UTILAZATION OF RICE STRAW AND TWON REFUSE COMPOSTS FOR IMPROVING SOIL PROPERTIES UNDER WHEAT AND CORN CROP YROTATION

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ABSTRACT

The objective of this investigation was to study the effect of organic amendments from composted rice straw and composted town refuse alone and combined with urea on some soil properties, yields and nutrients uptake of wheat (Sakha 94) and corn (Giza 352) cropping sequence. Two field experiments were conducted in the experimental farm of Sakha Agric. Res. Station. The obtained results showed a positive benefits for improving **the soil characteristics under study due to the applied composts as follows :**

1- Soil organic matter content was increased, while ECe values were reduced. pH values showed slight decrease.

2- In the first season the maximum wheat grain and straw yield were (3658.0 and 4452.5 kg /fed., respectively) when soil was mixed with town refuse (at rate of 30 ton/fed.) combined with urea (at rate of 60 kg /fed). The best 1000 grain weight (41.65 gm) was obtained using composted rice straw at rate of 30 ton /fed. The corresponding values in second season (under Corn cropping) were 3596.2, 6972.0 kg /fed. and 280.03 gm for composted rice straw combined with urea, composted town refuse and composted town refuse combined with urea, respectively. It could be concluded that the best yields were obtained with any of those composts combined with mineral fertilizer.

3- Application of composted rice straw was more effective for increasing available N, P and K in soil in the 2nd season (after corn), while composted town refuse gives an opposite trend.

4- The obtained results indicated a significant increase in NPK uptake under wheat and corn plants, with composts application. Composted town refuse combined with urea which was superior to the other treatments in the 1st season and composted rice straw combined with urea had the superiority in the 2nd season.

5- Available and total amounts (mg/kg soil) of Fe, Mn, Cu, Pb, Ni and Cd was 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- The applicated organic materials increased significantly the concentration of heavy metals in grain and straw of wheat and corn plants, these concentration were in the order : Fe > Pb > Mn > Ni > Cu > Cd. The results showed that Mn, Ni, Cd and Cu concentrations in the grain and straw of wheat and corn plants (except Cu in corn straw) being within the normal range. On the other hand Fe and Pb concentration in the grain and straw of wheat and corn plants and Cu in corn straw being within the critical concentrations range of these elements in plants.

7- Economical examination was carried out by calculating the benefit to cost ratio B/C parameter. The highest profit was obtained when soil was mixed with a half dose (15 ton fed^{-1}.) of composted rice straw combined with urea followed by treatment of a half dose (15 ton fed^{-1}.) of town refuse combined with urea.

INTRODUCTION

Much of the early criticism of inorganic fertilizers ranged from pollution; namely eutrophication of lakes and reservoirs, to the degradation of the soil itself. Excessive fertilizers use have been associated with pollution of both ground and surface water. The primary problem appears to come from nitrates, but other nutrients, including heavy metals, may add to the problems. Large quantities of nitrogen and phosphorus may also move into surface and causes serious problems with algae bloom. That can result in fish kill. Nitrogen usually more as a solution in runoff, but it and phosphorus can remove with erroded soil. 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. 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 corn plants. El-Sharawy *et al.*, (2003) reported that grain yields of wheat and corn plants as well as concentration of N, P, K, Fe, Mn, Zn and Cu either in plants leaves or in grains of wheat and corn 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 an improvements in the values of bulk density, hydraulic conductivity, soil consistance, 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 George (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. Therefore, the main purpose of this investigation was to study the effect of organic amendments from different sources (composted rice straw and composted town refuse) on some soil properties and also on the yield and nutrients uptake by wheat and corn plants.

MATERIALS AND METHODS

The main cereal crops; wheat (*Triticum aestivum* L.) and corn (*Zea mays* L.) were chosen to evaluate the effect of application of rice straw and town refuse 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 during the winter season of (2005) rotated by the summer season of (2006). Wheat (Sakha 94) was planted at November (2005) and followed by corn (Giza 352) cultivation at May (2006) in the same experimental area. The chemical composition of the used organic materials are presented in Table (2). The treatments for wheat were as follows :

1- Control (N- fertilizer as urea) at level of 60 K N/fed in two equal doses.
2- (OM_1), Rice straw compost was mixed with soil at the rate of 30 ton /fed.
3- (OM_1 + N) the soil was treated with rice straw compost at rate of 30 ton/fed and urea at level of 60 kg N/fed.
4- (½ OM_1 + ½ N) half of the mentioned rate in the third treatment wa applied.
5- (OM_2) town refuse compost was mixed with soil at rate of 30 ton /fed.

6- (OM_2 + N) application was conduced using town refuse at rate of 30 ton /fed and urea at level of 60 kg N/fed

7- (1/2 OM_2 + ½ N) half of the mentioned rate in the sixth treatments were applied.

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 corn.

The organic manures were mixed with the soil surface (0-15 cm) before wheat sowing and after wheat harvest the same experimental area was planted with corn without any addition of organic manures. Each treatment was replicated 4 times in completely block randomized design. Wheat and corn grain and straw samples were taken at the harvest, oven dried at 60°C, fine ground and prepared for N, P, K, Fe Mn, Cu, Pb, Ni and Cd analysis. Representative surface (0-15 cm) soil samples were collected from the treated plots after wheat and corn 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 Norvel (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 (1) : Some characteristics of the tested soil

Characteristics	Soil	Characteristics	Soil
pH (1:2.5 soil suspension)	7.52	**Available nutrients mg/kg soil**	
EC dSm^{-1} (soil paste) at 25°	3.04	N	30.5
OM %	1.95	P	8.5
Soluble cations, meq. L^{-1}:		K	416.9
Ca^{++}	13.42	Fe	6.62
Mg^{++}	8.86	Mn	1.86
Na^{+}	7.71	Cu	2.16
K^{+}	1.01	Pb	3.34
Solube anions, meq. L^{-1}		Ni	1.5
CO_3^{--}	-	Cd	0.5
HCO_3^{-}	3.5	**Partical siza distribution**	
Cl^{-}	18.72	Clay	51.30
SO_4^{--}	8.78	Silt	24.90
		Sand	23.8
		Texture class	Clayey

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

Characteristics	Rice straw compost	Town refuse compost
Bulk density g/cm^3	0.50	0.50
Moisture content %	38	41
Ec 1:10 ds/m	1.1	3.75
pH (1 : 10)	7.11	7.57
Organic matter %	43.66	26.2
Organic carbon %	25.38	15.23
C/N ratio	20.63	16.72
Total N %	1.23	0.91
Available nutrients (mg / kg):		
N	475.47	420.42
P	504.00	208.80
K	4401.54	642.16
Fe	10.04	1824
Mn	10.2	4.08
Cu	6.90	9.00
Pb	6.36	9.90
Ni	5.34	5.48
Cd	1.60	2.34
Total heavy metals (mg / kg):		
Fe	72.72	71.36
Mn	88.60	84.60
Cu	63.20	36.00
Pb	114.80	133.00
Ni	94.40	104.20
Cd	18.60	19.9

RESULTS AND DISCUSSION

Effect of composts application on soil organic matter, pH and ECe of soil:

Data in Table (3) showed that soil organic matter content was increased after wheat due to composts application, Such increase was arranged in the following descending order ; $OM_2 > OM_1 > OM_1 + N > OM_2 + N > ½ OM_1 + ½ N > ½ OM_2 + ½ N$. This may be due to presence of available N from urea application in $OM_1 + N$, $OM_2 + N$, $½ OM_1 + ½ N$ and $½ OM_2 + ½ N$ which enhanced the organic matter decomposition. It could be noticed that organic matter percent age of rice straw compost was higher than it in the town refuse compost, but both of them increased the soil organic matter content with the same value. This may be due to the narrow C/N ratio (16.72) of the town refuse compost which exhibited a relative high acceleration for decomposition. Concerning organic matter content after corn harvesting, it was lower than those after 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 corn).

Table (3) : Effect of composted rice straw and town refuse application on some chemical properties of the studied soil after harvesting of wheat and corn

Treatment	After wheat			After corn		
	OM %	Ec $dS\ m^{-1}$	pH	OM %	Ec $dS\ m^{-1}$	pH
1- Control (N)	2.29 e	2.36 a	8.20	1.81	1.34 ab	8.17
2- OM_1	3.44 a	1.92 bc	8.03	3.33	1.40 a	7.98
3- OM_1 + N	3.30 b	2.24 a	8.15	3.05	1.28 ab	8.04
4- ½ OM_1 + ½ N	2.46 d	2.04 b	8.19	2.09	1.28 ab	8.06
5- OM_2	3.45 a	1.85 c	8.09	2.24	1.34 ab	7.98
6- OM_2 + N	2.61 c	2.04 b	8.16	2.58	1.34 ab	7.95
7- ½ OM_2 + ½ N	2.44d	1.62 bc	8.22	2.01	1.21 b	8.1
L.S. D. 5%	0.13	0.03		0.05	0.03	
L. S. D. 1%	0.17	0.04		0.06	0.04	

In this respect, organic matter content of soil after corn harvesting takes an opposite trend. The best organic amendment was recorded with composted rice straw since it increases soil organic matter content up to 3.33%. The corresponding value for composted town refuse was 3.26 which may be due to the wide C/N ratio (20.65) of composted rice straw. These results are supported by Khater *et al.* (2004).

Data in Table (3) shows a slight decrease in soil pH values after wheat or corn harvesting. This may be due to the soil buffering capacity.

Concerning ECe values the obtained results showed that after wheat harvesting ECe values were reduced by 18.64% and 21.61 % due to OM_1 and OM_2 application, respectively as compared with the control (mineral fertilization). This decrease in ECe values may be due to increasing the aggregate stability of the soil as a result of the addition of OM_1 and OM_2 which tends modify poresize distribution bulk density water percolation and decrease of soluble salts. These results are in agreement with El-Ghamry *et al.* (2004).

Effect of composts application on grain yield, straw yield and 1000 grain weight of wheat and corn:

Data presented in Table (4) indicated that application of composted straw (OM_1) and town refuse (OM_2) had a beneficial effect on the studied plants. In the 1st season the maximum values of grain and straw yields were obtained with wheat (3658.00 and 4452.5 kg /fed., respectively), as soil mixed with (OM_2 + N), while the best 1000 grain weight was obtained with OM_1 (41.65 gm). The corresponding values in the 2nd season were obtained with corn (3596.2 , 6972.0 kg /fed and 280.03 gm for OM_1 + N , OM_2 and OM_2 + N respectively).

Table (4) : Composts application and their effect on grain and straw yields and 1000 grain weight

Treatments	Wheat			Corn		
	Grain yield (kg/fed.)	Straw Yield (kg/fed)	1000 Grain weight(g)	Grain yield (kg/fed.)	Straw Yield (kg/fed)	1000 grain weight (g)
1- Control	1884.00 e	2809.80 e	37.25 a	3242.80 bc	5670.0 d	259.80 a
2- OM_1	2038.50 d	3888.68 c	41.65 a	3196.20 c	6510.0 b	272.33 a
3- OM_1 + N	3004.5 b	4181.16 b	39.98 a	3596.20 a	5775.0 d	271.18 a
4- ½ OM_1 + ½ N	2448.00 c	4202.01 b	40.23 a	2926.70 d	4304.0 f	276.97 a
5- OM_2	2332.50 c	3235.01 d	41.45 a	3144.33 c	6972.0 a	277.08 a
6- OM_2 + N	3658.00 a	4452.5 a	39.53 a	3422.30 ab	6332.0 c	280.03 a
7- ½ OM_1 + ½ N	2947.50 b	3216.54 d	37.45 a	2711.85 e	5335.0 e	259.33 a
L.S.D. 5%	138.20	168.78	N.S	179.93	165.11	N.S
L.S.D. 1%	177.87	229.80	N.S	244.98	224.79	N.S

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

It could be concluded that the best yields were obtained with both composts combined with mineral fertilizer. This may be due to the enhancing effect of nitrogen fertilizer on the decomposition of organic manures. These findings are a good in agreement with those obtained by wolf and Snyder (2004). The trends obtained for grain yield of wheat as influenced by the different treatment can be arranged as follows : OM_2 + N > OM_1 + N > ½ OM_2 + ½ N > ½ OM_1 + ½ N > OM_1 > OM_2 > N. The grain yield of corn could be arranged as follows : OM_1 + N > OM_2 + N > N > OM_2 > OM_1 > ½ OM_1 + ½ N > ½ OM_2 + ½ N. However 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.

Effect of composts application on the availability of NPK :

Data in Table (5) revealed that the application of the 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 80.8, 80.0 and 658.9 mg/kg for OM_2 + N, OM_2 and OM_1 + N, respectively after wheat harvesting and up to 96.34 , 91.25 and 694.90 for OM_1 + N after corn harvesting. It was noticed that soil available nutrients contents resulting from the application of composted town refuse was higher in the 1st crop than in the 2nd crop of the rotation, this could be explained by its narrow C/N ratio which causes the rapid decomposition process at first then gradually slow down in at to the first measurement (5 months after wheat harvesting) and at the second measurement (10 months after corn harvest).

Table (5) : composted rice straw and town refuse application and its affect on available nutrients in the soil after wheat and corn harvesting

Treatment	Available nutrients (mg/kg soil)					
	After wheat harvest			After corn harvest		
	N	P	K	N	P	K
1- Control (N)	50.4 d	28.80 e	481.9 c	57.05 d	40.80 f	494.00 d
2- OM_1	42.2 a	68.92 b	594.35 c	68.06 c	78.20 b	710.90 a
3- OM_1 + N	75.60 a	70.70 0 b	658.9 a	96.34 c	91.25 a	694.90 a
4- ½ OM_1 + ½ N	68.6 b	52.00 d	542.77 b	77.32 b	65.10 c	629.30 b
5- OM_2	60.06 a	80.00 a	656.8 a	56.05 d	74.70 b	598.6 c
6- OM_2 + N	80.8 a	64.00 c	654.95 a	76.00 b	57.20 d	584.0 c
7- ½ OM_2 + ½ N	63.12 c	51.2 d	543.4 a	57.04 d	47.10 e	517.2 d
L.S. D. 5%	4.09	2.64	29.62	3.19	3.35	38.55
L. S. D. 1%	5.56	3.60	40.33	4.35	4.56	52.44

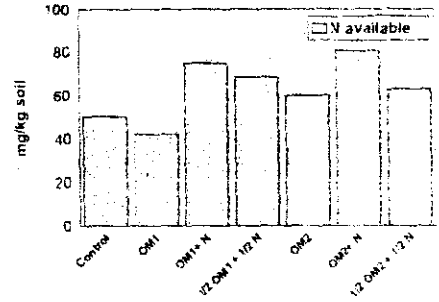
The application of composted rice straw was more effective for increasing available nutrients contents in soil in the 2nd season, this may be due to its wide C/N ratio. These highly levels were interpreted by many others, Metwally and Khamis (1998) stated that organic maturing plays role in increasing the 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.

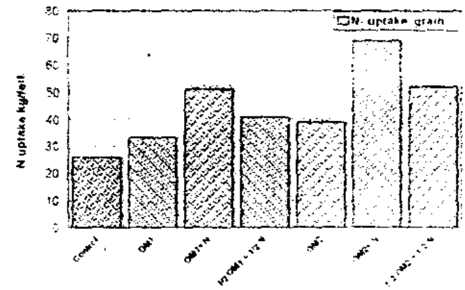
Effect of composts application on NPK uptake :

Date in Fig.1 (a,b and c) , Fig.2 (a, b and c) and Table (6) indicated a significant increase in the uptake of N, P, and K by wheat and corn plants. In the 1st season, such increases ranged between (28 % : 166.5 %), (16.6 % ; 147.6 %) and (16.33 % ; 149.3%) for uptake of N, P and K respectively by wheat grain. It was by wheat straw (53.6 % : 172.3 %), (78.3 : 113.2%) and (42.29 : 67.95) for uptake of N , P and K respectively. In the 2nd season, the corresponding increases ranged between (-7.02 % : 37.05 %), (-16.37 % : 31.30 %) and (- 6.37% : 47.42 %) for uptake of N , P and K respectively by corn grain and (- 13.96 % : 39.37 % :) , (78.31 % : 183.92 %) and (-9.8 % : 34.50 %) for uptake of N, P and K respectively by corn straw. These results prove that (OM_2 + N) and (OM_1 + N) are superior to the other treatments in the 1st and 2nd seasons respectively.

Table (6) : Relative changes % in NPK uptake by wheat and corn plants as affected by composts application.

Treatment	N		P		K	
	Grain	**Straw**	**Grain**	**Straw**	**Grain**	**Straw**
	Wheat					
OM_1	28.00	53.60	16.20	78.30	16.33	42.29
OM_1 + N	97.00	125.00	87.70	113.20	86.60	57.70
½ OM_1 + ½ N	58.00	95.00	40.10	60.70	44.58	52.71
OM_2	50.00	50.50	48.10	106.12	28.45	22.00
OM_2 + N	166.50	172.30	147.6	108.90	149.30	67.95
½ OM_2 + ½ N	101.00	76.10	71.00	88.50	74.14	18.51
	Corn					
OM_1	19.10	39.37	0.81	78.31	4.35	30.60
OM_1 + N	37.05	35.84	31.30	113.26	47.42	25.99
½ OM_1 + ½ N	5.94	-13.96	-.3.61	60.71	-9.76	-9.8
OM_2	13.16	45.51	1.41	106.12	1.52	34.50
OM_2 + N	28.25	32.16	17.65	183.92	9.28	30.52
½ OM_2 + ½ N	-7.02	5.64	-16.37	88.52	-16.40	12.15





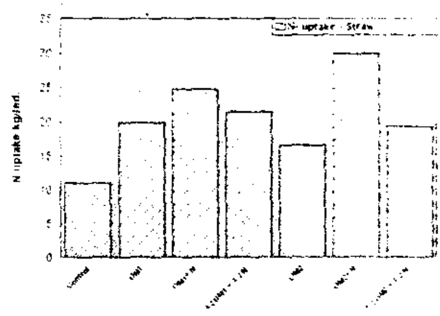
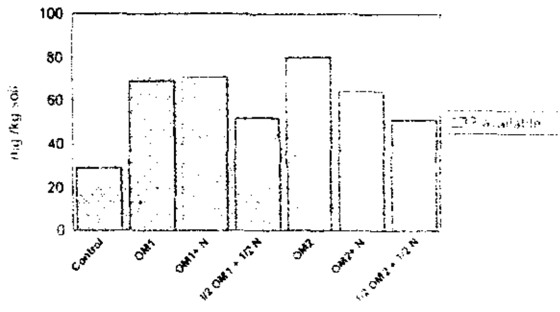
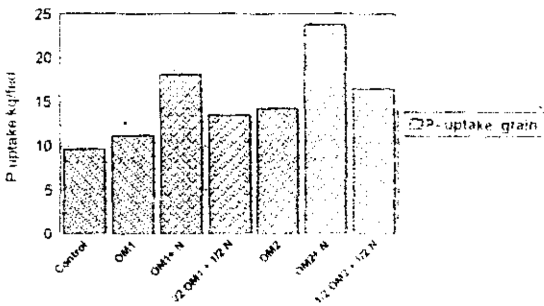


Fig. 1-a : Effect of the application composts and mineral fertilizers on the available N in the soil and their uptake by wheat crop





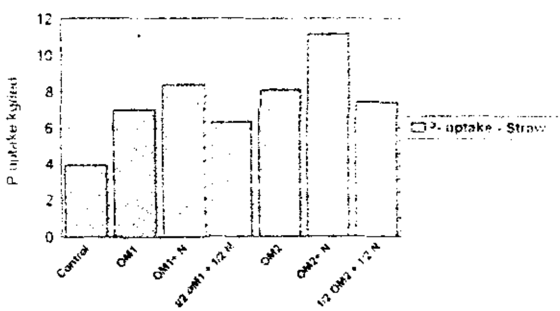


Fig. 1 b: Effect of the application composts and mineral fertilizers on the available P in the soil and their uptake by wheat crop

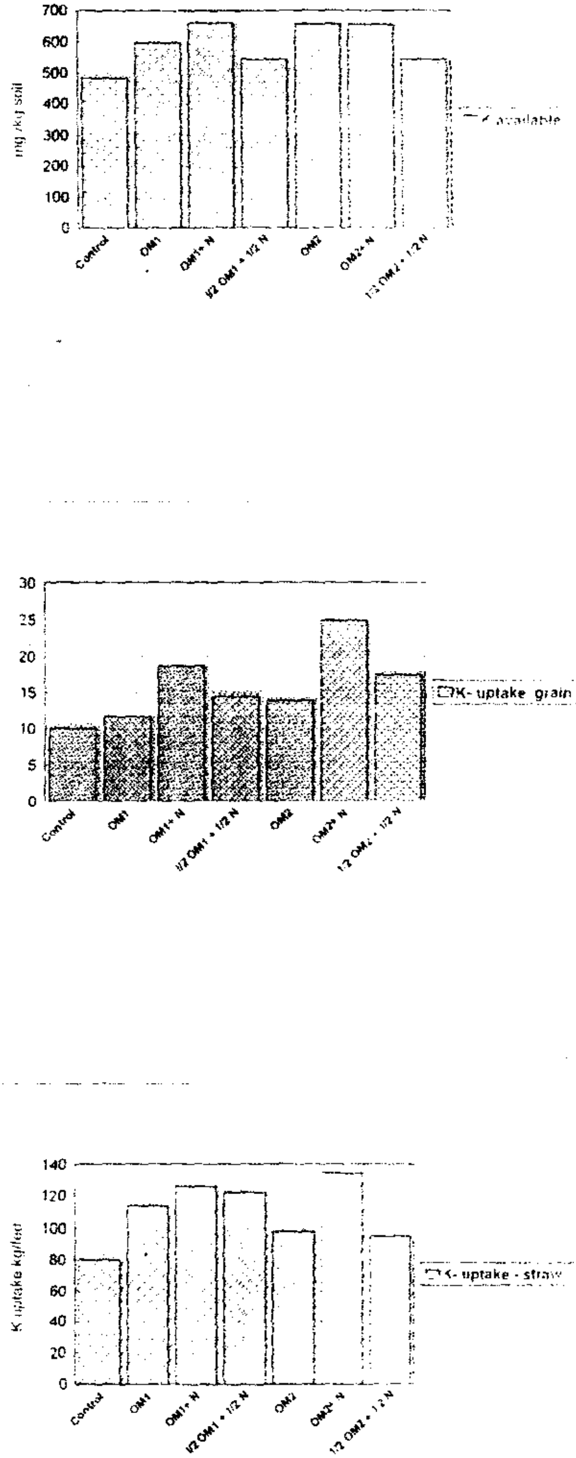


Fig. 1.c: Effect of the application coomposts and mineral fertilizers on the available K in the soil and their uptake by wheat crop

Table (7) : Total heavy metals contents (mg/kg) in the studied soils as affected by composts application after harvesting of wheat and corn

Treatments	Fe	Mn	Cu	Pb	Ni	Cd
	After wheat					
Control	8584	66.00	23.00	43.80	52.00	0.05
OM_1	9154	69.3	40.00	52.4	75.70	0.16
OM_1 + N	9195	75.2	49.00	79.20	96.00	0.18
½ OM_1 + ½ N	9133	71.2	47.3	64.00	88.3	0.09
OM_2	8672	67.0	37.80	60.80	86.00	0.12
OM_2 + N	8913	74.3	43.40	91.60	100.4	0.22
½ OM_2 + ½ N	8682	66.6	42.80	73.00	92.00	0.18
	After corn					
Control	8924	67.4	33.60	51.00	57.00	0.16
OM_1	9128	71.00	52.00	81.20	85.00	0.23
OM_1 + N	9588	75.60	55.20	106.20	99.40	0.25
½ OM_1 + ½ N	9280	72.40	45.80	86.40	96.40	0.20
OM_2	8790	70.80	51.80	84.5	106.00	0.21
OM_2 + N	9035	75.80	53.80	118.60	108.20	0.22
½ OM_2 + ½ N	9008	68.40	51.00	93.40	101.00	0.18

This finding could be, as mentioned before, due to the quality and rapid decomposition of concerned organic amendment, its chemical composition and C/N ratio along with its 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, as shown in Fig. (1, 2). These results could be enhanced by Khater *et al.*, (2004).

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

Treatments	Fe	Mn	Cu	Pb	Ni	Cd
	After wheat					
Control	6.2	4.36	0.39	1.68	0.86	0.005
OM_1	10.60	6.56	0.42	3.42	2.02	0.012
OM_1 + N	14.32	7.4	0.48	7.52	2.38	0.019
½ OM_1 + ½ N	7.50	5.3	0.41	3.92	1.10	0.007
OM_2	12.85	6.32	0.48	7.02	3.04	0.015
OM_2 + N	18.54	5.53	0.60	9.74	3.27	0.024
½ OM_2 + ½ N	9.64	4.74	0.54	6.1	1.42	0.014
	After corn					
Control	4.80	1.18	0.32	1.28	0.52	0.005
OM_1	6.09	1.44	0.38	2.80	1.04	0.015
OM_1 + N	6.40	1.64	0.41	6.50	2.20	0.020
½ OM_1 + ½ N	4.80	1.34	0.38	1.66	1.21	0.012
OM_2	5.52	1.40	0.41	5.32	1.55	0.015
OM_2 + N	8.70	1.56	0.44	7.34	2.46	0.024
½ OM_2 + ½ N	6.00	1.28	0.43	4.90	1.32	0.001

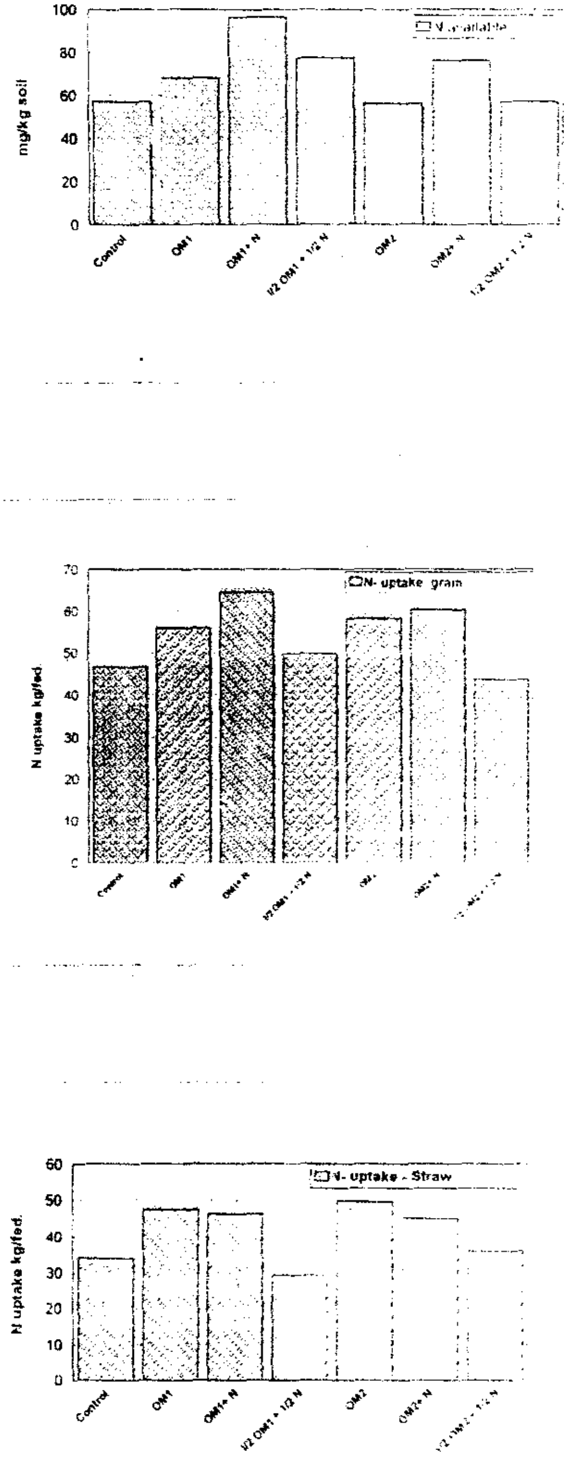


Fig. 2.a : Effect of the application composts and mineral fertilizers on the available N in the soil and their uptake by maize crop

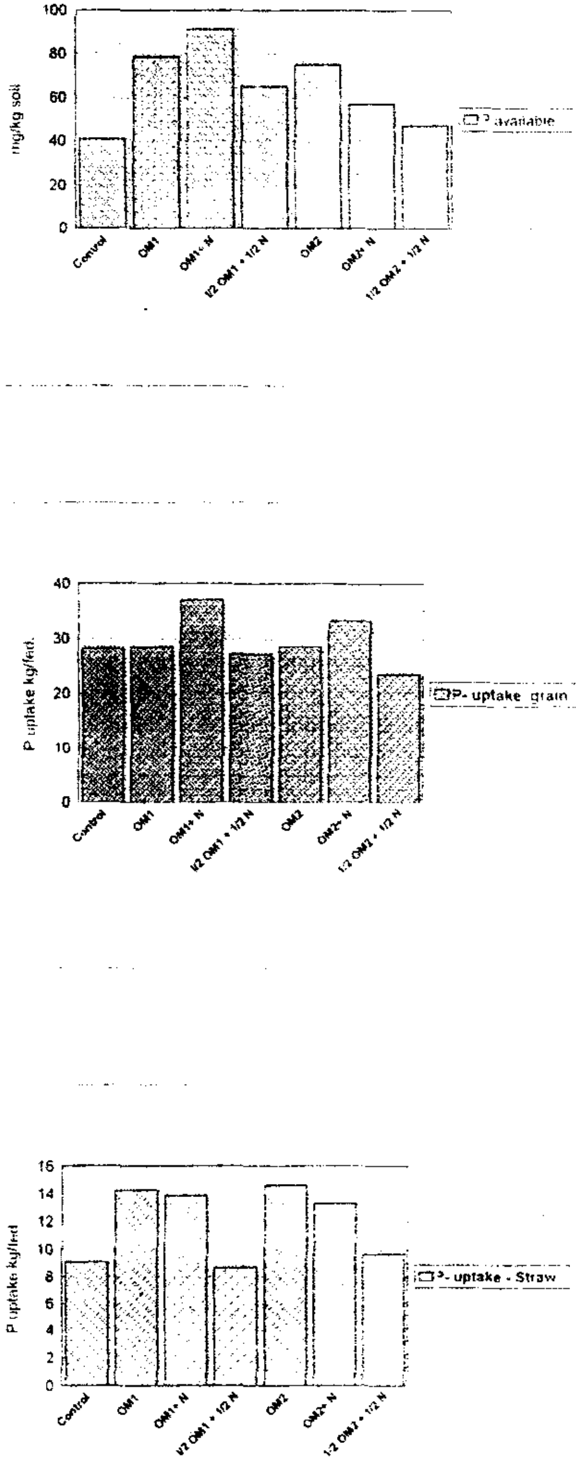


Fig. 2.b: Effect of the application composts and mineral fertilizers on the available P in the soil and their uptake by maize crop

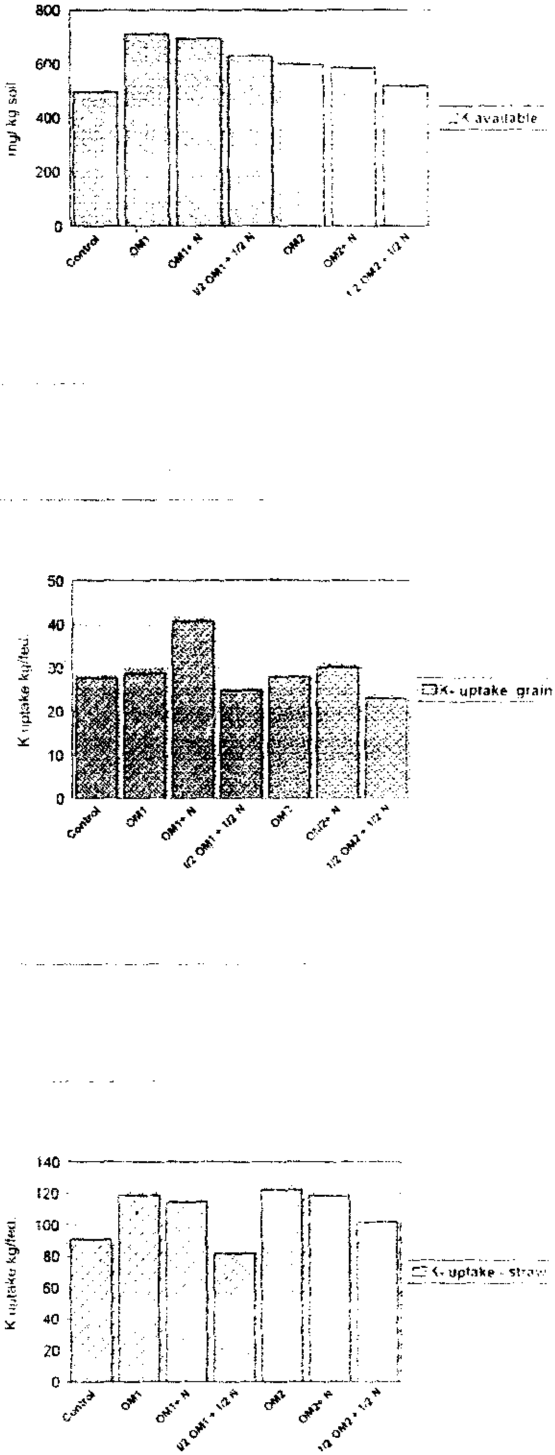


Fig. 2.c: Effect of the application composts and mineral fertilizers on the available K in the soil and their uptake by maize crop

Effect of composts application on total and available amount of Fe, Mn , Cu, Pb , Ni and cd (mg/kg soil) in the studded soils :

Data in Table (7) and (8) showed that the highest values of Fe, Mn and Cu were found in soil treated with composted rice straw combined with urea, while the highest values of pb, Ni, and Cd were found in soil treated with composted town refuse combined with urea, this could be due to the relatively higher content of Fe, Mn and Cu in the composted rice straw as shown in Table (2) and the relatively higher content of pb, Ni and Cd in the composted town refuse. The lowest values were found in control treatment (Chemical fertilizers). Recorded results after the 1st season (wheat) were also the same after the 2nd season (corn) since total heavy metal contents in the soil were increased after the harvesting of corn, which may be due to the rapid oxidation and decomposition of soil organic matter in summer season and the long period of decomposition. Data in Table (7) showed that, the highest values of available Fe, Cu, pb, Ni and Cd were found in the soil treated with composted town refuse combined while urea, while the highest value of available Mn was found in the soil treated with composted rice straw combined with urea. This could be due to the higher Fe, Cu, pb , Ni and Cd availability in composted town refuse than composted rice straw except the high availability Mn composted rice straw. The data showed also that the available heavy metal represent only a small percentage of the total content. These indicate that heavy metals applied to soil 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 contents of available heavy metals is relatively low after the second growth seasons (corn) comparing with the first one (wheat), which could be attributed to the consumption of corn plants from these metals in addition to wheat plants. These results were explained by Srivastava (1996) who concluded that the rapid decomposition of organic matter in the surface horizon may cause microbial fixation of trace element and the consequently decreased of its availability.

Effect of composts application on concentration of Fe, Mn, Cu, Pb, Ni and Cd in wheat and corn plants :

Data presented in Table (9, 10) showed that the application of organic materials significantly increased the concentration of heavy metals in both grain and straw of wheat and corn plants. The concentration of heavy metals in wheat and corn straw are more than its corresponding concentrations in the grains. Heavy metals concentrations in grain and straw of wheat and corn were in the order Fe > pb > Mn > Ni > Cu > Cd.

Results showed also that Mn, Ni, Cd and Cu concentration in grain and straw of wheat and corn plants (except Cu in corn straw) are in the range of normal concentration, while those of Fe and Pb concentration in grain, wheat straw, corn plants as well as Cu in corn 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 – treaded soil dose not necessarily lead to an increase in plant uptake of that element. He stated also that, Cd 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. It is also to note that, under the pH of the studied soil (7.95-8.22), heavy metals are precipitate which in turn affect their availability to plants. However, the low absorption of the amount of elements to of plant roots indicates that these elements are unavailable to the wheat and corn plants under the experimental conditions.

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

Treatments	Fe*	Mn**	Cu**	Pb**	Ni**	Cd**
	Grain					
Control	230.0 c	25.00 e	2.10 f	48.20 d	4.460 d	0.198 d
OM_1	290.0 b	33.90 b	4.30 e	74.16 b	6.450 c	0.340 c
OM_1 + N	340.0 a	38.48 a	6.60 b	89.20 a	5.870 c	0.470 b
½ OM_1 + ½ N	270.0 bc	32.50 bc	5.20 d	74.265 b	6.450 c	0.370 bc
OM_2	340.0 a	29.50 cd	4.80 de	57.633 c	8.800 a	0.390 bc
OM_2 + N	380.0 a	31.30 bc	9.45 a	59.583 c	7.700 b	0.720 a
½ OM_2 + ½ N	280.0 b	28.10 d	5.90 c	50.950 d	7.780 b	0.630 a
L.S.D 5%	46.328	3.047	0.671	5.063	0.827	0.112
L.S.D 1%	63.076	4.148	0.913	6.893	1.099	0.152
	Straw					
Control	359.0 d	38.500 e	20.00 f	122.500 d	6.485 e	0.580 c
OM_1	440.0 c	71.975 ab	28.00 de	137.725 c	8.200 cd	0.955 bc
OM_1 + N	460.0 bc	73.007 a	30.00 c	184.000 a	9.800 b	1.040 ab
½ OM_1 + ½ N	350.0 d	69.995 b	27.00 e	150.000 b	6.895 de	1.180 ab
OM_2	500.0 a	63.500 cd	34.955 b	115.988 e	8.950 bc	1.385 a
OM_2 + N	490.0 ab	65.000 c	41.900 a	150.125 b	11.500 a	1.440 a
½ OM_2 + ½ N	345.0 c	62.045 d	29.500 cd	134.900 c	7.300 de	1.280 ab
L.S.D 5%	37.727	2.325	1.839	5.976	1.398	0.382
L.S.D 1%	51.366	3.165	2.504	8.136	1.984	0.520
Critical cons in plan	300-1000	300-500	20-100	30-300	10-100	5-30

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

Treatments	Fe*	Mn**	Cu**	Pb**	Ni**	Cd**
	Grain					
Control	356.5 f	27.10 f	3.620 e	46.350 e	5.500 e	1.030 d
OM_1	413.0 de	48.00 e	4.920 bc	68.000 c	8.500 c	1.210 c
OM_1 + N	460.2 bc	71.225 a	5.400 ab	98.500 a	9.723 ab	1.350 b
½ OM_1 + ½ N	401.2 e	66.50 b	4.400 d	83.000 b	6.500 d	1.390 b
OM_2	476.0 b	47.20 e	5.500 a	56.200 d	8.900 bc	1.270 c
OM_2 + N	528.0 a	60.90 c	5.700 a	79.250 b	9.990 a	1.470 a
½ OM_2 + ½ N	436.8 cd	54.80 d	4.600 cd	76.400 b	6.700 d	1.430 a
L.S.D 5%	33.725	4.617	0.488	6.755	0.928	0.606
L.S.D 1%	45.917	6.287	0.664	9.197	1.264	0.082
	Straw					
Control	397.8 e	40.625 e	4.200 c	108.700 e	7.500 e	1.580 d
OM_1	417.0 d	87.20 b	4.860 b	128.200 c	8.500 de	2.365 abc
OM_1 + N	486.2 b	96.5 a	5.010 b	152.200 a	14.500 a	1.965 bcd
½ OM_1 + ½ N	401.3 e	91.1 ab	4.800 b	131.000 c	9.700 d	1.843 cd
OM_2	462.8 c	65.1 d	6.200 a	117.300 d	12.500 bc	2.250 bc
OM_2 + N	537.1 a	92.5 ab	6.060 a	136.500 b	13.500 ab	2.948 a
½ OM_2 + ½ N	498.875 b	81.225 c	5.220 b	120.000 d	11.80 c	2.590 ab
L.S.D 5%	15.533	5.384	0.438	3.692	1.453	0.589
L.S.D 1%	21.149	7.330	0.596	5.027	1.978	0.802
Critical cons in 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).***

Economical evaluation :

The economic evaluation carried out based on the benefit (B) to cost (C) ratio (B/C) for each material type Table (11). The data show that the B/C ratio was in the order of ½ OM_1 + ½ N > ½ OM_2 + ½ N > OM_2 + N > OM_1 + N = Control > OM_1 > OM_2 . therefore, (½ OM_2 + ½ N) treatment gave the highest profit followed by (½ OM_2 + ½ N) ones.

Table (11) : 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
Control	738	6458	1348	7806	7068	9.58	4
OM_1	786	6571	1866	8437	7087	9.02	5
OM_1 + N	894	8200	2006	10206	8568	9.58	4
½ OM_1 + ½ N	672	6676	2016	8692	7648	11.38	1
OM_2	786	6863	1552	8415	7065	8.99	6
OM_2 + N	894	8709	2137	10846	9208	10.30	3
½ OM_2 + ½ N	672	6955	1543	8498	7454	11.09	2

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الملخص العربي

الإنتفاع بمكمورات قش الأرز ومخلفات المدن فى تحسين خواص الأرض تحت نظام تعاقب القمح والذرة

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أقيمت تجربتان حقليتان فى المزرعة البحثية بمحطة البحوث الزراعية بسخا لدراسة تاثير إضافة المواد العضوية من مصادر مختلفة (مكمورة قش الأرز ومكمورة مخلفات المدن) منفردة أو مع إضافة اليوريا على خواص الأرض وإنتاجية محصول القمح (صنف سخا ٩٤) والذرة (صنف جيزة ٣٥٢) ومحتواهما من العناصر الغذائية ، وقد أكدت النتائج التأثير النافع للمواد العضوية المستخدمة كما يلى :

١- أدت إضافة المادة العضوية إلى زيادة مادة الأرض العضوية وإنخفاض الـ ECe بينما كان إنخفاض الـ pH ضئيلا.

٢- فى الموسم الأول (القمح) معاملة الأرض بمكمورة مخلفات المدن (٣٠ طن /فدان) مخلوطة مع يوريا (٦٠ كجم / فدان) أعطت أعلى محصول حبوب

وقش (٣٦٥٨,٠ ، ٤٤٥٢,٥ كجم / فدان) بينما أعلى قيمة لوزن الألف حبة كان (٤١,٦٥ جم) عند معاملة الأرض بمكمورة قش الأرز (٣٠ طن / فدان) وأعلى محصول قش (٦٩٧٢,٥ كجم / فدان) وأعلى وزن ١٠٠ حبه (٢٨٠,٠٨ جم) عند معاملة الأرض لمكمورة قش الأرز مخلوطة باليوريا ومكمورة مخلفات المدن ومكمورة مخلفات المدن مخلوطة باليوريا على التوالى وبنفس المعدلات المذكورة فى الموسم الأول.

٣- مكمورة قش الأرز كانت الأكثر فاعلية فى زيادة الـ NPK المتاح فى الأرض فى الموسم الثانى (بعد الذرة) بينما مكمورة مخلفات المدن كانت أكثر فاعلية فى الموسم الأول (بعد القمح).

٤- معاملة الأرض بمكمورة قش الأرز ومخلفات المدن أدت إلى زيادة إمتصاص نباتات القمح والذرة لعناصر NPK حيث كان فى الموسم الأول (القمح) أعلى قيم إمتصاص لهذه العناصر عند معاملة الأرض بمكمورة مخلفات المدن مخلوطة باليوريا بينما فى الموسم الثانى (الذرة) كان أعلى إمتصاص من هذه العناصر عند معاملة الأرض بمكمورة قش الأرز مخلوطة باليوريا.

٥- محتوى الأرض الكلى والميسر (Available) من الحديد والمنجنيز والنحاس والرصاص والنيكل والكادميوم . زاد عند معاملة الأرض بالمخلفات العضوية المختلفة وقد وجد أن تركيز العناصر الثقيلة الميسر ضئيل جداً بالنسبة للتركيز الكلى مما يدل على أن عند إضافة العناصر الثقيلة للتربة تمتص بقوة على مواقع availability, non exchangeable لهذه العناصر نتيجة إضافة مكمورة المخلفات العضوية المختلفة أخذت الترتيب التنازلى الآتى : الحديد > المنجنيز > الرصاص > النيكل > النحاس > الكادميوم.

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

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

٧- تم عمل تقييم إقتصادى نتيجة حساب B/C (benefit to cost ratio parameter) وكان أعلى Profit (١٥ طن / فدان) مخلوطة باليوريا (٣٠ كجم / فدان) يليها معاملة نصف جرعة من مخلفات المدن (١٥ طن / فدان) مخلوطة بيوريا (٣٠ كجم / فدان).