11

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Kinetics of N, P and K Release and CO_2 Evolution in Organic Wastes Treated Sandy Soils

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A LABORATORY incubation experiment was carried out for different time periods (0, 3, 7, 14, 30, 45 and 60 days) to study the effect of some organic wastes (farmyard manure, filter mud cake, compost and poultry manure) with and without biofertilizer incubation on some soil chemical properties (pH, EC and OM), CO2 evolution, and N, P and K release rates in a sandy loam soil amended with these organic wastes.

The effects of different organic wastes varied depending upon organic material type and the incubation period. The organic matter content and the pH of treated soil decreased with increasing the incubation periods especially with biofertilizer inocubation. The soil salinity significantly increased with adding each organic waste and with increasing the incubation period. The cumulative CO2 evolution level from each organic waste increased with the incubation time. The highest Corg level that were mineralized were found in the poultry manure amended soil, while the lowest ones were in the compost amended one.

The total amount of nitrogen, phosphorus and potassium released from each organic waste treated soil significantly increased over the control treatment with time to reach the maximum level at 45 days for N and P and after 60 days for K, particularly with the biofertilizer incubation. The highest released amounts of N, P and K were recorded in the poultry manure amended soil with adding the biofertilizer.

Keywords : Organic wastes, Biofertilizer, N, P, and K release in soil, Incubation periods

INTRODUCTION

Most of the newly reclaimed soils of Egypt are mainly sand and calcareous sand which are very poor in organic matter and plant nutrients, especially N and P. Additions of organic materials to these soils are essential not only to enrich their fertility but also to improve their physical and chemical properties.

The addition of organic wastes to soils is a current environmental and agricultural practice for maintaining soil quality. It has a great effect on organic matter and nutrient contents. It also improves the structure, water and air balance as well as microbiological activity of the soil (Chaturvedi *et al.,* 2008). Organic waste treated soils were reported to have significant effects on the soil organic matter content, pH and salinity (Mendoza *et al.*, 2006). Ewulo (2005) found that the soil organic matter (O.M), N, P and K increased with increasing the applied level of manure. (Usman *et al.*, 2004) in an incubation experiment indicated that the soil pH of calcareous soil decreased with increasing the levels (15, 45 and 90 t/ha) of organic wastes, while the soil salinity increased with the incubation time period.

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Applications of organic materials such as chicken manure, sheep manure, compost, sewage sludge and filter mud cake are emphasized by their beneficial effects on soil characteristics, macronutrients availability (Youssef, 2011 and Hadad *et al.,* 2015). Hellal *et al.* (2014) showed that organic fertilizers particularly farmyard manure (FYM) combined with effective microorganisms (EM) improved the physio-chemical properties of the soil and in turn had a better impact on the nutrient availability.

As soil organic matter increases, N and P availability in the soil increases (Ewulo *et al.*, 2008). Organic manures have been proven to reduce the need for chemical fertilizers and their hazardous effects (Myint *et al.,* 2010). Significant amounts of N, P and K were reported to release in soils treated with 30 t/fed of filter mud cake, sewage sludge and compost. Increases in the uptake of these nutrients were also recorded by corn and wheat plants grown on these treated soils (Hadad *et al.,* 2015). Ahmed and Ali (2005) found that the application of organic fertilizers to soils significantly increased the available P compared to the control. Sarwar *et al*. (2010) also showed that the application of organic manure to the soil caused increases in the contents of soil N, P and K. Also, the total N content of the soil increased with the application of organic fertilizer with bio-fertilizers (Das *et al.,* 2008). The application of organic manure in combination with beneficial microorganism inoculation could increase the soil fertility (Sulfab, 2013). Youssef (2011) showed that the available soil phosphorus significantly increased with applying organic manures alone or combined with EM over the control. Moreover, Adeleye *et al.* (2010) indicated that poultry manure application resulted in an increase in the total N, available P and K. Increases in the available and exchangeable potassium of the soil could be induced by the application of organic and biofertilizers (Dadhich *et al.,* 2011). The combined impact of organic materials and effective microorganisms (EM) on both available and exchangeable K was significantly positive compared with the control treatment (Youssef, 2011).

Dissolved organic carbon (DOC) in organic waste treated soils decreases with increasing the incubation time, mainly attributed to its mineralization by microorganisms (Moreno *et al.,* 1999). The total amounts of organic carbon that are mineralized could be expressed by the cumulative amount of CO2 that is evolved from the soil (Hadad, 2015). The mineralization of nitrogen is influenced by the incubation period, the application level of organic material, the moisture regime and the type of soil (Rahman *et al.,* 2013). Highest levels of cumulative CO2- evolution were recorded in soils treated with sewage sludge while lowest levels were in compost treated soils. The cumulative CO2- evolution increases with increasing both the applied level of the organic material and the incubation period (Hadad, 2015). After 60 days of incubation, the highest amounts of NH4+ were found in cow dung plus chicken manure treated soils followed by the chicken manure treatment (Roy and Kashem, 2014).

The current study aims to evaluate the application effects of some organic wastes (poultry manure, farm yard manure, compost and filter mud cake) and biofertilizer to a sandy loam soil at a level of 30 ton/fed on some soil chemical properties, CO2, N, P and K release rate in this amended soil.

Materials and Methods

An incubation experiment of a complete randomized block design was carried out in the laboratory of Faculty of Agriculture, South Valley University, Egypt, for 60 days to evaluate the changes of some soil chemical properties (pH, EC and OM) and the release of CO_2 , N, P and K in a sandy loam soil treated with different organic wastes.

Four organic materials were used in this study as follows: a - Filter mud cake (FMC): It was produced from the organic wastes of Quos Sugarcane Factory. b- Compost (C): It was made from the experimental farm residues of Faculty of Agriculture at Qena, South Valley University. c- Farmyard manure (FYM): It was produced from the animal production farm, Faculty of Agriculture at Qena, South Valley University. d- Poultry manure (PM): It was taken from the poultry farm, Faculty of Agriculture at Qena, South Valley University. Table 1 shows some chemical characteristics of the tested organic wastes.

In glass vessels, 100 g of the soil sample were thoroughly mixed with each investigated organic amendment at a level of 30 ton/fed. Each treatment was replicated eight times; four of them were inoculated with biofertilizers obtained from the production Lab., Faculty of Agriculture, South

TABLE 1. Some chemical characteristics of the tested organic wastes.

Property	Compost	Filter mud cake	Poultry manure	Farmyard manure
pH (1:10)	7.6	6.7	7.2	7.6
EC (1:10) (dS/m)	3.1	5.6	4.6	8.6
Organic matter (%)	25.29	65.34	27.60	42.20
Organic carbon (%)	14.67	37.90	16.01	24.40
Total nitrogen (%)	0.70	2.31	2.14	1.43
C/N ratio	20.96	16.41	7.48	17.06
Total P (%)	1.23	2.51	1.72	1.33
Total K (%)	0.66	0.32	1.31	1.05

Valley University which contain both nitrogen fixers (*Azotobacte chroococcum, Azospirillum lipoferum*) and phosphate dissolving bacteria (*Bacillus polymxa*) and the other 4 replications were without inoculation. The experiment also contained control treatments without applying the investigated organic materials. Both rock phosphate (30% P_2O5) and feldspar (10% K_2O) were applied to all treatment in the same rate (150kg/fed of each) that will be used in an organic experiment laid out in the field later on using the same treatments. The soil moisture content in each vessel was kept at the field capacity during the experiment time. All treatments were incubated at 30°C in a thermo cabinet for 60 days.

Soil samples were taken from each treatment at the end of each incubation periods of 0, 3, 7, 14, 30, 45 and 60 days to determine some soil chemical properties (pH, EC and OM) and the released amounts of CO2, N, P and K. The results of particle size analysis indicated that the texture of the soil is a sandy loam predominantly consisting of 59 % sand, 24% silt and 17% clay with pH (1:1) 8.26, ECe (dS/m) 3.56, CaCO3 (%) 9.31, OM (%) 0.67, total N (%) 0.01, total P (%) 0.021, total K (%) 0.019, available P (ppm) 6.35 and available K (ppm) 76.98.

The particle-size distribution, calcium carbonate, electrical conductivity (ECe), pH (1:1) of the soil samples, organic carbon in the soil and organic waste were carried out according to Jackson (1973). The pH and the EC of organic wastes were measured in the respective water suspensions and extracts of 1:10 ratio (Schlichting *et al.,* 1995). The available P in the soil samples was extracted using the $NaHCO_3$ method buffered at pH 8.5 (Olsen *et al.,* 1954) and measured using the chlorostannus-phosphomolybdic acid method by spectrophotometer (Jackson, 1973). The available potassium in the soil samples was extracted with 1 N ammonium acetate at pH 7.0 and determined using the flamephotometer (Jackson, 1973). A ground dried organic waste sample of 0.2 g was digested using 10 ml of a mixture of 7:3 ratio of sulfuric to perchloric acids and then analyzed for the total N, P and K as described by Jackson (1973).

For trapping CO_2 , vials containing 10 ml of 1 M NaOH solution were placed inside vessels filled with 100g of organic waste treated soil samples having the moisture content at the field capacity. Then, the vessels were tightly closed and incubated under controlled conditions at 30^{o}C. This temperature was chosen because the optimal temperature for the microbial activity ranges from 20 to 35^{o}C (Scheffer and Schachtschabel, 2002). The NaOH solution in the vials was taken after an incubation period of 0, 3, 7, 14, 30, 45 and 60 days. For 0 day period, the NaOH solution in the vials was taken after 1 hr. The CO_2 evolved during each incubation period was trapped in 1 M NaOH and the excess of NaOH was titrated with 0.1 M HCl after adding $BaCl_2$. Mineralized C was calculated as a cumulative CO_2- evolution (g kg−1 soil) according to Leifeld *et al.* (2002).

All data were subjected to the proper statistical analysis of variance according to the procedures outlined by Gomez and Gomez (1984). The differences between means of the different treatments were compared using the least significant difference (LSD) test at 5 % probability.

Results and Discussion

Effects of organic waste and biofertilizer additions on some oil properties

S*oil pH*

Applying the investigated organic materials with or without the biofertilizer to the soil significantly decreased the soil pH during the incubation periods except in the case of the compost treatment which acted as the control one and raised the soil pH at all incubation periods (Table 2). The reduction in soil pH varied within the organic wastes, depending upon the organic material type and its decomposition. Such processes tend to increase the concentration of protons in soil solution. Soil pH gradually decreased with the increase of incubation time (Roy and Kashem, 2014). Soil pH reduction in the organic waste treated soil might be attributed to the increase in the dissolved CO2 in soil solution as well as the released organic acids from organic carbon oxidation due to the microbial activity. Ali and Mustafa (2009) also indicated that the soil application of bio-organic fertilizer significantly decreased the soil pH.

Due to its lowest pH value among all used organic wastes (6.7), filter mud cake application resulted in the lowest soil pH values starting with 8.06 and 8.10 and ending terminating after a 60 day incubation period with 7.73 and 7.86 with or without adding the biofertilizer, respectively. However, the compost treatment recorded the highest soil pH values at all incubation periods starting with 8.24 and 8.25 and ending with 8.29 and 8.30 after 60 days of incubation with or without biofertilizer addition, respectively.

The inoculation with the biofertilizer along with the application of organic wastes always results in significant decreases in soil pH compared to the uninoculated treatments. Youssef (2011) showed that applying different organic materials and effective microorganisms (EM) to the soil significantly decreased the soil pH compared to the control. These decreases may be due to the production of organic acids, CO_2 and hydrogen ions produced from organic matter decomposition of these organic wastes by microorganisms (Usman *et al.,* 2004 and Hadad, 2015).

Soil salinity

After 60 days of incubation, the application of poultry manure, farmyard manure, filter mud cake and compost increased soil salinity (ECe) by 58.97, 58.46, 57.44 and 31.79 %, respectively, without biofertilizer and 77.97, 56.96, 55.70 and 30.63 %, respectively, with biofertilizer compared to the control (Table 3). Dikinya and Mufwanzala (2010) showed that the soil EC increased with increasing the application level of chicken manure (5, 10, 20 and 40 %).

TABLE 2. Effect of different organic wastes applied to the soil at 30t/fed with and without biofertilizer on the soil pH at various periods of incubation

Organic waste	Biofertilizer	Incubation period (day)						
		0	3	7	14	30	45	60
Control	Without	8.24	8.25	8.25	8.27	8.28	8.28	8.29
	With	8.22	8.23	8.24	8.26	8.26	8.27	8.28
Farmyard manure (FYM)	Without	8.27	8.24	8.25	8.23	8.21	8.16	8.13
	With	8.24	8.23	8.21	8.18	8.14	8.12	8.10
Filter mud cake (FMC)	Without	8.10	8.08	8.07	8.02	7.98	7.92	7.86
	With	8.06	8.03	7.93	7.86	7.80	7.77	7.73
Compost (C)	Without	8.25	8.27	8.29	8.29	8.28	8.28	8.30
	With	8.24	8.25	8.25	8.27	8.28	8.28	8.29
Poultry manure (PM)	Without	8.21	8.19	8.19	8.18	8.16	8.15	8.14
	With	8.19	8.18	8.17	8.15	8.14	8.12	8.10

$LSD_{0.05}$				
	A*	0.12	AC	0.04
	B**	0.19	BC	0.07
	AB	0.07	ABC	0.03
	C***	0.09		

A* organic wastes B biofertilizer C*** incubation times**

TABLE 3. Effect of different organic wastes applied at 30 t/fed with and without biofertilizer on the soil ECe (dS/m) at various periods of incubation

Organic waste	Biofertilizer	Incubation period (day)						
		0	3	7	14	30	45	60
Control	Without	3.63	3.67	3.67	3.73	3.79	3.90	3.90
	With	3.64	3.70	3.73	3.75	3.78	3.96	3.95
Farmyard manure (FYM)	Without	3.98	4.16	4.87	5.25	5.93	6.19	6.18
	With	4.00	4.21	4.97	5.27	5.94	6.20	6.20
Filter Mud Cake (FMC)	Without	3.94	4.12	4.75	5.14	5.75	6.12	6.14
	With	3.95	4.12	4.76	5.15	5.76	6.11	6.15
Compost (C)	Without	3.73	4.24	4.59	4.82	5.00	5.14	5.14
	With	3.72	4.25	4.70	4.82	5.01	5.15	5.16
Poultry manure (PM)	Without	4.00	4.21	4.97	5.27	5.94	6.20	6.20
	With	4.15	4.44	5.35	5.78	6.42	6.77	7.03
		$LSD_{0.05}$	A*	0.36		AC	0.14	
			B**	0.57		BC	0.22	
			AB	0.26		ABC	0.11	
						C***	0.41	

A* organic waste **B** biofertilizer** **C*** incubation period**

Generally, the tested organic materials could be arranged according to their effects on the soil EC increase in the descending order of poultry manure > farmyard manure > filter mud cake > compost. Sarwar *et al.* (2010) indicated that the application of organic manure caused a significant increase in the soil salinity.

Moreover, the highest ECe increase (7.03dS/m) occurred with the interaction of poultry manure (PM) and the biofertilizer at the end of the incubation period. Increases in the soil salinity induced by the application of organic fertilizers with bio-fertilizers were reported by other investigators (Ali and Mustafa, 2009; Dadhich *et al.,* 2011).

Soil organic matter

The application of the investigated organic wastes significantly increased the soil organic matter (SOM) content of amended soils (Table 4). In the beginning of the experiment, the increase in the soil organic matter content was 208, 221, 153, 217% over the control without the biofertilizer addition and 209, 223, 154 and 218% with the biofertilizer application for farmyard manure, filter mud cake, compost and poultry manure, respectively.

Filter mud cake treatment was the superior one in supplying the soil with organic matter compared to the other organic wastes which had the order of filter mud cake> poultry manure> farmyard manure> compost, either with or without biofertilizer addition during all incubation periods. Moreover, Bakayoko *et al.* (2009) found that poultry and cattle manure treatments significantly increased the soil organic matter content from 0.46 to 2.8 and 1.1%, respectively.

A slight decrease in the SOM occurred at all incubation periods when the biofertilizer was added with organic wastes. This decrease may be attributed to the biofertilizer increased microbial activity and more consumption of organic carbon during the decomposition of organic matter compared to those without biofertilizer addition. Free living rhizobacteria such as Azotobacter and Azospirillum spp. can motivate bacterial community in the soil by applying poultry manure, which becomes a source of carbon to the microbes thereby motivating their activities (Johansson *et al.,* 2004). Several studies have been showed that the addition of organic residues increased the soil organic carbon level (Usman *et al.,* 2004 and Hadad, 2015).

TABLE 4. Effect of different organic wastes applied at 30 t/fed with and without biofertilizer on the soil organic matter content (OM%) at various periods of incubation

Organic waste	Biofertilizer	Incubation period (day)						
		0	3	7	14	30	45	60
Control	Without	0.66	0.64	0.61	0.57	0.52	0.48	0.45
	With	0.65	0.62	0.59	0.55	0.50	0.46	0.43
Farmyard manure (FYM)	Without	2.03	2.00	1.98	1.95	1.91	1.88	1.85
	With	2.01	1.99	1.96	1.94	1.89	1.86	1.83
Filter Mud Cake (FMC)	Without	2.12	2.11	2.09	2.07	2.05	2.02	1.99
	With	2.10	2.09	2.06	2.04	2.01	1.98	1.96
Compost (C)	Without	1.67	1.66	1.64	1.63	1.60	1.58	1.55
	With	1.65	1.64	1.62	1.58	1.56	1.54	1.52
Poultry manure (PM)	Without	2.09	2.0	2.06	2.04	2.01	1.97	1.95
	With	2.07	2.05	2.03	2.00	1.98	1.96	1.93
$LSD_{0.05}$	A* 0.22	AC 0.08						
	B** 0.35	BC 0.13						
	AB 0.16	ABC 0.06						
	C*** 0.19							

A* organic waste B** biofertilizer C*** incubation period

The interaction effect of organic waste and biofertilizer significantly decreased the soil organic matter content with increasing incubation period. This decline in the soil organic matter content was more pronounced with the use of the filter mud cake, compost and poultry manure. This effect was also more evident after 7 to 45 days of incubation for filter mud cake or compost amended soil and up to 30 days for poultry manure amended one.

At the end of the incubation period, the increase in the soil organic matter content was reduced to be 8.87, 6.13, 7.19 and 6.7 % without biofertilizer addition and 8.96, 6.67, 7.88 and 6.76% with biofertilizer addition in the soil amended with farmyard manure , filter mud cake, compost and poultry manure, respectively, compared to the control treatment. Gulser *et al.* (2010) indicated that the organic carbon content decreased in the soil with time. El-Sherbieny *et al.* (2004) pointed out that the soil organic carbon of the plant residue amended soil decreased with increasing incubation period.

CO_2 evolution with time from organic waste and biofertilizers amended soil

The cumulative amount of CO_2 that is evolved from the soil treated with an organic material is referred by the total amount of dissolved organic carbon (DOC) in this soil (Moreno *et al.,* 1999 and Hadad, 2015). The dissolved organic C is the most important source of energy for microorganisms (Ipinmoroti, 2013). The highest concentrations of the dissolved organic carbon (DOC) were found in the soil treated with poultry manure (Fig. 1). However, the lowest cumulative amounts of the mineralized organic carbon (Corg) occurred in the compost treated soil. In an incubation experiment maintained for 60 days, Roy and Kashem (2014) revealed that the dissolved organic carbon content of manure treated soils reached its peak after 15 days and then decreased with time. The DOC increase with increasing the incubation time is mainly attributed to the amount of dissolved organic C that is mineralized by microorganisms. Similar results were reported by Hadad (2015). He recorded highest levels of cumulative CO_2 evaluation from sewage sludge treated soils but lowest ones from compost amended soils. Moursy and Abdel Aziz (2013) indicated that the organic carbon significantly declined with incubation time.

The addition of biofertilizer to the treated soil led to an increase in Corg mineralization compared to the treated one. The DOC also increased with increasing the incubation period for all organic waste treatments.

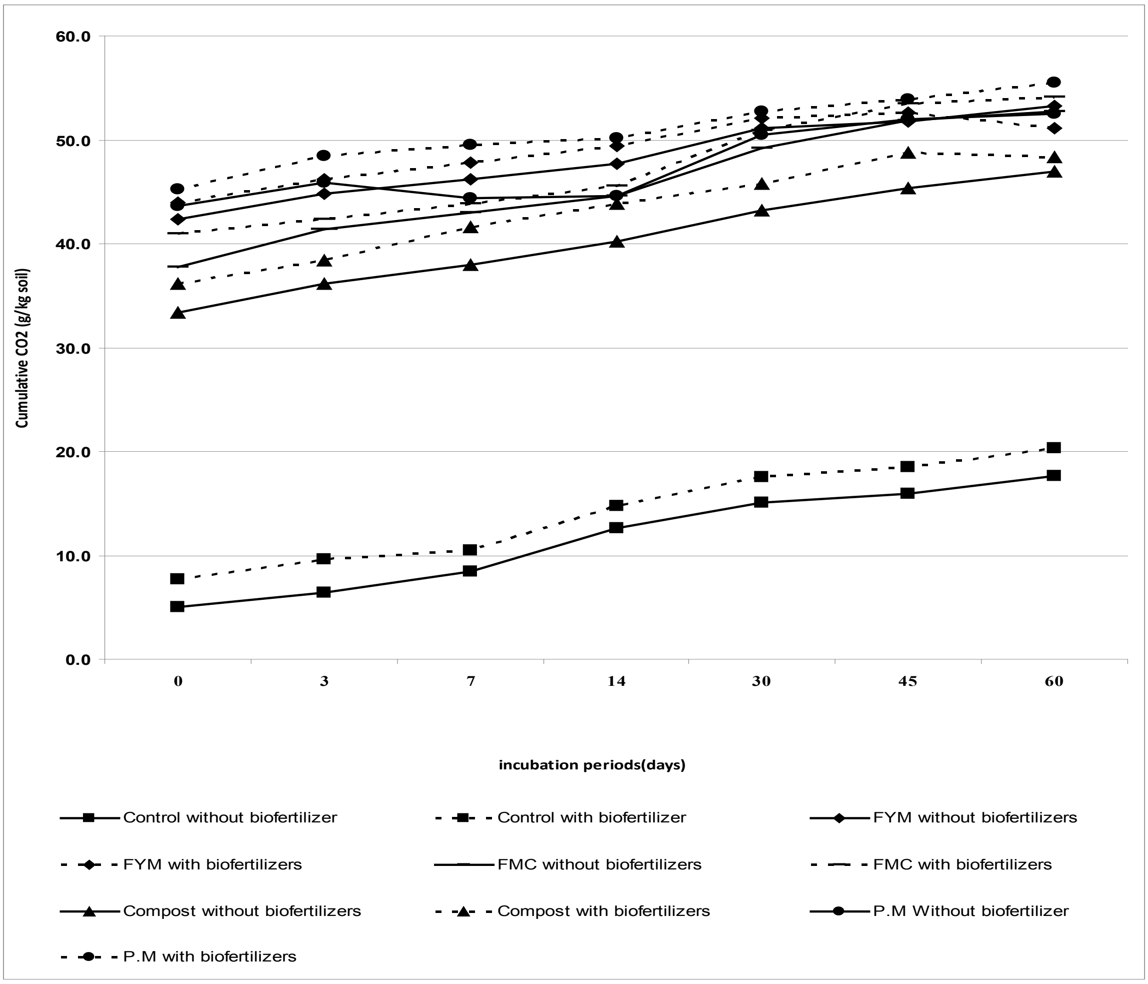

Fig. 1. Effect of different sources of some organic wastes, biofertilizer and incubation periods on the cumulative CO2 mineralization (g kg−1 soil).

Release of N, P and K with time in organic waste and biofertilizer amended soil.

Nitrogen

The total nitrogen released the soil treated with each investigated organic waste at each incubation period was significantly ($p<0.05$) higher than for that of the control (Figure 2). The application of each organic waste significantly increased the total available N in the soil with increasing the incubation time until 45 days and then decreased at 60 days. So, the total available N of the treated soil reached the maximum level at 45 days of incubation. These results are in an agreement with those of Ipinmoroti (2013). The release of nitrogen from the organic matter application tends to increase with the time of incubation (Anggeria *et al.,* 2012).

On the other hand, the results showed that the application of the tested organic wastes with the biofertilizer resulted in highest increases in the released total amounts of nitrogen compared to those without the biofertilizer at all the incubation periods. The efficiency of the effective microorganisms in bio-fertilizer treatments is attributed to their role in accelerating the mineralization process of organic matter, helping the release of nutrients and enhancing the utility values of soil organic matter content (Yadav, 1999).

The investigated organic wastes varied in their nitrogen ability releasing depending on the organic waste type and period of incubation either with or without biofertilizer. The tested organic wastes could be arranged according to

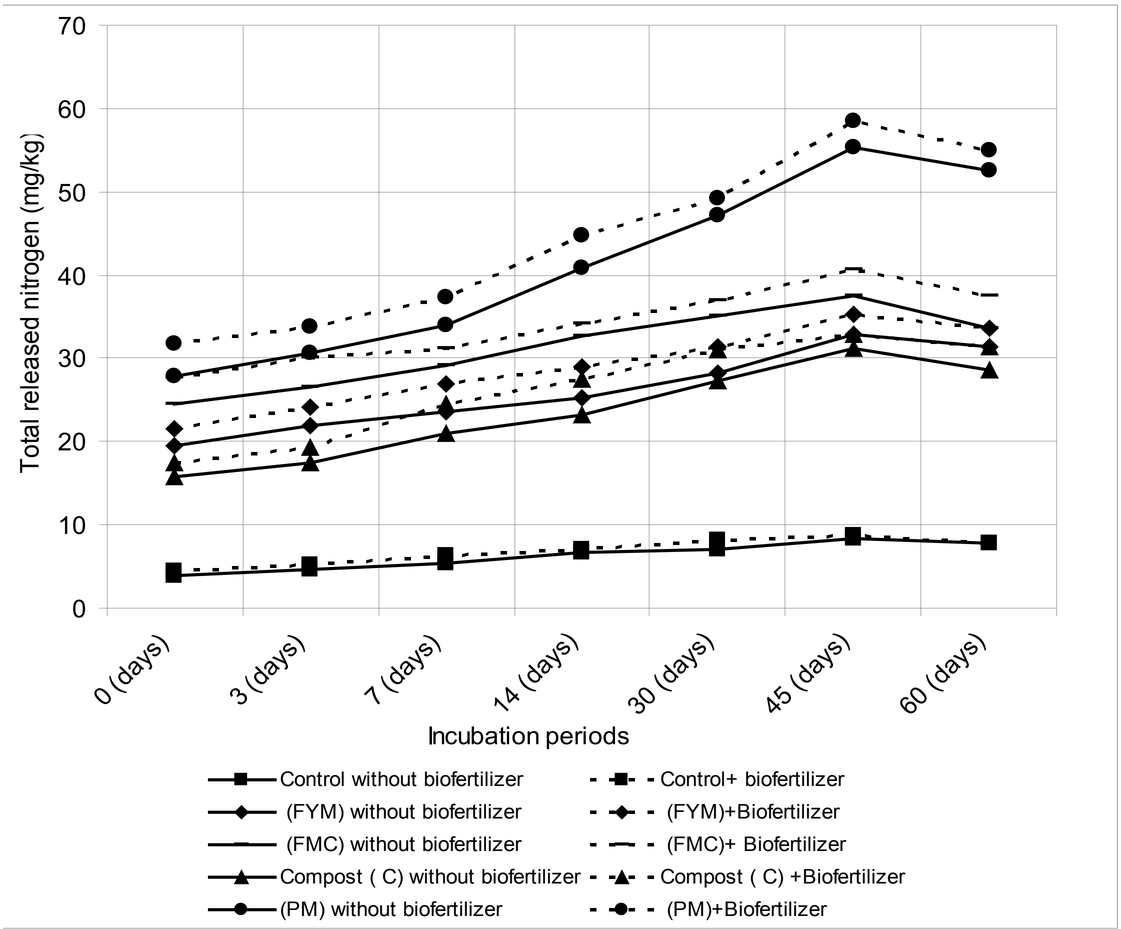

Fig. 2. Total N released in the soil treated with organic wastes compared to the control at different incubation periods

their ability to release nitrogen in the soil in the descending order of poultry manure> filter mud cake> farmyard manure> compost, without and with biofertilizer inocubation.

The maximum amount of nitrogen released from the poultry manure treated soil was 58.42 and 55.36 mg kg-1 at 45 days of incubation with and without biofertilizer application, respectively. Vel Murugan and Swarnam (2013) reported that manures and fertilizers significantly increased the concentration of mineral nitrogen (NH4+ + NO3- nitrogen) in the soil due to the net mineralization during the incubation period.

Phosphorus

Additions of organic wastes, with and without the biofertilizer, resulted in gradual significant increases in the soil available P to reach the maximum level at 45 days and then decreased at 60 days of the incubation (Table 5). The availability of P in the soil increases as the soil organic matter increases (Ewulo *et al.,* 2008). The decomposition of organic materials increasingly continued accompanied with increases in the released P up to 45 days but a substantial portion of the available P was immobilized by microorganisms after 45 days of incubation. The increase in the released phosphorus depends upon the type of the organic waste and the incubation period. Compared to the control treatments, the released available P reached the maximum level at 45 days of incubation with increases of 238, 237, 212 and 142 % without biofertilizer inoculation and 268, 264, 215 and 145 % with biofertilizer inoculation in the soil treated with filter mud cake, poultry manure, farmyard manure and compost, respectively. These results are in an agreement with those obtained by Abdel-Rahem (2006). The increase in the soil available-P induced by the application of organic materials might be due to their decomposition and producing organic acids

TABLE 5. Effect of different organic wastes applied to the soil at 30 t/fed with and without biofertilizer on the released phosphorus (mg/kg) at different periods of incubation

Organic waste	Biofertilizer	Incubation period (day)						
		0	3	7	14	30	45	60
Control	Without	9.85	11.48	13.66	14.79	15.57	14.82	14.31
	With	9.86	11.55	13.72	14.84	15.65	14.78	14.40
Farmyard manure(FYM)	Without	28.32	31.49	33.28	35.31	42.06	46.26	38.20
	With	28.97	32.23	33.83	35.19	42.78	46.59	38.67
Filter Mud Cake (FMC)	Without	32.97	36.20	37.67	41.48	46.02	51.01	44.64
	With	34.68	38.35	39.46	42.89	45.74	54.40	48.46
Compost (C)	Without	17.67	20.75	22.73	25.19	31.71	35.93	27.73
	With	18.32	21.49	23.28	25.07	32.06	36.26	28.38
Poultry manure (PM)	Without	31.76	35.13	37.77	40.62	46.55	50.16	45.38
	With	32.16	35.42	38.06	42.71	48.89	53.79	47.28
$LSD_{0.05}$ A		0.65	0.41	0.59	0.50	0.52	1.17	0.66
B		0.41	0.26	0.37	0.32	0.33	2.01	0.41
A*B		0.92	0.58	0.83	0.71	0.74	1.48	0.93

A* organic waste B** biofertilizer C*** incubation periods

which increase the phosphorus availability in the soil. It might also be attributed to the release of P after the decomposition of these organic materials. In addition, the biofertilizer contains phosphate dissolving bacteria (Bacillus polymxa) that can caused increases in the soil available P. Moreover, organic acids, CO2 and other products resulting from the microbial decomposition of organic matter may solubilize the insoluble phosphate forms by chelating cations, lowering soil pH and / or the partial occupation of organic anions on the surface of CaCO3 and clay minerals (El-Desoky and Ragheb, 1993).

Potassium

The available potassium in the soil significantly increased with the addition of organic wastes alone or in combination with the biofertilizer (Table 6). This result coincides with those obtained by Adeleye *et al.* (2010). The application of biofertilizer always shows positive significant effect on the soil available potassium in all treatments.

In addition, the available K increased gradually with time to reached the maximum levels of 186.39, 171.11, 166.39 and 129.73 mg kg-1 in poultry manure, farmyard manure, filter mud cake and compost soils, respectively, after 60 days of incubation without adding the biofertilizer, with increases of 116, 98, 93 and 50 %, respectively, compared to the control treatment. However, the available K reached the maximum values of 188.37, 173.09, 166.92 and 130.26 mg kg-1 in the respective treated soils after 60 days with the biofertilizer inoculation recording respective significant increases of 103, 87, 80 and 40 % compared to their control treatments.

Generally, the tested organic wastes could be arranged according to their effects on increasing in the soil potassium release in the descending order of poultry manure> farmyard manure> filter mud cake> compost with and without the biofertilizer inoculation. The increase in the available K released in the organic waste treated soil could be attributed to the decomposition of the investigated organic wastes as a result of microbial activity. The present study revealed that after 60 days of incubation, poultry manure and farm yard manure particularly in combination with biofertilizer inoculation improved the available soil K which they recorded higher K release levels of 16.47 and 15.19 % of the total initial K levels, respectively. Mohsen (2011) reported that the organic residues could be an alternative indigenous source of K because they could improve soil K levels of calcareous soils by increasing its release rate.

Conclusion

The investigated organic wastes (farmyard manure, filter mud cake, poultry manure and compost) applied at level 30 t/fed in combination with biofertilizer inoculation increased the soil salinity and decreased the soil pH and OM content with time. They increased the released amounts of N, P and K in the studied soil. On the other hand, the use of poultry manure and filter mud cake recorded the highest levels of available N, P and K in the soil without and with biofertilizer addition during incubation periods. Effects of the investigated organic wastes on the estimated soil chemical properties varied according to the organic waste type. These effects should be taken into consideration during crop production. A need for more prolonged incubation and field studies conditions to cover complete growth duration of the crops is required to provide some useful sights on the long-term changes in soil properties and dynamics of nutrient mineralization/release in the soil.

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حركية و تحررعناصر النيتروجين والفوسفور والبوتاسيوم وانطلاق ثانى اكسيد الكربون فى اراضى رمليه معامله ببعض المخلفات العضوية

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تم اجراء تجربة تحضين في المعمل لفترات مختلفة من التحضين (0، 3، 7، 14، 30، 45 و 60 يوم) لتقييم تأثير إضافة أنواع مختلفة من المواد العضوية (السماد البلدي، وطينة المرشحات، والكمبوست ، سماد الدواجن) مع إستخدام الأسمدة الحيوية وبدونها على بعض خواص التربة الكيميائية و على تصاعد غاز ثانى اكسيد الكربون وتحرر عناصر النيتروجين والفوسفور والبوتاسيوم في تربة رمليه لوميه معامله بهذه المخلفات.

اختلف تأثير المخلفات العضوية تبعا لنوع المخلف و فترة التحضين. ظهرانخفاض فى محتوى المادة العضوية وفى pH التربه المعامله بزيادة فترات التحضين خاصة مع التلقيح بالسماد الحيوى. حدثت زيادة معنوية فى ملحية التربة مع اضافة اى من المخلفات العضويه و مع زيادة مدة التحضين. زادت كمية ثانى اكسيد الكربون المنطلقه من كل مخلف عضوى مع زيادة مدة التحضين. كان اعلى معدل لمعدنة الكربون العضوى مع التربه المعامله بخلفات الدواجن بينما كان اقل معدل مع التربه المعامله بالكمبوست.

زادت الكميات الكليه المنطلقه من عناصرالنيتروجين والفوسفور والبوتاسيوم زياده معنويه في التربة المعامله باى من المخلفات العضويه مع زيادة فترة التحضين لتصل الى اعلى مستوياتها بعد 45 يوم من التحضين فى حالة عنصرى النيتروجين و الفوسفور و بعد 60 يوم فى حالة عنصر البوتاسيوم خاصة مع التلقيح بالسماد الحيوى. وكانت معاملة زرق الدواجن مضافا إليها التسميد الحيوى هى أفضل المعاملات فى الكميات المنطلقه من النيتروجين و الفوسفور و البوتاسيوم.