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EFFECT OF COMPOST ON MAIZE (*Zea mays*) YIELD AND SOME CLAY SOIL PHYSICAL PROPERTIES UNDER DEFICIT IRRIGATION

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ABSTRACT

Field experiments were conducted for two seasons in the clay soil located at South of Sahl El-Hosainiya Research Station, Port-Said Governorate, Egypt. Maize (*zea mays*) was used as an experimental plant. The current work aims to asses effect of compost application as organic amendment at rates of zero (C_0), 5.5(C_1), 11.0(C_2), and 16.5(C_3) Mg f^{-1} (1 Mg "megagram"= 10^6 g *i.e.* metric ton); under irrigation using two water levels of full irrigation (I_1) of 3300 m^3 f^{-1}, and deficit irrigation (I_2) of 2640 m^3 f^{-1} (80% of full irrigation). Grain yield in non-amended treatments was 1.788 to 2.482Mg f^{-1} while it was 2.757 to 6.316 Mg f^{-1} in compost- amended treatments. Water-use efficiency (in kg grains/m^3 water) was 0.542 to 0.940 for non-amended treatments and 0.835to 2.392for those compost-amended treatments causing, average increases of 34.1, 161, and 92.9% for the C_1, C_2, and C_3, respectively. The deficit irrigation 1_2 surpassed the full one I_1 by 58.3%. Soil moisture curves at tensions of 0.01 up to 15.00 atm and available water (AW) increased due to compost. Compost had a slight effect on total porosity, but affected the distribution of pore size fractions creating more water-useful pores (*i.e.* the quickly drainable-, slowly-, drainable- and water-holding-pores) and decreasing the less-water-useful ones (*i.e.* the fine capillary pores). Aggregation and aggregate stability increased by compost; the high rate gave 6.8% large aggregates while the no compost gave 4.3% only.

Keywords: Deficit irrigation, compost application, maize aggregation, soil moisture curve, porosity.

INTRODUCTION

Irrigated agriculture is extremely vital for Egypt where rainfed agriculture does not represent any significant part of arable farming in Egypt. Therefore, maximizing the return obtained from irrigation water is very important. Organic manuring has a significant positive effect on improving soil fertility and soil physical properties (Reeves, 1997). It could also increase the efficiency of water application beside its positive effect on yield increase and soil improvement (Bhattacharyya *et al.,* 2007). The use of different equations to determine irrigation water application is practiced and a number of different equations were proposed for irrigation of arable crop such as maize and other field crops. Elmarsafawy (1991) observed that water evapotranspiration calculated by equation was greater than actually given as consumptive use for maize grown in an alluvial soil. Application of organic manure increases soil organic matter content (Adani *et al*., 2007 and Soumare *et al.,* 2003), water infiltration, retention and the available water content of soils by 58–86% (Celik *et al*., 2004 and Adamtey *et al*., 2010).The aim of the current study is to assess response in terms of yield of maize, water use efficiency and some soil physical properties under compost application and deficit irrigation.

MATERIALS AND METHODS

Field experiments were conducted at South of Sahl El-Hosainiya Research Station in Port-Said Governorate, during two successive seasons of 2006 and 2007 on rather saline clay soil (Table 1) of newly reclaimed from excessive salinity. Maize *"Zea mays"* cv. single Hybrid 10" was sown on June 1st, and harvested on September 18th. Factors and treatments of the experiment were as follows:

Factor A: Irrigation (surface irrigation) (I): Two water applications: I_l: irrigation with 3300 m^3 f^{-l} considered as full irrigation treatment for maize in the areas similar to the one of the current study (Vereiren and Gopling, 1984 and Allen *et al.,* 1998); 1_2 deficit irrigation treatment of 2640 m^3 f^{-1} which is 80% of I_l. Water was given through flood irrigation using a water pump, and the amount of water was measured in the light of the discharge rate of the water from the pump (Vereiren and Gopling, 1984). Irrigation was done at 15-day intervals.

Factor B: Compost (C): Four treatments: C_o, C_l, C_2, and C_3 being: no compost application, 5.5, 11.0, and 16.5 Mg compost f^{-1}, respectively (one mega-gram "Mg" = 1000 kg).Compost was added before seeding. Properties of the compost are given in Table 2.

The execution of the experiment was done in a randomized complete block design (Gomez and Gomez, 1984), split-plot with irrigation as the main plots and compost treatments as subplots. The main plots representing irrigation were separated by 2m. The area of the experimental plot was 10.5 m^2. Treatments were done in three replicates. All plots received recommended doses of chemical fertilizers per feddan as follows:120 kg N as ammonium sulphate '20.6 %N'+ 13.1 kg P as calcium super phosphate '6.6 % P' + 20 kg K as potassium sulfate '40 % K'. Application of P and K was done before sowing. Application of N was done in three equal splits: before sowing, two weeks and five weeks after sowing. Properties of El-Salam canal water (used for irrigation) are given in Table 2.

A composite representative soil sample was taken from the field of the experiment to represent the initial status of the soil. After harvest of maize, soil samples were taken from each plot in order to assess the effect of treatments. The samples were taken form 0-15 cm depth.

Parameters measured for assessment of the treatment effects were as follows:

1-Grain yield; measured at harvest of the crop.

2-Water use efficiency (WUE); calculated using the following equation:

WUE= Grain yield (kg f^{-1}) /seasonal consumptive use (m^3 f^{-1}) = kg m^{-3}(*i.e.* kg grains/m^3 water)

3- Soil measurements:

Particle size distribution was carried out for characterization of the soil texture by the pipette method (Piper, 1950 and Gee and Bauder, 1986);

Soil pH, salinity, organic matter and total calcium carbonate (Page *et al.,* 1982) were also measured. Moisture contents retained at tensions of 0.01, 0.10, 0.33, 0.66, 1.00, and 15 atm; carried out as described by Richards and Weaver (1944) and Ascrof and Taylor (1952) using the pressure membrane apparatus (Richards, 1947). Soil bulk density was determined by core method (Klute, 1986). Pore size distribution was calculated according to De-leenher and De-Boodt (1965) and classified into 4 categories: Quickly drainable pores (QDP): >28.84µ diameter, slowly drainable pores (SDP): 28.84-8.62µ diameter, water holding pores (WHP): 8.62-0.19µ diameter and fine capillary pores (FCP): <0.19µ diameter. Aggregation and aggregate size distribution; done on dry basis (Richards, 1954) and wet basis (Yoder, 1936 and Ibrahim, 1964).

4- Irrigation water analyses

Analyses include salinity, soluble ions and pH (Richards, 1954).

Table 1: Properties of the soil of the experiment site

Property	**Value**	**Property**	**Value**
Coarse sand %	**3.00**	**Moisture %(w/w) at:**	
Fine sand %	20.1	0.01 atm	36.88
Silt %	11.9	0.10,,,	28.33
Clay %	65.0	0.33,,,	25.66
Texture class	Clay	0.66,,,	21.25
Organic matter g kg^{-1}	16.6	1.00,,,	20.78
$CaCO_3$ g kg^{-1}	44.8	15.00,,,	13.22
pH	8.02	Available moisture %	12.44
Bulk density Mg m^{-3}	1.18	Total porosity %	50.94

EC dSm^{-1}	**Soluble ions* mmol$_c$L^{-1}**							
	Ca^{2+}	**Mg^{2+}**	**Na^+**	**K^+**	**HCO_3^-**	**Cl^-**	**SO_4^{2-}**	**SAR**
6.65	7.00	16.0	41.9	0.50	4.50	45.0	15.9	12.4

Notes: *no CO_3^{2-} was detected; pH (1:2.5 w/v soil water suspension); EC (saturation extract.).

Table (2): Properties of the compost used in the experiment and the El-Salam canal water used for irrigation

A. Compost properties

EC(1:5) dSm^{-1}	**pH 1:2.5**	**Total nutrients g kg^{-1}**			**C/N ratio**	**OM %**	**BD Mg m^{-3}**	**Moisture %**	**Ash g kg^{-1}**	**WHC %**
		N	**P**	**K**						
2.68	7.44	11.0	8.2	22.0	17.8	37.69	0.35	11.8	420	160

B. Irrigation water properties

pH	**EC dSm^{-1}**	**Cations (mmol$_c$ L^{-1}):**				**Anions (mmol$_c$ L^{-1})***			**SAR**
		Ca^{2+}	**Mg^{2+}**	**Na^+**	**K^+**	**HCO_3^-**	**Cl^-**	**SO_4^{2-}**	
7.61	2.30	2.00	4.50	15.3	0.42	4.10	12.5	5.62	8.50

*** no carbonate was detected.**

RESULTS AND DISCUSSION

Grain yield (Table 3):

Compost caused marked increase in grain yield particularly with the medium rate (C_2). Increases due to C_1, C_2, and C_3 averaged 35.8, 161.8, and 93.8 % respectively. This shows that the increase was progressive up to the rate of 11Mg f^{-1}; thus such rate is the most appropriate for compost application. The highest rate of 16.5 Mg f^{-1} may have encouraged more immobilization of mineral available nutrients (particularly N) since its effect, though giving greater yield than the 5.5 Mg f^{-1} was of less magnitude than the medium rate of 11 Mg f^{-l}. The superiority of the medium rate over the high rate was most pronounced under conditions of the deficit irrigation. Under the standard irrigation the superiority of the medium rate over the high rate was of less magnitude. Beside its favorable effect due to its available nutrients, (Gupta, 2007) compost was reported to increase soil organic matter, particularly the soluble fraction of organic matter in soils (Wright *et al.,* 2008).

Deficit irrigation 1_2 (80% of the full amount I_l) gave greater yield. It surpassed I_l by an average of 26.7%, and such superiority was particularly marked under conditions of the medium rate of compost (which was the most efficient rate) giving about 29.9% more yield. Under conditions of the low compost rate it gave 10% over I_l. Deficit irrigation may have been more appropriate in creating more suitable conditions for plant growth improving aeration and reducing leaching losses of soluble nutrients. These results show that 2640 $m^3 f^{-1}$ is more appropriate for yield than 3300 m^3 f^{-1}.

Water use efficiency (WUE) (Table 3):

Compost application increased water use efficiency (WUE) by an overall average of 96%.The highest increase was under the medium rate of compost C_2 giving an average increase of 161% as compared with 34.1% under the low compost rate C_l, or 92.9% under the high compost rate C_3. Thus, as occurred with grain yield, the medium rate of compost proved the most efficient rate of organic matter addition with regard to WUE; the least effective compost rate was C_1. Superiority of C_2 over C_l was most considerable under conditions of 1_2 (giving 108% increase over C_l) rather than under conditions of I_l (giving 76.5% increase over C_1). This indicates that with deficit irrigation, applying compost at the proper C_2 rate increased the efficiency of water use. Deficit irrigation 1_2 surpassed the full irrigation I_l by an average of 58.3%. The increase was most prominent under the optimum C_2 compost rate (where 1_2 surpassed I_1 by 62.3%) than under the low C_l compost rate (where the comparable surpass was 37.9%). Abdel-Salam *et al.* (2006) demonstrated the importance of applying irrigation water at non-excessive amounts in order to obtain high WUE under Egyptian conditions. Organic matter addition increases water use efficiency by many crops including grass type canopy (Stroosnijder, 2008 and Ali, 2011) and improves fertility of arable soils particularly those under continuous cropping systems (Reeves, 1997). Such type of systems is commonplace in Egyptian agriculture.

Table (3): Maize grain yield (Mg f^{-1}) and water use efficiency (kg m^{-3}) as affected by compost addition under irritation treatments (average of 2 seasons)

Compost (C)	Irrigation treatment (I)					
	I_l	I_2	Mean	I_l	I_2	Mean
	Grain yield			Water use efficiency		
C_0	1.788	2.482	2.135	0.542	0.940	0.741
C_1	2.757	3.042	2.900	0.835	1.152	0.994
C_2	4.864	6.316	5.590	1.474	2.392	1.933
C_3	3.616	4.657	4.137	1.096	1.764	1.430
Mean	3.256	4.124	3.691	0.987	1.562	1.275
LSD at 0.05	I= 0.020	C= 0.028	IC=0.039	I=0.006	C=0.008	IC=0.011

Notes I_1: full irrigation 3300 m^3 f^{-1}; 1_2: deficit irrigation 2640 m^3 f^{-1} (80% of full irrigation); C_o (no compost), C_l, C_2, and C_3 compost at, 5.5, 11.0, and 16.5 Mg f^1, respectively

Soil moisture constants (Table 4):

The most effective factor which affected soil moisture contents was compost. Thus, presentation of results will be confined to its effect. The pattern of response to compost addition indicates marked increases in moisture contents at nearly all points of the moisture retention curve upon adding compost. The most pronounced effect was that of the optimum rate of compost (C_2) where contents of moisture increased by about one third to more than about nine tenths by compost application. Increases were particularly marked at the points of saturation (0.01 atm), near saturation (0.10 atm), and field capacity (0.33 atm). Increased capacity for water retention as a result of adding organic matter is a clear indication of its positive effect in modifying porosity and physical conditions of soil. Therefore, compost, particularly when applied at the optimum C_2 rate, increased the capacity of soil to retain greater amounts of water within the soil matrix, a characteristic feature of the positive effect of organic matter addition (Tejada and Gonzalez, 2008). Such effects of compost occurred under all conditions of irrigation and cultivation.

Considering available water which (the difference between moisture at 0.33 atm and that at 15.00 atm), results show a tendency for increase upon compost addition. However taking the overall average for the experiment, results show an increase by compost addition: the overall average of available water with no compost was 17.72%, compared with 18.33 %, 18.51%, and 19.80% for the compost-treated soils of C_l, C_2, and C_3 respectively. Increased available water is a direct result of the increased moisture capacity particularly field capacity (*i.e.* the 0.33atm moisture tension): the no-compost treatments showed a range of field capacity moisture of about 26% to about 27% contrasted with a range of about 30% to 36% for the compost-treated soils. The positive effect of compost application in increasing available water reflects the high capacity of organic amendments in retaining more moisture in the soil through creating more medium size pores in the soil in particular as well as increasing soil porosity in general.

Table (4): Soil moisture percent, (w/w) at different tensions (atm), and available water in samples taken after harvest from the different treatments of (average of 2 seasons)

Irrigation I	Compost C	Moisture tension (atm)						
		0.01	0.10	0.33	0.66	1.00	15	AW
I_1	C_o	37.47	27.43	25.90	24.59	19.88	8.16	17.74
	C_1	41.81	32.13	29.60	26.76	25.93	11.52	18.08
	C_2	51.33	38.79	35.78	32.31	28.50	16.04	19.74
	C_3	43.74	35.67	32.38	31.57	25.66	13.69	18.69
I_2	C_o	39.22	27.68	26.69	22.78	18.22	9.00	17.69
	C_1	44.70	36.64	32.69	29.98	24.55	14.11	18.58
	C_2	48.39	35.22	32.70	30.14	29.56	14.70	18.00
	C_3	44.03	35.06	32.13	26.54	24.63	11.22	20.91

See footnotes of Table 3 for treatment designations. Values are means, without statistical analysis

Soil porosity (Table 5):

Total porosity is closely related and linearly inversely correlated and decreasing bulk density is a direct function of increased total porosity (Black *et al.,* 1965).

Pore size distribution (Table 5):

There was an effect on the distribution of the different fractions of pores. The most positively affected categories of pores were the Quickly-drainable pores (QDP) and the water-holding pores (WHP).These two categories also represent major portions of soil porosity, and they are of a very important significance in soil fertility and plant growth. Both were increased by compost application, particularly marked with the C_2 by as much as about 100% in some cases. The QDP average values obtained in the current study are 8.07, 13.94, 20.34, and 15.68% due to C_o, C_1, C_2, and C_3 respectively. The WHP averages are 19.17, 23.77, 29.19, and 26.03% respectively. Increased values of such types of pores is an evident manifestation of the positive effect of organic matter addition in creating favored soil structure and forming pores which hold water useful for plant roots. The slowly drainable pores (SDP) decreased by compost addition; the average values were 6.38, 6.28, 6.33, and 5.53 % for the C_0, C_1, C_2, and C_3 treatments respectively. The capillary pores (FCP) decreased by applying compost with average values of 18.36, 16.71, 13.42 and 17.05% for C_0, C_I, C_2, and C_3 respectively.

Therefore, the positive effect of compost addition from the viewpoint of porosity is in terms of redistribution of pore size fractions so as to increase the water-useful fractions in particular, which represent a significant portion of the pores and hold easily available water for plants. Such changes in the pattern of pore size distribution would be reflected in increased water holding capacity, and would most certainly contribute in greater plant growth and ultimately higher grain yields as shown by the relevant data of these parameters. The most effective compost treatment was that of C_2. Increased proportions of water useful pores as a result of adding organic soil conditioners was observed by Mostafa (1986), Abdel-Salam *et al.* (2006) and Ali (2011) who applied organic manure up to 27 Mg f^{-1}, and Evanylo *et al.* (2008) who reported increased porosity as well as decreased bulk density upon adding rates of organic composts equivalent to 7.0 to 14.0 Mg f^{-1} under different organic farming systems. Compost addition with reduced tillage was reported by Ouattara *et al.* (2007) to have modified pore size distribution in a manner that increased water infiltration in soils of very heavy texture.

Table (5): Total porosity (TP), pore size distribution in soil after maize harvest (average of 2 seasons)

Irrigation I	Compost C	TP %	Pore size distribution (%)			
			QDP	SDP	WHP	FCP
I_1	C_o	51.47	9.02	6.18	19.25	17.02
	C_1	59.30	13.57	6.23	22.81	16.69
	C_2	67.02	19.17	6.30	28.96	12.59
	C_3	63.45	14.95	5.19	24.86	18.45
I_2	C_o	52.47	7.11	6.58	19.08	19.70
	C_1	62.09	14.30	6.33	24.73	16.73
	C_2	71.54	21.51	6.37	29.42	14.24
	C_3	65.11	16.40	5.87	27.20	15.64

See footnotes of tables 3, and 4; QDP (quickly drainable pores >28.84μ); SDP (slowly drainable pores 28.8-8.62μ); WHP (water holding pores 8.62-0.19μ); FCP (fine capillary pores <0.19 μ).

Soil aggregation (Tables 6 and 7):

Aggregation was affected by treatments. Distribution of stable aggregates showed marked variations associated with different treatments. The aggregate categories studied in this experiment are of the following diameters (mm): 10-2, 2-1, 1-0.5, 0.5-0.25, 0.25-0.125, 0.125-0.063 and < 0.063. For reasons of data presentation they are designated as follows, respectively: very large, large, medium, sub-medium, small, very small, and extremely small. Dry aggregation covered the 7 categories, but wet aggregation (because of its nature) covered the first 6 categories. Data show marked changes in all categories. Discussion will cover the three aggregate categories of "very large, sub-medium, and very small aggregates as representative for the effect of treatments on aggregation. Discussed here to assess implications of treatments on soil aggregation.

Different size fractions of dry-sieved aggregates (Table 6):

Before cultivation, data for the initial values of dry aggregate size distribution for the 3 categories of the very large (10-2 mmϕ), sub-medium (0.5-0.25 mmϕ) and very small (0.125-0.063 mmϕ) aggregates show respective averages of 70.03, 0.17 and 0.11 %. After cultivation, average values for all treatments were 64.35 %, 4.39 %, and 1.03 % for the three aforementioned categories respectively. Deficit irrigation, 1_2 caused a decrease in the "very large" as well as the "very small" aggregates, giving respective averages of 62.77 and 0.72 % compared with 65.91 and 0.84 % respectively caused by the higher I_l irrigation. Compost caused a decrease in the distribution percentage of the very large aggregates. The average values due to C_o, C_1, C_2 and C_3 were 70.51, 68.91, 60.76, and 57.21 respectively. Concerning the sub-medium aggregates, there was a decrease due to C_1 and C_3 but an increase due to C_2; the distribution values were 4.79, 2.27, 6.60, and 3.91 respectively. The positive and favorable effect of compost on soil physical properties is a manifestation of the influence of organic matter in creating soil structure favorable for plant growth.

Table (6): Size distribution fractions (%) of dry-sieved aggregates, in soil after maize harvest (Average of 2 seasons)[*]

Dry aggregate diameter (mm)		10-2	2-1	1-0.5	0.5-0.25	0.25-0.125	0.125-0.063	< 0.063
Initial Soil >>[**]		70.03	28.04	1.48	0.17	0.09	0.11	0.08
I_1	C_o	68.82	12.55	9.94	4.42	3.13	1.06	0.08
	C_1	72.89	13.63	8.23	3.29	0.93	0.69	0.34
	C_2	67.11	20.58	7.02	3.13	1.54	0.56	0.06
	C_3	54.88	24.88	11.34	5.72	2.06	1.04	0.08
I_2	C_o	72.19	11.16	9.25	5.17	1.23	0.78	0.22
	C_1	64.92	28.05	4.95	1.25	0.61	0.11	0.11
	C_2	54.41	14.41	11.31	10.07	8.34	1.40	0.06
	C_3	59.54	23.34	12.34	2.09	2.05	0.60	0.04

[*]See footnotes of tables 3 for treatment designations; [**]: values for soil before executing the experiment. Values are means, without statistical analysis

Different size fractions of wet-sieved aggregates (Table 7):

Before cultivation, data for the initial values of wet aggregate size distribution for the 3 categories of the very large, sub-medium and very small aggregates show respective averages 7.61 %, 16.07% and 6.28 %. After cultivation average values over all treatments were 4.54 %, 13.63 %, and 5.32 % for the three aforementioned categories, respectively. Value of total stable (wet) aggregates before cultivation was 57.31 %. Comparison between the different compost treatments concerning total of stable aggregates show little difference between the no compost and the compost treatments. The no compost treatment gave an average of 51.26% stable aggregates, while those receiving the low, medium and high compost rates gave very comparable averages of 50.09, 51.26 and 51.66% respectively. The effect was rather clearer concerning distribution of different sizes of aggregates. The C_o, C_1, C_2, and C_3 compost treatments gave values for very large aggregates of 4.33, 4.09, 2.94, and 6.79 % respectively, and sub-medium aggregates of 13.64, 14.19, 14.70, and 12.00 % respectively, and very small aggregates of 5.12, 4.95, 6.29, and 4.93 %, respectively. Thus there was a tendency for increase by compost addition, particularly by C_3 regarding large aggregates and C_2 regarding medium and small aggregates. Deficit irrigation I_2 gave average of 51.45% total aggregates while full irrigation 1_1 gave 50.68%. Also 1_2 gave more very small, sub-medium and very large aggregates (averaging 4.35, 14.01, and 5.12% respectively) than given by I_l (4.74, 13.26, and 5.52, respectively).

Table (7): Percentage of total of stable wet sieved aggregates "TSA", and their different size fractions in soil after harvest (Average of 2 seasons)[*]

Wet aggregate diameter (mm)		10-2	2-1	1-0.5	0.5-0.25	0.25-0.125	0.125-0.063	Total (TSA)
Initial Soil		7.61	10.94	8.38	16.07	8.03	6.28	57.31
I_1	C_o	5.43	12.41	13.14	9.13	3.81	5.07	48.99
	C_1	4.67	10.70	9.73	13.74	3.67	4.92	47.43
	C_2	2.47	7.60	15.10	16.09	4.48	7.68	53.42
	C_3	6.32	12.85	11.78	14.08	3.45	4.40	52.88
I_2	C_o	3.23	8.25	15.47	18.16	3.26	5.16	53.53
	C_1	3.51	9.62	15.91	14.64	4.09	4.97	52.74
	C_2	3.41	8.81	11.33	13.32	7.32	4.90	49.09
	C_3	7.26	13.95	10.37	9.93	3.47	5.46	50.44

***See footnotes of tables 3 and 6.**

Overall effect on aggregation:

Compost tended to have positive effect on aggregation and aggregate stability in soil. There was no marked difference between full and deficit irrigation. Positive effect due to compost addition is a direct consequence of organic matter addition. Increased aggregation and aggregate stability were demonstrated by Mostafa (1986) assessing effects of some organic conditioners on some Egyptian clay soils. Increased aggregate stability was also demonstrated by Tejada and Gonzales (2008) and Adamtey *et al*. (2010) upon addition of plant residue compost as well as chicken manure to soils in arid regions.

Conclusions

Compost increased grain yield markedly particularly with the medium rate causing up to 161.8% increase by the medium rate (of 11 Mg compost f^1) rendering it an appropriate rate above which an immobilization of mineral available nutrients may have occurred. The increase was also reflected in water use efficiency WUE by an average of 96 % particularly where the medium rate was applied (161% increase). Smaller increases occurred with the high rate (93% increase) or the low one (34% increase). Compost favored modified porosity. The effect was considerable on the redistribution of pore size fractions increasing the more-water-useful pores of QDP and WHP, and decreasing the less-water-useful ones such as the FCP. This caused more retention of available water, hence greater plant growth and ultimately higher grain yields. Compost affected aggregation through distribution of seven aggregate categories ranging from the "very large" to the "extremely small" aggregates with marked variation associated with different treatments. The changes in the 3 aggregate categories of the "very large (10-2 mmϕ)", the "sub-medium (0.50 -0.25 mmϕ)" and the "very small (0.125-0.063 mmϕ)" were marked. Deficit irrigation decreased the "very large" as well as the "very small" aggregates being 62.7 %, and 0.72%, respectively for 1_2 compared with 65.9% and 0.84 %, respectively for I_l. Compost decreased the "large" aggregates in particular by up to more than two thirds and to a less extent the "medium" aggregates but slightly increased the "small" aggregates. Concerning wet sieving, the total percentages of stable aggregates for I_l and I_2were rather comparable with averages of about 51%. Aggregate categories were also comparable by the two treatments. Compost tended to increase aggregates of these categories. The high compost rate gave 6.8% of "very large" aggregates while the no compost gave 4.3% only. The medium compost rate gave 14.7 % and 6.3 % sub-medium and very small aggregates, respectively. Deficit irrigation (I_2), which is 80% of the full irrigation (I_l) gave more yield than the full irrigation particularly under conditions of the medium compost rate of 11 Mg f^{-1} when it increased the yield by about one third. It may have created more suitable conditions for plant growth such as improved aeration. Deficit irrigation (2640 m^3 f^{-1}) also surpassed full irrigation (3300 m^3 f^{-1}) regarding water use efficiency (WUE) by an average of 58.3%, most markedly under medium compost rate (62.3% increase). There were little difference between the two irrigation treatments regarding porosity, water retention parameters or aggregation. The compost application proved more efficient for maize.

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تأثير سماد المكمورة على محصول الذرة الشامية وبعض الخواص الطبيعية للتربة الطينية تحت ظروف ري ناقص

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أجريت تجربة حقلية على موسمين بأرض طينية تقع في محطه بحوث جنوب سهل الحسينية بمحافظة بور سعيد واستخدم فيها نبات الذره الشامية كمدلول للدراسة. تهدف الدراسة الى تقييم أثر أستخدام الكومبوست كمصلح عضوي علي انتاجية محصول الذره الشامية وبعض الخصائص الفيزيائية للتربة الطينية تحت ظروف نقص المياه حيث تمت الاضافه علي اربع معدلات: صفر (C_0)، 5.5 (C_1)، 11.0 (C_2)، 16.5 (C_3) ميجا جرام /ف واستخدام كميتين لمياه الري هما : ري كامل(I_1) ويعادل 3300 م^3/ف وري ناقص(I_2) ويعادل 2640 م^3/ف والري الناقص يعادل 80% من الري الكامل. تراوح محصول الحبوب في المعاملات التي لم تستخدم المصلح العضوي بين 1.788 الي 2.482 ميجاجرام/ف أما في المعاملات المستخدم بها المصلح العضوي فتراوح بين 2.757 الي 6.316 ميجاجرام /ف. وتراوحت كفاءة استخدام المياه (كجم حبوب/م^3 ماء) بين 0.542 الي 0.940 في المعاملات التي لم يستخدم بها المصلح العضوي في مقابل 0.835 الي 2.392 في المعاملات التي استخدم فيها المصلح العضوي بزيادة مئوية 34.1، 161، 92.9 % نتيجة استخدام معدلات كمبوست C_3, C_2, C_1 علي الترتيب. وكانت كفاءة استخدام المياه في معاملة I_2 أعلي من تلك الخاصة بمعاملة I_1 بمقدار 58.3%. كذلك تم قياس الرطوبة علي مدي نقاط التوتر الرطوبي (منحنيات رطوبة التربة) بدءا من نقطة التشبع (سالب 0.01 جوي) الي نقطة الذبول (سالب 15.00 جوي) وتسبب الكمبوست في زياده الماء الميسر وتغيير في توزيع فئات المسام بما رفع من نسب المسام المفيدة مائيا كما رفع من التجمعات الارضية وثباتها فعند المعدل العالي منه كانت نسبة التجمعات الكبيرة (التجمعات المبتلة) ذات الاقطار من 2 الي 10 مم 6.8% مقارنة ب4.3% فقط في الارض التي لم تأخذ كمبوست.

وبناء علي هذه النتائج نوصى باستخدام ال كمبوست بمعدل 11.00 ميجا جرام للفدان تحت ظروف معدل ري 2640 م3/ف أي 80% من معدل الري الكامل عن طريق الري بالغمر لزيادة محصول الذره الشامية وتحسين الخواص الطبيعية للاراضي الطينية لمنطقة سهل الحسينية.

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