J. Agric. Sci. Mansoura Univ., 34 (12): 11503 - 11515, 2009

WATER MOVEMENT AND SOME SOIL PHYSICAL PROPERTIES IN SOME SOILS OF KAFR EL- SHIEKH IRRIGATED WITH DRAINAGE WATER

Ahmed, Hoda M. R. M.; Enshrah I. M. El-Maaz and H. M. Khalil
Soils, Water and Environment Res. Inst., Agric. Res. Center, Giza, Egypt

ABSTRACT

The study included six different soil profiles having clay textures. The irrigation drainage water reused from the main El-Gharbia drain. Undisturbed and disturbed soil samples were taken at soil depths 0 – 30, 30 – 60, 60 – 90 and > 90 cm. The obtained results indicated that values of soil bulk density increased with reuse of drainage water in irrigation, but decreased the values of total porosity. The wet sieving resulted in broking down of the large aggregates specially which have 10 - 2 mm to small aggregates, and the values of water stable aggregates (W.S.A) decreased due to the reuse of drainage water. Values of soil structure parameters have no clear trend .Values of pore size of large drainable pores were decreased, while the fine capillary pores (F.C.P) increased. Values of both saturated hydraulic conductivity and drainable pores were decreased due to dominant of clay and increasing soil salinity and alkalinity, and accordingly available water was decreased.

INTRODUCTION

In the last few years, reuse of low quality water became part of the extension program for maximizing the use of water resources. However, the uncontrolled application of such water must have unfavorable effects on both soils and grown plants, especially in the long term use. The hazard effects are mainly related to the soil properties and water quality beside the type of growing crops. In many regions where irrigation water is scare, drainage water is used to meet crop water requirements. Due to rapid increase of irrigation water demand, the available water supply in Egypt is supplemental by the reuse of agricultural drainage water which is often of low quality. The quality of the drainage water determines which crops can be irrigated. However, precautions should be taken to ensure that the quality of the drainage water does not harm the grown crops or causes environmental hazard. As a general view, Nabulsi (2001) found that use of saline drainage water for irrigation causes decrease in total porosity. Abdel –Mawgoud *et al.* (2006) stated that using drainage water for irrigation decreased both drainable pores (quickly + slow) and water holding pores, and consequently increased the fine capillary pores compared to that in the soil irrigated by canal water. Chang *et al.* (2002) stated that the aggregates stability of the soil was generally adversely affected by the more saline and sodic irrigation water. Ghadiri et al. (2007) stated that less values of EC of the clay soil with high ESP led to weakening of its stable aggregates and increased erosion. Slavich *et al.* (2002) stated that hydraulic conductivity of soil may be decreased when a saline sodic soil is leached with low salinity water. Walker and Lin (2008) studied soil property changes after four decades of waste water irrigation and results showed that depression areas had the highest mean surface K sat. . Khater *et al.* (2002) reported that the water constants tend to decrease in the soil irrigated with the low quality water. Drainage water could be used for irrigation to partially satisfy the need of water (Seyam and Ragab 2005).

This work aims to study the influence of reuse of drainage water on the soil physical properties of Al-Hamul area (Kafr El- Sheikh Governorate).

MATERIALS AND METHODS

1. Soil Sampling: This work carried out to study the effect of irrigation with drainage water on some soil physical properties. For this purpose, areas were selected from Al-Hamul, as illustrated in Table (1).

Table (1): Locations of the studied soil profiles.

Profile No.	Governorate	Studied Area	Location Name	Drainage Name
1	Kafr El-Sheikh	Al-Hamul	Timbari	El-Gharbia
2	Kafr El-Sheikh	Al-Hamul	Ta'awen Awal	The main El-Gharbia
3	Kafr El-Sheikh	Al-Hamul	Qaryah No. 7	The main El-Gharbia
4	Kafr El-Sheikh	Al-Hamul	Qaryah No. 9	The main El-Gharbia
5	Kafr El-Sheikh	Al-Hamul	Qaryah No. 13	The main El-Gharbia
6	Kafr El-Sheikh	Al-Hamul	Al-Khash'ah	The main El-Gharbia

Undisturbed and disturbed soil samples were taken at soil depths of 0–30, 30–60, 60–90 and > 90 cm.

2. Determination: Particle size distribution was carried out by the pipette method described by Gee and Bauder (1986). The total soluble salts (EC) was determined by using electrical conductivity meter at 25 ^{o}C in soil and water extract (1: 5) as dsm^{-1} and organic matter content (OM %) was determined by using Walkely and Blacks rapid titration method according to Jackson, (1973). Soil bulk and real densities were determined as described by Abdel–Aal (1971). Total soil porosity was calculated as percentage using the values of soil bulk and real densities. Dry sieving stable aggregates % and soil hydraulic conductivity were determined according to Richard's (1954). Water sieving stable aggregates % were determined using wet sieving technique as described by Ibrahim (1964). Mean weight diameter was estimated by using the values of both dry and water stable aggregates and calculated according to Yonker and Mc Guiness (1956), then Δ M.W.D was estimated by the difference between mean weight diameters of dry and wet sieving. Aggregation state , index and degree were calculated as described by Richard's (1954). Wilting point was determined according to Stakman & Vanderhast (1962), while field capacity was determined as described by Richard's (1954). Pore size distribution was calculated according to Deleenheer and De Boodt (1965) and classified to quickly drainable, slowly drainable, water holding and fine capillary pores.

3. Irrigation water analysis: Analysis includes salinity, soluble ions and pH (Richards, 1954).

Table (2): Some chemical analysis of irrigation water.

pH	EC ds/m	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	CO_3^{2-}	HCO_3^{-}	SO_4^{2-}	Adj SAR
7.34	1.50	3.11	2.10	8.89	0.31	7.30	-	5.70	1.44	13.22

RESULTS AND DISCUSSION

The main studied Physical properties of soil irrigated by drainage water can be discussed as follows:-

1. Particle size distribution:-

The values of particle size distribution of the studied soil samples (Table, 3) show that all soils under study have a clay texture at the different soil depths. The detailed results obtained for different studied layers as well as profiles mean values show that the classical distribution of different soil particles was closely associated with the process of sedimentation of suspended matters. Data indicated that the content of sand fraction was generally low in all soil profiles.

Table (3): Particle size distribution (%) and some chemical properties of the studied soil samples of Al-Hamul area.

Profile No.	Soil Depth (cm)	Particle Size distribution				Texture Grade	EC ds/m 1:5	O.M (%)
		C. Sand	F. Sand	Silt	Clay			
1	0 – 30	2.62	15.46	30.60	51.32	Clay	6.34	2.40
	30 – 60	1.78	17.52	25.61	55.02	Clay	2.90	2.00
	60 – 90	0.78	16.37	17.80	65.05	Clay	2.50	1.96
	> 90	0.62	11.84	18.21	69.33	Clay	1.60	1.20
	Mean	1.45	15.29	23.05	60.19	Clay	3.34	1.89
2	0 – 30	1.64	19.06	35.12	44.18	Clay	4.20	2.30
	30 – 60	0.90	18.40	33.45	47.25	Clay	1.15	2.00
	60 – 90	0.67	16.13	30.80	52.40	Clay	1.10	1.12
	> 90	0.41	11.96	28.16	59.47	Clay	0.77	0.84
	Mean	0.90	16.38	31.88	50.82	Clay	1.80	1.56
3	0 – 30	1.93	12.34	37.61	48.12	Clay	6.11	2.24
	30 – 60	1.18	15.19	24.61	59.02	Clay	5.50	1.90
	60 – 90	0.93	17.34	19.80	61.93	Clay	4.43	1.77
	> 90	0.54	13.60	18.76	67.10	Clay	3.24	1.20
	Mean	1.15	14.61	25.19	59.04	Clay	4.82	1.77
4	0 – 30	2.21	19.45	37.00	41.34	Clay	4.14	2.20
	30 – 60	2.10	19.40	26.50	52.00	Clay	3.94	1.89
	60 – 90	1.40	13.98	25.96	58.66	Clay	3.64	1.60
	> 90	0.44	11.56	23.10	64.90	Clay	2.49	1.15
	Mean	1.53	16.09	28.14	54.22	Clay	3.55	1.71
5	0 – 30	1.07	22.80	25.93	50.20	Clay	4.34	2.30
	30 – 60	0.84	16.36	31.25	51.55	Clay	3.23	1.80
	60 – 90	0.59	14.20	28.21	57.00	Clay	2.60	1.41
	> 90	0.40	10.99	28.84	59.77	Clay	2.10	1.10
	Mean	0.73	16.08	28.55	54.63	Clay	3.06	1.65
6	0 – 30	2.10	21.60	27.50	48.80	Clay	5.40	1.15
	30 – 60	1.61	19.67	28.80	49.92	Clay	4.40	1.30
	60 – 90	0.96	19.80	23.50	55.74	Clay	3.50	1.15
	> 90	0.56	17.00	25.40	47.04	Clay	2.50	0.90
	Mean	1.55	19.51	26.30	52.87	Clay	3.96	1.12

As well as, the sand fractions (coarse + fine) and silt fraction frequently decreased by increasing soil depth. This result may be attributed to the environmental conditions prevailing during Nile mud sedimentation (Bahlawan, 1997).Data also show that the clay fraction has the majority content in all soil profiles under study. The clay content was increased by increasing the soil sampling depth. This may be due to the fine fractions migration from the soil upper layers to the down ones by irrigation and leaching processes. The results of El-Sheikh (2003) who found that the clay content increased by increasing the soil sampling depth confirmed our results.

2. Soil densities and soil total porosity:-

2.1. Soil bulk density:-

Data illustrated in Table (4) indicated that, the values of soil bulk density of different soil profiles under study were higher; this may be due to use of drainage water in soil irrigation which decreased soil macro-pores and consequently increased soil bulk density. The result is in agreement with Abdel-Mawgoud *et al.*, (2006) who stated that using of low quality water enhanced the dispersion of soil particles and this condition increased particle orientation which blocked the conducted pores and in turn increased soil bulk density. From data in Table (4), it can be noticed that the values of soil bulk density in the soil surface layers were lower than those of subsurface layers . This may be due to the high content of organic matter in the surface layers and compaction effect in the subsurface layers (Heggy, 1983).

2.2. Soil real density:-

It is well known that real density is a special characterizing property of soil because it is well related to material which is one of the major soil formation factors. Data in Table (4) show that the values of soil real density are not affected by irrigation with drainage water.

2.3. Total soil porosity:-

Total soil porosity is an index of the relative volume of pores in the soil. On the other hand, the total soil porosity is a special formula which explains the relationship between both the soil real and bulk densities. Data presented in Table (4) showed that the highest values of total soil porosity were found in the soil surface layers. This could be due to the fact that the subsoil layers are more compacted, and compactness reduces the soil porosity. Also, the less amount of organic matter in subsoil layers causes poor soil aggregation. The results of Dosoky (1999) confirmed our results.

Table(4): Soil bulk& real densities and total soil porosity of soil samples of Al-Hamul area.

Profile No.	Soil Depth (cm)	Bulk density (g/cm^3)	Real density (g/cm^3)	Total soil porosity (%)
1	0 – 30	1.26	2.32	46.00
	30 – 60	1.32	2.30	43.00
	60 – 90	1.35	2.38	43.00
	> 90	1.33	2.38	44.00
	Mean	1.31	2.34	44.00
2	0 – 30	1.19	2.30	48.00
	30 – 60	1.33	2.31	42.00
	60 – 90	1.25	2.31	45.00
	> 90	1.28	2.31	45.00
	Mean	1.26	2.31	45.00
3	0 – 30	1.16	2.27	49.00
	30 – 60	1.32	2.38	44.00
	60 – 90	1.31	2.38	45.00
	> 90	1.32	2.38	45.00
	Mean	1.27	2.35	45.70
4	0 – 30	1.26	2.44	48.00
	30 – 60	1.30	2.44	46.00
	60 – 90	1.32	2.48	46.00
	> 90	1.35	2.48	45.00
	Mean	1.30	2.46	46.20
5	0 – 30	1.25	2.41	48.00
	30 – 60	1.26	2.45	48.00
	60 – 90	1.30	2.47	46.00
	> 90	1.31	2.50	48.00
	Mean	1.28	2.46	47.50
6	0 – 30	1.30	2.35	45.00
	30 – 60	1.30	2.40	45.00
	60 – 90	1.32	2.50	47.00
	> 90	1.32	2.50	47.00
	Mean	1.31	2.44	46.00

Generally, values of soil total porosity are not high in all areas under study. This may be due to high values of exchangeable sodium percent (ESP) in soil resulted from drainage water irrigation which causes clay dispersion and migration of fine clay particles, hence blocking the conductivity pores which reduces the volumes of pores that leading to reducing of total soil porosity. The results of Khater *et al.* (2002) confirmed our results.

3. Pore size distribution:-

Data in Table (5) show that the values of fine capillary pores (F.C.P) were higher than the other pores. This may be attributed to the high values of clay in the studied soils and use of drainage water having high salinity in irrigation for long term which increases Na^+ concentration and ESP of soil that has a dispersion effect on formed aggregates (false) which causes a decrease in values of macro pores (drainable) and increase of micro pores (fine capillary). It can be deduced also from these results, that the values of fine pores are frequently increased with the soil depth. This may be due to increase of clay content with the soil depth. Also, data indicated that the values of quickly, slow and water holding pores show no clear trend could be observed with soil depth. The results of Abdel-Mawgoud *et al.* (2006) confirmed our results.

4. Soil hydraulic conductivity:-

Data in Table (5) show that the values of hydraulic conductivity were decreased by increasing the soil depth. The highest values of hydraulic conductivity of the soil surface layer could be attributed to its relatively high contents of coarse fractions and quickly drainable pores.These results are in with findings of Crescimanno and Lovino (1996), who found that the hydraulic conductivity was positively correlated with coarse sand (%) and quickly drainable pores (> 28.8 µ). On the other hand, the high clay content and fine pores in subsurface layers are reflected on their low hydraulic conductivity.

Table (5): Pore size distribution from total volume (%) and soil conductivity (cm^3/h) of the studied soil samples of Al-Hamul area.

Profile No.	Soil Depth (cm))	Pore Size Distribution (%)					K (cm^3/h)
		Q.D.P > 28.8	S.D.P 28.8 - 8.62	D.P > 8.62	W.H.P 8.62 - 0.19	F.C.P < 0.19	
1	0 – 30	7.50	4.10	11.60	13.90	20.50	0.40
	30 – 60	5.30	5.70	11.00	13.90	18.10	0.16
	60 – 90	5.10	8.20	13.30	12.60	17.10	0.10
	> 90	5.20	5.90	10.10	14.60	19.30	0.01
	Mean	5.52	5.90	11.40	13.70	18.70	0.20
2	0 – 30	6.30	7.90	14.20	12.20	21.60	0.25
	30 – 60	3.10	3.10	6.20	11.90	23.90	0.06
	60 – 90	4.90	9.40	14.30	10.90	19.80	0.10
	> 90	3.90	8.80	12.70	11.90	20.40	0.09
	Mean	4.50	7.30	11.80	11.70	21.40	0.13
3	0 – 30	6.50	8.60	15.10	11.70	22.20	0.10
	30 – 60	7.60	3.10	10.70	14.30	18.80	0.02
	60 – 90	6.10	4.00	10.10	14.20	19.70	0.03
	> 90	5.80	6.20	12.00	10.90	22.10	0.04
	Mean	6.50	5.40	11.90	12.77	20.70	0.05
4	0 – 30	10.60	7.00	17.60	11.20	19.20	0.40
	30 – 60	8.50	8.30	16.80	9.80	19.40	0.30
	60 – 90	8.30	8.40	16.70	11.70	17.60	0.03
	> 90	7.60	6.90	14.50	9.80	20.70	0.09
	Mean	8.70	7.70	16.40	10.67	19.22	0.20
5	0 – 30	7.90	7.00	14.90	13.60	19.50	0.17
	30 – 60	8.40	5.60	14.00	12.70	21.30	0.10
	60 – 90	6.80	6.60	13.40	11.40	21.20	0.08
	> 90	6.70	5.60	12.30	11.20	23.40	0.60
	Mean	7.50	6.20	13.70	12.20	21.40	0.23
6	0 – 30	7.10	8.20	13.30	11.30	20.40	0.30
	30 – 60	8.40	7.30	15.70	12.60	16.50	0.62
	60 – 90	8.50	7.50	16.00	9.80	21.10	0.05
	> 90	6.50	5.70	12.20	10.70	24.10	0.05
	Mean	7.62	6.60	14.20	11.10	20.50	0.25

Q.D.P = Quickly Drainable Pores. **K = Hydraulic Conductivity.**
S.D.P = Slow Drainable Pores . **D.P = Drainable Pores.**
W.H.P = Water Holding Pores. **F.C.P = Fine Capillary Pores.**

Generally, the values of hydraulic conductivity in all soil samples under study were low. This may be due to increasing of clay content of soil under study that irrigated with drainage water which increases soil sodium salts and the exchangeable one on account the exchangeable calcium, that led to destruction of the largest aggregates into very small ones which may be associated with migration of clay particles that block the pores and decrease hydraulic conductivity in soil. The results of Khater *et al.* (2002) and El-Sheikh (2003) confirmed our results.

5. The aggregation stability:-

5.1. Dry sieving stable aggregates (D.S.A %):-

The dry sieving aggregates are shown in Table (6). Data reveal that the dry stable aggregates (D.S.A %) which having diameters from 10.0 to 2.0 mm were found to be the largest size presented in the different studied areas. While the percentages of other sizes of dry stable aggregates decrease as their diameters decrease, especially the aggregates those have diameters less than 0.063 mm which the lowest values were found. The percentage of different aggregates sizes was increased by using drainage water for irrigation (El-Sheikh (2003)).

Table (6): Dry stable aggregates (%) of the studied soil samples of Al-Hamul area.

Profile No.	Soil Depth (cm)	Dry Aggregates Diameter (mm)						
		10-2	2 - 1	1 - 0.50	0.50-0.25	0.25-0.125	0.125-0.63	<0.63
1	0 – 30	76.81	11.74	6.07	3.05	1.00	0.15	0.48
	30 – 60	84.58	5.60	5.12	2.65	1.25	0.45	0.35
	60 – 90	88.93	4.28	3.69	1.85	0.75	0.39	0.11
	> 90	67.74	13.28	7.23	3.70	2.96	3.98	1.11
	Mean	79.90	8.72	5.52	2.81	1.49	1.41	0.51
2	0 – 30	85.73	6.65	4.78	1.91	0.65	0.24	0.04
	30 – 60	86.26	5.58	4.28	2.12	0.82	0.70	0.24
	60 – 90	80.54	7.06	5.80	3.47	1.98	0.99	0.16
	> 90	69.89	9.89	7.30	5.38	4.88	1.77	0.89
	Mean	80.60	7.29	5.54	3.22	2.05	0.93	0.33
3	0 – 30	86.28	4.02	4.42	3.42	1.04	0.94	0.18
	30 – 60	68.70	.10.70	6.23	3.44	5.33	4.71	0.89
	60 – 90	86.49	3.22	3.83	2.39	1.29	2.03	0.78
	> 90	91.66	2.09	2.81	1.78	0.90	0.56	0.20
	Mean	83.28	5.01	4.32	2.75	2.14	2.06	0.51
4	0 – 30	79.72	9.37	6.16	2.76	1.16	0.62	0.21
	30 – 60	89.54	3.40	3.70	1.89	0.88	0.41	0.19
	60 – 90	85.34	5.22	3.95	1.95	1.61	1.33	0.60
	> 90	67.94	8.95	534	3.79	4.24	8.76	0.98
	Mean	80.63	67.35	4.78	2.58	1.97	2.78	0.49
5	0 – 30	80.29	9.02	5.27	2.74	1.28	1.02	0.38
	30 – 60	74.06	9.41	4.68	3.77	4.25	3.16	0.67
	60 – 90	79.06	6.06	6.38	3.82	2.25	1.02	0.53
	> 90	79.80	7.32	6.09	3.41	1.75	1.21	0.42
	Mean	78.50	7.92	5.60	3.43	2.38	1.60	0.50
6	0 – 30	85.75	3.80	4.95	2.95	1.52	0.66	0.37
	30 – 60	91.55	2.89	2.65	1.41	0.95	0.51	0.04
	60 – 90	88.62	2.59	3.28	1.98	0.98	1.64	0.91
	> 90	92.30	2.23	2.35	1.71	0.80	0.47	0.14
	Mean	89.60	2.87	3.21	2.02	1.06	0.82	0.37

On the other hand, Ahmed (2005) found that these variations may be related to the management practices and environmental conditions. As well as, the almost of the percents of dry stable aggregates are increased with increasing the soil depth except large size aggregates which have diameters 10-2 mm. This may be due to the high content of clay with increasing the soil depth and high content of coarse fraction in the surface soil layers (Ahmed, 2005)

5.2. Wet sieving stable aggregates (W.S.A):-

Data in Table (7) show the values of water stable aggregates (W.S.A) as well as distribution of aggregates size fractions. These data indicate that the mean values of aggregates having diameters between 1 to 0.50 mm and 0.50 to 0.25 mm were higher than other aggregates fraction diameters in most soils under study.

Table (7): Water stable aggregates (%) of the studied soil samples of Al-Hamul area.

Profile No.	Soil Depth (cm)	Wet Aggregates Diameter (mm)						
		10 - 2	2 - 1	1 - 0.50	0.50-0.25	0.25-0.125	0.125-0.63	Total
1	0 – 30	10.24	1.11	15.93	5.59	0.32	2.72	36.00
	30 – 60	1.11	3.35	14.42	22.09	3.49	6.95	51.41
	60 – 90	1.50	6.19	14.85	9.41	0.30	0.13	32.40
	> 90	0.70	2.12	6.32	7.94	4.45	11.85	33.40
	Mean	3.38	3.19	12.88	11.25	2.14	5.41	38.31
2	0 – 30	12.81	8.34	13.30	1.50	0.91	1.01	38.00
	30 – 60	3.19	7.76	25.38	12.43	1.65	1.64	52.05
	60 – 90	5.21	24.31	16.79	9.69	3.51	0.62	60.13
	> 90	0.92	1.13	3.41	4.57	.48	8.17	21.70
	Mean	5.53	10.38	14.72	7.05	8.38	8.86	42.90
3	0 – 30	1.00	4.88	11.33	14.26	3.12	9.90	44.50
	30 – 60	0.45	0.46	2.02	5.23	3.61	6.56	21.33
	60 – 90	0.23	0.06	0.16	0.94	3.50	11.19	16.10
	> 90	1.57	0.89	1.78	3.05	2.68	6.04	16.01
	Mean	0.81	1.57	3.82	5.87	3.22	9.17	24.50
4	0 – 30	14.81	9.76	12.01	9.63	3.15	4.64	54.00
	30 – 60	19.07	10.40	13.82	9.55	2.18	2.93	58.00
	60 – 90	4.21	2.12	6.96	5.82	3.48	3.00	25.60
	> 90	6.43	4.03	2.67	0.03	2.00	8.11	23.30
	Mean	11.13	6.57	8.80	6.25	2.70	4.67	40.22
5	0 – 30	9.30	11.10	15.12	10.52	3.18	5.86	55.08
	30 – 60	0.08	0.27	0.91	2.18	2.73	6.88	13.05
	60 – 90	0.27	0.55	2.14	9.93	1.96	5.61	20.46
	> 90	17.93	13.42	12.85	10.54	4.72	6.32	65.78
	Mean	6.89	6.34	7.80	8.29	3.14	6.16	38.59
6	0 – 30	15.51	11.61	11.20	5.00	0.32	2.53	46.17
	30 – 60	0.28	1.81	5.81	8.55	4.58	7.40	28.43
	60 – 90	2.01	1.15	1.33	0.40	1.01	3.75	9.65
	> 90	4.20	0.51	0.58	0.45	2.17	4.95	12.86
	Mean	5.50	3.80	4.73	3.60	2.02	4.65	24.30

Generally, the total water stable aggregates (W.S.A) were low. This may be due to using of drainage water in irrigation which increased Na^+ concentration that led to increasing soil ESP which causes the destruction and encourage increase of the percent of small aggregates. The results of El-Sheikh (2003) and Abdel-Mawgoud *et al.* (2006) confirmed our results.

Concerning the distribution of water stable aggregates (W.S.A) with soil depth, data in Table (7) showed no clear trend could be noticed. But, it could be said that most values of W.S.A were higher in the soil surface layers than in the subsurface ones (> 90 cm) and that may be due to increase the content of organic matter in the surface layers. This result is in agreement with Zaghloul (1977) who found a positive correlation between organic matter and total water stable aggregates, especially in the surface layers.

5.3. Soil structure parameters:-

5.3.1. Aggregation state (A.S):-

The stability of soil structure is referred to the resistance of the aggregates to be dispersed by water and mechanical manipulation (Dosoki, 1999). The values of aggregate state for different soil samples are shown in Table (8). From these data, it can be noticed that the values of aggregation state (A.S) were not higher in all studied samples. This is because of increasing the exchangeable sodium percent (ESP) of soil samples under study which were irrigated with drainage water. It can be also noticed that the values of A.S were relatively decreased by increasing the soil depth of soil samples under study. This may be due to high content of organic in the soil surface layers. The results of Dosoki (1999) confirmed our results.

5.3.2. Aggregation degree (A.D):-

The values of aggregation degree (A.D) are shown in Table (8) . Data show that there is no clear trend can be noticed between A.D and soil depth for all soil profiles under study. This may be attributed to many different soil characteristics, and the most important of them are the contents of soluble and exchangeable cations of sodium, magnesium and calcium. The results of El-Sheikh (2003) confirmed our results.

5.3.3. Aggregation index (A.I):-

The high values of A.I were found in the soil surface layers due to increasing of the content of organic matter in the surface layers. This result is in agreement with Burzi (1957) who noticed a positive correlation between aggregation index and organic matter.

Generally, the use of drainage water in irrigation decreases the values of aggregation state, degree and index. The results of El-Sheikh (2003) confirmed our results.

5.3.4. The difference of mean weight diameter (Δ M.W.D):-

The values of mean weight diameter (Δ M.W.D) of soil aggregates are shown in Table (8). Data revealed that the Δ M.W.D values were relatively increased with increasing the soil sampling depth. It can be concluded that the high values of Δ M.W.D were found in the soil samples rich in clay and organic matter contents. These results are in agreement with the finding of El-Sheikh (2003) who found that clay content and CEC have the highest direct and indirect effects on the values of Δ M.W.D.

Table (8): Structure parameters, i.e, aggregation state (A. S.), aggregation degree (A.D.), aggregation index (A.I.) and differences in mean weight diameter (Δ M.W.D.) of Al-Hamul area.

Profile No.	Soil Depth (cm)	A.S	A.D.	A.I	Δ M.W.D
1	0 – 30	45.90	66.00	0.97	3.92
	30 – 60	51.41	96.00	0.48	4.89
	60 – 90	32.30	48.00	0.50	5.10
	> 90	33.30	92.00	0.24	4.17
	Mean	40.20	75.50	0.55	4.52
2	0 – 30	37.80	77.00	0.93	3.89
	30 – 60	52.05	67.00	0.77	4.76
	60 – 90	50.12	94.00	0.90	4.10
	> 90	57.00	50.00	0.15	4.30
	Mean	49.24	72.00	0.69	4.25
3	0 – 30	44.40	60.00	0.45	4.99
	30 – 60	20.80	63.00	0.62	4.27
	60 – 90	15.60	78.00	0.43	5.24
	> 90	16.02	91.00	0.65	4.62
	Mean	24.20	73.00	0.54	4.78
4	0 – 30	54.00	95.00	0.88	3.81
	30 – 60	57.00	67.00	0.61	4.02
	60 – 90	50.00	33.00	0.38	4.88
	> 90	21.00	27.00	0.39	3.81
	Mean	45.55	55.50	0.56	4.13
5	0 – 30	37.00	95.00	0.96	4.13
	30 – 60	40.20	52.00	0.05	4.60
	60 – 90	21.40	97.00	0.12	4.87
	> 90	46.60	85.00	0.98	3.52
	Mean	36.30	82.30	0.52	4.28
6	0 – 30	41.10	32.00	0.99	4.04
	30 – 60	28.40	97.00	0.51	5.42
	60 – 90	9.60	31.00	0.28	5.24
	> 90	12.80	17.00	0.24	5.32
	Mean	22.98	44.30	0.51	5.01

6. Soil moisture characteristics:-

Field capacity, wilting point and the calculated available water are considered the main soil moisture constants. Data in Table (9) show that the soil moisture content at field capacity had no clear trend with the soil depth. The soil moisture content at wilting point for all studied areas was higher in the surface soil than the subsurface one (> 90 cm). This may be due to cultivation effect and plant residues (El-Maaz, 2005). Data in Table (9) show that the values of available water are small. This may be attributed to high salinity levels of both irrigation water and soil, which leads to raising of osmotic pressure and accordingly increase the soil retention moisture content at field capacity and wilting point especially at wilting point because the increase of soil ESP increases the fine capillary pores (wilting point) compared with that of field capacity which leads to decrease the available water.

Table (9):-Soil moisture constants (%) of the studied soil samples of Al-Hamul area.

Profile No.	Soil Depth (cm	Soil moisture constant (%)		
		F.C	W.P	A.W
1	0 – 30	36.80	20.50	16.30
	30 – 60	31.00	18.10	12.90
	60 – 90	27.30	17.10	10.20
	> 90	35.90	19.30	17.60
2	0 – 30	33.80	21.60	12.20
	30 – 60	35.80	23.90	11.90
	60 – 90	28.00	19.80	8.20
	> 90	32.30	20.40	11.90
3	0 – 30	33.90	22.20	11.70
	30 – 60	33.10	18.80	14.30
	60 – 90	33.90	19.70	14.20
	> 90	33.00	22.10	10.90
4	0 – 30	32.60	19.20	13.20
	30 – 60	29.20	19.40	9.80
	60 – 90	29.30	17.60	11.70
	> 90	30.50	20.70	9.80
5	0 – 30	33.10	19.50	13.60
	30 – 60	34.00	21.30	12.70
	60 – 90	32.60	21.20	11.40
	> 90	34.70	23.40	11.30
6	0 – 30	31.70	20.40	11.30
	30 – 60	29.10	16.50	12.80
	60 – 90	30.90	21.10	9.80
	> 90	34.80	24.10	10.70

F.C = Field Capacity.
A.W = Available Water.
W.P = Wilting Point.

Also, it can be noticed that the values of available water percentage were affected by soil sampling depth. The highest values of A.W % were found in the soil surface layers, while the lowest ones were observed in the deeper layer.

Conclusion:-

The soils in the studied area characterized by bad physical properties because of the high content of salts resulted in the drainage irrigation water. Therefore, it must be reclaimed to overcome the soil problems and enhancement the physico-chemical soil properties.

REFERENCES

Abd El-Aal, R. M. (1971). Effect of ground water and parent material on different soil characteristics in the north eastern Nile Delta. PH.D Thesis, Fac. of Agric., Cairo Univ. Egypt.

Abdel-Mawgoud, A. S. A.; Azza, R. A.; El-Sheikh, M. A. B. and Selem, M. M. I. (2006). Avoiding the hazardous impacts of low irrigation water quality on soil properties and rice yield using some amendments. Menofiya J. Agric. Res., 31(5) 1305-1322.

Ahmed, H. M. (2005). Study on some salt affected soils in Egypt. Ph. D. Thesis, Fac. of Agric., Menof. Univ., Egypt.

Bahlawan, M. H. (1997). Ped. Chemical characteristics of some salt affected soils. Ph. D. Thesis, Fac. of Agric., Ain-Shams Univ., Egypt.

Burzi, T. E. (1957). The aggregation of mechanical component chestnut soils into water stable aggregates. Bachvovebenie, 12: 111-113, (C.F. Soil & Fert. 1958, Vol. 21, 983).

Chang, C.; Jong, E. D.; Mikalson, D.; Bennett, D. R. and Buckland, G. D. (2002). Soil salinization and sodication from alternate irrigation rain. Canadian Journal of Soil Science, Agricultural Institute of Canada, Ohawa, Canada, 82(3): 297-309, 40 Ref.

Crescimanno, L. and Lovino, I. (1996). Evaluating the effects of using saline-sodic solution on the hydraulic conductivities of soil. Soil and Fert., 59(7): 5884.

Deleenheer, L. and De Boodt, M. (1965). Soil physical international training center for post, Grandnaty Soil Science Tests, Gent, Belgium.

Dosoky, A. K. (1999). Effect of saline water on physical and chemical soil properties. M. Sc. Thesis,Fac. Agric., Moshtohor, Zagazig Univ., Egypt.

El-Maaz, E. I. (2005). Pedological and mineralogical studies on soils adjacent to some lakes at the North of Egypt. PH. D. Thesis, Fac. of Agric., Menofiya Univ., Egypt.

El-Sheikh, O. M. (2003). Salinity problems of soil irrigated with water of low qualities. PH. D. Thesis, Fac. of Agric., Zagazig Univ., Egypt.

Gee, G. W. and Bauder, J. W. (1986). Partial size analysis in methods of soil analysis. Klute, Ed., Part 1, Agron, 9(15): 383-409, Am. Soc. Agron. Madison, Wisconsin, U.S.A.

Ghadiri, H.; Hussain, J. and Rose, C. W. (2007). A study of the interaction between salinity, soil erosion and pollutant transport of three Queens land soil. Australian Journal of Soil Research, Csiro Bublishing, Colling Wood, Australia, 45(6): 404-413, 43 Ref.

Heggy, S. E. M. (1983). The effect of water table on soil properties and plant growth. PH. D. Thesis, Fac. of Agric., Ain-Shams Univ., Egypt.

Ibrahim, S. A. (1964). Studies of the size distribution of water stable aggregates in the soil of the Nile Delta. M. Sc. Thesis, Fac. of Agric., Ain-Shams Univ., Egypt.

Jackson, M. L. (1973). Soil chemical analysis. Prentic Hall of Indian Private Limited, New Delhi, India.

Khater, E. A.; Abdel-Aal, T. S. and Farrage, F. R. (2002). Potential effect of low quality water for irrigation and in El-Fayoum Governorate, Egypt. Egyp, J. Soil Sci., 42(1): 161-183.

Nabulsi, A. A. (2001). Saline drainage water irrigation frequency and crop species effects on some physical properties of soil. Journal of Agronomy and Crop Science, 186(1): 15-20.

Richards, A. L. (1954). Diagnosis and improvement of Saline and Alkali Soils. U.S.Dept. Agric. Hand Book, No. 60. U S A.

Seyam, H. M. M. and Ragab, A. A. M. (2005). Drainage water assessment in some regions of Nile Delta for both pollution and quality for irrigation. Egyp. J. of Appl. Sci., 20: 12.

Slavich, P. G.; Petterson, G. H. and Griffin, D. (2002). Effects of irrigation water salinity and sodicity on infiltration and luccrne growth over a

shallow water table. Australian J. of Experimental Agriculture, 42(3): 281-290.
Stakman, W. P. and G. G. Vanderhast (1962). The use of the pressure membrane apparatus to determine soil moisture constants at P.F 3.0 to 4.2 inclusive. Institute for Land and Water Management Research, Note No. 139.
Walker, C. H. and Lin, S. (2008). Soil property changes after four decades of waste water irrigation: A landscape prospective, Catena, 73: 63-74.
Yonker, R. E. and . G. L. Mc Guiness (1956). A short method of obtaining mean weight diameter values of aggregates. Analysis of Soils. Soil Sci., 83 : 291 .
Zaghloul, K. F. (1977). Changes in soil physical properties associated with changes in management procedure in calcareous soil in A.R.E. PH. D. Thesis, Fac. of Agric., Cairo Univ., Egypt.

حركة الماء وبعض خواص الأرض الطبيعية فى بعض أراضى كفر الشيخ المروية بمياه الصرف

هدي محمد رجائي محمود أحمد ، انشراح إبراهيم محمد المعاز و حسين محمود خليل
معهد بحوث الأراضي والمياه والبيئة – مركز البحوث الزراعية

تهدف هذه الدراسة إلي معرفة الآثار المترتبة على استخدام مياه قليلة الجودة أو مياه صرف زراعي على الخواص الطبيعية للأرض الزراعية وذلك في منطقة الحامول بمحافظة كفر الشيخ. اشتملت الدراسة على ٦ قطاعات من التربة ذات القوام الطيني وكل هذه القطاعات تروى من مصدر واحد للمياه وهو مصرف الغربية الرئيسي. تم أخذ عينات مثارة و غير مثارة لكل طبقة من طبقات القطاع ٠ – ٣٠ ، ٣٠ – ٦٠ ، ٦٠ – ٩٠ ، > ٩٠ سم لتقديربعض الخواص الطبيعية والكيميائية وهي التوصيل الكهربي (EC) والمادة العضوية والتوزيع الحجمي للحبيبات والتوزيع الحجمي للتجمعات الثابتة في الماء ومدلولات البناء الأرضى (AI, AD, AS) والمسامية الكلية والتوزيع الحجمي للمسام والكثافة الظاهرية والحقيقية والتوصيل الهيدروليكى للتربة المشبعة والثوابت الأرضية الرطوبية. وقد أظهرت النتائج المتحصل عليها الآتى:

١- زادت قيم الكثافة الظاهرية لطبقات التربة و تناقصت نسب المسامية الكلية للأرض نتيجة لاستخدام مياه الصرف الزراعى فى الرى ٠
٢- أدى النخل المبتل إلى انهيار التجمعات الكبيرة وخصوصا ذات أقطار ٢ – ١٠ سم وكذلك المتوسطة إلى حبيبات ذات أحجام صغيرة وذات أقطار صغيرة ، وتناقصت نسب التجمعات الثابتة فى الماء نتيجة لاستخدام مياه الصرف الزراعي في الري.
٣- لم تتأثر قيم مدلولات البناء الأرضى(AI, AD, AS) نتيجة لاستخدام مياه الصرف الزراعى فى الري.
٤- تناقصت مسام الصرف (السريعة والبطيئة) ، فى حين زادت مسام الصرف ذات الأقطار الصغيرة الدقيقة (F.C.P) الأقل من ٠,١٩ μ.
٥- انخفضت قيم التوصيل الهيدروليكى للتربة المشبعة نتيجةلأرتفاع قيم الطين بالأرض ونقص مسام الصرف.
٦- انخفضت قيم الماء الميسر بالتربة نتيجة لزيادة الملوحة فى مياه الرى والتربة التى تؤدى إلى رفع الضغط الأسموزى ، وتزيد حدود كل من السعة الحقلية ونقطة الذبول وبخاصة أكثر عند نقطة الذبول فتقل كمية الماء الميسر.

قام بتحكيم البحث

أ.د / سامى عبد الحميد حماد	كلية الزراعة – جامعة المنصورة
أ.د / سعيد السيد حجى	مركز البحوث الزراعية