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NUTRITIONAL STATUS OF N AND P AS AFFECTED BY ADDING SOME ORGANIC MANURES AND ROCK PHOSPHATE IN BOTH SANDY AND CALCAREOUS SOILS

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ABSTRACT

The current work aims to study the effect of some applied organic manures namely: Qattamia, Biogreen and Nile compost at rates 2 & 4 %, added alone or in combination with rock phosphate at the rate of 0.02 % to sandy and calcareous soils on nutritional status of N & P during soil incubation experiment.

The obtained results indicate that the application of organic manures either alone or in combination with rock phosphate increased the available content of N& P, with superiority of organic manures for increasing organic matter content in soils. The Nile compost at the rate of 4 % mixed with rock phosphate surpassed the other applied treatments for nutritional status of both N & P, in addition to it gave the greatest organic matter content. In all treatments the released of N and P increased in soil during the incubation period of the organic materials. It is also noticed that N and P released form the Nile compost treatment surpassed the other applied organic manures.

Keywords: Organic manures, N & P availability, sandy and calcareous soils

INTRODUCTION

Nowadays, universe technique is going now on the way of clean agriculture with minimum pollution effects. The use of natural materials such as organic manures is recommended to substitute the chemical fertilizers. The application of organic materials in the form of manures and compost has beneficial effects on soil fertility. Some micronutrients in organic manures can be more available than the quantities of these nutrients applied as chemical fertilizers. Nutrients released from plant residues and organic manures depend on soil microbial activity, particularly the C:N ratio of applied residues.

Schlegel (1992) studied the influence of composted manure on soil chemical properties and observed an increase in N and P levels by increasing the applied rates. Sen *et al.* (1994) showed that application of pig manure, rice straw or urea increased organic matter and total N in paddy soils. Rodrigues *et al.* (1996) found that application of green and poultry manures increased the P concentration in the soil. Pearson *et al.* (1998) found that applying waste compost at 300 tons ha^{-1} increased soil N and P. Panda *et al.* (1999) declared that application of organic manures had beneficial effects on soil fertility such as C / N ratio. Narvaez *et al.,* (2000) found that adding each of cowpea, chicken manure or compost to soil increased the soil available P by 20 mg/ kg soil.

In Egyptian soils, Abdel-Moez *et al* (1995) reported that the percentages of N, P and K in soil were influenced with application of organic waste to soil. Beheiry *et al.* (1998) found that soil organic matter content and total soil nitrogen increased by all treatments received the organic

conditioners. El-Kholy *et al.* (1999) showed an improvements being revealed in soil available phosphorus as a result of applying FYM. Badran et al. (2002) showed that incubation of organic manures increased soil available N and P in sandy soils.

Therefore, the present work was carried out to evaluate the impact of applied some organic manures such as Qattamia, Biogreen and the Nile manures added with different rates to sandy and calcareous soils, on some micronutrients.

MATERIALS AND METHODS

To study the effect of using different sources of organic manures on the nutritional status of N and P in sandy and calcareous soils treated with various rates of manures, a pot experiment was conducted at Plant Nutrition Research Greenhouse, Agriculture Research Center (ARC), Giza, Egypt. The materials and procedures are presented in the following:

MATERIALS

Soil samples:

Two surface soil samples (0 – 30 cm depth) were collected from Meet Kinana, Qalyuobia governorate and El-Bangur area, El-Nubaria region to represent sandy and calcareous soils, respectively. Soil samples were air dried ground and sieved to pass through a 2 mm sieve then thoroughly mixed and kept for the chemical analyses. The characteristics of these soils are illustrated in Table 1.

Organic manures:

Three organic manures viz; Qattamia compost (Town refuses compost), Biogreen compost (includes chicken manure + plant residuals) and the Nile compost (includes animals and plant residuals) were used in this study. All these manures were air-dried pulverized and then sieved through 0.2 mm screen size and finally they were thoroughly mixed. The chemical composition of these manures is presented in Table 2.

The incubation experiment:

200 g portions of each soil sample were placed in plastic pots and received either of the concerned organic manures at 4 or 8 g/pot and rock phosphate at a rate of 4 g/ pot. The organic manures or rock phosphate were mixed thoroughly with sample and each treatment was replicated three times in a complete randomized blocks design. Soil moisture was keeping at field capacity range by water addition every other day through the course of the experiment. Half of the recommended doses of nitrogen and phosphorus were added. To study the chemical changes that might occur in the soil during the incubation period (55 days) due to manure application, some soil samples of the incubated pots were air dried, finely ground and kept in plastic bags to be later analyzed for soil organic carbon as well as available N, P and K.

Table 1: Some physical and chemical characteristics of the studied soils.

Characteristics	sandy soil	calcareous soil
Particle size distribution %		
Coarse sand	81.60	3.20
Fine sand	9.30	48.80
Silt	3.20	19.00
Clay	5.90	29.00
Textural class	Sandy	Sandy clay loam
Calcium carbonate %	0.36	17.40
Organic matter %	0.26	0.91
pH (1:2.5)	7.89	8.34
Saturation percent (SP)	17.00	29.00
EC ($dS.m^{-1}$) soil paste	4.30	5.25
Available N ($mg\ kg^{-1}$)	22.40	46.10
Available P ($mg\ kg^{-1}$)	4.65	5.90
Available K ($mg\ kg^{-1}$)	89.00	245.00
Available Fe ($mg\ kg^{-1}$)	3.20	4.20
Available Mn ($mg\ kg^{-1}$)	0.82	0.96
Available Zn ($mg\ kg^{-1}$)	0.67	0.84
Available Cu ($mg\ kg^{-1}$)	0.53	0.71
Soluble cations and anions in soil paste extract ($me\ L^{-1}$)		
Ca^{2+}	20.70	23.96
Mg^{2+}	7.62	11.00
Na^{+}	17.08	18.59
K^{+}	0.30	0.75
CO_3^{2-}	0.00	0.00
HCO_3^{-}	1.80	2.34
Cl^{-}	18.00	30.82
SO_4^{2-}	25.90	21.14

Table 2: Some chemical characteristics of the studied organic manures

Characteristics	Organic manures		
	Qattamia	Biogreen	Nile
pH (1:5)	8.3	8.45	8.01
EC (1:5) dSm-1	5.4	6.3	4.1
Total C%	22.7	26.3	33.78
Total N%	1.3	1.45	2.38
C / N ratio	17.46	18.14	14.68
Organic matter %	39.04	45.35	58.1
Total P%	0.35	0.47	0.59
Total K%	0.69	0.93	1.26
Available N mg kg^{-1}	591	1037	1585
NO3 – mg kg-1	71	90	125
NH4 + mg kg-1	520	947	1460
Available P mg kg^{-1}	250	485	1310
Available K mg kg^{-1}	4200	5500	8300
Available Fe mg kg^{-1}	459	700	1325
Available Mn mg kg^{-1}	127	184	195
Available Zn mg kg^{-1}	30	72	103
Available Cu mg kg^{-1}	82	125	178

The experiment involved the following treatments with 3 replicates:

1- Control.
2- Qattamia compost at a rate of 2 & 4 %.
3- Biogreen compost at a rate of 2 & 4 %.
4- Nile compost at a rate of 2 & 4 %.
5-Qattamia compost at a rate of 2 & 4 % + 2 % rock phosphate.
6-Biogreen compost at a rate of 2 & 4 % + 2 % rock phosphate.
7-Nile compost at a rate of 2 & 4 % + 2 % rock phosphate.

METHODS OF ANALYSES:

Organic manure analyses:

* Organic matter was determined according to Walkely and Black (1934)..
* Total nitrogen was determined according to Jackson, (1976).
* Available nutrients: N, P and K were determined according to Jackson, (1976).
* Available micronutrients of Fe, Cu, Mn, and Zn were extracted by DTPA according to Lindsay and Norvell (1978) and determined using Atomic Absorption Spectrometer Perkin Elmer model (3300).
* Manure pH value was measured according to Jodice *et al*. (1982) in 1:5 manure-water suspensions.

Soil analyses:

The performed soil analyses were:

* Mechanical analysis was carried out using the international pipette method as described by Piper (1950).
* Calcium carbonate was determined using Collin's Calcimeter (Piper, 1950).
* Soil pH was measured in 1: 2.5 soil water suspension Jackson, (1976).
* Electrical conductivity and soluble ions in soil paste extracts was determined according to the methods described by Jackson (1976).
* Soil organic matter was determined according to Walkely and Black (1934).
* Available nitrogen was extracted with 1% potassium chloride and determined according to Bremner and Keeney (1962) as described by Black (1965).
* Available phosphorus was extracted according to Olsen *et al*., (1954).
* Available K was determined according to the methods described by (Jackson, 1976).
* Available micronutrients of Fe, Cu, Mn, and Zn were extracted by DTPA according to Lindsay and Norvell (1978) and determined using Atomic Absorption Spectrometer Perkin Elmer model (3300).

RESULTS AND DISCUSSION

Organic matter content and the released N & P during soil incubation:

Soil organic matter content:

The organic matter contents in the sandy and calcareous soils as affected by the applied different sources of organic manures at end the incubation period are shown in Table 3. The application of organic manures

alone increased organic matter from 0.26 to 0.30, 0.46 and 0.48 % when Qattamia, Biogreen and the Nile manures were added to the sandy soil at a rate of 2 % vs. 0.35, 0.48 and 0.53 % at a rate of 4 % respectively. The corresponding values in the calcareous soil were 0.92, 0.98 and 1.24 % at a rate of 2 % vs. 1.01, 1.12 and 1.29 at a rate of 4 % respectively. The relative increase percentages of organic matter content as a result of applying the respective organic manures solely at a rate of 4 % to the sandy soil were 34.62, 84.62 and 103.85 %, respectively. The corresponding values in the calcareous soil are 13.48, 25.84 and 44.94 % respectively.

Data reveal that the application of the Nile manure at rate of 2 or 4 % was more effective on soil organic matter content than that of Qattamia or Biogreen manure due to its higher content in the nutrients and organic matter percentage. As for addition of rock phosphate in combination with organic manures, data indicate that soil organic matter content of both the studied soils tended to be higher as compared to those attained due to the sole application of any of the studied organic manures. This may be owing to its beneficial effect on biological activation in soil

Table 3: Soil organic matter content of both the two studied soils at end period of incubation then treated with the tested organic manures

Treatments	Rate of application	The sandy soil		The calcareous soil	
		O.M %	Relative increase%	O.M %	Relative increase%
Control	0%	0.26	0.00	0.89	0.00
Qattamia compost	2 %	0.30	15.38	0.92	3.37
	4 %	0.35	34.62	1.01	13.48
Biogreen compost	2 %	0.46	76.92	0.98	10.11
	4 %	0.48	84.62	1.12	25.84
Nile compost	2 %	0.46	76.92	1.24	39.33
	4 %	0.53	103.85	1.29	44.94
Qattamia compost+RP	2 %	0.32	23.08	0.94	5.62
	4 %	0.37	42.31	1.04	16.85
Biogreen compost +RP	2 %	0.46	76.92	1.01	13.48
	4 %	0.50	92.31	1.13	26.97
Nile compost +RP	2 %	0.47	80.77	1.26	41.57
	4 %	0.55	111.54	1.32	48.31
Mean		0.42	68.27	1.09	24.16

Regarding the organic matter content of the two studied soils, it could be noticed that the values of organic matter in calcareous soil were relatively higher than the corresponding once in the sandy soil. These results may be attributed to the differences in both the physical and chemical properties of the sandy soil, which accelerating the rapid decomposition rate of organic materials. Similar results were obtained by Abdel-Malek et al. (1977). Also, Abdel-Hakem (1995) found that soil content of both ammonia and nitrate nitrogen increased with increasing incubation time as well as with increasing the rate of the applied organic manure.

Released nitrogen.

Data in Tables 4 and 5 indicate that the values of soil N as (NH_4^+ and NO_3^-)in the studied sandy and calcareous soils, in general, tended to increase during the incubation period with all different studied organic manures at both rates of application. The released N depended on the chemical composition of the applied organic manure .Also, it is noticed that the N released from Nile compost treatment surpassed the other applied ones, may be due to its relatively higher content of N and its low C/N ratio, which accelerates organic materials decomposition as compared to Qattamia and Biogreen manures.

Table 4: Available N (NH_4^+ and NO_3^- mg/kg) at end of incubation period in the sandy soil.

Treatments	Rate of application	The sandy soil			
		NH_4^+		NO_3^-	
		Content (mg/kg)	Relative increase %	Content (mg/kg)	Relative increase %
Control	0%	20.00	0.00	25.27	0.00
Qattamia	2 %	22.82	14.10	26.97	6.73
	4 %	23.56	17.80	29.40	16.34
Biogreen	2 %	24.90	24.50	33.49	32.53
	4 %	28.80	44.00	36.93	46.14
Nile	2 %	26.60	33.00	33.61	33.00
	4 %	29.60	50.50	37.39	63.95
Qattamia +RP	2 %	24.30	21.50	30.02	18.80
	4 %	25.80	29.00	32.59	28.97
Biogreen+RP	2 %	27.00	35.00	37.28	47.53
	4 %	30.10	50.50	41.43	63.95
Nile+RP	2 %	29.80	49.00	37.65	48.99
	4 %	32.40	62.00	43.20	70.95
Mean		26.59	33.15	34.25	36.76

RP = Rock phosphate

The higher NO_3^- content as compared to NH_4^+ in the calcareous soil than the sandy one, may be due to the higher loss of NH_4^+ by volatilization as a result of the relatively higher values of soil pH and $CaCO_3$ content. On the other hand, the relative higher content of NH_4^+in the sandy soil than the calcareous once may be due to its adsorbed on the charged colloids.

Applying rock phosphate as a natural P–resource, at a rate of 2 % of the applied manures, resulted in an further increase in released N. This is probably due to the released phosphorus which leads to increase the microorganisms activity as well as manure decomposition. Moreover, the released N is more pronounced at the higher applied rate of 2 % of all the organic manures used than at the lower one 1 %. Khater et al. (2002) showed that applying organic amendments to a sandy soil led to an increase in the released nutrient N.

Table 5: Available N (NH_4^+ and NO_3^- mg/kg) at end of incubation period in the calcareous soil.

Treatments	rate of application	The calcareous soil			
		NH_4^+		NO_3^-	
		Content (mg/kg)	Relative increase %	Content (mg/kg)	Relative increase %
Control	0%	15.00	0.00	26.30	0.00
Qattamia	2 %	16.49	9.93	33.26	26.46
	4 %	17.55	17.00	35.14	33.61
Biogreen	2 %	17.56	17.07	35.41	34.64
	4 %	19.80	32.00	39.95	51.90
Nile	2 %	19.95	33.00	40.26	53.08
	4 %	22.35	49.00	45.10	61.14
Qattamia +RP	2 %	17.03	13.53	34.13	29.77
	4 %	19.62	30.80	39.23	49.16
Biogreen +RP	2 %	18.15	21.00	36.63	39.28
	4 %	21.00	40.00	42.38	61.14
Nile+RP	2 %	20.40	36.00	41.26	56.88
	4 %	23.25	55.00	46.92	78.40
Mean		19.09	27.26	38.15	44.27
RP = Rock phosphate					

Released phosphorus.

Data obtained from the incubation experiment showed the effect of applied organic manures on the availability of phosphorus released in the studied two soils. Available phosphorus in both the sandy and calcareous soils increased as a result of applied organic manures. The increase was more obvious by increasing the applied rate of organic manures from 2 to 4 % in all treatments.

In the sandy soil, the highest values of available phosphorus were given at the higher rate (4%) of the applied composts. These values were 5.01, 5.35 and 5.66 mg/kg for Qattamia, Biogreen and Nile compost, respectively. The corresponding values of calcareous soil were 6.57, 7.34 and 7.54 mg/kg, respectively. On the other side, the relative increases of available phosphorus at the higher rate 4 % of applied composts were 31.84, 40.79 and 48.95 % for Qattamia , Biogreen and Nile compost in the sandy soil, vs 28.22, 43.92 and 47.84 % in the calcareous one respectively.

Concerning effect of the rock phosphate addition in combination with organic manures, data show that the soil available phosphorus of both the studied soils tended to slightly increase as compared its content obtained due to application of the organic manures solely.

Application of the Nile manure either on in combination with rock phosphate at the both rates (2 and 4 %) was more effective for increasing available phosphorus, than Qattamia or Biogreen manure.

In general, the mean value of available P was higher in the calcareous (6.69 mg/kg) than that of the sandy one (5.08 mg/kg). In spite of the relatively high phosphorus content of the calcareous soil, yet the relative increases of its released rate from the applied manures were more pronounced in the sandy one. This may be due to the occurrence of relatively higher values of $CaCO_3$ and pH, which representing restrictive factors for P

availability. Negm et al. (2003) and Hegazi et al. (2005) found that application of organic compost increased available P in soil.

Table 6: Available P at end of the incubation period in the soils treated with the organic manures.

Treatments	Rate of application	The sandy soil		The calcareous soil	
		Phosphorus (mg/kg)	Relative increase%	Phosphorus (mg/kg)	Relative increase%
Control	0%	3.80	0.00	5.10	0.00
Qattamia compost	1 %	4.60	21.05	5.97	17.06
	2 %	5.01	31.84	6.57	28.82
Biogreen compost	1 %	4.86	27.89	6.32	23.92
	2 %	5.35	40.79	7.34	43.92
Nile compost	1 %	5.02	32.10	6.53	28.04
	2 %	5.66	48.95	7.54	47.84
Qattamia compost +RP	1 %	4.71	23.95	6.07	19.02
	2 %	5.32	40.00	6.87	34.71
Biogreen compost +RP	1 %	5.05	32.89	6.43	26.08
	2 %	5.57	46.58	7.65	50.00
Nile compost +RP	1 %	5.24	37.89	6.68	31.98
	2 %	5.89	55.00	7.90	54.90
Mean		5.08	33.76	6.69	31.25

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الحالة الغذائية لعنصري النتروجين والفوسفور ومدى تأثرها بإضافة بعض المخصبات العضوية وصخر الفوسفات في كلٍ من الأراضي الرملية والجيرية.

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يهدف البحث إلي دراسة تأثير إضافة بعض المصادر العضوية سواء بمفردها أو بخلطها ببعض المصادر الطبيعية مثل صخر الفوسفات وذلك على تيسر وانطلاق بعض المغذيات الضرورية للنبات (النتروجين والفوسفور)، تحت ظروف الأراضي الرملية والجيرية.

ولتحقيق ذلك تم استخدام ثلاثة أنواع من المكمورات العضوية : كمبوست القطامية وهو عبارة عن مخلفات المدن، وكمبوست البيوجرين وهو عبارة عن زرق الدجاج + المخلفات النباتية ، وكمبوست النيل ويتكون من مخلفات حيوانية ونباتية.

وقد أقيمت تجربة تحضين لنوعين من الأراضي (رملية, جيرية), وعوملت بمعدلات 2, 4 % من المخلفات العضوية السابقة, بالإضافة إلى 2 % من صخرالفوسفات لمدة 55 يوم, مع المحافظة على رطوبة التربة عند السعة الحقلية.

وتتلخص أهم النتائج المتحصل عليها في الآتي:

1- أدى إضافة االمكمور العضوي بمفرده أو مخلوطاً بصخر الفوسفات إلى زيادة نسبة المادة العضوية في كلا الأرضين تحت الدراسة, وكان تأثير الإضافات سواء منفردة أو مشتركة مع صخر الفوسفات على النحو التالي: كمور النيل > مكمور البيوجرين > مكمور القطامية

2- بصفة عامة زاد معدل تيسر عنصري النتروجين والفوسفور في كل من الأراضي الرملية والجيرية نتيجة إضافة المكمور العضوي بمفرده أو مخلوطاً بصخر الفوسفات.

3 – كانت أعلى زيادة في انطلاق عنصري النتروجين والفوسفور في كلا الأرضين عند إضافة مكمور النيل بنسبة 4 % مخلوطاً بصخر الفوسفات وذلك مقارنة بمكموري البيوجرين والقطامية .

4 - كان تأثير الإضافات المنفردة أو المشتركة بصخر الفوسفات على النحو التالي:

مكمور النيل > مكمور البيوجرين > مكمور القطامية

والنتائج المتحصل عليها من هذه الدراسة توضح أن تحسين الحالة الغذائية لعنصري النتروجين و الفوسفور قد تحققت نتيجة لإضافة المخصبات العضوية وصخر الفوسفات وذلك لما تحتويه من مركبات ذات تأثير إيجابى على الصفات الطبيعية والكيماوية للتربة وكذلك حفظ المغذيات الضرورية للنبات في صورة ميسرة تسهل من إمتصاصها بواسطة جذور النباتات بالإضافة إلى غناها بالعناصر الكبرى والصغرى الضرورية للنبات والتي تزيد من إنتاجية الاراضي.