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EVALUATOIN OF DIFFERENT COMPOST SOURCES TO IMPROVE SOME SOIL PROPERTIES UNDER WHEAT AND MAIZE CROPS ROTATION

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ABSTRACT

The objective of this study is to evaluate the effect of nine compost types on soil properties and their positive effect on plant growth during two successive seasons. The organic treatments were nine types; poultry manure, sawdust, farmyard manure, town refuse, sewage sludge , cottons stalks , sawdust activated by organic compost, treated sawdust by NaOH, and treated of cotton stalks by NaOH. The experiments were conducted at the experimental farm of Sakha Agric. Res. Station, Kafr EL-sheikh governorate, Egypt. longitude 30^{o} 56^{-} E and latitude 31^{o} 5 N., Wheat, variety (Sakha 94) was planted on November (2011) and followed by maize, variety (Giza 352) cultivated on May (2012) in the same experimental area. The experiments were conducted in a randomized complete block design with four replicates. 50% of the recommended nitrogen was applied to each treatment.

The obtained results application due to composts could be summarized as follows:

1- Soil organic matter content and EC_e values were increased, while pH values showed slight decrease.
2- In the first, season the maximum wheat grain and straw yields (3.09 (Mg/fed and 5.98 Mg/fed., respectively) were obtained when soil was mixed with farmyard manure and sawdust activated by compost combined with urea at rate of 50% of recommended dose. The highest 100 grain weight (4.46gm) was obtained with using composted farmyard manure combined with urea at rate of 50% recommended dose . The corresponding values in the second season under maize crop were 4.21 Mg /fed, 6.63Mg/fed and 32.58 gm for composted sawdust activated by organic compost, sewage sludge compost and farmyard manure combined with urea, respectively.
3- Application of different composted materials were more effective in increasing available N, P and K in soil in the 1st and 2nd seasons.
4- The obtained results indicated a significant increase in NPK content of wheat and maize plants, with composts application.
5- Available and total amounts (mg/kg soil) of Fe, Mn, Cu, Pb, Ni and Cd were increased with composts application. Data showed that the available heavy metal represented only a small percentage of the total content. This indicates that heavy metals applied to soil were strongly sorbed in non exchangeable form. The availability of these metals due to composts application can be arranged descendingly as follows: Fe, Mn, Pb, Ni, Cu and Cd.
6- Application of different composts increased significantly the concentration of heavy metals in grain and straw of wheat and maize plants, these contents were in the order: Fe > Pb > Mn > Cu > Ni > Cd. The results showed that Mn, Ni, Cd and Cu concentrations in the grain and straw of wheat and maize plants (except Cu in wheat straw) being within the normal range. On the other hand Fe and Pb concentration in the grain and straw of wheat and maize plants and Cu in maize straw are being within the critical concentrations range of these elements in plants.
7- Application of different composted improved some soil physical properties such as bulk density and aggregate parameters.

8- Economical evaluation was done by calculating the benefit to cost ratio B/C parameter. The highest profit was obtained when soil was mixed with composted sawdust activated by compost.

Keywords: composts, maize, wheat, nutrients, uptake, soil properties

INTRODUCTION

Intensive using of chemical fertilizers in conventional agriculture led to increase the pollution of soil, water and food as well as increased the input costs. Nowday, the growers tended to use the natural sources and biofertilizers and conditioners via using the organic manures and biofertilizers. Recently, on the way of sustainable agriculture with minimum pollution effects, the use of natural materials such as plant residues, i. e., cotton stalks, rice straw and town refuse composts is recommended to substitute chemical fertilizers. Increasing sustainability of cropping systems involves the reduction of agrochemical and fertilizer inputs through the reliance in soil ecosystem processes and biological interactions for the plant nutrients (Drinkwater and snapp 2007).Management of soil fertility through organic fertilizer has always been a pivotal principle of sustainable agriculture (Chivenge *et al* . 2011).

Wheat is considered the most strategic crop for Egypt as well as some other developing countries .Although , bread is the essential food constituent for most of the Egyptians ,there is , for tens years, a wide gap between the wheat local productions and consumption. Great attention and efforts have been paid by the Egyptian Government and scientists to narrow that gap.

Maize is one of the important cereal crop in Egypt needs high rates of N-mineral application , reached 300kg urea /fed. in normal soils (Nofal and Hinar2003) .These large quantities of N-mineral fertilizer , especially in the salt affected soils ,cause chemical environmental pollution through drainage water or other N-contaminated water (Mantripukhri,2006). Rechcigl (1995), reported that the use of any organic manure, in addition to the mineral fertilizers (NPK), increased dry matter yield and N, P and K uptake by maize plants. El-Sharawy *et al*., (2003) reported that grain yields of wheat and maize plants as well as concentration of N, P, K, Fe, Mn, Zn and Cu either in leaves or in grains of wheat and maize were significantly increased due to composts application (cotton stalks and rice straw composts). Khater *et al*., (2004) showed positive benefits for improving soil characteristics under study due to amendments application where improvements in the values of bulk density, hydraulic conductivity, soil consistence, available water content, pH value, organic matter content and the released content of available nutrient i.e. N, P, K, Fe , Mn , Zn and Cu were recorded. Wolf and Snyder (2004) stated that various advantages have been cited for compost use, such as improvement of CEC. pH, water retention, soil structure, SOM and disease suppression with a decrease in fertilizer need and damage from soil contaminants. In addition, organic matter produces a number of chelates substances that keep several metallic elements available over wide range of pH. Zhao *et al.*, (2006) reported that soil NO_3 movement out of the effective crop root zone is an important pathway of N losses in winter wheat- summer maize rotation system. Takahashi *et al*. (2007) found that the fertilizer requirement for an equivalent yield was decreased in soils with compost application than without. Ashmaye *et al*(2008)recorded that the combination treatments of organic farm and 85 kg N/fed. resulted in an increases in the available N,P, and K and the available micronutrients Fe,Mn ,Zn and Cu concentrations for maize grains .Sarwar *et al*(2008) also reported that the compost prepared will not only supplement the chemical fertilizers but also reduce the environmental pollution .Hamidpour *et al*(2011) reported that the application of compost increased the saturated hydraulic conductivity , the aggregate stability, organic carbon and electrical conductivity whereas it slightly decreased the soil pH and bulk density. Roghanian *et al*., (2012) showed that composted municipal waste increased plant growth as well as increased the availability of certain nutrients. The objective of this study is to evaluate the effect of supplementing 50% of N- mineral fertilizers by organic composts on soil properties and its positive effect on the plant growth during two successive seasons.

MATERIALS AND METHODS

The main cereal crops; wheat (*Triticum aestivum* L.) and maize (*Zea mays* L.) were chosen to evaluate the effect of application of different composts on chemical properties of the studied soil along with crop yield and nutrients uptake by such plants. Some physical and chemical properties of the experimental soil are shown in Table (1). The experiments were conducted at the experimental farm of Sakha Agric. Res. Station, Kafr EL-Sheikh governorate, Egypt. longitude 30^{o} 56^{-} E and latitude 31^{o} 05 N. during the winter season of (2011/2012) rotated by the summer season of (2012). Wheat (Sakha 94) was planted in November (2011) and followed by maize (Giza 352) cultivated in May (2012) in the same experimental area .The organic treatments were application of 50% of the recommended N dose(35 kg /fed for wheat +60kg/fed for maize) as composts from each type calculated as the total N in the composts. The chemical composition of the used organic materials is presented in Table (2). The treatments for wheat were as follows:

1- Control (N- fertilizer as urea) at level of 75 Kg N/fed. where 15 kg N was applied as starter dose and 60 kg N/fed. was added in two equal doses .
2- (OM_1), poultry manure compost was mixed with soil at the rate of 3.28 ton /fed. +50% of N- mineral fertilizers.
3- (OM_2), sawdust, the soil was treated with compost at rate of 6.49 ton/fed +50% of N- mineral fertilizers.
4- (OM_3), farmyard manure compost was mixed with soil at rate of 6.71 ton /fed.+ 50% of N- mineral fertilizers.
5- (OM_4) town refuse compost was mixed with soil at rate of 10.99 ton /fed.+ 50% of N- mineral fertilizers.
6- (OM_5) sewage sludge compost was mixed with soil at rate of 4.86 ton /fed. +50% of N- mineral fertilizers.

7- (OM_6) cotton stalks compost was mixed with soil at rate of 6.10 ton /fed. + 50% of N- mineral fertilizers.

8-(OM_7)*, sawdust activated by organic compost was mixed with soil at rate of 6.76 ton /fed.+ 50% of N- mineral fertilizers.

9-(OM_8) ** treated sawdust activated by organic compost was mixed with soil at rate of 6.33 ton /fed. +50% of N- mineral fertilizers.

10-(OM_9)** treated cotton stalks activated by mineral compost was mixed with soil at rate of 6.17 ton /fed.+50% of N- mineral fertilizers.

** Trearment of sawdust (SD) and cotton stalks (CS) by NaOH (5%): a part of each SD and CS was rinsed in a solution of NaoH(5%); 1:5 w/v for 48hrs. Each rinsed materials was decanted and washed with tap water until pH of washed reached 7.4 .The alkali treated (TSD and TCS) materials were air dried.

*Organic augmentation (OA) by adding poultry manure as a source of organic N, P ,C mostly .

*Mineral augmentation (MA) by adding both urea –N(46.5%N) and triple superphosphate (37.5% p_2o_5) as a sources of mineral N and P.

All treatments were fertilized with superphosphate (15 kg P_2O_5 /fed), potassium sulphate (24 kg K_2O/fed) and urea (15 kg N/fed) before sowing of both wheat and maize.The added second dose for wheat and maize after month of first dose.

Table (1): Some characteristics of the tested soil

Characteristics	Soil	Characteristics	Soil
pH (1:2.5 soil: water suspension)	7.82	**Available nutrients mg/kg soil**	
EC dSm^{-1} (soil paste) at 25^o	3.24	N	28.5
OM %	1.25	P	6.3
Soluble cations, meq. L^{-1}:		K	406.9
Ca^{++}	13.42	Fe	6.62
Mg^{++}	8.86	Mn	1.86
Na^+	7.91	Cu	2.16
K^+	1.01	Pb	3.34
Solube anions, meq. L^{-1}		Ni	1.5
CO_3^{--}	-	Cd	0.5
HCO_3^-	3.50	**Partical siza distribution**	
Cl^-	18.92	Clay	51.30
SO^{--}_4	8.78	Silt	24.90
		Sand	23.8
		Texture class	Clayey

The organic manures were mixed with the soil surface (0-15 cm) one dose 21 days before wheat sowing. The experimental plot area was $12m^2$ (3x4m). After wheat harvest, the same experimental area was planted with maize without any addition of organic manures, all treatments were fertilized with urea at rat 60 kg N/fed (50% of recommended dose except the control which fertilized with 120kg N/fed). Each treatment was replicated 4 times in randomized complete block design. Wheat and maize grain and straw samples were taken at the harvest, oven dried at 60^oC, fine ground and prepared for N, P, K, Fe Mn, Cu, Pb, Ni and Cd analysis. Representative soil samples at depth 0-15 cm were collected from the treated plots after wheat and maize harvesting. The collected soil samples were air dried and prepared for chemical analysis. Chemical properties of soil as well as composts were determined according to the standard methods (Page *et al*., 1982) and (Jackson 1973). Available Fe, Mn, Cu, Pb, Ni and Cd were Chemically extracted by using 0.05 M DTPA according to Lindsay and Norvell (1978) and measured using the atomic absorption spectrophotometer. Dry matter was digested by using a mixture of sulphuric and percloric acids (Jackson 1967). N, P, K, Fe, Mn, Cu, pb, Ni and Cd were determined in the digested plant materials.

Table (2): Some characteristics of the tested compost after maturing

Characteristics	Poultry manure OM_1	Sawdust OM_2	Farmyard manure OM_3	Town refuse OM_4	Sewage sludge OM_5	Cotton stalks OM_6	Sawdust Active organic OM_7	Treated sawdust OM_8	Treated Cotton stalks OM_9
Bulk density g/cm^3	0.56	0.26	0.25	0.50	0.25	0.26	0.28	0.28	0.26
Moisture content %	42	30	33	41	45	40	33	33	35
Ec 1:10 ds/m	4.31	2.48	3.46	3.75	3.15	5.72	2.80	2.87	4.16
pH (1 : 10)	7.11	6.23	6.15	7.57	6.25	6.23	6.4	6.16	6.11
Organic matter %	55.6	75.62	46.50	26.2	48.6	68.54	76.23	72.61	61.27
Organic carbon %	32.33	42.8	27.09	15.23	28.26	39.85	44.32	42.21	35.62
C/N ratio	10.59	26.45	20.33	16.72	13.73	24.67	29.98	26.73	22.52
Total N %	3.05	1.54	1.49	0.91	2.06	1.64	1.48	1.58	1.62
Available nutrients (mg / kg):									
N	1071	257.0	1571.6	420.42	210	868.17	229.00	201.00	783.45
P	120.32	231.57	164.07	268.80	101.52	232.21	234.39	237.02	247.98
K	537.2	194.0	874.00	6452.16	14.50	801.00	185.5	177.00	281.00
Fe	40.12	8.15	158.10	18.24	39.52	17.10	8.05	7.95	16.15
Mn	3.69	28.65	519.9	4.08	34.40	66.35	25.00	21.30	50.50
Cu	4.90	0.90	1.00	9.00	9.94	1.35	0.78	0.65	0.75
Pb	8.89	7.40	6.75	9.90	10.84	7.40	7.30	7.20	6.35
Ni	0.31	2.45	3.75	5.48	0.45	2.65	2.43	2.40	2.65
Cd	0.27	0.20	0.10	2.34	0.66	0.10	0.15	0.10	0.05
Total heavy metals (mg / kg):									
Fe	367.6	273.36	846.38	71.36	877.40	346.02	162.56	51.75	351.07
Mn	35.6	24.28	47.50	84.60	290.80	26.94	24.50	24.76	30.73
Cu	38.00	30.46	32.00	36.00	127.00	32.56	30.11	29.75	31.21
Pb	81.20	166.91	193.17	133.00	190.20	185.89	182.81	198.71	169.89
Ni	3.40	142.12	134.00	104.20	3.00	131.23	140.67	139.21	150.21
Cd	22.80	23.36	21.86	19.9	49.60	22.57	23.30	23.21	24.68

RESULTS AND DISCUSSION

Effect of compost application on organic matter, pH and EC_e of soil:

Data in Table (3) show that soil organic matter content was increased after harvesting of wheat due to composts application, Such increase was arranged in the following descending order; $OM_5 > OM_3 > OM_1 > OM_7 > OM_4 > OM_2 > OM_8 > OM_6 > OM_9 >$ control. The corresponding values after harvesting of maize were $OM_7 > OM_4 > OM_1 > OM_6 > OM_9 > OM_8 > OM_2 > OM_5 >$

OM_3> control. It could be noticed that the highest organic matter percent after harvesting of wheat was recorded with OM_5 , this may be due to its narrow C/N ratio (13.13) which exhibited a relative high acceleration for decomposition. In this respect, organic matter contents in soil after maize harvesting had a opposite trend .The highest organic amendment was recorded with OM_7. This may be due to that the organic matter percent duration of $OM_7$was higher than that in the OM_5. This could be explained by the wide C/N (29.98) of OM_7 .These results are supported by Khater *et al*.(2004) and Talha *et al*.(2007).

Concerning organic matter content after maize harvesting, it was lower than those after harvesting of wheat. This could be due to the rapid oxidation and decomposition of soil organic matter in summer season, and the long period of the decomposition (5 months for wheat and 10 months for maize).

Table (3): Effect of different compost source application on some chemical properties of the studied soil after harvesting of wheat and maize

Treatment	After wheat harvesting			After maize harvesting		
	OM %	Ec dS m^{-1}	pH	OM %	Ec dS m^{-1}	pH
Control (N)	1.37 e	2.88 h	7.88	1.68 f	2.52 g	7.92
OM_1	2.88 ab	3.70 f	7.72	2.36 ab	2.75 f	7.82
OM_2	2.80 bc	3.00 g	7.70	2.23 d	2.75 f	7.85
OM_3	2.94 a	4.80 c	7.68	2.15 e	2.87 e	7.88
OM_4	2.80abc	5.92 a	7.74	2.47 a	4.72 a	7.94
OM_5	2.96 a	4.71 d	7.71	2.22 d	2.55 g	7.91
OM_6	2.76 c	4.61 e	7.71	2.35 bc	3.86 c	7.93
OM_7	2.84abc	4.92 b	7.70	2.50 a	3.96 b	7.90
OM_8	2.79 bc	4.95 b	7.75	2.27 cd	3.87 c	7.95
OM_9	2.62 d	4.55 e	7.82	2.28 cd	3.17 d	7.98
L.S. D. 0.05	0.13	0.09		0.05	0.08	
L. S. D. 0.01	0.17	0.12		0.06	0.11	

Data in Table (3) show a slight decrease in soil pH values after wheat or maize harvesting. This may be due to that the organic and inorganic acids were released as a result of organic matter decomposition , soil reactions and hydrogen from mineralization. However, after maize harvesting no clear sequence and the difference between the treatments and the control were less clear . These results are in agreement with Hamidpour *et al*.(2011)and Habteselassic *et al*. (2006) they stated that soil pH gradually decreased with the application of organic matter and releasing of organic and inorganic acids such as carbonic , citric and malic acids as well as H^+ produced from mineralization of nitrogen in the organic matter.

Concerning EC_e values, the obtained results showed that after wheat harvesting ECe values were increased by 28.47, 4.16, 66.66, 105.55, 63.54, 60.06, 70.83, 71.87%and 57.98% due to OM_1, OM_2, OM_3, OM_4, OM_5, OM_6, OM_7, OM_8 and OM_9 application, respectively as compared with the control (mineral fertilization). The corresponding values after maize harvesting were 9.12, 9.12, 13.88, 87.3, 1.19, 53.17, 57.14, 53.57% and 25.79%. This increase in ECe values may be due to increasing the salinity content in values of organic treatments(Table 2). Sarwar *et al*.,(2003) stated that the decomposition of organic materials released acids or acid forming compounds that reacted with the sparing soluble salts already present in the soil and either converted them into soluble salts or at least increased their solubility .Hence ,the EC_e of soil was increased. The second season (after maize harvesting) EC_e values were reduced because aggregate stability of the soil as a result of the addition of organic treatments which tends to modify pore size distribution, bulk density, water percolation and decrease soluble salts in addition to the amount of salts absorbed by wheat and maize along growth periods. These results are in agreement with El-Ghamry *et al*. (2004). Zhaug *et al*.,(2006) who concluded that the decrease in ECe values after maize may be due to crop uptake and leaching of solutes overtime.

Effect of compost application on grain yield, straw yield and 100 grain weight of wheat and maize:

Data presented in Table (4) indicate that application of different composted had a beneficial effect on the studied plants. In the 1st season, the maximum values of grain and straw yields were obtained with wheat (3.09 **(**Mg/fed**.)**and 5.98 Mg/fed., respectively), as soil mixed with (OM_3 and OM_7) while the highest 100 grain weight was obtained with OM_3 (4.46 gm). The corresponding values in the 2nd season were obtained with maize (4.21Mg/fed**.**, 6.63Mg /fed. and 32.58 gm for OM_7, OM_5 and OM_6 respectively).

Table (4): Effect of different composts sources on grain and straw yield and 100 grain weight of wheat and maize.

Treatments	Wheat			maize		
	Grain yield (Mg/fed)	Straw yield (Mg/fed)	100 grain weight(g)	Grain yield (Mg/fed)	Straw yield (Mg/fed)	100 grain weight (g)
Control (N)	2.73 e	4.85 f	3.48 d	3.41 e	5.00e	28.48 b
OM_1	2.86 cd	5.51cde	3.86 cd	3.69 d	5.50d	30.50 ab
OM_2	2.99abc	5.41 e	3.92 bcd	3.7cd	5.95c	31.57 a
OM_3	3.09a	5.47 de	4.46 a	3.83bcd	6.04c	32.38 a
OM_4	2.97a-d	5.85 ab	4.06 abc	3.87bcd	6.00c	30.55 ab
OM_5	2.97a-d	5.33 e	3.99 abc	389 bc	6.63a	31.56 a
OM_6	2.93 bcd	5.72 bc	4.18abc	3.80bcd	6.20b	32.58 a
OM_7	3.00ab	5.98 a	4.40ab	4.21a	6.50a	28.54 b
OM_8	2.84de	5.71 bc	4.08abc	3.95b	628b	30.89a
OM_9	2.86cd	5.67 bcd	4.40ab	3.90bc	6.20b	31.01a
L.S. D. 0.05	1.38	0.12	0.40	1.70	0.16	1.10
L. S. D. 0.01	1.77	0.20	0.47	2.01	0.22	1.19

Means followed by a common letter are not significantly different at the 5% level by DMRT

The trends obtained for wheat grain yield as influenced by the different treatments can be arranged as follows: $OM_3 > OM_7 > OM_2 > OM_4 > OM_5 > OM_6 > OM_1 > OM_9 > OM_8 >$control. The grain yield of maize could be arranged as follows: $OM_7 > OM_8 > OM_9 > OM_5 > OM_4 > OM_3 > OM_6 > OM_2 > OM_1 >$control. This may be due to the difference in C/N ratio (Table 2) and the enhancing effect of nitrogen fertilizer on the decomposition of organic manures. These findings are good agreement with those obtained by wolf and Snyder (2004). Rechcigl (1995) concluded that, additions of N fertilizer after application of compost to soil may overcome the problem of immobilization of N and consequently increases N available for plant development. Also, the applied organic manure is enriched in both organic and mineral substances essential to plant growth and activating the bio-chemical processes in plants, i.e., respiration, photosynthesis and chlorophyll content, which increased the grain quality and quantity (Hegazi, 2004).The increase in grain and straw yields have also been reported by Sarwar *et al*.(2008) who concluded that favorable environment results in an increased activity and increased water and nutrient use efficiency resulting in more succulent plants. An increase in soil organic matter and nutrient availability after compost application had been observed by many researchers (Ashmaye *et al*.2008), Hamidpour *et al*.,(2011) Roghanian *et al*.2012 and subehia *et al*.,(2013).

Effect of compost application on the availability of NPK in the soil:

Data in Table (5) reveal that application of the different organic materials had a significant effect on the availability of N, P and K. Available N, P and K content in soil were increased up to 87.25, 14.23 and 866.92 mg/kg for OM_1, OM_7 and OM_8, respectively after wheat harvesting and up to 95.75, 18.52 and 1614.60 for OM_7, OM_4 and OM_2 after maize harvesting.

Table (5):Effect of different compost sources on nutrients available in the soil after wheat and maize harvesting

Treatment	Available nutrients (mg/kg soil)					
	After wheat harvesting			After maize harvesting		
	N	P	K	N	P	K
Control (N)	31.65 e	7.61 g	561.63e	35.00g	7.80g	522.5e
OM_1	87.25a	11.08d	761.00bc	91.50de	14.96bc	1175.85bc
OM_2	78.00 d	11.24c	673.83d	81.00f	13.20de	1614.6a
OM_3	85.34b	12.41b	765.18bc	86.88e	14.57bcd	1526.85a
OM_4	79.45c	11.22cd	843.93a	92.25bc	18.52a	1058.55bcd
OM_5	77.40c	12.45b	818.85ab	81.25f	11.75f	631.8e
OM_6	79.34c	10.18f	855.05a	81.25f	10.67f	885.7d
OM_7	77.68d	14.23a	860.48a	95.75a	15.31b	1228.5b
OM_8	79.45c	12.45b	866.92a	94.25ab	14.60bcd	1251.9b
OM_9	85.40b	10.80e	690.00cd	91.88c	13.53cd	980.3cd
L.S. D. 0.05	1.09	1.64	25.61	2.10	2.35	35.44
L. S. D. 0.01	1.56	2.10	33.00	3.30	3.56	48.43

These highly levels were interpreted by many authors, Metwally and Khamis (1998) stated that organic manuring plays an important role in increasing N availability through microorganism activities, beside decreasing N losses by leaching and volatilization. Micro flora can directly assimilate significant amounts of organic N compounds from plant residues or from dead biomass (Mary *et al*., 1996). The increase in the availability of soluble P from additions of compost which has an effect that described as resulting from phosphohumic complexes that minimize immobilization processes, anion replacement of phosphate by humate ions, and coating of sesquioxide particles by humus to form a cover which reduces the phosphate fixating capacity of the soil (Rechcigl 1995). Concerning the increasing of available K after addition of composts, Tan (1993) found that humic and fulvic acids are capable for dissolving very small amounts of potassium from the soil minerals by chelating, complex reaction or both with released amounts of K being increased with time.

Effect of compost application on NPK relative content :

Date in Table (6) indicate a significant increase in the uptake of N, P, and K by wheat and maize plants. In the 1st season, such increases ranged between (24.57 %: 58.87 %), (25.19 %; 45.80 %) and (18.02 %; 36.76%) for content of N, P and K respectively by wheat grain. While the uptake by wheat straw (9.01 %: 30.64 %), (9.79: 62.11%) and (6.60: 30.63) for content of N, P and K respectively. In the 2nd season, the corresponding increases ranged between(12.65 % : 49.01%), 26.91 % : 98.85 %) and(13.49% : 42.08 %) for content of N , P and K respectively by maize grain and (21.43 % : 87.71 %) , (25.00 % : 65.45 %) (12% : 45.62 %) for content of N, P and K respectively by maize straw.

Table (6): Relative changes % in NPK content by wheat and maize plants as affected by compost application

Treatment	N		P		K	
	Grain	Straw	Grain	Straw	Grain	Straw
	W h e a t					
OM_1	52.25	13.59	26.56	27.84	33.91	17.59
OM_2	51.34	11.53	45.80	11.60	36.76	6.60
OM_3	58.87	9.01	27.33	12.89	19.55	30.63
OM_4	24.57	27.13	31.60	20.62	18.02	11.46
OM_5	29.84	30.64	44.89	9.79	23.83	7.82
OM_6	35.09	17.88	25.19	62.11	22.20	13.32
OM_7	25.89	29.92	42.14	23.20	31.47	16.27
OM_8	41.55	17.72	43.21	47.16	21.49	16.99
OM_9	36.36	23.18	39.54	17.00	19.35	10.99
	maize					
OM_1	12.65	21.43	26.91	25.00	13.49	12.00
OM_2	27.26	36.00	48.09	40.64	23.35	23.33
OM_3	21.15	39.64	70.92	48.27	37.46	27.39
OM_4	31.39	37.14	42.98	30.90	24.71	24.36
OM_5	19.46	87.71	68.62	38.64	34.02	45.62
OM_6	14.29	35.27	59.62	57.82	16.94	30.76
OM_7	49.01	48.57	98.85	65.45	42.08	19.13
OM_8	16.57	43.53	56.38	59.82	39.15	35.19
OM_9	18.04	35.27	49.92	57.82	28.74	31.67

This finding could be, as mentioned before, due to the quality and rapid decomposition of concerned organic amendments, their chemical composition and C/N ratio along with their applied rate or the initial state in soil in organo-metalic forms as storehouse and their mobility increase or availability for uptake by plants. Generally, it could be concluded that the nutrient contents in plants were extending parallelly close to the corresponding available nutrient contents in soil, these results could be enhanced by Khater *et al*., (2004).

Effect of composts application on total and available amounts of Fe, Mn , Cu, Pb , Ni and Cd (mg/kg soil) in the studied soils

Analytical results in Table (7 and 8) indicated that, on the average of values, the highest mean values of total and available of Fe, Mn, Cu, Ni, Pb and Cd mgkg^{-1} were recorded for treatments OM_5 (sewage sludge) after wheat and maize harvesting in the two seasons.

Table (7): Total heavy metals contents (mg/kg) in the studied soils as affected by different compost sources after harvesting of wheat and maize

Treatments	Fe	Mn	Cu	Pb	Ni	Cd
	After wheat harvesting					
Control	7531	71.20	31.50	38.12	43.20	0.11
OM_1	7590	77.6	39.30	45.10	46.13	0.15
OM_2	75.85	78.4	35.60	51.13	49.55	0.17
OM_3	7601	75.2	37.20	66.19	55.12	0.18
OM_4	7599	79.10	40.50	56.25	51.50	0.14
OM_5	7620	85.12	49.11	73.20	59.18	0.21
OM_6	7582	76.13	36.19	70.11	53.11	0.20
OM_7	7590	74.30	38.13	69.14	55.20	0.19
OM_8	7573	73.90	35.60	75.15	53.35	0.16
OM_9	7588	78.00	37.12	71.20	52.27	0.17
	After maize harvesting					
Control	8121	73.50	33.19	46.20	47.28	0.13
OM_1	8290	81.20	40.15	55.13	50.23	0.21
OM_2	8300	79.60	37.50	61.20	55.75	0.23
OM_3	8275	80.20	39.18	76.25	60.24	0.24
OM_4	8195	82.50	41.95	66.50	56.13	0.20
OM_5	9600	95.60	52.20	85.19	69.15	0.29
OM_6	8250	79.13	39.50	80.33	59.20	0.27
OM_7	8320	77.90	41.11	78.28	60.40	0.25
OM_8	8310	76.20	38.60	87.30	61.18	0.20
OM_9	8292	79.50	37.17	82.15	63.11	0.23
L.S.D 0.05	12.00	5.20	4.23	4.95	3.82	0.04
L.S.D 0.01	8.50	2.50	2.12	2.91	1.95	0.01
Critical concentration in soil ppm	0.1-20%	20-300	1-40	0.1-20	2-50	0.01-0.70

This could be due to the relatively higher content of Fe, Mn, Cu,Pb and Cd in the composted OM_5 (sewage sludge) as shown in Table (2). The lowest values were found in the control treatment (mineral fertilizers). Recorded results after the 1st season (wheat) were also the same sequence after the 2nd season (maize) since total heavy metal contents in the soil were increased after the harvesting of maize, which may be due to the long period of decomposition. The data showed also that the available heavy metals represent only a small percentage of the total content. These indicate that heavy metals applied to soil through organic material, were strongly sorbed in non exchangeable form.

Aboulroos *et al*., (1991); Badawy and Helal (1997) showed that the soluble and exchangeable fractions represent only 1-5% from the total Cd, Co, Ni, pb, Cu and Zn content of the soil irrigated with sewage effluent. Soil content of available heavy metals is relatively low after the second growth seasons (maize) comparing with the first one (wheat), which could be attributed to soil pH which help in soil reactions to convert the available element to fixed i.e., iron phosphate, manganese phosphate ..etc., which reflected on decrease the available form and increase the total form. In addition to the amounts uptake by wheat and maize .

Table (8): Available heavy metals contents (mg/kg) in the studied soils as affected by different composts sources after harvesting of wheat and maize

Treatments	Fe	Mn	Cu	Pb	Ni	Cd
	After wheat					
Control	18.60	6.50	2.15	3.25	0.96	0.02
OM_1	31.80	8.30	2.95	4.18	1.02	0.04
OM_2	35.25	6.90	2.56	4.99	1.17	0.05
OM_3	37.12	6.75	2.85	5.56	1.30	0.06
OM_4	34.25	7.12	3.20	4.98	1.45	0.09
OM_5	45.16	8.15	3.77	6.77	1.55	0.11
OM_6	41.20	6.69	2.75	6.15	1.10	0.07
OM_7	40.15	6.45	2.89	5.45	1.22	0.06
OM_8	39.22	6.55	2.79	6.66	1.27	0.08
OM_9	41.50	6.92	2.95	6.13	1.23	0.07
	After maize					
Control	16.22	4.15	2.05	2.85	0.66	0.02
OM_1	29.15	7.23	2.76	3.88	0.80	0.03
OM_2	31.20	5.85	2.49	4.59	0.97	0.04
OM_3	32.18	5.17	2.77	5.16	1.10	0.05
OM_4	31.20	6.55	2.95	4.58	1.25	0.08
OM_5	42.13	7.23	3.05	6.33	1.35	0.09
OM_6	39.11	5.50	2.49	5.75	0.90	0.06
OM_7	38.15	5.10	2.61	5.05	1.05	0.05
OM_8	34.20	5.19	2.29	6.26	1.08	0.07
OM_9	38.15	5.85	2.45	5.73	1.04	0.06
L.S.D 0.05	3.85	2.40	0.22	1.88	0.05	0.02
L.S.D 0.01	1.55	1.10	0.09	0.20	0.01	0.01
Critical concentration in soil ppm	2.50-4.00	20-300	1-40	0.1-20	2-50	0.01-0.70

Effect of different composts sources on concentration of Fe, Mn, Cu, Pb, Ni and Cd in wheat and maize plants:

Data presented in Table (9 and 10) show that the application of organic materials significantly increased the concentration of heavy metals in both grain and straw of wheat and maize plants.

The concentration of heavy metals in wheat and maize straw are more than its corresponding concentrations in the grains. Heavy metals concentrations in grain and straw of wheat and maize were in the order Fe > pb > Mn > Cu > Ni > Cd. Results showed also that Mn, Ni, Cd and Cu concentration in grain and straw of wheat and maize plants (except Cu in wheat straw) are in the range of normal concentration, while those of Fe and Pb concentration in grain, wheat straw, maize plants as well as Cu in wheat straw are within the critical concentrations in plants (Kabata and Pendias 2000) in spite of the higher total concentration in soil of these metals. These results were supported by Rechcigl (1995) who found that an increase in the total content of any trace element in compost – treated soil dose not necessarily lead to an increase in plant uptake of that element. He stated also that, Cu uptake from compost-treated soil is too low to cause a serious health threat as a result of organic matter complexes Cu and the reductions of its availability as well as toxicity to plants.

Table (9): Heavy metals contents (mg/kg) in grain and straw of wheat plants as affected by compost sources.

Treatments	Fe*	Mn**	Cu**	Pb**	Ni**	Cd**
	Grain					
control	125.00 i	19.50 i	3.09 g	43.17 j	3.11 h	0.18 g
OM_1	156.25 g	23.09 h	6.25 f	65.60 d	5.13 f	0.25 f
OM_2	200.00 e	28.50 f	7.50 e	69.16 c	4.90 g	0.33 e
OM_3	143.75 h	33.00 b	8.13 d	70.22 b	5.70 e	0.41 bc
OM_4	293.75 b	27.11 g	8.75 c	65.11 e	6.02 c	0.38 cd
OM_5	337.50 a	35.00 a	8.13 d	79.16 a	7.75 a	0.47 a
OM_6	218.75 d	27.50 g	11.25 a	55.09 g	6.20 b	0.36 de
OM_7	179.38 f	31.00 d	9.38 b	51.16 h	5.78 d	0.33 e
OM_8	262.50 c	30.00 e	9.38 b	49.18 i	4.95 g	0.43 b
OM_9	262.50 c	32.00 c	8.75 c	56.13 f	5.15 f	0.40 bc
L.S.D 0.05	12.12	2.92	0..55	6.01	0.6.2	0.12
L.S.D 0 .01	16.02	3.18	0..61	7..02	1.11	0..09
	Straw					
control	302.50 h	39.00 f	6.25 d	107.30 i	4.67 g	0.54 h
OM_1	425.00 g	46.22 ef	35.00 b	164.00 d	7.70 e	0.75 g
OM_2	350.00 de	57.11 de	35.00 b	172.90 c	7.35 f	0.99 f
OM_3	400.00 b	61.00 bc	30.00 c	175.55 b	8.55 d	1.23 c
OM_4	350.00 de	55.13 de	35.00 b	162.78 d	9.03 c	1.14 d
OM_5	485.00 a	71.50 b	37.50 a	197.90 a	11.63 a	1.41 a
OM_6	450.00 f	53.11 a	30.00 c	137.73 f	9.30 b	1.08 e
OM_7	325.00cd	59.25 ef	30.00 c	127.90 g	8.67 d	0.99 f
OM_8	350.00 de	60.12 de	37.50 a	122.95 h	7.43 h	1.29 b
OM_9	375.00 c	63.05 cd	30.00 c	140.32 e	7.73 e	1.05 e
L.S.D 0.05	25.12	2.12	1.70	6.19	1.40	0..25
L.S.D 0.01	31.66	3.10	2.40	7. 36	1.99	0..11
Critical concentration in plants	300-1000	300-500	20-100	30-300	10-100	5-30

Table (10): Heavy metals contents (mg/kg) in grain and straw of maize plants as affected by composts sources.

Treatments	Fe*	Mn**	Cu**	Pb**	Ni**	Cd**
	Grain					
	330.50 h	31.12 g	3.75 i	33.12 i	4.92 f	1.30 f
OM_1	414.12 g	39.10 f	4.75 e	39.96 h	5.11 e	1.37 e
OM_2	490.30 bc	40.13 f	4.91 d	40.19 g	5.23 e	1.41 cde
OM_3	436.20 e	49.12 de	4.33 g	49.13 f	6.19 d	1.49 ab
OM_4	482.01 c	47.29 e	4.11 h	50.11 e	6.50 c	1.39 de
OM_5	518.50 a	59.16 a	5.29 a	66.13 a	8.13 a	1.52 a
OM_6	423.14 f	50.60 bc	4.55 f	50.10 e	8.00 a	1.43 cd
OM_7	496.12 b	51.20 b	4.91 d	51.20 d	7.13 b	1.44 bcd
OM_8	450.19 d	49.13 cd	5.01 c	55.13 c	6.23 d	1.46 bc
OM_9	433.11 e	48.29 de	5.12 b	59.22 b	7.11 b	1.40 de
L.S.D 0.05	33.725	3. 17	0.06	4.20	0.72	0.10
L.S.D 0.01	45.917	5.99	0..25	6.50	1.00	0.08
	Straw					
	372.11 g	46.68 h	4.13 g	82.80 h	5.90 h	1.95 f
OM_1	491.50 f	58.65 g	4.99 e	99.90 g	6.13 g	2.06 e
OM_2	500.16 e	60.20 f	5.13 cd	100.48 g	6.28 f	2.12 cde
OM_3	492.18f	73.68 cd	5.02 de	122.83 f	7.43 e	2.24 ab
OM_4	519.11 c	70.94 e	4.73 f	125.28 e	7.80 d	2.09 de
OM_5	598.10 a	88.74 a	6.66 a	165.33 a	9.76 a	2.28 a
OM_6	501.13 e	75.90 bc	5.02 de	125.25 e	9.60 b	2.15 cd
OM_7	550.12 b	76.80b	5.14 c	128.00 d	8.56 c	2.16 cd
OM_8	510.13 d	73.70 cd	5.91 b	137.83 c	7.48 e	2.19 bc
OM_9	515.10 cd	72.44 de	5.06 cde	148.05 b	8.53 c	2.10 de
L.S.D 0.05	15.533	5.384	0.42	5.32	0.03	0.02
L.S.D 0.01	21.149	7.330	0.55	7.56	0.25	0.05
Critical concentration plants	300-1000	300-500	20-100	30-300	10-100	5-30

In a column, means followed by a common letter are not significantly different at the 5% level by DMRT.

*** the high Fe concentration in the range of 300-1000 mg-kg^{-1} dry weight (Ottow et al., 1983).**

**** Data from Kabata and Pendias (2000).**

It is also to note that, under the pH of the studied soil (7.68 7.98), heavy metals are precipitate which in turn affect their availability to plants. However, the low uptake of the amount of elements by plant roots indicates that these elements are unavailable to the wheat and maize plants under the experimental conditions.

Effect of compost sources on some physical properties after harvesting of maize

The main studied of soil physical characteristics were bulk density and aggregate stability to assess their alterations upon application of different composting materials in Table (11) .Soil aggregation may be characterized in terms of the size distribution of aggregates present in the soil and by the water stability of those aggregates. Measurement of aggregate stability is considered one of the most common determination on soil structure studied for these reasons ,measurements of aggregation index (AI);mean weight diameter (MWD) ;water stable aggregates (TWAS %) as well as optimum size aggregate (OPt.size) and structure coefficient (SC) where, measured after harvest of maize plants are illustrated in Table (11). As previously discussed the application of different composts sources increases the total organic matter in the soil , that in turns has positive effects on the studied physical properties ; decreased the bulk density and increased all the others, compared the control treatment. This result is confirmed by Macrae, and Mehuys(1985)who stated that total organic matter is a primary factor responsible for the stability of soil aggregates . OM_1 treatment recorded the best value for B.D. (1.19 Mgm^{-3}) while OM_8 treatment recorded the best values for AI(0.74) ,MWD(1.48), Opt. size (31.90) ,SC(1.71) and TWSA %(63.11). These results are in agreement with those obtained by Hamoud (2001).

Table (11): Effect of different compost sources on some physical properties of the studied soil after harvesting of maize .

Treatments	B.D. (Mgm^{-3})	A.I.	MWD mm)(	Opt. size (mm)	S.C.	Total WSA%
control	1.45	0.30	0.60	23.49	0.63	38.33
OM_1	1.19	0.46	0.92	31.50	0.61	40.13
OM_2	1.30	0.69	1.39	25.90	1.35	57.36
OM_3	1.29	0.34	0.68	23.80	0.65	36.50
OM_4	1.21	0.42	0.84	23.31	0.93	55.13
OM_5	1.20	0.43	0.86	20.44	0.66	39.49
OM_6	1.28	0.58	1.16	29.12	1.29	56.25
OM_7	1.23	0.68	1.36	30.41	1.42	58.66
OM_8	1.27	0.74	1.48	31.90	1.71	63.11
OM_9	1.20	0.64	1.28	31.40	1.21	54.64
L.S.D 0.05	0.10	0.15	0.12	2.50	0.25	2.88
L.S.D 0.01	0.02	0.05	0.06	1.11	0.09	1.15

B.D: bulk density , AI: Aggregation index, MWD: Mean weigh diameter,T. W.S.A.:Total water stable aggregate, Opt.S: Optimum size of aggregate, S.C.: structure coefficient.

Economical evaluation :

The economic evaluation carried out based on the benefit (B) to cost (C) ratio (B/C) for each material type Table (12). The data show that the B/C ratio was in the order of OM_7 > OM_6 > OM_9 > OM_5 > OM_3 > OM_2 > OM_8 > OM_4 >Control> OM_1; therefore, OM_7 treatment gave the highest profit.

Table (12): The benefit to cost ratio for the studied field treatments

Treatments	Cost (L.E)	Grain price (L.E)	Straw price (L.E)	Total income (L.E)	Profit (L.E)	Benefit/cost ratio	order
1- Control (N)	2070	10686	1952	12638	10568	5.10	9
2-OM_1	2410	11309	2203	13512	11102	4.61	10
3-OM_2	2110	11704	2236	13940	11830	5.61	6
4-OM_3	2160	12071	2233	14304	12144	5.62	5
5-OM_4	2210	11790	2352	14142	11932	5.40	8
6-OM_5	2110	11800	2235	14035	11925	5.65	4
7-OM_6	2010	11605	2326	13931	11921	5.93	2
8-OM_7	2110	12220	2433	14653	12543	5.94	1
9-OM_8	2125	11530	2329	13859	11734	5.52	7
10-OM_9	2025	11521	2310	13831	11806	5.83	3

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تقييم لبعض أنواع المكمورات لتحسين خواص الأرض تحت نظام تعاقب القمح والذرة

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معهد بحوث الأراضى والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر

أقيمت تجربتان حقليتان فى المزرعة البحثية بمحطة البحوث الزراعية بسخا لدراسة تاثير إضافة الاسمدة العضوية من مصادر مختلفة (مكمورات كل من سماد الدواجن وحطب القطن ومخلفات المجارى ومخلفات المدن ونشارة الخشب والسماد البلدى ونشارة الخشب المنشطة عضويا ونشارة الخشب وحطب القطن المعاملين بالصودا الكاوية) بالمقارنة بالتسميد النتروجينى المعدنى الموصى به لكل من محصول القمح والذرة مع إضافة ٥٠% من السماد المعدنى لمعاملات الاسمدة العضوية وذلك على خواص الأرض وإنتاجية محصول القمح (صنف سخا ٩٤) والذرة (صنف جيزة ٣٥٢) ومحتواهما من العناصر الغذائية وتقليل ٥٠% من التسميد النتروجينى ، وقد أكدت النتائج التأثير النافع للاسمدة العضوية المستخدمة كما يلى:

١- أدت إضافة مكمورات المخلفات العضوية المختلفة إلى زيادة مادة الأرض العضوية والــ ECe بينما كان إنخفاض الــ pH ضئيلاً.

٢- فى الموسم الأول (القمح) معاملة الأرض بمكمورة السماد البلدى ونشارة الخشب المنشطة عضويا أعطت أعلى محصول حبوب وقش (٣.٠٩ طن للفدان ، ٥.٩٨طن / فدان) بينما أعلى قيمة لوزن مائةحبة كان (٤.٦٠ جم) عند معاملة الأرض بمكمورة السماد البلدى وفى الموسم الثاني كان أعلى محصول حبوب

(٤.٢١ طن للفدان) وأعلى محصول قش (٦.٦٣طن للفدان) وأعلى وزن مائة حبه (٣٢.٥٨ جم) عند معاملة الأرض لمكمورة نشارة الخشب المنشطة عضويا ومكمورة حمأة المجارى ومكمورة السماد البلدى على التوالى وبنفس المعدلات المذكورة فى الموسم الأول.

٣ - المكمورات المختلفة كانت الأكثر فاعلية فى زيادة الـ NPK الميسر فى الأرض في كلا الموسمين

٤- معاملة الأرض بالمكمورات المختلفة أدت إلى زيادة إمتصاص نباتات القمح والذرة لعناصر NPK فى كلا الموسمين.

٥- زاد محتوى الأرض الكلى والميسر (Available) من الحديد والمنجنيز والنحاس والرصاص والنيكل والكادميوم عند معاملة الأرض بالمكمورات العضوية المختلفة وقد وجد أن تركيز العناصر الثقيلة الميسر ضئيل جداً بالنسبة للتركيز الكلى مما يدل على أنه عند إضافة العناصر الثقيلة للتربة تمتص بقوة على المواقع الغير تبادلية non exchangeable وميسره هذه العناصر نتيجة إضافة مكمورة المخلفات العضوية المختلفة أخذت الترتيب التنازلى الآتـــى : الحديد > المنجنيز > الرصاص > النحاس > النيكل > الكادميوم.

٦- أدى إضافة المكمورات العضوية إلى زيادة تركيز العناصر الثقيلة تحت الدراسة زيادة معنوية فى حبوب وقش القمح والذرة وقد أخذت الترتيب الآتى : الحديد > الرصاص > المنجنيز > النحاس > النيكل > الكادميوم.

أوضحت الدراسة أن تركيز كل من المنجنيز ، النيكل ، الكادميوم والنحاس فى حبوب وقش القمح والذرة (كانت فى المدى العادى normal range من ناحية أخرى كان تركيز الحديد والرصاص فى حبوب وقش الذرة والقمح فى مدى التركيز الحرج (critical concentration) .

٧- ادت اضافة المكمورات العضوية المختلفة الى زيادة بعض الخواص الطبيعية مثل دليل التحبب ، ونصف القطر الموزون ، ومعامل البناء ،الحجم الأمثل للحبيبات الثابته فى الماء ،مجموع التجمعات الثابته فى الماء ، وانخفاض فى الكثافة الظاهرية .

٨- تم عمل تقييم إقتصادى من خلال حساب B/C (benefit to cost ratio parameter) وكان أعلى دخل Profit (OM_7) مع معاملة نشارة الخشب المعاملة بالقلوى يليها معاملة (OM_6) معاملة حطب القطن.

قام بتحكيم البحث

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