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RESIDUAL EFFECT OF APPLYING PLANT WASTE COMPOSTS ON CALCAREOUS SOILS UNDER DIFFERENT IRRIGATION SYSTEMS

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ABSTRACT

A field experiment was carried out at Maryut Experimental Station of the Desert Research Center, in summer 2006, to evaluate the effects of residual application of plant waste composts on physical and chemical properties of calcareous soil, as will as the yield of corn plants growing under different irrigation systems. The experiment was carried out in split plots design, where irrigation systems occupied the main plots, and the compost treatments occupied the sub main plots. The used irrigation systems were: Traditional short furrows (TF), Gated-pipe long furrows (GF), Surface drip (D); and Subsurface drip at 20-cm depth (SD). The compost treatments were: 0, 10, 20, and 30-m^3 compost /fed. denoted as (C0);(C1); (C2); and (C3), respectively. The obtained results indicated that both irrigation systems and compost amounts had significant influences on yield and some physical-chemical properties of soil. The average values of losses water ranged from 31.6 to 37.3 %, 27.0 to 29.9%, 13.8 to 16.0% and 8.9 to 15.4% by (TF), (GF), (D) and (SD) treatments, respectively with recent addition of compost. While average values of water distribution uniformity (DU) under (TF), (GF), (D) and (SD) treatments ranged from 0.54 to 0.59, 0.56 to 0.67, 0.81 to 0.87, and 0.85 to 0.94, respectively. Compost amounts, subsurface drip and gated furrow irrigation treatments led to apparent decrease in average values of soil bulk density and apparent increase in average values of total porosity, and hydraulic conductivity. Soil pH and EC values decreased by increasing of application rate of compost under all the used irrigation systems. On the other hand, the application of compost treatments led to increase organic matter, total N and available P values of the investigated soil. The yield of corn grains and cobs favorably affected by the applied treatments as the maximum average yield of corn grains were 4.78 and 4.1 t/fed. obtained by recent application under SD and GF irrigation systems, respectively. Whereas the maximum average yield of corn cobs were 0.78 and 0.58 t/fed. obtained by recent application under SD and GF irrigation systems, respectively.

Keywords: drip irrigation, subsurface drip, gated-pipe long furrows, traditional short furrows, irrigation performance, compost additions, residual effect, calcareous soil, physical-chemical properties, corn.

INTRODUCTION

With the growing demand for continued efforts to achieve sustainable food security, there is increase need to maximize the productivity of both land and water. 'Inputs' to land may improve land productivity but 'inputs' to water may not change the productive capacity of water. Highly calcareous soils are widely spread in Egypt. High calcium carbonate ($CaCO_3$), particularly the active fraction with high specific surface area in these soils distinctly affects their hydro-Physical, chemical characteristics, their fertility and water use for production, Patil and Sheelavantao (2004).

Management of calcareous soils is still a problem in several locations as many unsuitable practices are still applied and cause retarding in their productivity. The high content of calcium carbonate, especially in the active fraction, promotes different problematic soil characters, such as pudlling, compaction, poor aeration, nutrient fixation and surface crusting, El-Sherbiny (2002). Field evaluation of irrigation system performance is an essential to improve irrigation management. Volumetric water control and distribution uniformity in irrigation system are essential factors in achieving accurate water applications, Smith and Watts (1986). Surface irrigation is the most widely used irrigation method. This is due to its low capital and maintenance costs, and low energy requirements, Hanson *et al.* (1993). Results reported by Oyonarte and Mateos (2002) illustrated that the spatial variability of the soil hydraulic characteristics is one of the variables determining irrigation performance. Water infiltration in the subsurface drip irrigation (SDI) takes place in the region directly around the dripper, which is small compared with the total soil volume of irrigated field. Sustaining calcareous soil productivity depends on maintaining favorable soil physical, nutritional and biological properties that enhance plant growth. Organic matter affects on crop growth and yield, either directly by supplying nutrients, or indirectly by modifying soil physical properties that can improve the root environment and stimulate plant growth. A soil seldom has sufficient organic matter for optimal plant growth, Wallace and Wallace (1986). Beheiry and Heikal (2007) concluded that the uptake of N, P, K, Fe, Mn and Zn in sunflower seeds increased significantly depending upon the water quantity, the application rates of farmyard manure and irrigation system. The positive effect of such factors on increasing the contents of such nutrients is a true reflection of improving some physical and chemical properties of the calcareous soil.

The objective of this study is to study the residual effect of different rates of compost under mentioned irrigation systems and their interactions on some physical and chemical properties of calcareous soil as well as corn yield.

MATERIALS AND METHODS

A field experiment was carried out in summer 2006 at Maryot Experimental Station of Desert Research Center, Alexandria Governorate. Some physical and chemical properties of soil in which the experiment was carried out are shown in Tables (1 and 2). The soil of experimental site was deep, well-drained calcareous sandy clay loam in texture. Some properties of the applied plant residues compost represented in Table (3).

Table (1): Some physical properties of the experimental soil site.

Soil depth (cm)	Particle size distribution (%)				D_p* (g/cm^3)	D_b (g/cm^3)	Total porosity (%)	F.C (V%)	W.P (V%)	A.W (V%)
	C. Sand	F. Sand	Silt	Clay						
0-15	23.90	32.02	22.72	21.36	2.30	1.50	30.45	20.89	8.05	12.84
15-45	23.65	31.98	22.94	21.43	2.31	1.52	31.41	20.36	8.68	11.68

***D_p= Particle density; D_b= Bulk density; F.C= Field capacity; W.P= wilting point and A.W= Available water.**

Some chemical properties of irrigation water along the season represented in Table (4). Before swing and after harvesting, representative soil samples were collected from each replicate for the determination of some soil physical and chemical properties. The following soil physical properties were determined; namely, Particle density (D_p), bulk density (D_b) were measured according to Klute (1986), soil porosity (S_t) was calculated using the formula: S_t% = 100 ($1-D_b/D_p$). Some chemical properties were determined according to the methods described by Black (1983) and Baker and Thompson (1992).

Table (2): Some chemical properties of the experimental soil site.

Soil depth (cm)	EC (dS/m)	pH*	OM (%)	Total (ppm) N	$CaCO_3$ (%)	Soluble Cations (meq/l)				Soluble Anions (meq/l)			
						Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
0-15	2.77	7.97	0.62	112	27.84	7.60	5.73	13.99	0.38	-	2.92	13.88	10.89
15-45	2.44	7.83	0.49	90	29.66	6.37	4.48	13.23	0.31	-	3.25	12.28	8.86

*pH= soil pH of soil paste; O M= Organic matter; and EC= Soil electrical conductivity.

Table (3): Average values for some properties of the applied compost.

pH	EC (dS/m)	Total macronutrients(%)			Db (g/cm^3)	Organic carbon(%)	C/N ratio	Total micronutrients (µg/g)						
		N	P	K				Fe	Mn	Zn	Cu	Cd	Ni	Pb
7.6	7.0	1.46	0.4	0.75	0.86	15.33	10.5	6370	266	180	18	0.1	5.7	2.5

Table (4): Some chemical properties of the irrigation water.

pH	EC (dS/m)	Soluble cations (meq/l)				Soluble anions (meq/l)				SAR
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	
7.28	2.36	3.56	3.76	15.61	0.63	-	1.78	17.80	3.98	6.04

Irrigation systems and experimental treatments:

A field experiment area was divided into four equal main plots of 6.75 x 48.0-m represent the four applied irrigation treatments. Each main plot was divided into four equal subplots (6.75 x 12.0-m) representing compost rate addition treatments. Each subplot was divided into nine rows 12.0-m in length and 0.75-m between them. The experiment was laid out following the split plot design and 4 replications of each treatment. The irrigation systems were surface furrow irrigation, which represented as: Traditional short furrows (TF) and Gated-pipe furrows (GF); and Drip irrigation system which represented as: Surface drip (D); and Subsurface drip (SD) at 20-cm depth from soil surface. Recent compost addition rate treatments were mixed with surface soil layer three weeks before cultivation in the half area (with considering as continues the same amounts), where the total area was affected by residual compost application in previous season in sub-plots at: 0, 10, 20, and 30-m^3/fed. designated as C0, C1, C2 and C3, respectively.

Recommended potassium (potassium sulphate) and phosphorus (triple super phosphate) fertilizers added during soil preparation at the rate of 50 and 150-kg/fed., respectively, while nitrogen was applied at the rate of 150-kg N/fed. (Ammonium nitrate) in three equal doses; the first dose was applied at soil preparation, while the others were applied after 30 and 60 days after sowing, respectively.

Under surface furrows the average inflow rate was 55-lpm/furrow for both GP and TF, which checked by volumetric methods during several irrigation events, according to Walker (1989). Irrigation runoff was negligible, which the furrows were closed-ends. Thus, the net amount of irrigation water was the amount of water added to the field during each irrigation event coincided with the crop's growth stage (Doorenbos and Pruitt, 1977) and soil storage moisture content, in order to raise the moisture content of the soil to its field capacity. A Surface Irrigation Simulation Model SRFR Ver. 4.06 was used to simulate the interactive data with a series of performance indicators, such as application efficiency (AE%), distribution uniformity of low-quarter (DU), and adequacy of irrigation, Strelkoof and Clemmens, (1999). These indicators are the baseline to compare between the irrigation methods, Vazquez (2006).

Each plot in drip irrigation treatments had one valve, one pressure gauge and one flow meter. Lateral drip lines were 16-mm Polyethylene (4.05-lph GR inline type and 0.33-m dripper spacing) used at depths of 0.0 and 20-cm from soil surface in the middle of ridges.

The variety of corn was Sakha 324, sown at the depth of 10 cm in raised furrow ridges spaced at 30-cm apart on ridge of furrow.

The experiment plant density was 4 - 4.5 plant/m^2 on an average. Preplant irrigation for all treatments was applied before sowing to weeds control.

Soil moisture content:

Neutron probe scattering was calibrated and used for soil moisture determination content. Access tubes were pressed at the center of the row to a depth of 1.20-m. Measurements of soil moisture content (volumetrically) in all treatments were started at depth of 0.3-m from ridge surface with increments of 0.15-m till 1.05-m to follow the soil moisture along growth stages of corn crop during 1$^{st.}$, 4$^{th.}$, 6$^{th.}$ and 8$^{th.}$ watering events by furrow system and with 2$^{nd.}$, 5$^{th.}$, 8$^{th.}$ and 12$^{th.}$ watering events by drip system.

Irrigation performance parameters:

Water application efficiency (AE%) and water distribution uniformity (DU) were calculated for the 100-cm soil depth according to James (1988) as an average value for considered irrigation events. The data were statistically analyzed according to Snedecor and Cochran (1982).

Estimation of water requirements and irrigation schedule:

Methodology formulated by Allen *et al.* (1998) was used for irrigation scheduling. Since the precipitation, deep percolation and surface runoff could be ignored under the experiment conditions, therefore, the irrigation water amount was estimated using the field balance equation as follow:

$$I = ET_c \pm \Delta S$$

Where: I = irrigation amount, mm

ET_c = crop evapotranspiration, mm

ΔS = change of soil water storage, mm

Corn yield:

At harvest time (100 days after sowing) grains and cobs samples from each treatment were collected and weighed after dried (adjusted to 15.5% water content) to estimate the yield t/feddan. After harvest, the representative soil samples were collected from each replicate for the determination some soil physical and chemical properties. All data were statistically analyzed according to Snedecor and Cochran, (1982).

RESULTS AND DISCUSSIONS

Performance of irrigation systems:

Irrigation performance parameters were calculated for the applied treatments. Average values of water application efficiency (AE%) shown in Fig. (1), It is clear that (TF), (GF), (D) and (SD) treatments, the average values of losses water ranged from 31.6 to 37.3 %, 27.0 to 29.9%, 13.8 to 16.0% and 8.9 to 15.4%, respectively, with recent addition of compost. These variations of the obtained results depend on the rate of added compost. However the corresponding valued under the residual added composts were 36.0 to 37.7%, 28.0 to 29.3%, 16.6 to 20.3% and 11.9 to 17.5%, respectively.

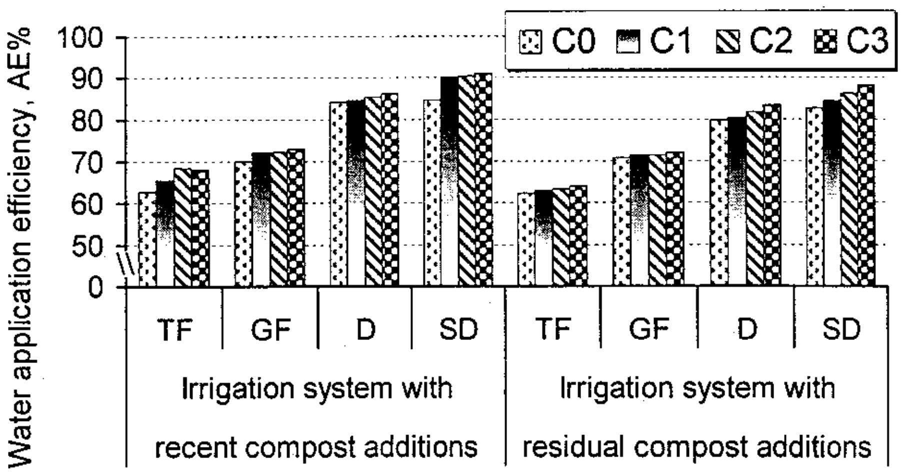

Fig. (1): Effect of irrigation systems and compost additions on water application efficiency (AE%)

Irrigation water distribution uniformity:

By surface irrigation system, Fig. (2) illustrated average values of water distribution uniformity (DU) by (TF) treatment, were ranged from 0.54 to 0.59 under recent compost additions, while under residual compost additions, it ranged from 0.53 to 0.56, depending on the rates of compost addition. These values by (GF) treatment, it were ranged from 0.56 to 0.67 under recent compost additions, while under residual compost additions, it ranged from 0.54 to 0.66, depending on the rates of compost addition. Average values of distribution uniformity (DU) by (D), it were ranged from 0.81 to 0.87 by recent compost additions, while under residual compost additions, it ranged from 0.8 to 0.84, depending on the rates of compost.

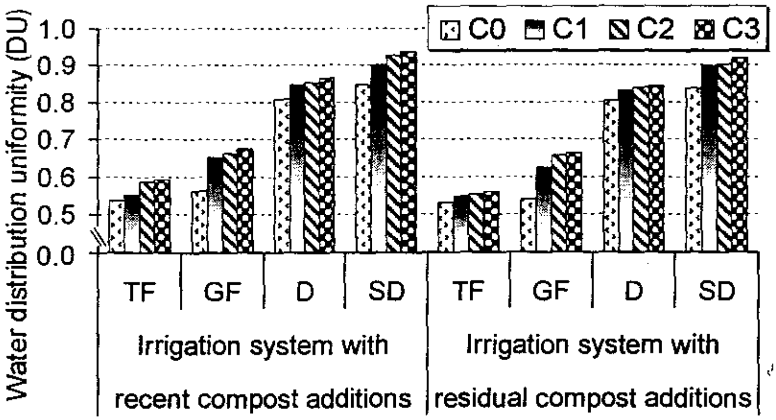

Fig. (2): Effect of irrigation systems and compost additions on water distribution uniformity (DU)

These values under (SD), it were ranged from 0.85 to 0.94 under recent compost additions, while under residual compost additions, it ranged from 0.84 to 0.92, depending on the rates of compost addition. According to Bralts *et al.* (1981), DU greater than 0.87 implied an excellent functioning of the drip lines. It is clear that with increasing of compost application amounts the values of DU increase under all the studied irrigation systems. In the same time, addition of C2 had no-significant differences in average DU values compared with C3 under all irrigation treatments.

Effect of compost and irrigation systems on some chemical properties of the investigated soil:

Data presented in Table (5) show the effect of the applied composts additions on the chemical properties of calcareous soil under investigation.

Values of soil pH:

Data in Table (5) indicate that soil pH values varied according to the applied treatment, as the values decreased by increasing compost additions under all the irrigation systems.

In addition, the values associated with the residual additions of compost were lower than that associated with the recent additions of compost. The positive effect of organic compost on reducing soil pH values may be due to the acidic effect of the decomposable products (organic acids such fulvic acid, humic acid and other inorganic acids) of such composts due to decay by the soil microbes.

Values of soil EC:

Data in the same Table (5) indicate that the EC values of the investigated soil were favorably affected by the applied treatments either addition of compost or irrigation systems. It is clear that the EC values decreased by increasing both level of compost addition. Also the values of

EC in residual addition of compost were lower than that treated with the recent one. The highest value of EC (2.77-dS/m) obtained under TF*C0 treatment. However, the lowest EC value (2.68 dS/m) obtained under GF irrigation system when 30m^3 of compost was added.

Table (5): Effect of compost addition rates and irrigation system treatments on some soil chemical properties.

Irrigation system	Compost addition rate (m^3/fed.)							
	Recent addition				Residual addition			
	C0	C1	C2	C3	C0	C1	C2	C3
pH								
TF	7.80	7.70	7.52	7.43	7.79	7.61	7.48	7.40
GF	7.78	7.68	7.39	7.38	7.74	7.58	7.42	7.38
D	7.76	7.68	7.38	7.31	7.74	7.56	7.36	7.32
SD	7.78	7.58	7.34	7.30	7.69	7.52	7.35	7.33
Ec(ds/m)								
TF	2.77	2.75	2.71	2.71	2.80	2.75	2.75	2.72
GF	2.74	2.69	2.67	2.68	2.79	2.77	2.75	2.73
D	2.76	2.71	2.71	2.69	2.79	2.79	2.76	2.74
SD	2.75	2.71	2.70	2.69	2.78	2.78	2.75	2.71
Organic Matter (%)								
TF	0.77	1.24	1.35	1.36	0.64	0.80	0.90	1.03
GF	0.78	1.28	1.38	1.51	0.56	0.64	0.86	1.02
D	0.97	1.31	1.46	1.57	0.88	1.07	1.33	1.43
SD	0.97	1.36	1.46	1.58	0.78	0.75	1.33	1.46
Total N (µg/g)								
TF	98.85	105.75	113.40	123.75	86.64	92.52	86.00	99.00
GF	108.00	146.00	154.00	166.00	101.04	104.00	102.00	107.64
D	109.00	164.00	167.10	177.00	105.84	116.76	121.92	116.00
SD	96.00	156.00	164.00	171.00	95.00	106.00	119.00	110.00
Available P (µg/g)								
TF	7.52	8.93	9.40	11.10	7.32	8.01	8.28	9.00
GF	10.90	13.55	13.70	14.24	9.90	11.33	12.03	12.20
D	9.40	11.70	12.96	12.99	8.80	10.20	10.20	10.60
SD	8.88	10.66	13.25	14.20	8.72	10.04	10.33	10.62

Generally, the favorable effect of compost on reducing EC values may be due to its role in improving physical properties of the soil under investigation, consequently, more soluble salts may be leached out and moved downward vertically with the water movement.

Organic matter:

Data in the same Table (5) indicate that organic matter (OM) of soil under investigation increased by increasing compost addition rate under any of the applied irrigation systems. This may be due to the higher initial content of organic carbon in the applied compost (Table 3) .In general, regardless of compost treatments, the efficiency of the used irrigation systems on increasing soil organic matter content can be arranged in the following order: SD > D > GF > TF. As the average values of OM under the recent applied compost reached 1.47, 1.45, 1.39 and 1.32 % for SD, D, GF and TF, respectively. While, the respective values under the residual applied compost reached 1.18, 1.14, 0.84 and 0.91%.

Total N:

From the same Table (5) we can notice that total N values of the investigated soil took the same trends residually mentioned for organic matter content. It can be noticed that the rate of increment in total N under the recent applied compost was higher than that of residual applied compost. As the rate of increment over the control reached 38.8, 45.3 and 54.9% for C1, C2 and C3, respectively, regardless of the applied irrigation systems. The positive effect of compost on increasing total N of soil may be due to the decomposition of such compost by soil microorganisms.

Available P:

It is clear from Table (5) that the available P of the investigated soil was favorably affected by compost application under all the used irrigation systems. The highest value of available P (12.24 µg/g) obtained at 30-m^3 of compost (recent application) under GF irrigation system. However the lowest value (7.32 µg/g) obtained when TF irrigation system applied without any addition of compost.

Effect of compost and irrigation systems on some physical properties of the investigated soil:

Soil bulk density (Db):

Data in Fig. (3) show pronounced decrease in soil bulk density (Db) associated with different added amounts of compost under the considered irrigation systems. As the rate of decrement under recent additions reached to 11.46, 12.53 and 13.97% for C1, C2 and C3 compared to C0, respectively. Whereas, the respective values under residual compost additions reached 7.90, 9.20 and 10.84% compared with C0. With recent addition, the decrease of Db reached to 1.39, 1.40 and 1.47% with soil three depths 0-15, 15-30 and 30-45-cm, respectively. Whereas the decreases were non-significant to the residual addition under the $1^{st.}$ and $2^{nd.}$ soil layers, it reached to 1.47 and 1.49% in $3^{rd.}$ layer under recent and residual application, respectively.

This behavior might be attributed to that rapid microbial degradation of compost which could be responsible for the lack of marked changes in soil bulk density. These results were in agreement with Gregory *et al.* (1999) who reported that the soil bulk density was significantly improved in the soil amended with 22 ton /ha waste potato compost and 45ton/ha farmyard manure after 3 years of application. Schjonning *et al.* (1994) attributed the high decrease in bulk density of soil amended with farmyard manure to some decrease in particle density and increase in volume of soil pores epically in the size range responsible for holding available water to plant.

Regarding the influence of the irrigation systems on soil bulk density, it was decrease and reached to 2, 4, and 27%, respectively, by recent addition compared with TF treatment (as control).

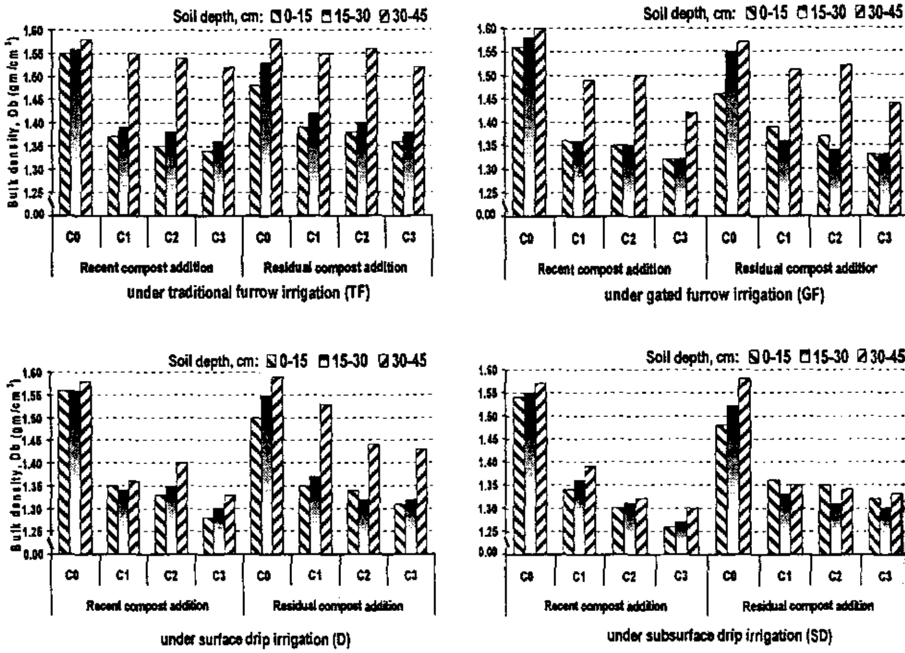

Fig. (3): Effect of irrigation systems and compost additions treatments on soil bulk density at different soil depths

Whereas, amount decrease and reached to 2, 3, and 5%, respectively, by residual addition compared to TF treatment. This may be attributed to increasing the soluble $CaCO_3$ upon increasing soil moisture with TF and GF, which precipitated within conducting soil pores, thereby soil bulk density increases. The interaction between addition rates of compost (recent and residual) under irrigation system led to decrease in soil bulk density with C3 (recent) and SD reached to 1.28-g/cm^3.

With respect to the effect of residual or recent addition of compost, data revealed that decrease of soil bulk density under recent and residual application reached 20% and 7% respectively. These results were in agreement with the findings of Zebarth *et al.* (1999) who reported that soil bulk density was reduced due to the addition of 2% organic matter and the values of soil bulk density after 3 years of composted sheep dung application was 1.41 Mg/m^3 compared with 1.69 Mg/m^3 for the control.

Total porosity (S_t):

Data in Fig. (4) revealed that the recent or the residual application of compost at any rate was able to increase the total porosity amounts by 20% and 14 % respectively as compared with the control. The rate of increment under recent compost addition reached 23, 25 and 30% for C1 ,C2 and C3 respectively. While the respective increment under residual compost application were 16 , 18 and 21%, respectively, compared with control, Khadr (2003) mentioned that organic manures addition enhances both soil porosity and pore size distribution and plays an important role in preventing soil compatibility of enhancing the formation of granular structure.

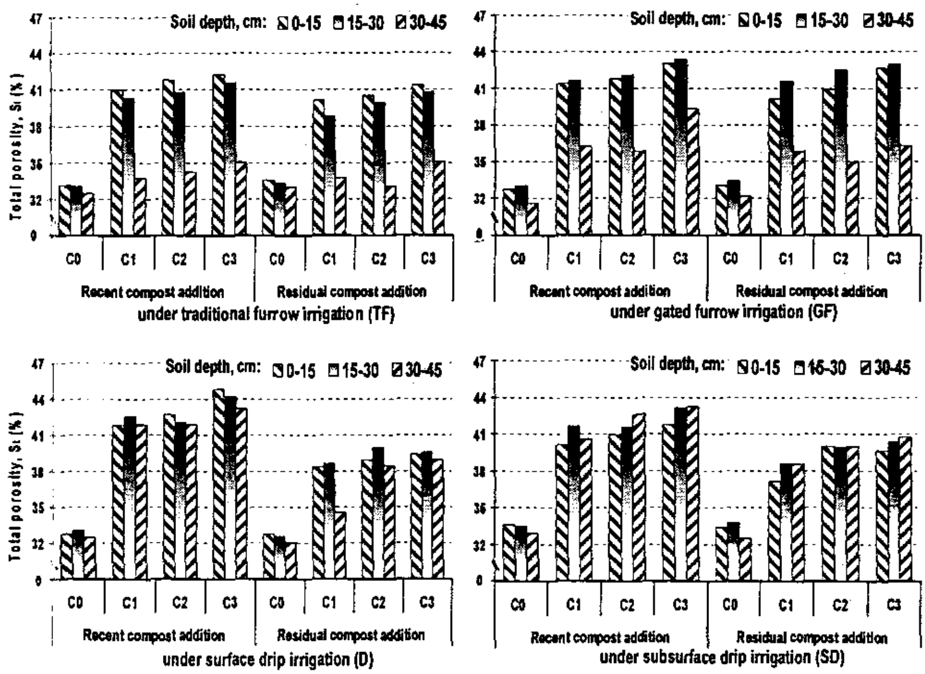

Fig. (4): Effect of irrigation systems and compost additions treatments on soil total porosity at different soil depths.

The same data show clearly that S_t has the same trend of soil Db, hence the fineness of recent composting addition may be responsible for the high increasing percent as it can migrate between soil particles easily more than the other one. So, total porosity of the soil depth (0-15-cm) showed the greatest modification compared to depths (15-30 and 30-45-cm). This behavior could be attributed to the enhancement of soil agreeability subsequently increase of soil porosity, Hiekal *et al.* (2008). Skidmore *et al.* (1986) concluded that soil physical degradation is often associated with a decline in the organic matter content. The loss of organic matter is generally associated with a decline in soil porosity and aggregate stability. Concerning the effect of irrigation system on soil total porosity, data showed that realizing of soil total porosity increasing amounts of 10, 7, and 3% under recent addition by SD, D, and GF, respectively, compared with TF treatment. Whereas, the residual addition was 8, 5, and 3% by SD, D, and GF, respectively, compared with TF treatment. This may be attributed to much water might have caused partially poor aeration of roots, (Xiao *et al.*, 2004). The interaction between addition rate of compost (recent and residual) under irrigation system led to increase of soil total porosity associated with

SD-C3treatment under these conditions the increase in soil total porosity reached to 40% over the TF-C0 treatment.

Saturated hydraulic conductivity (SHC):

Fig. (5) indicates the influence of recent and residual compost additions under different irrigation systems on saturated hydraulic conductivity (SHC) of calcareous soil under investigation. It is clear that SHC changed from Moderately-slow to Moderately-rapid and from Moderate to Moderately-rapid due to residual and recent addition of compost respectively. The recent treatments surpassed the residual ones in mean increasing percent in soil SHC.

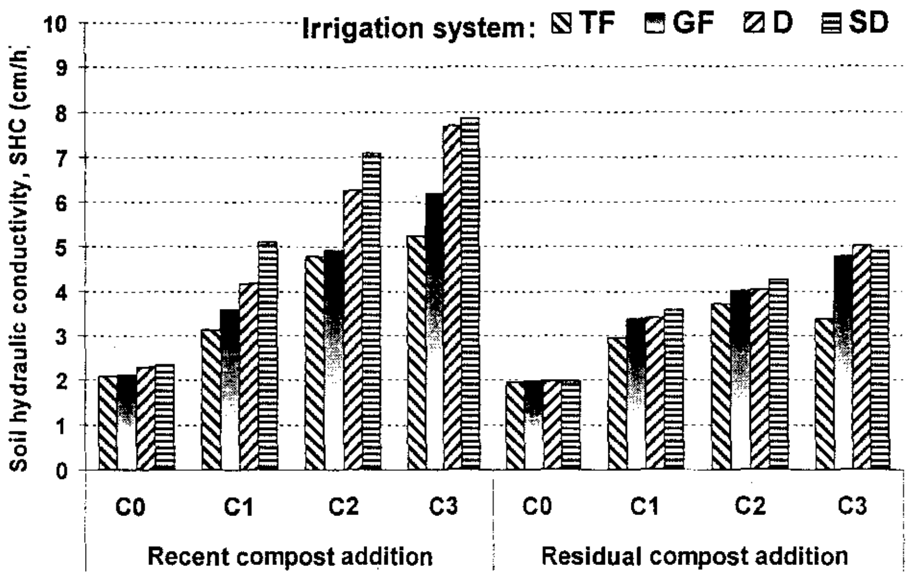

Fig. (5): Effect of irrigation systems and compost additions treatments on soil saturated hydraulic conductivity

The mean increasing percent reached 149% and 113% for recent and residual applications, respectively, as compared to the control. The rate of increment in soil SHC under recent application reached 203, 158 and 79% for C1, C2 and C3 of compost, respectively, as compared to the control. Meanwhile, the respective values under residual application reached 68, 103 and 167%. The effect of compost applications on increasing SHC of the soil could be attributed to increase organic matter content and the improvement of soil structure consequently increase in soil porosity and root penetration through the soil . Increased moisture in soil profile with organic compost application was due to higher fine and coarse aggregates with increased porosity, mean weight diameter and hydraulic conductivity and this might have increased infiltration rate and reduced bulk density (Mishra and Sharma, 1997). These results matched with Stevenson (1994) who observed that the frequent addition of easily decomposable organic residues leads to better ability of water to infiltrate and percolate downward through the soil. El-Sherbiny (2002) reported that SHC increased in calcareous soil by addition of composting manure. This attributed to that the particles are held together by cementing substances such as hums and $CaCO_3$ subsequently increase macro pores and velocity of water movement within the soil. Concerning the effect of irrigation systems on SHC, data in the same Figure showed that declare a tendency of increasing SHC of the soil upon compost addition rate from C0 to C3 under SD treatment, these variation of increase correspond to soil water movement transmission from 1.98 cm/h Moderately-slow (MS) to 6.31 cm/h Moderately-rapid (MR) under residual application and from 2.34 cm/h Moderate (M) to 8.5 cm/h Moderately-rapid (MR) under recent application. The mean rate of increment in soil SHC under residual application reached 70, 119, 124 and 138% for TF, GF, D, and SD irrigation systems, respectively. Meanwhile the respective values under recent application reached 109, 131, 162 and 162%. These results may be attributed to that TF and GF irrigation systems led to aggregate disintegration caused by fast water rate compared with D and SD. These results were in agreement with Lado *et al.* (2004) who reported that aggregate disintegration caused by fast water rate. Data in Fig. (5) matched that irrigation system SD and D increase soil SHC compared to TF and GF. This may be attributed to irrigation water ponds at the TF and GF, after irrigation event, it induce soil particle are held together by cementing substance such as hums and $CaCO_3$ subsequently, induce soil particle condensations and soil pore diameter decrease, subsequently SHC decrease. Russell (1989) reported that hydraulic conductivity decreases as the pore sizes decrease.

Effect of irrigation systems and compost additions on corn yield:

Data in Figs. (6 and 7) indicate that the grain and cob yields of corn plant grown on the soil under investigation were significantly increased by increasing organic compost additions rate under any of the all used irrigation systems. The highest yields in recent addition of compost reached to 4.801 and 0.783 ton/fed. for grains and cobs, respectively, by SD*C3 treatment. The positive effect of organic compost on increasing grain and cob yields of corn plants may be due to that organic compost contains essential nutrients for plant growth such as N, P, K, Fe, Mn and Zn, which it will abundance in root zone. Consequently the uptake of nutrients and dry matter formation of the plants increased.

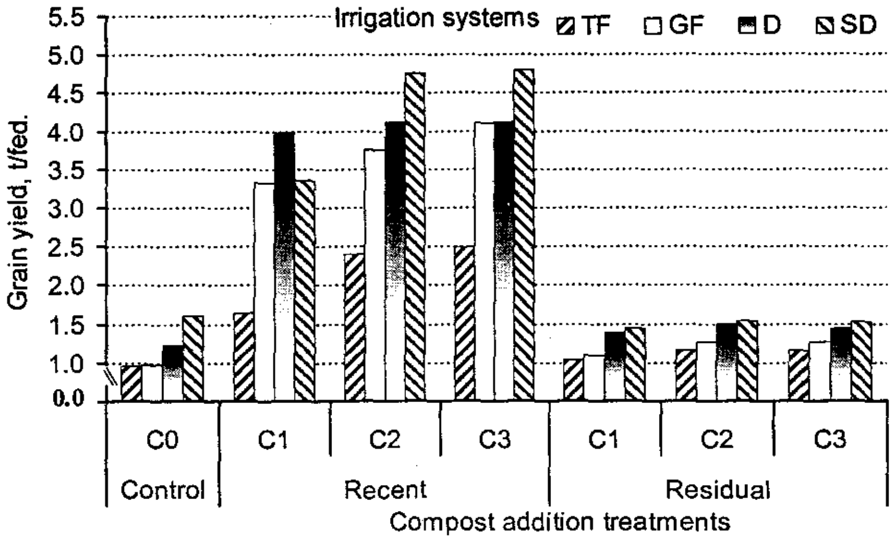

Fig. (6): Effect of irrigation systems and compost additions treatments on corn grains

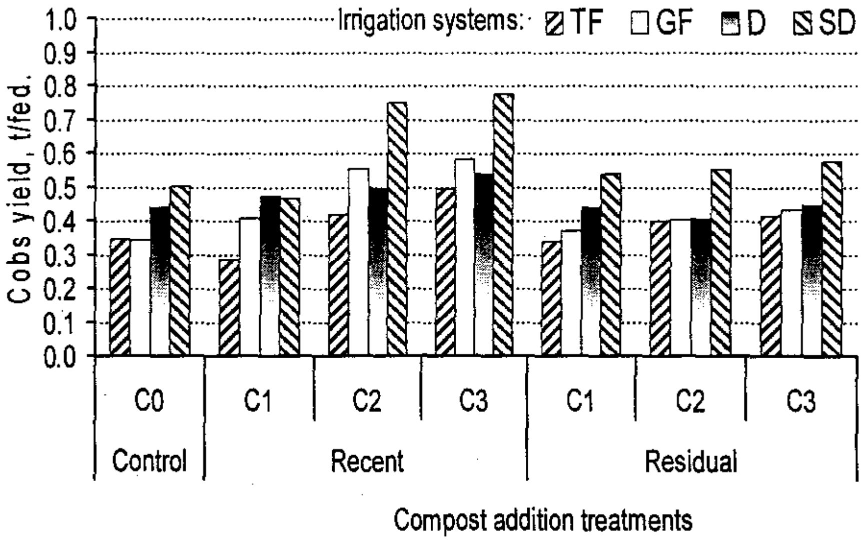

Fig. (7): Effect of irrigation systems and compost additions treatments on cobs yield

REFERENCES

Allen, R.G.; L.S. Pereira; D. Raes and M. Smith (1998). Crop evapotranspiration: Guidelines for computing crop water requirements. FAO Irrig. and Drain. Paper 56, 103-134, Italy.

Baker, W.H. and T.L. Thompson (1992). Determination of total nitrogen in plant samples by Kjeldahl. Plant Anal. Ref. Proc. for S. US (SCSB # 368), pp: 13-16.

Beheiry, G.Gh.S. and H.A.M. Hiekal (2007). Evaluation of the relationship between natural amendments application and different irrigation systems on calcareous soil properties and its productivity. Egypt J. Appl. Sc., 22(6A): 310-329, Egypt.

Black, C.A. (1983). Methods of soil analysis. Part 2, Agron. Monogr. No.9, ASA, Madison, WI, USA.

Bralts, V.F.; I.P. Wu and H.M. Gitlin (1981). Manufacturing variation and drip irrigation uniformity. Trans. of the ASAE 24, 113–119, USA.

Doorenbos, J. and W.O. Pruitt (1977). Crop water requirements. FAO Irrig. and Drain. Paper 24, 144 pp., Rome, Italy.

El-Sherbiny, W.A. (2002). A study on some management practices in calcareous soils and their reflection on soil physical, mechanical and crop production. Ph.D. Thesis, Moshtoher Fac. of Agric, Benha Branch, Zagazig U., Egypt.

Gregory, A.P.; B.O. Geraldine; W.B. Bradbuy; J.C. Mcburne and J.A. Sisson (1999). Soil management and supplement irrigation effects on potato: 1- Soil properties, tuber yield and quality. Agron. J. 91: 416-425, USA.

Hanson, B.R.; T.L. Pritchard and H. Schulbach (1993). Estimating furrow infiltration. Agric. Water Mgt. 24: 281-298, USA.

Hiekal, H.A.M.; W.A. El-Sherbiny and R.H. Ghodia (2008). Effects of irrigation systems and compost additions on potato yield and calcareous soil-physical properties. In Misr Soc. of Agric. Eng. 15th. Conf. in Coop. with Agric. Mec. Sector, ARC 12-13 March 2008, "Agricultural Mechanization and Engineering Between Existing and Prospected", Misr J. of Agric. Eng. 25 (2): 425 - 444.

James, L.G. "Ed." (1988). Principles of farm irrigation system design. John Wiley & Sons, New York, 543 pp., USA.

Khadr, M.Y.A. (2003). Evaluation of soil compact ability using micromorphological characteristics and mercury intrusion porosimetry data. Egypt J. Soil Sc. 43 (4): 495- 508.

Klute, A. "Ed." (1986). Methods of soil analysis. Part 1, 2nd. Ed. Agron. Monogr. No.9, 1172 pp., ASA and SSSA, Madison, USA.

Lado, M.; A. Paz and M. Ben-Hur (2004). Organic matter and aggregate-size interactions in saturated hydraulic conductivity. SSSA J. 68: 234-242.

Mishra, V.K. and R.B. Sharma (1997). Effect of fertilizers alone and in combination with manure on physical properties and productivity of Entisol under rice-based cropping systems. J. Indian Soc., Soil Sc. 45 (1): 84-88.

Oyonarte, N.A. and L. Mateos (2002). Accounting for soil variability in the evaluation of furrow irrigation. Trans. of the ASAE 46 (1): 85–94, USA.

Patil, S.L. and M.N. Sheelavantao (2004). Effect of cultural practices on soil properties, moisture conservation and grain yield of winter sorghum (Sorghum bicolar L. Moench) in semi-arid tropics of India. Agric. water Mgt. 64: 49-67.

Russell, E.W. (1989). Soil conditions and plant growth., ELBS edition of eleventh edition (1988), Reprinted 1989.

Schjonning, P.; B.T. Cheristensen and B. Carstensen (1994). Physical and chemical properties of sandy loam receiving animal manure, mineral fertilizer or no fertilizer for 90 years. European J.of Soil Sc.45(3):257-268.

Skidmore, E.I.; J.B. Layton; B.V. Armbrust and M.I. Hooker (1986). Soil physical properties as influenced by cropping and residue management. Soil Sc. Am. J. 50: 415-419.

Smith, J. and P.J. Watts (1986). Analysis and design of gated irrigation pipelines. Agric. Water Mgt. 12: 99 – 115, USA.

Snedecor, G.W. and W.G. Cochran (1982). In "Statistical methods". 7th Ed. Iowa State U. Press, 593 pp., Ames, USA.

Stevenson, F.J. (1994). Humus chemistry: Genesis, composition Reaction, 2nd Ed. John Wiley, NY, 496 pp., USA.

Strelkoof, T.S. and A.J. Clemmens (1999). SRFR Program Software V. 6.04, US Water Cons. Lab., USDA agency source, USA.

Vazquez, E. (2006). Comparison between continuous flow and increased discharge irrigation in blocked end furrows using a mathematical model. Appl. Eng. in Agric. 22(3): 375-380, USA.

Walker, W.R. (1989). Guidelines for designing and evaluating surface irrigation systems. FAO Irrig. and Drain. Paper 45, 137pp., Italy.

Wallace, A. and G.A. Wallace (1986). Additive and synergistic affects on plant growth from polymers and organic matter applied to stimulant eously . Soil Sc. 141: 334-341.

Xiao, J.; T.W. Lei; P.F. Jiang and Y.D. Yu (2004). Effects of water quality in furrow irrigation on corn yield and soil salinity. Anal. ASAE/CSAE Meeting Pres. Paper No. 042037, 1-4 August Ottawa, Ontario, Canada.

Zebarth, B.J.; G.H. Nielsen; E. Hogue and D. Nielsen (1999). Influence of organic waste amendments on selected soil physical and chemical properties. Canadian J. of Soil Sc.79 (3): 501-504.

الأثر المتبقي لإضافة المخلفات النباتية المكمورة للأراضي الجيرية تحت نظم ري مختلفة

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أقيمت تجربة حقلية بمحطة بحوث مريوط التابعة لمركز بحوث الصحراء فى الموسم الصيفى ٢٠٠٦م بهدف تقييم الأثر المتبقي لاستخدام كمبوست مخلفات المزرعة النباتية على بعض الصفات الطبيعية والكيميائية للتربة الجيرية بالإضافة إلى محصول نبات الذرة النامي بها تحت نظم ري مختلفة .وقد نفذت التجربة بنظام القطع المنشقة حيث شغلت نظم الري المستخدمة القطع الرئيسية فى حين شغلت معاملات الكمبوست القطع تحت الرئيسية . وكانت نظم الري المستخدمة هي SD, D, GF, TF في حين كانت مستويات الكمبوست المستخدمة هي صفر , ١٠، ٢٠،٣٠ م[٣] /فدان مشارا إليها C3, C2, C1, C0 على الترتيب.

أوضحت النتائج إن كل من نظم الري ومعدلات إضافة الكمبوست المستخدمة ذات تأثير معنوي على بعض الخواص الطبيعية ، الكيميائية للتربة ومحصول الذرة على النحو التالي :-

- تراوحت متوسطات قيم الماء المفقود بواسطة نظم الري SD, D, GF, TF بين ٣١,٦- ٣٧,٣ و ٢٧- ٢٩,٩ و ١٣,٨-١٦ و ٨,٩-١٥,٤% على الترتيب.
- تراوحت متوسطات قيم إنتظامية توزيع مياه الرى لنفس النظم السابقة بين ٠,٥٤-٠,٥٩ و ٠,٥٦-٠,٦٧و ٠,٨١-٠,٨٧و ٠,٨٥-٠,٩٤ على الترتيب.
- أدت إضافة الكمبوست مع نظامى الرىGF وSD إلى إنخفاض ملحوظ في قيم الكثافة الظاهرية حيث أدت نفس المعاملات إلى زيادة ملحوظة في قيم المسامية الكلية وقيم التوصيل الهيدرولكى للتربة بزيادة مستوى الكمبوست المضاف.
- انخفضتا قيم EC و pH التربة بزيادة مستوى إضافة الكمبوست تحت اى من نظم الري المستخدمة تحت ظروف الدراسة.
- أدت إضافة الكمبوست الى زيادة قيم المادة العضوية ، النتروجين الكلى ، والفوسفور الميسر بالتربة تحت ظروف الدراسة.
- تأثر محصول حبوب الذرة معنويا بالمعاملات تحت الدراسة وبلغ أقصى متوسط للزيادة ٤,٧٨ ، ٤,١ طن/فدان في الإضافة الحديثة للكمبوست تحت نظامي SD وGF على الترتيب، فى حين بلغت قيمة اقل متوسط للزيادة ٠,٧٨ و ٠,٥٨ طن/فدان فى الإضافة الحديثة تحت نفس نظامى الرى على الترتيب.