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RESIDUAL EFFECT OF SOME ORGANIC RESIDUES PRODUCED FROM BIOGAS UNITS ON GROWTH AND NUTRIENTS UTILIZATION BY WHEAT PLANTS

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ABSTRACT

A green house experiment was carried out at Training Center for Recycling of Agricultural Residues (TCRAR) at Moshtohor, Qualubia governorate to compare the residual effect of the following amendments: biogas (BMC: biogas manure produced from cattle dung alone; BMW: biogas manure produced from cattle dung mixed with water hyacinths; BMI: biogas manure produced from cattle dung mixed with food industries wastes), CMP: compost manure, each added at 20g/ kg soil (2%) and mineral fertilizers 85 mg N + 20 mg P + 40 mg K / kg soil using sandy, sandy calcareous and clay soils. Effects were measured on growth and nutrients uptake by wheat plants (2nd crop) after which succeeded maize plants (1st crop). Mineral fertilizers (MFT) of a mixture of ammonium sulphate, calcium superphosphate and potassium sulphate.

Results obtained could be summarized as follows

1-Application of the organic sources increased the dry matter yield of wheat plants (2nd crop) more than the MFT with superiority to BMI (13.3 g pot^{-1}).

2-The use of mineral fertilizers caused a slight and non significant increase in the dry matter yield.

3-The residual effect of organic manures on uptake of N, P and K by wheat plants was more pronounced in the clay soil than those the other soils.

4-The organic manures increased the concentration and uptake of N, P and K more than the mineral fertilizer. The BMI was more effective than other treatments.

5-Residual effect of applied organic manures caused a marked increase in concentration and uptake of Fe, Mn, Zn and Cu by wheat plants (2nd crop) grown on the tested soils. This increase seemed dependent on the manure type.

6-The organic matter, total N, total count of bacteria and dehydrogenase activity, were increased by manure application with greater values recorded following the preceding (1st) crop (i.e., the maize crop) than following the wheat (2nd) crop.

Key words: Residual effect – biogas – soil – nutrients – wheat.

INTRODUCTION

Clean agriculture involves minimum pollution effects and the use of natural materials is recommended to substitute chemical fertilizers in crop production. Accordingly, organic manures are well accepted to be a major source for plant nutrition in almost all the world, due to their direct as well as residual improving effect on the physical, chemical and biological characteristics of soil.

In Egypt the reclamation of new lands and intensive cropping are becoming a necessity to overcome the food gap. The poor desert soil needs many efforts to improve its hydro-physical properties as well as its productivity. Application of organic matter to such soils are disparately needed. Manures are, in essence, slow release fertilizers. Nutrients are slowly released from the added organic materials through the microbially induced mineralization process. The rate of the release process is affected by the properties of added organic materials and those of the soil. Hassan (1999) found a significant increase in N, P and K uptake by wheat plants (2^{nd} crop) grown in a sandy soil treated with composted sugar beet residues. Significant increase in dry matter yield of maize (2^{nd} crop) and the uptake of N, P and K were reported by Ali (1999) as a result of the combined effect of organic plant residues compost, biogas manure, FY M and inorganic NPK fertilizer applied to sandy and clayey soils. Basyouny (2001) showed that application of organic manures or $FeSO_4$ and $ZnSO_4$ alone or in combination to calcareous and non calcareous soils had a marked positive effect on the dry matter yield and the content of Fe and Zn in maize plants (2^{nd} crop). Badran (2001) studied the residual effect of biogas manure, chicken manure, town refuse and poudratte manure applied either solely or composted with inorganic fertilizer mixtures on maize plants (2^{nd} crop) after removal of wheat plants (1^{st} crop) grown on a sandy soil. Results indicated that, there were significant increases in dry mater yield and nutrients uptake (N. P, K, Fe, Mn, Zn and Cu) by maize plants when organic source was applied. Nasef *et al.* (2004) found that the residual effect of organic manures (FYM and chicken manure) applied either alone or combined with boifertilizers led to a highly significant increase in N, P and K uptake by rocket plants grown on sandy, calcareous and clayey soils. Negm *et al.* (2003) found that the count of bacteria and dehydrogenase activity were increased by manuring the soil with organic amendments.

The current study aims at investigating the residual effects of biogas manure, compost manure and inorganic NPK fertilizers on growth and nutrient uptake by wheat plants grown on sandy, calcareous and clayey soils. Some chemical and microbiological properties of the soil samples collected after corn (1^{st} crop) and wheat plants (2^{nd} crop) harvesting were determined.

MATERIALS AND METHODS

The current study was conducted mainly to evaluate the residual effect of different biogas manures produced from different organic residues on plant

growth and the utilization of essential nutrients by growing plants. To fulfill these objective, green house experiments were carried out as indicated in the following:

Soil under study:

The experiment involved three soils collected from the surface 0-20 cm layer. Two soils (a sand and a calcareous) were collected from Nobaria, El-Beheira governorate, and a clay soil was collected from Ebshway, El-Faiyoum governorate. Soil samples were air dried, ground and sieved to pass through a 2 mm sieve then thoroughly mixed to be homogenous and kept for physical and chemical analyses as well as conducting the experiment. The main properties of the studied soil were determined by the procedures outlined in Piper (1950) and Jackson (1973), and are shown in Table (1). The soils were subjected to the current experiment after the removal of corn plants (1st crop) grown for 75 days under the treatments after explained later. The same soil in the same pots were replanted with wheat (seds 1) for 60 days (2nd crop) to evaluate the residual effects of the studied treatments.

Organic materials used for preparing biogas manures:

Animal waste (cattle dung) was collected from the Agriculture Experimental Station of the Faculty of Agriculture at Moshtohor, Zagazig University, Benha. The animal waste was air dried, shredded and prepared for anaerobic fermentation. Water hyacinths plants were collected from water canals. Food industries wastes (Jew's mallow) were collected from the united company for food industry, Montana, located 20 Km to the north of Cairo at Qualubia governorate.

Biogas manure preparation:

Organic materials were air dried and chopped to small pieces (1-2 cm) for biogas manure preparent. Three biogas manures were as follows:

1- Cattle dung digested as biogas manure (BMC).
2- Cattle dung mixed with water hyacinth digested as biogas manure (BMW).
3- Cattle dung mixed with food industries wastes digested as biogas manure (BMI).

The mixtures were digested in a 4 liter laboratory fermenters and kept for 90 days under anaerobic conditions at 45 ± 2°C.

Compost preparation (CMP):

The compost material was maize stalks residues was supplied with Training Center for Recycling of Agriculture Residues at Moshtohor.

The biogas manures as well as the compost were air dried pulverized and then sieved through 0-2 mm sieve size and were thoroughly mixed. The chemical compositions of the tested manures are presented in Table (2), all of them were applied at one rate i.e. 2% (40 g pot^{-1}).

Mineral fertilizers (MFT):

The mineral fertilizers assembly was as follows: 170mg N/pot as ammonium sulfate (21% N), 40mg P/pot as superphosphate (15.5% P_2O_5) and 80mg K /pot as potassium sulfate (48% K_2O).

Table (1): Some physical and chemical analysis of the investigated soils.

Characteristic	Soil			Characteristic	Soil		
Particle size distribution	Sandy	Calca-reous	Clay	Soluble ions (m mol L^{-1})	Sandy	Calca-reous	Clay
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+}	9.70	28.0	17.0
Silt %	1.01	2.00	39.3	Na^{+}	8.69	23.9	18.5
Clay %	0.59	2.90	45.7	K^{+}	1.73	1.90	1.70
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-}	6.42	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 %	6.26	9.15	23.1
EC (dSm^{-1})	3.24	8.52	4.70	Total count of bacteria	$1.3x10^7$	$1.8x10^7$	$2.1x10^7$
pH (1:2.5suspension)	7.31	7.47	7.73	Dehydrogenase activity	41.0	58.0	69.0
$CaCO_3$ %	2.2	12.4	7.30				

Table (2): 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

Greenhouse experiment:

The soil left after the removal of the 1st experimental crop (maize) was replanted with wheat (Triticum Aestivum cv. Seds-1) under the same previous treatments of 1st plant and without any new treatments, to investigate the residual effect of the tested organic manures and mineral fertilizers on improving some soil properties as well as enhancement of plant growth. A pot experiment (2.0 kg

soil / pot) was conducted in a randomized complete block design, factorial. Factors and treatment of the experiment were as follows:

Factor A: manuring treatments: there were 6 treatments as follows 1- no addition 2- BMC 3- BMW 4- BMI 5- CMP 6- MFT.

Factor B: Soil: there were three soils 1- sand 2- calcareous sand 3- clay.

Each treatment was replicated in 4 replicates. Manure as well as compost rate was 20 g/kg soil; mineral fertilizers were applied so as to give N, P and K rates of 85, 20 and 40 mg/kg soil, respectively.

Each pot received 10 wheat seeds. One week later, the wheat seedlings were thinned to 5 plants pot^{-1} and weed were removed as soon as they appeared. After 60 days of germination, plants were harvested and divided into roots and shoots, dried at 70°C, and dry matter yield was recorded. Plant samples were acid digested to measured their contents of N, P, K, Fe, Mn, Zn and Cu. Analysis of organic manures and plants were determined for N (Chapman and Pratt, 1961), P (colorimetrically according to (Murphy and Riley, 1962 as modified by John, 1970), K by flame photometrically (Jackson, 1973), organic carbon (APHA, 1992), pH (Jodice *et al.*, 1982 in 1: 5 manure-water ratio) and Fe, Mn, Zn and Cu were measured using atomic absorption spectrophotometer, Perkin elemer 3110.

The viable microbial counts were estimated by the standard plate count method using soil extract agar medium (Allen, 1959). Dehydrogenase activity in soil was assayed according to Casida *et al.* (1964).

Statistical analysis:

The obtained results were subjected to analysis of variance according to (Snedecor and Cochran, 1989).

RESULTS AND DISCURSION

Effect on dry matter yield:

Data presented in Table (3) showed that the mean values of dry matter yield of wheat plants attained due to the residual effect of all manure treatments were significantly higher than the corresponding ones of the control treatment.

Regarding the effect of the investigated organic manures and mineral fertilizers in the sandy soil on weight of plants (roots + shoots), they can be arranged in the order: BMW > BMC > BMI > CMP > MFT, The corresponding relative increase were 108.4%, 106.9%, 98.2%, 77.1% and 60.5%, respectively. These results show the superiority of the BMW in the sandy soil where the value of dry matter yield of wheat plants grown thereon was 13.85 g pot^{-1}. These results are similar to those obtained by El-Sherbiney *et al.* (1991) and Ismail and Abu-Hussin (1995) who found that composted plant residues increased the dry matter yield and nutrient uptake of wheat plants grown on a sandy soil (second crop).

In the calcareous soil, data show that the highest value of dry weight of wheat plants were obtained by the BMI, while the lowest one was attained by adding the BMW. The effects of BMC, compost manure and mineral fertilizers were between in according the following order: BMI > BMC > CMP > MFT >

BMW whose corresponding dry matter weight values were 11.25, 8.85, 7.65, 6.45 and 5.95 g pot^{-1}, respectively.

Table (3): Residual effect of different types of organic manures and inorganic fertilizers on dry matter yield (g pot^{-1}) of wheat plants as a 2nd crop grown on the studied soils.

Treatments (T)	Soils (S)									Mean
	Sandy			Calcareous			Clayey			
	Root	Shoot	Total	Root	Shoot	Total	Root	Shoot	Total	
Control	3.05	3.60	6.65	2.15	3.50	5.66	3.85	6.85	10.7	7.66
BMC	5.00	8.75	13.75	3.20	5.65	8.85	4.70	9.50	14.2	12.26
BMW	4.25	9.60	13.85	2.70	3.25	6.45	5.35	10.6	15.95	11.9
BMI	5.50	7.65	13.15	2.50	3.95	11.25	4.80	10.00	14.8	13.3
CMP	4.80	6.95	11.75	3.15	4.60	7.65	5.50	11.6	17.1	12.2
MFT	4.15	6.50	10.65	4.90	6.35	5.95	4.40	8.10	12.5	9.86
Mean	4.74	7.83	12.6	3.29	4.76	8.05	4.95	9.96	14.9	11.8
L.S.D. 0.01	S = 1.22			T = 1.46			S X T = 1.84			

BMC: biogas manure of cattle dung; **BMW:** biogas manure of cattle dung mixed with water hyacinth plant residues; **BMI:** biogas manure of cattle dung mixed with food industry waste; **CMP:** compost made of maize stalks residues, **MFT:** mineral fertilizer of 85 mg N + 20 mg P + 40 mg K / kg soil.

Concerning the clay soil the highest weight was obtained by CMP, while the lowest one was by MFT according to the descending order: CMP > BMW > BMI > BMC > MFT with weights of 17.1, 15.95, 14.8, 14.2 and 12.5 gpot^{-1}.

Regarding the effect of soil type, it is clear that the dry matter yield of wheat plants (14.9g pot^{-1}) grown on the clay soil treated with different organic manures and mineral fertilizers were higher than the corresponding one in the sandy and calcareous soils which were 12.6 and 8.05 g pot^{-1}, respectively.

The beneficial effect of the organic matter on soil is due to the retention of nutrients to meet plant growth requirements and consequently lessen their loss by leaching. Organic matter represents a good source of available nutrients, due to its decomposition. Such obtained results are in accordance with those recorded by Ramamurthy and Shivashankar (1996) and Badran (2001).

Effect on Nitrogen concentration and uptake:

Data presented in Table (4-6) indicate that all treatments which received manures and mineral fertilizers increased N-concentration by wheat plants grown on the tested soils compared to the control treatment. The effect of treatments was in the following order BMI > BMC > CMP > BMW > MFT, whose values were 3.9, 3.82, 3.59, 3.2 and 2.86%, respectively. In the calcareous soil, results show the following order: BMW > CMP > BMI > BMC > MFT with values of 4.3, 4.14, 4.0, 3.42 and 3.18%, respectively. In the clay soil, the effect can be arranged to the descending order: BMW > BMC > BMI > CMP > MFT whose values were 3.94, 3.8, 3.52, 3.34 and 3.4%, respectively.

Table (4): The residual effect of the different types of organic manures and mineral fertilizers on N, P and K concentration and uptake values by wheat plants grown on the sandy soil.

Treatments	N					
	Concentration %			Uptake (mg pot^{-1})		
	Root	Shoot	Total	Root	Shoot	Total
Control	1.10	1.24	2.34	33.6	44.6	78.2
BMC	1.75	2.08	3.82	87.5	182	268
BMW	1.20	2.01	3.20	51.0	192	242
BMI	1.70	2.20	3.90	93.5	168	260
CMP	1.64	1.95	3.59	56.5	136	202
MFT	1.15	1.71	2.86	47.5	111	158.5
Mean	1.48	1.99	3.47	69.0	158	227
	P					
Control	0.08	0.17	0.25	0.48	6.10	6.58
BMC	0.20	0.26	0.46	10.0	22.8	32.8
BMW	0.12	0.35	0.47	5.10	33.6	38.7
BMI	0.27	0.37	0.64	14.9	28.3	43.2
CMP	0.15	0.25	0.40	6.20	18.2	24.4
MFT	0.10	0.28	0.38	4.50	17.6	22.1
Mean	0.17	0.30	0.47	8.14	24.1	32.2
	K					
Control	1.15	1.27	2.42	35.1	54.7	80.8
BMC	2.09	2.57	4.66	105	225	330
BMW	1.92	2.22	4.14	81.5	213	294.5
BMI	2.34	2.69	5.03	129	206	335
CMP	1.63	2.04	3.67	76.5	129	205.5
MFT	1.70	1.85	3.55	67.5	133	200.5
Mean	1.93	2.27	4.20	91.9	181	273

As for the N-uptake, data in Tables (4-6) indicate that the values of N-uptake by wheat plants grown on the sandy, calcareous and clay soils. The order were as follows for each soil: the sandy soil: BMC > BMI > BMW > CMP > MFT; the sandy calcareous soil; BMI > CMP > BMC > BMW > MFT; the clay soil: BMW > CMP > BMC > BMI > MFT.

Effect on Phosphorus concentration and uptake:

Data presented in Tables (4-6) indicated that the P-concentration and uptake were higher for treatments receiving amendments than the control treatment in all the tested soils. The highest mean value of P-concentration in wheat plants grown on the sandy and the clay soils was attained with the treatment BMI while, the lowest one was found by the mineral fertilizers treatment. In the calcareous soil, data indicate that the highest mean value of P-concentration in wheat plants was attained by using the compost manure treatment while the lowest one was attained due to the mineral fertilizers treatment.

Concerning the residual effect of organic and inorganic fertilization on P-uptake data showed that the highest value of P-uptake by wheat plants grown on all tested soils were obtained with BMI treatment.

In sandy soil P-uptake by wheat plants increased from 6.58mg pot^{-1} in the control treatment to 32.8, 38.7, 43.2, 24.4 and 22.1 mg pot^{-1} in the treatments receiving BMC, BMW, BMI, CMP and MFT, respectively. In the calcareous soil, P-uptake increased from 7.4 mg pot^{-1} (control treatment) to 21.1, 13.9, 23.2, 19.6 and 11.0 mg pot^{-1} for plants grown in soils treated with the BMC, BMW, BMI, CMP and MFT, respectively.

In the clay soil, P-uptake increased from 22.0 mg pot^{-1} (control) to 36.5, 41.4, 56.6, 43.3 and 28.2 mg pot^{-1} up treating the soil with the BMC, BMW, BMI, CMP and MFT, respectively. The positive residual effect of the organic manures on concentration and uptake of P by plants was reported by Rabie *et al.* (1997), Badran (2001) and El-Emam (2002).

Effect on Potassium concentration and uptake

Results in table (4-6) show that the residual effect of organic sources and mineral fertilizers increased K-concentration and uptake by wheat plants (2^{nd} crop) grown on the three investigated soils as compared to the control treatment.

Table (5): The residual effect of the different types of organic manures and mineral fertilizers on N, P and K concentration and uptake values by wheat plants grown on the calcareous soil.

Treatments	N					
	Concentration %			Uptake (mg pot^{-1})		
	Root	Shoot	Total	Root	Shoot	Total
Control	1.14	1.26	2.40	19.4	44.1	63.5
BMC	1.60	1.82	3.42	51.2	103	154.2
BMW	1.62	2.68	4.30	43.7	87.1	130.8
BMI	1.76	2.25	4.01	86.2	143	229.2
CMP	1.92	2.23	4.14	60.5	102	162.5
MFT	1.46	1.72	3.18	36.5	67.9	104.4
Mean	**1.67**	**2.14**	**3.81**	**55.6**	**101**	**156.6**
	P					
Control	0.10	0.15	0.25	2.15	5.25	7.40
BMC	0.20	0.26	0.46	6.40	14.7	21.1
BMW	0.12	0.33	0.45	3.20	10.7	13.9
BMI	0.15	0.25	0.40	7.35	15.9	23.2
CMP	0.23	0.27	0.50	7.20	12.4	19.6
MFT	0.11	0.21	0.32	2.75	8.25	11.0
Mean	**0.16**	**0.26**	**0.42**	**5.38**	**12.4**	**17.8**
	K					
Control	1.35	1.58	2.93	29.0	55.3	84.3
BMC	1.60	1.76	3.36	51.2	99.4	150.6
BMW	1.66	1.75	3.41	44.8	56.9	101.7
BMI	1.48	2.98	4.46	75.5	189	264.5
CMP	1.57	2.86	4.43	49.5	132	181.5
MFT	1.40	1.67	3.07	35.0	66	101
Mean	**1.54**	**2.20**	**3.74**	**51.2**	**109**	**160.2**

Table (6): The residual effect of the different types of organic manures and mineral fertilizers on N, P and K concentrations and uptake values by wheat plants grown on the clayey soil.

Treatments	N					
	Concentration %			Uptake (mg pot^{-1})		
	Root	Shoot	Total	Root	Shoot	Total
Control	1.24	1.61	2.85	47.7	110	157.7
BMC	1.44	2.36	3.80	67.6	224	291.6
BMW	1.80	2.14	3.94	96.3	227	323.3
BMI	1.70	1.82	3.52	81.6	182	263.6
CMP	1.38	1.96	3.34	75.9	222	297.9
MFT	1.30	1.74	3.04	57.2	141	198.2
Mean	1.52	2.00	3.52	75.7	199	274.7
	P					
Control	0.16	0.23	0.39	6.15	15.8	22.0
BMC	0.23	0.27	0.5	10.8	25.7	36.5
BMW	0.24	0.27	0.51	12.8	28.6	41.4
BMI	0.20	0.47	0.67	9.60	47.0	56.6
CMP	0.21	0.28	0.49	11.6	31.7	43.3
MFT	0.18	0.25	0.43	7.90	20.3	28.2
Mean	0.21	0.30	0.51	10.5	30.7	41.2
	K					
Control	1.34	1.49	2.83	51.6	102	153.6
BMC	1.73	2.76	4.49	81.3	262	343.3
BMW	1.77	2.09	3.86	94.7	221	315.7
BMI	1.69	2.51	4.2	81.1	251	332.1
CMP	1.55	1.87	3.42	82.3	212	294.3
MFT	1.46	1.57	3.03	64.2	127	191.2
Mean	1.64	2.16	3.80	81.3	214	295.3

Abbreviations: as those stated for Table (3).

The most pronounced residual effect of organic manures and mineral fertilizer on K-concentration and uptake by the plants grown on the sandy and calcareous soils were noticed with the use of BMI treatment. The corresponding values were 5.03 and 4.46% for concentration, 335 and 264.5 mg pot^{-1} for uptake, respectively.

From the abovementioned results, it can be noticed that values of N, P and K concentration and uptake in the clayey soil were generally higher than the corresponding ones achieved in the sandy and calcareous soils.

Effect on Iron concentration and uptake:

Data in Tables (7-9) indicated that the residual effect of organic and inorganic fertilization caused a marked increase in Fe-concentration and uptake by wheat plants (second crop) grown on the tested soils. This increase was more obvious in the plants treated with organic manures and seemed dependent on the manure type. Such increases in Fe-concentration and consequently its uptake by the plants can be attributed to the high content of Fe in the used organic manures.

Table (7): The residual effect of different types of organic manures and mineral fertilizers on Fe, Mn, Zn and Cu concentration and uptake values by wheat plants grown on sandy soil.

Treatments	Fe					
	Concentration (mg/kg)			Uptake (mg pot^{-1})		
	Root	Shoot	Total	Root	Shoot	Total
Control	83.9	91.1	175	0.25	0.44	0.69
BMC	325.0	620	945	1.63	5.42	7.05
BMW	281.7	531	812.7	1.20	5.10	6.3
BMI	252.6	701	953.3	1.39	5.36	6.75
CMP	386.8	653	1040	1.92	4.54	6.46
MFT	103.1	167	270	0.42	1.09	1.51
Mean	**269**	**534**	**804**	**1.31**	**4.30**	**5.61**
	Mn					
	Concentration (mg/kg)			Uptake (µg pot^{-1})		
Control	19.0	27.3	46.3	57.5	98.0	155.5
BMC	33.6	52.0	85.6	168	455	623
BMW	42.3	60.6	102.9	179	582	761
BMI	37.4	71.5	108.9	206	547	753
CMP	40.2	76.3	116.5	181	530	711
MFT	22.9	30.1	53	95.0	196	291
Mean	**35.2**	**58.1**	**93.3**	**169**	**462**	**631**
	Zn					
Control	17.4	26.5	43.9	53.0	95.0	148
BMC	48.2	86.7	134.9	241	755	996
BMW	40.5	70.2	111.7	272	670	942
BMI	38.0	58.3	96.3	209	445	654
CMP	50.3	93.5	143.8	211	649	860
MFT	20.6	29.9	50.5	85.0	194	279
Mean	**39.5**	**67.7**	**107.2**	**184**	**543**	**727**
	Cu					
Control	15.9	20.1	35.9	48.0	72.0	120
BMC	34.1	46.7	80.8	171	409	580
BMW	29.6	36.1	65.7	126	347	473
BMI	32.0	39.2	71.2	176	389	565
CMP	28.0	44.0	72.0	126	306	432
MFT	19.2	25.7	44.9	97.5	167	264.5
Mean	**28.5**	**38.3**	**66.8**	**135**	**323**	**458**

The highest Fe-concentration of wheat plants grown on the sandy soil (1040 mg kg^{-1}) was obtained with CMP treatment. In the sandy calcareous soil, the highest (1067.8 mg kg^{-1}) was recorded by BMC. In the clay soil, the highest (1461.4 mg kg^{-1}) was achieved by BMI.

Concerning the Fe-uptake data reveal that all treatments receiving amendments were higher in Fe-uptake by wheat plants as compared with the control. In the sandy soil, the highest (7.05 mg pot^{-1}) was due to BMC. In the sandy calcareous soil, the highest (5.53 mg pot^{-1}) was recorded by the treatment of BMI. In clay soil, the highest (11.7 mg pot^{-1}) was obtained with CMP.

Effect on manganese concentration and uptake:

Concerning Mn concentration and uptake, results indicate that all treatments receiving materials showed greater Mn concentration as compared with the control treatment. In the sandy soil, the highest Mn-concentration was achieved with CMP while the lowest one was found with MFT. As for the Mn-uptake, data presented in Table (7) reveal that the highest uptake was obtained by BMW, while the lowest one was found by MFT. In the sandy calcareous soils, the highest Mn-concentration and uptake were obtained with BMW. In the clay soil, data in Table (9) show that the highest Mn-concentration and uptake by wheat plants were attained by applying CMP while, the lowest one occurred by MFT.

Effect on Zinc concentration and uptake:

Results in Tables (7-9) reveal higher Zn-concentration and uptake by the plants grown in soils receiving amendments as compared with the control treatment. These results are in agreement with those obtained by El-Sherbieny *et al.* (1991) and Badran (2001) who found that Zn-concentration and uptake by barley and maize plants (second crop) increased as a result of application of biogas, chicken, town refuse and poudratte manures.

In the sandy soil, data show that the highest Zn-concentration of the organic amendment treatments was attained by CMP while the lowest one was found with the MFT, As for Zn-uptake treatments receiving amendments can be arranged as follows: BMC > BMW > CMP > BMI > MFT.

In the sandy calcareous soil, the highest Zn-concentration (177.5mg kg^{-1}) was recorded due to the treatment of BMC while, the lowest one was attained by MFT. With respect to Zn-uptake data reveal that organic manures increased Zn-uptake by wheat plants in the following order: BMI > BMC > CMP > BMW. The MFT treatment showed lower uptake than the organic treatments.

In the clay soil, data presented in Table (9) indicate that the highest Zn-concentration of wheat plants was attained by CMP while, the lowest one was obtained by adding MFT. As for Zn-uptake the order was as follows: CMP > BMI > BMW > BMC > MFT

Effect on Copper concentration and uptake:

The residual effect of organic manures and mineral fertilizers on Cu-concentration and uptake by wheat plants grown on sandy, calcareous and clayey soils are shown in Tables (7-9). Data indicate that the organic manures led to an increase in Cu-concentration and uptake by the plants more than the mineral fertilizer. These results agree with those reported by Badran (2001).

In the sandy soil, the highest Cu-concentration (80.8 mg kg^{-1}) was attained by BMC treatment. The lowest value of Cu-concentration was recorded by the use of MFT (44.9 mg kg^{-1}). Regarding to Cu-uptake, the residual effect of organic manure treatments can be arranged according to the following order: BMC > BMI > BMW > CMP > MFT

Table (8): The residual effect of different types of organic manures and mineral fertilizers on Fe, Mn, Zn and Cu concentration and uptake values by wheat plants grown on calcareous soil.

Treatments	Fe					
	Concentration (mg/kg)			Uptake (mg pot^{-1})		
	Root	Shoot	Total	Root	Shoot	Total
Control	9.01	105.3	114.3	0.19	0.37	0.56
BMC	363.2	704.6	1067.8	1.16	3.98	5.14
BMW	392.1	583.6	975.7	1.06	1.90	2.96
BMI	298.5	641.5	940	1.46	4.07	5.53
CMP	316.7	696.3	1030	1.00	3.20	4.2
MFT	121.2	245.8	367	0.30	0.97	1.27
Mean	**298**	**576**	**874**	**1.00**	**2.82**	**1.91**
	Mn					
	Concentration (mg/kg)			Uptake (µg pot^{-1})		
Control	21.2	27.8	49	106	139	245
BMC	46.8	63.9	110.7	234	320	554
BMW	43.7	74.0	117.7	219	370	589
BMI	39.1	70.3	109.4	196	352	548
CMP	37.0	77.6	114.6	185	388	573
MFT	25.9	38.4	64.3	130	192	322
Mean	**38.5**	**64.8**	**103.3**	**193**	**324**	**517**
	Zn					
Control	19.3	26.2	45.5	44.5	90.5	135
BMC	54.5	123.0	177.5	174	695	869
BMW	61.2	84.7	145.9	165	257	422
BMI	43.7	105.3	149	216	669	885
CMP	51.6	79.6	131.2	163	366	529
MFT	23.2	39.7	62.9	58.0	157	215
Mean	**46.8**	**86.4**	**133.2**	**155**	**432**	**587**
	Cu					
Control	16.3	23.7	40.0	35.0	82.5	117.5
BMC	33.4	45.3	787.0	107	256	363
BMW	32.8	48.9	81.7	88.5	159	247.5
BMI	28.1	35.2	63.3	138	224	362
CMP	36.9	42.8	79.7	116	197	313
MFT	19.9	25.7	45.6	49.5	102	151.5
Mean	**30.2**	**39.5**	**69.7**	**99.5**	**187**	**286.5**

In case of the calcareous soil conditions, the highest Cu concentration (81.7 mg kg^{-1}) was attained with BMW. while, the lowest value of Cu concentration (45.6 mg kg^{-1}) was achieved with the BMI treatment. The higher Cu-uptake (363 µg pot^{-1}) was recorded by MFT treatment and the lowest one was found by MFT.

In the clay soil, the highest Cu concentration (87.2 mg kg^{-1}) was attained by BMI. Treatments receiving amendments can be arranged according to the following order: BMI > CMP > BMC > BMW > MFT.

Table (9) The residual effect of different types of organic manures and mineral fertilizers on Fe, Mn, Zn and Cu concentration and uptake values by wheat plants grown on clayey soil.

Treatments	Fe					
	Concentration (mg/kg)			Uptake (mg pot^{-1})		
	Root	Shoot	Total	Root	Shoot	Total
Control	112.3	138.9	251.2	0.43	0.95	1.38
BMC	526.3	788.2	1314.5	2.47	7.49	9.96
BMW	596.2	802.0	1398.2	3.19	8.50	11.7
BMI	620.1	841.3	1461.4	2.98	8.41	11.4
CMP	633.0	727.0	1360	3.48	8.25	11.7
MFT	141.2	223.5	364.7	0.62	1.81	2.43
Mean	503	678	1181	2.55	6.98	9.53
	Mn					
	Concentration (mg/kg)			Uptake (µg pot^{-1})		
Control	26.8	35.9	62.7	103	246	349
BMC	49.8	79.2	129	234	752	986
BMW	42.0	90.1	132.1	225	955	1180
BMI	53.5	68.7	122.2	256	687	943
CMP	59.7	93.3	153	328	1058	1386
MFT	29.0	38.9	67.9	126	315	441
Mean	46.8	74.0	120.8	234	750	984
	Zn					
Control	22.2	29.3	51.5	85.0	201	286
BMC	56.9	93.1	150	267	882	1149
BMW	40.6	96.4	137	217	1022	1239
BMI	50.2	123.1	173.3	241	1230	1471
CMP	63.8	115.2	179	351	2807	3158
MFT	24.0	32.1	56.1	106	260	366
Mean	47.1	91.9	139	203.6	940	1143.6
	Cu					
Control	18.0	24.3	42.3	69.0	166	235
BMC	36.2	40.8	77.0	170	387	557
BMW	28.6	43.4	72.0	153	460	613
BMI	32.3	54.9	87.2	155	549	704
CMP	36.0	49.8	85.8	198	565	763
MFT	20.7	29.3	50.0	91.0	237	328
Mean	30.7	43.6	74.3	153	439	592

Abbreviations: as those stated for Table (3).

Soil organic matter content

Results obtained in Table (10) show that the effect on soil organic matter content in soils which were supplied with amendments (organic or mineral). The organic matter contents were higher in all treatments which were supplied with organic material than in the treatments which were supplied with mineral fertilizer or control. The values of organic matter content after maize were greater than their after wheat. These results agree with that of Negm *et al.* (2003). Generally, the organic matter percentage in the clay soil is greater than in the sandy and sandy calcareous soils. This might be due to the higher initial organic matter content of the clay soil than the corresponding ones of the sandy and calcareous soils.

Table (10): Some fertility parameters of the investigated soils as functions of the applied manures and mineral fertilizers.

Analysis	Sample	Manure														
		BMC			BMW			BMI			CMP			MFT		
		Soil														
		Sandy	Calca-reous	Clay	Sandy	Calca-reous	Clay	Sandy	Calca-reous	Clay	Sandy	Calca-reous	Clay	Sandy	Calca-reous	Clay
Organic Matter (%)	After maize	0.87	1.24	2.76	0.88	1.27	2.78	0.98	1.25	2.74	1.01	1.50	2.80	0.76	1.09	2.54
	After wheat	0.82	1.15	2.63	0.80	1.14	2.60	0.82	1.18	2.63	0.83	1.36	2.67	0.75	1.07	2.53
Organic carbon (%)	After maize	0.51	0.72	1.60	0.52	0.74	1.62	0.57	0.73	1.59	0.59	0.87	1.63	0.44	0.63	1.48
	After wheat	0.48	0.67	1.53	0.47	0.66	1.51	0.48	0.69	1.53	0.56	0.79	1.55	0.43	0.62	1.47
Total N (%)	After maize	0.12	0.14	0.23	0.12	0.17	0.24	0.14	0.18	0.26	0.14	0.20	0.25	0.13	0.15	0.22
	After wheat	0.11	0.12	0.20	0.10	0.13	0.20	0.11	0.14	0.23	0.11	0.17	0.20	0.11	0.14	0.20
C/N ratio	After maize	4.25	5.14	6.96	4.33	4.35	7.71	4.07	4.06	6.11	4.21	4.35	6.52	3.38	4.20	6.72
	After wheat	4.36	5.58	7.65	4.70	5.07	7.94	4.36	4.92	6.65	5.09	4.65	7.75	3.90	4.42	7.35
Total count bacteria* (x 10^7)	After maize	5.8	8.1	1.15	6.0	8.3	1.19	6.1	7.8	1.18	5.9	8.5	1.31	2.7	3.8	5.4
	After wheat	4.9	6.9	9.7	5.1	7.2	1.06	5.4	6.3	1.10	5.0	7.2	1.17	1.6	2.9	3.8
Dehydro-genase**	After maize	204.0	273.0	292.0	213.0	270.0	295.0	215.0	280.0	298.0	212.0	267.0	293.0	47.0	68.0	74.0
	After wheat	185.0	214.0	236.0	192.0	232.0	246.0	196.0	242.0	263.0	194.0	221.0	241.0	36.0	49.0	58.0

* In cell / g dry soil.

** In ul H / g dry soil / 24 hrs at 30°C.

Abbreviations: as those stated for Table (3).

Biological activity:

The bacterial plate counts and dehydrogenase activity (DHA) in the tested soils treated with different types of manures and chemical fertilizers are presented in Table (10).

Data show that the soil supplemented with organic amendments showed higher counts and activities than that recorded in the soils treated with mineral fertilizer or the control treatments. These results agreed with those of Estefanous and Sawan (2002) and Negm *et al.* (2003). Soils receiving chemical fertilizer exhibited slight increases in the total count bacteria and DHA in comparison with the control. Application of BMI showed the highest positive effect on DHA followed by BMW, CMP, BMC and MFT.

With respect to the total count of bacteria results indicate that the CMP possessed the highest activity among all treatments while the lowest activity among treatments receiving amendments was in soil amended with BMC, followed by MFT. The increases of microbial counts might be due to the activities of a large number of living microorganisms with the presence of readily utilizable carbon sources given by the organic manures.

Generally the total count of bacteria and DHA in the sandy soil showed low activity than in the sandy calcareous or the clay soil. These results agree with the finding by Mohamed (1995).

CONCLUSION

It could be concluded that application of organic manures increased N, P, K, Fe, Mn, Zn and Cu concentration and uptake as well as the dry matter yield of wheat plants grown on the tested soils. The increase in nutrient uptake could be attributed to one or more of the following reasons (1) the high content of these nutrients in organic manures, (2) increasing the cation exchange capacity of the soils particularly in soils treated with organic manures and (3) improvement of soil structure decreasing nutrient loss by leaching and deep percolation.

Taking the soil into consideration, Fe, Mn, Zn, and Cu, concentration and uptake of wheat plants, total count of bacteria and DHA in the clay soil were higher than the other soils.

Effect of the mineral fertilizer showed lower values of concentrations and uptake of nutrients as well as plant growth compared with organic manures.

REFERENCES

Ali, A.M. (1999): Studies on nutrients availability from residues and different organic fertilizers. Ph.D. Thesis, Fac. Agric. Moshtohor, Zagazig Univ., Egypt.

Allen, O.N. (1959): Experiments in soil bacteriology. 3rd Ed. Burgess Publ., U.S.A.

APHA (American Public Health Association) (1992): Methods for the examination of water and waste water. 18th ed. Washington, D.C., U.S.A.

Badran, N.M. (2001): Residual effect of nutrients enriched organic residues on growth nutrients utilization by corn plants grown on a sandy soil. Annals of Agric. Sci., Moshtohor, 39 (1): 611-630.

Basyouny, E.M. (2001): Plant response to fertilization in relation to micronutrients status in plant and soil. Ph.D. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

Casida, L.E.; Klein, D.A. and Santora, T. (1964): Soil dehydrogenase activity. Soil Sci., 98: 371-378.

Chapman, H.D. and Pratt, F.P. (1961): Methods of analysis for soils, plants and waters. Univ. of California, Div. of Agric. Sci.

El-Emam, M.A. (2002): Response of plants to some types of unconverntional fertilizers. A thesis Fac. Agric. Moshtohor, Zagazig University., Egypt.

El-Sherbieny, A.E.; Fouda, E.E.F., Awad, E. and Abd El-Kariem, A. (1991): Residual effect of different sources of Zn and Mn to barley plant. Egypt. J. Soil Sci. Special issue: 425-441.

Estefanous, A.N. and Sawan, Omiama, M. (2002): Effect of inoculation sources on Okra yield and some properties of calcareous soil. Inter. Symp. of the Horizons of Using Organic Matter and Substrates in Horticulture, Cairo, Egypt, 6-9 April.

Hassan, M.M. (1999): Organic refuse composted by microorganisms and their effect on the availability of some nutrients in newly reclaimed soils. Ph.D. Thesis Fac. Agric. Zagazig Univ., Egypt.

Ismail, A.S. and Abu Hussin, H.E. (1995): Effect of application of different levels and sources of composted plant residues on sandy and calcareous soils and plant growth under greenhouse conditions. 1-Wheat plants. Egyptian Soil Science Society (ESSS) 5th Nat. Congress, Nov., 20-21, 1995, Cairo.

Jackson, M.L. (1973): Soil chemical analysis – Prentice Hall, Inc. Englewood cliffs, N.J.

Jodice, R.; Luzzati, A. and Nappi, P. (1982): The influence of organic fertilizers obtained from poplar barks on the correction of iron chlorosis of Luipinus albus L. Plant and Soil, 65: 309-317.

John, M.K. (1970): Colorimetric determination of phosphorus in soil and plant materials with ascorbic acid. Soil Sci., 19: 214-220.

Mohamed, G.A. (1995): Microbiological and chemical studies on biogas manure. M.Sc. Thesis, Fac. Agric., Al-Azhar Univ., Egypt.

Murphy, J. and Riely, J.P. (1962): A modified single solution method for the determination of phosphate in natural water. Anal. Chem. Acta. 27: 31-36.

Nasef, M.A.; Khalil, A.A.; Ghazal, F.M. and El-Emam (2004): The residual effect of organic manures with or without Bio-fertilizer applied to wheat grown on sandy, calcareous and clay soils, on growth and NPK-uptake of recket plants. Egypt. J. Agric. Res., 82 (2): 235-246.

Negm, M.A.; Rifaat, M.G. and Estefanous, A.N. (2003): Impact of composted saw-dust and some nitrogenous sources on the production of squash and table beet crops grown on soil calcareous in nature. Fayoum J. Agric., Res. & Dev., 17 (1): 116-135.

Piper, C.S. (1950): Soil and plant analysis. Interscience Pub. Inc., New York, USA.

Rabie, M.H.; Negm, A.Y.; Mona, M. and Abdel-Sabour, M.F. (1997): Influence of two sewage sludge sources on faba bean and sorghum plants growth and elements uptake. Egypt J. Soil Sci., 37 (4): 425-435.

Ramammurthy, V. and Shivashankar, K. (1996): Residual effect of organic and phosphorus on growth and quality of maize (*Zea mays*). Indian. J. Agron., 41: 247-251.

Snedecor, G. and Cochran, W. (1989): Statistical methods. 8th Ed. The Iowa State Univ. Press, Iowa U.S.A.

التأثير المتبقى لبعض المخلفات العضوية الناتجة من وحدات البيوجاز على نمو نباتات القمح

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أجريت تجربة أصص بمركز تدريب تدوير المخلفات الزراعية بمشتهر بمحافظة القليوبية لمقارنة التأثير المتبقى الناتج من إضافة بعض أسمدة البيوجاز (BMC : سماد البيوجاز الناتج من روث الأبقار ، BMW : سماد البيوجاز الناتج من روث الأبقار + ورد النيل ، BMI :سماد البيوجاز الناتج من روث الأبقار + مخلفات مصانع أغذية) وسماد الكمبوست بمعدل ٢% وكذا الأسمدة المعدنية المضافة بمعدل ٨٥ ملليجرام نيتروجين باستخدام سلفات نشادر + ٢٠ ملليجرام فوسفور باستخدام سوبر فوسفات الكالسيوم + ٤٠ ملليجرام بوتاسيوم باستخدام سلفات البوتاسيوم لكل كجم تربة لثلاثة أنواع من الأراضى وهى رملية – جيرية – طينية وتأثير ذلك على نمو وامتصاص نباتات القمح (المحصول الثانى) بعد حصاد نباتات الذرة (المحصول الأول). ويمكن إيجاز النتائج المتحصل عليها فيما يلى :

١- ازداد محصول المادة الجافة لنباتات القمح (المحصول الثانى) بإضافة المصادر العضوية المختلفة بمعدل أعلى من السماد المعدنى وكان المخلف الأعلى تأثيرا هو BMI (١٣,٣ جرام / أصيص) بالمقارنة بالأسمدة العضوية الأخرى.

٢- استخدام الأسمدة المعدنية أدى إلى زيادة محصول المادة الجافة زيادة طفيفة ولكنها غير معنوية .

٣- كان التأثير المتبقى للأسمدة العضوية على امتصاص النيتروجين والفوسفور والبوتاسيوم أكثر وضوحا فى التربة الطينية عنه فى بقية الأراضى.

٤- ازدادا تركيز وامتصاص النيتروجين والفوسفور والبوتاسيوم بواسطة نباتات القمح بإضافة الأسمدة العضوية بمعدل أعلى من السماد المعدنى وكان سماد BMI الأكثر تأثيراً عن بقية المعاملات الأخرى.

٥- أدى التأثير المتبقى لإضافة الأسمدة العضوية إلى زيادة تركيز وامتصاص الحديد والمنجنيز والزنك والنحاس بواسطة نباتات القمح (المحصول الثانى) النامية فى الأراضى تحت الدراسة وهذه الزيادة تختلف من مخلف لآخر.

٦- تشير النتائج إلى زيادة محتوى التربة من المادة العضوية والنيتروجين الكلى وأعداد الميكروبات الكلية ونشاط إنزيم الديهيدروجينيز كنتيجة لإضافة الأسمدة العضوية وكانت الزيادة بعد محصول الذرة (المحصول الأول) هى الأعلى عنه بعد محصول القمح (المحصول الثانى).