Egypt. J. Soil Sci. **Vol. 57,** No. 3, pp. 293 - 301 (2017)

Prediction of Reclamation Processes in Some Saline Soils of Egypt

A. A. Saad El-Dein and M. E. Galal
Soil Dept., Fac. of Agric., Ain Shams Univ., Cairo, Egypt

TO ASSESS leaching intensity under different qualities and quantities of water (depend on soil properties) in new reclaimed saline soils of Egypt, four representative soil samples were chosen to find the different variations in the impact of soil Hydrophysical properties on leaching intensity.

The studied soil samples were of loamy sand texture class. Laboratory column experiment was achieved using different artificial qualities of water (*i.e.* 230, 1500 and 3000 ppm), and also different quantities calculated as ratio from the drainable pores. Continuous leaching method was used in this experiment. The residual soluble salts concentration was determined to judge the leaching intensity.

The obtained results revealed, in general that pore size distributions, $CaCO_3$% and initial salts concentration in the different soil layers affected the residual salts concentration after leaching processes. In addition, correlation equations were obtained and allow to predict the residual salts concentration after leaching.

The obtained prediction equations considered many factors. Among them is salt concentration in the upper layers, pore size distribution, water quality and $CaCO_3$ content.

Keywords: Saline soils, Water and solute transport,Leaching, Salinization, Reclamation, Pore size distributions.

Introduction

Soil salinity is one of the major constraints in the development of irrigated agriculture in humid, arid and semiarid regions all over the world. Every year about 4×10^4 ha of land becomes unfit for agricultural production because of salinization problem. In addition, reports published by specialized agencies of the United Nations indicated that about 50% of irrigated area of the world is either salinized or has potential danger at future (Tyagi, 1986).

Salinity problems occurred due to accumulation of soluble salts in the root zone. These excess salts can reduce plant growth and vigor by altering water uptake and causing ion-specific toxicities or imbalances.

Soil salinity can be reclaimed by leaching of the salts out of root zone. However, in most arid countries the major problem due to limited fresh water. Hence, lot of researchers studied the possible alternatives to leach with another resources like sea water, source of drainage water and fresh water mixed with drainage water.

Extensive area of land in the arid regions and, particularly, in Egypt became out of cultivation due to salt accumulation. Poor water management, inadequate drainage, tidal inundation, precipitation, soil characteristics, vegetation communities, climatic conditions, beside water table fluctuation, depth and dissolved salts are considered the most effective factors causing and confirms

Regarding plant growth salinity limits water uptake by plants by reducing the osmotic potential making it more difficult for the plant to extract water. Some constituents of salinity may also cause specific-ion toxicity or upset the nutritional balance of plants. In addition, the salt composition of soil water influences the composition of cations on the exchange complex of soil particles, which may influence soil permeability and tilth (Dennis et al., 2007).

DOI : 10.21608/ejss.2017.4167
©2017 National Information and Documentation Center (NIDOC)

To manage saline soils, there are three ways. First, salts can be moved below the root zone by applying more water than the plant needs. This method is known as the leaching requirement method. The second method, where soil moisture conditions dictate, combines the leaching requirement method with artificial drainage. Third, salts can be removed away from the root zone to locations in the soil, other than below the root zone, where they are not harmful. This third method is called managed accumulation (Cardon et al., 2011).

Therefore, to prevent the accumulation of excessive soluble salts in irrigated soils, more water than required to meet the evapotranspiration needs of the crops must pass through the root zone to leach excessive soluble salts. When saline soils are being developed and leached, it is especially necessary to affect the regulation of water supply, leaching operations, drainage systems and pumping of drainage water.

In arid and semi-arid regions, many problems has to be laced. Among then is the shortage of rain and water resources exists and water resources of good quality, beside the adequate quantities of water to reduce soil salinity to suitable salinity level for plants grown under different water qualities and calculating quantities of water for leaching depend on its soil properties (Beltran, 1999).

The objectives of this work are:Studying the behavior of total soluble salts before and after reclamation processes with minimizing of water required for soil reclamation , Establishing the magnitude of leaching reclamation and with different quality and quantities of waters in new reclaimed soils in Egypt. Predicting equations for reclamation requirements.

Material and Methods

To investigate the suitability of used qualities of water to leach salts out of saline soils and to predict the quantities from each water quality, four loamy sand soil samples were collected as follows:Four saline loamy sand soil samples were collected randomly from Beni Suef Governorate (sample 1) N 29 26 67, E 31 19 19, (Sample 2) from El-Fayoum Governorate N 29 30 13, E 30 52 04. Samples 3 and 4 were collected from Ismailia Governorate, N 30 27 37, E 32 03 58 and N 30 29 57, E 32 07 14, respectively. Soil samples were taken at four depths (*i.e.,* 0 to 10, 10 to 20, 20 to 30 and 30 to 40 cm) to represent the salinity distribution found in the profile. Soil was re-packed into plastic columns of 12.7 cm diameter and 50 cm height, ensuring that each layer was in the same sequence and thickness as in the field. Each soil column was 40 cm in height.

Soil analysis

Hydro-physical and chemical properties, in each soil layer were determined according to the standard methods described by Page (1982) and Klute (1986). After leaching, Electrical Conductivity (EC) was measured to judge the leaching intensity, using EC-meter.

Leaching experiments

Leaching experiments were performed in columns under open field conditions. Three quantities of leaching water were used; depending on θs- θr, where θs is the total porosity and θr is the soil moisture content at wilting point when $\Delta \theta / \Delta h = 0$, T1 the quantity of leaching water was 3× V× (θs - θr), in T2 was 5× V× (θs - θr), and in T3 was 7× V× (θs - θr), where V is the soil column volume ($h\pi r^2$). In sample 1, where (θs - θr) = 0.21, the height of added water in T1, T2 and T3 equal 3.20, 5.32 and 58.8 cm in Sample 2 where (θs - θr) =0.23 the height of added water in T1, T2 and T3 equal 27.6, 46 and 64.4 cm, in Sample 3, where (θs - θr) = 0.3 the height of added water in T1, T2 and T3 equaled 36, 60 and 84 cm. In Sample 4 (θs - θr) = 0.28 the height of added water in T1, T2 and T3 equal 33.6, 56 and 78.4 cm, respectively. Three water qualities were used for leaching salts where; S1 is fresh water of 230 ppm, S2 is of 1500 ppm and S3 is of 3000 ppm. S2 and S3 were prepared by mixing fresh water and stock solution, containing NaCl, $MgCl_2$ and $CaCl_2$, to reach the demanded salts concentration. So, nine treatments were used for leaching reclamation (i.e. T1S1, T1S2, T1S3, T2S1, T2S2, T2S3, T3S1, T3S2 and T3S3).

Statistical analysis

SPSS program was used in statistical analysis and to perform the predictive equations for leaching saline soils and its relation to different soil properties.

Results and Discussion

Table 1 shows the chemical properties of the selected soil samples. The obtained data indicate that OM% is generally low and range between 0.01 and 0.30%. Soil heterogeneity appeared in Calcium carbonate content distribution, where it ranges between 2.99 and 9.66% and decreases by depth. This finding agreed with the results obtained by Mohamed (2002) and Abou Hussien et al. (2008). Also, samples showed heterogeneity in the salinity distributions which range between 1.09 and 19.1 dS/m. So, according to Dellavalle (1992) most of layers are considered very strongly saline.

Data in Table 1 show also the concentration of different soluble cations and anions. The dominant soluble cation was Na^+ followed by Ca^{++}, Mg^{++} and K^+, respectively, The concentration of soluble Na^+ ranged between 4.86 and 83.1 meq/ l, Ca^{++} ranged between 2.30 and 52.9 meq/ l, Mg^{++} ranged between 2.10 and 50.3 meq/ l and K^+ ranged between 0.17 and 3.80 meq/ l. The dominant soluble anion was Cl^- followed by $SO_4^=$, HCO_3^- and $CO_3^=$, respectively. The concentration of soluble Cl^- ranged between 3.15 and 178 meq/ l, $SO_4^=$ ranged between 0.09 and 55.9 meq/ l, HCO_3^- ranged between 1.50 and 10.2 meq/ l, while, $CO_3^=$ was not detected in all samples.

Table 2 shows some soil physical properties of the studied loamy sand soils. The values of soil bulk density ranged between 1.71 and 1.83 g/ cm^3, total porosity ranged between 29.2 to 32.9% and the values of soil total porosity ranged between 20 and 24%.

Soil water retention curve (SWRC) is defined as the relationship between water content θ on volume bases and suction. In this concern, Fig. 1. Illustrates that the curve shape can be explained according to the fact that soil moisture content at high value of suction is affected by adsorption capacity of the soil which depends on soil texture more than soils structure, (Elwan, 1983 and Galal, 1984). Figure 2 shows that $K_{sat.}$ as one of the most important soil properties for determining the maximum capacity of the soil to conduct water,

TABLE 1. Some chemical properties of the studied soil samples.

No.	depth (cm)	PH (1:2)	EC (dS/m) (1:2)	Describe Soil salinity degree*	OM (%)	$CaCO_3$ (%)	Soluble cations (meq L^{-1})				Soluble anions (meq L^{-1})			
							Ca^{++}	Mg^{++}	Na^+	K^+	HCO_3^-	$CO_3^{=}$	Cl^-	$SO_4^{=}$b
1	0 to10	7.25	19.1	VStS	0.11	5.22	52.9	50.3	83.1	3.80	10.2	n.d	178	1.86
	10 to 20.	7.33	8.12	VStS	0.11	4.02	16.2	10.2	53.8	1.10	8.11	n.d	53.7	19.5
	20 to 30	7.36	5.41	VStS	0.06	4.11	11.4	9.40	32.4	0.80	7.05	n.d	32.8	14.2
	30 to 40	7.38	4.11	VStS	0.07	3.66	6.20	2.22	32.1	0.51	5.21	n.d	18.1	17.9
2	0 to 10	7.64	11.9	VStS	0.25	9.66	21.1	15.1	80.2	1.78	6.50	n.d	55.8	55.9
	10 to 20.	7.7	8.42	VStS	0.01	8.11	15.1	10.6	57.1	1.23	5.08	n.d	46.2	32.9
	20 to 30	7.84	1.91	SS	0.02	9.53	6.20	5.69	6.80	0.39	3.51	n.d	6.15	9.43
	30 to 40	7.9	1.09	MS	0.02	8.11	3.40	2.20	4.86	0.32	3.05	n.d	3.15	4.63
3	0 to 10	7.81	1.43	S	0.11	5.88	2.30	2.10	9.22	0.34	3.03	n.d	10.1	0.86
	10 to 20.	7.82	1.18	MS	0.09	5.21	2.50	2.80	6.22	0.30	1.50	n.d	8.50	1.82
	20 to 30	7.84	1.35	S	0.02	4.80	2.30	2.30	8.60	0.22	3.22	n.d	10.1	0.09
	30 to 40	7.84	2.13	SS	0.01	2.99	5.60	2.25	13.2	0.26	4.50	n.d	16.2	0.58
4	0 to 10	7.33	3.54	VStS	0.30	6.77	7.59	5.67	21.5	0.28	3.11	n.d	30.8	1.19
	10 to 20.	7.11	2.75	SS	0.11	5.17	6.56	2.88	17.8	0.23	2.50	n.d	20.1	4.87
	20 to 30	7.42	2.71	SS	0.03	4.23	5.30	3.50	17.5	0.25	5.14	n.d	18.2	3.30
	30 to 40	7.44	2.43	SS	0.02	3.99	4.50	5.50	14.1	0.17	5.58	n.d	16.0	3.23

b, found by calculation.

* According to Dellavalle (1992) in soil water extract 1:2:

NS is non-saline soil dSm^{-1} <0.4. VSlS is very slightly saline soil dSm^{-1} 0.4 to 0.8.

MS is moderately saline soil dSm^{-1} 0.8 to 1.2. S is saline soil dSm^{-1} 1.2 to 1.6.

SS is Strongly Saline soil dSm^{-1} 1.6-3.2. VStS is Very Strongly Saline soil dSm^{-1} >3.2.

TABLE 2. Some physical properties of the studied soil samples .

No.	SP* %	ρs	ρb	*f*%	** Particle size distribution %			Texture class
					Clay	Silt	Sand	
1	24.0	2.42	1.71	29.2	11.6	7.00	81.4	loamy sand
2	20.1	2.49	1.67	32.9	9.60	4.00	86.4	
3	20.3	2.63	1.78	31.5	13.03	3.37	83.6	
4	23.0	2.62	1.83	30.2	15.28	2.25	82.5	

•Saturation percentage (%), ** According to ISSS classification, ρs is the particle density, ρb is the Bulk density, *f*% is the percentage of porosity.

and its values is related mainly to porosity and pore size distribution (PSD) (Julie et al.,1988 and Kandil, 2007), the values of $K_{sat.}$ ranged between 61.1 and 91.3 cm/ hr. According to De leenher and De Boodt (1965), PSD divides to four ranges which are: Quickly drainable pores (QDP) which is equal to θ_s - $\theta_{0.1}$, ranged between 48.2 and 82.8%, Slowly drainable pores (SDP) which is equal to $\theta_{0.1}$-$\theta_{0.3}$, ranged between 6.77 and 9.62%, Water holding pores (WHP) which is equal to $\theta_{0.3}$-θ_{15}, ranged between 4.44 and 15.6%, and Fine capillary pores (FCP) which is equal to $>\theta_{15}$, ranged between 4.95 and 28.9%, as shows in Fig 2.

It can be noticed from Fig. 2 and Table 2 that although all samples are of one similar texture class,

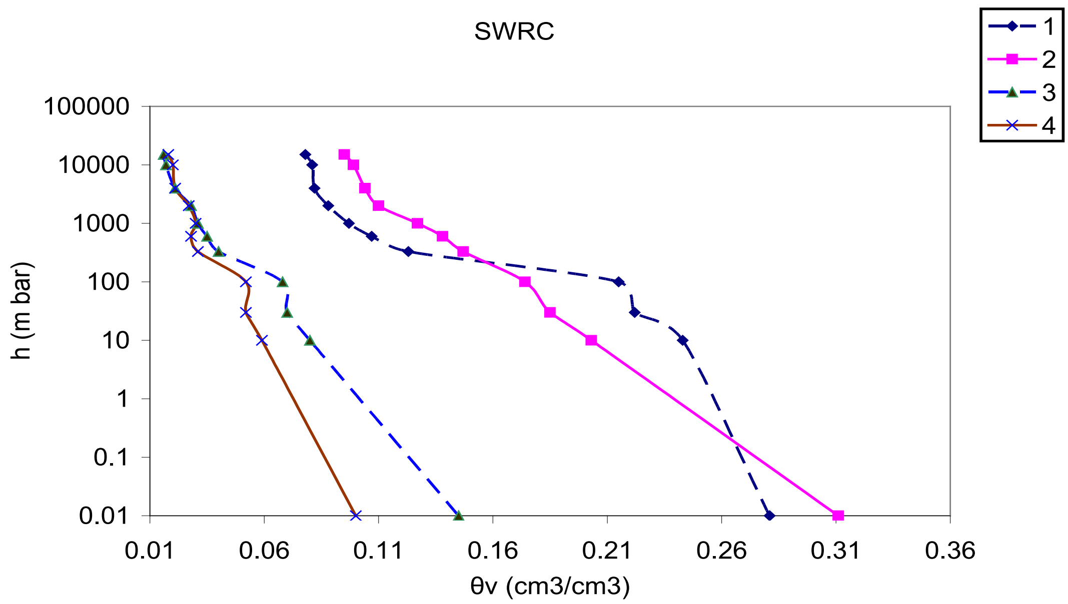

Fig. 1. The measured soil water retention curves for the studied soil samples.

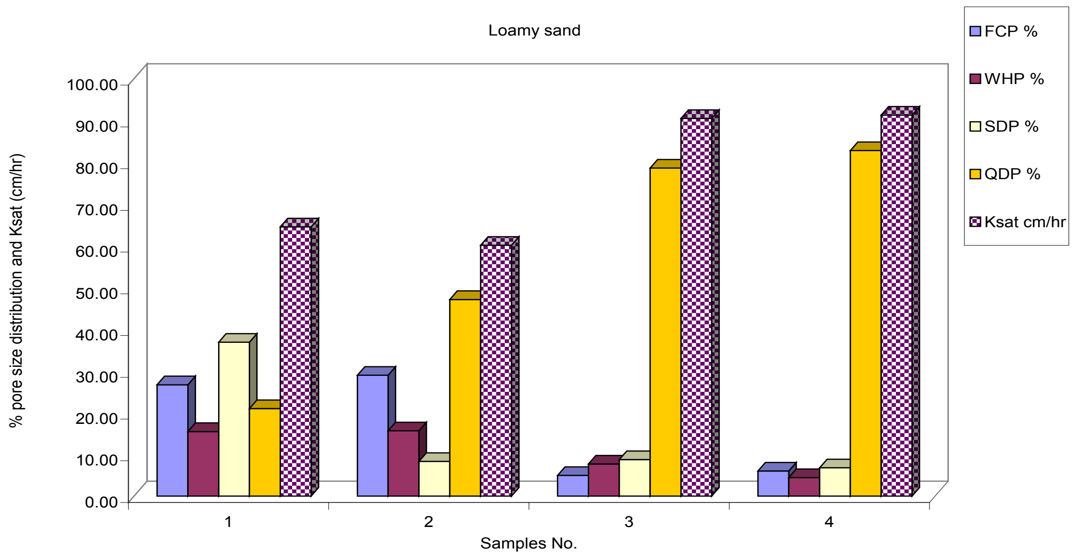

Fig. 2. Pore size distribution and saturated hydraulic conductivity for the studied soil samples.

they are varying in Ksat and PSD values. Therefore, the capacity of the soil to conduct water varied.

Salt movement and distribution in the studied samples before and after leaching are shown in Table 3. The percentage of accumulation ratio which were obtained from dividing the values of E.C. after leaching (C) by the values of initial E.C. before leaching (C_o), (Fig. 3).Tables 1 & 3 and Fig. 1 - 3 show that, samples No. 1 and 2 have the highest salt concentration in all layers, in contrast with samples No 3 and 4, especially in the upper layers. Samples No 1 and 2 have accumulation in salts (increasing salts concentration than the initial one), but samples No 3 and 4 didn't show any salts accumulation.

In sample 1 there was salts accumulation in the layer of 20 to 30 cm in treatment T1S3 and initial salt concentration rised from 5.4 to 10.3 dS/ m, and also salts accumulation in the layer of 30 to 40 cm in treatments T1S1, T1S2, T1S3 and T2S3; since the initial salt concentration rised from 4.1 to 5.9, 6.81, 12.6, 4.97 dS/ m, respectively. While sample 2 had salts accumulation in the layer of 20 to 30 cm in treatments T1S2 and T1S3; since initial salt concentration rised from 1.91 to 2.56 and 2.8, respectively. Also, salts accumulation in the layer of 30 to 40 cm in all treatments, and these salts accumulation decreased with increasing water quantity and quality.

Samples 3 and 4 didn't show any salts accumulation in all layers and with different treatments. Leaching intensity increased with increasing water quantity and quality. Leaching intensity in sample 3 was higher than in sample 4; due to that sample 4 had the lowest values in initial salts concentration. Samples 2 had the highest values of $CaCO_3$ content, especially, at depths of 20 to 30 and 30 to 40 cm, This reflects the salts accumulation in these depths. Samples 1 and 2 showed the highest values of WHP% and FCP%. They showed also the lowest values for Ksat. While, samples 3 and 4 showed the highest values of QDP% and the lowest values of Ksat.

From these results, we can conclude that: salts movement and leaching intensity depend on: initial salt concentration in the layer itself in the upper layers (Busaidi and cookson, 2004), content and distribution of $CaCO_3$% (Elwan, 1983), pores size distribution "PSD", quantity of water (Whiting et al., 2010), the use of more quantity of water did not have any significant effect on salinity reduction (Kaveh et al., 2011) and quality of water (Ahmed et al., 1999 and Whiting et al., 2010).

Using the lowest water quality "S3" is not recommended in the case of using the lowest quantity from this water "T1 and T2" but the use of allotted quantities of this water is recommended to achieve the same, or be near to results obtained using S2 (Horneck et al., 2007). The improvement programs should be carried out before cultivation period (Kaveh et al., 2011).

Predicting equations for reclamation requirements

Multi regression analysis was done to produce the predictive equations for leaching intensity in soil samples. Stepwise option, from SPSS program was used to express the effect of some soil properties, which are:

1, "X1, X2, X3 and X4" refer to EC in 1:2 soil water extract before leaching dSm^{-1} in soil depths, of 0 to 10, 10 to 20, 20 to 30 and 30 to 40 cm, respectively. 2, "X5" refers to total drainable pores, TDP%. 3, "X6" refers to CaCO3% content. 4, "X7" refers to water quality, ppm.

First, treatments (T1)under water quality S1, S2 and S3: ($R^2 = 0.898$)

$Y = -5.945+0.315X1+0.03X2+0.381X3+0.474X4+3.615X5+10.27X6+0.00058X7$.

Second, treatments (T2) under water quality S1, S2 and S3: ($R^2 = 0.960$)

$Y = -3.413+0.199X1+0.027X2+0.083X3+0.22X4+3.04X5+.036X6+0.0002X7$.

Third, treatments (T3) under water quality S1, S2 and S3: ($R^2 = 0.855$)

$Y= -1.329 + 0.126X1 + 0.024X2-0.09X3 + 0.097X4+1.463X5-2.047X6+0.0001X7$

Under similar conditions, these equations could be used to predict the residual salts concentration in any layer using different quantities of water depending on soil water behavior as mentioned previously.

References

Abou Hussien, E.A., Heggy, S.E.M. and Ahmed, H.M.R. (2008) Assessment Soil Profile Homogentity of some salt affected soils of Egypt. *Egypt. J. Soil Sci.* **48** (2), 253-265.

Abdel-Dayem, S., Rycroft, D.W., Ramadan, F., El-Baroudy, I. and Tahoun, A. (2000) Reclamation of saline clay soils in the Tina Plain, Egypt. *Journal of the International Commission on Irrigation and Drainage* (ICID) **49,**17-28.

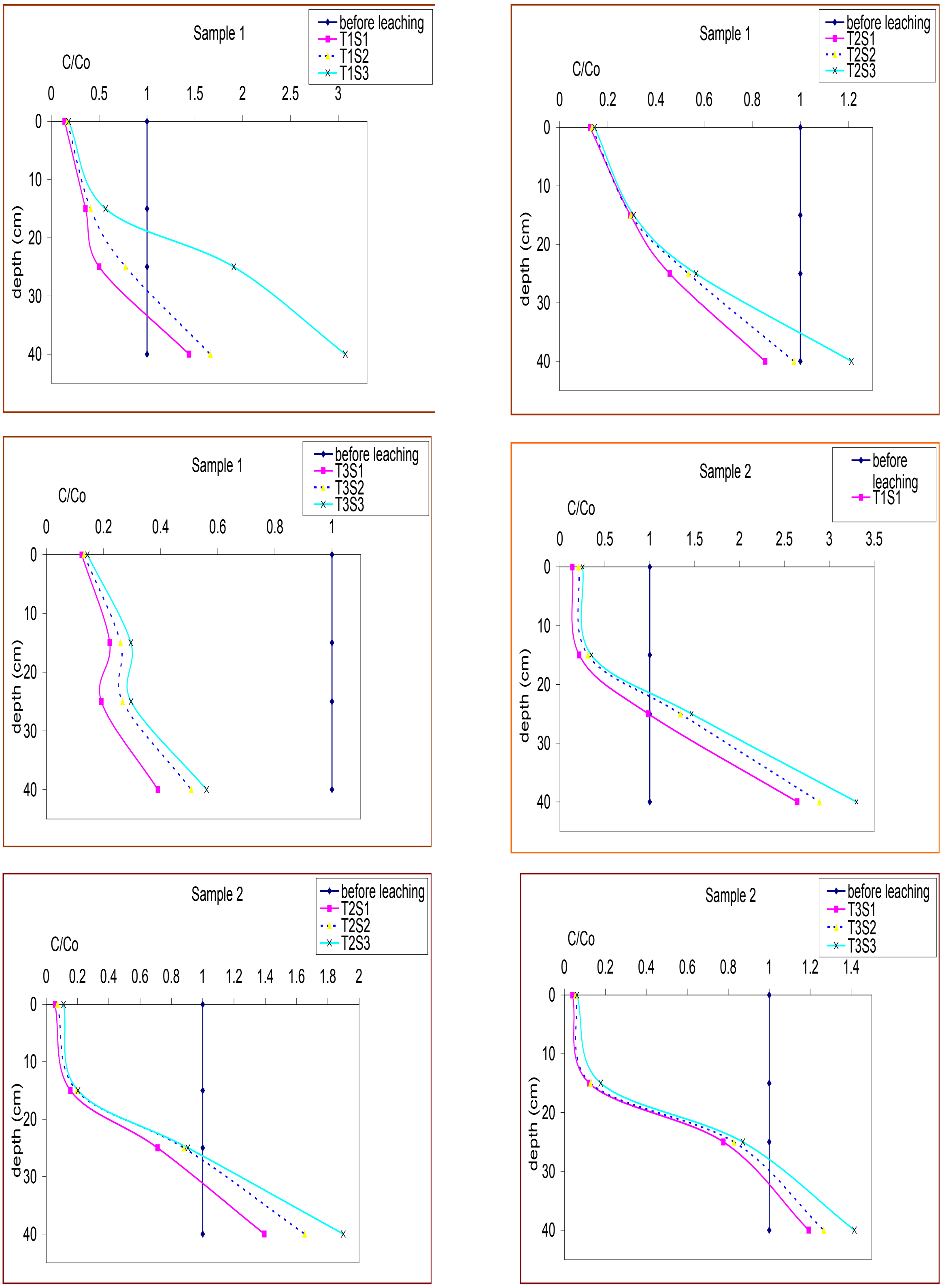

Fig. 3. Leaching intensity in studied the soil samples

S1 is fresh water of 230 ppm, S2 is of 1500 ppm and S3 is of 3000 ppm.
In Sample 1, the height of added water in T1, T2 and T3 equal to 25.2, 42 and 58.8 cm.
In Sample 2, T1, T2 and T3 equal to 27.6, 46 and 64.4 cm.
In Sample 3, T1, T2 and T3 equal to 36, 60 and 84 cm.
In Sample 4 T1, T2 and T3 equal to 33.6,56 and 78.4 cm, respectively.

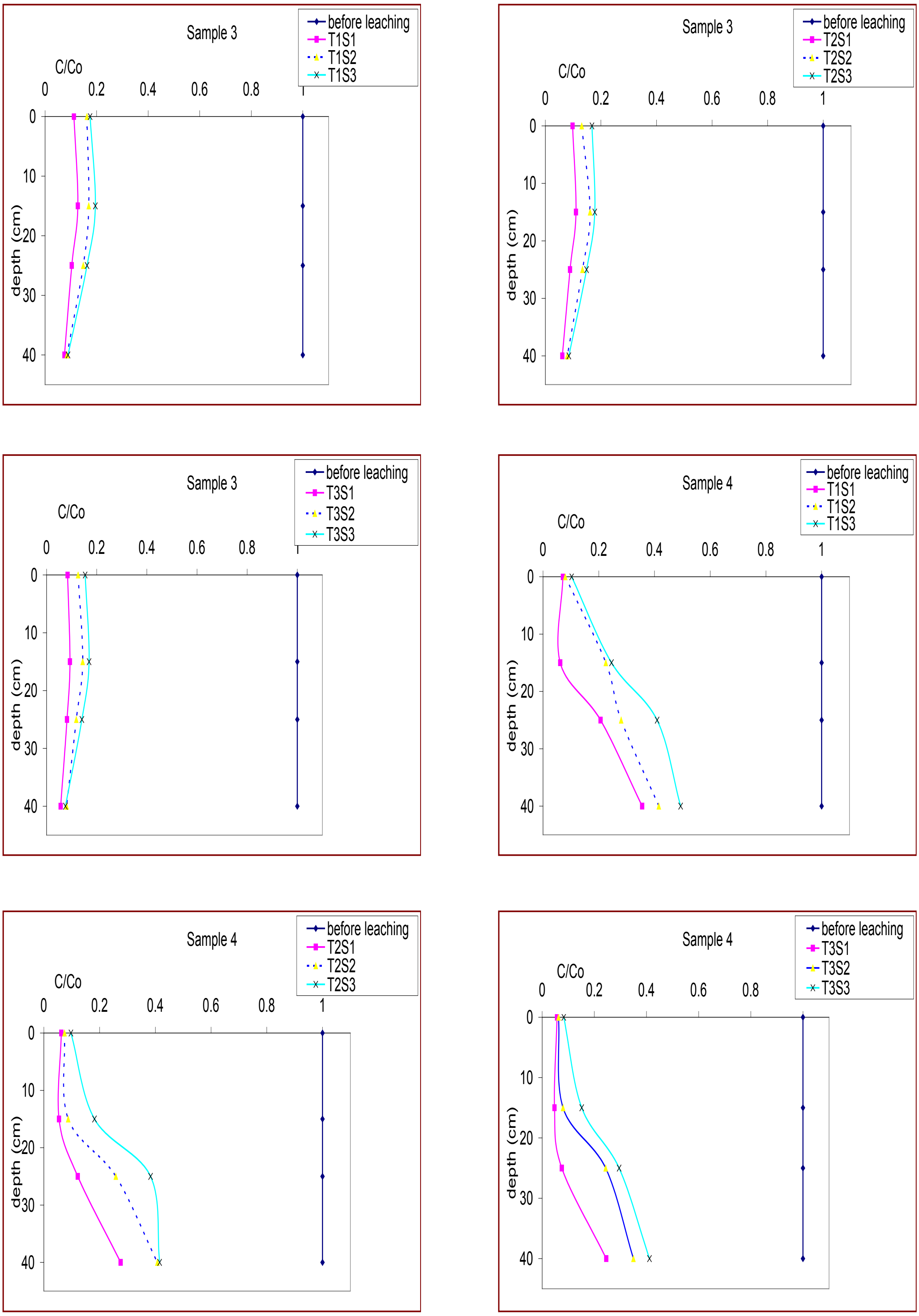
Sample 3
C/Co
depth (cm)
before leaching
T1S1
T1S2
T1S3
Sample 3
C/Co
depth (cm)
before leaching
T2S1
T2S2
T2S3
Sample 3
C/Co
depth (cm)
before leaching
T3S1
T3S2
T3S3
Sample 4
C/Co
depth (cm)
before leaching
T1S1
T1S2
T1S3
Sample 4
C/Co
depth (cm)
before leaching
T2S1
T2S2
T2S3
Sample 4
C/Co
depth (cm)
before leaching
T3S1
T3S2
T3S3
0
0.2
0.4
0.6
0.8
1
0
10
20
30
40

Fig. 3. Cont.

TABLE 3. Electrical conductivity of deferent soil treatments before and after leaching in the studied soil samples.

No.	Depth cm	EC (1:2) dSm^{-1} before Leaching. (Co)	Treatments	EC (1:2) dSm^{-1} after leaching. (C)			No.	Depth cm	EC (1:2) dSm^{-1} before Leaching. (Co)	Treatments	EC (1:2) dSm^{-1} after leaching. . (C)		
				S 1	S2	S3					S 1	S2	S3
1	0 to10	19.01	T1	2.65	3.15	3.44	3	0 to 10	1.43	T1	0.16	0.23	0.25
	10 to 20	8.12		2.9	3.33	4.61		10 to 20	1.18		0.15	0.2	0.23
	20 to 30	5.4		2.7	4.19	10.3		20 to 30	1.35		0.14	0.2	0.22
	30 to 40	4.1		5.9	6.81	12.6		30 to 40	2.13		0.16	0.18	0.19
	0 to 10	19.01	T2	2.4	2.55	2.76		0 to 10	1.43	T2	0.14	0.19	0.24
	10 to 20	8.12		2.39	2.4	2.5		10 to 20	1.18		0.13	0.19	0.21
	20 to 30	5.4		2.47	2.89	3.06		20 to 30	1.35		0.12	0.18	0.2
	30 to 40	4.1		3.5	3.99	4.97		30 to 40	2.13		0.13	0.17	0.18
	0 to 10	19.01	T3	2.35	2.5	2.73		0 to 10	1.43	T3	0.12	0.18	0.22
	10 to 20	8.12		1.8	2.11	2.4		10 to 20	1.18		0.11	0.17	0.2
	20 to 30	5.4		1.04	1.44	1.6		20 to 30	1.35		0.11	0.16	0.19
	30 to 40	4.1		1.6	2.08	2.3		30 to 40	2.13		0.12	0.17	0.16
2	0 to 10	11.85	T1	1.64	2.44	2.99	4	0 to 10	3.5	T1	0.25	0.28	0.36
	10 to 20	8.4		1.8	2.61	2.94		10 to 20	2.75		0.17	0.62	0.68
	20 to 30	1.91		1.88	2.56	2.8		20 to 30	2.71		0.56	0.76	1.11
	30 to 40	1.09		2.88	3.15	3.6		30 to 40	2.43		0.87	1.01	1.2
	0 to 10	11.85	T2	0.67	0.84	1.31		0 to 10	3.5	T2	0.22	0.26	0.34
	10 to 20	8.4		1.3	1.63	1.708		10 to 20	2.75		0.15	0.24	0.5
	20 to 30	1.91		1.36	1.68	1.73		20 to 30	2.71		0.33	0.7	1.04
	30 to 40	1.09		1.52	1.8	2.07		30 to 40	2.43		0.67	0.99	1.01
	0 to 10	11.85	T3	0.47	0.64	0.727		0 to 10	3.5	T3	0.2	0.22	0.29
	10 to 20	8.4		1.019	1.07	1.49		10 to 20	2.75		0.13	0.22	0.42
	20 to 30	1.91		1.483	1.58	1.663		20 to 30	2.71		0.2	0.66	0.8
	30 to 40	1.09		1.3	1.38	1.543		30 to 40	2.43		0.6	0.85	1

Abou Hussien, E.A., Heggy, S.E.M. and Ahmed, H.M.R. (2008) Assessment soil profile homogentity of some salt affected soils of Egypt**.** *Egypt. J. Soil Sci.* **48** (2), pp. 253-265.

Ahmed, M., Al-Rawahy, S.A., Al-Kalbani, M.S. and Al-Handaly, J.K. (1999) Leaching potential of some Omani Soils. *SQU Journal for Scientific Research – Agricultural Sciences* **4,** 65-70.

Beltran, J.M. (1999**)** Irrigation with saline water: benefits and environmental impact. *Agric Water Manage*. **40,**183–194

Busaidi, A. A. and Cookson, P. (2004) Leaching potential of sea water in saline soils. *Agricultural and Marine Sciences,* **9**(1), 27-30.

Cardon, G. E., Davis, J.G., Bauder, T. A. and Waskom, R.M. (2011) Managing Saline Soils. Colorado State University Extension and Jean. Reeder, *Ph.D.,* USDA-ARS (retired).

De leenher, L. and De Boodt, M. (1965) Soil physics International training center for post-graduate. *Soil Science, Gent.*

Dennis L., Corwin, J., Rhoades, D. and Jirka, S. (2007) Leaching requirement for soil salinity control: Steady-state versus transient models. *Agricultural Water Management.* **90,** 165–180

Dellavalle, N.B. (1992) Determination of specific conductance in supernatant 1:2 soil: water solution**.** *In" Handbook on Reference Methods for Soil Analysis". Soil and Plant Analysis Council,* 44-50. *Inc. Athens, GA***.**

Elwan, I.M.M. (1983) Soil moisture constants as affected by calcium carbonate, organic matter and clay content. *M.Sc Thesis,* Fac. of Agric., Ain Shams Univ., Cairo, Egypt 112-115.

Galal, M.S. (1984) Salt and Water movement as affected by different soil moisture contents in some Egyptian soils. *Ph.D. Thesis,* Fac. of Agric. Ain Shams Univ, Cairo, Egypt 20-60.

Horneck, D.A. Ellsworth, J.W., Hopkins, B.G., Sullivan, D. M. and Stevens, R. G. (2007) Managing Salt-affected Soils for Crop Production. *Irrigation Water Quality in the Pacific Northwest.* PNW 597-E. Oregon State Univ. Corvallis, OR.

Julie, G.L., Wagenet, R.J., Bouma, J. and Wasten, J.H.M. (1988) Variability of saturated hydraulic conductivity in a Glassaquic Hapludalf with macropore**.** *Soil Sci.***145,** 20- 27.

Kandil, M.I. (2007) Evaluation of water quality of El-Salam canal and prediction of its effect on soil and plant characteristics. *Ph.D. Thesis,* Fac. of Agric., Ain Shams Univ., Cairo, Egypt. 75- 76.

Kaveh, A., Pazira, E. and Masihabadi, M. (2011) Desalinization of saline - sodic soils via leaching. *Iranian Journal of Plant Physiology.* **1,** 269- 272.

Klute, A. (1986) Water retention: Laboratory methods. A. Klute (ed.) In: *"Methods of Soil Analysis,* Part

1",2 nd ed., pp.635- 662, Agronomy Monogr. 9. ASA and SSSA, Madison, WI,

Mohamed, A.A. (2002) Water quality control in open drains and its effect on soil properties, *Ph.D. Thesis,* Fac. of Agric., Ain Shams Univ., Egypt: 30- 80.

Page, A.L. (1982) Methods of soil Analysis, Part 2. *"Chemical and Microbiological",* A.L. Page, (Ed.), Agronomy Monograph No.9., 2nd ed., Am. Soc., of Agron., Madison, Wisc., USA.

Whiting, D., Card, A. and Wilson, C. (2010) *"Saline Soils"*, pp.224- 229 Colorado State University Extension.

Tyagi, N.K. (1986) Optimal water management strategies for salinity control**.** *Irrigation and Drainage* **112,** 81- 97.

(*Received :* 17 / 2 /2016;
acecpted : 15 / 3 /2016)

التنبؤ بعمليات الإستصلاح لبعض الأراضي الملحية فى مصر

أحمد عادل سعد الدين و محمد السيد جلال
قسم الاراضي- كلية الزراعة- جامعة عين شمس - القاهرة- مصر

تعتبر ملوحة التربة واحدة من اهم العوامل التى تحد من الزراعة و بالذات فى المناطق الجافة و شبة الجافة .وجد أن ٤×$١٠^{٤}$ هكتار من الاراضى الزراعية بالعالم تصبح غير صالحة للانتاج الزراعي بسبب مشاكل الملوحة سنوياً. فالهيئات الخاصة بالأمم المتحدة تؤكد أن حوالي ٥٠٪من الأراضي المزروعة بالعالم إما ان تكون مالحة أو مهددة بخطر التملح. والمشاكل الناتجة عن الملوحة تكون بسبب زيادة تراكم الاملاح الذائبة بمنطقة انتشار الجذور و هذه الزيادة تؤدى الى نقص نمو النباتات حيث تؤثر على امتصاص الماء و كذلك التسمم أو خلل بالإتزان الغذائي بسبب زيادة تركيز بعض الأيونات.

إن إستصلاح الاراضى الملحية يكمن فى غسيلها بالمياه لازالة الزيادة من الأملاح خارج منطقة إنتشار الجذور, و لكن المشكلة تكون أساساً فى محدودية المياه العذبة. لذلك إتجهت الأبحاث الى إمكانية إستخدام مياه أقل جودة كإعادة إستخدام مياه الصرف الزراعى أو مياه البحر أو مزج بين المياه العذبة و بالنوعين السابقين.

يهدف هذا البحث الى تقييم شدة عملية الغسيل باستخدام كميات مياه مختلفة الجودة. و هذه الكميات مقدرة على أساس خواص التربة الهيدروفيزيائية

بناء على ما سبق تم جمع أربع عينات تربة ملحية (عينة من محافظة بنى سويف و عينة من محافظة الفيوم وعينتان من محافظة الاسماعيلية), جميعهم لهم رتبة قوامية واحدة و هى السلتية الرملية ولكن مختلفة فى باقى الخواص. تم إجراء تجارب غسيل الأملاح باستخدام أعمدة تربة ذات قطر ١٢,٧ سم و ارتفاع ٥٠ سم تحت الظروف الحقلية بإستخدام مياه ذات درجات جودة مختلفة محضرة بالمعمل ٢٣٠ و ١٥٠٠ و ٣٠٠٠ ملىجرام/لتر و كذلك ثلاث كميات مختلفة من هذه المياه مقدرة على أساس خواص التربة الهيدروفيزيائية وهى كالتالى ٢٥,٢ و ٤٢ و ٥٨,٨ سم فى العينة الاولى اما الثانية ٢٧,٦فكانت و ٤٦ و ٦٤,٤ سم بينما الثالثة ٣٦,٦ و ٦٠ و ٨٤ سم و فى الرابعة ٣٣,٦ و ٥٦ و ٧٨,٤ سم . أستخدمت طريقة الغسيل المستمر و فى النهاية تم تقدير التركيز المتبقى للأملاح للحكم على شدة عمليات الغسيل.

أشارت النتائج المتحصل عليها بصفة عامة الى الأتي:

التوزيع الحجمي للمسام و التوصيل الهيدروليكي المشبع و المحتوى من كربونات الكالسيوم و التركيز الابتدائى للأملاح فى طبقة التربة تحت الدراسة و التركيزات فى الطبقات التى تعلوها و جودة و كمية المياه كل ذلك يؤثر بشكل أساسى على شدة عمليات الغسيل. و فى النهاية تم إستنتاج عدة معادلات رياضية للتنبؤ بتركيز الأملاح بعد عملية الغسيل للطبقات المختلفة تحت نفس ظروف البحث.