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MAIZE PRODUCTION IN EL-NUBARIA SOILS AS AFFECTED BY AGRICULTURAL PRACTICES AND WATER MANAGEMENT.

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ABSTRACT

A Field trial was conducted at El-Nubaria Agricultural Experimental Statio Station of the Agricultural Research Center, A.R.C. to study the effect of some agriculture practices aiming at participating in solving calcareous soil problems related to mechanical and physical parameters and hence increasing crop production. The experimental treatments comprised three treatments namely; three compost addition rates (0, 15 and 30 Mg/fed), two irrigation water depletion levels (50 and 70% of available water) and two plowing depths (15 and 30 cm).

The obtained results show that increasing the application rate of compost, irrigation at 50% depletion from soil available water and plowing at 30 cm depth considerably decreased soil bulk density and soil penetration resistance and on the other hand increased total porosity and hydraulic conductivity as compared with the control.

The correlation and regression analysis indicated highly significant negative relation between maize yield and each of the penetration resistance, and soil bulk density. On the other hand highly significant but positive relation was found between maize yield and each of total porosity and hydraulic conductivity.

Keywords: Calcareous soil, compost, irrigation intervals, plowing depth, Bulk density, Penetration resistance, Hydraulic Conductivity, total porosity, maize crop.

INTRODUCTION

The use of organic compost in crop production is receiving considerable attention worldwide. The application of organic manures occasionally influences plant growth physiologically as stated by Kawata *et al*. (1976) because they provide the plants with growth- regulating substances and modify soil physical behavior as reported by Khaled (1993). El-Sayed *et al*. (2006) revealed that soil bulk density and penetration resistance decreased with increasing the rates of applied compost. El-Sherbiny(2007) stated that applying 2.5, 5.0 and 7.5 M/fed organic matter in the 0-30 cm reduced soil bulk density and the percent reduction from the control was 7.4,8.1 and 10.1, respectively.

Tillage is one of the most important production factors that influences soil physical and mechanical properties and consequently crop yield

Rashidi and Keshavarzpour (2008) observed that the soil of the conventional tillage had a lower bulk density (BD) penetration resistance and highest moisture content compared to the no till (NT). Mielke *et al.* (1986) found that major differences in soil physical characteristics between tillage practices were largely confined to the top 75 mm of soil, bulk density was greater and total porosity in the surface layer was as much as 10% less for no-tilled than for plowed treatments. El-Swaify *et al.* (1985) showed that moldboard plowing was particularly effective in reducing the bulk density and thus improving the productivity of fine – textured Alfisols of the semi-arid tropics. On the contrary, Afifi *et al*. (1991) reported that there were small differences among the applied tillage treatments that included chisel; moldboard – disk; moldboard – chisel and ripper, in their effects on soil bulk density, strength and maize yielded from calcareous sandy loam soil.

Kitur *et al.* (1993) stated that the effects of tillage on pore size distribution, for the first two years of the experiment, were significant only at planting. They showed that the total porosity was higher for MP (moldboard plowing) than CP (chisel plowing) and NT (no tillage) in both years. At midseason, 1991, total porosity was lower with MP than with NT and CP.

Hassan (1998) reported that the tillage treatments has resulted in remarkable decrease in penetration resistance of the top, 0-10 and 10- 22cm layers of the control (unplowed site)

However many investigators showed that irrigation regime and/or soil moisture conditions may affect the effectiveness of organic materials in reducing soil bulk density, among them El-Maghraby (1997) who found that under 7-days irrigation interval the bulk density of calcareous soil decreased more than that under 14-days. He attributed this behavior to the inferiority in the formation and stabilization of soil aggregates upon increasing the irrigation intervals.

Concerning the influence of soil moisture regime on soil porosity, El-Sersawy *et al.* (1993) reported that total porosity of calcareous soil was positively affected by the irrigation regime. On the other hand, Aziz *et al*. (1999) showed that the total porosity increased with short irrigation regime due to soil conditioning in all treatments (farmyard manure and tafla) especially in the surface (0-10cm) soil layer.

Hassan (1998) observed a remarkable decrease in penetration resistance under the different plowing treatments (top soil 0-22cm and subsoil 22-50cm) compared with control (unplowed site) and the irrigation at depletion equivalent to 20% of the available moisture range for plant growth led to a greater decrease in the resistance to penetration values as compared with those obtained under depletion corresponding 80% of such range. The main objective of this investigation was to assess the effect of tillage system, irrigation regime and compost addition on physical and mechanical properties of a calcareous soil and production of the maize crop grown thereron.

MATERIALS AND METHODS

Field experiments were conducted during summer seasons 2008/2009 at El-Nubaria Agricultural Experimental Station of the A.R.C., West of Alexandria, in the north western coastal zone of Egypt. Physical and chemical characteristics of the investigated soil are presented in Table 1. Data revealed that the soil of the experimental site is calcareous throughout the profile as calcium carbonate content is 28.66% at the depth of 0-15 cm and

31.7% at the depth of 15-30cm. It is of a sandy clay loam texture in the top and subsurface soil layer, non saline and mild alkaline.

Table 1: Soil physical properties of the studied El-Nubaria soil

Depth cm	Particle size distribution %				TC	C_aCO_3 %	O.M%	B_d	P_d	F.C %	W.P %	A.W %
	C.S	F.S	St	Cl								
0-10	2.46	49.82	20.53	27.19	S.C.L	28.66	0.61	1.44	2.35	19.52	9.43	10.9
10-20	2.35	38.12	26.03	33.50	S.C.L	31.32	0.96	1.47	2.40	19.86	10.15	9.71
20-30	2.o7	50.41	22.22	25.3	S.C.L	31.07	0.53	1.57	2.55	21.56	12.23	9.33

C.S: Coarse Sand- F.S: Fine Sand- St: Silt- Cl: Clay-TC: Textural class OM: Organic Matter B_d: Bulk density- P_d :Particle density- F.C: Field capacity- W.P: Wilting Point-A.W: Available Water

The field experiment involved 12 plots arranged in a split-split plot design with four replicates. Each plot area was 3x3.5m (1/400fed). The experiment included the following treatments:

a) Three application rates of compost i.e 0, 15 and 30 Mg/fed
b) Two irrigation regimes, in which irrigation water was applied whenever the soil moisture depletion in the effective root zone reached either 50 or 70 % of total available water range for the plant growth. The interval between irrigations was calculated depending on the meteorological data of the area to calculate the monthly E T_0 value (mm/day) and on Kc of the maize plant at each stage of growth period to get ETc (mm/day), as well as the available soil moisture range for plant growth, according to the modified Blany-Criddle equation (Doorenbos and Pruitt, 1977).
c) Two plowing depths 15 and 30 cm depth.

Table 2: Soil chemical properties of the studied area in El-Nubaria soil

Depth cm	pH	EC dSm-1	Soil anions $mmol_cL^{-1}$				Soil cations $mmol_cL^{-1}$			
			HCO_3	Cl^-	SO_4^{2-}	CO_3^{2-}	Ca^{2+}	Mg^{2+}	Na^+	K^+
0-10	7.79	2.80	1.47	5.86	5.63	0.00	2.05	2.11	7.80	1.00
10-20	7.81	2.43	0.32	3.09	3.29	0.00	2.82	2.85	0.73	0.30
20-30	7.80	2.10	1.48	3.29	3.53	0.00	1.03	1.67	5.00	0.80

All plots received 13 kg P/f as superphosphate before cultivation, 120 kg N/f as NH_4NO_3 and 40 kg K/f as K_2SO_4. Nitrogen fertilizer was added in two equal doses, the first after 30 and the second arter 60 days from sowing.

Table 3: Averege meteorological data of El-Nubaria soil

Month	Min. T C°	Max. T C°	Sun light hours/day	Relative Humidity %	Wind speed m/sec
May	18	26	11	68	3
June	21	28	12	71	2.7
July	23	30	12	73	2.9
August	20	28	12	72	3
September	23	30	11	68	2.3

Table 4: Some basic properties of compost material.

pH	EC dSm-1	O.M %	C/N ratio	Total N %	Total P %	Total K %
7.55	4.61	33.20	1:21	1.20	0.65	0.95

Maize seeds (*Zea mayes* L. c. v. single cross 10) were planted in 2008 and 2009 summer seasons into rows, 70 cm apart.Irrigation was carried out as furrow irrigation. Seeding rate was 20 kg seed /f. Disturbed and undisturbed soil samples from 0-15 and 15-30 cm soil layer were collected for determination of soil physical properties including bulk density (B_d) and particle density (P_d),and consequently calculated % porosities (St) were recorded. Soil penetration resistances were measured in situ as recommended by Klute (1986).

RESULTS AND DISCUSSION

Bulk density (B_d)

Data in Table 5 and Fig 1 show the effect of plowing depth, soil moisture depletion and the rates of applied compost on the total average of soil bulk density (B_d). Results show that increasing the application rates of compost considerably decreased soil bulk density. This reduction occurred in the three depths. For the top soil layer (0-10cm) the average soil bulk densities were 1.38 and 1.30 gm^{-3} as a result of applying compost at the rates of 15 and 30 Mg/fed. Percent reduction from the control was 4.8 and 10.3 % respectively.

However, the diminished effect of the applied composts on soil bulk density, in general, might be attributed to their effect on soil aggregation on one hand and the lower density of the applied amendment on the other hand. Such a finding stands in well agreement with those of El-Sersawy and Khalil (1991), El-Maghraby (1997), and El-Sherbiny (2007).

Regarding the effect of soil moisture depletion on (B_d) the data pointed out that irrigation at 50% depletion from soil available water significantly decreased (B_d) as compared with 70% depletion at the three depths. The data show that average value of (B_d) decreased to 1.30 gm^{-3} at the 50% depletion corresponding to percent reduction about 9.7 % of the control. Values of (B_d) average 1.38 gm^{-3} at 70% depletion corresponding to reduction percentage of 5.5 %. This trend might be renderd to the suitability of moisture condition, which enhances the root system development and microbial activity thereby encourages the aggregation process and cosequently Bd decreased.

The data also show that average values of soil bulk density decreased to 1.36 and 1.32 gm^{-3} as a result of plowing at 15cm and 30cm depths respectively. Regarding the other depths of the investigated soil the data point out that the treatments affected on (B_d) in a way similar so that in the top layer. These results are in accordance with these of Rashidi and Keshavarzpour (2008) who observed that tillage method significantly affected soil physical properties where the soil of the conventional tillage (CT) treatment had consistently the highest moisture content (19.6%) and the lowest bulk density (1.41g/cm3) and penetration resistance (560kPa) while the soil of the no till (NT) treatment had the lowest moisture content (16.8%) and the highest bulk density (1.52g/cm3) and penetration resistance (1250kPa).

Table 5: Effect of plowing depth, irrigation water depletion level and addition rates of compost on soil bulk density (gcm^{-3}) of El-Nubaria calcareous soil.

Plowing depth	Depletion level	Compost rates Mg/fed			Mean
		0	15	30	
0 – 10 depth layer					
15cm	50%	1.45	1.35	1.29	1.32
	70%	1.47	1.44	1.35	1.4
Average		1.46	1.4	1.32	1.36
30cm	50%	1.42	1.31	1.25	1.28
	70%	1.45	1.4	1.32	1.36
Average		1.44	1.36	1.29	1.32
General mean		1.45	1.38	1.3	1.34
10 – 20 depth layer					
15cm	50%	1.45	1.41	1.33	1.37
	70%	1.5	1.44	1.39	1.42
Average		1.5	1.43	1.36	1.39
30cm	50%	1.46	1.35	1.3	1.33
	70%	1.48	1.42	1.34	1.38
Average		1.47	1.39	1.32	1.35
General mean		1.49	1.41	1.34	1.37
20 – 30 depth layer					
15cm	50%	1.55	1.45	1.39	1.42
	70%	1.53	1.49	1.42	1.46
Average		1.54	1.47	1.41	1.44
30cm	50%	1.5	1.39	1.33	1.36
	70%	1.55	1.45	1.41	1.43
Average		1.53	1.42	1.37	1.4
General mean		1.53	1.45	1.39	1.42

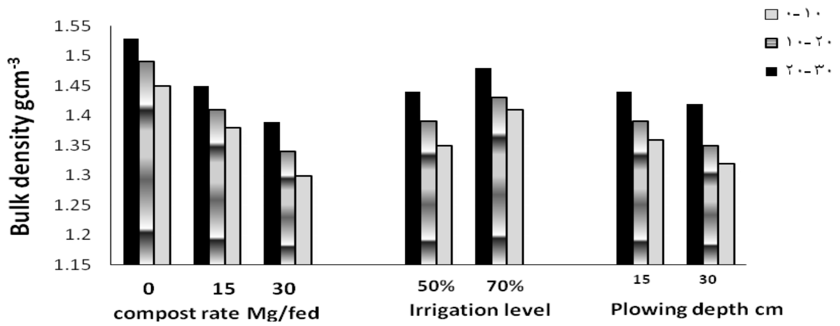


Fig.1: Effect of plowing depth, irrigation water depletion level and addition rates of compost on soil bulk density (gcm^{-3}) of El-Nubaria calcareous soil.

Total porosity (TS)

Data in table 6 and Fig. 2 clarified that the compost addition for calcareous soil of El-Nubaria soil was more effective on increasing total soil porosity as compared with control. A sensible increase was achieved in soil porosity by increasing the application rates of compost indicating pronounced ameliorating soil structure. For the top soil layer (0-10cm) the increase percentage relative to control 8.7 and 14.5 % as a result of applying compost with 15 and 30 Mg/fed. These results were agreement with those reported by El-Sherbiny (2007) and Negm *et al*. (2005) as they observed that a linear relation between soil porosity and the compost application rate. It is generally obvious that, porosity of the soil depth (0-10 cm) showed the greatest modification followed by the other two depths, i.e. (10-20 and 20-30 cm).

In regard to the effect of irrigation water depletion on total porosity, the data in the same table revealed that the compost addition under 50% depletion level surpassed another one of 70% depletion level in increasing total porosity of the soil. The magnitude of increase amounted 11.6 and 9.8 % as compared with the control for the former depletion and the latter one. This behavior could be attributed to the enhancement of soil aggregability subsequently soil porosity under the effect of first condition rather than the second one. These results are in accordance with those of El-Sersawy *et al*. (1993), El-Maghraby(1997) and El-Sherbiny(2007).

Table 6: Effect of plowing depth, irrigation water depletion level and addition rates of compost on total porosity (percent) of El-Nubaria calcareous soil.

Plowing depth	Depletion level	Compost rates Mg/fed			Mean
		0	15	30	
0 - 10 cm depth layer					
15cm	50%	40.11	43.78	45.87	44.83
	70%	39.09	42.11	44.09	43.1
Average		39.6	42.95	44.98	43.96
30cm	50%	40.53	45.42	47.38	46.4
	70%	39.53	43.12	44.95	44.04
Average		40.03	44.27	46.17	45.22
General mean		39.82	43.61	45.57	44.59
10 – 20 cm depth layer					
15cm	50%	36.81	39.21	41.36	39.82
	70%	36.47	38.61	40.11	39.59
Average		36.64	38.91	40.74	39.71
30cm	50%	36.95	39.97	41.77	40.53
	70%	36.69	39.24	41.15	40.36
Average		36.82	39.61	41.46	40.45
General mean		36.73	39.26	41.1	40.08
20 – 30 cm depth layer					
15cm	50%	34.88	36.88	37.95	36.94
	70%	34.34	36.13	36.78	36.7
Average		34.61	36.51	37.37	36.82
30cm	50%	34.77	36.93	37.89	37.24
	70%	34.51	36.73	37.41	37.16
Average		34.64	36.83	37.65	37.2
General mean		34.63	36.67	37.51	37.01

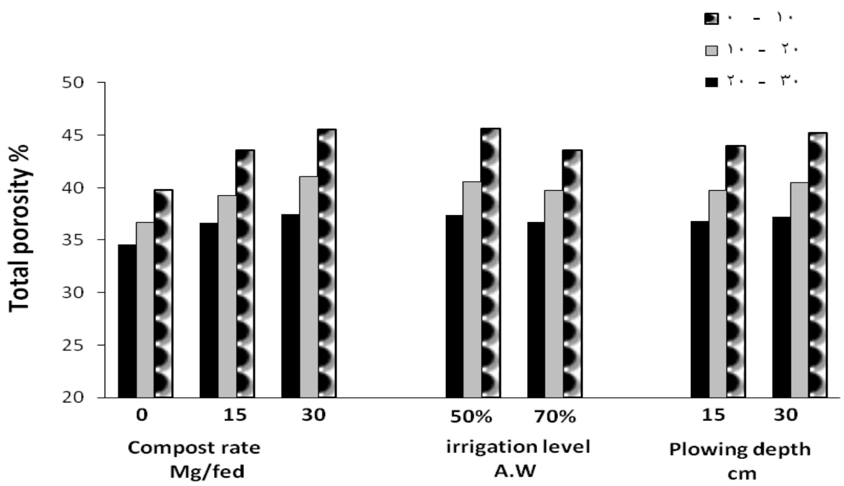


Fig.2: Effect of plowing depth, irrigation water depletion level and addition rates of compost on total porosity (percent) of El-Nubaria calcareous soil.

Concerning the effect of plowing depth on total porosity, data at the same table revealed that plowing at 30cm depth is superior for increasing total porosity compared to plowing at 15 cm. Values of soil total porosity were 43.96 % and 45.22 % as a result of plowing at 15 cm and 30 cm depth respectively. The increases in soil total porosity due to plowing at15 and 30 cm are 9.9 and 11.5 % compared to the control treatment. The obtained results are in agreement with those of El- Swaify *et al.* (1985), Mielke *et al*. (1986), Kiture *et al*. (1993) and El-Sherbiny (2007) as they found that major difference in soil physical characteristic between tillage practices.

Soil penetration resistance (P)

Calcareous soils are mainly characterized by high resistance to penetration by plant root. This could be rendered to the homogeneity of soil particles originated from lime accumulation for soils high in $CaCO_3$ content and especially its colloidal form. These features led to pudding under wetting and hardness under drying. The data in Table 7 and Fig.3 reveal the effect of the rates of applied compost, irrigation regime and plowing depth on soil penetration resistance of soil at (0-10), (10-20) and (20-30) cm depths. The data show general reduction in soil resistance upon applying compost. This reduction occurs in the studied soil depths but at varying degrees. The relative decrease in penetration resistance in the lower depth can be attributed to the relative high content of organic matter and to higher microbiological activity and growth in such depth. Bradford (1986) reported that penetration resistance increased with depth.

It is also evident that the rate of decrease in penetration resistance seemed to be dependent on rate of the applied compost. The decreasing percent of soil resistance at soil depth of (0-10cm) increased from 47.7 to

56.9 % (mean value) as application rate increased from 15 to 30 Mg/fed. The second depth (10-20cm) produced less resistance reduction by whose percentages were 21.9 and 49.1 % under change in application rate from 15 to 30 M/fed. This reduction was more less at the third depth (20- 30 cm) by percent of 19.9 and 30.5 % respectively. These results are concomitant with those reported by El-Sersawy(1997) who found that using compost town refuses, farmyard manure and mixture of them in calcareous soil at a rate of 10 ton/fed led to 39% reduction in penetration resistance. El-Sherbiny (2007) found that application of the farmyard manure at rates of 7.5, 5.0 and 2.5 Mg/fed reduced penetration resistance by 62 %, 51 %, and 34%, respectively with the control treatment.

Table 7: Effect of plowing level, irrigation water depletion level and addition rates of compost on penetration resistance (MPa) of El-Nubaria calcareous soil.

Plowing depth	Depletion level	Compost rates Mg/fed			Mean
		0	15	30	
0 – 10 cm depth layer					
15cm	50%	0.61	0.31	0.26	0.29
	70%	0.72	0.42	0.35	0.39
Average		0.67	0.37	0.31	0.34
30cm	50%	0.59	0.27	0.21	0.24
	70%	0.68	0.37	0.31	0.34
Average		0.64	0.32	0.26	0.29
General mean		0.65	0.34	0.28	0.31
10 – 20 cm depth layer					
15cm	50%	1.19	0.77	0.48	0.79
	70%	1.25	1.19	0.73	0.88
Average		1.22	0.98	0.61	0.83
30cm	50%	1	0.66	0.43	0.68
	70%	1.12	0.92	0.69	0.74
Average		1.06	0.79	0.56	0.71
General mean		1.14	0.89	0.58	0.77
20 – 30 cm depth layer					
15cm	50%	1.42	0.98	0.73	1.09
	70%	1.48	1.36	1.3	1.21
Average		1.45	1.17	1.02	1.15
30cm	50%	1.33	0.91	0.88	1.02
	70%	1.41	1.28	1	1.08
Average		1.37	1.1	0.94	1.05
General mean		1.41	1.13	0.98	1.1

The effect of irrigation regime as the application of 50 or 70 % depletion level on penetration resistance was shown in the same table. The data revealed that the interaction between composting addition and irrigation water frequency caused a great reduction in penetration resistance at the three soil depths. The decrease percent amounted 51.7 and 60 % under the irrigation regime of 50 % depletion while it amount 42.9 and 52.9 % under of 70 % depletion level. This trend could be rendered to the co-operative effect of organic compost and wetting and drying cycles of irrigation water on reducing mechanical strength and compaction of calcareous soil. These results are in agreement with those of Soane *et al*. (1990), El- Sersawy (1997) and El-Sherbiny (2002). who concluded that the incorporation of compost and farmyard manure was able to overcome compaction and recover structure of soil through repeated wetting –drying cycles.

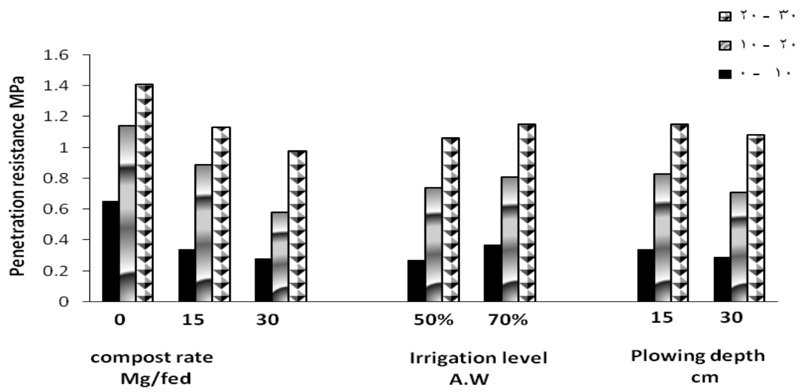


Fig. 3: Effect of plowing level, irrigation water depletion level and addition rates of compost on penetration resistance (MPa) of El-Nubaria calcareous soil.

The data also show that average soil penetration resistance decreased to 49.3 and 54.7 % as a result of plowing at 15 and 30 cm depths, respectively. Fernandez *et al.* (2009) found that the penetration resistance was two times greater in the soil of no tillage compared with the treatment of conventional tillage to a depth of 15 cm.

Soil hydraulic conductivity

Table 8 and Fig 4 reveal that soil hydraulic conductivity was markedly increased by increasing compost rates at all depths but it was more obvious in for the top soil layer (0-10 cm). The compost addition increased (K_{sat}) by 10 and 19 times its value for the control upon its usage at the rates of 15 and 30 Mg/fed. It became 9 and 15 times its value for the control at the second depth and 4 and 6 time in the subsoil layer (20-30 cm). Kladivko (1994) found that crop residuals and organic matter additions tended to increase saturated hydraulic conductivity (K_{sat}) due to increasing soil macropores. El-Sherbiny (2007) showed that farmyard manure, plant residuals and mixture of them increase saturated hydraulic conductivity (K_{sat}) by 24, 18.5, and 15.5 times its value for the control, respectively and this increase was concomitant with increasing the application rates of these composts.

Table 8: Effect of plowing depth, irrigation water depletion level and addition rates of compost on hydraulic conductivity(cm/h) of El-Nubaria calcareous soil.

Plowing level	Depletion level	Compost rates Mg/fed 0	15	30	Mean
		0 – 10 cm depth layer			
15cm	50%	0.35(S)	3.88(M)	6.73(MR)	5.31
	70%	0.31(S)	2.21(M)	5.45(M)	3.83
Average		0.33(S)	3.05(M)	6.09(M)	4.57
30cm	50%	0.45(S)	5.00(M)	8.46(MR)	6.73
	70%	0.37(S)	3.89(M)	7.15(MR)	5.52
Average		0.41(S)	4.45(M)	7.81(MR)	6.13
General mean		0.37(S)	3.75(S)	6.95(MR)	5.35
		10 – 20 cm depth layer			
15cm	50%	0.27(S)	2.58(M)	4.15(M)	3.37
	70%	0.21(S)	1.60(S)	2.88(M)	2.24
Average		0.24(S)	2.99(M)	3.52(M)	2.81
30cm	50%	0.32(S)	3.01(M)	4.91(M)	3.96
	70%	0.29(S)	2.72(M)	4.00(M)	3.39
Average		0.31(S)	2.90(M)	4.46(M)	3.68
General mean		0.27(S)	2.50(M)	3.99(M)	3.25
		20 – 30 cm depth layer			
15cm	50%	0.23(S)	0.88(S)	1.43(S)	1.16
	70%	0.17(S)	0.56(MS)	0.88(MS)	0.72
Average		0.20(S)	0.72(MS)	1.16(MS)	0.94
30cm	50%	0.31(S)	1.65(MS)	2.12(M)	1.89
	70%	0.22(S)	0.88(MS)	1.13(MS)	1
Average		0.27(S)	1.27(MS)	1.63(MS)	1.45
General mean		0.23(S)	0.99MS)	1.39(MS)	1.19

S: Slow M: Moderately; MS: Moderately slow; MR: Moderately rapid O`Neal (1952).

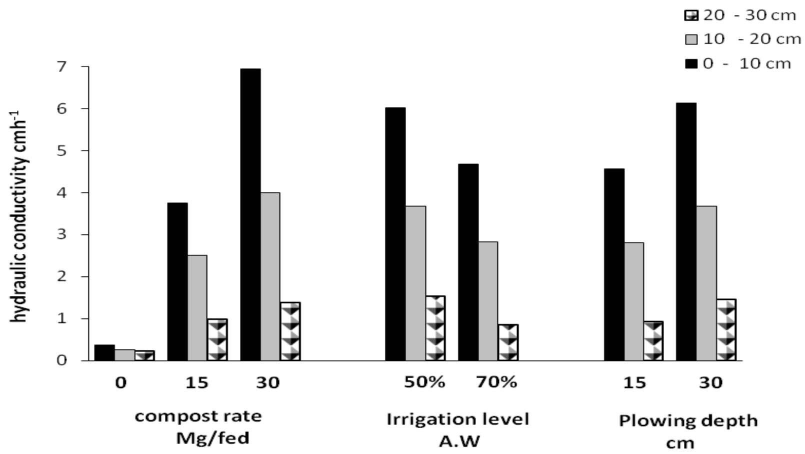


Fig. 4: Effect of plowing level, irrigation water depletion level, and addition rates of compost on hydraulic conductivity (cm/h) of El-Nubaria calcareous soil.

Regarding the effect of depletion levels, the data indicated that 50% depletion level was of greater effect on (K_{sat}) rather than 70% depletion at the three soil depths. The short irrigation intervals induced the formation of water stable aggregates, while long one destroyed it and hence increased micropores which led to increase hydraulic conductivity as compared with the short one. These conclusions stand in well agreement with those reported by Aziz *et al* (1999), El- Sersawy (1989), and El-Sherbiny (2002).

The data in the same table show the effect of plowing depth on soil hydraulic conductivity (K_{sat}). There was an increase in (K_{sat}) values with increasing plowing depth due to loosen and disturbed soil. Soil hydraulic conductivity decreased with increasing soil depth. The decreases in soil hydraulic conductivity was not only due to the decreasing soil porosity, but also size of macro pores.

Crop production

The effects of the rate of compost, irrigation regime, and plowing depth on grain yield, plant height, and dry weight are presented in Tables 9,10,11,12 and 13 and Fig. 5. The data reveal the pronounced increase in grain yield, plant height and dry weight (ear leaf at silking) were influenced by rate of compost. Percent increase over the control was 41.2 and 57.8% (grain yield), 26.5 and 36.19 % (plant height) and 15.2 and 25.7 % (dry weight of the ear leaf) pertaining to the compost application rates 15 and 30 Mg/fed, respectively. This finding stands in well agreement with those of Kawata *et al*. (1976) Khaled (1993), Saleh *et al.* (2003) and El-Sherbiny (2007) who reported that the application of organic compost materials led to a significant increase in crop production compared with that of the control treatment. This response may be due to the decomposition of organic matter and release of their available nutrients.Furthermore it has beneficial effect on soil chemical, physical and their nutrients uptake.

The application of irrigation water regime as, 50 % depletion from Available water high crop production percent increase over the control was 56.5 and 42.5 % (grain yield), 36 and 26.9 % (plant height) and 23.3 and 17.9 This effect may be due to upon increasing water stress the photosynthesis decreased and respiration increased causing a reversal effect on crop production. Janardhan *et al*. (1986) and Singh Singh (1989) reported that soil water deficit significantly decreased the mean area of leaves, weight of plants, delayed flowering of the uppermost branch heads, number of heads/plant of sunflower.

Due to the fact that soil compaction directly affected the system of macrospores, it drastically affected the soil physical growth factors; i.e. soil moisture, soil aeration, soil temperature and soil mechanical resistance therefore, maize yield was affected by the plowing depth. Data in Table 7 reveal that plowing at 30 cm depth has resulted in a considerable increase in crop production compared with the other one i.e 15 cm depth. Percentages increase over the control were 48.3 and 53 % (grain yield), 29.67 and 33.9 % (plant height) and 19.2 and 22.1 % (dry weight of the ear leaf) pertaining to available water surpassed the other irrigation regime of 70 % depletion in plowing at 15 and 30 cm depth, respectively.These results are in agreement with those Rashidi and Abbassi (2011) they observed that tillage treatments (conventional tillage, reduced tillage and minimum tillage) significantly affected yield and quality of sugar beet compared with the treatment of no tillage. The response of crop yield to rates of compost, depletion % of available water and plowing depth was statistically confirmed. Data indicated high significant correlations between grain yield (Y) and both hydraulic conductivity cm/h (X1), total porosity % (X2), bulk density gcm^{-3} (X3) and penetration resistance MPa (X4).The simple correlation coefficients (r) are: 0.702*,0.900**,0.978** and 0.928** (*sig 0.05,**sig 0.01) respectively.

Table 9: Effect of plowing depth, irrigation water depletion level, and addition rates of compost on crop production of maize for El-Nubaria soil.

Treatment		Grain yield Mg/fed	Plant height cm	Dry weight g(ear leaf)
Plowing depth cm	15	2.90	205	4.931
	30	3.78	228	5.665
$L.S.D_{0.05}$		0.51	15.3	0.442
Irrigation level A.W	50%	4.00	236	5.64
	70%	2.68	197	4.957
$L.S.D_{0.05}$		0.99	21.76	0.397
Compost rate Mg/fed	0	1.46	146	4.198
	15	2.79	200	4.948
	30	3.89	233	5.648
$L.S.D_{0.05}$		0.89	27.4	0.639

Table 10: Effect of interaction between plowing depth and irrigation water depletion level, on crop production of maize for El-Nubaria soil.

Plowing depth cm	Irrigation level A.W	Grain yield Mg/fed	Plant height cm	Dry weight g(ear leaf)
15	50%	3.52	211	5.300
	70%	2.28	199	4.563
30	50%	4.48	261	5.980
	70%	3.09	194	5.351
$L.S.D_{0.05}$		1.11	9.65	0.688

Table 11: Effect of interaction between plowing depth and addition rates of compost on crop production of maize for El-Nubaria soil.

Plowing depth cm	Compost rate Mg/fed	Grain yield Mg/fed	Plant height cm	Dry weight g(ear leaf)
15	0	1.5	144	3.986
	15	2.45	192	4.508
	30	3.35	218	5.355
30	0	1.78	151	4.411
	15	3.14	208	5.389
	30	4.43	248	5.942
$L.S.D_{0.05}$		0.89	36.77	0.498

The regression equations are:

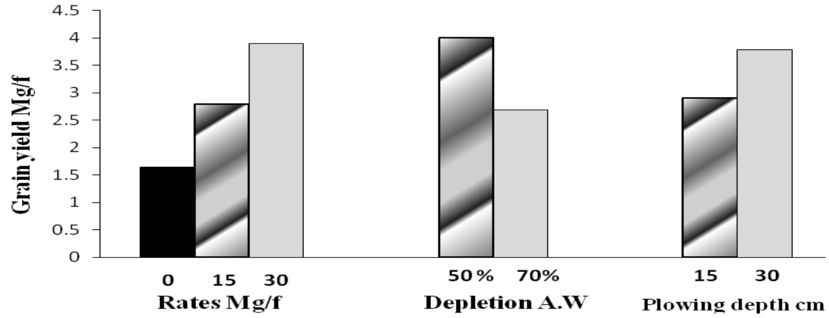
$Y=1.87 + 2.745 (X_1)$

$Y=-19.46+5.652(X_2)$

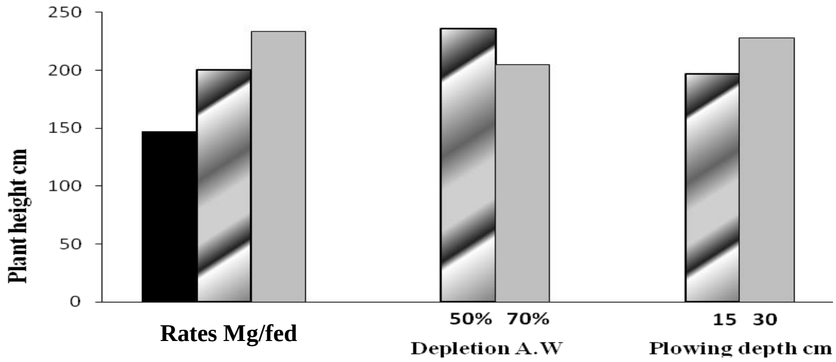
$Y=27.197-1.730(X_3)$

$Y=7.057- 5.652 (X_4)$

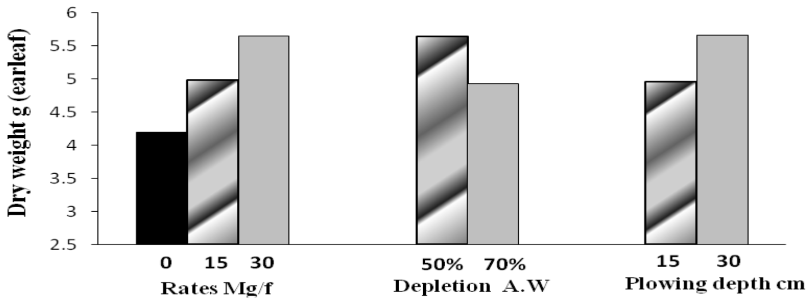
These results indicate that maize production under El-Nubaria conditions was significantly increased by increasing hydraulic conductivity and total porosity, decreasing soil bulk density and soil penetration resistance.



Grain Yield Mg/f



Plant height cm



Dry weight g (ear leaf)

Fig. 5: Effect of plowing depth, irrigation water depletion level, and addition rates of compost on maize production of El-Nubaria calcareous soil

Table 12: Effect of interaction between irrigation water depletion level and addition rates of compost on crop production of maize for El-Nubaria soil.

Irrigation level A.W	Compost rate Mg/fed	Grain yield Mg/fed	Plant height cm	Dry weight g(ear leaf)
50%	0	1.74	151	4.328
	15	3.65	211	5.344
	30	4.35	261	5.936
70%	0	1.54	144	4.069
	15	1.93	189	4.533
	30	3.43	261	5.361
$L.S.D_{0.05}$		0.79	40.12	0.654

Table 13: Effect of interaction between plowing depth, irrigation water depletion level, and addition rates of compost on crop production of maize for El-Nubaria soil.

Plowing depth cm	Irrigation level A.W	Compost rate Mg/fed	Grain yield Mg/fed	Plant height cm	Dry weight g(ear leaf)
15	50%	0	1.57	147	4.111
		15	3.22	197	4.876
		30	3.82	225	5.723
	70%	0	1.42	141	3.86
		15	1.67	187	4.139
		30	2.88	210	4.987
30	50%	0	1.91	155	4.544
		15	4.08	225	5.811
		30	4.88	297	6.148
	70%	0	1.65	146	4.277
		15	2.19	190	4.966
		30	3.98	198	5.942
$L.S.D_{0.05}$			2.78	86.97	1.047

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إنتاجية الذرة الشامية تحت تأثير بعض العمليات الزراعية والإدارة المائية فى أرض النوبارية

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أقيمت تجربة حقلية بمحطة بحوث النوبارية التابعة لمركزالبحوث الزراعية لدراسة تأثير بعض العمليات الزراعية والإدارة المائية على تنمية انتاجية الذرة الشامية واشتملت المعاملات على 3معدلات إضافة كمبوست (صفر ، 15 ، 30 طن/فدان) ومعدلين للرى عند إستنفاذ 50 % ، 70% من الماء الميسر فى التربة وعمقين للحرث 15 ،30 سم واستخدم محصول الذرة الشامية كدليل على زيادة الإنتاجية وتحسين الخواص الطبيعية.

أدى أضافة الكمبوست بمعدل 30 طن/فدان والرى عند استنفاذ 50% من الماء الميسر فى التربة والحرث على عمق 30 سم الى انخفاض الكثافة الظاهرية وزيادة المسامية الكلية للتربة بدرجة أكبر من اضافة الكمبوست بمعدل 15طن/ فدان والرى عند استنفاذ 70% من الماء الميسر فى التربة والحرث على عمق 15 سم وكانت قيمة النقص فى الكثافة الظاهرية للتربة 8.3 % والزيادة فى المسامية الكلية 14.5% كنتيجة اضافة الكمبوست بمعدل 30 طن/فدان مقارنة بالكنترول.

كما وجد أن هناك زيادة فى معامل التوصيل الهيدروليكى ونقص فى مقاومة التربة للإختراق تحت تأثير اضافة الكمبوست بمعدل 30طن/ فدان والرى عند استنفاذ 50 % من الماء الميسر فى التربة والحرث على عمق 30 سم ووجد أن هناك علاقة ارتباط عالية المعنوية السالبة لمحصول الذرة الشامية مع الكثافة الظاهرية ومقاومة التربة للإختراق ، والمعنوية الموجبة مع المسامية الكلية والتوصيل الهيدروليكى.

كما وجد زيادة فى محصول الذرة الشامية وارتبطت تلك الزيادة مع كفاءة استخدام مياه الرى حيث بلغت نسبة الزيادة لكفاءة استخدام مياه الرى 57.9 % ، 56.3 % ، 52.9 % على الترتيب لكل من إضافة الكمبوست بمعدل 30 طن / فدان والرى عند استنفاذ 50 % من الماء الميسر بالتربة والحرث عند عمق 30 سم.

قام بتحكيم البحث

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