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Effect of Composted Plant Residues on the Availability of some Nutrients in Newly Reclaimed Soils

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THIS STUDY aims to evaluate the role of two composted plant residue of rice straw and banana residues used in two different soils, *i.e.*, clay and calcareous on available nutrient content (N, P, K, Fe, Mn and Zn). Two heaps of rice straw and banana residues each heap was enriched with some chemical activation up to 4 months. Two soil samples from soil surface layer 0 – 30 cm of two newly reclaimed soils were collected from Noubaria (calcareous one) and Kom Osheem (clay).

A pot experiment was conducted including, the two studied soil types, two sources of organic compost and 8 treatments of different combination of organic manure rates 0, 5 and 10 ton/fed and mineral NPK proportions of their recommended doses 0, 50, 75 and 100%. Wheat (*Triticum aestivum*) was planted till maturity followed with maize (*Zea mays* L.) for 70 days only.

The soil availabilities of N, P, K, Fe, Mn and Zn tended to increase by organic and mineral application high rates when they were in combination. Applying of composts only (C_5M_0 or $C_{10}M_0$) were effective in increasing available nutrients in the soils than mineral fertilizer ($C_0M_{100\%}$). Rice straw compost in clay soil was the best in raising available N while banana residue compost in calcareous soil was the best in case of available P, K, Fe, Mn and Zn. These availabilities were decreased along with time of cultivation (from after wheat to after maize). Calcareous soil type was in more need to compost applications than clay one.

There are many benefits for additions of organic manures, which composted plant residues is one of them, to calcareous and clay soils. Badawi (2003) showed that the addition of composted plant residues to soil led to an increase in the availability of N, P and K. El-Sharawy *et al.* (2003) found that application of rice straw compost to cultivated soil was better in improving available N, P and K than cotton stalks compost application. Basyouny *et al.* (2004) reported that the superiority of compost for increasing the availably N,P and K as compared to mineral fertilizers. El-Sadfy *et al.* (2005) reported that the addition of 5 ton compost to sandy soil had on effect on available phosphorus, but it heightened available potassium. Modaihsh

et al. (2005) found that application of composts at the various rates increased the available P and K in the investigated soil. El-Sebaey (2006) found that NH_3-N, P and K increased with increasing organic manure. Bashandy & Samah (2007) stated out that treating sandy soils with date palm waste compost increased the total-N, available P and K content of post harvest soils as compared with the untreated soils or NPK fertilizers treatments. Taha (2007) found that application of sesame straw composts to sandy soil significantly increased their available N, P and K in the treated soils after harvesting of the two successive crops as compared to control. Mostafa *et al.* (2001) found that application of organic manures consistently increased available Fe and Zn content in two soils. Bonde *et al.* (2004) found that addition of organic residues like wheat straw (5 t/ha), sugarcane trash (5 t/ha), press mud compost (10 t/ha) and farmyard manure (5 t/ha) in vertisol were beneficial in enhancing the availability of micronutrients in soil. Modaihsh *et al.* (2005) showed that application of composts at the various rates increased the available micronutrients (Fe, Mn and Zn) in the tested soil. Hamad *et al.* (2006) showed that integration of composted rice straw plus nitrogen fertilizer increased the availability of Fe, Mn and Zn in the tested soil.

This study aims to evaluate the role of two plant residue composts (rice straw and banana residues) in two different soils (clay and calcareous) on available nutrient contents (N, P, K, Fe, Mn and Zn).

Material and Methods

Two soil samples from the surface layer (0 - 30 cm)of two newly reclaimed soils differ in their chemical and physical properties were taken, one of them was calcareous light textured from Noubaria located at the Cairo-Alexandria Desert Road 70 km to Alex. The another was non-calcareous clay one or what so it can be called tafla from Kom Osheim Research Station Farm at El Fayoum Governorate. Soil samples were air dried, crushed and prepared to physical and chemical property determination as shown in Table 1.

Four hundred kilograms of each of rice and banana plant residues were aerobic composted according to the method described by Abou El-Fadle (1970). Biological and chemical analyses of the two compost are listed in Table 2.

A pot experiment was conducted in a green house including two soil types, two sources of compost and eight treatments of different combinations of organic manure and mineral NPK rates as follow :

(C_0M_0) control, zero organic with zero mineral fertilizer.
(C_5M_0) 5 tons organic with zero mineral fertilizer.
($C_{10}M_0$) 10 tons organic with zero mineral fertilizer.
($C_5M_{50\%}$) 5 tons organic with 50% NPK recommended.
($C_{10}M_{50\%}$)10 tons organic with 50 % NPK recommended.
($C_5M_{75\%}$) 5 tons organic with 75 % NPK recommended.
($C_{10}M_{75\%}$)10 tons organic with 75 % NPK recommended.
($C_0M_{100\%}$) zero organic with 100% NPK, (full recommended).

TABLE 1. Some physical and chemical properties of the tested soils

Characters	Calcareous	Clay
Particle size distribution %		
Clay	25.4	57.45
Silt	15.7	26.56
Fine sand	48.9	15.99
Course sand	9.91	0.50
Textural class	Sandy loam	Clay
Ca Co_3	16.3	6.28
S.P.	33	132
Chemical analysis		
pH (1 : 2.5)	8.55	8.45
EC (dS/m)	7.36	4.48
Soluble ions (mg/100g soil)		
Na	39.8	28.3
K	3.59	1.16
Ca	14.5	4.5
Mg	14.5	9.5
CO_3	--	---
HCO_3	11.4	8.6
Cl	47.0	33.0
SO_4	13.99	2.36
Organic matter (%)	0.45	0.6
Organic carbon (%)	0.26	0.35
Total N (%)	0.12	0.17
C/N ratio	2.2	5.52
Available contents (mg/kg soil)		
N	110	127
P	5.29	4.15
K	246	325
Fe	3.46	8.45
Mn	2.04	5.30
Zn	1.33	1.87

Recommended fertilization dose for wheat according to the new Agricultural Ministry Annual Bulletin were 224 kg/fed ammonium nitrate (33.5% N), 100 kg/fed mono-calcum phosphate mono hydrate (23% P) and 48 kg/fed potassium sulphate (40% K).

Each treatment was replicated 3 times in complete randomized factorial design. The glazed earthenware pot of 30 cm in diameter and 20 cm of length,

were filled with 7 kg of mixture soil–organic compost, sown with wheat (*Tritcum aestivum*) variety Giza 169 on the 15th of November, 2004. On the 20th of May, 2005 to achieve the residual effect of these applications, kernels of maize (*Zea mays* L.) variety Hageen 2 were sown after quick repreparation of each without any new additions. Practical recommended of thinning and irrigation were followed. Soil sample of each pot was taken after wheat and maize harvested for chemical analyses.

TABLE 2. Some chemical properties of the used organic residues.

Character	Rice straw	Banana straw
EC (dS/m)	2.80	1.88
pH	6.70	7.30
Organic matter (%)	64.16	55.38
Organic carbon (%)	37.30	32.20
Total N (%)	1.86	1.78
C/N ratio	20.05	18.08
Moisture content (%)	23.00	27.00
Total contents		
P (%)	0.56	0.59
K (%)	0.99	1.06
Fe (mg/kg)	560	750
Mn (mg/kg)	94	151
Zn (mg/kg)	65	85

Analyses for compost

pH, total soluble salts, total organic mater, organic carbon were determined total nitrogen total phosphorus, potassium, iron, manganese and zinc (Brunner & Wasmer, 1978).

For soil

Mechanical analysis Soil organic matter content of Walkley and Black method, Calcium carbonate, pH value, EC, available nitrogen available phosphorus, available potassium, in the soil ; (Page *et al.* ,1982) and available micronutrients of Fe, Mn and Zn ; (Lindsay & Norvell, 1978).

The obtained data were statistically analyzed according to the methods described by Snedecor & Cochran (1971) using computer M. Stat Program.

Results and Discussion

Soil available N

Data of available nitrogen in soil after wheat and maize plants cultivated in clay and calcareous soil were presented in Fig. 1. The values of available

nitrogen in soil after wheat in clay soil increased significantly more than calcareous one, as well as when used of rice compost as compared with banana one, also $C_{10}M_{75\%}$, more than others and increased available N by two fold of control and one and half fold of C_0M_{100} treatment.

All treatments of each compost (rice or banana) were the same in their significant in clay soil and represented superior to those of calcareous, also $C_{10}M_{75\%}$ treatment of each above compost was superior compared to others, but that treatment was more effect in clay soil on the available N.

The values of soil available N after maize cutting as a residual effective more or less followed the same trend of those concern after wheat season with very sharp depression reached to less than one third of wheat season values. This results presented in (Fig.1). Obtained results were recorded by Basyouny *et al.* (2004); El-Sedfy *et al.* (2005) and El-Sebaey (2006).

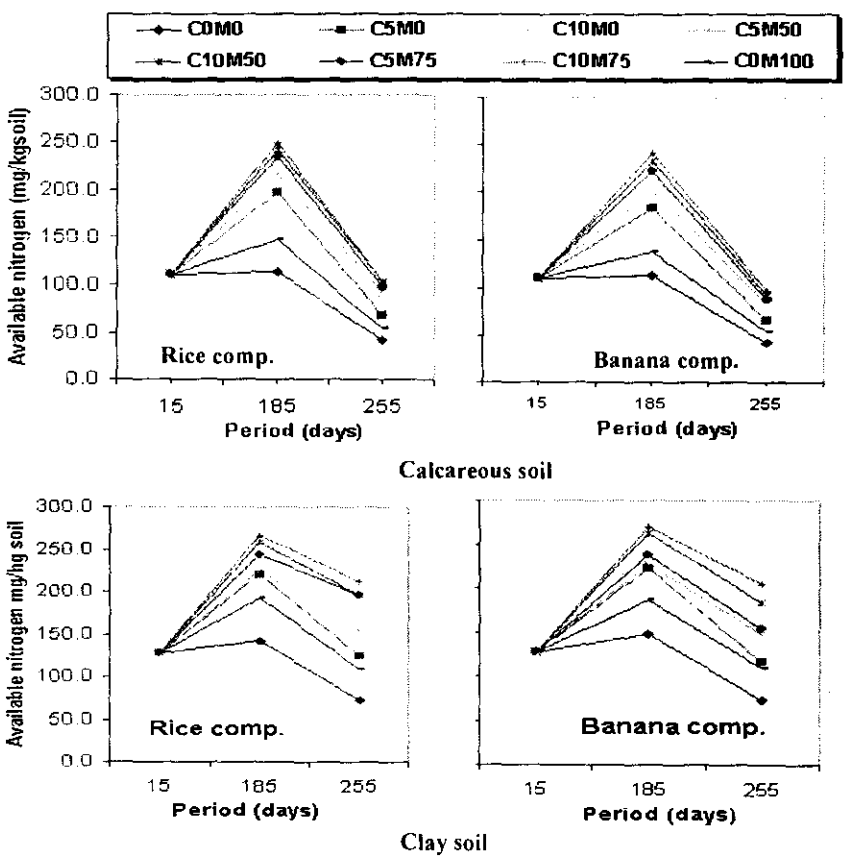

Fig. 1. Available N in soil after wheat and maize as affected with different manuring treatments.

Soil available P

There was significant difference in the available P in calcareous soil higher than clay one, and the values increased with banana compost more than in case of rice, also $C_{10}M_{75\%}$ was the best treatment significantly and increased available P by six fold of control and four fold of C_0M_{100} treatment.

Banana compost in calcareous soil gave the highest values of available P. From other wise $C_{10}M_{75\%}$ of banana compost gave the highest P values in both soils. The same rate ($C_{10}M_{75\%}$) of rice straw compost produced similar high P values in calcareous soil. Similar results were obtained by Basyouny *et al.* (2004) and El-Sebaey (2006).

The values of available P in soil after maize cutting as a residual effect of the used treatments followed the same trend of wheat season (Fig. 2).

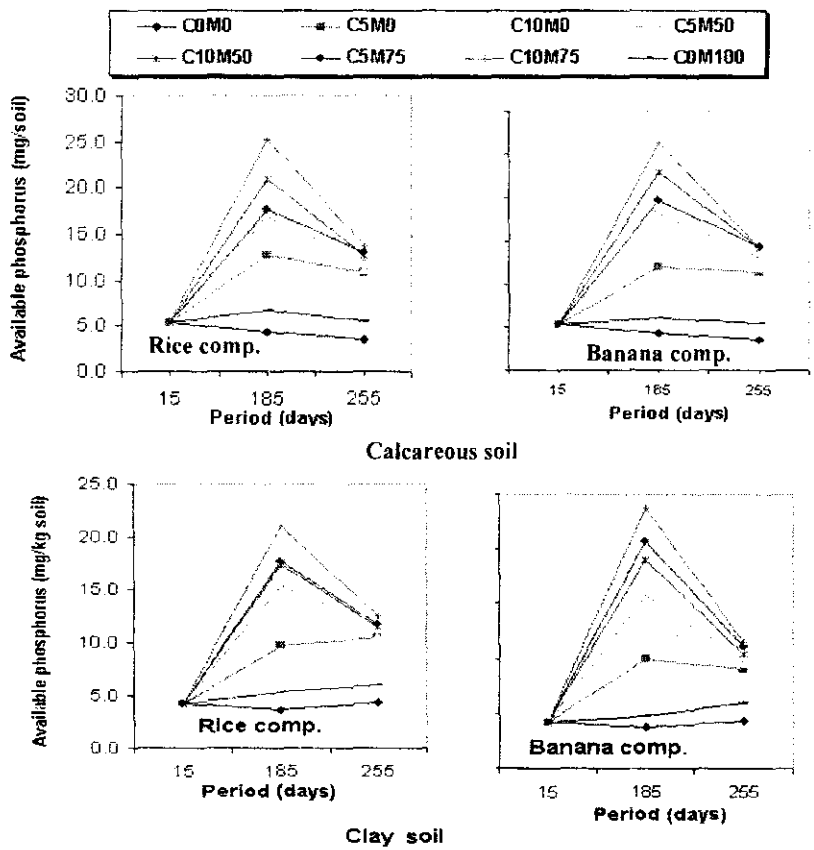

Fig. 2. Available phosphorus in soil after wheat and maize as affected with different manuring treatments.

Soil available K

The available K in calcareous soil was higher than that of clay one, also banana compost increased K significantly more than rice compost. Also, there were significant differences among all treatments, and $C_{10}M_{75\%}$ was the best one and represented two fold of control and one and half fold of C_0M_{100} treatment. Concerning the all interactions were of significant effects among each other due to the effects of the individual factors presence. Similar results were obtained by Basyouny *et al.* (2004) and El-Sebaey (2006).

The values of available K in soil after maize cutting as a residual effect of the used treatments followed the same trend of wheat season, also $C_{10}M_{75\%}$ increased the same fold as above of wheat (Fig. 3).

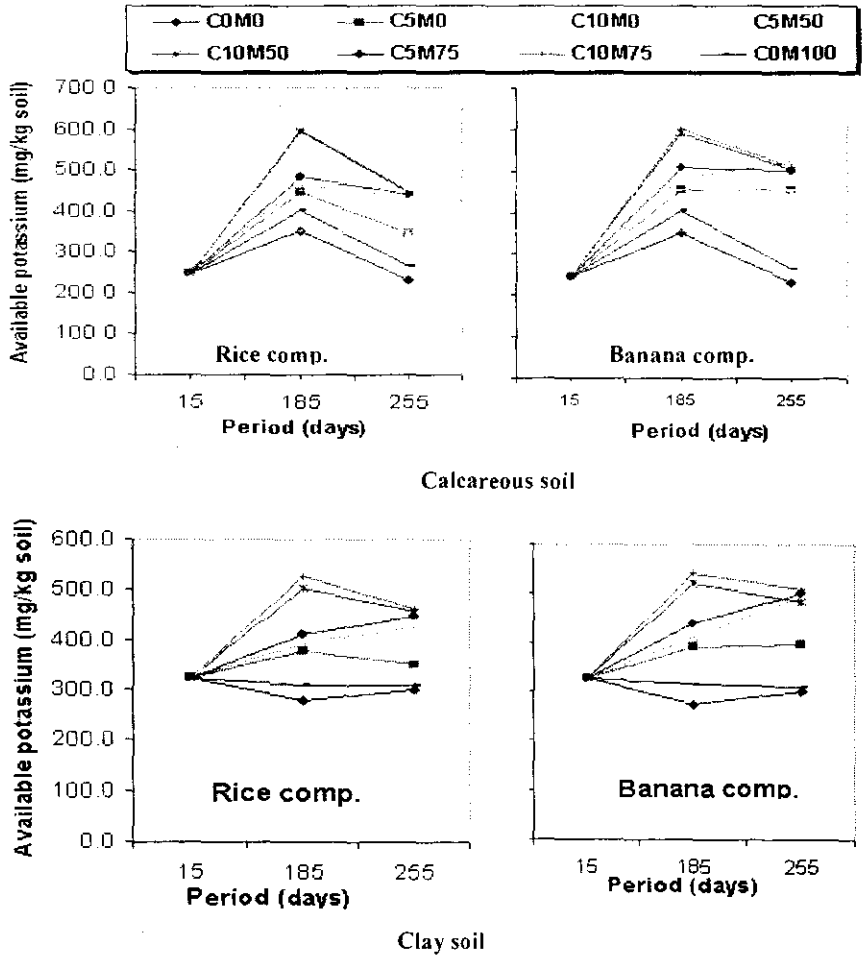

Fig. 3. Available potassium in soil after wheat and maize as affected with different manuring treatments.

Soil available Fe

Available Fe was affected by organic manure application or with mineral fertilizer, where the clay soil was significantly higher than calcareous one. The available Fe was increased with banana residues compost application superior than rice compost. Increasing treatments of compost application revealed significant difference among rates, where the $C_{10}M_{75\%}$ rate was better than others, which increased by three folds of either control or the treatment just used mineral fertilizer with zero compost, while $C_5M_{75\%}$ and $C_5M_{50\%}$ were the same.

As for all the interactions effects of combination of soil-compost, soil-treatments, or compost-treatments had followed the same trend of their individual factors, in addition to that, the treatments of rice and banana compost had the same effect on available Fe. These results were agree with Modaihsh *et al.* (2005) and Hammad *et al.* (2006).

Values of soil available Fe after maize cutting as a residual effect followed the same trend of wheat season with exception that treatments of $C_5M_{50\%}$ and $C_{10}M_{50\%}$ were semilar and better than others. with respect to the combined interaction of all used factors, the treatment of $C_5M_{50\%}$ of banana compost in calcareous soil was higher than others (Fig. 4).

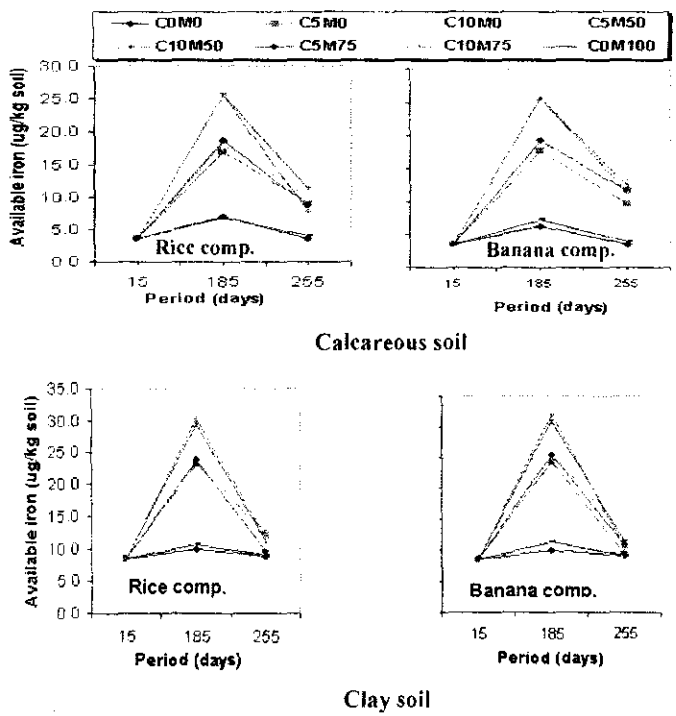

Fig. 4. Available iron in soil after wheat and maize as affected with different manuring treatments .

Soil available Mn

Available Mn in clay soil was significantly better than calcareous one, also, banana compost was higher than rice one. The values were increased significantly by increasing treatment, where the $C_{10}M_{75\%}$ was the best one, which relatively increased by two folds of either control or the treatment just used mineral fertilizer with zero compost.

The combined interaction of soil-compost, followed the same trend of individual factors. Also the soil-treatments, data showed that values of available manganese increased significantly by increasing rates, whereas $C_{10}M_0$, $C_{10}M_{50\%}$ and $C_{10}M_{75\%}$ in clay soil were statistically the same and higher than others. These results were agree with Modaihsh *et al.* (2005) and Hammad *et al.* (2006).

The values of available Mn in the soil after maize cutting as a residual effect followed the same trend of wheat season (Fig.5).

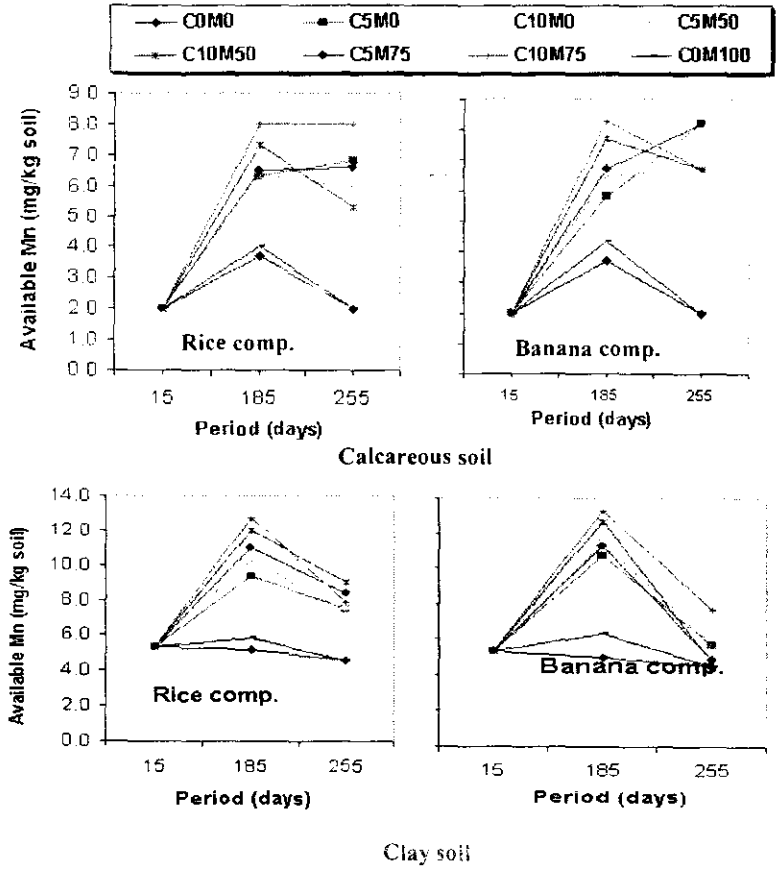

Fig. 5. Available Mn in soil after wheat and maize as affected with different manuring treatments.

Soil available Zn

The values of available Zn in the clay soil were higher than calcareous one, as well as with banana compost than rice compost. Also, they were increased by increasing the application treatments, where those had 10% compost whatever mineral fertilizer added, the available Zn was the highest.

Just the combined interactions of soil-treatments were significant whereas $C_{10}M_{50\%}$ and $C_{10}M_{75\%}$ were the same and superior treatments. These results were agree with Modaihsh *et al.*(2005) and Hammad *et al.* (2006).

The values of available Zn in the soil after maize cutting as a residual effect followed the same trend of wheat season (Fig.6).

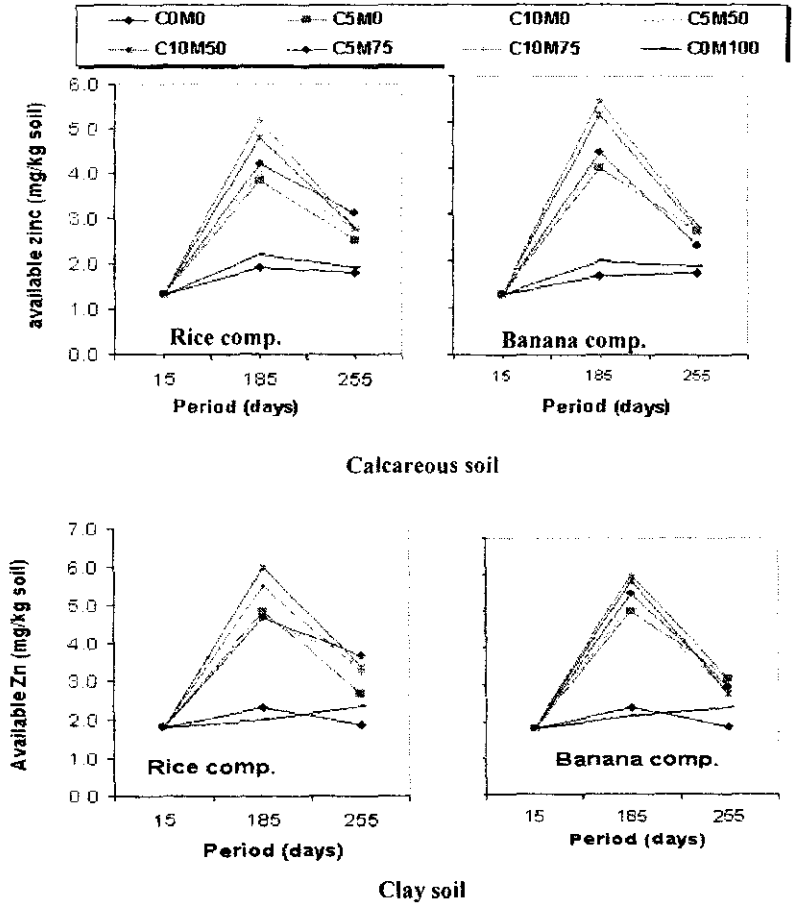

Fig. 6. Available zinc in soil after wheat and maize as affected with different manuring treatments.

References

Abou-El-Fadle, M. (1970) Organic Fertilizers. Cairo, El-Saada Press (in Arabic).

Bashandy, Samah S.O. (2007) Recycling of Date palm Wastes as a Source of Organic Fertilizer. *M. Sc Thesis*, Fac. Agric., Minia Univ., Egypt.

Basyouny, El.A.; Gawish, Sh.M. and Behairy, S.S. (2004) Response of plants grown on sandy soil to organic and mineral fertilization. *Egypt J. Appl. Sci.* **19** (3): 375-387.

Badawi, F.Sh.F. (2003) Studies on bio-organic fertilization of wheat under newly reclaimed soils. *Ph. D. Thesis*, pp. 917-934, Fac.Agric., Cairo Univ., Egypt.

Bonde, A.N.; Karle, B.G.; Deshmukh, M.S.; Tekale, K.U. and Patil, N.P. (2004) Effect of different organic residues on physico-chemical properties of soil in cotton – soybean –intercropping in vertisol. *J. Soils Crops* **14** (1): 112-115.

Brunner, P. H. and Wasmer, H.R. (1978) Methods of analysis of swage sludge, solids wastes and compost. WHO international reference center for wastes disposal. CH-8600 Dubendorf, Switzerland.

El-Sebaey, M.M. (2006) Effect of Inorganic, Organic and bio-fertilizer on wheat plant grown in new cultivated land.

El-Sedfy, O.F.; Bioumy, A.M.M. and Badawy, A.A. (2005) Response of maize to bio, organic and nitrogen fertilization in sandy soil. *Egypt. J. Agric. Sci.* **20** (11): 269-284.

El-Sharawy, M.A.O.; Aziz, M.A. and Aliy, L.k. (2003) Effect of the application of plant residues compost on some soil properties and yield of wheat and corn plants. *Egypt. J. Soil Sci.* **43**(3): 421-434.

Hammad, S.A.; El-Hamdi, K.H.; Ghanem, S.A. and Naeem, E.S. (2006) Impact of rice straw on availability of some nutrient elements in flooded rice soils. *J. Agric. Sci. Mansoura Univ.* **31** (6): 4007-4015.

Lindsay, W.L. and Norvell, W.A. (1978) Development of DTPA soil test for zinc, iron, manganese and copper. *Soil Sci. Soc. Amer. J.* **42** : 421-428.

Modaihsh, A.S.; Taha, A.A. and Mahjoub, M.O. (2005) Impact of some compost on wheat plant grown in calcareous soils. *J. Agric. Sci., Mansoura Univ.* **30** (12): 8313-8321.

Mostafa, M.A.; Gawish, Sh.M. and Basyouny, E.A. (2001) Effect of enriched organic manures with Fe and Zn on the availability of Fe and Zn in newly reclaimed soils. *Minufiya J. Agric. Res.* **26** (6): 1667-1680.

Page, A. L.; Miller, R.H. and Kenney, D.R. (1982) "*Methods of Soil Analysis Soil Sci.*" Amer. Madison ,Wisconsin, U.S.A.

Snedecor, G.W. and Cohran, W.G. (1971) "*Statistical Methods*". 7th ed., lowa State Univ. Press. Ames.

Taha, M.B. (2007) Recycling of Organic Wastes for Using as Soil Amendments. *Ph. D. Thesis*, Fac. Agric., Al-Minia Univ.

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تاثير المخلفات النباتية المكمورة على تيسر بعض العناصر فى الأراضى المستصلحة حديثاً

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تهدف هذة الدراسة الى تقييم دور نوعين من المخلفات النباتية قش القمح ومخلفات الموز فى نوعين من الأراضى جيرية وطينية على المحتوى الميسر من العناصر(نتروجين، فوسفور، بوتاسيوم، حديد، منجنيز، زنك). حيث تم عمل مكمورة لكل مخلف حيث أضيف لهما مخلوط منشط كيماوى مع السماد البلدى ورطبت بالماء وتركت لمدة أربعة اشهر. كما تم اخذ عينات تربة من الطبقة السطحية من اراضى الأستصلاح (جيرية) من النوبارية وطينية (طفلة) من كوم اوشيم بالفيوم. وقد أقيمت تجربة اصص فى صوبة قسم تغذية النبات بمعهد بحوث الاراضى والمياة استغرقت موسمين زراعيين الأول موسم شتوي زرع فية نبات القمح (*Triticum aestivum*) حتى وصل الى مرحلة النضج ، والثاني موسم صيفي (تأثير المتبقيات) زرع فية نبات الذرة الشامية (*Zea mays* L.) لمدة ٧٠ يوم فقط، متضمنة نوعين من الأرض ونوعين من المكمور وثمانية معاملات خلط (مكمور+سماد معدنى) وأن معدلات المكمور هى صفر، ٥ ، ١٠ طن/فدان وان معدلات السماد المعدنى هى صفر، ٥٠، ٧٥، ١٠٠٪ من الموصى به. وتم تحليل التربة بعد كل تجربة وقدر الميسر من النتروجين،البوتاسيوم، الفسفور، الحديد، المنجنيز والزنك.

ويمكن تلخيص النتائج المتحصل عليها كما يلى :

حققت معاملة الأرض بالسماد العضوي المكمور سواء كان منفردا أو متحدا مع الأسمدة المعدنية زيادة ملحوظة في محتواها من العناصر الغذائية مثل النيتروجين، الفوسفور، البوتاسيوم، الحديد، المنجنيز والزنك وذلك بزيادة معدلات الإضافة من الأسمدة العضوية والمعدنية كما أن زيادة السماد العضوي فقط أدى إلى زيادة ملحوظة في تيسر هذه العناصر مقارنة بالتسميد المعدني فقط وأن إضافة مخلفات قش الأرز في الأرض الطينية أدت إلى زيادة تيسر النيتروجين، بينما إضافة مخلفات الموز في الأرض الجيرية كانت أفضل في تيسر عناصر الفوسفور، البوتاسيوم، الحديد و المنجنيز بينما تساوى المخلفان فى نوعى الأراضى فى تيسر الزنك . وهذه الزيادات فى عينات التربة بعد زراعة القمح. ولكن بعد زراعة الذرة الشامية فأن التيسر سلك نفس المسلك السابق مع انخفاض التركيزات.