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EFFICIENCY OF SOME AMENDMENTS ADDED TO CLAYEY SOIL IRRIGATED WITH DRAINAGE WATER

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ABSTRACT

A field experiment was conducted at the farm of El- Serw experimental station (ARC), Domiatta governorate, Egypt in 2002/2003 seasons. This study aims to evaluate the effect of added Gypsum (6 ton fed^{-1}) or FYM ($20m^{r}$ fed^{-1}) or Gypsum + FYM on some chemical and physical characteristics of the clay soil and on the yield of wheat under the conditions of irrigation with drainage or Nile water.

The obtained data revealed that:

(1) Wheat grains yield and wheat straw yield significantly decreased because of irrigation with drainage water, but application of any experimental amendment significantly increased them in comparing with the control (not-amended) under irrigation with drainage or Nile water, with the highest increment with a mixture of Gyps + FYM. The beneficial effect of the added amendments was more obvious on straw yield irrigated with drainage water, whereas increasing in relative yield (%) of straw yield was the highest under irrigation with drainage water.

(2) Treated soil with FYM or Gypsum either in a single or in a combine form caused improving in EC (dS/m), O.M % and available P, K, Fe, Mn and Zn (mg/kg) of soil comparing with the untreated soil (control) under irrigation with Nile or drainage water. Generally, the treatment of FYM + Gypsum occupied the first order in improving the previous characteristics.

(3) Bulk density (BD, gm/cm^{r}), regardless the type of irrigation water, decreased with application of different amendments and the highest decrement noted with Gypsum+ FYM treatment. While it increased in sub-surfaces layers than in surfaces layers.

Total soil porosity (TP %) increased in the two studied soil depths because of application of FYM or Gypsum+ FYM to soil irrigated with Nile water, but under irrigation with drainage water it increased in soil treated with solo gypsum in comparing with the corresponding values in the untreated control soil.

Total soil aggregates (%) values, under irrigation with Nile water, generally increased in the surface and sub-soil layers of soil treated with any used amendments in comparison with the corresponding values of the control treatment. While, in soils irrigated with drainage water, their values decreased only in sub-soil layers because of amendments application comparing with the control treatment.

Keywords: Farmyard manure (FYM), Gypsum,Clay soil,Drainage water, Wheat yield , Soil properties.

INTRODUCTION

Because of the shortage in good quality water resources for crop irrigation and the huge amounts of annual discharge of drainage waters, ≈ *11.8 X* 10^{9} m^{3} *(Amer and De Ridder 1989)*, therefore the use of drainage water for irrigation crops becomes very necessary. However, the highly saline nature of these waters, *T.D.S ranged between 1000-8000 mg/L (Wagdi and Hamdi, 1974)*, restricted their fully exploiting. Many investigations were used different soil amendments, such as organic manures, mineral fertilizers, sulfur and gypsum to avoid the risks of irrigation with drainage water on growing crops (Draz *et al.*, 1993, Farh *et al.*, 1997, and El-Banna *et al.*, 2004). Also the roles of these amendments on amelioration of some chemical and physical properties of different soils were investigated by many scientists such as Mukhtar et al (1974), Ismail and El Shall (1978) Wahadan *et al.* (1999), El- Maghraby (1997) and Laila (1993).

The current work aims to assess the improving role of FYM and Gypsum whether added solo or in a mixture form on the characteristics of clay soil, irrigated with drainage water, and on the yield of wheat which grown on this soil.

MATERIALS AND METHODS

This experimental work was conducted at El- Serw experimental station (ARC), Domiatta governorate, Egypt in 2002/2003 season. Some soil properties and tested irrigation water were carried out as described by Jackson (1973), and the results are shown in Table 1 and 2

The experimental field was divided into two splits, one of them irrigated with Nile water and the other irrigated with drainage water (chemical analyses, as Jackson 1973, are shown in Table 2. The plots, in every split were treated, before sowing of wheat, with one amendment of: No amendment (control), Gypsum at rate 6 ton fed^{-1}, Farmyard manure (FYM) at rate 20 m^3 fed^{-1} and Gypsum (6 ton fed^{-1})+ FYM (20 m^3 fed^{-1}). The experimental plot area was 21 m^2 and replicated three times. The main characteristics of the used FYM and chemical composition of gypsum were carried out according to the methods recorded by Black, 1965 and shown in Table 3

Table 1: Some characteristics of the experimental soil, at different soil depths, under different irrigation.

Irrigation	Depth (cm)	Organic matter (%)	pH (Soil paste)	EC, dSm^{-1} (Soil paste)	Particle size distribution (%)					Soil available nutrients mg kg^{-1}				
					Sand (%) Coarse	Sand (%) Fine	Silt (%)	Clay (%)	Texture	K	P	Fe	Mn	Zn
Nile	0-10	1.55	7.77	2.75	0.10	15.38	21.52	63.00	Clay	87.3	6.5	5.0	3.5	1.8
	10-20	2.01	7.87	2.64	0.38	19.93	13.44	66.25		121.6	2.5	5.5	5.8	1.4
	20-30	1.55	7.89	2.38	0.51	15.69	23.82	59.98		111.6	5.0	6.0	5.5	1.4
	30-40	1.36	7.97	1.95	1.32	40.78	11.05	46.85		121.6	3.0	7.5	6.6	1.6
	40-60	1.08	8.01	1.65	0.52	18.14	19.67	61.67		101.4	6.5	7.0	6.5	2.2
Drainage	0-10	2.06	7.65	4.40	0.34	10.00	15.65	74.01	Clay	108.4	3.0	6.0	6.9	1.8
	10-20	2.01	7.74	4.16	0.35	22.95	33.12	43.58		129.5	5.5	7.5	6.9	1.6
	20-30	1.31	7.79	3.93	0.24	15.32	5.72	78.72		129.5	3.5	7.5	7.5	1.0
	30-40	1.90	7.88	3.17	0.81	9.56	17.86	71.77		129.5	4.5	7.5	7.9	2.4
	40-60	2.09	7.92	3.52	0.47	12.17	13.44	73.92		107.4	5.0	8.0	7.1	2.2

Table 2 Some chemical composition of irrigation water.

Chemical Characteristics	Sources of irrigation water	
	Nile Water	Drainage Water
EC, dS/m	0.69	2.34
Cations:(me./ L)		
Ca^{++}	2.83	3.43
Mg^{++}	1.69	5.11
Na^{+}	3.23	17.99
K^{+}	0.24	0.39
Anions: (me./L)		
$CO_3^{=}$	0.32	1.04
HCO_3^{-}	3.23	3.53
Cl^{-}	2.40	17.69
$SO_4^{=}$	2.04	4.66
N (mg/L)	0.66	0.70
P (mg/L)	0.59	0.78
Fe (mg/L)	0.50	0.19
Mn (mg/L)	0.27	0.32
Zn (mg/L)	0.05	0.03

All the experimental plots were received the recommended doses of nitrogen fertilizers (100 kg $Nfed^{-1}$. as ammonium sulphate, 20.5% N) at three equal doses at 15,45 and 60 days from planting, potassium fertilizers (48 kg.K_2O/fed. as K_2SO_4, 48 % K_2O) at two equal doses with the first and the second doses of nitrogen and phosphorus fertilizers (30 kg P_2O_5/fed. as super phosphate, 15.5% P_2O_5) applied before planting. Wheat grains (*Triticum aestivum L.*,Giza168 variety) had been sown in 25/11/2002.

At the harvesting stage, disturbed and undisturbed soil, samples were collected from five soil layers, each of 10 cm followed by one layer of 20 cm deep. Some soil physical determinations were carried out on these selected samples, bulk density (BD, gm cm^3) by using the core method (Vomocil, 1965), soil stable aggregates (%) by wet sieving according to (USSL staff, 1954), soil moisture retention curve by the pressure cooker (Stakman and Vander, 1962), then pore diameter by volume were calculated from the moisture retention curves at the different tenssion.

Table 3 a: Some characteristics of the used Farmyard manure (FYM).

O.M.%	O.C.%	C/N	Total elementals (%)		
			N	P	K
10.50	6.09	12.18	0.50	0.29	3.76

b: Chemical composition of gypsum in saturated extract (≈ 30me./L).

pH	EC (dS/cm)	Soluble Ions (me./L)							
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
7.37	2.63	20.77	4.21	1.10	0.23	0.11	1.20	4.50	20.50

After plants harvesting, the grains and straw yields of wheat plants were recorded and soil samples were taken from the five soil depths mentioned above and air dried ,saved through a 2 mm and chemically analyzed for Electrical Conductivity (EC) of soil paste (dSm^{-1}) and soil organic matter (%) using the modified Walkley method according to Jakson, 1973.

Available P, K, Fe, Mn and Zn of the taken soil samples were extracted by NH_4HCO_3-DTPA (AB-DTPA) extraction method (Soltanpour and Schwab, 1977). Phosphorus was calorimetrically estimated using ascorbic acid method (Herget, 1970), potassium by flame photometer and Fe, Mn and Zn were measured using atomic absorption spectrophotometer (Dewis and Freits, 1970).

The obtained data were exposed to proper statistical analysis of variance (ANOVA) by using the Minitab program (Barbara and Brain, 1994), and the least significant differences (LSD, at 5%) were calculated.

RESULTS AND DISCUSSION

1) Wheat yield of grains and straw:

Data presented in Table 4 showed that the soil experimental plots irrigated with drainage water achieved lower grains and straw yield than those plots that irrigated with Nile water. However, under irrigation with drainage or Nile water, treated soil with FYM or gypsum either in solo or in a mixture form gave obvious increment in grains and straw yield comparing with untreated soils (control). The mixture treatment of FYM + Gypsum was the first treatment in this trend.

Table 4 Dry yield of Wheat plants (Grains and Straw) under different irrigation water and soil amendments addition.

Treatments		Wheat grains		Wheat straw	
Irrigation	Amendments	Yield (Ardab/fed)	Relative Yield (%)	Yield (Ardab/fed)	Relative Yield (%)
Nile Water	Control	10.81	100	2.64	100
	Gypsum	11.76	109	2.76	105
	FYM	11.98	111	2.82	107
	Gyps + FYM	13.64	126	2.98	113
Drainage Water	Control	8.71	100	2.04	100
	Gypsum	9.10	104	2.16	106
	FYM	9.56	110	2.42	119
	Gyps + FYM	10.34	119	2.73	134
L.S.D (5%) :					
Irrigation		0.07		0.02	
Amendment		0.10		0.03	
Irrig. X Amend.		0.11		0.03	

* (Ardab = 150 Kg)

On the other hand, under the conditions of irrigation with drainage water, the beneficial effect of the added amendments was more obvious on straw yield. Whereas increasing in relative yield of straw (%) was more under irrigation with drainage water than under irrigation with Nile water.

The positive role of amendments on soil was possibly due to their beneficial effects on the physicochemical properties (*e.g.* soil structure, available water, soil salinity & acidity and availability of nutrients in soil), and then plants will be grow better even under saline stress (El-Maghraby et al, 1996 and El-Maghraby, 1997).

2) Soil Salinity:

Electrical conductivity (EC, dSm^{-1}) of soil paste was used to express soil salinity and results are shown in Table 5. In general, in all treatments the values of EC significantly decreased in soils irrigated with Nile water than those irrigated with drainage water (Selem *et al.*, 1989-a and Sakr *et al.*, 1995).

It can also noticed, in the treatments of control, gypsum and FYM+Gypsum, that the EC mean value (3.51 dSm^{-1}) of the sub-layers of soil, 30-60 cm, was higher than the corresponding value of the surface layers, 0-30cm, (2.08 dSm^{-1}). This may be due to gypsum allow continuous calcium supply replacing sodium from soil matrix and forming new stable aggregates led to increase hydraulic conductivity and encourage the water to flow down leaching the salt out (Llyas *et al.*, 1993). As well as increasing the amount of rainfall during the growing season in the location of experiment, allow to removal amounts of salts to down layers. Contrary trend was observed in soil treated with FYM, whereas EC values were markedly higher in surface layers (0-30 cm) than in the sub- surface layers (30-60 cm). This could be referred to the high ability of FYM mixed with the surface layers to chelate different cations and anions by chemical agents products from their decomposition (Draz *et al.*, 1993 and El-Maghraby *et al.*, 1997).

On the other hand, data improved that treated soil with the different amendments significantly decreased soil salinity, regardless the type of irrigation water, comparing with the control treatment (no- amendment). FYM + Gypsum gave the best effects in this trend, because of the reasons mentioned above as well as, the role of manure in improving the status of soil salinity (Sadek *et al.*, 1993 and El-Maghraby *et al.*, 1997). While, the treatment of gypsum in solo form was the latest effect in decreasing soil salinity, because of it added relatively little soluble salts to soil (Table3: b) and to ions resulting from the reactions of gypsum with the soil. The previous findings were in agreement with Wassif *et al.*, (1995), Farh *et al.*, (1997), Mohamed *et al.*, (1997) and Wahdan *et al.*, (1999).

3) Organic matter content of soil (%):

Data in Table 5 reveal that the values of soil organic matter (%) were higher in soil irrigated with drainage water than that irrigated with Nile water. These trends could be due to the role of high soil salinity levels in preserving the organic matter and in decreasing their decomposition rate (Sadek 1978).

In addition, O.M % was higher in the surface layers (0-30 cm) than in sub-surface layers (30-60 cm. This due to accumulate the residues of previous crops as well as the amounts of organic manures, added as experimental treatment, to the surface layers.

Under the use of any irrigation water, soils treated with FYM and FYM + Gypsum were higher in their O.M %, due to FYM (Sadek *et al.*, 1993).

Table 5: Some soil characteristics as affected by different experimental treatments.

Treatments			Soil characteristics									
Irrig. Water Type	Amend	Soil Depth (cm)	EC dSm^{-1} soil paste	O.M (%)	Available nutrients (mg/kg)					BD g.cm^{-3}	Total Porosity (TP,%)	Total Aggregate (%)
					P	K	Fe	Mn	Zn			
Nile Water	Control	0-10	2.62	2.38	6.93	88.42	5.72	5.50	1.0	1.24	61.22	78.17
		10-20	2.90	2.39	2.48	95.26	6.02	6.35	1.6	1.26	61.41	74.55
		20-30	1.57	2.43	4.95	109.48	5.90	5.50	1.0	1.29	68.02	70.88
		0-30	2.36	2.40	4.79	97.72	5.88	5.78	1.20	1.26	63.55	74.53
		30-40	2.41	2.16	6.93	119.47	6.96	5.50	1.20	1.29	54.95	60.88
		40-60	3.15	1.06	6.44	130.00	7.86	6.63	1.46	1.32	97.99	47.70
		30-60	2.90	1.43	6.60	126.49	7.56	6.25	1.37	1.31	63.64	52.09
	Gypsum	0-10	1.83	3.49	9.90	97.37	8.65	7.60	1.55	1.14	57.60	76.50
		10-20	2.66	2.34	11.52	103.68	8.79	7.35	1.85	1.16	63.56	80.98
		20-30	1.57	1.84	8.84	114.21	8.00	7.35	1.55	1.17	60.58	74.29
		0-30	2.02	2.56	10.09	105.09	8.48	7.43	1.68	1.15	60.58	77.26
		30-40	2.60	1.49	15.26	124.74	8.08	8.25	1.40	1.18	63.60	60.76
		40-60	2.82	1.33	11.44	124.74	8.70	7.00	1.80	1.18	67.15	48.86
		30-60	2.75	1.38	12.71	124.74	8.49	7.42	1.67	1.18	65.97	52.88
	FYM	0-10	1.75	3.12	5.94	131.58	10.07	7.75	1.80	1.14	62.60	72.44
		10-20	2.61	2.75	6.44	121.58	12.57	7.80	2.00	1.15	70.84	76.73
		20-30	1.54	3.34	5.45	87.37	10.13	7.70	1.20	1.16	63.08	64.53
		0-30	1.97	3.07	5.94	113.51	10.92	7.75	1.67	1.15	65.51	71.23
		30-40	1.50	1.82	6.53	170.53	12.65	7.50	1.70	1.18	72.76	55.89
		40-60	1.49	1.65	8.91	121.58	10.12	8.00	1.81	1.15	62.09	58.28
		30-60	1.49	1.71	8.12	137.90	10.96	7.83	1.77	1.16	65.65	57.45
	Gyps + FYM	0-10	2.05	2.34	6.44	121.99	10.17	8.00	2.20	1.10	64.63	71.93
		10-20	1.13	2.34	5.48	115.58	15.00	8.02	2.80	1.11	66.80	77.56
		20-30	1.15	2.59	5.48	115.93	15.00	8.02	1.20	1.10	67.56	74.43
		0-30	1.44	2.42	5.80	117.83	13.43	8.01	2.07	1.10	66.33	74.64
		30-40	165	2.07	7.45	112.63	11.20	8.17	2.00	1.15	64.87	57.66
		40-60	1.70	1.84	9.39	127.72	14.64	9.13	2.20	1.15	78.00	62.77
		30-60	1.68	1.92	8.74	122.69	13.49	8.81	2.13	1.15	73.62	61.06
Drainage Water	Control	0-10	3.02	2.93	3.97	79.47	7.63	6.00	1.00	1.24	68.68	75.20
		10-20	3.17	2.49	4.01	97.37	7.56	8.00	1.60	1.28	70.59	70.27
		20-30	4.16	2.05	3.52	92.63	7.56	6.00	1.60	1.27	67.33	72.43
		0-30	3.45	2.49	3.83	89.82	7.58	6.67	1.40	1.26	68.86	72.63
		30-40	4.03	1.78	3.53	99.53	8.05	6.75	1.40	1.33	67.34	65.16
		40-60	4.72	1.55	4.61	101.68	8.56	7.13	1.60	1.27	66.02	76.14
		30-60	4.49	1.63	4.25	100.96	8.39	7.00	1.53	1.29	66.58	72.48
	Gypsum	0-10	4.08	3.08	6.74	106.37	15.44	7.30	.62	1.09	70.26	83.92
		10-20	2.67	2.94	8.63	99.68	10.40	8.05	1.82	1.18	63.22	73.79
		20-30	3.64	2.34	6.95	89.27	5.36	7.30	1.62	1.20	73.78	76.92
		0-30	3.46	2.79	7.44	99.44	10.40	7.55	1.69	1.16	69.75	78.21
		30-40	3.39	2.02	8.45	87.05	11.40	6.54	1.42	1.23	69.27	43.70
		40-60	3.86	1.93	9.41	101.39	9.86	8.04	1.82	1.20	76.02	57.48
		30-60	3.70	1.96	9.09	96.61	10.38	7.54	1.69	1.21	73.77	55.88
	FYM	0-10	4.58	4.97	4.93	124.21	12.60	8.00	2.00	1.09	60.58	75.39
		10-20	3.16	4.94	3.97	107.37	12.60	8.42	1.60	1.18	61.04	70.88
		20-30	3.76	4.77	3.97	121.58	10.08	7.42	2.00	1.19	74.09	73.74
		0-30	3.83	4.89	4.29	117.72	11.76	7.96	1.87	1.15	65.23	73.33
		30-40	3.04	4.36	5.92	125.21	10.08	7.83	1.40	1.11	70.51	67.76
		40-60	2.54	4.45	6.41	114.68	12.76	8.75	2.20	1.20	76.55	52.72
		30-60	2.71	4.42	6.25	118.19	11.87	8.44	1.93	1.17	74.54	52.73
	Gyps + FYM	0-10	2.87	4.00	2.97	91.58	12.06	8.75	2.00	1.03	64.92	73.38
		10-20	2.66	3.81	6.44	79.47	15.09	1.00	2.20	1.12	69.59	72.71
		20-30	2.70	3.63	4.56	107.37	15.09	9.25	2.20	1.18	62.60	63.30
		0-30	2.74	3.81	4.66	92.81	14.08	9.33	2.13	1.11	65.70	69.80
		30-40	3.44	3.35	5.97	100.53	12.05	9.25	3.00	1.10	65.32	65.38
		40-60	3.83	3.18	6.53	138.60	16.64	9.63	4.10	1.16	69.64	56.32
		30-60	3.70	3.24	6.34	125.91	15.11	9.50	3.73	1.14	68.20	59.34
L.S.D (5%)	Irrig.W		0.01	0.01	0.01	3.95	0.02	0.08	0.07			
	Amend		0.02	0.01	0.01	1.68	0.02	0.11	0.10			
	Depth		0.02	0.01	0.02	1.88	0.03	0.13	0.12			

4) Available nutrients of soil:

Available P and K:

As shown in Table (5) using drainage water for irrigation caused decreasing in the values of soil available-P and soil available-K when compared with that irrigated with Nile water. In addition, in general, available-P and available-K were higher in the sub-surface layers (30-60 cm) than in the surface layers (0-30 cm). These results were in agreement with Selem *et al.*, 1989-a.

As for the role of amendments, data show that, under irrigation with drainage or Nile water, added amendments to soil led to significant increasing in the amounts of available-P and available-K in soil comparing with the control (untreated) soil.

The highest values of available-P were achieved in soil treated with gypsum amendment. The favorable effect of gypsum might be due to either increasing the availability of phosphorus in soil because of reducing soil pH (Wahdan *et al.*, 1999) or to release of phosphate ions from soil colloids by sulfate ion (SO_4^{--}). In addition, Mahours *et al.*, (1983) concluded that available-P increases due to an increase in solubility of calcium phosphate under high carbon dioxide partial pressure and the lowering of soil pH by flooding.

On the other hand, highest available – K values were noticed in the soils treated with solo FYM. This may be due to the beneficial role of FYM on the physicochemical properties of soil and to the role of chelating agents, induced during FYM decomposition, in increasing the availability of potassium in soil (El-Maghraby *et al.*, 1997). Meanwhile, soils amended with solo gypsum achieved the lowest increment in available-K, due to the role of gypsum in reducing soil pH which causes reduction in the amounts of available – K by precipitation or fixation (El- Shall *et al.*, 1986). It is worthy to mention that decreasing the soil pH will led to the dissolution of Fe-oxides and calcium carbonates which occurred as a coating and /or cementing agent of soil. Consequently, new retention sites will take place and more K will be retained (Saleh and Khalied, 1993).

Relative increases, as percentage from control, of available-P and available-K were more pronounced in soils irrigated with drainage water than that irrigated with Nile water. Whereas, these relative increases percentage (RI%) values of available-P were 100%, 23%, 27% in soils irrigated with Nile water and were 105%, 30 % and 36% in soils irrigated with drainage water for soils amended with solo gypsum, solo FYM and Gyps + FYM, respectively.

The corresponding RI % values of available-K were 3%, 12% and 7% under irrigating with Nile water and 2%, 24% and 15% for soils amended with solo gypsum, solo FYM and Gyps + FYM, respectively. These results reflected the beneficial role of manures added solo or in combine with gypsum on increasing the availability of P and K especially under saline conditions.

Available Fe, Mn and Zn:

Data presented in Table 5 showed that available Fe, Mn and Zn of soil significantly increased under irrigation with drainage water than Nile water

(Rahim, 1993 and El-Magraby *et al.*, 1996). Generally, they increased with depth probably due to the translocation within the soil profile (Mayalagu and Paramasivam, 1990).

Amended soil with the different experimental amendments increased the contents of available Fe, Mn and Zn in comparing with not-amended soil (control treatment). Soils treated with Gyps + FYM achieved the highest increasing in their content of available-micronutrients compared with the other treatments. The superiority of Gyps + FYM treatment in this manner may be due to the role of organic manure in modifying the status of these micro-nutrients in soil, since: it consider a source of different micronutrients in soil, provides chelating agents protecting the micronutrients from precipitation and decreasing their loss by leaching (El-Maghraby, 1996). As well as the rôle of gypsum application in increasing the availability of Fe, Mn and Zn in soil, due to the decreasing in soil pH because of reaction of applied gypsum with the soil (Lindsay and Norvell, 1978, Lindsay, 1979 and Mohamed *et al.*, 1997).

5) Some physical properties of soil:

Bulk density (BD, gm/cm^3):

Soil bulk density is a major product of the changes in the soil and field conditions. Data in Table 5 showed that, regardless the type of irrigation water, soil bulk density values at (0-30 cm) and (30-60 cm) depths decreased by using the amendments in comparison with the corresponding depths of control area. Mean values of soil BD (gm cm^{-3}) ranged from 1.29 for soil control to 1.18, 1.16 and 1.13 under using Gypsum, FYM and Gyps + FYM, respectively. On the other hand, BD of soil increased with soil depth increasing, whereas their mean values were 1.17gm cm^{-3} at layer 0-30 cm depth and 1.20 gm/cm^3 at the layer of 30- 60 cm. This may be due to the effect of overlaying layers on the values of BD (Selem *et al.*, 1989-b).

The maximum decreasing of soil BD values were obtained by using the treatment of Gyps + FYM when using Nile or drainage water for irrigation with no difference was shown between them.

Total porosity (TP,%):

Total porosity (%) of soil, (Table 5), increased in surface and sub-surface layers of soils treated with Gyps + FYM or with solo FYM amendment and irrigated with Nile water, and also increased in soil treated with solo gypsum and irrigated with drainage water compare with the untreated soil irrigated with the corresponding water (control). In general, TP (%) of soil increased with soil depth, whereas the mean values of total porosity were 65.69 % and 68.99% in surface and sub-surface layers, respectively. These findings were in agreement with the findings of Laila (1993).

Total aggregates (%):

Tabulated data (Table 5) show that total aggregates (%) increased in both surface and sub-surface layers of soils treated with Gyps + FYM or with solo gypsum and irrigated with Nile water, while in soil treated with solo FYM total aggregate (%) increased only in sub-surface layers comparing with the same values of the corresponding soil depths of untreated soil.

Under irrigation treatment with drainage water, the values of total aggregates (%) of soil treated with Gyps + FYM decreased in the two studied soil depths. While in soils treated with solo gypsum or with solo, FYM total aggregates values (%) increased in surface layers and decreased in sub-surface layers comparing with the same values of the corresponding depths of untreated soil.

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فعالية بعض محسنات التربة المضافة للأرض الطينية المروية بماء الصرف الزراعي

طارق عبد الرحمن ابو الضيفان ، إبراهيم محمد محمد البنا ، طه عبد الخالق المغربى ، محمد السيد عبد الله ومحمود محمد ابراهيم سليم.
معهد بحوث الأراضى والمياه والبيئة– مركز البحوث الزراعية– الجيزة.

أجرى هذا البحث فى محطة البحوث الزراعية بالسرو محافظة دمياط لدراسة تأثير محسنات التربة (جبس زراعي بمعدل ٦ طن / فدان أوالسماد البلدى بمعدل ٢٠ م^3 / فدان أو من خليط منهما وبنفس معدلاتهم) على محصول الحبوب والقش وبعض خصائص الأرض الطينية تحت ظروف الرى بماء النيل أو ماء المصارف. وقد أوضحت النتائج التحصل عليها مايلى:

- حدوث نقص في محصول حبوب القمح ومحصول القش بسبب الرى بماء المصارف عن الرى بماء النيل.ومن ناحية اخرى ، أدت اضافة أى من محسنات التربة إلى حدوث زيادة معنوية فى محصول حبوب القمح ومحصول القش وذلك مقارنة بالمعاملة صفر محسنات وكانت هذه الزيادة أكثر تميزا تحت ظروف الرى بماء النيل، وكانت أكثر المعاملات تأثيرا فى إحداث الزيادة هى المعاملة الخليط من كلا المحسنين .
- أدت معاملة التربة بالسماد البلدى أو الجبس سواء كانت الإضافة فى صورة منفردة أو خليط إلى تحسن درجة التوصيل الكهربى فى التربة وعحتواها من المادة العضوية ، كما حسنت من محتواها من الصورة الميسرة لعناصر البوتاسيوم والفوسفور والحديد والمنجنيز والزنك وذلك سواء كان الرى بماء النيل أو ماء المصارف. وكانت أفضل المعاملات التجريبية عامة هى المعاملة الخليط.
- تناقصت قيم الكثافة الظاهرية (جم/ سم^3) فى العمقين (صفر – ٣٠ سم) و(٣٠ – ٦٠ سم) نتيجة معاملة التربة بأى من المحسنات المستخدمة وذلك بغض النظر عن نوعية مياه الرى المستخدمة ، وكان أكبر نقص فى المعاملة سماد بلدى + الجبس وذلك مقارنة بمعاملة الكونترول كما زادت قيم الكثافة الظاهرية فى الطبقات تحت السطحية عن الطبقات السطحية.

وزادت قيمة المسام الكلية للتربة (%) فى كلا العمقين المدروسين فى معاملات السماد البلدى بمفرده أو السماد البلدى + الجبس وذلك فى الأراضى المروية بماء النيل ، كما لوحظت نفس الزيادة فى الأراضى المروية بماء المصارف المعالجة بالجبس وذلك مقارنة بمعاملة الكونترول الغير معالجة.

كما زادت بصفة عامة قيم التجمعات الأرضية الثابتة (%) فى كلا العمقين المدروسين فى الأراضى المروية بماء النيل والمعالجة بأى محسن مستخدم مقارنة بمعاملة الكنترول الغير معالجة. أما فى الأراضى المروية بماء المصارف فإن قيم التجمعات الأرضية الثابتة (%) تناقصت فى الطبقة االتحت السطحية فقط مع إضافة المحسنات وذلك مقارنة بمعاملة الكنترول الغير محسنة.