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IMPACT OF DIFFERENT IRRIGATION WATER SOURCES ON HYDROPHYSICAL PROPERTIES OF SOME SOIL TYPES

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ABSTRACT

Long-term lysimeter experiments were conducted at Sakha Agric. Res. St. during twelve successive growing seasons started in summer season 1997 to summer season 2003. The aim of this study was to evaluate the effect of irrigation water quality (fresh, treated sewage water and drainage water) on some soil hydrophysical properties of four soils (clay, loamy, sandy and calcareous) with drip irrigation system. The main results could be summarized as follows:

The highest values of soil moisture content at different tensions, quickly, slowly and total drainable pores, water holding pores, soil hydraulic conductivity and total porosity as well as the lowest values of fine capillary pores and bulk density were achieved with irrigation by treated sewage water in clay and loamy soils. In sandy and calcareous soils the values of quickly, slowly and total drainable pores were decreased, while the water holding pores and fine capillary pores were increased due to irrigation with treated sewage water.

The high clay content of soil led to increase the soil moisture content, water holding pores, fine capillary pores and total porosity meanwhile soil moisture retention curves were gradually sloped. But the values of quickly, slowly and total drainable pores, hydraulic conductivity and bulk density were decreased.

On the other hand, the high content of sand fractions decreased the soil moisture content, slowly drainable pores water holding pores, fine capillary pores and total porosity, therefore, soil moisture retention curves were very sharply sloped. But the quickly and total drainable pores, hydraulic conductivity and bulk density values were increased.

The data indicated that the soil moisture content at different tensions, slowly drainable pores, water holding pores, fine capillary pores and total porosity were highly significantly positively correlated with clay and organic matter contents and EC of soil, but highly negatively with coarse sand. While quickly and total drainable pores, hydraulic conductivity and bulk density are highly significantly positively correlated with coarse sand but highly significantly negatively correlated with clay and organic matter contents and EC of soil.

It could be concluded that the long term irrigation by treated sewage water improved the soil hydrophysical properties, especially in sandy and calcareous soils.

Keywords: water sources, hydrophysical properties, soil moisture characteristics, pore size distribution, soil types.

INTRODUCTION

The capacity of a soil to receive or store water which is available to plants is of great importance to agricultural production. Soil moisture retention is one of the limiting factors on agriculture development, particularly in arid and semi-arid regions, where the amount of irrigation water is very limited. Therefore, more attention has been given to the re-use of sewage and drainage waters in irrigation (Wild, 1988).

Pore size distribution is responsible for the behavior of water retained in the soil, and it is strongly affected by soil texture and structure. Amer

(1980) and El-Kommos (1983) found that the water held at 0.33 atm. was mainly dependent upon the texture and exchangeable cations of soil, while soil moisture tension at 0.1 atm. was found to be dependent on both soil texture and structure.

Talha *et al* (1987) and Salwa Fikry and Fawzia Ibrahim (1990) observed that the moisture content at field capacity and wilting point, available soil water and total porosity were positively correlated with clay or silt plus clay and organic matter contents and negatively correlated with fine and coarse sand fractions.

The application of saline irrigation water plays an active role in changing soil physical properties, especially pore-size distribution, which in turn, reflects on water movement in soils. Increasing SAR of saline irrigation water caused a decrease in the values of total porosity, quickly drainable pores, total drainable pores and soil hydraulic conductivity (Talha *et al.*, 1979 and El-Sammanoudi, 1992).

The quickly, slowly and total drainable pores, were significantly and positively correlated with sand fractions, while water holding and fine capillary pores were positively correlated with silt and/or clay contents (Talha *et al.*, 1978 and Salwa Fikry and Fawzia Ibrahim, 1990).

Belyuchenko and Dronov (1988) found that using sewage effluent for irrigation improved soil hydrophysical properties. Abd El-Naime *et al.*, (1984) reported that after using sewage water, the organic matter increased about three times and the water holding capacity increased from 20.3 to 30.4%. Also, field capacity was increased from 8.9 to 16.6%, wilting point and available water were increased while the bulk density gradually decreased from 1.68 to 1.45 g/cm^3.

Soil hydraulic conductivity was positively correlated with coarse and fine sand, macro porosity and total drainable pores, but it was negatively correlated with clay and clay plus silt content, bulk density, ESP and fine capillary pores (Abd El-Rasoul *et al.*, 1994). Khan and Afzal (1990) and Ghazy (1994) reported that hydraulic conductivity (k_h) was significantly increased with increasing total soluble salts, however, the increasing of sodicity (ESP) caused a significant reduction in the k_h.

The purpose of this investigation is to study the effect of irrigation water quality on some soil hydrophysical properties of four different soil textures with drip irrigation system.

MATERIAL AND METHODS

Long term lysimeter experiments were conducted at Sakha Agric. Res. Station during twelve successive growing seasons started in summer season 1997 to summer season 2003 to study the effect of irrigation water quality on some soil hydro-physical properties such as soil moisture characteristics, pore size distribution, hydraulic conductivity, bulk density and total porosity. This study was carried out on four different soil textures with drip irrigation system. The lysimeter units (2m long x 1 m wide x 1.8 m deep), were planted with different field crops such as cotton, sugar beet, soybean, canola, sunflower, maize...etc.

A split –plot design with three replicates was used as follows:

1st- Main plots represent (soil types):

- clay soil
- loamy soil
- Sandy soil
- Calcareous soil

2nd- Irrigation water sources sub plots

F.W. : fresh water (Nile water)

S.W. : secondary treated sewage water

D.W. : drainage water.

Some physical and chemical properties of the soil types before experiments were determined in the upper (0-40 cm) layer according to Black (1965) and Garcia(1978) as shown in Table 1.

Table 1: Some physical and chemical properties of the studied four soil types before experiments .

Soil type	Particle size distribution, %				Texture grade	EC dSm^{-1}	SAR	Bulk density $g.cm^{-3}$	O.M. %	Total carbonate %	Moisture characters, %		
	Coarse sand	Fine sand	Silt	Clay							FC	WP	ASW
Clay	9.1	11.6	20.9	58.4	Clayey	2.6	6.05	1.24	1.3	2.2	42.3	22.6	19.7
Loamy	8.9	18.3	40.5	32.3	Loamy	1.75	4.95	1.21	0.92	1.8	35.2	21.0	14.2
Sandy	59.5	17.3	22.1	1.10	Sandy	0.94	3.50	1.83	0.15	2.4	10.2	4.5	5.7
Calcareous	60.3	8.2	29.5	2.0	Sandy loam	1.15	4.10	1.41	0.25	13.0	15.6	7.10	8.5

FC: Field capacity WP: Wilting point ASW: Available soil water

Some chemical and biological properties of irrigation water quality were determined according to Greenberg *et al.* (1985) and are presented in Table 2. Undisturbed and disturbed soil samples were prepared for physical and chemical properties.

Table 2: Some chemical and biological properties of irrigation water quality.

Irrigation water quality	EC dSm^{-1}	SAR	COD mg/L	BOD mg/L	$NH_4(N)$ mg/L	$NO_3(N)$ mg/L	Suspended solids mg/l	Dissolved solids mg/l
Fresh water	0.54	1.48	24	9	1.4	5.6	242	520
Treated Sewage water	1.38	4.70	130	78	20	41	930	1280
Drainage water	1.96	6.30	48	24	13	31	415	1556

COD: Chemical oxygen demond BOD: biological oxygen demond.

Parameters studied:

1- Soil moisture retention values: soil moisture characteristic curves, saturation percentage (SP), field capacity (FC), wilting Point (WP) and available soil water(ASW) were determined using the pressure membrane extractor with regulated air pressure (Garcia, 1978) under 0.0, 0.1, 0.33 and 15 atm. then recalculated on volume basis.
2- Pore size distribution: was calculated as a percent of total volume according to De-Leenher and De-Boodt (1965), and can be classified to

quickly drainable pores, QDP(> 28.8μ), slowly drainable pores, SDP (28.8 – 8.62 μ). Total drainable pores, TDP (> 8.62 μ), water holding pores, WHP (8.62 – 0.19 μ) and fine capillary pores, FCP(< 0.19 μ)which retain soil moisture content at a suction of 15.0 atm.

3- Soil hydraulic conductivity (K_h): was determined using undisturbed core samples according to Klute (1986), and calculated using Darcy law.
4- Bulk density (ρa) and total porosity: ρa was determined using the core method according to vomocil (1957) and total porosity was calculated according to Black (1965).

The simple correlation coefficient was calculated as recorded by Murray, 1961.

RESULTS AND DISCUSSION

Effect of irrigation water quality and soil types on:

1- Soil moisture retention values:

Soil moisture contents at different tensions ranging from 0.0 to 15 atm. are given in Table 3 and Fig. 1. Data indicated that the soil moisture retention values were affected by irrigation water quality. The studied four soil types irrigated with sewage water recorded the highest values of soil moisture contents at different tensions. This increase is clearly obvious in the sandy and calcareous soils. This result may be due to the increase of organic matter content in soil due to the suspension particles in sewage water and these particles can held more water as films at high tension due to their large surface area (Abd El-Naime *et al.*, 1984, Belyuchenko and Dronov, 1988 and Askar *et al.*, 1994).

A similar trend can be observed for available soil water at irrigation with different water qualities. The irrigation by treated sewage water led to increase the available soil water in the four soil types as compared with irrigation using fresh or drainage water. This increase may be due to the increase of organic matter content and consequently increasing the water holding pores (Abd El-Naime *et al.*, 1984 and Ghazy, 1994).

Data in Table 3 and Fig. 1 reveal that the soil moisture contents are decreased by increasing the applied tension and this function is mainly affected by soil types. The higher the clay content as in clay soil, the greater is the water retained at any particular tension, and the more gradual sloping tension curves. The low clay and high coarse fractions as in sandy and calcareous soils can decrease soil moisture contents and increase the sharpness of soil retention curves at any particular tension. Similar results were obtained by Talha *et al.* (1987) and Salwa Fikry and Fawzia Ibrahim (1990).

Field capacity, wilting point and available soil water are considered the three main soil moisture limits and can be elucidated from the soil moisture characteristic curves. Data in Table 3 showed that the soil moisture contents at FC, WP and ASW are decreased by increasing the coarse fraction as found with sandy and calcareous soils, due to the low clay and OM contents.

Table 3: Volumetric soil moisture contents at different applied tensions and available soil water as affected by irrigation water quality and soil types.

Treatments		Depth cm	Applied tensions atm.				Available soil water
Soil type	Water quality		0.0 (SP)	0.10	0.33 (F.C.)	15.0 (W.P.)	%
CLAY	Fresh water	0-20	69.22	61.22	54.07	32.92	21.15
		20-40	67.77	61.52	55.77	35.65	20.12
		mean	68.50	61.37	54.92	34.29	20.81
	Treated Sewage water	0-20	71.40	62.50	55.50	30.00	25.50
		20-40	71.30	63.10	56.85	33.85	23.00
		mean	71.35	62.80	56.18	31.93	24.25
	Drainage water	0-20	67.55	60.20	54.75	34.30	20.45
		20-40	67.51	61.01	55.11	36.36	18.75
		mean	67.53	60.61	54.93	35.33	19.60
LOAMY	Fresh water	0-20	60.09	49.20	43.44	24.33	19.11
		20-40	60.04	48.87	43.43	25.21	18.22
		mean	60.07	49.04	43.43	24.77	18.67
	Treated Sewage water	0-20	63.14	51.11	44.09	22.21	21.88
		20-40	62.18	50.82	44.18	23.18	21.00
		mean	62.66	50.97	44.14	22.70	21.44
	Drainage water	0-20	61.81	51.32	46.99	28.52	18.47
		20-40	61.37	52.07	46.30	29.65	16.65
		mean	61.59	51.70	46.65	29.09	17.56
				(FC)		(W.P.)	
SANDY	Fresh water	0-20	41.54	14.22	12.42	6.22	8.00
		20-40	40.60	13.46	11.40	7.11	6.35
		mean	41.07	13.84	11.91	6.67	7.18
	Treated Sewage water	0-20	45.40	19.87	17.80	8.59	11.28
		20-40	42.32	16.65	14.65	7.28	9.37
		mean	43.86	18.26	16.23	7.94	10.33
	Drainage water	0-20	42.90	15.80	13.80	7.72	8.08
		20-40	43.52	14.13	12.10	6.96	7.17
		Mean	43.21	14.97	12.95	7.34	7.63
CALCAREOUS	Fresh water	0-20	51.27	28.91	24.94	14.41	14.50
		20-40	50.47	29.89	25.95	16.24	13.65
		Mean	50.87	29.40	25.45	15.33	14.08
	Treated Sewage water	0-20	55.47	33.96	29.36	17.76	16.20
		20-40	51.61	31.31	27.30	16.40	14.91
		mean	53.54	32.64	28.33	17.08	15.56
	Drainage water	0-20	48.89	27.00	23.00	13.70	13.30
		20-40	48.09	26.90	22.90	14.65	12.25
		mean	48.49	26.95	22.95	14.18	12.78

The data in Table 4 show that the clay and organic matter contents as well as EC of soil have a high positive effect on SP, FC, WP and A.S.W. values. While the relation between coarse sand and such hydro-physical properties (SP, FC, WP and ASW) were highly negative. No significant relationships were found between each of SP, FC, WP and ASW and fine sand, silt and total carbonate content similar results were found by Talha *et al.* (1987) and Salwa Fikry and Fawzia Ibrahim (1990).

Pore size distribution:

The volume of water that removed from a given volume of a soil at specific tension represents the volume of pores soil. The data in Table 5 indicate that pore size distribution was affected by irrigation water quality. Irrigation with treated sewage water gave the highest values of quickly drainable pores (QDP), slowly drainable pores (SDP), total drainable pores (TDP) and water holding pores (WHP), meanwhile it achieved the lowest values of fine capillary pores (FCP) in clay and loamy soils.

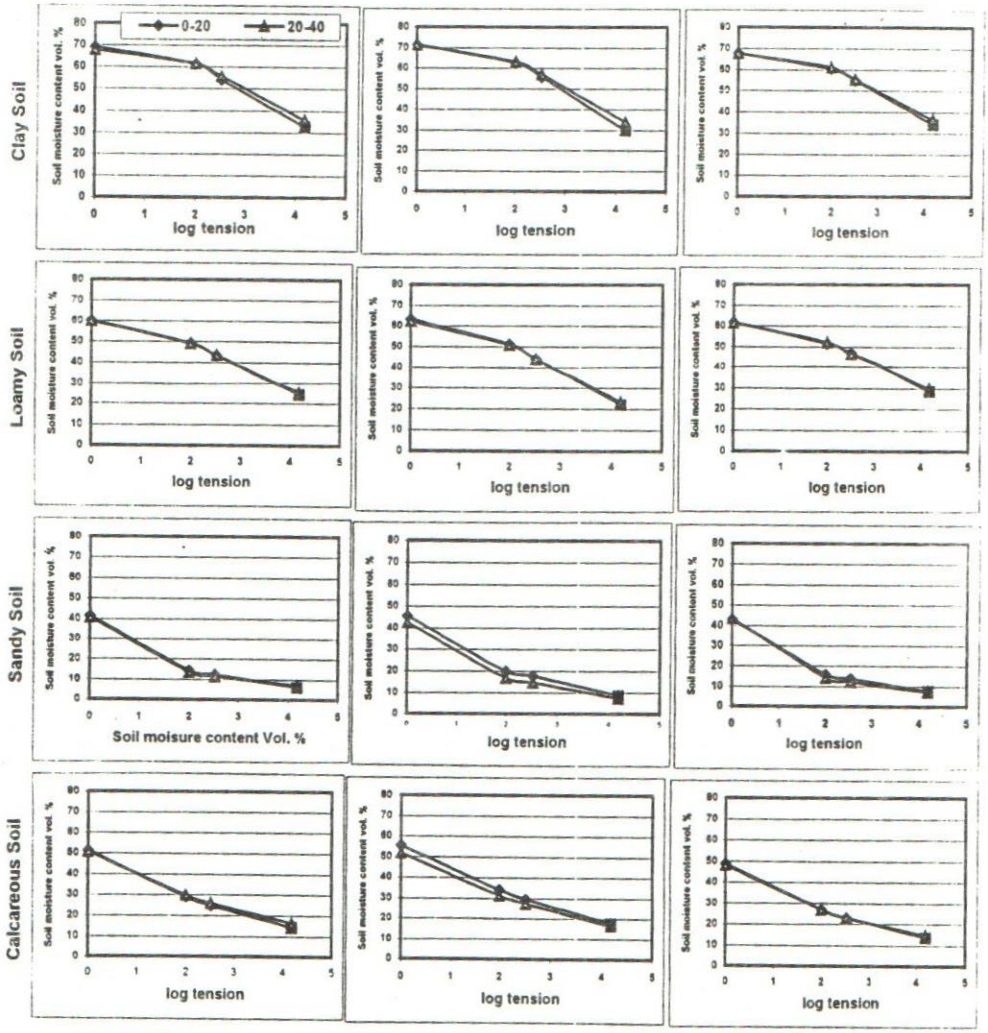

Fig. 1: soil moisture characteristic curves as affected by soil types and irrigation water quality

On the other hand, irrigation the sandy and calcareous soils with treated sewage water led to decrease the QDP, SDP and TDP and increase the WHP and FCP comparing with fresh or drainage water. These results are related to the increase of organic matter and suspension particles of sewage water which may fill the pores, consequently reduce its volume. The obtained results are similar to those found by Abd El-Naime *et al.* (1984), Belyuchenko and Dronov (1988) and Askar *et al.* (1994).

The pore size distribution is mainly affected by soil texture. The data also reveal that the lowest values of QDP, SDP and TDP are attained for clay and loamy soils, while the higher values of WHP and FCP are recorded in these soils. This result may be due to the increase of clay or clay plus silt and OM contents. On the other hand, the lower values of SDP, WHP and FCP and higher values of QDP and TDP are attained for sandy and calcareous soils. This may be attributed to the low clay and OM contents in these soils. These findings are in harmony with those recorded by Talha *et al.* (1978) and (1979) and Salwa Fikry and Fawzia Ibrahim (1990).

The relationships between soil properties and pore size distribution are shown in Table 4. It is obvious that the correlation coefficient between each of QDP and TDP and coarse sand is highly significant positive correlation, while the correlation is highly significant negative with clay OM contents and EC of soil. The relationships in between SDP, WHP and FCP values and coarse sand are highly significant negative correlation, while they are highly significant positive with clay, OM contents and EC of soil. No significant correlation between pore size distribution and fine sand, silt or total carbonate contents. Similar trend was observed by Talha *et al.* (1978) and (1979) and Salwa Fikery and Fawzia Ibrahim (1990).

Hence, it could be concluded that pore size distribution is of great importance as it is usually taken as an indicator of the status and behaviour of soil water.

In general, the soil moisture characteristics and pore size distribution for different soils under study are affected by soil texture more than by quality of irrigation water. This may be attributed to the pore size distribution and depends mainly on the particle size distribution as well as the way in which these particles are arranged.

2- soil hydraulic conductivity (K_h):

Water movement in soils (hydraulic conductivity K_h) depends on many factors the most important of which are total porosity and pore size distribution, especially volume drainable pores.

The data in Table 5 show that the values of K_h in different soil types are slightly affected by the quality of irrigation water. The values of K_h obtained with treated sewage water are higher than those with fresh water or drainage water. This may be due to the effect of treated sewage water on alteration of the soil porosity which is reflected on both K_h and pore size distribution (Belyuchenko and Dronov, 1988). On the other hand, increasing EC of drainage water decreased the K_h values and the rate of decrease is greatly affected by SAR. This behaviour may be related directly to the soil dispersion and movement of clay particles to block the conducting pores (EL-Samanoudi, 1992).

Table 4: correlation coefficient (r) between some physicochemical and hydrophysical properties of the soil.

Physico chemical properties	0.0 SP	0.1 atm	0.33 atm F.C.	15 atm W.P.	Available soil water	Quaicky drainable pores	Slowly drainable pores	Total drainable pores	Water holding pores	Fine capillary pores	Hydraulic conductivity	Bulk density	Total porosity
Coarse sandy %	-0.865	-0.898**	-0.888**	-0.859**	-0.814**	0.920**	-0.815**	0.920**	-0.909**	-0.859**	0.872**	0.685**	-0.685**
Fine sandy %	-0.152	-0.106	-0.108	-0.152	-0.182	0.051	-0.191	0.010	-0.005	-0.152	0.132	0.351	-0.351
Silt %	-0.052	0.001	-0.030	-0.068	0.067	-0.064	0.114	-0.084	0.078	-0.068	-0.155	-0.113	0.113
Clay %	0.946**	0.954**	0.954**	0.944**	0.859**	-0.946**	0.846**	-0.944**	-0.922**	0.944**	-0.881**	-0.740**	0.740**
Total carbonate %	-0.221	-0.253	-0.270	-0.229	-0.111	0.287	-0.082	0.335	-0.314	-0.229	0.148	-0.145	0.145
O.M. %	0.906**	0.895**	0.891**	0.825**	0.910**	-0.860**	0.856**	-0.834**	0.943**	0.825**	-0.828**	-0.783**	0.783**
EC dSm^{-1}	0.697**	0.688**	0.707**	0.726**	0.599**	-0.664	0.576**	-0.667**	0.606**	0.726**	-0.611**	-0.613**	0.613**

** : significant at 1% level *: significant at 5% level

Table 5: Pore size distribution, hydraulic conductivity , bulk density and total porosity as affected by irrigation water quality and soil types

Treatments		Depth cm	Pore size distribution at volume, %					Hydraulic conductivity cm/h	Bulk density gcm^{-3}	Total porosity %
Soil type	Water quality		QDP >28.8µ	SDP 28.8-8.62µ	Total drainable pores >8.62µ	Water holding pores 8.62-0.19µ	Fine capillary pores < 0.19 µ			
CLAY	Fresh water	0-20	8.00	7.15	15.15	21.15	32.92	1.03	1.22	53.96
		20-40	6.25	5.75	12.0	20.12	35.65	0.60	1.23	53.58
		mean	7.13	6.45	13.58	20.64	34.29	0.81	1.23	53.58
	Treated Sewage water	0-20	8.90	7.00	15.90	25.50	30.00	1.18	1.16	56.22
		20-40	8.20	6.25	14.45	23.00	33.85	0.84	1.19	55.10
		mean	8.55	6.63	15.18	24.25	31.92	1.01	1.18	55.47
	Drainage water	0-20	7.35	5.45	12.80	20.45	34.30	0.78	1.20	54.72
		20-40	6.50	5.90	12.40	18.75	36.36	0.58	1.22	53.96
		mean	6.93	5.68	12.60	19.60	35.33	0.68	1.21	54.34
LOAM	Fresh water	0-20	10.89	5.76	16.65	19.11	24.33	6.12	1.27	52.07
		20-40	11.17	5.44	16.61	18.22	25.21	1.60	1.29	51.32
		mean	11.03	5.60	16.63	18.67	24.77	3.86	1.28	51.70
	Treated Sewage water	0-20	12.13	6.92	19.05	21.88	22.21	7.20	1.22	53.96
		20-40	11.36	6.64	18.00	21.00	23.18	1.85	1.24	53.21
		mean	11.75	6.78	18.53	21.44	22.70	4.53	1.23	53.58
	Drainage water	0-20	10.49	4.33	14.82	18.47	28.52	5.52	1.25	52.83
		20-40	9.30	5.77	15.07	16.65	29.65	1.40	1.26	52.45
		mean	9.90	5.05	14.95	17.56	29.09	3.46	1.26	52.64
SANDY	Fresh water	0-20	27.32	1.50	28.82	6.20	6.22	35.34	1.79	32.45
		20-40	27.14	2.06	29.20	4.29	7.11	32.22	1.81	31.70
		mean	27.23	1.78	29.01	5.25	6.67	33.78	1.80	32.08
	Treated Sewage water	0-20	25.53	2.07	27.60	9.21	8.59	45.00	1.59	40.00
		20-40	25.67	2.00	27.67	7.37	7.28	41.50	1.65	37.74
		mean	25.60	2.04	27.64	8.29	7.94	43.25	1.62	38.87
	Drainage water	0-20	27.10	2.00	29.10	6.08	7.72	34.81	1.72	35.09
		20-40	29.39	2.03	31.42	5.14	6.96	31.01	1.75	33.96
		Mean	28.25	2.02	30.26	5.61	7.34	32.91	1.74	34.34
CALCAREOUS	Fresh water	0-20	22.36	3.97	26.33	10.53	14.41	22.57	1.38	47.92
		20-40	20.58	3.94	24.52	9.71	16.24	19.00	1.40	47.17
		Mean	21.47	3.96	25.43	10.12	15.33	20.79	1.39	47.55
	Treated Sewage water	0-20	21.51	4.60	26.11	11.60	17.76	23.21	1.29	51.32
		20-40	20.30	4.01	24.31	10.90	16.40	19.76	1.33	49.81
		mean	20.90	4.31	25.21	11.25	17.08	21.49	1.31	50.57
	Drainage water	0-20	21.89	4.00	25.89	9.30	13.70	21.58	1.34	49.43
		20-40	21.19	4.00	25.19	8.25	14.65	17.25	1.36	48.68
		mean	21.54	4.00	25.54	8.78	14.18	19.42	1.35	49.06

QDP: quickly drainable pores. **SDP: slowly drainable pores**

It is clear from Table 5 that soil hydraulic conductivity is highly dependent on soil texture. The highest values are attained in sandy and calcareous soils, while the lowest ones are obtained in clay and loamy soils, i.e. soil K_h decreases with heavy textured soils. Similar results were observed by Khan and Afzal (1990), and Abd El-Rasoul *et al.* (1994).

The data also, indicate that the K_h values of surface layers were higher than of the subsurface layers. This may be due to the increase of OM content and soil aggregation in surface layer (Tester, 1990 and Ghazy, 1994). In the present study the relations between the soil K_h and coarse sand are positive and highly significant, but they are highly significant negative correlation with EC, clay and OM contents. No significant correlation is found between soil K_h and fine sand, silt or total carbonate contents.

3- Bulk density (ρa) and total porosity:

Values of bulk density and total porosity (%) as affected by water quality are shown in Table 5. The data indicated that the irrigation with treated sewage water decreased ρa and increased total porosity comparing with irrigation using fresh or drainage water. This increase is obvious in sandy and calcareous soils. This result may be due to the increase of organic matter in soil, which forms stable aggregates and decreases ρa and increase total porosity (Tester, 1990, Askar *et al.* 1994 and Ghazy, 1994).

Also, the data in Table 5 show that the bulk density and total porosity are mainly affected by soil texture. The lowest values of ρa and highest values of total porosity are attained for clay and loamy soils. These results may be attributed to the increase of clay and OM contents. On the other hand, the higher values of ρa and lower values of total porosity were obtained with sandy and calcareous soils. This may be related to the decrease of clay, OM contents and soil aggregation (Tester, 1990 and Ghazy, 1994).

The data indicate that the ρa values of subsurface layers were higher than those of surface layers, but the opposite trend was found with total porosity values. This may be due to the decrease of OM content and soil aggregation in subsurface layers.

The correlation coefficient results in Table 4 reveal that the coarse sand highly and positively correlated with the bulk density, and highly negatively correlated with the total porosity. While the clay and OM contents as well as EC of soil have a highly negative effect on ρa and high positive effect on total porosity. No significant correlation was found between fine sand, silt or total carbonate in soil and both of ρa and total porosity.

Generally, it could be concluded that the long term irrigation by treated sewage water improved the soil hydrophysical properties, especially in sandy and calcareous soils.

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تأثير الري بمصادر مياه مختلفة على الخواص الهيدروفيزيائية لبعض أنواع الأراضي

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أقيمت تجارب في أحواض أسمنتية (الليزميترات) فى محطة البحوث الزراعية الزراعية بسخا لفترة زمنية طويلة مقدارها أثنى عشر موسما زراعيا على التوالي بداية من الموسم الصيفي ١٩٩٧ إلى الموسم الصيفي ٢٠٠٣م. تهدف هذه الدراسة إلى تقييم تأثير الري بمصادر مياه مختلفة النوعية (ماء عذب- ماء صرف صحي معالج ، ماء صرف زراعي) على بعض الخواص الهيدروفيزيائية لأربعة أنواع من الأراضي مختلفة القوام (طينية - لوميه- رمليه - جيريه) تحت نظام الري بالتنقيط.

يمكن تلخيص أهم النتائج كما يلي:

- أدى الري بماء الصرف الصحي المعالج الى زيادة محتوى الرطوبة بالتربة عند مختلف الضغوط كما أدى إلى زيادة مسام الصرف الواسعة و الضيقة و الكلية و المسام ألتي لها قدرة على حفظ الماء و النسبة المئوية للمسامية الكلية و كذلك التوصيل الهيدروليكي في التربة. في حين أدى إلى انخفاض المسام الشعرية الدقيقة و الكثافة الظاهرية فى الأراضي الطينية و اللوميه.
- أدى الري بماء الصرف الصحي المعالج أيضا إلى انخفاض قيم كل من المسام الصرفية الواسعة و الضيقة و الكلية و زيادة المسام التي تحتفظ بالماء و المسام الشعرية الدقيقة في الأراضي الرملية و الجيرية.
- زيادة المحتوى من الطين في الأرض يؤدى الى زيادة محتواها من الرطوبة و كذلك المسام التي تحتفظ بالماء و المسام الشعرية الدقيقة و النسبة المئوية للمسامية الكلية و اتضح أن منحنيات الرطوبة المتحصل عليها لهذه الأراضي متدرجة الانحدار الى جانب انخفاض في قيم المسام الصرفية السريعة و البطيئة و الكلية و التوصيل الهيدروليكي و أيضا الكثافة الظاهرية نتيجة لزيادة نسبه الطين بها كما في فلأراضي الطينية.
- على الجانب الأخر يؤدى زيادة المحتوى من الرمل الخشن في التربة إلى انخفاض محتوى الرطوبة الأرضية و المسام الصرفية الضيقة و المسام ألتي تحتفظ بالماء الى جانب المسام الشعرية الدقيقة و النسبة المئوية للمسامية الكلية و كانت منحنيات الرطوبة لهذه الأراضي حادة الانحدار. و كان هناك زيادة في مسام الصرف السريعة و الكلية و التوصيل الهيدروليكي و الكثافة الظاهرية في التربة نتيجة زيادة محتواها من الرمل الخشن كما في الأراضي الرملية و الجيريه.
- وضحت النتائج وجود ارتباط موجب عالي المعنوية بين محتوى الأرض من الطين و المادة العضوية و ملوحة التربة و كل من محتوى الرطوبة الأرضية عند مختلف الضغوط و المسام الصرفية الضيقة و المسام ألتي تحتفظ بالماء و المسام الشعرية الدقيقة و النسبة المئوية للمسامية الكليه، في حين كان الارتباط بين الصفات السابقة و محتوى التربة من الرمل الخشن سالبا و عالي المعنوية.
- أوضحت النتائج أيضا وجود ارتباط موجبا عالي المعنوية بين محتوى التربة من الرمل الخشن و كل من المسام الصرفية الواسعة و الكلية و التوصيل الهيدروليكي و الكثافة الظاهرية و عالي المعنوية سالبا بين الصفات السابقة و محتوى التربة من الطين و المادة العضوية و الملوحة بها.
- عموما فان الري بماء الصرف الصحي المعالج لفترة زمنية طويلة يؤدى إلى تحسين الخواص الهيدروفيزيائية للتربه و خاصة في لأراضى الرملية و الجيرية.