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EFFECT OF APPLICATION OF AGRICULTURE ORGANIC WASTES ON PROPERTIES OF A SANDY SOIL, AND THE IMPACT ON MAIZE AND BARLEY GROWN ON THE SOIL:
II- SOIL CONTENTS OF AVAILABLE N, P, AND K; MAIZE AND BARLEY GROWTH AND NUTRIENTS UPTAKE.

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ABSTRACT

A sandy soil from Meet Kenana, Qalyoubia Governorate was used in the current study. Four sources of organic wastes were used; i.e. chicken manure (CM), charred rice straw (CRS), sugar beet residue compost (SBC) and sugar lime (SL). The latter is a waste sludge of lime-rich material residual from beet sugar factories. Rates of applications were 2 %, 4 % and 8 % w/w equivalent to 10, 20, and 40 metric tons / fed., on the basis of 30 cm soil depth under field conditions. Pots of 5 kg capacity were used and watered to about the water-holding capacity and left for one month to allow the biodegradation. Watering was done weekly. Thereafter, 20 grains of maize (*Zea mays* cv. hybrid 2 Taba) were sown and plants grew for 45 days then cut; thereafter a second crop of barley (*Hordum vulgare* cv. Giza. 123) was sown (20 grains / pot) in the same pots for another 45 days. After cutting each crop soil samples were taken for determination of available N, P and K contents. The dry weight of both maize and barley seedling was recorded. The obtained results could be summarized as follows:

1 - All materials, except CRS treatment, significantly increased availability of N, P and K in the soil as well as the dry matter yield of maize and barley. CRS application decreased available nutrients in soil, but significantly increased the dry matter yield of plants. Available nutrients contents after barley cutting were lower than that after maize harvesting, but still higher than that of the untreated soil.

2 - All residues increased N, P K, Fe, Mn, and Zn uptake by maize and barley seedlings, except with CRS which decreased such uptake in barley. The decrease was particularly significant with P, Mn and Zn. Uptake of macronutrients by maize and barley seedlings followed a trend almost similar to that of the availability of macronutrients in soil, effects being also dependent on the kind and rate of applied material.

3 - Utilization of these organic wastes as a soil conditioners in newly reclaimed sandy soils are recommended.

INTRODUCTION

The agriculture development aims at improving the agriculture activities through area expansion and yield increase programs. Cultivation of sandy soils in Egypt is the main target for area expansion. The main fertility and productivity problems of such soils are their poverty in plant nutrients and leaching losses nutrients. Increasing the fertility of these soils can be achieved with applying organic materials which increase soil productivity by providing plant nutrients (Fresquez *et al.*, 1990), and by improving soil physical properties (Abu Sharar. 1993). Sinha (1972) emphasized the importance of mineralization of organic matter through its decomposition for the availability of nutrients. Organic substances play a direct role in sustaining soil fertility by liberating available nutrients form during mineralization (Smith and Sharpley, 1990). Omar (1983) and Mahmoud (1994) found that the increases caused by application of organic manures regarding soil organic matter and plant nutrients are dependent on the source and rate of the manure as well as the soil.

Organic wastes differ in their efficiency as nutrient sources depending on their origin, composition and processing techniques. Khamis (2000) reported that poultry manure and rice straw are adequate used sources of K for potato grown on sandy loam soil since their application increased available K content and K-uptake by potato plants, and maintained continuous supply of K in the soil during most of the growing period of potato plants.

Aziz *et al.* (1998) reported that farmyard manure applied to a sandy soil increased cucumber yield; and attributed this increase to the role of organic matter in improving soil structure, biological activities, nutrients balance and status, and water holding capacity of this coarse textured soil. El-Zaher *et al.* (2004) reported that farmyard manure applied to a sandy clay loam soil increased yields of sugar beet roots, maize grains as well as uptake of N, P and K by plants. Barsoom (1998) reported that farmyard manure applied to a sandy soil increased its available N, P, Fe, Mn and Zn contents as well as yields of clover and wheat and the effect was more pronounced regarding Fe and Mn.

Abdel Magid *et al.* (1998) found that addition of chicken manure to a sandy soil increased wheat grains and straw yields, N and P uptake and the increase was a function of the rate of addition.

Elsharawy *et al.* (2003) reported that application of rice straw compost to sandy soil significantly increased grain yields of wheat and maize plants as well as concentration of N, P K, Fe, Mn, Zn and Cu in plant leaves and in grains.

Most agricultural farm wastes represent a large bulk of organic matter at low costs. With the rising cost of chemical fertilizer these wastes could be used as sources of plant nutrients.

The aim of the current investigation was to assess the benefits of using farm wastes of chicken manure, rice straw, sugar beet residues and sugar lime on the availability of N, P and K, and their uptake by maize and barely plants and their implications on plant growth.

MATERIAL AND METHODS

Sandy soil sample was taken from the surface 0 - 15 cm of a soil in Meet Kenana, Qalyoubia Governorate, Egypt. The soil was air-dried, crushed and sieved through a 2 mm sieve then thoroughly mixed and kept for analysis as well as the experimental work. Physical and chemical properties of the studied soil, were determined according to the standard methods outlined by Klute (1986) and Page *et al.* (1982), and are presented in Table 1 .

Table (1): Some physical and chemical properties of the investigated sandy soil.

Soil Properties	
Particle size distribution	
Coarse sand (%)	82.59
Fine sand (%)	10.35
Silt (%)	2.27
Clay (%)	4.79
Texture	Sand
Saturation percentage (%, w/w)	22.04
Field capacity(%)	10.73
Wilting point (%)	5.39
Available water (%)	5.34
Bulk density (g cm^{-3})	1.73
Particle density (g. cm^{-3})	2.95
Total porosity (%)	35.04
Hydraulic conductivity (cm h^{-1})	28.28
EC (dSm^{-1} in saturation extract)	3.59
PH	8.10
$CaCO_3$ (%)	0.36
Organic matter (%)	0.36
Soluble ions (mmol/L in saturation extract)	
HCO_3^-	6.40
Cl^-	14.31
CO_3^{2-}	0.00
SO_4^{2-}	16.16
Ca^{2+}	5.28
Mg^{2+}	3.36
Na^+	21.40
K^+	6.83
Exchangeable cations (cmol$_c$ kg^{-1})	
Ca^{2+}	5.16
Mg^{2+}	2.33
Na^+	0.79
K^+	2.33
CEC	10.60
Available macro-nutrient (mg kg^{-1})	
N	24.3
P	14.6
K	195.0
Available micro-nutrient (mg kg^{-1})	
Fe	9.2
Mn	3.6
Zn	4.0

pH: in 1:2.5: soil: water suspension at; soluble ions: in paste extract with SO_4^{2-} being calculated by difference between cations and anions.
Available nutrients: Extracted by ammonium bicarbonate – DTPA; available N denotes NO_3-N

Organic wastes used in the experiment are:

(1) **Chicken manure (CM):** manure collected from a chicken farm.
(2) **Charred rice straw (CRS):** rice straw burnt anaerobically (with no aeration) till becoming a black material resembling charcoal.
(3) **Sugar beet residue compost (SBC):** leaves and residues of sugar beet crop collected from fields at harvest as well as residues obtained after roots preparation for sugar extraction mixed together and composted as described by Abou El- Fadl (1970).
(4) **Sugar lime (SL):** The sugar lime is a waste by-product of sugar refinery industry obtained from the beet sugar Factory, El-Hamoul, Kafr El-Shaikh Governorate. It was dried made in a form of powder of light brown colour. Upon drying, the lumps break down easily to very fine powder. It is rich in calcium carbonate ($CaCO_3$, 73.1%).

Table (2) shows properties of the organic wastes used in the current experiment.

Table (2): Chemical and physical properties of the organic wastes (materials) used in the current study.

Property	CM*	CRS**	SBC***	SL****
PH in (1:5) soil suspension	6.94	8.15	8.58	8.80
EC dSm^{1-} in (1:10) soil suspension	8.73	4.36	8.75	1.90
Organic carbon(%)	11.60	14.60	8.40	3.40
Total nitrogen (%)	3.80	1.80	4.90	0.90
C: N ratio	3.05	8.11	1.71	3.78
Organic matter (%)	23.20	29.20	16.80	6.80
Total P (%)	0.89	0.48	0.52	0.62
Total K (%)	2.43	2.48	6.81	0.25
Ca^{2+} (%)	1.08	0.84	1.80	9.72
Mg^{2+} (%)	0.58	0.29	1.66	0.94
Na^{+} (%)	0.22	0.21	5.90	0.26
Total Fe (mg kg^{-1})	3745	829	6001	1110
Total Mn (mg kg^{-1})	140	85	200	157
Total Zn (mg kg^{-1})	1113	850	1659	1279
Moisture content (%)	9.25	6.84	4.47	3.49
Bulk density g cm^{-3}	0.69	0.24	0.64	0.74

*: Chicken manure; **: Charred rice straw; ***: Sugar beet compost; ****sugar lime

Greenhouse pot experiment:

A pot experiment was carried out in the greenhouse to study the effect of adding organic wastes on soil content of available N, P and K; maize and barley growth and nutrient uptake by such plants.

The soil was packed in plastic pots of 5 kg capacity. The experimental design was a randomized complete block, factorial; involving two factors as follows:

(1) **The organic wastes:** chicken manure (CM), charred rice straw, (CRS), sugar beet compost (SBC) and sugar lime (SL)
(2) **The rate of addition:** 2.0, 4.0, and 8.0 % [rates equivalent to 10, 20, and 40 metric tons / fed., on the basis of 30 cm soil depth]. A no-organic matter treatment (control) was also, carried out. Therefore, there were 13 treatments [i.e. (4 organic waste materials x 3 rates) + 1 control].

Treatments were done in three replicates. Organic materials were added and thoroughly mixed with the soil. All pots were watered to maintain the soil moisture content at about the water holding capacity. Soil pots were left without cultivation for one month to permit a degree of biodegradation of the added waste and mineralization of nutrient elements. Thenafter, 20 seeds of maize (*Zea mays*, cv. Hybrid 2 Taba) were planted in each pot. Watering of pots was conducted to maintain the soil moisture content at about the water holding capacity during the period of the experiment. The experiment lasted 45 days, after which maize seedlings were cut, and soil samples were taken for determination of available N, P and K. A second crop succeeded maize was barley (Hordum vulgare cv. Giza 123). Barely was sown (20 grains/pot) in the same pots for another 45 days to study the residual effect of the added organic wastes on soil and plant. After cutting barley seedlings, soil samples were taken for analysis of available N, P and K. Plant samples were dried at 70°C, and the dry weights were recorded . Samples of 0.5 g were digested using sulphoric acid and perchloric acid (1:1) and plant nutrients N, P, K, Fe, Mn and Zn were determined

All data were subjected to statistical analysis according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1 - Contents of available nutrients in soil:

A - Available nitrogen (N):

Results in Table 3 show that available N content, after maize and barley harvesting, is significantly increased due to addition of organic wastes, except CRS treatment which in which it decreases. The increase in available N content due to addition of CM and SBC may be due to their high contents of nitrogen (see Table 2) as compared with the CRS which had a wide C/N ratio which causes a considerable immobilization of soil nitrogen by soil microorganisms and hence decreases available nitrogen.

Adding CM, SBC and SL increases available N content as follows: 10.4, 32.9 and 3.3 % after cutting maize plants, and 14.2, 37.8 and 12.6 % after cutting barley plants. However, CRS caused a decrease of 14.5 after maize and 14.6 % after barley plants. Increasing available N in soil could be arranged as follows: SBC > CM > SL. The superiority of SBC over CM and SL could be attributed to its high content of N which is more easily decomposed than that of CM and SL. Nitrogen release in an available form depends on the nature of the added organic matter and the mineralizability of its nitrogen content as well as on the activities of soil microorganisms (Fine *et al.*, 1983).

Increasing the application rate of organic waste increases available N content progressively and significantly. The increases in available N are 2.5, 7.9, and 13.6 % for R_1, R_2 and R_3, respectively following maize; comparable increases following barley are 4.7, 11.9 and 20.0 %, respectively. With regard to increasing rate of each source, increasing CM and SBC in particular and SL to a less extent progressively and significantly increases available N content, whereas, increasing CRS progressively and significantly decreases it. Such interaction occurred following maize as well as following barley.

The SBC treatment at its highest rate shows the highest available N content after maize (36.28 mg/kg) as well as after barley (34.02mg/kg), whereas the lowest one after maize (17.08 mg/kg) as well as after barley (15.99 mg/kg) are obtained by CRS at R_3.

B - Available phosphorus (P):

Results in Table 3 show that available P (like available N) significantly increases after maize and barley as a result of addition of CM, SBC and SL, but it decreases due to the addition of CRS.

CM, SBC and SL additions increase available P by 52.6, 19.3 and 3.1 %, respectively after maize and by 55.0, 20.6 and 9.8 %, respectively after barley. Available P it decreases by 10.0 and 16.7 % due to application of CRS after maize and barley, respectively. Decomposition of the organic residues and the subsequent release of organic and inorganic acids may have enhanced the solubility and availability of P. Other possibility could be the effect of organic residues on lowering the fixation of phosphorous through several mechanisms such as chelation and formation of organic complexes relatively available for plants.

CM is the most effective organic waste in this respect, since it had the highest contents of nutrients compared with the others. On the other hand, CRS had the lowest P compared with the others as well as a wide C/N ratio which must have caused an increase in the population of soil microorganisms. This would consequently lead to a greater immobilization of available nutrients including P.

Increasing the rate of addition increases available P content in soil after maize and barley. These increases are 7.4, 16.4 and 26.6 % after maize and 7.0, 17.5 and 27.8 after barley at R_1, R_2 and R_3, respectively. However, increasing CM, SBC or SL is associated with an increase in available P, whereas, increasing CRS is associated with a decrease in available P.

The highest available P contents after maize (23.97 mg/kg) as well as after barley (22.02 mg/kg) occurred by CM at R_3, whereas, the lowest ones after maize (10.93 mg/kg) as well as after barley (9.02 mg/ kg) occurred in CRS treatment at R_3

C - Available potassium:

Like with available N and P, results in Table 3 show a positive effect of adding CM, SBC, SL on the soil available potassium content after maize and barley. On the other hand, a negative effect is found due to CRS addition; the effect was more pronounced at the higher rates of addition.

Available K increases by 40.4, 45.6 and 24.4 %, after maize, and 43.2, 48.1 and 25.7 %, after barley, due to the addition of CM, SBC and SL, respectively, and a decreases by 8.8 % after maize and 7.7 % after barley due to CRS addition, respectively. The highest increase obtained by SBC reflects its high content of K. The current results are almost similar to those of Elsharawy *et al.* (2003) and Khamis (2000).

Increasing the rate of addition is associated with an increase in K in soil. Available K increases by 14.0, 25.4 and 36.8 % after maize, and by 16.4, 27.3 and 36.1 %, after barley, at R_1, R_2 and R_3, respectively. However, increasing CM, SBC and SL addition rates are associated with an increase, whereas, CRS addition is associated with available K decrease.

Table (3): Effect of applying agriculture organic wastes on available nitrogen, phosphorus and potassium contents (mg. kg^{-1} soil) in sandy soil under study*.

Treatment (M)	Available nutrients content in soil after maize.											
	N				P				K			
	Rates of addition (R)											
	R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean
CM	24.02	25.06	27.04	25.37	16.17	19.51	23.97	19.88	232	271	311	271
CRS	21.96	19.92	17.08	19.65	12.34	11.91	10.93	11.73	186	175	166	176
SBC	25.30	30.07	36.28	30.55	14.03	15.58	17.03	15.55	240	283	321	281
SL	23.02	24.18	24.22	23.74	13.47	13.68	14.03	13.43	221	240	259	240
Mean	23.56	24.81	26.11		14.00	15.17	16.49		220	242	264	
LSD at 5%	M = 1.60 R = 1.58 MxR = 2.77				M = 1.26 R =1.20 MxR =2.19				M=18 R= 15 MxR = 21			
Control	22.99				13.03				193			
	Available nutrients content in soil after barley.											
CM	23.01	24.02	25.03	24.02	15.01	18.91	22.02	18.65	223	262	301	262
CRS	19.87	18.04	15.99	17.97	11.02	10.30	9.02	10.02	178	169	160	169
SBC	23.91	28.97	34.02	28.97	13.02	14.58	15.93	14.51	231	271	310	271
SL	22.02	23.09	25.95	23.69	12.08	13.01	14.50	13.21	218	229	244	230
Mean	22.20	23.53	25.24		12.87	14.13	15.37		213	233	249	
LSD at 5%	M=1.30 R = 1.29 MxR 2.25				M=1.12 R=1.10 MxR= 2.03				M=20 R =18 MxR =25			
Control	21.03				12.03				183			

*A sandy soil (from Meet Kenana). R_1 = 2 % (w/w) R_2 = 4 %(w/w) R_3= 8 %(w/w)
CM: chicken manure, CRS: Charred rice straw, SBC: Sugar beet compost, SL: Sugar lime

The highest available potassium contents of 321 mg/kg after maize and 310 mg/kg after barley occur by SBC at R_3 whereas the lowest ones (166 mg/kg) after maize and (160 mg/kg) after barley are obtained by CRS at R_3.

2 - Plant growth and nutrients uptake.

A – Plant growth and dry matter yield:

Results in Table 4 reveal that both maize and barley dry matter yields significantly increase due to the addition of CM, CRS, SBC and SL; these increases are 135.4, 65.6, 151.8 and 132.9 %, respectively for maize dry matter yield; and 54.2, 9.0, 101.6 and 36.5 %, respectively for barley dry matter yield. These results are almost similar to those obtained by Elsharawy *et al.* (2003). Such increases reflect the positive effect of the added materials in providing nutrients to the growing plants as well as improving soil physical properties, (Abdel-Sabour and Abo-El-Seoud, 1996). The superiority of SBC over CM, CRS and SL may be attributed to its higher contents of nutrients.

Table (4): Effect of applying Agriculture organic wastes on dry weight of corn and barley plants (seedlings) (g. pot^{-1}) grown on sandy soil under study.

Treatment (M)	Dry weight (g/pot)							
	Maize plants (seedlings)				Barley plants (seedlings)			
	Rate of addition (R)							
	R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean
CM	21.21	16.02	14.03	17.09	3.34	5.01	5.99	4.78
CRS	8.30	8.90	19.47	12.22	3.61	3.32	3.21	3.38
SBC	17.16	17.50	21.08	18.58	4.85	6.44	7.46	6.25
SL	15.17	15.79	20.61	17.19	3.79	3.99	4.91	4.23
Mean	15.46	14.55	18.80		3.89	4.69	5.39	
LSD at 5%	M= 2.10 R = 1.51 M x R = 3.30				M=2.10 R= 1.10 M x R= 1.62			
Control	7.38				3.10			

Increasing organic waste addition rates associated with an increase in the dry matter yield of both maize, except CM, and barley plants; this is may be due to the high salinity content of chicken manure which would affect maize plant growth more than barley. These increases are progressive with the rate and significant at all of the added rates in the case of maize plants and only at R_2 and R_3 in the case of barley plants. These increases are of 109.5, 97.2 and 154.7 %, respectively for maize growth, and 25.7, 51.3 and 74.0 %, respectively for barley growth. Abdel Magid *et al.* (1998) found that wheat grain yield, grain quality and straw yield were increased by adding chicken manure and the increase progressed with the increase in the rate of addition.

There was an interaction effect between the type of organic waste and its rate of addition. In the case of maize plants the highest increase under R_1 occurs with CM, but the highest increase under R_3 occurs with SBC. Thus, CM was more effective than the others when added at a low R_1 rate whereas CRS, SBC and SL were superior to CM under conditions of the high rates. In the case of barley plants the four materials are rather similar in the effect when the rate low (R_1), but under conditions of medium (R_2) and high (R_3) rates SBC is superior to the others.

The highest maize dry matter yield (21.21 g/pot) is obtained by CM at R_1 and the lowest (8.30 g/pot) is obtained by CRS at R_1. The highest barley dry matter yield (7.49 g/pot) is obtained by SBC at R_3, and the lowest (3.21g/pot) is obtained by CRS at R_3.

2 - Nutrient uptake

i) - Nitrogen uptake

Results in Table 5 show that N-uptake by maize is significantly increased due to CM, CRS, SBC, and increased due to SL additions, whereas N-uptake by barley plants is significantly increased due to CM, SBC and SL, and decreased due to CRS additions. The increases in N-uptake are 160.6, 119.7, 231.4 and 43.8 % in maize due to CM, CRS, SBC and SL additions, respectively. The increases for barley are 108.3, 168.8 and 43.8 % due to the additions of CM, SBC and SL, respectively; and the decrease in N-uptake by barley plants, due to CRS addition is 12 %. Thus, sugar beet compost is the most effective conditioners used for this particular respect.

The increases in N-uptake by maize plants due to CM, CRS, SBC and SL additions is an out come of the increase in plant growth caused by the beneficial effects of such materials particularly the much richer SBC . On the other hand, the very low nitrogen content and wide C/N ratio of CRS enhance the population of microorganisms to immobilize available nitrogen in soil and the low barley plant growth causes a decrease in N- uptake by these plants.

Increasing the rate of addition increases N-uptake by maize and barley plants, except CRS where its high rate decreases N-uptake by barley plants, probably due to the low barley growth in this treatment. The increase is progressive with the rate and significant only at the high rate. The main effect of the rate shows that R_1, R_2 and R_3 cause increases in N-uptake of 88.2, 116.7, 212.6 %, respectively by maize plants and 35.4, 54.2 and 143.8 %, respectively by barley plants.

The interaction effect between the kind of organic waste and its rates showed the followings: The increasing rate of CM decreases N- uptake in maize plants and the highest N-uptake is obtained at R_1 addition, whereas SBC and CRS R_3 give the highest N-uptake, and SL increasing rate increases N-uptake. In the case of barley, increasing CM, SBC and SL rate is associated with a progressive increase in N-uptake, but increasing CRS rate is associated with a progressive decrease in N-uptake.

For maize, the highest N-uptake (147.3 mg / pot) occurs by adding SBC at R_3 and the lowest (35.5 mg/pot) occurs by adding CRS at R_1. For barley, the highest N-uptake (190 mg / pot) occurs by adding SBC at R_3 and the lowest (38 mg/pot) occurs by adding CRS at R_3. The residual effect of the organic wastes and the decomposition of maize roots in the soil could increase soil available N. Mineralization of plant nutrients over the two seasons could release nutrients during microbial decomposition (Abdel Magid *et al.* 1998).

ii) - Phosphorus uptake:

Results in Table 5 show similar trend to that of N-uptake. The increases in P-uptake are 257.5, 74.8, 189.0 and 183.5 % due to additions of CM, CRS, SBC and SL, respectively; for barley the increases in P-uptake are 124.1, 172.4 and 70.7 % due to adding CM, SBC and SL, respectively, and a decrease of 19.5

% due to CRS addition. The high P-uptake by maize plants due to CM addition may be attributed to its high content of P which reflected on increasing available P in the soil and hence increased P-uptake by the first crop cultivated on the soil. The high uptake of P by maize plants had been reflected on P-uptake by barley plants where it decreased.

Increasing the rate of addition significantly increases P-uptake by plants, and the increase is progressive with the rate and significant. Such results agree with those reported by Abdel Magid *et al.* (1998) who reported that N and P uptake by wheat plants progressively increased by increasing chicken manure application rate. Increasing the rate of addition increases P-uptake by maize plants by 153.5, 161.0 and 213.4 % at R_1, R_2 and R_3, respectively; comparable increases for barley are 59.8, 86.8 and 110.9 %, respectively.

There is a significant interaction between the kind of organic waste and its rate. In the case of maize plants, with CM CRS and SL R_3 is superior to R_1 and R_2, with SBC R_3 is similar to R_2. In the case of barley plants, with CM, SBC and SL significant increases occurs with each increasing rate; but, with CRS no significant differences occurs between R_1 and R_2; or between R_2 and R_3, but significant difference occurs between R_3 and R_1.

It could be concluded that the added materials enhanced soil P supply of nutrients through direct and indirect effects. The direct effect includes the continuous release of inorganic P and the indirect effect is the role of organic acids and other compounds of acidic effect which would solubilize more P from insoluble potential P (Allam, 1999).

The highest P-uptake by maize plants (45.4 mg/pot) occurs by adding CM at R_3 and the lowest (22.2 mg/pot) occurs by adding CRS at R_3. For barley plants the highest (56.2 mg/pot) occurs by adding SBC at R_3 and the lowest (12.3 mg/pot) occurs by adding CRS at R_3.

iii) – Potassium uptake

Results in Table 5 reveal that the effect of the added organic wastes on K-uptake by maize and barley plants is similar to that obtained with N and P-uptake. K-uptake by maize and barley plants significantly increased by addition of CM, SBC and SL. With regard to CRS, its addition significantly increases K-uptake by maize but slightly decreases it by barley. Khamis (2000) reported that poultry manure and rice straw are sources containing adequate K for potato grown on sandy loam soil.

K-uptake significantly increases with increasing the rate of addition and the highest K-uptake occurs at R_3 addition.

There is a significant interaction effect between the kind of organic waste and its rate of addition. In the case of maize, with CM, CRS and SL progressive significant increases occur with progressive rates, whereas with SBC, although R_3 gives highest uptake, no significant differences occur between R_1 and

R_2. In the case of barley, with CM and SBC, progressive increases occur with progressive rates, whereas with SL there is a significant difference between R_1 and each of R_2 and R_1; and no significant difference occurs between R_2 and R_3. On the other hand, with CRS addition, no significant differences in K-uptake occur among the three rates.

The highest K-uptake by maize plants (1225 mg K/pot) is obtained by CM addition at R_3 whereas the lowest (874 mg K/pot) is obtained by CRS addition at R_3. The highest K-uptake by barley plants (349 mg K/pot) is obtained by CM addition at R_3, whereas the lowest (77 mg K/pot) is obtained by CRS addition at R_3.

Table (5): Effect of Agriculture organic wastes application on nitrogen; phosphorus and potassium uptake by maize and barley seedlings (mg/pot^{-1}) grown on the sandy soil under *study.**

Treatment (M)	Macronutrients uptake by maize plants											
	N				P				K			
	Rates of addition (R)											
	R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean
CM	98.2	95.2	68.2	87.2	46.7	46.1	43.4	45.4	1380	1169	1125	1225
CRS	35.5	47.4	137.5	73.5	14.6	15.0	36.9	22.2	526	575	1520	874
SBC	78.8	106.6	147.3	110.9	34.5	37.3	38.2	36.7	902	905	1507	1105
SL	38.5	40.6	65.3	48.1	32.9	34.2	40.8	36.0	862	934	1278	1025
Mean	62.8	72.5	104.6		32.2	33.15	39.8		918	896	1358	
LSD at 5%	M= 15 R = 14 M x R = 18				M=1.19 R=1.14 R= 2.04				M=30 R =28 M x R=35			
Control	33.46				12.70				307			
	Macronutrients uptake by barley plants											
CM	63	87	150	100	35.3	39.6	42.1	39.0	170	308	349	275
CRS	46	43	38	42	15.9	13.9	12.3	14.0	95	84	77	85
SBC	96	101	190	129	38.3	47.6	56.2	47.4	160	229	278	222
SL	54	65	89	69	21.8	28.9	36.3	29.7	143	188	197	167
Mean	65	74	117		27.8	32.5	36.7		142	202	225	
LSD at 5%	M = 30 R = 28 M x R = 35				M=1.18 R=1.13 M x R = 2.03				M = 20 R = 18 M x R =25			
Control	48				17.4				100			

The increase of nutrients uptake caused by organic application could be an outcome of the followings: (1) Increasing the availability of nutrients in soils, (2) increasing the catione exchange capacity, (3) changing physical, chemical, biological and fertility properties in a positive manner.

It could be concluded that the addition of such organic wastes significantly increases available N, P and K contents in the soil and consequently their uptake by the growing plants which reflects on increasing the yield.

IV - Iron, manganese and zinc uptake:

Results presented in Table 6 show that the addition of organic materials significantly increases Fe, Mn and Zn uptake except CRS where its addition significantly decreases their uptake by barley. Such a decrease is in line with the decrease in plant growth and the low content of these nutrients in CRS. Besides maize plants which preceded barley must have depleted the soil of CRS treatment to a high extent and consequently, low content of the available nutrients which leads to low uptake of these nutrients by barley. The high micronutrients uptake in the other three treatments of CM, SBC and SL reflects their high contents of micronutrients. organic materials can influence the solubility of micronutrients in soils by different ways causing an increase in their solubility by forming relatively stable organic complexes. In this concern, Allam, (1999) reported that the release of organic acids during the decomposition of plant residues increases the micronutrients availability to the growing plants via their abilities to chelate Fe, Mn, Zn and Cu.

Table (6): Effect of Agriculture organic wastes application on Fe, Mn and Zn uptake by maize and barley seedlings (mg/pot^{-1}) grown on the sandy soil under study*.

Treatment (M)	Micronutrients uptake by maize seedlings											
	Fe				Mn				Zn			
	Rate of addition (R)											
	R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean	R_1	R_2	R_3	Mean
CM	2.98	3.29	3.52	3.26	1.11	1.31	1.40	1.27	2.95	3.63	4.62	3.73
CRS	2.46	2.57	2.64	2.56	0.64	0.66	0.70	0.67	2.75	2.78	2.82	2.78
SBC	3.63	4.36	5.05	4.35	0.91	1.00	1.14	1.02	3.52	4.71	5.44	4.56
SL	2.60	2.90	3.33	2.94	0.80	0.86	0.93	0.86	3.01	3.30	3.81	3.37
Mean	2.91	3.28	3.63		0.87	0.96	1.04		3.06	3.61	4.17	
LSD at 5%	M = 0.28 R = 0.22 M x R = NS				M= 0.08 R= 0.03 M x R = NS				M = 0.18 R = 0.15 M x R = 0.25			
Control	2.45				0.62				2.73			
	Micronutrients uptake by barley seedlings											
CM	2.61	2.91	3.05	2.86	0.65	0.99	1.01	0.88	2.54	3.15	4.31	3.33
CRS	2.00	1.91	1.57	1.84	0.10	0.06	0.04	0.07	2.23	2.01	1.97	2.07
SBC	3.25	4.03	5.08	4.12	0.45	0.53	0.71	0.56	3.73	4.57	5.81	4.70
SL	2.23	2.70	3.36	2.76	0.34	0.39	0.44	0.39	3.38	2.68	3.63	2.90
Mean	2.52	2.90	4.62		0.39	0.49	0.55		2.72	3.10	3.93	
LSD at 5%	M = 0.23 R = 0.20 M x R= NS				M=0.03 R=0.02 MxR = NS				M=0.19 R=0.14 MxR=0.24			
Control	2.04				0.13				2.32			

Increasing CM, SBC and SL rates is associated with a progressive and significant increase in Fe, Mn and Zn-uptake by plants of both crops, whereas increasing CRS rate is associated with a progressive and significant increase of the three nutrients by maize plants only, and a progressive decrease by barley plants; thesis may be due to the low Fe, Mn and Zn contents of CRS as compared with the others materials and also to the high depletion of these nutrients by the preceded maize plants.

There is no significant interaction between the kind of organic waste and its rate of addition with regard to Fe as well as Mn uptake. On the other hand, in the case of Zn-uptake there is an interaction: only with CRS that all rates were similar; with the others increasing rates causes an increase of Zn uptake.

Concerning the residual effect of organic wastes on the growth and nutrients uptake by barley plants it noticed, from the obtained results, that in cases where the growth and nutrients uptake by maize plants increased, the growth and nutrients uptake by barley plants decreased and visa versa; this may be due to high extraction of nutrients by the growing plants. It could be concluded that addition of organic wastes had a simulative residual effect on soil content of available nutrients and barley growth. (Abdel-Sabour *et al.* (1999) reported that the previous single application of organic waste composts to a sandy soil exhibited a positive residual effect and increased soil productivity even after four successive crops .

CONCLUSION

Agricultural organic wastes represent a large bulk and may pose a potential pollution hazard. Addition of such materials to sandy soils may be of a favorable effect on increasing their contents of available plant nutrients which in turn will be reflected on increasing the yield of the growing plants. Also, these organic wastes had a benefit residual effect on the soil content of available nutrients such as N, P and K since they could be considered a potential source for these elements. The effect of these wastes depend on the kind and the rate of applied material. The most favorable effects occurred with SBC and CM, particularly when the rate was high. Utilization of these organic wastes as a soil conditioners in newly reclaimed sandy soils may be recommended or for conditioning the soils under reclamation.

REFERENCES

Abdel Magid, H.M.; Abdel-Aal, Sh.I.; Rabie, R.K. and Sabrah, R.E.A. (1998): Chicken manure as a biofertilizer for wheat grown on sandy soils of Saudi Arabia. Egypt. J. Soil Sci. 38 (1 – 4): 329 – 338.

Abdel-Sabour, M. F. and Abo-El-Seoud, M. A. (1996): Effect of organic compost addition on sesame growth, yield and chemical constituents. Agriculture., Ecosystem. and Environment, 60: 157 – 164.

Abdel-Sabour, M.F.; Abo-El-Seoud, M.A. and Rizk, M. (1999): Physiological and chemical response of sunflower to previous organic waste composts application to sandy soils. Egypt. J. Soil Sci. 39 (4), 407 - 420.

Abou El-Fadl, M. (1970). Organic manures. El-Safa public. Cairo, Egypt. (In Arabic).

Abu-Sharar, T.M. (1993): Effects of sewage sludge treatments on aggregates slaking, clay dispersion, and hydraulic conductivity of a semi-arid soil sample, Geoderma 59, 327.

Allam, E.H. (1999). Studies on production of organic fertilizers from some sugar crops wastes and their effects on reclamation of sandy soils. M. Sc., Thesis, Fac. Agric. Moshtohor, Zagazig Univ.

Aziz, M.A.; Sallam, M. F.A.; El-Gendy, A.M. and Abd El-Moniem, M. (1998): Effect of natural soil conditioners and irrigation conditions on some chemical properties of sandy soils of Inshas and cucumber yield. Egypt. J. Soil Sci. 38 (1 – 4): 377 – 411.

Barsoom, S.W. (1998): Effect of moisture on nutrient content in new reclaimed soils during the decomposition of organic manure. Egypt. J. Soil Sci. 38 (1 – 4): 55 – 67.

Elsharawy, M.A.O.; Aziz, M.A., and Ali, L.K.M. (2003): effect of the application of plant residues composts on some soil properties and yield of wheat and corn plants. Egypt. J. Soil Sci. 43, (3): 421 – 434.

El-Zaher, H.; Elmeniesi, A.I.A.; Zaki, R.N. and Mohammedain, A.A. (2004): Comparative study on saw-dust and farmyard manure with combination of N sources in relation to sugar beet and maize dry matter and their chemical compositions. 7th Noational Conference on New Approaches In Soil Technology. ESSS, December, 27 – 28, (2004); Cairo, Egypt.

Fine, P.; Mingelrin, U. and Varon, B. (1983). Nitrogen mineralization in sludge amended soils in to soil type and application rate. (proceeding of the second International symposium: Peat in Agriculture and Horticulture). C.F. Soils & Fert. 48: [10623].

Fresequez, P.R.; Francis, R.E. and Dennis, G.L. (1990): Sewage sludge effects on soil and plant quality in a degraded semi-arid grassland. J. Environ. Qual., 19, 324.

Khamis, M.A. (2000): Evaluation of poultry manure and rice straw as sources of potassium for potato in sandy loam soil. Egypt. J. Soil Sci. 40 (4), 437 - 452.

Klute, A. (ed.) (1986): Method of Soil Analysis. Part I. 2nd Ed. Agron. Monogr.9. ASA, Madison, WI.

Mahmoud, M.M. (1994): Microbiological studies on the management of urban wastes. Ph. D. Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Egypt.

Omar, M. S. (1983): Soil aggregation as affected by management under different cropping system. Egypt. J. Soil Sci. 23 (1), 43.

Page, A.L., Miller, R.H. and Keeney, D.R. (1982): "Methods of Soil Analysis." No. 9 (Part II) in the Series Agronomy. Am. Soc. Agron. Madison. Wis USDA.

Sinha, M.K. (1972): Organic metallic phosphate. IV- The solvent action of fulvic acid on insoluble phosphate. Plant and Soil. 37, 457.

Smith, S.J. and Shrpley, A.N. (1990): Soil nitrogen mineralization in the presence of surface and incorporated crop residues. Agron. J. 82, 122.

Snedecor, G.W. and Cochran, W.G. (1980): Statistical Methods, 6th ed. Iowa State Univ. Press, Iowa, USA.

تأثير إضافة المخلفات الزراعية العضوية على خواص الأراضى الرملية وعلى نمو نبات الذرة والشعير

٢ – محتوى التربة من النتروجين والفوسفور والبوتاسيوم الميسر ونمو نبات الذرة والشعير وإمتصاص العناصر المغذية.

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يهدف البحث إلى دراسة تأثير إضافة بعض مخلفات المزرعة العضوية على المحتوى الميسر من عناصر النتروجين والفوسفور والبوتاسيوم فى الأرض الرملية وعلى نمو كل من نباتات الذرة والشعير النامية عليها وإمتصاصها لبعض العناصر الغذائية. حيث إستخدمت عينة من الطبقة السطحية (صفر – ١٥ سم) لأرض رملية من قرية ميت كنانة محافظة القليوبية ، وقد استخدم كل من سماد الدواجن وقش الأرز المتفحم (قش الأرز المحروق بمعزل عن الهواء) وكمبوست مخلفات بنجر السكر (أوراق + جذور) ومخلفات تصنيع بنجر السكر (Sugar mud; sugar lime) حيث تم إضافتها بمعدل نسب وزنية / وزنية هى ٢ ، ٤ ، ٨ %. والتى تكافئ ١٠ ، ٢٠ ، ٤٠ طن للفدان لعمق ٣٠ سم وقد تم إجراء تجربة تحضين تحت ظروف الصوبة أستخدم فيها أصص سعة ٥ كجم ثم أضيفت المواد العضوية تحت الدراسة إلى التربة بكل أصيص ثم رويت الأرض إلى السعة الحقلية وتركت فى فترة تحضين لمدة ٣٠ يوم للسماح بالتحلل الميكروبى للمواد المضافة وتفاعلها مع التربة مع المحافظة على ثبات نسبة الرطوبة قرب السعة المائية. بعد ذلك تم زراعة ٢٠ حبة ذرة صنف (هجين ثنائى طابا ٢) بكل أصيص لمدة ٤٥ يوم ، ثم أعقبها زراعة ٢٠ حبة شعير صنف (جيزة ١٢٣) فى نفس الأصص لمدة ٤٥ يوم أخرى مع المحافظة على نسبة الرطوبة عند السعة الحقلية طوال هذه المدة.. بعد قطع كل نبات أخذت عينة من التربة للتحليل وتقدير محتواها من العناصر (النتروجين – الفوسفور – البوتاسيوم) الميسرة. تم تجفيف النباتات فى الفرن على درجة ٧٠م° وقدر الوزن الجاف لها وهضم جزء منها لتقدير محتواها من العناصر الممتصة. ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:

١ – أدت إضافة المخلفات العضوية المستخدمة فيما ،عدا قش الأرز المتفحم إلى زيادة محتوى التربة من النتروجين والفوسفور والبوتاسيوم الميسر وكذلك زيادة محصول المادة الجافة لكل من نباتات الذرة والشعير

٢ – أدت إضافة قش الأرز المتفحم إلى خفض المحتوى الميسر من العناصر الغذائية تحت الدراسة بينما حدثت زيادة معنوية فى محصول المادة الجافة لنباتات الذرة وزيادة طفيفة فى محصول المادة الجافة لنباتات الشعير

٣ – ازدادت الكمية الممتصة من العناصر الغذائية تحت الدراسة (النتروجين – الفوسفور – البوتاسيوم – الحديد – المنجنيز – الزنك) بواسطة نباتات الذرة والشعير نتيجة إضافة المخلفات العضوية تحت الدراسة فيما عدا فى حالة إضافة قش الأرز المتفحم والذى أخفض إمتصاصهم بواسطة نبات الشعير فقط.

٤ - أظهرت النتائج أن إمتصاص العناصر المغذية الكبرى بواسطة نباتات الذرة والشعير أخذ إتجاه مشابه تقريبا إلى إتجاه تيسر هذه العناصر فى التربة ، وأن التأثير يبدوا معتمداً على نوع المحسن ومعدل إضافته.

٥ - إتضح من الدراسة أن إضافة المواد العضوية تحت الدراسة إلى الأرض الرملية قد يكون ملائم أو مواتى كما أن هذه المخلفات لها تأثير متبقى مفيد فى زيادة المحتوى الميسر من عناصر النتروجين والفوسفور والبوتاسيوم بالتربة وقد كان التأثير يتوقف على نوع ومعدل المادة المضافة. وقد حدثت التأثيرات الأكثر ملائمة عند إضافة كمبوست بنجر السكر وسماد الدواجن خاصة عندما أضيفت بمعدل عالى.

٦ - الإستفادة من هذه المخلفات العضوية فى الأراضى حديثة الإستصلاح أوالأراضى تحت الإستصلاح مثل الأراضى الرملية يؤدى إلى تقليل تلوث البيئة بمثل هذه المخلفات