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EFFECT OF SOME ORGANIC CONDITIONERS ON SOME CHEMICAL AND PHYSICAL PROPERTIES OF NEWLY RECLAIMED SOILS IN EGYPT

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ABSTRACT

Two field experiments were conducted on sandy and calcareous soils at Atfeeh region, Giza Governorate to study the effect of different organic materials, i.e., farmyard manure (FYM), town refuse compost and vinasse at two rates of 5 and 10 ton fed.$^{-1}$ on some physical and chemical properties of the studied calcareous clay loam and non calcareous sandy soil. These soils were cultivated with maize in the summer season and wheat in the winter season. The results showed that the application of organic materials (vinasse, FYM, town refuse compost and farm refuse compost) to both the calcareous clay loam and non calcareous sandy soils caused areduction in the values of bulk density compared to the control treatment, however, the higher rate of these materials was of more pronounced effect on the reduction of bulk density. Addition of the organic materials to the non calcareous sandy soil caused lower value of hydraulic conductivity compared to the control treatment, whereas, the corresponding hydraulic conductivity of the calcareous clay loam soil achieved higher value compared to the control treatment.

Concerning the porosity and available water content, addition of the organic materials increased the values of these parameters in both soils as compared with those of the control treatment however, the application of the farm–refuse compost at its different rates was of more pronounced effect on porosity and available water than the other used organic materials. The results also revealed that addition of the used organic conditioners though favorably improved soil organic matter (OM) yet it increased the soil EC slightly over the control treatments in both the calcareous and sandy soils. Also, results indicated that soil pH was reduced owing to application of the organic conditioners and the reduction was more pronounced upon application of vinasse in both soils. Accordingly, it could be deduced from this investigation that application of farm refuse compost as an organic conditioner was of more favorable effect on improving some soil physical properties of both the sandy and calcareous soils as compared with the other organic materials (FYM, town refuse compost and vinasse).

Keywords: Farmyard manure- town refuse and farm refuse- compost-vinasse- soil

INTRODUCTION

The land mass area of the country is fairly large, as it extends over one million square kilometers. However, the actively cultivated area is only 3.6 million hectares, located mostly in the Nile Valley and the Delta. Recently, it became necessary to look for soils suitable for cultivation among the desert soils. This would be an aimed target to over come the gab between food production and the increased population.

These soils involve both sand and calcareous which are poor in minerals and organic colloids, and consequently are low in fertility i.e. suffer shortage in both macro- and micronutrients. Besides these soils are of low water retention. The primary sources of soil organic matter are plant and animal residues. Soil organic matter is important for maintaining good soil structure, which enhances the movement of air and water in soil. Organic matter also plays an important role in nutrient cycling. It has been shown that addition of soil amendments improved soil properties such as water-holding capacity, hydraulic conductivity and bulk density (Carter and Stewart, 1996; Zebarth *et al.*, 1999; Franzluebbers, 2002). Tisdall (1994) and Smith and Read (1997) showed that improvement of soil properties by organic matter addition positively affects the germination of seeds, and the growth and development of plant roots and shoots. Aggelides and Londra (2000) found that porosity and water retention capacity of loamy and clay soils increased with application of compost. Celik *et al.* (2004) found that total porosity of the soil increased with compost application, depending upon the amount of materials added.

The present work aims at studying effect of applying different organic soil conditioners on some physical properties of sandy and calcareous soils cultivated with wheat and maize as two of the most important cereal crops in Egypt.

MATERIALS AND METHODS

Study area

The present study was carried out through two field experiments conducted at two different soil types i. e. calcareous clay loamy and non calcareous sandy soils in private farms at Atfeeh, Giza Governorate, south Cairo.

Some chemical and physical properties of the investigated soils were determined just before growing maize in summer season and before application of the different soil conditioners.

Soil samples were colleted from the surface layer (0-30 cm depth) and analyzed according to the standard methods as reported by Jackson (1973) and the obtained results are listed in Table 1.

Table 1 : Physical and chemical properties of the investigated soils.

Soil	Particle size distribution			Textural class	Organic matter %	$CaCO_3$ (%)	pH at (1:2.5) soil : water suspension	EC $dS\ m^{-1}$
	Clay %	Silt %	Sand %					
Calcareous Clay loamy	21.40	23.50	55.10	Clay loamy	1.43	34.00	7.50	4.20
non Calcareous sandy	10.12	15.60	74.28	Sandy	0.12	6.75	7.15	2.55

pH (1: 2.5 w/v soil : water suspension) and EC ($dS\ m^{-1}$) in soil paste extract)

Preparation of the conditioners used in the experimental work:

Three sources of common traditional organic manures: FYM, farm refuse compost and town refuse compost besides of on untraditional one i. e. vinasse were used in this experiment.

(A1) vinasse

Vinasse is a final byproduct of the sugar industry. Sugar beet and sugar cane are processed to produce crystalline sugar, pulp and molasses. The latters are further processed by fermentation to alcohol. After the removal of the alcohol by distillation, the remaining material is vinasse. Vinasse is a byproduct used in agriculture, because of its contents of organic matter, N, K and some micronutrients. The pH of vinasse varies from 4.02 to 7.10.The specific gravity of the dilute vinasse was about 1 kg L^{-1} according to the proportion of sugar cane in the original material.

(A2) Farmyard manure

Farmyard manure refers to the decomposed mixture of dung and urine of the farm animals along with litter and left over materials from roughages or fodder fed to the cattle.

(A3) Town refuse compost

Municipal solid waste is largely made-up of kitchen and yard waste and its composting has been adopted by many municipalities. Composting is seen as a method of diverting organic waste materials from landfills while creating a product, at relatively low-cost, that is suitable for agricultural purposes. The quality of town refuse compost is dependent on many sources of variation including the composting facility design and source and proportions used and composting procedure, and length of maturation. The town refuse compost was obtained from 15 May Factory for Composting Town refuses Wastes, Helwan Governorate.

(A4) Farm –refuse compost

This compost was made from a mixture of stubble manure, grasses and plant leaves composted for 4 months under atmospheric conditions in heaps of an approximate temperature of 60 - 65 °C and a moisture content not lower than 40%. The mixture was turned from a time to time. Temperature was measured by introducing a thermometer in the centre of the pile. Farm –refuse compost was obtained from 15 May Factory for Composting Farm Refuse Wastes animal and plant, Helwan Governorate.

The experimental work.

The used soil conditioners (vinasse, FYM, town refuse compost and farm refuse compost) were applied at rates of 5 and 10 ton fad^{-1}. Soil conditioners were mixed thoroughly with the top 30 cm surface layer of each plot. Some characteristics of the studied conditioners are presented in Table2.

Maize (Zea mays, single cross 10) was planted in the summer season of 2007, in plots, area of each is 10.5 m^2.

The experiment was conducted in a randomized complete block design with three replications.

All plots, received the NPK fertilizers at recommended doses for maize crop before cultivation where P and K were applied at rates of 15 kg fed^{-1} and 24 kg fed^{-1} as superphosphate (15%P_2O_5) and potassium sulphate

(48% K_2O), respectively. Nitrogen was applied at a rate of 120 kg N fed^{-1} as ammonium nitrate (33.5%N) at three equal doses at 15, 45 and 60 days after sowing. Wheat (Triticum aestivum L., sakha 69) was sown after maize harvest, as winter crop on 15 November 2007 and harvested on 5^{th} of may 2008, and the recommended doses of N, P and K were added to each plot which did not receive further organic materials.

At the end of the second season, composite samples were taken from each plot at a depth of 0-30 cm. Bulk density, total porosity, saturated hydraulic conductivity and field capacity were determined from undisturbed soil samples. according to the standard methods outlined by Klute and Dirksen (1986).

Total porosity was calculated as percentages from the values of real and bulk densities (Danielson and Sutherl 1986). Saturated hydraulic conductivity was determined by the falling-head method (Bouyoucos, 1962). Water retention capacity at 33 kPa (field capacity) was measured in the undisturbed soil samples. Also, water retained at 1500 kPa (permanent wilting point) was measured in disturbed soil samples. Available water content (AWC) was then determined as the difference between water retained at 33 and 1500 kPa (Klute and Dirksen1986).

Table 2: Some Physical and chemical properties of the vinasse, farmyard manure, town refuse compost and farm–refuse compost used in the experimental work.

Parameter	Vinasse	FYM	Town refuse compost	Farm-refuse compost
B.D (g/cm^3)	–	0.29	0.29	0.25
Organic matter %	75.00	68.70	18.91	72.31
pH (1: 2.5 w/v organic amendment : water suspension)	4.02	7.61	7.40	8.20
EC (dS m^{-1}, 1: 2.5 w/v soil: water suspension)	18.90	6.60	41.50	52.00
Total N %	1.08	1.43	1.03	1.33
Total P %	0.55	0.81	0.61	0.70
Total K %	10.41	0.71	0.21	0.60
Available Fe mg / kg	944	600	143	50.00
Available Zn mg /kg	18.00	100	28.00	26.00
Available Mn mg / kg	6.50	50.32	25.00	28.00
Available Cu mg / kg	38.00	18.00	60.00	10.00
C/N ratio	15.70:1	13.20:1	16.60:1	14.72:1

BD bulk density

Statistical analysis

Data were analyzed by the methods described by Snedecor and Cochran (1982).

RESULTS AND DISCUSSION

The conditioning effects of either FYM, farm refuse compost, town refuse compost, or vinasse on some physical properties of the investigated soils were recorded at end of the second growing season (after wheat crop). Data in Table 3 and illustrated graphically in Fig. 1 show that addition of the different organic conditioners at their two rates of application to both the studied soils (i. e. the calcareous clay loam and the non calcareous sandy soils) resulted in a decrease in the bulk density and the decrease was higher with increasing rate of the applied conditioners. In general, FYM, farm refuse compost and town refuse compost were superior effects as compared to vinasse. The effect was more pronounced in the calcareous clay loamy soil than that of non-calcareous sandy soil. Moreover, farm refuse compost application caused a higher reduction in the value of bulk density compared to the other soil conditioners under both soils.

Table 3: Effect of the used soil conditioners on some physical properties of the investigated soils.

Item	Rate	calcareous caly loamy soil					non calcareous sandy soil					Means				
		A_1	A_2	A_3	A_4	M	A_1	A_2	A_3	A_4	M	A_1	A_2	A_3	A_4	M
Bulk density Mg/cm^3	non	1.32					1.63					1.48				
	R_1	1.31	1.26	1.30	1.27	1.29	1.62	1.59	1.61	1.58	1.60	1.47	1.43	1.46	1.43	1.44
	R_2	1.26	1.24	1.28	1.25	1.26	1.60	1.58	1.59	1.53	1.58	1.43	1.41	1.44	1.39	1.42
	mean	1.29	1.25	1.29	1.26	1.27	1.61	1.59	1.60	1.56	1.59	1.45	1.42	1.45	1.41	1.43
Total porosity (%)	non	44.30					35.80					40.05				
	R_1	45.50	47.00	46.00	48.00	46.63	36.20	38.20	37.90	38.50	37.70	40.85	42.60	41.95	43.25	42.16
	R_2	46.80	50.00	47.00	50.20	48.50	38.00	39.00	38.00	40.00	38.75	42.40	44.50	42.50	45.10	43.63
	mean	46.15	48.50	46.50	49.10	47.56	37.10	38.60	37.95	39.25	38.23	41.63	43.55	42.23	44.18	42.89
bolmic onductivi (cm/h)	non	13.85					26.90					20.38				
	R_1	14.08	14.15	14.22	14.55	14.25	26.30	26.00	26.20	26.00	26.13	20.19	20.08	20.21	20.28	20.19
	R_2	14.80	15.30	15.00	15.25	15.09	25.80	25.70	26.00	25.50	25.75	20.30	20.50	20.50	20.38	20.42
	mean	14.44	14.73	14.61	14.90	14.67	26.05	25.85	26.10	25.75	25.94	20.25	20.29	20.36	20.33	20.30
filed capacity w/w%	non	23.20					7.30					15.25				
	R_1	23.60	24.00	23.80	25.00	24.10	7.50	7.80	7.65	7.90	7.71	15.55	15.90	15.73	16.45	15.91
	R_2	24.10	25.10	24.30	25.90	24.85	8.00	8.50	8.23	8.60	8.33	16.05	16.80	16.27	17.25	16.59
	mean	23.85	24.55	24.05	25.45	24.48	7.75	8.15	7.94	8.25	8.02	15.80	16.35	16.00	16.85	16.25
welting point w/w%	non	13.00					3.10					8.05				
	R_1	13.25	13.50	13.39	14.00	13.54	3.26	3.60	3.40	3.60	3.46	8.25	8.55	8.40	8.80	8.50
	R_2	13.56	14.20	13.65	14.55	13.99	3.55	3.90	3.70	4.00	3.79	8.56	9.05	8.68	9.28	8.89
	mean	13.41	13.85	13.52	14.28	13.76	3.40	3.75	3.55	3.80	3.63	8.40	8.80	8.54	9.04	8.69
available water w/w%	non	10.20					4.20					7.20				
	R_1	10.35	10.50	10.41	11.00	10.57	4.25	4.20	4.25	4.30	4.25	7.30	7.35	7.33	7.65	7.41
	R_2	10.54	10.90	10.65	11.35	10.86	4.45	4.60	4.53	4.60	4.55	7.50	7.75	7.59	7.98	7.70
	mean	10.45	10.70	10.53	11.18	10.71	4.35	4.40	4.39	4.45	4.40	7.40	7.55	7.46	7.81	7.55

LSD at 0.05		TP	BD	HC	FC	WP	AW
	S	0.42	0.05	1.20	0.12	0.94	0.12
	A	0.59	0.65	ns	0.17	1.33	0.17
	R	ns	ns	ns	0.12	ns	0.12
	SA	ns	0.10	ns	0.24	ns	0.25
	SR	ns	ns	ns	0.17	ns	0.17
	AR	0.84	ns	ns	0.24	ns	0.24
	SAR	1.19	ns	ns	0.34	ns	0.35

Notes: S, Calcareous soil S, Sandy soil control - non ad
A, Vinasse A, FYM A, Town refuse compo
A, farm refuse compost R, Ton fed⁻ R, Ton fed⁻

Concerning the total porosity, data in Table 3 and Fig 1 show that values of total porosity increased in the plots which received the different organic materials as compared to those of the control treatments. The total porosity increased in the non calcareous sandy soil from 35.80 % in the control treatment to average values of 37.10, 38.60, 37.95 and 39.25% due to application of vinasse, FYM, town refuse compost and farm refuse compost, respectively. The total porosity of the calcareous clay loamy soil increased from 44.30% (control) to 46.15, 48.50, 46.50 and 49.10% at the same respective order.

The addition of organic materials (or conditioners) promoted the total porosity of the soils because the microbial decomposition products of organic manures such as polysaccharides and bacterial gums are known to act as soil particle binding agents. These binding agents increase the porosity and decrease the bulk density of the soil. (Bhatia and Shukla, 1982). It may be worth to mention that the highest value of total porosity was recorded due to application of the farm refuse compost at its highest level in both the investigated soils.

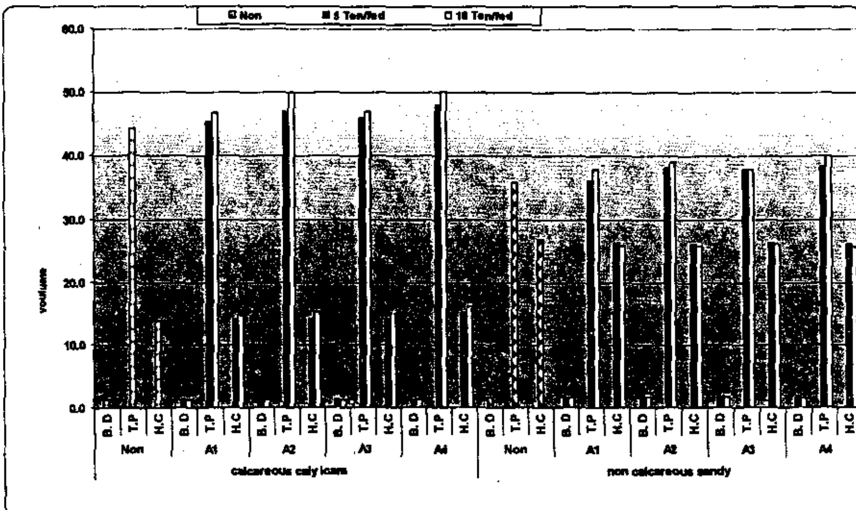

Fig (1): Effect of the used soil conditioners on bulk density (g/cm³), total Porosity (%) and hydraulic conductivity (cm/h) in both the investigated soil.

As expected, application of the different organic conditioners tended to increase the content of organic carbon in the studied soils. In general, the farm refuse compost and FYM were superior compared to both vinasse and town refuse compost, also the effect is being more pronounced in the calcareous clay loamy soil than the non calcareous sandy one. Similar results were obtained by Abdel-Nasser and Harhash (2000) who found that using organic manures resulted in improved soil properties.

Values of hydraulic conductivity were affected by application of the different organic conditioners. Data in Table 3 and Fig. 1 reveal that application of the organic conditioners to the non calcareous sandy soil decreased values of its hydraulic conductivity as compared to that of the control treatment. Value of the hydraulic conductivity decreased from 26.90 cm/h in the control treatment to 26.05, 25.85, 26.10 and 25.75 cm/h. due to application of vinasse, FYM, town refuse compost and farm refuse compost, respectively. On the other hand, values of hydraulic conductivity of the calcareous clay loam soil increased from 13.85 cm/h in the control treatment to 14.44, 14.73, 14.61 and 14.90 cm/h due to application of vinasse, FYM, town refuse compost and farm refuse compost, respectively. The increase in the hydraulic conductivity of the calcareous soil may be attributed to the enhancing effect of the applied organic conditioners on increasing aggregation of the soil particles and hence increasing percentage of the macropores and consequently values of the hydraulic conductivity increased. These results are in accordance with those obtained by Negm *et al.*, (2005)

Data in Table 3 and Fig. 2 demonstrate the effect of the applied organic conditioners on the moisture constants i. e. wilting point, field capacity and available water in the different studied soils. The data indicated that application of organic conditioners to both soils can markedly increase values of the field capacity as well as values of the moisture retained at the wilting point.

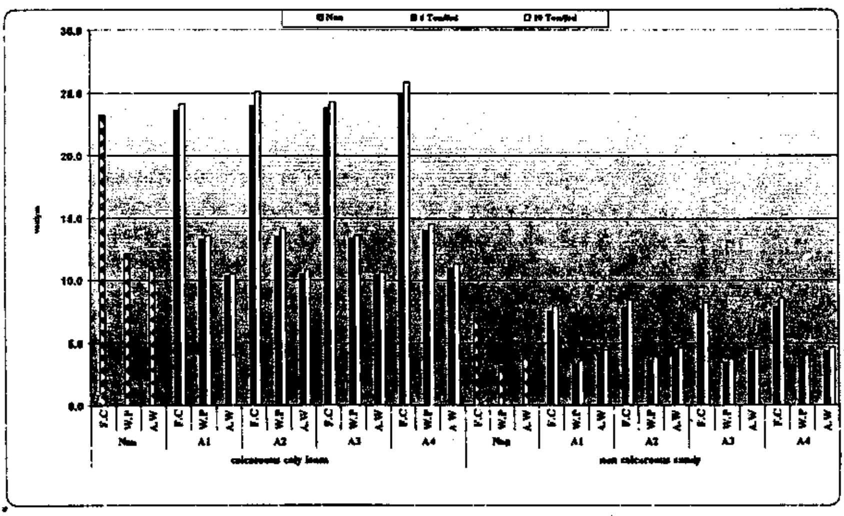

Fig. (2): Effect of the used conditioners on field capacity (%), wilting point(%) and available water(%) in both of the investigated soils.

However, the increases occurred in values of the field capacity were relatively higher than the corresponding ones occurred the values of the wilting point (W.p), therefore available water (A.W) content (which corresponds the difference value between the moisture contents at the FC and Wp) in creased. The improvement occurred in pore size distribution might account for the increases occurred in the soil moisture contents and accordingly in the values of available water. These results stand in well agreement with those of Khaleel *et al.* (1981) who concluded that for fine textured soils with waste organic matter addition, the increase in water holding capacity at field capacity was greater than that at wilting point. At higher tensions close to wilting point (1.5 MPa), nearly all pores are filled with air and water retention is mainly determined by the surface area and thickness of water films at these surface. likewise, Aggelides and Londra (2000) and Nyamangara *at al.,* (2001) determined that water retention capacity of loamy and clay soils improved with application of both compost and cattle manure.

The highest values of available water (AW) (4.45% in the non calcareous sandy soils) and (11.81% in the calcareous clay loam soil) were attended due to application of the farm refuse compost at a rate 72 % and FYM at the same rate, respectively. On the other hand, the lowest amounts of available water contents were observed in the untreated soils whose values were significantly lower than the corresponding ones attained due to the used soil conditioners. The results obtained herein agree with those of Haynes and Naidu, (1998) and Sanchez *et al.* (1989)

Soil chemical properties:

Data in Table 4 and Fig. 3 show effect of the different applied organic conditioners and rates of their application on soil electrical conductivity (EC), soil reaction (pH) and organic matter (OM) in both the calcareous clay loamy and non calcareous sandy soils. Obtained data reveal that application of the different organic conditioners resulted in slight increases in both EC and OM compared with the corresponding values of the control; the increase seemed more pronounced upon application of the higher rates of the soil conditioners to both the investigated soils. Overall results also showed that the highest values of EC and OM in both the investigated soils were recorded Owing to application of vinasse and farm refuse compost, respectively.

Table (4): Effect of the used conditioners on the chemical properties of the investigated soils.

Item	Rate	calcareous caly loam					non calcareous sandy soils					Means				
		A_1	A_2	A_3	A_4	M	A_1	A_2	A_3	A_4	M	A_1	A_2	A_3	A_4	M
EC ds/m	non	4.20					2.22					3.21				
	R_1	4.29	4.22	4.23	4.25	4.25	2.27	2.25	2.26	2.28	2.27	3.28	3.24	3.25	3.27	3.26
	R_2	4.35	4.32	4.35	4.37	4.35	2.30	2.30	2.34	2.35	2.32	3.33	3.31	3.35	3.36	3.34
	mean	4.32	4.27	4.29	4.31	4.30	2.29	2.28	2.30	2.32	2.29	3.30	3.27	3.30	3.31	3.30
PH	non	8.01					7.65					7.83				
	R_1	7.82	7.89	7.90	7.85	7.87	7.66	7.59	7.63	7.60	7.62	7.74	7.74	7.77	7.73	7.74
	R_2	7.67	7.77	7.80	7.69	7.73	7.39	7.49	7.56	7.46	7.53	7.63	7.63	7.68	7.58	7.63
	mean	7.75	7.83	7.85	7.77	[illegible]	7.63	7.54	7.60	7.53	7.57	7.69	7.69	7.72	7.65	7.69
OM (%)	non	0.46					0.19					0.33				
	R_1	0.54	0.58	0.57	0.60	0.57	0.21	0.25	0.23	0.26	0.24	0.38	0.42	0.40	0.43	0.41
	R_2	0.66	0.70	0.61	0.73	0.68	0.25	0.30	0.28	0.33	0.29	0.46	0.50	0.45	0.53	0.48
	mean	0.60	0.64	0.59	0.67	0.62	0.23	0.28	0.26	0.30	0.26	0.42	0.46	0.42	0.48	0.44

LSD at 0.05	OM	pH	EC
S	0.01	0.70	0.24
A	0.01	0.09	0.34
R	ns	ns	0.24
SA	ns	0.13	0.48
SR	ns	0.10	0.34
AR	0.01	ns	ns
SAR	0.02	ns	ns

Notes: control = non
A_1 Vinasse A_2 FYM A_3 Town refuse compost
A_4 farm refuse Compost R_1 5 Ton fed.$^{-1}$ R_2 10 Ton fed.$^{-1}$

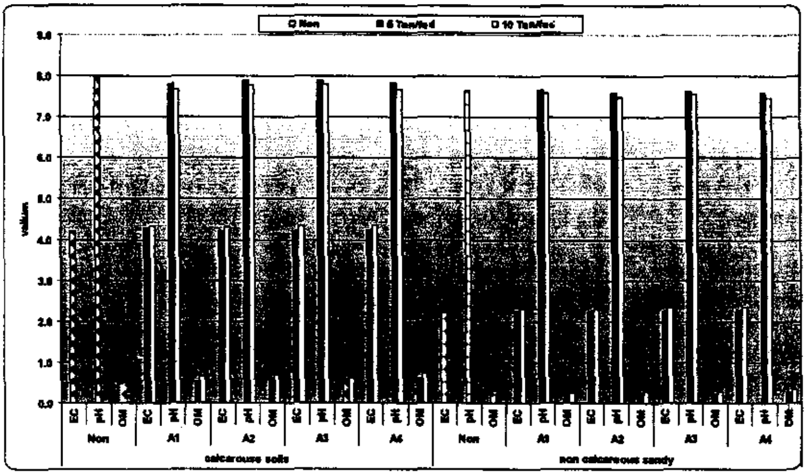

Fig. (3): Effect of soil the used conditioner (A1, A2, A3 and A4) on EC, pH and organic matter of the investigated soils.

The high increase in soil electrical conductivity as a result of vinasse application may be attributed to the high salt content of vinasse as shown in Table (2) The altemations occurred in EC of the non calcareous sandy and calcareous clay loamy soils are final products of the chemical composition of the added organic conditioners.

On the other hand, applications of soil conditioners decreased soil reaction (pH) slightly and the reduction in soil pH was more noticeable at the higher rates of the applied organic conditioners in both the investigated soils. The decrease in soil pH is due to the in creaser CO and organic acids produced during organic materials decomposition. The highest reduction in soil pH was detected owing to application of the vinasse as a soil conditioners in both the calcareous and sandy soils. This might be due to more release of the organic acids up on application of vinasse. This finding resembles that of Çabrera (1996a) who reported that the vinasse is a dense liquid with high organic matter and salt contents.

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تأثير بَعض المحسنات العضويةِ على بَعض الخواص الطبيعيةِ و الكيميائية لبعض الاراضى حديثة الاستصلاح في مصر

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أجريت تجربتان حقليتان في أراضي غير جيرية رملية وجيرية طمية طينية في منطقة اطفيح ، محافظة الجيزة لدراسَة تأثير بعض محسنات التربة العضويةِ مثل الفيناس و السماد البلدي ومكمورة مخلفات المدن ومكمورة مخلفات المزرعة بمعدل أضافة هما ٥ و١٠ طنّ / فدان على بَعْض الخواص الطبيعيةِ و الكيميائية لأراضى المذكورة والتى زرعت بالذرة الصفراء في فصل الصيف والحنطة (القمح) في فصلِ الشتاء وأظهرت النَتائِجُ ان اضافة المحسنات العضويةِ (الفيناس و السماد البلدي و مخلفات المدن و السماد العضوي) إلى التُرَبِ الغير جيرية الرمليةِ والجيرية الطمية الطينية قد سبّب انخفاضا في قِيَم الكثافةِ الظاهرية بالمقارنة مع الكنترول، وكان التاثير أكثر وضوحا فى حالة اضافة المواد المختبرة بالمعدل الاعلى الى كلتا الارضين. أيضا ادى إضافة المواد العضويةِ إلى التربة الغير جيريةِ الرمليةِ الى خفض قيم التوصيل الهيدروليكي لها مقارنة مع الكنترول. أما اضافة هذة المواد العضوية الى الارض الجيرية الطمية الطينية فقد أدى الى زيادة قيم التوصيلِ الهيدروليكي في التربةِ الجيريةِ مقارنة بالكنترول. فيما يتعلق بالمساميةِ والماء الميسر فان إضافةِ الموادِ العضويةِ أدى الى ذيادة نسبة المسامية الكلية والماء الميسر في كلتا الأرضين ، وعلى أية حال ادى اضافة السماد العضوي بالمعدل الاعلى الى أثر أكثرَ وضوحا على كل من المسامية والماءَ الميسرَ. أوضحت النَتائِج أيضاً ان أضافة المحسناتِ العضويةِ أدى الىّ أنخفاض في رقم pH التربة وكَانَ هذا الاثرأكثرَ وضوحاً باستخدام الفيناس في كلا الارضين . وقد بينت الدراسةِ ان اضافة سماد مكمورة مخلفات المزرعة كمحسن عضوي كَانَ أكثرَ فعّالية من بقى المحسّناتِ العضوية الاخرى على الصفات الطبيعية لكلا النوعين من الأراضي.

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