 12.00 g/kg to 12.99 g/kg in soils that organically managed for 6 years (8.25% increase), and from 13.19 g/kg to 15.69 g/kg in organically managed soils for 10 years (18.90% increase) as shown in Table 2. In SEKEM location, the corresponding increases were from 7.69 g/kg to 10.93 g/kg (42.13% increases) in organically managed soils for 20 years, and from 11.85 g/kg to 13.87 g/kg (17.05% increase) in organically managed soils for 30 years. In

Salhyia location, the SOC content followed the same trend as that of Fayoum and SEKEM locations, being higher in organically than conventionally managed soils by 14.37, 13.63, and 29.80% after 8, 10, and 12 years of organic farming, respectively (Table 2). SOC can have a beneficial impact on soil quality, enhancing soil structure and fertility, and increasing water infiltration and storage (Magdolf, 2004). A higher concentration of SOC is often considered to be an inevitable result of conversion to organic farming system (Stockdale *et al.,* 2001). These results are in agreement with those reported by many authors who found a higher concentration of SOC in organically managed soils (Mader *et al.,* 2002; Pulleman *et al.,* 2003). In Egypt, Omar (2010) reported a comparable results, He found that total organic matter had increased in organically managed soils with the increase in organic farming period in both of Fayoum and SEKEM locations.

Total Nitrogen, T-N

Analysis of variance summary (Table 1) indicated that T-N followed almost the same trend as that of SOC, i.e., was significantly affected by farming system and the period of organic farming practice, being higher in organically managed soils than in conventionally managed ones. The percent increase in T-N concentration in Fayoum organically managed soils over conventionally managed ones was 5.66, 9.40, and 9.20 % due to 4, 6, and 10 years of organic farming, respectively (Table 2). The corresponding percentages for SEKEM location were 22.10 and11.16 % due to 20 and 30 years of organic farming, respectively. While the percent increase for Salhyia location was 29.60, 29.28, and 23.64 % due to 8, 10, and 12 years of organic farming, respectively. The higher levels of SOC and T-N are also observed in all of the organic soil with various plants by Shu Wang *et al.* (2012). To some extent, higher C and N in organic farming system suggest that soil quality in organic farms have been improved (Shu Wang *et al.,* 2012). The similar pattern that was observed between SOC and T-N is to be expected, since the total nitrogen content of a soil is primarily a component of the soil`s organic matter content.

Soil pH

Statistical analysis (Table 1) revealed that soil pH was significantly affected by farming system as well as period of organic farming. All the soils of both conventional and organic fields were alkaline in reaction (Table 2). The pH values ranged from 8.01 to 8.24 in the organic fields and from 8.08 to 8.78 in the conventional fields. Organically managed soils exhibited a slight but significant decline in pH values compared with conventionally managed counterparts. The overall mean indicated that the pH values decreased from 8.15 to 8.06 in Fayoum location, from 8.29 to 8.18 in SEKEM location, and from 8.61 to 8.23 in Salhyia location (Table 2). The decrease in soil pH in organically managed soils might be due to the formation of organic acids during decomposition and mineralization of organic manure and compost. In a column and a batch study using Fayoum and SEKEM composts and different soil types, Omar (2010) found that compost addition decreased soil pH with time up to 336 days after addition in the batch experiment and up to

112 days after addition in the column experiment. These results confirm the previous conclusion cited by Gosling and Shepherd (2005).

Table 1:Analysis of variance summary for soil organic carbon (OC), total nitrogen (T-N), soil pH and EC as affected by season, period of organic farming (P), and farming system in different soil locations.

Location	Source	*df*	OC	T-N	pH	EC
Fayom	Period, P	2	***	***	***	***
	Farming, F	1	***	***	***	NS
	P * F	2	***	***	***	**
	Error	24				
	CV, %		2.93	4.25	0.19	34.81
SEKEM	Season, S	1	NS	NS	NS	NS
	Period, P	1	***	***	**	***
	Farming, F	1	***	***	**	***
	S * P	1	NS	NS	***	NS
	S * F	1	NS	NS	***	NS
	P * F	1	NS	NS	NS	***
	S * P * F	1	NS	NS	**	NS
	Error	32				
	CV, %		11.89	11.03	1.30	9.8
Salhyia	Season, S	1	NS	NS	NS	NS
	Period, P	2	***	***	***	***
	Farming, F	1	***	***	***	***
	S * P	2	NS	NS	NS	NS
	S * F	1	NS	NS	NS	NS
	P * F	2	**	NS	**	***
	S * P * F	2	NS	NS	NS	NS
	Error	48				
	CV, %		10.87	10.89	2.10	15.67

,**, Significant at the 0.05, 0.01, and 0.001 probability levels, respectively, NS = not significant.**

Soil Salinity, EC

Analysis of variance (Table 1) showed that soil EC was significantly affected by farming system as well as period of organic farming. In general, EC value in each organically managed field was significantly less than its value in the conventionally managed counterpart, except one field in Fayoum location (Table 2). In Fayoum location, the EC values ranged from 0.67 dS/m to 1.30 dS/m in the organic fields and from 0.77 dS/m to 2.08 dS/m in the conventional fields. The corresponding ranges for Salhyia location were from 0.41 to 0.84 dS/m and from 0.67 to 1.07 dS/m, respectively. In SEKM location, EC values followed the same trend, being significantly higher in conventionally managed soils than in organically managed ones. The increase of the EC in the conventionally managed soils could be due to the higher input of salts in the form of chemical fertilizers and/or pesticides (Gasparatos *et al.*, 2011). The relatively low EC levels in the organically managed soils indicate that the use of composts has not resulted in increased salinity (Clark *et al.,* 1998). The results of the present study are in agreement with those of Gasparatos *et al.* (2011). It is noteworthy that under both agricultural systems, the EC was low and did not impact plant growth.

Table 2. Organic carbon (OC), Total nitrogen (T-N), pH, and EC of soils as affected by farming system and period of organic farming.

Code	OC, g/kg			T-N, g/kg			pH			EC, d S/m		
	Organic	Convent.	% increase over conventional farming	Organic	Convent.	% increase over conventional farming	Organic	Convent.	% increase over conventional farming	Organic	Convent.	% increase over conventional farming
F4	11.77	10.89	8.08 *	2.24	2.12	5.66 ns	8.09	8.08	0.12 ns	0.67	0.97	-30.92 ns
F6	12.99	12.00	8.25 *	2.56	2.34	9.40 *	8.07	8.18	-1.34 *	1.13	2.08	-45.67 *
F10	15.69	13.19	18.9 *	2.73	2.50	9.20 *	8.01	8.18	-2.08 *	1.30	0.77	68.83 ns
Mean	13.48	12.03	12.11 *	2.51	2.32	8.19 *	8.06	8.15	-1.10 *	1.04	1.27	-18.11 ns
A20	10.93	7.69	42.13 *	1.99	1.63	22.10 *	8.12	8.25	-1.57 *	1.15	1.30	-11.54 *
A30	13.87	11.85	17.05 *	2.79	2.51	11.16 *	8.24	8.32	-0.96 *	2.42	3.03	-20.13 *
Mean	12.40	9.77	26.92 *	2.39	2.07	15.46 *	8.18	8.29	-1.27 *	1.78	2.17	-17.97 *
S8	7.48	6.54	14.37 ns	1.97	1.52	29.60 *	8.18	8.32	-1.68 ns	0.41	0.67	-38.81 *
S10	10.92	9.61	13.63 *	2.87	2.22	29.28 *	8.29	8.71	-4.90 *	0.42	1.03	-59.22 *
S12	14.46	11.14	29.80 *	3.19	2.58	23.64 *	8.23	8.78	-6.50 *	0.84	1.07	-21.49 *
Mean	10.95	9.09	20.41 *	2.68	2.11	27.01 *	8.23	8.61	-4.40 *	0.56	0.92	-39.13 *

- **Significant at $p < 0.05$, ns = not significant.**

Availability of plant nutrients (N, P&K)

Analysis of variance and mean values of available nutrients as affected by organic farming system and period of organic farming are shown in Table 3, 4, and 5.

Organically managed soils contained higher levels of available N than the conventionally managed ones. In Fayoum location, the concentration of available N increased by about 11, 4, and 37 % in soils that managed organically for 4, 6, and 10 years, respectively. The corresponding increases in SEKEM location were 45 and 12 % in soils managed organically for 20 and 30 years, respectively. While the corresponding increases in Salhyia location was 11, 26, and 37 % in soil that organically managed for 8, 10, and 12 years, respectively. The increase in available N in organically managed soils over conventionally managed ones could be ascribed to the production of appreciable quantities of carbonic acids during decomposition of organic matter which mineralize the complex organic substances, which in turn would contribute to N pool (Bhanuvally, 2006).

Statistical analysis (Table 3) revealed that available P was significantly affected by organic farming system as well as period of organic farming in all the studied locations. In general, P concentration increased progressively with increasing the period of organic farming in both conventional and organic farming system within each location (Table 4). Organically managed soils had higher P content than conventionally managed soils. Available P concentration ranged from 8.1 to 17.8 with an average of 12.8 mg/kg in conventionally managed soils and from11.3 to 24.0 with an average of 19.7 mg/kg in organically managed soils in Fayoum. In Salhyia location, P concentration ranged from 15.0 to 30.7 with an average of 25.4 mg/kg in conventionally managed soils and from 20.0 to 50.2 with an average of 28.0 mg/kg in organically managed soils. In SEKEM location, P concentration ranged from 23.9 to 30.7 with an average of 27.3 mg/kg in conventionally managed soils and from 34.4 to 53.4 with an average of 43.9 mg/kg in organically managed soils. The observed increase in available P levels appeared to be the direct result of inputs. The greatest amounts of P were applied to the organic systems as constituents of the applied composts. These results are in agreement with those reported by Clark *et al.* (1998), Marinari *et al.* (2005), Herencia *et al.* (2008), and Gasparatos *et al.* (2011).

Table 3 Analysis of variance summaries for some available macro- and micro-nutrients as affected by season, period of organic farming (P), and farming system in different soil locations.

Location	Source	*df*	N	P	K	Fe	Mn	Cu	Zn
Fayom	Period, P	2	***	***	**	*	NS	NS	**
	Farming, F	1	***	***	***	*	*	NS	NS
	P * F	2	***	***	NS	NS	NS	NS	NS
	Error	24							
	CV, %		8.84	4.54	10.21	13.92	9.70	16.28	32.10
SEKEM	Season, S	1	NS	***	NS	NS	**	***	NS
	Period, P	1	***	***	NS	***	NS	***	***
	Farming, F	1	***	***	**	***	***	NS	***
	S * P	1	NS	***	NS	NS	NS	NS	NS
	S * F	1	NS	***	NS	NS	NS	NS	NS
	P * F	1	*	***	NS	*	NS	NS	***
	S * P * F	1	NS	NS	NS	NS	NS	NS	NS
	Error	32							
	CV, %		11.56	4.97	22.12	8.84	19.30	12.11	8.01
Salhyia	Season, S	1	NS	***	NS	NS	NS	NS	NS
	Period, P	2	***	***	***	NS	***	NS	***
	Farming, F	1	***	***	**	NS	NS	NS	NS
	S * P	2	***	NS	NS	NS	NS	NS	NS
	S * F	1	NS	Ns	NS	NS	NS	NS	NS
	P * F	2	**	***	NS	NS	**	NS	NS
	S * P * F	2	**	NS	NS	NS	NS	NS	NS
	Error	48							
	CV, %		15.38	9.93	10.99	22.51	25.17	55.90	13.84

,**, Significant at the 0.05, 0.01, and 0.001 probability levels, respectively, NS = not significant.**

Available K concentration did not follow a consistent trend among the three locations. In Fayoum location, K concentration was significantly higher in organic fields than conventional fields. However, in SEKEM and Salhyia locations, K concentration showed a reverse trend being significantly higher in conventional fields of SEKEM location and consistently higher in conventional fields of Salhyia location. However, the level of available K was high in both conventional and organic farming systems in the three locations.

DTPA extractable micronutrients (Fe, Mn, Cu &Zn)

The data on DTPA extractable micronutrients content of soil as affected by organic farming and period of organic farming is given in Table 3 and 5.

Iron level was significantly affected by organic farming system and period of organic farming in Fayoum and SEKEM locations. While in Salhyia location, differences in Fe concentration between conventional and organic farming systems did not reach the significant level. In all locations, the organically managed soils contained higher Fe level than did the conventionally ones (Table 5). Fe concentration ranged from 5.78 to 6.60 with an average of 6.14 mg/kg in conventional fields vs. from 6.16 to 7.90 with an average of 6.83 mg/kg in organic fields of Fayoum location. The corresponding ranges for SEKEM location fields were from 5.38 to 6.30 with an average of 5.84 mg/kg in conventional farming system vs. 5.76 to 7.63 with an average of 6.80 mg/kg in organic farming system. In Salhyia location, Fe concentration ranged from 6.25 to 7.11 with an average of 6.59 mg/kg in conventionally managed soils and from 6.39 to 7.76 with an average of 6.98 mg/kg in organically managed soils.

Organically managed soils in all the studied locations exhibited higher Mn concentration than the conventionally managed soils (Table 5). Mn concentration ranged from 11.40 to 12.25 mg/kg in conventionally managed soils of Fayoum location and from 12.36 to 13.19 mg/kg in organically managed soils. In SEKEM location, Mn concentration in organically managed soils was significantly higher than in conventionally managed counterparts, and ranged from 21.61 to 24.42 mg/kg in organic farming system and from 16.71 to17.43 mg/kg in conventional farming system. Mn concentration in soils of Salhyia location followed the same pattern as Fayoum and SEKM locations.

Table 4: Availability of some macronutrients (N, P, K) as affected by farming system and period of organic farming

Code	Available N, mg/kg			Available P, mg/kg			Available K, mg/kg		
	Organic	Convent.	increase over conventional	Organic	Convent.	increase over conventional	Organic	Convent.	increase over conventional
F4	55.9	50.4	10.91 ns	11.3	8.1	39.51 *	371	361	2.77 ns
F6	63.2	60.6	4.36 ns	23.8	17.8	33.71 *	466	379	22.96 *
F10	94.5	69.1	36.76 *	24.0	12.4	93.54 *	472	379	24.54 *
Mean	**71.2**	**60.02**	**18.56 ***	**19.7**	**12.8**	**53.91 ***	**436**	**373**	**16.89 ***
A20	51.3	35.5	44.51 *	34.4	23.9	43.93 *	519	642	-19.16 *
A30	67.5	60.4	11.85 *	53.4	30.7	73.94 *	445	721	-38.28 *
Mean	**59.4**	**48.0**	**23.75 ***	**43.9**	**27.3**	**60.81 ***	**482**	**682**	**-29.32 ***
S8	35.7	32.2	10.87 ns	20.0	15.0	33.33 *	400	417	-4.08 ns
S10	59.9	47.2	26.91 *	43.9	30.4	44.41 *	421	513	-17.93 *
S12	79.7	58.3	36.71 *	50.2	30.7	63.52 *	558	577	-3.29 ns
Mean	**58.4**	**45.9**	**27.23 ***	**28.0**	**25.4**	**10.24 ***	**460**	**503**	**-8.55 ns**

Table 5 Availability of some micronutrients (Fe, Mn, Cu, Zn) as affected by farming system and period of organic farming.

Code	Available Fe, mg/kg			Available Mn, mg/kg			Available Cu, mg/kg			Available Zn, mg/kg		
	Organic	Convent.	% increase over conventional farming	Organic	Convent.	% increase over conventional farming	Organic	Convent.	% increase over conventional farming	Organic	Convent.	% increase over conventional farming
F4	7.90	6.60	19.70 *	12.98	11.40	13.86 ns	2.35	2.70	-12.96 ns	0.23	0.39	-41.02 *
F6	6.43	5.78	11.25 ns	12.36	12.25	0.90 ns	2.63	2.75	-4.36 ns	0.35	0.37	-5.41 ns
F10	6.16	6.04	1.99 ns	13.19	11.99	10.00 ns	2.18	2.30	-5.22 ns	0.26	0.39	-52.00 *
Mean	**6.83**	**6.14**	**11.24 ***	**12.84**	**11.88**	**8.08 ns**	**2.39**	**2.58**	**-7.36 ns**	**0.28**	**0.38**	**-26.32 ***
A20	5.97	5.38	10.97 *	24.42	16.71	46.14 *	0.88	0.95	-7.37 ns	5.07	5.31	-4.52 ns
A30	7.63	6.30	21.11 *	21.61	17.43	23.98 *	0.62	0.63	-1.58 ns	2.06	3.98	-48.24 *
Mean	**6.80**	**5.84**	**16.44 ***	**23.02**	**17.07**	**34.86 ***	**0.75**	**0.79**	**-5.06 ns**	**3.57**	**4.66**	**-23.39 ***
S8	6.39	6.25	2.24 ns	13.10	12.23	7.11 ns	5.17	6.24	-17.15 ns	1.81	1.88	-3.72 ns
S10	6.78	6.40	5.94 ns	15.10	14.96	0.94 ns	3.25	5.08	-36.02 ns	1.50	1.58	-5.06 ns
S12	7.76	7.11	5.92 ns	16.65	15.80	5.38 *	4.98	5.28	-5.68 ns	2.00	2.08	-3.85 ns
Mean	**6.98**	**6.59**	**5.92 ns**	**15.62**	**14.33**	**9.00 ns**	**4.47**	**5.53**	**-19.17 ns**	**1.77**	**1.85**	**-4.32 ns**

In contrast to Fe and Mn behavior, the extractable Cu and Zn were notably lower in organically managed soils than in conventionally managed ones (Table 5). However, the data on DTPA extractable micronutrients in studied soils revealed that concentration of Fe, Zn, and Cu in all the studied soils irrespective of farming system was above the critical limits (4.5, 0.5, and 1.1 mg/kg, respectively). However, Mn concentration was less than the critical limit (50 mg/kg) as reported by Westerman (1990).

The above mentioned results regarding DTPA-extractable micronutrients are in agreement with those reported by several authors. Herencia *et al.* (2008) found that organically managed soils had more Fe and Mn than the conventionally ones, they reported that the slightly higher levels of these micronutrients could be due to the formation of organic complexes with the organic materials. The lower concentration of Cu and Zn in organically managed soils compared to conventionally managed soils could be due to the application of agrochemicals, such as pesticides (cupper containing fungicides) and synthetic fertilizers (containing both Cu and Zn), in the conventional farming system (Gasparatos *et al*. 2011)

Microbial population

The data on the microbial population (total bacteria, actinomycetes, azotobacter, and fungi) of soils from Fayoum location showed a consistent increase in organically managed soils compared with conventionally managed ones in all the studied periods of organic farming practice (4, 6 &10 years).

Organically managed soils had higher bacterial population ($\log_{10}$n cfc/g soil) than conventionally managed counterparts. Under organic farming for 4 years, bacterial population increased from 7.17 to 7.60. The corresponding increase in bacterial population was from 7.23 to 7.61 under 6 years of organic farming, and from 7.29 to 7.70 under 10 years of organic farming (Fig. 1).

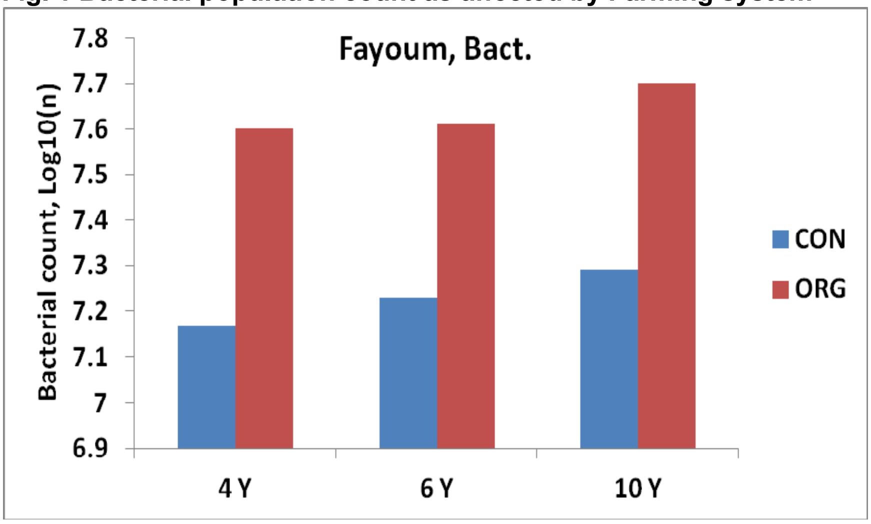
Actinomycetes, azotobacter, and fungal populations followed the same trend as that of total bacterial population with different magnitudes (Fig. 2, 3, 4). Log count of actinomycetes increased from 6.10 in conventionally managed soils for 4 years to 6.37 in organically managed soils, the corresponding increases under 6 and 10 years of organic farming were from 5.98 to 6.48 and from 6.15 to 6.5, respectively.

Organically managed soils recorded an enhanced dehydrogenase activity over the conventionally managed soils regardless of organic farm location or period of organic farming. In SEKEM location, dehydrogenase activity was higher by about 47% in the organically managed soils for 20 years over their conventionally counterparts. The corresponding increase in the organically managed soils for 30 years was 26%. Similar pattern was observed in Salhyia location with an increase of 62% and 20% due to organic farming for 8 and 10 years, respectively (Fig.5).

Alkaline phosphatase activity exhibited similar trend as that of dehydrogenase activity. The increase in alkaline phosphatase activity in the organic system over the conventional system was 17 % and 18% for 20 and 30 years of organic farming practices, respectively. The corresponding increase for Salhyia location was 32% and 28% due to organic farming for 8 and 10 years, respectively (Fig.6).

Urease activity was significantly higher in organically managed soils than in conventionally managed soils either after 8 or 10 years of organic practices. The increase in Urease activity was 33% in 8y-organically managed soil and 13% in 10y-organically managed soils (Fig.7).

Fig. 1 Bacterial population count as affected by Farming system



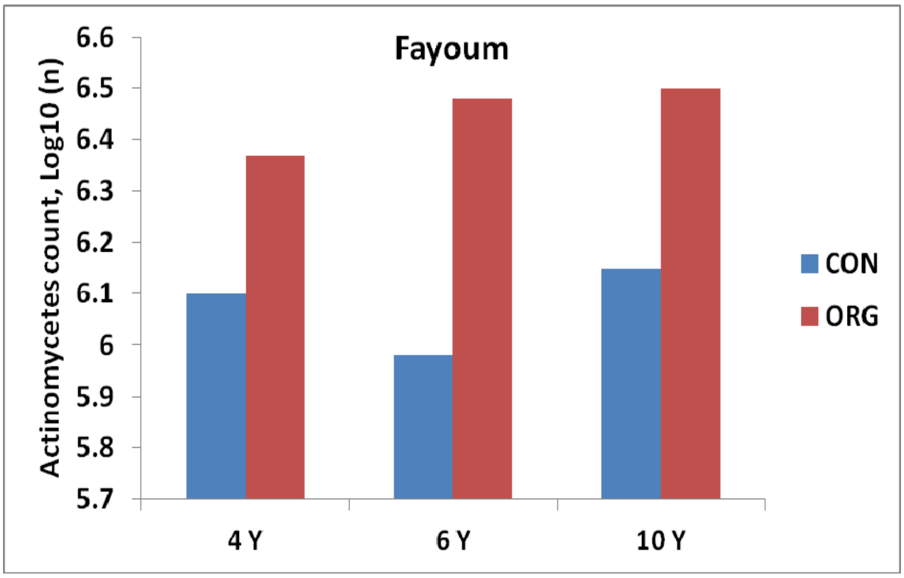


Fig. 2 Actnomycetes population count as affected by Farming system

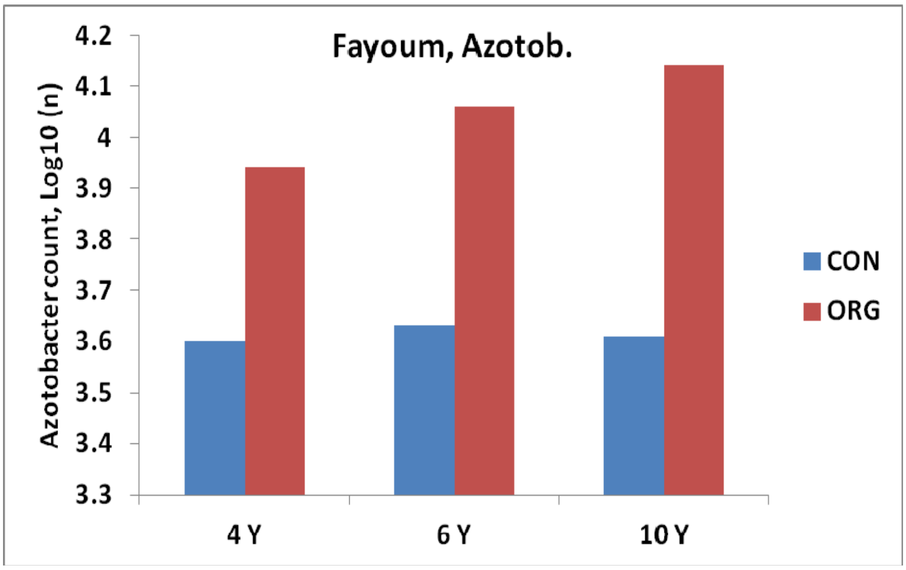


Fig. 3 Azotobacter population count as affected by farming system

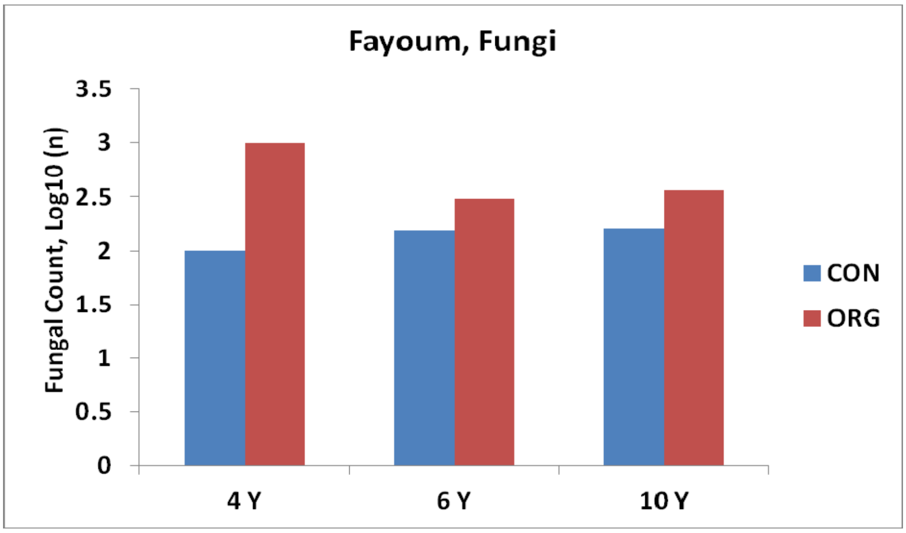


Fig. 4 Fungal population count as affected by Farming system

Enzyme activities

Activity of all the studied enzymes was, in general, significantly higher in the organic fields than in the conventional ones (Table 6).

Table 6: Analysis of variance summary for soil enzyme activities (dehydrogenase, DH, Alkalie phosphataes , Alk-PH, and Urease, UR, as affected by season, period of organic farming (P), and farming system (F) in different soil locations.

Location	Source	*df*	DH	Alk-PH	UR
SEKEM	Season, S	1	NS	NS	ND
	Period, P	1	NS	***	ND
	Farming, F	1	***	***	ND
	S * P	1	NS	NS	ND
	S * F	1	NS	NS	ND
	P * F	1	NS	**	ND
	S * P * F	1	NS	NS	ND
	Error	16			ND
	CV, %		17.76	5.24	ND
Salhyia	Season, S	1	***	*	NS
	Period, P	1	***	***	***
	Farming, F	1	NS	***	***
	S * P	1	NS	NS	NS
	S * F	1	NS	NS	NS
	P * F	1	NS	NS	***
	S * P * F	1	NS	NS	NS
	Error	16			
	CV, %		7.00	3.18	5.86

,**, Significant at the 0.05, 0.01, and 0.001 probability levels, respectively, ND = not determined, NS = not significant.**

The observed increases in both of microbial populations and enzyme activity in the organic farming system compared to the conventional farming system are not surprising because of the addition of composts, crop rotation and the excluding of chemical fertilizers and pesticides in organically certified system. Although the applied organic composts and amendments can often contain enzymes, the increase in the activity of organically managed soils is likely due to the simulation of microbial activity rather than the direct addition of enzymes from organic sources (Martens *et al*., 1992). These results are in agreement with those reported by Kremer and Li (2003) and Okur et al. (2009).

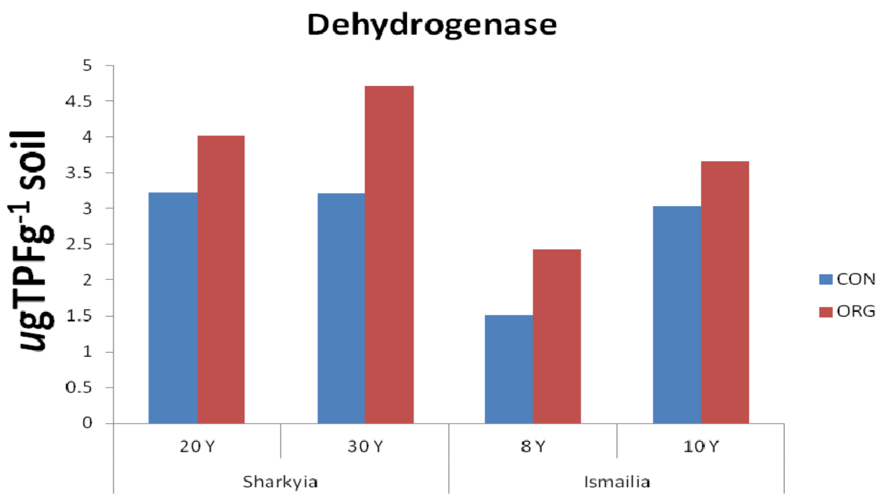


Fig. 5 Dehydrogenase activity as affected by Farming System.

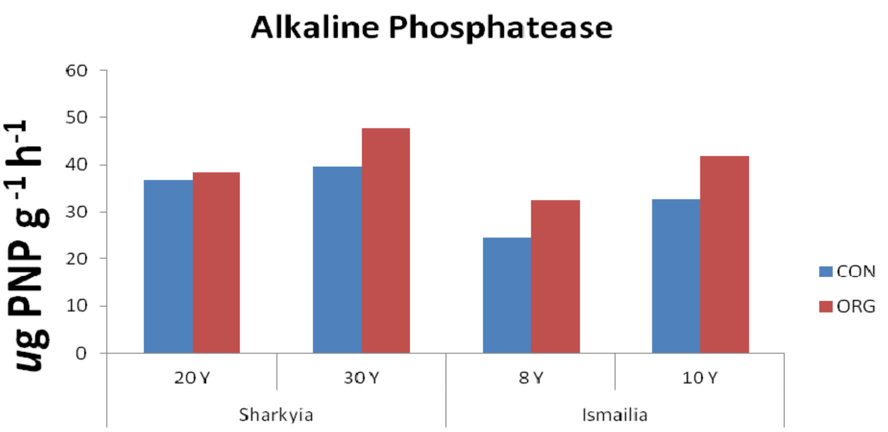


Fig. 6 Alkaline phosphatase activity as affected by Farming System

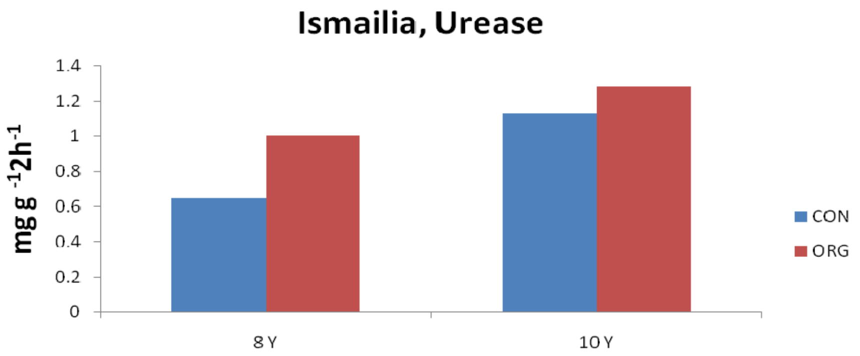


Fig. 7 Urease activity as affected by Farming System

REFERENCES

Ademir S.F. Araujo, Luiz f.C. Leite, Valdinar B. Samtos and Romero F.V. Carneiro 2009. Soil microbial Activity in conventional and organic Agricultural systems. Sustanability 2009, 1, 268-276.

Black, A. (Editor), Evans, D. D., Ensminger, F. E., White, J. I. Clark, F. E. and Dinaver, R.C. (1965) "Methods of Soil Analysis" (Part I & II) ser. Argon. No. 9 Am. Soc. Agron. , Madison, Wisconsin.

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

Clark, M. S.; Harwath, W. R.; Shenan, C. and Kate M. Scow. (1998). Changes in soil chemical properties resulting from organic and low-input farming practices. Agron. J. 90:662-671.

CoStat Statistical Software. (2003). CoHort v. 6.2, Monterrey, CA.

Eivazi, F. and Tabatabai, M. A. (1977). Phosphorus in soil. Soil Biology and biochemistry 9:167-172.

Gasparatos, D., P.A. Roussos, E.Christofilopoulou and C. Haidouti 2011. Comventional apple orchard management on soil chemical properties and plant mineral content under miditerranean climate condition. Journal of soil science and plant nutrition, 11 (4) : 105-117.

Gosling, P., Shepherd, M. 2005. Long-term changes in soil fertility in orgainc arable farming system in England, with praticular reference to phosphorus and patassium. Agriculture, Ecosystems and Environment 105. 425-432.

Herencia, J.D., Ruiz-Porras, J.C., Morillo, E., Melero S., Villarerde, J. & Maqueda, C. (2008). The effect of orgainc and mineral fertilizatio on micronutrient arailability in soil . Soil science 173: 69-80 .

J.F. Herencia, J.C. Ruiz, S. Melero, P.A. Garcia Galavis and C. Maqueda. 2008. A short-term comparison of organic V. conventional agriculturein a silty loam soil using two organic amendments.

Kandeler, E. and Gerber, H. (1988) Short-term assay of soil Urease activity using colorimetric determination of ammonium. Biol, Fertil Soil 6(1988(: 68-720.

Kremer, R. I., Li, J. (2003) Developing weed-suppressive soils through improved soil quality management. Soil Till. Res.: 193-202.

Lindsay, W. L., and Norvell, W. A. (1978) Development of DTPA soil test for zinc, iron, manganese and copper. Soil Sci. Soc. Am. J. 42, 421.

Mader,P., FileBbach,A.,Dubois,D. , Gunst, L., Fried , P., Niggli, u.. 2002. Soil fertility and biodiversity in organic farming.Science 96,1674-1696.

Marinari, S., Mancinelli, R., Campiglia, E., Grego, S. (2006) Chemical and biological indicators of soil quality in organic and conventional farming systems in Central Italy. Ecological Indicators 6, 701-711.-

Martens,D.A., J.B. Johansonand W. T. Frankenberger, Jr. 1992. Production and persistence of soil enzymes with repeated additions of organic residues. Soil Sci. 153:53-61

Melero, S., J.C.R Porras, J.F. Herencia and E. Madejon 2006. Chemical and biochemical properties of acloy soil under conventional and organic management soil Till. Res. 90 : 162-170.

Okur, N., Altindisli, A., Cengel, M., Gocmez, S., and Kayikcio, H. H. (2009) Microbial biomass and enzyme activity in vineyard soils under organic and conventional farming systems. Turk J. Agric. 33(2009): 413-423.

Okur, N.,Y. tuzela and S. Goemez. 2006. Effect of organic manure application and solarization on soil microbial biomass and enzyme activities under green house conditions.Biol.Agric.Hortic.23: 305-320.

Omar, M. A. D. (2010). Forms and distribution of some nutrients in soils under organic farming conditions. Ph.D. Thesis, Fac. of Agric., Cairo Univ., Egypt.

Pulleman, M., Jongmans , A., Marinissen , J., Bouma, J., 2003. Eddects of organic versus conventional arable elynamics in a marine koam in the Netherland . Soil use Mamage . 19, 157-165.

Reganold, J.P. 1988. Compraison of soil properties as influenced by orgainc and conventional farming systems. Am.J. Altern. Agric. 3: 144-155.

Sara Marinari, Reberto Mancinelli, Enio Campiglia Stephano Grego. 2005. Chemical and viological indicator of soil quality in orgainc and conventional farming systems in central Italy. Ecologial Indicators 6 : 701-711.

Shepherd, M. A., Harrison, R., Webb, J., (2002). Managing soil organic matter – implication for soil structure on organic farms. Soil Use and management 18, 284-292.

Shu Wang, L. , Z., and Fan G. (2012) Soil quality and microbes in organic and conventional farming systems. African J. Microbiology Res. 692021):5077-5085.

Stockdale, E.A, la,pkin, n.h. Hovi, M., Keatinge, R., Lennartsson, E.K.M, Macdonald, D.W., Padels, S., Tahersall, F.H., Wolfe, M.S., Watson, C.A. 2001. Agronomic and environmental implications of organic farming system. Advance in agronomy 70 : 261-327.

Thalmann, N. (1968) Zur methodic der bestimmung der deydrogenaseaktivitaet im boden mittels Triphenyltetrazoliumchloride (TTC). Landwirtschaft Forschung. 21:249-258. (cf. Okur et al., 2009).
USLL (1954) Diagnosis and Improvement of Saline and Alkaline Soils. US Dept. Handbook 60.
Wander, M.M., S.J. Traina, B.R, Stinner, and S.E Peters. 1994. Organic and convention management effects on biologically active soil organic matter pools. Soil. Sci. Soc. Am. J. 58 : 1130-1139.
Watanabe, F. S., and Olsen, S. R. (1962) Colorimetric determination of phosphorus in water extracts of soil. Soil Sci. 93:183-188.
Westerman, R. L. (1990). Testing soils for Cu, Fe, Mn, and Zn.. pp. 229-264. In. R. L. Westerman (ed.) Soil Testing and Plant Analysis, Soil Sci. Soc. Am. Book Series No. 3. Madison Wisconsin, USA.
Willer, H. and Kilcher, L. (2010) The World of Organic Agriculture.

المعايير الكيميائية والحيوية لجودة التربة تحت أنظمة الزراعة العضوية والتقليديةتحت الظروف المصرية

حسن احمد خاطر*، محمد عبد العزيز ضيف*، محمد عبد العليم، مى محمد ريحان***
***قسم علوم الاراضى، كلية الزراعة، جامعة القاهرة، الجيزة**
****قسم الميكربيولوجى، كلية الزراعة، جامعة القاهرة، الجيزة.**

شهدت الزراعة العضوية فى السنوات الاخيرة انتشارا واسعا سواء فى مصر او فى دول العالم نتيجة لاعتبارات بيئية واقتصادية واجتماعية. ويصاحب التحول من الزراعة التقليدية الى الزراعة العضوية تغييرات فى مجموعة من صفات التربة والعمليات الحيوية التى تحدث بها مما يؤثر على خصوبة التربة. وتهدف هذه الدراسة الى مقارنة تأثير كل من الزراعة العضوية والتقليدية على مجموعة من الصفات الكيميائية والحيوية للتربة تحت الظروف المصرية. الصفات الكيميائية التى تمت دراستها شملت (pH, EC, soil organic carbon, T-N, available macronutrients (N, P, K) and micronutrients (Fe, Mn, Cu, Zn), and CEC) . بينما شملت الصفات الحيوية للتربة مايلى: (Bacterial total count, actinomycetes, azotobacter, fungi, as well as dehydrogenase, alkaline phosphatase, and urease activity).

تم اخذ عينات تربة سطحية (0-30cm) ممثلة لعدد من المزارع العضوية من ثلاث محافظات. من مزرعة الفيوم العضوية بمحافظة الفيوم تم اخذ عينات من ثلاثة حقول تحت الزراعة العضوية لمدة 4, 6, and 10 سنوات وثلاثة حقول مجاورة تمثل الزراعة التقليدية. ومن مزرعة سيكام بمحافظة الشرقية تم اخذ عينات تربة تمثل حقلين تحت الزراعة العضوية لمدة 20 and 30 عاما بالاضافة الى حقلين مجاورين يمثلان الزراعة التقليدية. ومن مزرعة عضوية خاصة بمدينة الصالحية بمحافظة الاسماعيلية تم اخذ عينات ممثلة لثلاثة حقول تحت الزراعة العضوية لمدة 8, 10, and 12 عاما بالاضافة الى ثلاثة حقول مجاورة تمثل الزراعة التقليدية.

وتشير النتائج المتحصل عليها الى ان الاراضى التى تحت نظام الزراعة العضوية قد أظهرت تحسنا معنويا فى الصفات الكيميائية والغذائية والبيولوجية مقارنة بالاراضى تحت نظام الزراعة التقليدية وان هذا التحسن قد تأكد وازداد بزيادة فترة الزراعة العضوية.

قام بتحكيم البحث

أ.د / السيد محمود الحديدى	**كلية الزراعة – جامعة المنصورة**
أ.د / انيس السعيد محمد ابراهيم	**مركز البحوث الزراعيه**