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EFFECT OF SOME ORGANIC AND MINERAL AMENDMENTS SOURCES ON CHEMICAL AND BIOLOGICAL SOIL PROPERTIES UNDER DIFFERENT MOISTURE CONTENTS

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ABSTRACT

The main objective of this investigation is to comparative the effect of treating the soil with different types of biogas manure (BMC, BMW and BMI), compost manure (CMP) and mineral fertilizer (MFT) under two levels of soil moisture. Each was added at a rate of 2% (20 g/ Kg soil) and the mineral fertilizer involved 85 mg N + 20 mg P + 40 mg K/ Kg soil using sandy, calcareous and clay soils. Incubation was performed to investigate the availability of some macro and micronutrients (P, Fe, Mn, Zn, and Cu), NH_4-N, NO_3-N, Organic matter, CO_2 evolved from the soil and pH values after periods of 0, 15, 30, 60 and 120 days. Organic manures increased soil organic matter, DHA and CO_2 evolved to values higher than the initial ones. There was a gradual and consistent decreased in pH as a result of adding organic manures. All organic substances as well as mineral fertilizers increase NH_4-N, NO_3-N, and availability of P, Fe, Mn, Zn and Cu. The effect of organic sources was more pronounced than mineral fertilizer. Increasing the moisture content from 75 to 100% of field capacity increased the organic matter percentage, CO_2 evolved from the soil, NH_4-N, NO_3-N and available of P, Fe, Mn, Zn and Cu. Available P, Fe, Mn, Zn and Cu in the clay soil greatly exceeded those of the other soils.

INTRODUCTION

Organic manures increase the soil organic matter and hence improve their physical, chemical and biological properties of many soils. Consequently, availability of nutrients for plant will be increased. The biological activity induced by the organic matter has the potential to antagonize root diseases and supply different growth factors. The organic manures as fertilizer would lead to decreasing soil pH which results in increasing solubility of nutrients and nutrient availability to the plants. Poonia *et al.* (1986) concluded that the effect of organic manure on availability of macro and micronutrients is dependent on the nutrient concentration, the nature of applied manure and the soil type. Such manures stimulate biodegradation through increasing the population and activities of microorganisms in the soil (Amara and Dahdoh, 1995). On the other hand, low fertility soils would benefit from application of organic materials. Organic materials in some cases may act as a slow release fertilizer (Abd El – Sabour *et al.*, 1999).

Several investigators showed that application of organic manures increased the availability of soil macronutrients i.e. N, P and K (Salam *et al.*, 1996; El–Ghozoli, 1998; Badran *et al.*, 2000 and El–Emam, 2002). Also the availability of micronutrients i.e. Fe, Mn, Zn and Cu is improved upon addition of organic manures (Abd El – Hamied, 1996, Salam *et al.*, 1996 and Basyouny, 2001).

With respect to the effect of organic manure on some soil chemical properties, Pearson *et al.* (1998) in two trials on a Levin silt loam soil found that applying waste compost at 300 tons ha^{-1} increased soil organic carbon content from 2.7% in the control to 3.6%. El–Emam (2002) reported that organic matter percentage increased upon application of organic manures (chicken and farmyard manures) combined with or without biofertilizers to soils (sandy, calcareous and clayey). Basyouny (2001) found that that application of farmyard manure or chicken manure to calcareous and noncalareous soils decreased the soil pH values at different stages of growth.

Regarding to the effect of organic manure on activity soil microorganisms, Mostafa (1994) mentioned that the microbial activity and CO_2 evolution reached high levels in calcareous soil compared with a sand soil in organic manured soil than soils receiving mineral fertilizers. El-Badawy (1997) reported that the rate of CO_2 evolved in soil increased with increasing growth period and gave the highest values at 60 days and decreased thereafter. Also, CO_2 evolved reached the highest values in case of biogas manure application at a rate of 100 kg N fed^{-1} *combined* with mycorrhizal strain. El–Shimi (1998) recorded that the N – supplements either in the form of chemical fertilizer or organic manuring (farmyard manure or biogas manure) increased the microbial respiration and CO_2 evolved from the clay soil.

The present work was carried out to study nutrient release from sandy, calcareous and clayey soils incubated with different types of biogas manure, compost manure and mineral fertilizers under two levels of field capacity. The study aimed also at investigating the changes that take place in some chemical and biological properties of the studied soils due to manuring.

MATERIAL AND METHODS

The current investigation is a trial aiming at throwing light on the effect of some types of biogas manure which produced from different organic residues, compost manure and mineral fertilizer on some macro and micronutrients status as well as the organic matter content, pH values and CO_2 evolved in the three different textured soils. The materials and procedures followed to fulfill the purpose of this study are presented in the following:

1 - Soil samples.

Three soils were investigated. The soils were collected from the 0-20 cm soil surface. Two soils were collected from Nobaria, El–Beheira governorate (sandy and calcareous) and one soil (a clay) from Ebshway, El – Fayoum governorate. Soil materials were air dried, ground and sieved to pass through a 2 mm sieve then thoroughly mixed to be homogenous. The main physical and chemical properties of the tested soils were determined according to **Jackson** (1958) and Piper (1950) and presented in Table 1-a

Table (1-a): Some characteristics of the investigated soils.

Characteristic	Soil			Characteristic	Soil		
	Sandy	Calcar-eous	Clay		Sandy	Calcar-eous	Clay
Particle size distribution				Soluble ions ($m\ mol_c\ L^{-1}$)			
Coarse sand %	22.2	13.6	6.00	Ca^{2+}	12.3	34.0	10.0
Fine sand %	76.2	81.5	9.00	Mg^{2+}	9.7	28.0	17.0
Silt %	1.0	2.0	39.3	Na^{+}	8.7	23.9	18.5
Clay %	0.6	2.9	45.7	K^{+}	1.7	1.9	1.7
Textural class	Sand	Sand	Silty clay	CO_3^{2-}	0.0	0.0	0.0
Organic matter %	0.74	1.05	2.53	HCO_3^-	3.4	6.5	10.0
Available N ($mgkg^{-1}$)	22.6	25.0	43.1	Cl^-	22.6	50.2	27.0
Available P ($mgkg^{-1}$)	6.04	5.79	9.88	SO_4^{2-}	6.4	31.1	10.2
Total N %	0.10	0.13	0.21	Field capacity %	14.7	19.8	44.6
Total P %	0.02	0.05	0.11	Wilting point %	6.3	9.2	23.1
EC (dSm^{-1})	3.24	8.52	4.70				
pH (1:2.5suspension)	7.31	7.47	7.73				
$CaCO_3$ %	2.2	12.4	7.30				

2 - Organic manures :

1) Biogas manures (BMC, BMW and BMI):

The different types of biogas manure used in this study are as follows:

1- Cattle dung alone (BMC).
2- Cattle dung mixed with water hyacinth (BMW).
3- Cattle dung mixed with wastes of food industries (BMI).

2) Compost manure (CMP):

Compost of maize stalks was obtained from the Training Center for Recycling of Agriculture Residues at Moshtohor.

Both biogas and compost manures were air dried and sieved through 2 mm sieve and finally they were thoroughly mixed. Each of them was applied at a rate of 2% (20 g pot^{-1}). The chemical compositions of the tested manures are presented in Table (1-b). Organic carbon was determined according to the method recommended by (A.P.H.A., 1992), manure pH value was measured according to Jodice *et al.* (1982) in 1: 5 manure – water ratio, total nitrogen was determined by the micro Kjeldah method (Jackson, 1973).

Table (1-b): Some chemical analysis of the tested manures.

Manure parameters	Manures			
	BMC	BMW	BMI	CMP
Organic carbon %	29.6	32.0	33.2	27.8
Organic matter %	50.9	55.1	57.1	47.8
Total N %	1.78	1.9	1.96	1.9
C / N ratio	16.6	16.8	16.9	14.6
Total P %	0.89	0.57	0.94	0.47
Total K %	1.04	1.62	1.86	1.69
pH (1: 5)	7.04	6.96	6.89	7.05
EC (dSm^{-1})	4.20	5.32	4.37	4.25
C / P ratio	33.3	56.1	34.3	27.7
Total Fe %	0.42	0.48	0.69	0.55
Total Mn µg/g	360	300	350	540
Total Zn µg/g	210	302	360	840
Total Cu µg/g	390	480	630	517

3) Mineral fertilizers (MFT):

The inorganic nutrient sources assembly was as follows: 85 mg N/ pot as ammonium sulfate (21% N), 20 mg P/pot as superphosphate (6.5% P) and 40 mg K/pot as potassium sulfate (40% K).

Incubation experiment:

The experimental part in this investigation included a laboratory incubation experiment to investigate the changes that may take place in soils due to organic and inorganic manuring pot experiment using randomized complete block design 1 kg soil were put in each pot (20 cm height and 23 cm diameter in four replicates. The treatments involved could be briefly described in the following:

1- None	2- BMC	3- BMI
4- BMW	5- CMP	6- MFT

Biogas and compost manure applied at a rate of 2% (20 gm pot^{-1}) were used as manure sources. All the conducted treatments besides the none manured one (soil without any applications) were sampled at different intervals i.e. at 0, 15, 30, 60 and 120 days of incubation. The removed subsamples were subjected to determination of pH, $NH_4 - N$, $NO_3 - N$, CO_2 evolved, organic matter content and available P, Fe, Mn, Zn and Cu. The experiment was subjected to statistical analysis as a factorial design involving the following factors: 1- Manure treatment (T): six treatments as mentioned above 2- Incubation period (P): five timing periods, as mentioned above. 3- Soil moisture status: two moisture treatment i.e. 75% and 100% of the water holding capacity (equivalent to field capacity).

The samples were analyzed for CO_2 evolved according to Gaur *et al.* (1971), Dehydrogenase activity according to Casida *et al.*, (1964), NH_4 – N and NO_3 – N were determined according to Bremner and Keeny (1965), available P by exteraction with 0.5 M $NaHCO_3$ solution of pH 8.5 according to (Olsen *et al.*, 1954), outlined by Jackson (1973), available Fe, Mn, Zn and Cu were extracted according to Soltanpour (1985) using ammonium bicarbonate-DTPA exteractant and determination using atomic absorption spectrophotometer, Perken Elmer 3110; organic matter contents were determined according to the method of Walkley and Black, outlined by Jackson (1973) and soil moisture content at field capacity and the wilting point were determined according to Veihmeyer and Hendrickson (1949). The statistical analysis was carried out according to Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Dehydrogenase activity (DHA):

Changes in dehydrogenase activity (DHA) during incubation of soils amended with different manure types are presented in Table 2. Results show, in general, significant positive effects of the added organic manures on DHA due to prolonging the incubation period. This effect differed according to manure type, moisture content and from one soil to another. Data also, indicate that the CMP possessed the highest significant activity among all treatments while the lowest activity was in soil amended with MFT.

In the sandy soil, the values of DHA increased with increasing the contact period from zero to 120 days. In the calcareous soil, results show that the effects on DHA were increased as the incubation period increased from zero to 60 days where the values reached maximum followed by a sudden decreasing trend at 120 days. In the clay soil, the values of DHA were increased as the incubation period increased from zero to 30 days followed by a sudden decrease till the end of incubation. The variation in DHA at the different incubation periods in soils could be attributed to the growth and proliferation of soil microorganisms following the moistening of soil (Kadhim, 1986). Regarding the effect of moisture content, results indicate that all treatments that received organic manure or MFT at 100% field capacity gave higher DHA values than at 75% field capacity.

Effect on organic matter content (OM):

The obtained results show that the net effect on soil organic matter content through the course of the experiment, that lasted for 120 days, differed according to organic manure type and from one soil to another. Results in Tables 3–5 reveal that all mean values of organic matter content were higher than the none manured treatment. In the sandy soil, data in Table 3 show that the soil organic matter content was initially increased with increasing the incubation period from zero to 30 days, thenafter it decreased at the fourth period (60 days) then slightly increased up to 120 days. It seems reasonable that such variations depend mainly on the prevailing processes of mineralization due to the differential effects of microbial activity. It is clear that the CMP which was added to the sandy soil gave the highest increase in soil organic matter content. Generally, sandy soils should be supplemented with organic matter every year to maintain suitable amount of organic material for keeping and improving their physical, chemical and biological properties.

In the calcareous soil, results in Table 4 show that the positive effect increased up to 60 days, then decreased gradually till the end of incubation period.

In the clay soil, the organic matter content increased with increasing the incubation period from zero to 30 days, thenafter it decreased till end of the incubation period (120 days). The highest mean value of soil organic matter content was obtained with the use of CMP. Generally, the organic matter percentage of the clay soil was greater than in the other soils.

Such results indicate that addition of organic manures to soils increased their organic matter to values higher than that of the MFT or the none-manured soils. This result is in accordance with the findings of Mostafa (1996) and EL-Emam (2002).

Regarding the effect of moisture content, results indicate that the treatments that received organic manure at 100% field capacity gave higher organic matter content than at 75% field capacity. This may indicate more organic matter losses by oxidation of in the soil of 75% field capacity.

Soil pH :

Results in Tables 3 – 5 show gradual and consistent decrease in pH values in soils as a result of adding organic manures and incubation period of the studied soils. The net effect of the different organic manures on soil pH value is mainly dependent on the nature and characteristics of soils and applied manures. Such effects could be attributed to organic acids and CO_2 produced during manure decomposition. These results are similar to those achieved by El-Ghozoli (2003) who found that increasing rate of the applied humic acid from 750 to 1500 mg Kg^{-1} caused soil pH to decrease.

CO_2 evolved:

The rate of CO_2 evolved from soil is a function of the activity of soil microorganisms. Results in Tables 3-5 reveal that CO_2 evolved increased due to manuring in all treatments in the three investigated soils. Organic manuring and mineral fertilization tended to increase the total count of bacteria due to increased nutrients and therefore increasing soil biological activities.

In general, data indicate that as the soil moisture was increased, the CO_2 evolved was also increased. This can be attributed to high soil water contents, diffusion of soil gases may be greatly reduced, resulting in a greater concentration of carbon dioxide in the plant rhizosphere (Chaney, 1984).

Table (2): Dehydrogenase activity (UL H/ g dry soil / 24 hrs at 30°C) in soils as affected by manuring during different incubation periods.

Incubation periods (days) (P): 0 — Soil moisture (as % of field capacity) (C) — Soil

Treatments (T)	75% Sandy	75% Calcareous	75% Clay	100% Sandy	100% Calcareous	100% Clay
None manured	25.3	26.1	31.2	25.9	27.2	32.5
BMC	40.7	43.8	[illegible]	[illegible]	46.9	67.0
BMW	[illegible]	61.0	[illegible]	[illegible]	[illegible]	70.3
BMI	49.8	[illegible]	[illegible]	52.6	53.8	67.1
CMP	62.3	[illegible]	[illegible]	65.2	67.4	72.3
MFT	34.2	[illegible]	40.3	[illegible]	35.3	42.6
Mean	48.8	[illegible]	61.4	51.5	53.2	63.9

Incubation periods (days) (P): 15

Treatments (T)	75% Sandy	75% Calcareous	75% Clay	100% Sandy	100% Calcareous	100% Clay
None manured	22.0	24.2	26.4	23.6	24.3	27.1
BMC	47.3	50.0	66.7	48.7	51.2	70.0
BMW	61.2	64.2	73.4	63.6	66.0	76.1
BMI	55.3	56.5	69.8	59.3	61.0	71.0
CMP	67.8	69.2	76.3	72.4	73.5	80.1
MFT	39.1	36.2	45.8	39.9	38.7	44.2
Mean	54.1	55.2	66.4	56.8	58.1	68.3

Incubation periods (days) (P): 30

Treatments (T)	75% Sandy	75% Calcareous	75% Clay	100% Sandy	100% Calcareous	100% Clay
None manured	19.0	21.2	22.9	20.1	22.0	23.8
BMC	53.1	56.5	72.7	58.0	61.3	76.3
BMW	68.7	70.3	81.9	69.4	71.9	89.1
BMI	57.3	63.6	74.2	61.2	63.8	77.7
CMP	70.9	77.1	83.5	74.1	72.5	92.3
MFT	41.1	42.1	49.7	43.4	43.8	50.2
Mean	58.2	61.9	72.4	61.2	62.7	77.1

Incubation periods (days) (P): 60

Treatments (T)	75% Sandy	75% Calcareous	75% Clay	100% Sandy	100% Calcareous	100% Clay
None manured	15.3	17.0	19.3	16.7	15.8	19.5
BMC	54.9	58.4	70.1	60.5	63.0	71.2
BMW	70.3	78.2	72.9	70.8	80.1	80.3
BMI	62.7	69.0	71.6	65.1	71.4	73.5
CMP	71.3	78.6	76.7	76.7	82.7	81.9
MFT	42.7	43.0	44.9	44.2	45.6	43.1
Mean	60.4	65.4	67.2	63.5	68.6	70.0

Incubation periods (days) (P): 120

Treatments (T)	75% Sandy	75% Calcareous	75% Clay	100% Sandy	100% Calcareous	100% Clay
None manured	9.8	10.2	11.9	10.5	11.3	14.0
BMC	57.2	49.3	61.3	62.4	54.8	63.4
BMW	71.6	61.3	70.2	72.9	65.3	76.2
BMI	66.1	56.7	62.5	68.2	61.2	70.3
CMP	74.8	63.8	71.3	80.3	72.1	79.8
MFT	45.1	40.0	41.0	46.0	38.3	40.7
Mean	63.0	54.2	61.3	66.0	58.3	66.1

L.S.D 0.01	P	T	C	P x T	P x C	T x C	P x T x C
Sandy :	P= 1.83	T= 2.11	C= 1.13	P x T= 2.21	P x C= 1.81	T x C= 2.70	P x T x C = 1.03
Calcareous :	P= 1.98	T= 2.42	C= 1.26	P x T= 2.35	P x C= 2.05	T x C= 2.19	P x T x C = 1.20
Clay :	P= 2.10	T=2.11	C= 1.48	P x T= 2.30	P x C= 2.13	T x C= 1.93	P x T x C = 1.16

Table (3): Effec[illegible] organic manures and inorganic fertilizers on pH, CO_2 and organic matter content of El-Nobaria sandy soil during different incubation periods.

Incubation periods (days) (P): 0 — Soil moisture (as % of field capacity) (C)

Treatments (T)	75% pH (1:2.5 suspension)	75% CO_2 (μg g^{-1} dry soil/hr)	75% O.M (%)	100% pH (1:2.5 suspension)	100% CO_2 (μg g^{-1} dry soil/hr)	100% O.M (%)
None manured	7.95	18.1	1.15	7.93	18.3	1.13
BMC	7.86	39.8	1.62	7.93	40.1	1.64
BMW	7.91	33.0	1.43	7.88	32.6	1.42
BMI	7.89	35.7	1.59	7.90	35.8	1.62
CMP	7.88	36.4	1.65	7.85	37.5	1.68
MFT	7.93	23.6	1.16	7.92	24.1	1.16
Mean	7.89	33.7	1.49	7.87	34.0	1.50

Incubation periods (days) (P): 1[illegible]

Treatments (T)	75% pH (1:2.5 suspension)	75% CO_2 (μg g^{-1} dry soil/hr)	75% O.M (%)	100% pH (1:2.5 suspension)	100% CO_2 (μg g^{-1} dry soil/hr)	100% O.M (%)
None manured	7.95	19.4	1.18	7.94	20.3	1.21
BMC	7.76	50.3	1.77	7.73	50.2	1.69
BMW	7.88	41.4	1.60	7.89	43.1	1.67
BMI	7.86	42.7	1.67	7.88	41.8	1.76
CMP	7.85	48.1	1.76	7.83	49.3	1.79
MFT	7.90	25.9	1.22	7.91	26.4	1.25
Mean	7.85	41.7	1.60	4.84	42.2	1.63

Incubation periods (days) (P): 30

Treatments (T)	75% pH (1:2.5 suspension)	75% CO_2 (μg g^{-1} dry soil/hr)	75% O.M (%)	100% pH (1:2.5 suspension)	100% CO_2 (μg g^{-1} dry soil/hr)	100% O.M (%)
None manured	7.92	20.6	1.23	7.89	21.0	1.21
BMC	7.71	61.2	1.82	7.54	63.5	1.78
BMW	7.80	44.7	1.75	7.53	53.7	1.76
BMI	7.82	51.8	1.77	7.62	52.1	1.81
CMP	7.83	50.2	1.78	7.66	51.8	1.83
MFT	7.87	28.7	1.23	7.80	30.3	1.25
Mean	7.80	47.3	1.66	7.63	50.3	1.68

Incubation periods (days) (P): 60

Treatments (T)	75% pH (1:2.5 suspension)	75% CO_2 (μg g^{-1} dry soil/hr)	75% O.M (%)	100% pH (1:2.5 suspension)	100% CO_2 (μg g^{-1} dry soil/hr)	100% O.M (%)
None manured	7.90	22.1	1.20	7.92	22.8	1.19
BMC	7.66	66.3	1.72	7.85	70.1	1.73
BMW	7.76	48.2	1.68	7.80	61.3	1.70
BMI	7.80	56.1	1.70	7.89	53.5	1.73
CMP	7.77	53.4	1.72	7.88	55.6	1.76
MFT	7.82	34.2	1.22	7.90	37.2	1.23
Mean	7.80	51.4	1.60	7.86	55.5	1.63

Incubation periods (days) (P): 1[illegible]

Treatments (T)	75% pH (1:2.5 suspension)	75% CO_2 (μg g^{-1} dry soil/hr)	75% O.M (%)	100% pH (1:2.5 suspension)	100% CO_2 (μg g^{-1} dry soil/hr)	100% O.M (%)
None manured	7.88	24.0	1.21	7.85	23.3	1.24
BMC	7.64	69.7	1.79	7.74	71.4	1.78
BMW	7.58	57.0	1.76	7.61	66.8	1.79
BMI	7.68	56.2	1.78	7.83	58.7	1.76
CMP	7.72	54.8	1.81	7.69	57.5	1.83
MFT	7.79	36.6	1.26	7.76	38.1	1.26
Mean	7.68	54.9	1.68	7.72	58.5	1.68

L.S.D.$_{0.01}$

pH : P = 0.11 T = 0.15 C = 0.12 P x T = 0.23 P x C = 0.26 T x C = 0.17 P x T x C = 0.08

CO_2 : P = 1.38 T = 2.11 C = 1.19 P x T = 2.26 P x C = 1.89 T x C = 2.91 P x T x C = 1.07

O.M : P = 0.10 T = 0.12 C = 0.11 P x T = 0.16 P x C = 0.19 T x C = 0.20 P x T x C = 0.05

Table (4): Effect of organic manures and inorganic fertilizers on pH, CO_2 and organic matter content of El-Nobaria calcareous soil during different incubation periods.

Treatments (T)	Incubation periods (days) (P): 0						15						30						60						120					
Soil moisture (as % of field capacity) (C)	75%			100%			75%			100%			75%			100%			75%			100%			75%			100%		
	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)
None manured	7.97	20.3	1.17	7.96	20.6	1.21	79.3	22.2	1.18	7.93	24.9	1.25	7.86	23.5	1.22	7.88	24.6	1.26	7.84	25.3	1.27	7.83	26.6	1.28	7.88	23.1	1.25	7.89	23.0	1.24
BMC	7.83	41.5	1.45	7.82	43.3	1.44	78.0	58.6	1.68	7.82	59.1	1.69	7.75	67.2	1.71	7.73	70.7	1.80	7.68	78.1	1.84	7.62	77.2	1.87	7.73	62.0	1.73	7.78	61.8	1.78
BMW	7.89	36.0	1.41	7.85	35.7	1.45	7.83	46.3	1.47	7.81	50.3	1.53	7.78	54.1	1.59	7.77	57.1	1.69	7.73	69.0	1.67	77.0	70.1	1.76	7.78	51.1	1.52	7.80	52.3	1.63
BMI	7.86	38.9	1.43	7.80	40.2	1.48	7.83	55.6	1.51	7.77	59.4	1.55	7.70	60.3	1.78	7.71	63.9	1.73	7.66	70.5	1.82	7.65	71.2	1.79	7.79	53.4	1.70	7.79	55.5	1.72
CMP	7.85	38.7	1.50	7.81	39.9	1.50	7.79	53.2	1.69	7.76	55.7	1.72	7.71	61.0	1.75	7.68	66.8	1.81	7.67	79.6	1.88	7.61	78.0	1.87	7.73	61.6	1.76	7.76	62.2	1.74
MFT	7.88	25.9	1.18	7.83	25.3	1.19	7.86	26.7	1.20	7.81	27.5	1.26	78.2	28.3	1.25	7.79	28.7	1.29	7.80	30.3	1.28	7.78	34.6	1.30	7.83	28.1	1.26	7.82	30.3	1.25
Mean	7.86	36.2	1.39	7.82	36.9	1.41	7.82	45.1	1.51	7.79	50.4	1.55	7.75	54.2	1.63	7.73	57.4	1.66	7.70	65.5	1.69	7.67	66.2	1.71	7.77	51.2	1.59	7.79	52.4	1.62

L.S.D.$_{0.01}$

pH: P = 0.09 T = 0.11 C = 0.10 P x T = 0.14 P x C = 0.13 T x C = 0.17 P x T x C = 0.60

CO_2: P = 2.20 T = 1.61 C = 1.03 P x T = 2.35 P x C = 2.63 T x C = 2.29 P x T x C = 1.18

O.M: P = 0.07 T = 0.09 C = 0.10 P x T = 0.14 P x C = 0.20 T x C = 0.15 P x T x C = 0.4

Table (5): Effect of organic manures and inorganic fertilizers on pH, CO_2 and organic matter content of El-Fiyoum clay soil during different incubation periods.

Treatments (T)	Incubation periods (days) (P): 0						15						30						60											
Soil moisture (as % of field capacity) (C)	75%			100%			75%			100%			75%			100%			75%			100%			75%			100%		
	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)	pH (1:2.5 suspension)	CO_2 (µg g^{-1} dry soil/hr)	O.M (%)
None manured	8.11	21.8	1.57	8.09	21.9	1.56	8.06	23.8	1.59	8.05	25.0	1.60	7.97	25.6	1.63	7.95	28.1	1.62	7.92	24.2	1.60	7.89	26.9	1.60	7.86	23.1	1.63	7.87	25.0	1.59
BMC	7.93	38.1	1.73	7.94	40.3	1.75	7.82	46.7	1.78	7.85	47.6	1.83	7.80	58.9	1.79	7.76	61.7	1.85	7.69	56.1	1.72	7.70	60.2	1.79	7.61	54.4	1.70	7.63	57.3	1.76
BMW	7.99	29.9	1.67	7.93	32.5	1.65	7.95	39.0	1.70	7.96	41.3	1.79	7.84	51.4	1.76	7.82	58.8	1.77	7.73	50.3	1.74	7.75	55.3	1.73	7.70	48.2	1.69	7.72	50.1	1.68
BMI	7.92	42.7	1.65	7.95	45.7	1.63	7.93	49.1	1.72	7.89	58.4	1.84	7.77	68.3	1.86	7.73	73.7	1.88	7.60	63.4	1.76	7.63	68.7	1.82	7.57	60.5	1.72	7.58	61.8	1.77
CMP	8.01	43.2	1.70	7.98	47.0	1.71	7.92	50.3	1.76	7.90	59.9	1.89	7.82	73.1	1.91	7.80	75.9	1.89	7.72	70.0	1.80	7.71	70.8	1.90	7.68	63.8	1.83	7.65	62.9	1.84
MFT	8.07	22.2	1.58	8.04	21.9	1.59	8.01	24.4	1.60	7.99	24.8	1.60	7.93	26.5	1.61	7.90	29.6	1.63	7.88	26.0	1.59	7.86	27.6	1.60	7.86	24.8	1.60	7.83	26.2	1.64
Mean	7.98	35.2	1.66	7.96	37.5	1.66	7.92	41.9	1.71	7.91	46.4	1.79	7.83	55.6	1.78	7.80	59.9	1.80	7.72	53.2	1.72	7.73	56.5	1.76	7.68	50.3	1.70	7.68	51.7	1.73

L.S.D.$_{0.01}$

pH: P = 0.10 T = 0.14 C = 0.12 P x T = 0.22 P x C = 0.19 T x C = 0.15 P x T x C = 0.06

CO_2: P = 1.41 T = 1.62 C = 1.25 P x T = 2.33 P x C = 2.19 T x C = 1.98 P x T x C = 1.15

O.M: P = 0.11 T = 0.13 C = 0.10 P x T = 0.20 P x C = 0.18 T x C = 0.19 P x T x C = 0.07

Considering the sandy soil, results in Table 3 show that the values of CO_2 evolved in sandy soil amended with organic manures and mineral fertilizers increased with increasing the incubation period from zero to 120 days. The average CO_2 evolved was the highest in soil treated with BMC where it reached 58.3 µg/g dry soil/ hr. The lowest CO_2 evolved rate was attained from the MFT where it was as low as 30.5 µg /g dry soil/ hr.

In the calcareous soil, results in Table 4 show that CO_2 evolved were increased as the incubation period increased from zero to 60 days where the values reached maximum followed by a sudden decrease at 120 days. The average CO_2 evolved was highest in the soil treated with BMC where it reached 62.0 µg/g dry soil/hr followed by CMP (59.7), BMI (56.9), BMW (52.2) and MFT (28.6) µg /g dry soil / hr.

In the clay soil, values of CO_2 evolved were increased as the incubation period increased from zero to 30 days followed by a sudden decrease till the end of incubation. The average values of CO_2 evolved were the highest in the soil treated with CMP where it reached 61.7 µg / g dry soil / hr. The lowest values of CO_2 evolved rate was attained from the MFT where it reached 25.4 µg / g dry soil / hr. The variation in CO_2 evolved at the different incubation periods in soils could be attributed to the rates of organic matter decomposition and the number of microorganisms in soils. Also, it is noticed that the values of CO_2 evolved increased by increasing the moisture content.

Effect on soil available P:

The effects of the added organic manures from different sources, on the available P in sandy, calcareous and clayey soils, during the different incubation periods are presented in Tables 6 – 8.

In the sandy soil, results in Table 6 show, in general, significant positive effect of the added organic manures on soil available P due to prolonging the incubation period. This effect showed a periodically changing pattern rather than a steady consistent trend. The general features of this pattern are, a sharp increase through the first 15 days of incubation followed by a sudden decrease trend at 30 days of incubation, followed again by a sharp increase till the end of the incubation period where maximum levels of soil available P were attained. Such effects could be attributed to the microbial activity and magnitude of microbial products particularly the organic acids or the compounds of acidic effects that may induce P availability in such soils and may be due to the content of used organic manure from P. Such results confirm those of Abd El-Raheem (1982).

The results of Table 7 show a significant increase in soil available P in the calcareous soil due to the application of different treatments. This increase depends on the type of manure and incubation period. The soil content of available P was initially increased with increasing the contact period from 0 to 30 days, thereafter decreased at 60 days then drastically increased to maximum values up to 120 days. Such variations depend mainly on the prevailing processes of soil P mineralization or immobilization due to the rate and differentiated effects of microbial activity.

Table (6): Effect of organic manures and inorganic fertilizers on NH_4^+-N, NO_3^--N and available P ($mgkg^{-1}$) of El-Nobaria sandy soil during different incubation periods.

Treatments (T)	Incubation periods (days) (P)																													
	0						15						30						60						120					
	Soil moisture (as % of field capacity) (C)																													
	75%			100%			75%			100%			75%			100%			75%			100%			75%			100%		
	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)
None manured	19.2	20.0	9.8	20.1	9.9	9.9	21.3	22.2	10.3	22.7	24.0	10.6	22.8	27.1	9.9	21.9	28.6	9.93	23.7	28.3	10.5	24.1	29.4	10.7	21.6	22.8	10.8	21.0	23.6	11.2
BMC	30.1	28.1	19.8	30.7	20.5	20.5	36.1	42.2	37.5	37.3	43.8	36.9	44.3	50.7	26.6	45.8	53.7	26.7	48.9	55.2	33.7	43.1	56.9	35.3	42.6	49.6	39.3	40.7	46.2	40.2
BMW	29.3	23.2	16.2	29.8	17.3	17.3	38.0	28.1	25.9	37.1	30.2	26.6	39.0	48.2	20.3	41.6	50.1	21.5	41.1	50.0	30.1	38.5	53.4	30.4	31.2	41.3	328.0	30.9	41.0	38.6
BMI	31.3	26.3	20.7	31.9	21.4	21.4	40.2	29.8	36.9	41.7	31.7	38.2	42.1	66.3	25.8	43.8	63.3	25.7	49.3	68.3	26.7	40.2	69.6	28.9	40.1	52.7	36.7	36.1	50.5	36.3
CMP	33.3	27.8	22.3	33.2	25.1	25.1	58.7	46.1	45.7	57.9	48.8	46.1	53.6	78.5	31.2	52.9	69.8	31.9	59.6	80.4	43.1	47.8	73.7	41.8	50.8	61.6	51.3	41.4	57.6	52.4
MFT	35.4	20.4	10.2	36.1	10.6	10.6	40.0	23.2	17.5	40.5	26.6	16.7	32.1	40.4	11.4	35.3	41.9	11.8	30.3	42.8	12.6	30.0	44.2	13.3	26.0	32.1	13.9	23.9	37.8	14.1
Mean	31.9	25.2	17.8	32.3	26.2	19.0	42.6	33.9	32.7	42.9	36.2	32.9	42.2	56.8	23.1	43.9	55.8	23.5	45.8	59.3	29.2	39.9	59.6	29.9	38.1	46.5	35.8	34.6	46.6	36.3

L.S.D.$_{0.01}$

NH_4^+:	P = 3.26	T = 2.94	C = 1.97	P x T = 5.23	P x C = 2.68	T x C = 3.29	P x T x C = 1.77
NO_3^-:	P = 3.12	T = 2.78	C = 1.13	P x T = 8.17	P x C = 2.31	T x C = 3.01	P x T x C = 1.06
av.P:	P = 6.12	T = 5.4	C = 1.21	P x T = 13.3	P x C = 4.7	T x C = 3.9	P x T x C = 1.15

Table (7): Effect of organic manures and inorganic fertilizers on NH_4^+-N, NO_3^--N and available P ($mgkg^{-1}$) of El-Nobaria calcareous soil during different incubation periods.

Treatments (T)	Incubation periods (days) (P)																													
	0						15						30						60						120					
	Soil moisture (as % of field capacity) (C)																													
	75%			100%			75%			100%			75%			100%			75%			100%			75%			100%		
	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)
None manured	18.8	19.3	7.96	19.0	20.4	8.03	19.7	21.8	8.09	20.7	22.0	8.15	22.1	23.1	9.02	22.0	24.0	9.11	20.1	21.6	8.46	20.7	22.6	9.01	21.4	23.5	8.78	21.7	23.3	9.23
BMC	21.3	20.6	12.1	21.5	20.9	12.5	33.3	38.9	15.7	32.4	37.8	18.1	45.7	53.2	49.7	50.2	55.2	50.6	39.8	50.0	43.4	41.8	43.3	46.2	46.3	48.9	48.9	48.5	49.6	50.2
BMW	19.9	20.1	10.7	20.2	20.0	10.9	26.5	36.1	11.8	24.9	39.1	12.0	39.8	46.5	40.3	40.1	47.1	41.8	28.7	36.7	28.5	31.3	34.2	32.3	38.2	40.6	39.3	39.4	46.8	41.4
BMI	20.6	19.9	10.6	21.1	20.6	10.8	31.2	31.7	11.3	33.6	32.5	12.2	48.6	49.9	45.6	49.0	51.1	44.2	38.2	41.1	35.2	39.6	43.8	38.2	42.4	48.1	46.2	44.1	49.3	49.7
CMP	25.4	23.7	18.6	26.3	24.7	19.1	46.3	41.1	25.5	48.2	43.0	26.7	59.1	63.4	31.4	60.6	61.6	33.7	47.3	53.8	21.7	48.7	52.6	29.8	55.8	58.7	41.6	58.1	60.2	51.6
MFT	30.1	19.6	8.14	31.4	19.7	8.20	48.1	29.8	8.32	49.0	30.3	8.41	49.3	34.6	11.2	49.2	35.9	11.3	32.6	34.5	9.84	33.0	35.3	9.78	32.7	34.1	10.9	32.9	36.1	11.1
Mean	23.5	20.8	12.0	24.1	21.2	12.3	37.3	35.5	14.5	37.6	36.5	15.5	48.5	49.5	35.6	49.8	50.2	36.3	37.3	43.2	27.7	38.9	41.8	31.3	43.1	46.1	37.4	44.6	48.4	40.8

L.S.D.$_{0.01}$

NH_4^+:	P = 2.6	T = 3.14	C = 1.18	P x T = 5.2	P x C = 4.19	T x C = 9.2	P x T x C = 2.03
NO_3^-:	P = 2.36	T = 4.02	C = 1.69	P x T = 6.15	P x C = 5.1	T x C = 8.17	P x T x C = 1.58

In the clay soil, in spite of the generally positive effect due to extending the incubation period on availability of soil P, the obtained results show a slight increase through the first 15 days of incubation followed by a more pronounced increase after 30 days, then a decrease at 60 days of incubation period, followed again by an increase till end of the incubation period. The abovementioned change in the pattern of available P in the clay soil was consistent with the different treatments under the investigation. Such results are in accordance with those of El–Ghozoli (1998).

It may be concluded that available P in the tested soils increased as a result of manuring according to the following order:
The sandy soil: CMP > BMC > BMI > BMW > MFT.
The calcareous soil: BMC > BMI > CMP > BMW > MFT.
The clay soil: CMP > BMI > BMC > BMW > MFT.

The initial analysis of the investigated raw manures may give reasonable explanations for these results as follows: Although BMI showed the highest P content, it failed to yield the highest effect on soil available P in the soils. Such trend may be attributed to the relatively high Fe content of BMI as compared with the other manures Table 1-b. Accordingly it may be that P in BMI could be mainly as iron phosphate and thus less soluble than calcium phosphate. Therefore P availability in the previous soils is related not only to the soil type but also to types of the different organic manures.

Such results may confirm those obtained by Poonia *et al.* (1986), Salam *et al.* (1996) and Badran *et al.* (2000) who concluded that the effect of organic manure on the availability of macro and micronutrients is dependent on the nutrient concentration, type of applied manure and soil type.

Regarding the effect of mineral fertilization which included ordinary superphosphate on soil available P, the obtained results show that the inorganic fertilization significantly increased extractable P in the investigated soils. El–Fahham (1997) found that the inducing effect due to applied inorganic P on soil P availability was increased with increasing level of its application.

Mean values of extractable P at the end of incubation period in the sandy and calcareous soil were 13.2 and 9.72 mg P kg^{-1} the corresponding was 20.1 mg P kg^{-1} soil in the clay soil of available P. Data in Tables 6-8 indicate that the positive effect of soil moisture on available P was increased by increasing the soil moisture content from 75% to 100% of field capacity in three soil under investigation. These results could be attributed to the fact that when the soil moisture is reduced, the mobility of phosphorus is decreases. The reduction in the mobility of P is more pronounced in the soil that had low moisture content. Such results coincide with those obtained by Abd El- Nour (1981) who noticed that when the soil moisture increase the availability of P also increased.

Results show significant positive interactions regarding organic amendments, incubation period and moisture on soil available P. The effect was maximized after 120 days of incubation and by using 100% field capacity. The most efficient treatment was that of CMP especially in the clay soil.

Effect on ammonium and nitrate nitrogen:

Soil enrichment with nitrogen after addition of biogas manure depends upon the manure nitrogen content. Changes in ammonium and nitrate nitrogen contents in soils amended with organic materials and inorganic fertilizers are presented in Tables 6–8. In all treatments, ammonium and nitrate nitrogen contents in the sandy soil amended with organic amendments and inorganic fertilizers were higher than the non-amended treatment. Throughout the incubation period, NH_4^+–N and NO_3^-– N increased with increasing the contact period from zero to 60 days, thenafter decreased at 120 days. These results are in agreement with those obtained by Joung and Reddy (1992) who found that NH_4^+–N and NO_3^- – N in soil increased with increasing the incubation period up to 60 days. Decrease in NH_4^+– N can be attributed to oxidation to nitrate by nitrifying bacteria, consumption of ammonia by microorganisms and loss of ammonia through volatilization in the sandy soil (Russel, 1980).

Concerning application of inorganic N data show that the NH_4^+– N decreased with time. It ranged between 35.4 to 36.1 $mgkg^{-1}$ soil at the beginning at 75 and 100% of field capacity and decreased with time to be in the range of 26.0 to 23.9 $mgkg^{-1}$ soil after 120 days of incubation.

The mean value of NO_3^-– N in the sandy soil after 60 days of incubation was 28.9 $mgkg^{-1}$ soil for the non-amended treatment. However, with regard to the soil treated with BMC, BMW, BMI, CMP, and MFT, comparable contents were 56.1, 51.7, 69.0 and 77.1 $mgkg^{-1}$ soil, respectively. This is due to the conversion of ammonium to nitrate through nitrification process. These results are similar to those reported by Mohamed (1995) and Mostafa (1996).

In the calcareous soil, NH_4^+– N and NO_3^- – N increased with increasing the incubation period from zero to 30 days, thenafter decreased up to the fourth period (60 days) then drastically up to 120 days. Variations in soil amended with different manures could be attributed to the decomposition rate of organic matter in the soil. In the clay soil, changes in NH_4-N and No_3 – N are presented in Table 8. The results indicate that the NH_4^+- N and NO_3^- – N increased with increasing of the incubation period from zero to 30 days, thenafter decreased at 60 days and then increased up to 120 days at 75% or 100% of field capacity.

Regarding to the effect of different sources of organic manures and mineral fertilizers, it is noticed that the CMP gave the highest value of NO_3^-–N and MFT gave the lowest value in all studies soils. Generally, ammonium and nitrate nitrogen contents increased with increasing of the soil moisture content from 75% to 100% field capacity.

Effect on the soil available Fe:

Results obtained show significant differences in the values of available Fe in the tested soils due to the different incubation periods.

In the sandy soil, the results in Table 9 show slight increases during the first 15 days of incubation. With prolonging the incubation period, these values increased to reach maximum values up to 120 days of incubation. Such effects could be attributed to organic and inorganic acids which would result from the decomposition of the organic matter and decrease the soil pH and hence the Fe would become more available.

Concerning the effect of incubation period on the calcareous and clay soils treated with different organic manures data in Tables 10 and 11 indicate that the values of available Fe were increased as the incubation period increased and the maximum values occurred after 120 days of incubation. This increases may be due to the microbial activity that encourages the formation of humic substances which play a major role in soil fertility. Such results confirm those of El–Ghozoli (1998).

It can be deduced from the abovementioned results that the BMC was the most efficient manure in inducing soil Fe availability, while MFT was the least. The increase in soil available Fe due to treating the studied soils with the different manures could be attributed to mineralization process of organic matter supplied to soil through manuring which should be expected to release micronutrients. These results are in accordance with the findings of Abd El-Latif and Abd El-Fattah (1985) who attributed increase in Fe availability to the high content of micronutrients and the low pH values of the organic manures during the decomposition which plays an important role on extraction of the micronutrients.

Because the clay soil initially contained relatively higher values of soil available Fe, therefore, its extractable Fe reached values relatively higher than the corresponding ones in the sandy and calcareous soils. On the other had, the extractable Fe from the calcareous soil was less than of sandy and clayey ones. This could be partially attributed to the lime reducing effect on Fe activity in the calcareous soil.

It might be concluded that the addition of N, P and K fertilizers increased the available Fe in the tested soils. This may be attributed to the indirect effect on some chemical properties of soil such as soil pH. The abovementioned results indicated that the effect of organic manures on available Fe was more pronounced than the effect of mineral fertilizers.

Obtained results showed that increasing the soil moisture content from 75% to 100% of field capacity significantly increased the soil available Fe in the tested soils. It could be concluded that increasing moisture level increased the efficiency of microbial activity and consequently the rate of mineralization process of organic manures applied to the soil and Fe become more available. These findings are in agreement with those of Fahmy (1995).

Table (8): Effect of organic manures and inorganic fertilizers on NH_4^+-N, NO_3^--N and available P ($mgkg^{-1}$) of El-Fiyoum clay soil during different incubation periods.

Incubation periods (days) (P); Soil moisture (as % of field capacity) (C)

Treatments (T)	0						15						30					
	75%			100%			75%			100%			75%			100%		
	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)
None manured	24.8	27.0	11.3	24.8	27.6	11.4	26.5	29.3	12.8	26.6	29.1	12.1	27.2	29.9	13.8	27.7	29.8	14.2
BMC	28.9	29.3	21.5	29.6	31.7	22.1	34.6	40.3	26.3	36.3	40.2	28.3	45.9	51.6	43.6	47.2	52.2	45.8
BMW	26.1	28.0	17.7	27.2	29.2	17.8	30.9	36.5	19.8	31.2	38.6	20.9	42.1	46.6	33.8	42.9	47.9	33.7
BMI	29.3	30.2	21.7	29.8	33.1	21.9	38.1	41.3	25.8	39.4	42.6	27.4	46.6	56.8	47.1	48.7	56.7	49.3
CMP	30.1	31.3	20.6	30.3	34.0	21.0	41.2	42.1	23.8	41.9	44.9	25.8	51.3	63.7	49.9	51.6	64.1	51.3
MFT	24.9	28.1	16.4	25.1	29.0	16.5	26.3	29.6	19.1	26.5	30.1	18.2	28.1	31.3	20.3	28.5	31.4	20.8
Mean	27.9	29.4	19.6	28.4	31.4	19.9	34.2	38.8	23.8	35.1	39.3	24.1	42.8	50.0	38.9	43.8	50.5	40.2

Treatments (T)	60						120					
	75%			100%			75%			100%		
	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)	NH_4-N ($mgkg^{-1}$)	NO_3-N ($mgkg^{-1}$)	av-P ($mgkg^{-1}$)
None manured	25.9	29.3	13.1	25.6	29.4	13.9	26.7	28.9	14.4	27.1	29.7	14.6
BMC	41.0	48.7	38.9	43.1	45.2	40.0	54.2	45.3	53.4	54.8	47.3	57.8
BMW	38.6	40.3	29.4	36.9	38.7	28.2	49.3	38.8	48.9	49.1	40.2	50.2
BMI	41.1	46.7	36.8	40.8	43.4	38.3	51.8	43.1	56.7	52.7	46.1	58.9
CMP	43.7	52.1	40.7	44.6	49.3	41.6	61.7	47.6	63.8	62.0	50.6	64.6
MFT	26.8	30.3	19.3	26.9	29.6	19.5	27.9	29.8	21.0	28.0	29.9	21.1
Mean	38.2	43.6	33.0	38.5	41.2	33.5	49.8	40.9	48.8	49.3	42.8	50.5

L.S.D.0.01

NH_4^+: P = 2.79 T = 3.90 C = 1.68 P x T = 4.02 P x C = 2.83 T x C = 3.31 P x T x C = 1.56

NO_3^-: P = 2.91 T = 2.63 C = 1.95 P x T = 5.03 P x C = 2.13 T x C = 3.44 P x T x C = 1.47

av.P: P = 3.06 T = 2.11 C = 1.40 P x T = 3.81 P x C = 2.52 T x C = 2.68 P x T x C = 1.27

Table (9): Effect of organic manures and inorganic fertilizers on available Fe and Mn ($mgkg^{-1}$) of El-Nobaria sandy soil during different incubation periods.

Incubation periods (days) (P); Soil moisture (as % of field capacity) (C)

Treatments (T)	0				15				30				60				120				Mean		Mean		Grand mean	
	75%		100%		75%		100%		75%		100%		75%		100%		75%		100%		75%	100%	75%	100%		
	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe		Mn		Fe	Mn
None manured	4.01	3.14	4.13	3.21	4.09	3.17	4.18	3.25	4.12	3.21	4.21	3.30	4.17	3.18	4.25	3.20	4.22	3.10	4.28	3.12	4.12	4.21	3.16	3.21	4.16	3.18
BMC	16.7	13.1	16.8	13.6	17.2	14.6	18.0	15.1	18.5	15.8	19.1	16.3	20.1	14.3	21.3	15.0	20.4	13.5	22.4	13.9	18.58	19.52	14.26	14.70	19.05	14.52
BMW	15.0	10.8	15.6	11.4	15.7	12.1	16.3	12.6	16.9	13.5	17.2	14.0	18.8	12.0	19.3	12.5	19.0	10.9	19.5	11.3	17.08	17.58	13.44	12.36	17.33	12.90
BMI	15.3	11.2	16.3	11.7	16.4	13.0	16.7	13.1	17.0	13.9	17.5	14.2	18.8	13.1	19.6	12.9	19.4	12.0	20.3	11.6	17.38	18.08	12.64	12.70	17.73	12.67
CMP	15.8	11.4	16.2	11.5	16.5	13.6	16.9	12.8	17.3	14.3	17.7	14.4	19.2	13.4	19.8	13.2	19.7	11.8	20.6	11.7	17.70	18.24	12.90	12.72	18.0	12.8
MFT	6.73	4.62	6.78	4.81	6.83	4.70	6.81	4.92	6.85	4.90	6.92	5.01	6.91	4.95	6.99	4.80	7.08	5.06	7.12	4.69	6.88	6.92	4.84	4.84	6.90	4.84
Mean	13.90	10.18	14.33	10.60	14.52	11.60	14.94	11.70	15.31	12.48	15.68	12.78	16.80	11.55	17.39	11.68	17.11	10.65	16.98	10.63	15.5	16.1	11.6	11.5	15.8	11.55

L.S.D.0.01

Fe: P = 1.31 T = 1.23 C = 0.41 P x T = 1.53 P x C = 1.69 T x C = 1.42 P x T x C = 2.30

Mn: P = 0.80 T = 0.76 C = 0.64 P x T = 1.02 P x C = 1.11 T x C = 0.83 P x T x C = 0.20

Table (10): Effect of organic residues and inorganic fertilizers on available Fe and Mn ($mgkg^{-1}$) of El-Nobaria calcareous soil during different incubation periods.

Treatments (T)	Incubation periods (days) (P)																									
	0				15				30				60				120				Mean		Mean		Grand mean	
	Soil moisture (as % of field capacity) (C)																									
	75%		100%		75%		100%		75%		100%		75%		100%		75%		100%		75%	100%	75%	100%		
	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe		Mn		Fe	Mn
None manured	2.91	3.65	2.95	3.72	2.96	3.77	3.03	3.91	3.01	3.89	3.10	3.99	3.01	4.07	3.21	4.13	3.14	3.90	3.26	3.92	3.01	3.11	3.85	3.93	3.06	3.89
BMC	11.2	9.82	11.9	10.2	11.8	10.1	12.1	11.7	12.6	11.0	12.8	12.1	13.1	12.0	14.2	12.6	14.7	9.96	14.8	10.5	12.6	13.2	10.5	11.4	12.9	11.45
BMW	9.83	10.1	9.93	11.0	9.95	10.8	10.1	11.5	10.2	11.3	10.5	11.9	10.7	12.6	10.9	12.4	11.4	10.1	11.3	10.8	10.6	10.5	10.9	11.5	10.55	11.2
BMI	11.1	10.2	11.3	10.3	11.5	10.7	12.2	10.5	12.1	11.6	12.7	11.8	13.3	12.4	13.8	12.7	14.0	10.3	14.6	11.2	12.4	12.92	11.0	11.3	12.7	11.15
CMP	10.7	9.63	10.9	9.88	10.9	10.3	10.9	10.3	11.6	11.2	11.5	11.1	11.6	11.8	13.3	12.8	13.3	10.0	13.9	10.3	11.6	12.1	10.7	10.8	11.85	10.75
MFT	5.07	4.43	5.10	4.52	5.19	4.72	5.13	4.82	5.42	5.02	5.21	5.17	5.50	5.50	5.35	5.43	5.68	4.89	5.62	4.93	5.33	5.28	4.85	4.97	5.31	4.91
Mean	9.58	8.83	9.82	9.18	9.86	9.32	10.0	9.76	10.3	10.0	10.5	10.4	10.74	10.8	11.5	11.1	11.8	9.05	12.0	11.7	10.5	10.8	9.59	9.99	10.7	9.89

$L.S.D._{0.05}$

Fe: P = 0.82 T = 0.68 C = 0.71 P x T = 1.34 P x C = 1.29 T x C = 1.50 P x T x C = 0.52

Mn: P = 0.61 T = 0.43 C = 0.54 P x T = 1.10 P x C = 0.93 T x C = 1.08 P x T x C = 0.24

Table (11): Effect of organic residues and inorganic fertilizers on available Fe and Mn ($mgkg^{-1}$) of El-Fiyoum clay soil during different incubation periods.

Treatments (T)	Incubation periods (days) (P)																									
	0				15				30				60				120				Mean		Mean		Grand mean	
	Soil moisture (as % of field capacity) (C)																									
	75%		100%		75%		100%		75%		100%		75%		100%		75%		100%		75%	100%	75%	100%		
	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe	Mn	Fe		Mn		Fe	Mn
None manured	4.95	2.98	5.03	3.11	5.08	3.08	5.13	3.32	5.21	3.72	5.25	3.52	5.30	3.34	5.32	3.20	5.42	3.10	5.41	3.04	5.19	5.22	3.24	3.23	5.20	3.23
BMC	18.1	13.5	18.4	13.7	18.7	15.2	19.2	16.1	19.6	16.9	21.2	17.1	20.6	16.0	23.1	14.6	22.6	14.1	24.8	13.6	19.92	21.34	15.14	15.02	20.67	15.08
BMW	17.0	12.9	17.8	13.0	17.5	13.4	18.3	14.2	18.9	15.1	19.2	16.3	19.7	13.6	20.6	13.3	20.8	12.2	21.7	12.9	18.78	19.52	13.44	13.94	19.15	13.64
BMI	17.7	13.8	17.9	14.0	18.3	14.9	18.9	15.5	19.5	18.1	21.7	17.3	20.1	15.9	22.9	15.3	21.1	13.8	23.3	14.2	19.34	20.94	15.30	15.62	20.14	15.28
CMP	17.4	14.7	17.7	14.9	17.8	16.6	18.1	15.9	18.6	17.8	19.8	17.7	19.6	16.1	21.8	15.4	20.5	14.3	23.9	13.8	18.78	20.26	15.90	15.54	19.52	15.72
MFT	6.73	4.97	6.82	5.09	6.89	5.13	6.93	5.25	6.99	5.93	7.02	6.13	7.08	5.02	7.16	5.88	7.17	4.99	7.25	5.23	6.97	7.03	5.20	5.52	7.00	5.36
Mean	15.38	11.97	15.72	12.13	15.83	13.04	16.28	16.23	15.71	14.76	17.78	14.90	17.41	13.32	19.11	12.89	18.43	11.87	20.19	11.94	16.75	17.81	12.99	13.05	17.29	13.01

$L.S.D._{0.05}$

Fe: P = 0.70 T = 0.51 C = 0.46 P x T = 0.88 P x C = 1.03 T x C = 0.90 P x T x C = 0.44

Mn: P = 0.36 T = 0.28 C = 0.21 P x T = 0.67 P x C = 0.59 T x C = 0.73 P x T x C = 0.18

Effect on soil available Mn:

The obtained results show significant differences among the values of available Mn in the tested soil due to the different incubation periods.

In the sandy soil, as indicated in Table 9, results show increases up to 30 days, then decreases till the end of incubation period. The most effective period was 30 days of incubation where the maximum available Mn was extracted. Such variations depended mainly on Mn mineralization or immobilization due to differential effects of the involved treatments as well as the microbial activity associated with such treatments. Although the values of Mn gradually decreased, they were still higher than the those in soil not treated with organic manured.

In the calcareous soil, results exhibited in Table 10 show that all values of available Mn as affected by the manure treatments sharply increased up to 60 days, then decreased gradually after 120 days from incubation.

In the clay soil, results show an increase in the content of available Mn due to the incubation period. The general trend observed with respect to available Mn through the course of the incubation experiment, show increases after 30 days followed by decreases till the end of incubation period. The most effective period was 30 days. This increase in available Mn in the soils under investigation could be attributed to the mineralization process of organic manures added to soil and to the low pH values of those materials during the decomposition period which play an important role on increasing the extracted micronutrients. On the other hand, the decrease in available Mn after 30 days of incubation may be due to formation of stable organo-mineral clay complexes at the terminal stage of the decomposition of organic manures and thus decrease available soil Mn. These results are similar to those obtained by Abd El-Kariem (1989) and El- Koumy *et al.* (2000).

Regarding the effect of treatments on soil available Mn, the orders was as follows for each soil:

The sandy soil: BMC> BMW> CMP> BMI> MFT

The calcareous soil: BMC> BMW> BMI> CMP> MFT

The clay soil: CMP> BMI> BMC> BMW> MFT

Concerning the effect of soil moisture content on Mn, the obtained results show increases in soil available Mn in the tested soils. This is a result of increasing the soil moisture which may increase microbial activity and mineralization of organic manures supplied to the soil.

Effect on soil available Zn:

Obtained results show significant differences in the values of soil available Zn. The maximum values obtained in the sandy or the clay soils occurred after 120 days of incubation, while in the calcareous soil it after 30 days of incubation.

Concerning the effects due to manuring on the soil available Zn, they can be arranged in the order:

The sandy soil: BMI> BMW> BMC> CMP> MFT

The calcareous soil: BMW> CMP> BMI> BMC> MFT

The clay soil: BMI> CMP> BMW> BMC> MFT

With respect to the effect of soil moisture, the obtained results show that when the soil moisture level was increased from 75% to 100% of field capacity, the soil available Zn was increased in the three investigated soils. Such results lead to a general conclusion that the most efficient treatment with respect to inducing Zn availability in the sandy and clay soils was the BMW at 100% of field capacity. This effect was maximized after 120 days from its incubation.

Effect on soil available Cu:

The effect of different organic and inorganic fertilization on the available Cu in the sandy, calcareous and clay soils during different incubation periods are presented in Tables 12 – 14. Data show significant differences among the values of the soil available Cu extracted from the tested soils as a result of added organic manures. These results are in accordance with those obtained by Hegazy *et al.* (1989) and El-Ghozoli (1998) who stated that available Cu was significantly increased as a result of organic manures application.

In the sandy soil, data reveal that available Cu increased as the incubation period increased. The maximum values were obtained after 120 days of incubation. In the calcareous soil, results indicate that the most effective incubation period in inducing available soil Cu was 60 days for the different treatments.

In the clay soil, the values at zero time were 8.66, 7.59, 8.29, 7.96 and 3.60 mg Cu kg^{-1} soil for BMC, BMW, BMI, CMP and MFT, respectively. These values increased to reach 9.09, 8.25, 8.83, 8.51 and 3.91 mg Cu kg^{-1} soil at 30 days of incubation, followed by a decrease after 60 days but values were still higher than those obtained at zero time of incubation, followed again by an increase till the end of incubation period (120 days). Such results may lead to a general conclusion that the most effective treatment with respect to inducing available Cu in both the tested sandy and clayey soils was BMC while the most effective in the calcareous soil was CMP.

Generally, the increase in availability of Fe, Mn, Zn, and Cu by increasing soil moisture content is probably attributed to an increase in the microbial activity in soil. These findings are in agreement with those obtained by Awad (1991) and Fahmy (1995).

Finally, the previous results show that values of soil organic matter, DHA, CO_2, pH, NH_4^+, NO_3^-, available P, Fe, Mn, Zn and Cu differed according to the soil type, incubation period, source of organic materials and the soil moisture content.

Table (12): Effect of organic residues and inorganic fertilizers on available Zn and Cu (mgkg^{-1}) of El-Noubaria sandy soil during different incubation periods.

Treatments (T)	Incubation periods (days) (P)																								Grand mean	
	0				15				30				60				120				Mean		Mean			
	Soil moisture (as % of field capacity) (C)																									
	75%		100%		75%		100%		75%		100%		75%		100%		75%		100%		75%	100%	75%	100%		
	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn		Cu		Zn	Cu
None manured	2.76	2.02	2.83	2.08	2.81	2.10	2.90	2.12	3.09	2.17	3.15	2.18	3.18	2.23	3.22	2.31	3.27	2.41	3.38	2.40	2.18	2.21	3.02	3.09	2.19	3.05
BMC	9.76	6.96	9.78	6.99	10.2	7.42	11.0	7.52	11.5	8.71	11.2	8.55	12.1	8.70	13.0	9.03	12.9	9.22	13.8	10.1	8.20	8.43	11.29	12.19	8.31	11.24
BMW	9.80	7.33	9.91	7.41	10.1	7.62	10.4	7.88	11.3	8.76	11.6	9.01	12.5	8.73	13.2	9.10	13.3	9.23	14.7	9.18	8.33	8.51	11.40	11.96	8.42	11.68
BMI	8.88	7.92	8.82	7.95	9.52	8.16	9.16	8.10	9.98	8.82	11.0	8.92	10.8	8.77	10.5	9.12	11.2	9.17	11.1	9.10	8.56	8.63	10.07	10.11	8.59	10.09
CMP	9.52	6.89	9.80	6.97	9.97	7.54	9.93	7.61	10.6	8.80	10.8	8.72	11.1	8.95	11.7	8.94	11.9	9.13	12.5	9.08	8.26	8.26	10.61	10.94	8.26	10.77
MFT	3.82	2.72	3.92	2.81	3.95	2.93	4.12	2.92	4.09	3.12	4.52	3.02	4.31	3.22	4.81	3.20	4.79	3.18	5.06	3.16	3.03	3.02	4.21	4.48	3.02	4.34
Mean	8.35	6.36	8.44	6.42	8.74	6.73	8.93	6.80	9.49	7.64	9.82	7.64	10.16	7.67	10.64	7.87	10.81	7.98	11.43	8.12	7.27	7.37	9.51	9.83	7.32	9.62

L.S.D.$_{0.01}$

Zn: P = 0.30 T = 0.24 C = 0.21 P x T = 0.63 P x C = 0.50 T x C = 0.55 P x T x C = 0.13

Cu: P = 0.21 T = 0.16 C = 0.14 P x T = 0.25 P x C = 0.32 T x C = 0.31 P x T x C = 0.10

Table (13): Effect of organic residues and inorganic fertilizers on available Zn and Cu (mgkg^{-1}) of El-Noubaria calcareous soil during different incubation periods.

Treatments (T)	Incubation periods (days) (P)																								Grand mean	
	0				15				30				60				120				Mean		Mean			
	Soil moisture (as % of field capacity) (C)																									
	75%		100%		75%		100%		75%		100%		75%		100%		75%		100%		75%	100%	75%	100%		
	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn		Cu		Zn	Cu
None manured	3.70	2.71	3.75	2.70	3.93	2.79	3.91	2.93	4.14	2.89	4.33	3.05	4.02	2.97	4.15	3.16	3.81	2.82	3.95	3.01	2.83	2.97	3.92	4.01	2.90	3.96
BMC	9.86	5.88	9.90	5.84	9.96	6.02	10.1	6.12	10.3	6.37	10.9	6.51	9.87	6.85	10.6	6.79	9.63	6.28	10.4	6.53	6.27	6.35	9.92	10.38	6.31	10.11
BMW	8.79	6.83	8.82	6.82	8.92	6.94	8.95	6.99	9.71	7.72	9.61	7.65	9.80	7.91	9.17	8.01	8.84	7.63	9.21	7.84	7.40	7.46	9.21	9.15	7.43	9.18
BMI	9.66	6.26	9.83	6.31	9.98	6.74	9.99	6.91	10.3	7.50	10.8	7.23	9.78	7.68	10.7	7.31	9.64	7.07	10.5	7.36	7.05	7.02	9.87	10.46	7.03	10.16
CMP	10.3	6.56	10.2	6.61	10.6	6.82	10.8	6.90	11.1	7.44	11.5	7.32	10.7	7.52	10.5	7.80	10.1	7.33	10.2	7.61	7.13	7.24	10.56	10.64	7.18	10.06
MFT	4.51	3.22	4.62	3.18	4.67	3.35	4.78	3.48	5.01	3.67	5.11	3.40	4.80	3.88	4.75	3.74	4.73	3.59	4.78	3.86	3.54	3.53	4.74	4.80	3.53	4.63
Mean	8.69	5.75	8.67	5.75	8.82	5.97	8.92	6.08	9.28	6.54	9.58	6.35	8.99	6.76	9.14	6.73	8.58	6.38	9.01	6.64	6.27	6.32	8.86	9.17	6.29	8.82

L.S.D.$_{0.01}$

Zn: P = 0.19 T = 0.20 C = 0.17 P x T = 0.36 P x C = 0.47 T x C = 0.29 P x T x C = 0.12

Cu: P = 0.20 T = 0.18 C = 0.17 P x T = 0.27 P x C = 0.31 T x C = 0.36 P x T x C = 0.07

Table (14): Effect of organic residues and inorganic fertilizers on available Zn and Cu ($mgkg^{-1}$) of El-Fayoum clay soil during different incubation periods.

Treatments (T)	Incubation periods (days) (P)																								Grand mean	
	0				15				30				60				120				Mean		Mean			
	Soil moisture (as % of field capacity) (C)																									
	75%		100%		75%		100%		75%		100%		75%		100%		75%		100%		75%	100%	75%	100%		
	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn	Cu	Zn		Cu		Zn	Cu
None manured	3.82	3.10	3.91	3.13	3.98	3.25	3.96	3.31	4.07	3.32	4.13	3.44	4.23	3.18	4.38	3.30	4.42	3.23	4.60	3.35	4.10	3.21	4.19	3.30	3.65	3.74
BMC	8.73	8.64	8.81	8.67	8.70	8.97	8.93	8.92	8.98	9.09	9.12	9.10	9.36	8.83	9.26	8.88	9.65	8.89	10.3	8.98	9.09	8.88	9.28	8.89	8.98	9.08
BMW	10.4	7.56	10.2	7.61	10.5	7.82	9.93	7.98	10.7	8.17	10.5	8.33	11.0	8.01	11.3	8.89	11.5	8.13	11.4	7.99	10.8	7.93	10.6	8.13	9.36	9.56
BMI	9.87	8.30	9.85	8.28	9.94	8.99	10.0	8.80	10.2	8.77	10.4	8.89	10.6	8.61	10.8	8.72	10.9	8.65	10.5	8.78	10.3	8.66	10.3	8.71	9.48	9.36
CMP	10.1	7.93	10.3	7.98	10.5	8.10	10.7	8.18	11.0	8.32	10.8	8.70	11.2	8.21	10.7	8.53	11.3	8.23	11.2	8.71	10.8	8.15	10.7	8.42	9.47	9.56
MFT	5.41	3.61	5.61	3.60	5.93	3.68	5.72	3.72	5.83	3.82	5.90	4.01	5.96	3.66	6.05	3.75	6.02	3.58	6.11	3.65	5.83	3.63	5.87	3.64	4.73	4.75
Mean	8.90	7.20	8.95	7.22	9.11	7.51	9.05	7.52	9.34	7.63	9.34	7.80	9.62	7.46	9.62	7.75	9.89	7.49	9.92	7.62	9.36	7.45	9.35	7.55	8.40	8.45

$L.S.D._{0.05}$

Zn: P = 0.23 T = 0.31 C = 0.26 P x T = 0.43 P x C = 0.38 T x C = 0.40 P x T x C = 0.10

Cu: P = 0.14 T = 0.13 C = 0.16 P x T = 0.23 P x C = 0.29 T x C = 0.26 P x T x C = 0.05

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تأثير بعض المصادر العضوية والمعدنية علي خواص التربة الكيميائية والبيولوجية تحت مستويات مختلفة من الرطوبة الأرضية.

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

يهدف هذا البحث إلى دراسة مقارنة بين أنواع مختلفة من سماد البيوجاز (BMC- BMI- BMW) مع الكمبوست(CMP) والسماد المعدني (MFT) تحت مستوين من الرطوبة الأرضية على حالة بعض خواص التربة الكيميائية والبيولوجية. ولتحقيق ذلك أجريت تجربة تحضين لدراسة أثر المعاملات التسميدية في ثلاثة أنواع مختلفة من الأراضي وهي رملية – جيرية – طينية على مدى تيسر بعض المغذيات الكبرى والدقيقة (النيتروجين الأمونيومى والنيتراتي – الفسفور – الحديد – المنجنيز – الزنك – النحاس) وكذا نسبة المادة العضوية وثاني أكسيد الكربون المنطلق من التربة والتغير في رقم حموضة التربة pH وكذا نشاط إنزيم الديهيدروجينيز. وخلال فترة التحضين أخذت عينات على فترات صفر، ١٥ ، ٣٠ ، ٦٠ ، ١٢٠ يوم. وقد أوضحت النتائج ما يلى:

- ازدادت نسبة المادة العضوية وثاني أكسيد الكربون المنطلق من الأراضي موضع الدراسة وكذا نشاط إنزيم الديهيدروجينيز نتيجة للإضافات العضوية وقد اختلفت هذه الزيادة من أرض لأخرى وكذا تبعا لنوع السماد المضاف .
- انخفاض قيم الـ pH للأراضي موضع الدراسة نتيجة معاملتها بالأسمدة العضوية .
- أوضحت النتائج المتحصل عليها أن معاملة الأراضي موضع الدراسة بكل من الأسمدة العضوية أو المعدنية أدى إلى زيادة معنوية لتيسير كل من النيتروجين الأمونيومى والنيتراتي – الفسفور – الحديد – المنجنيز – الزنك – النحاس وكان التسميد العضوي أكثر وضوحا من التسميد المعدني .
- زيادة المحتوى الرطوبي للتربة التي حضنت مع المخلفات العضوية من ٧٥ % إلى ١٠٠ % من السعة الحقلية أدى إلى زيادة كل من المادة العضوية – ثاني أكسيد الكربون المنطلق – النيتروجين الأمونيومى والنيتراتي – الفسفور – الحديد – المنجنيز – الزنك – النحاس .

أوضحت النتائج أن زيادة تيسر كل من الفسفور – الحديد – المنجنيز – الزنك – النحاس كان أكثر وضوحا في الأرض الطينية عنه في بقية الأراضي.