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INORGANIC PHOSPHORUS FORMS IN A DESERTIC SOIL AMENDED WITH SOME ORGANIC WASTES

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ABSTRACT: **Informations about soil P fractions could be useful to predict the bioavailability of P in soil as well as to predict the likelihood of P mobility in soil. In this study, we used a sequential fractionation procedure to investigate the forms of P in calcareous soil. Each of the organic wastes (sheep dung "SD" biogas manure "BM" town refuse compost "TC") and at rates of 0,2 and 4% for each source either with or without rock phosphate application were thoroughly mixed with 100 gram portions of the investigated soil in columns. The treated soil columns 0-30cm were incubated for 20, 40 and 80 days. After the incubation periods, soil columns good mixed, air dried and baked in plastic bottle for the soil analyses. The obtained results showed that after the incubation periods studied, the fractions of the inorganic P were higher with than without rock phosphate application. The results showed that Labile-P was highest with biogas refuse application and the values ordered as affect of the incubation period as the follow: 20, 40 and 80 days. Al-P fraction give the highest value (0.51$\mu g.g^{-1}$) with sheep refuse application and after 80 days. With respect to Fe-P fraction, the results showed that the town refuse application give the highest value (0.79$\mu g.g^{-1}$) after 20 days incubation. But with respect of Ca-P fraction, the data showed that sheep refuse give the highest (94.5$\mu g.g^{-1}$) after 20 days incubation.**

INTRODUCTION

To investigate amending the effects of organic wastes on forms of soil P, it may be preferable to identify and quantify individual P compounds in soil, but because the chemistry of soil P in so complex, it is almost impossible to identify individual P compounds. Instead, main classes of soil P compounds are often defined functionally by specific extractants that remove them from soil material in a sequential fractionation scheme. Sequential fractionation procedures are based on the assumption that chemical extractants selectively dissolve discrete groups of P compounds, and such operationally defined soil P fractions are subject to broad interpretations. Nevertheless, the informations obtained from P fractionation schemes has been useful for interpretations of soil development (Walker and Syers, 1976; Smeck, 1972; 1985; Cross and Schlesinger, 1995; Nair *et al.*, 1995) as well as P availability to plant use (Tiessen and Moir, 1993; Cox, *et al.*, 1997). This procedure aims at quantifying plant-available (NH_4Cl-P), Ca-associated (HCl-extractable), Fe-oxide-and Al-oxide-associated inorganic P (NaOH-extractable), as well as both labile and stable organic P pools. More informations about the forms of P in organic wastes-amended soils is needed to assess the environmental consequences of the very high levels of P that may occur in soils. Our objectives in this study were to quantitatively document the effects of organic waste amendments on soil P fractions to qualitatively investigate transformations among soil P fractions after organic wastes application.

MATERIALS AND METHODS

Surface soil sample (0-30cm) were collected to represent a calcareous soil at Mariyout (Agricultural Farm of the Desert Research Center). The samples were thoroughly mixed air dried finely, ground to pass through a 2-mm sieve and stored for laboratory analyses and performing the laboratory experiment. Some physical and chemical properties of the investigated soil are shown in Table (1).

The organic wastes involved in the current work were sheep dung (SD) and biogas wastes taken from the Agricultural Frames of the Desert Research center at Mariyout and Wadi Sudr, respectively. Town refuse was taken from the Egyptian Organic Manure Plant (Shoubra). Some chemical characteristics of the studied organic wastes are presented in Table (2).

Table (1): Some physical and chemical properties of invest-soil.

Properties													
Soil constituents							DTA Extractable nutrients (µg.g^{-1})						
Sand (%)	Silt (%)	Clay (%)	Organic matter (%)	pH (1:2.5)	EC dS.m^{-1}	$CaCO_3$ (%)	P	Fe	Mn	Available N	C (%)	N (%)	C: N ratio
48.30	20.60	31.10	0.80	7.80	0.91	27.50	10.15	5.00	11.50	40.00	0.47	0.068	6.90

Table (2): Some chemical properties of organic wastes.

Organic wastes	pH 1:2.5	EC 1:5 dSm^{-1}	Organic matter	Total carbon	Total N	C/M ratio	Available elements (µg.g^{-1})			
			(%)				P	Fe	Mn	Zn
Sheep dung	7.10	12.48	41.51	24.08	1.33	18.10	18.70	14.0	5.0	5.3
Biogas refuse	7.76	16.33	22.52	13.06	1.50	8.37	15.69	19.0	10.7	7.2
Town refuse compost	6.75	8.93	27.23	15.79	1.11	14.22	30.00	6.7	7.3	8.5

Incubation experiment:

Plastic columns of 50 cm length and 20 cm internal diameter and having a side drainage hole of about 1 cm diameter were contacted with plastic tubes. A piece of glass wool was placed over each column and covered with leached sand. Each column was packed with 3kg of the tested soil up to a depth of about 30cm.

The soil columns were divided into two groups, the first received no phosphate rock "PR" while the other group columns were treated with PR at rate of 0.4 g/colamn.

Each organic amendment was thoroughly mixed with the investigated soil in columns. The rates of organic wastes applications were 0, 2% and 4% of the packed soil column. Each treatment was replicated 3 times. The treated soil columns were incubated for 20,40 and 80 days. The moisture content was keept at about 70% of field capacity by using the tape water. By the end of the experiment, the soil in removed columns were air dried and packed in plastic bags for soil analysis.

Soil analyses:

The tested soil sample was sylyected to the following analysis:

- Particale size distribution using the international pipette method with sodium hexameta phosphate as a dispersing agent (Piper, 1950).
- Calcium carbonate using Collin's calcimeter (Wright, 1939).
- Organic matter according to the method of Walkley and Black (Jackson, 1983).
- Soil reaction (pH) in 1: 2.5 soil: water suspension using Beckman's pH meter according Page, *et al.* (1982).
- Electrical conductivity in 1:5 soil: water extractable using a conductivity bridge (US.Sal. Lab. Staff., 1969).
- Soil contents of available P, Fe and Mn were extracted using the method of Soltanpour and Schwab (1977) and both Fe and Mn were measured using an atomic absorption spectrophotometer type Perkin Elmer 380. While P was determined using Murphy and Riley method as according, Jackson, (1973).
- ***Fractionation* of soil inorganic-P:** Duplicate 1.0 gm of soil samples representing the column were used to determine the various fractions of inorganic P.

Easily-*soluble* P: A 50ml solution of 0.5 M NH_4Cl was added and shaken for 30 min. (Chang and Jackson, 1957).

- **NH_4F-P (aluminium-bound P):** A 50 solution of 0.5 m NH_4F adjusted at pH 8.2, shaken for 24 hours was used as an extractant for this P (Khin and Leeper, 1960).
- **NaOH-P (iron-bound P):** This fraction was extracted using 50 ml solution of 0.1 N NaOH + 1 M NaCl shaken for 17 hours. (Williams *et al.*, 1967).
- **H_2SO_4-P (Ca-P):** shaken 50 ml solution of 0.5 N H_2SO_4 for 1 hour.

Organic wastes analyses:

- The organic amendments were air dried and finely ground; suitable weights of each was digested using sulphuricperchloric acids mixture (Jackson, 1973).
- Micronutrients were determined in the digests using atomic absorption spectrophotometer type 380.
- Nitrogen was determined volumetrically using the micro Kjeldahl method.
- Organic matter content was determined by Weakley and Black described by Page, *et al.* (1982).

RESULTS AND DISCUSSION

Data in Tables (3-6) showed the distribution of the inorganic-P, vz., easily soluble-P (NH_4Cl-), NH_4F-P (Al-P), NaOH-P (Fe-P) and H_2SO_4-P (Ca-P) as affected by type and rates of organic wasters (sheep, biogas and town refuse) applications with and without rock phosphate treatments and incubation for the three periods i.e. 20, 40 and 80 days.

The effect of sheep dung:

Labile-P (NH_4Cl-P Fraction):

The obtained results in Table (3) showed the effect of sheep dung incubated in calcareous soil with and without applied PR, for 20,40 and 80 days. As mean values, data showed that the concentration of labile-P fraction decreased with increasing the incubation period time in either with or without rock phosphate application, while with rock phosphate application, the concentration of labil-P increased with increasing the time of the incubation.

With respect to the effect of sheep dung application, data in Table (3) showed that labile-P fraction increased gradually with increasing the rate of sheep dung application with or without rock phosphate application, being greater with rock phosphate application comparing with its absence. In general, the highest values of P in the labile-P pool were, 5.06 and 7.09$\mu g.g^{-1}$ at the 4% rate of sheep dung applications in without and with rock phosphate for the incubation periods 20 and 40 days, respectively.

Al-P Fraction:

The mean values of P in Al-P fraction in Table (3) showed that P in this fraction increased gradually with the increasing the incubation period either without or with PR application with higher values of Al-P under PR than without PR application. With respect to the effect of the rate of sheep dung application, data in Table (3), reveal that the main fractions of inorganic P in a soil received no rock phosphate treated with sheep dung showed that there no clear trend. however the effect of rock phosphate was more obviores. The highest concentration of P in the Al-P fraction were 0.35 and 0.62 $\mu g.g^{-1}$ under the 2% and 4% rates of sheep dung applications without and with rock phosphate application, respectively.

Table (3): The main fractions of inorganic P in a soil treated with rock phosphate and sheep dung .

Rate of O.W (%)	Without rock phosphate						With rock phosphate					
	NH_4Cl-P	Al-P	Fe-P	Ca-P	Total	Ca-P / Total	NH_4Cl-P	Al-P	Fe-P	Ca-P	Total	Ca-P / Total
						20 days						
Control	3.05	0.06	0.21	42.8	46.12	92.8	4.15	0.29	0.56	88.8	93.80	94.7
2 (%)	4.10	0.17	0.12	75.5	80.19	94.5	4.44	0.17	0.27	101.6	106.48	95.4
4 (%)	5.06	0.18	0.23	71.4	76.87	92.9	6.89	0.19	0.25	93.0	100.33	92.7
Mean	4.07	0.14	0.19	63.3	67.70	93.4	5.16	0.22	0.36	94.5	100.10	94.3
						40 days						
Control	0.41	0.21	0.35	32.5	33.47	97.1	0.77	0.25	0.49	71.7	73.21	97.9
2 (%)	1.44	0.19	0.08	23.7	25.41	93.3	5.60	0.29	0.41	83.7	90.00	93.0
4 (%)	2.18	0.21	0.16	30.1	32.65	92.2	7.09	0.29	0.84	88.9	97.12	91.5
Mean	1.21	0.20	0.20	28.8	30.50	94.2	4.49	0.28	0.58	81.4	86.80	94.1
						80 days						
Control	0.93	0.23	0.12	39.2	40.48	96.8	2.06	0.45	0.33	61.8	64.64	95.6
2 (%)	0.49	0.35	0.15	24.4	25.39	96.1	2.18	0.45	0.19	66.4	69.22	95.9
4 (%)	1.34	0.21	0.35	25.1	27.00	93.0	3.52	0.62	0.52	66.1	70.76	93.4
Mean	0.92	0.26	0.17	29.6	31.00	95.3	2.59	0.51	0.35	64.8	68.20	95.0

Fe-P fraction:

Data presented in table (3) point out that as average mean values, the higher values of P in Fe-P under the rate application of sheep dung and rock phosphate than without PR application after the incubation period for 40 days. The highest values were 0.2 and 0.58 $\mu g.g^{-1}$ of P in Fe-P fraction without and with rock phosphate application, respectively. With respect to the effect of sheep dung rate, data showed that the highest values of P concentration in Fe-P fraction were 0.35 and 0.16 $\mu g.g^{-1}$ P with control soil sample and the 4% rate of sheep dung application after 40 and 80 days of incubation in absence of PR application, respectively, while with rock phosphate application, the corresponding value of P concentration was 0.84 $\mu g.g^{-1}$ with 4% rate application of sheep wastes after 40 days of the incubation time.

Ca-P fraction:

Data in Table (3) show that the mean values of P in Ca-P fraction were decreased with the increasing the incubation period either without or with rock phosphate application. The results showed that PR application gave higher values of Ca-P fraction than without PR application. With respect to the rate application of sheep dung, data in Table, (3) did not show a clear trend on P concentration. But the effect of the application rate of sheep dung gave higher values of P with PR application than without. The highest values of p in Ca-P fraction were 75.8 and 101.6 $\mu g.g^{-1}$ for 2% of the application rate of sheep dung after 20 days of incubation without and with PR application, respectively. With respect to percentage of P in Ca-P fraction and total estimated fractions, data in Table (3) showed that the mean values of P as affected by application rates of sheep dung were highest after 80 days incubation and a simple difference was found between the effect of without and with PR application. The highest values of P percentage were 97.1 and 97.9 $\mu g.g^{-1}$ for the 40 days incubation period in case of control samples, while the lowest values were 92.2 and 91.5 $\mu g.g^{-1}$ with 4% application rate of sheep dung without and with rock phosphate application, respectively.

The effect of biogas wastes:

Data in Table 4 show the main fractions of inorganic P in soil treated with PR after incubation periods of 20,40 and 80 days.

Labile-P (NH_4Cl-P fraction):

The obtained results in Table (4) reveal that the mean values of NH_4Cl-P fraction was positively affected by application rates of biogas manure, this effect was higher with rock phosphate than without application under all the incubation periods studied. On the other hand, P in NH_4Cl fraction decreased. Generally, the highest values of NH_4Cl-P fraction occurred after 20 days of incubation either without or with PR application. The highest values of NH_4Cl-P were 4.73 and 11.75 $\mu g.g^{-1}$ for 2% and 4% rate of biogas manure absence of PR.

Table (4) the main fractions of inorganic P in a soil treated with rock phosphate and biogas wastes and with rock phosphate application after 20 days incubation, respectively.

Al-P fraction:

Results in Table (4) also show that the mean values of P in Al-P fraction as affected by biogas waste treatments were higher with rock phosphate than with its absence after all the testes incubation periods. They highest values were 0.22 and 0.39 $\mu g.g^{-1}$ after 40 and 80 days incubation in absence of rock phosphate application, respectively. The highest values of Al-P fraction under all the tested treatments amounted to 0.25 and 0.45 $\mu g.g^{-1}$ under incubation of BM (at rate 2%) for 40 days and that of the control incubated for 80 days, respectively.

However, the highest P values in the Al-P fraction extracted through nonphosphated and rock phosphates treatments were 0.39 and 0.99 $\mu g.g^{-1}$ under the incubation of BM at the rate of 4% for without rock phosphate for 80 days and incubation of PR and TC at 4% rate, in the calcareous soil for 20 days.

Fe-P fraction:

Results show that the mean values of Fe-P fraction were higher with rock phosphate application and lower its for all the tested periods of incubation.

The highest P values were 0.29 and 0.62 $\mu g.g^{-1}$ for 80 and 20 days incubation either without or with rock phosphate application, respectively. The lowest values were 0.25 and 0.40 $\mu g.g^{-1}$ after 40 and 80 days of incubation either without or with rock phosphate application, respectively. With respect to the application rate of BM, data showed the after 40 days incubation, data revealed to decreased P in Fe-P fraction with increasing the BM application rates either with or without rock phosphate application. While after 20 and 80 days of the incubation, the results do not gave a clearly trend. Generally, the highest concentrations of P in the Fe-P fraction were 0.39 and 0.99 $\mu g.g^{-1}$ as affected by rate 4% rate of biogas waste and after 80 and 20 days of the incubation times without and with rock phosphate application, respectively.

Ca-P fraction:

Data in Table (4) showed that the mean values of Ca-P fraction decreased gradually with increasing the incubation period to 80 days in case of incubation the studied soil without rock phosphate application, while in case of rock phosphate application, the mean values of P under BM treatments decreased with the incubation period in ordered; 40> 80> 20 days. With respect to effect the rates application of BM on the

P in Ca-P fraction, data in Table (4) showed that there is a clear effect in case of 40 and 80 days of the incubation periods. Without rock phosphate application, the result showed an increasing effect and decreasing on with increasing the rate application of BM after 40 and 80 days of the incubation time, respectively. But after 20 days incubation did not show a clear trend where the effect of rate application BM ordered as 2% 4%> control. In case of rock phosphate, the effect of the applications rate of BM on the Ca-P fraction a gradually increasing with increasing the incubation periods 20, 40 and 80 days. Data reveal that the Ca-P decreased with from to the rate of the organic source application but of the incubation period, while P concentration in Ca-P fraction increased with increasing of the rate application of biogas waste after 40 and 80 days of the incubation period. Generally, the highest values of P in Ca-P fraction were 69.2 and 102.4 $\mu g.g^{-1}$ as affected by the rates 2% and 4% of biogas waste application after 20 and 40 days of the incubation periods in case of without and with rock phosphate application, respectively. While, the lowest values of p concentration were 22.4 and 60.9 $\mu g.g^{-1}$ were as affected by the rate 4% of BM. without and with rock phosphate application and after 80 and 20days of the incubation periods, respectively.

With respect to P percentage of the total extractable inorganic fractions, data in Table (4) showed that with rock phosphate application the mean values of P percentage of total inorganic fraction of P were gradually increased with increasing the incubation period in ordered; 80> 40>20 days, and 40>20>80 days, under no PR application.

With regard to the effect of the rate BM application on P percentage of total inorganic P fractions data showed in case of rock phosphate application, a gradually decrease in P/total inorganic fraction with increasing 97.9$\mu g.g^{-1}$ occurred with the control treatment and after 40 days of incubation while the lowest value i.e. 82.4$\mu g.g^{-1}$ occurred with application of BM at the rate of 4% after 20 days of incubation.

With respect of the effect of BM, it was that the percentage of P decreased with increasing the rate of BM application. The highest and lowest values of P percentage of the total inorganic fractions were 97.1 and 82.7 $\mu g.g^{-1}$ under the control treatment and rate 4% of BM application under 40 and 80 days incubation, respectively.

Table (4): The main fractions of inorganic P in a soil treated with rock phosphate and biogas manure .

Rate of O.W (%)	Without rock phosphate						With rock phosphate					
	NH_4Cl-P	Al-P	Fe-P	Ca-P	Total	Ca-P / Total	NH_4Cl-P	Al-P	Fe-P	Ca-P	Total	Ca-P / Total
							20 days					
Control	3.05	0.06	0.21	42.8	46.12	92.8	4.15	0.29	0.56	88.8	93.80	94.7
2 (%)	4.73	0.23	0.31	69.2	74.47	92.9	6.42	0.19	0.31	75.2	82.12	91.6
4 (%)	3.55	0.10	0.33	43.6	47.58	91.6	11.75	0.27	0.99	60.9	73.94	82.4
Mean	3.80	0.13	0.28	51.9	56.10	92.4	7.45	0.25	0.62	75.0	83.30	89.6
							40 days					
Control	0.41	0.21	0.35	32.5	33.47	97.1	0.77	0.25	0.49	71.7	73.21	97.9
2 (%)	4.36	0.25	0.27	58.0	62.88	92.2	4.40	0.27	0.43	78.0	83.10	93.9
4 (%)	2.24	0.19	0.14	59.4	61.97	95.9	8.54	0.16	0.45	102.4	111.55	94.8
Mean	2.34	0.22	0.25	50.0	52.80	95.1	4.57	0.23	0.46	84.0	89.30	94.5
							80 days					
Control	0.93	0.23	0.12	39.2	40.48	96.8	2.06	0.45	0.33	61.8	64.64	95.6
2 (%)	2.12	0.21	0.37	25.7	28.40	90.5	2.72	0.37	0.45	68.5	72.04	95.1
4 (%)	4.13	0.18	0.39	22.4	27.10	82.7	4.86	0.35	0.41	81.3	86.92	93.5
Mean	2.39	0.21	0.29	29.1	32.00	90.0	3.21	0.39	0.40	70.5	74.50	94.7

The effect of town refuse compost:

Data in Table (5) pointed out to the effect of town wastes and rock phosphate incubated with calcareous soil for different periods on their contents of some inorganic phosphorus fractions.

Regarding the effects on soil content of some P fractions, results reveal the following:

NH_4Cl-P fraction:

The results in Table (5) show that the mean values of NH_4Cl-P fraction in soil gradually decreased with increasing the incubation periods whether with or without of PR application, but the higher with PR treatment. Results did not give a clear trend whether with or without PR application. However PR treatments gave highest values of the NH_4Cl-P under all incubation periods. The highest values of P were 3.05 and 4.15 $\mu g.g^{-1}$ P in case of the control treatments after 20 days of incubation in abcence and presence application, respectively. The lowest values of P were 0.41 and 0.77 $\mu g.g^{-1}$ in case of the control treatments after 40 days the incubation period without and with PR application, respectively.

Table (5): The main fractions of inorganic P in a soil treated with rock phosphate and town refuse compost .

Rate of O.W (%)	Without rock phosphate						With rock phosphate					
	NH_4Cl-P	Al-P	Fe-P	Ca-P	Total	Ca-P / Total	NH_4Cl-P	Al-P	Fe-P	Ca-P	Total	Ca-P / Total
						20 days						
Control	3.05	0.06	0.21	42.8	46.12	92.8	4.15	0.29	0.56	88.8	93.80	94.7
2 (%)	1.32	0.16	0.29	67.9	69.67	97.5	2.23	0.39	0.76	79.5	82.88	95.7
4 (%)	1.53	0.14	0.29	38.4	40.36	95.1	2.82	0.25	0.91	70.3	74.28	94.6
Mean	2.00	0.12	0.26	50.0	52.10	95.5	3.10	0.31	0.79	79.5	83.70	95.1
						40 days						
Control	0.41	0.21	0.35	32.5	33.47	97.1	0.77	0.25	0.49	71.7	73.21	97.9
2 (%)	2.39	0.19	0.23	55.8	58.61	95.2	2.06	0.27	0.45	90.2	92.98	97.0
4 (%)	2.20	0.17	0.37	32.7	35.44	92.3	2.84	0.31	0.68	92.7	96.53	96.0
Mean	1.70	0.19	0.32	0.4	42.50	94.9	1.89	0.28	0.54	84.9	87.60	97.0
						80 days						
Control	0.93	0.23	0.12	39.2	40.48	96.8	2.06	0.45	0.33	61.8	64.64	95.6
2 (%)	1.79	0.17	0.25	56.8	59.01	96.3	1.89	0.21	0.53	68.4	71.03	96.3
4 (%)	0.95	0.19	0.45	38.0	39.59	96.0	1.15	0.25	0.49	67.1	68.99	97.3
Mean	1.20	0.20	0.27	0.45	46.40	96.4	1.70	0.30	0.45	65.8	68.20	96.4

Al-P fraction :

Results in Table (5) showed in general that the mean values of the Al-P fraction were higher with rock phosphate treatment than without its application under all tested treatments. On absence of PR application the Al-P fraction increased with increasing of the incubation period, but no clear trend was found under PR application.

With regard to Al-P fraction as affected by different rates of TC the main fraction of inorganic P in the PR-treated soil results did not show any clear trend with its application. The highest values of Al-P fraction under the control treatments of TC 0.23 and 0.45 $\mu g.g^{-1}$ in case of the occurred with soil incubation for 80 days without and with rock phosphate applications, respectively. The lowest values of Al-P i.e. 0.06 and 0.17 $\mu g.g^{-1}$ P were in case of the control treatment under the rate 2% of town waste under 20 and 80 days of the incubation, respectively in absence of PR application for both treatment.

Fe-fraction:

Data in Table (5) showed that the mean values of the Fe-P fraction were higher with PR application than without it under all the tested treatments. With PR application Fe-P fraction decreased with the increasing of the incubation time, but no clear trend fond without rock phosphate application. Results in Table (5) did not show any clear effect due to PR application, however the highest P values in absence and presence of PR application i.e. 0.45 and 0.91 $\mu g.g^{-1}$ P, occurred under application of TC incubated 80 and 20 days respectively.

The lowest values 0.12 and 0.33 $\mu g.g^{-1}$ of the control treatment of TC treatment 80 days of the incubation treatment in absence and presence of PR respectively.

Ca-P fraction:

Data in Table (5) showed that the mean values of the Ca-P fraction were higher in case of rock phosphate treatment than without it under the all of the incubation periods. The results did not show any clear trend due to the incubation periods, but the mean of Ca-P fraction 50.0 and 79.5 $\mu g.g^{-1}$ occurred without and with PR application incubated BM for 20 days, respectively. With regard to the characteristic of P in Ca-P fraction as affected by the different rates of TC application, results did not show any clear trend due to rock phosphate applications. The highest values of P were 67.9, 55.8 and 56.8 $\mu g.g^{-1}$ in case of the application rate of 2% of TC of 20,40 and 80 days respectively, upon incubation in absence of PR. With rock phosphate application, the Ca-P fraction decreased with increasing the rate of applied TC under incubation period of 20 days but whereas an opposite trend was mostly with 40 and 80 days incubation.

With regard to the effect of the incubation periods on P percentage of total inorganic fraction of P, data in of the mean values of total inorganic P as percentage of total soil P, did not show clear with rock phosphate application at any incubation period. The highest values of P percentage were 46.4 and 97.0 $\mu g.g^{-1}$ with the incubation periods of 40 and 80 days either without or with rock phosphate treatments, respectively. The Ca-P fraction as percentage of total inorganic P fractions decreased gradually under the rate application of TC. These results were obvious only in case of 40 and 80 days incubation in absence of PR application and after 40 days incubation with rock phosphate. In general, the results showed that the lowest values Ca-P percentage of the total inorganic fraction estimated in absence and presence of PR application were 92.3 and 94.6% under 4% of TC incubated for 40 and 20 days, respectively. On the other hand, the highest values of Ca-P percentage of the total inorganic fractions in case of absence and presence of PR were 97.5 and 97.9% under the rate of 2% incubated for 20 days and the control treatment of TC incubated for 40 days, respectively.

As a comparison between the effect of the studied organic wastes, data in Table (6) showed that rock phosphate applications have the greatest effect on the Inorganic P fractions with any of the studied organic wastes and under all the studied the incubation periods. Without rock phosphate treatment, the results showed that the descendingly ordered values of NH_4-P as affected by organic wastes application were; 4.07, 2.39 and 2.34 $\mu g.g^{-1}$ for dung manior in case of 20, 80 and 40 days incubation, with Sh.D, BM and TC, respectively. With PR treatment, the ordered values of NH_4Cl-P were; 7.45, 4.57 and 3.21 $\mu g.g^{-1}$ with BM incubation 20, 40 and 80 days, respectively. The results showed that the descendingly ordered values of Al-P as affected by organic wastes without rock phosphate treatments were; 0.26, 0.22 and 0.14 $\mu g.g^{-1}$ for Sh.D BM and Sh.D under 80, 40 and 20 days incubation, respectively. With PR treatments the corresponding sequence was 0.51, 0.31 and 0.28 $\mu g.g^{-1}$ for with rock phosphate application the highest positive effect on the ragnitude of Al-P fraction could be ordered in the sequence of 0.51, 0.31 and 0.28 $\mu g.g^{-1}$ P (inorganic due to Sh.D, TC and both of Sh.D and TC incubated for periods of 80, 20 and 40 days respectively. The obtained results in Table (6) showed that the ordered values of Fe-P as affected by organic wastes without rock phosphate treatments were; 0.32, 0.29 and 0.28 $\mu g.g^{-1}$ P for TC, Sh.D and BM under 40, 80 and 20 days incubation, respectively. With rock phosphate treatments the ordered values were 0.79, 0.58 and 0.45 $\mu g.g^{-1}$ P for TC, ShD and TC under 20, 40 and 80 days incubation, respectively. The Ca-P fraction, values under no rock phosphate application amounted descandingly as 63.3 , 50 and 45 $\mu g.g^{-1}$ P for Sh.D, BM and TC incubated for 20, 40 and 80 days, respectively. With rock phosphate treatments, the greatest ordered values were 94.5, 84.9 and 70.5 $\mu g.g^{-1}$ for Sh.D, TC and BM under incubation period at 20, 40 and 80 days, respectively.

In conclusion the obtained results as well as those obtained preciously in reveal that the studied treatments fluctuated their effects of the distribution and occurrence of P fractions in the soil columns and pointed out that the organic wastes deffered in their effects on increasing the inorganic P fractions. In this respect, Radwan (1997) pointed out to the important effect of organic matter on the distribution of P fractions in calcareous soil. He added that the organic matter (FYM) did not give any significant trend effect along three seasons of wheat plant growth.

Generally, the effect of the organic wastes as explained by several researchers. i.e. Lyamuremye, *et al.* (1996), found that organic amendments decreased P sorption that was related to changes in some soil chemical properties (e.g., pH and exchangeable Al). However addition of organic residues to soil may also affect P sorption by adding PO_4 or releasing organic P during mineralization of residues and hence redistribution of P among P pools in soil. They added that the P fractions increased with manure or alfalfa amendments. These fractions are sites for P-sorption; thus, increases in these fractions provide evidence that P-rich organic amendments can decrease future P sorption in soils by reacting with these sorption sites.

Table (6): The effect of type of organic wastes on the main fractions of inorganic P in a soil treated with rock phosphate.

Type of O.W (%)	Without rock phosphate						With rock phosphate					
	NH_4Cl-P	Al-P	Fe-P	Ca-P	Total	Ca-P / Total	NH_4Cl-P	Al-P	Fe-P	Ca-P	Total	Ca-P / Total
	20 days											
Sh.D	4.07	0.14	0.19	63.3	67.7	93.4	5.16	0.22	0.36	94.5	100.1	94.3
B.M	3.80	0.13	0.28	51.9	56.1	92.4	7.45	0.25	0.62	75.0	83.3	89.6
T.C	2.00	0.12	0.26	50.0	52.1	95.5	3.10	0.31	0.79	79.5	83.7	95.1
	40 days											
Sh.D	1.21	0.20	0.20	28.8	30.5	94.2	4.49	0.28	0.58	81.4	86.8	94.1
B.M	2.34	0.22	0.25	50.0	52.8	95.1	4.57	0.23	0.46	84.0	89.3	94.5
T.C	1.70	0.19	0.32	00.3	42.5	94.9	1.89	0.28	0.54	84.9	87.6	97.0
	80 days											
Sh.D	0.92	0.26	0.17	29.6	31.0	95.3	2.59	0.51	0.35	64.8	68.2	95.0
B.M	2.39	0.21	0.29	29.1	32.0	90.0	3.21	0.39	0.40	70.5	74.5	94.7
T.C	1.20	0.20	0.27	45.0	46.4	96.4	1.70	0.30	0.45	65.8	68.2	96.4

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صور الفوسفور الغير عضوى فى أرض صحراوية معالجة ببعض المخلفات العضوية

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أجريت تجربة تحضين لتربة جيرية مع ثلاثة أنواع من المخلفات العضوية (سماد مخلفات الخراف والبيوجاز والمدن) لمدة تحضين (٢٠، ٤٠،٨٠ يوماً) فى وجود الصخر الفوسفاتى. وبدونه.

وقدرت صور الفوسفور الغير عضوى وكانت النتائج كالآتى:

أوضحت النتائج أن إضافة الصخر الفوسفاتى أعطى زيادة فى تركيز صور الفوسفور الغير عضوى عنه فى حالة عدم استخدامه. كما أعطى مخلف البيوجاز نقص فى تركيز صورة الفوسفات NH_4Cl-P مع ازدياد زمن التحضين من ٢٠ حتى ٨٠ يوماً. وأعطى مخلف الخراف أعلى تركيز لصورة الفوسفور Al-P (٠,٥١ جزىء فى المليون) بعد ٨٠ يوماً من التحضين. أوضحت النتائج أن مخلف المدن أعطى أعلى قيمة لصورة الفوسفور Fe-P (٠,٧٩ جزىء فى المليون) بعد ٢٠ يوماً من التحضين. وأيضاً كانت أعلى قيمة للصورة Ca-P (٩٤,٥ جزىء فى المليون) بعد ٢٠ يوماً من التحضين.