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EFFECT OF DIFFERENT SOIL SALINITY LEVELS ON SOME SOIL PROPERTIES AND WHEAT PLANT

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ABSTRACT

A pot experiment was conducted under the green house condition at Fac. of Agric., Mansoura Univ. to investigate effects of different soil salinity levels on some soil properties and wheat plant (*Triticum aestivum L*) . Four soil salinity levels were assessed with two kind of salinity,(0.4, 0.6, 0.8 and 1.0%) using NaCl and (NaCl +$CaCl_2$ 1:1), comparing to control (soil with soil salinity level of 0.2 %) on the studied traits.

The results could be summarized as follows:

- The high soil salinity led to an increase in EC, pH, the concentration of soluble ions and SAR of soil. Also it led to increase in exchangeable sodium and ESP in the soil but the increase was more with treatment of NaCl . Exchangeable calsium increased with increasing salinity level with using (NaCl +$CaCl_2$ 1:1) while decreased with using NaCl in salinization the soil.
- The increase of soil salinity increased bulk density and soil saturation , but this increase was more for treatments salinized by (NaCl 100%). On the other hand, it decreased soil porosity and soil structure factor.
- The increase of salinity levels decreased the final germination percentage, fresh weight and dry weight of wheat at boating stage. Also it decreased water consumption by wheat.
- The increase of salinity levels decreased the N, P, K, Ca content (%) and uptake by wheat. On the other hand, it increased Na content (%) and decreased Na uptake by wheat.

Keywords: Soil salinity, soil properties, wheat plant.

INTRODUCTION

Salinity affects 7% of the world's land area, which amounts to 930 million hectares (Munns, 2002). It is mainly due to excessive and uncontrolled irrigation, accumulation of salts in the top layer due to higher evapotranspiration in arid conditions, excessive use of chemical fertilizers containing chlorides, sulphates etc. and poor drainage conditions. Soil salinity can affect soil physical properties by causing fine particles to bind together into aggregates especially with calcium salts. Salinity can damage soil structure with increasing Na+ concentration in the soil solution and accumulation on clay particles causing sodicity (Rengasamy, 2006). Bulk density increase with increase in TSS and ESP but ESP effect is more.Porosity decrease with increase in TSS and ESP and decrease is more due to ESP (Shakir *et al.,* 2002) .Mostafa *et al*., (2004) indicated that increasing water salinity increased soluble cations and anions with different rates. For instance, SO_4^{--} concentration in soil extract showed considerable increases as the time increases, reaching 6 folds of those found for the soils irrigated with tap water. Also, SAR increased .The increase in the concentrations of water parameters (EC, SAR and RSC) led to an increase in EC, pH and the concentration of soluble ions exception soluble K (Abd-Elhady *et al.,* 2011). Wheat (*Triticum aestivum L*.) is the staple foods for more than 35% of world population (Jing and Chang, 2003). Salt accumulations in agricultural land affect plant growth adversely and reduce crop production. In the advanced stages, plants can be killed and the land, rendered unusable. Any effect that drought might have should be most considerable under salt-stressed conditions, because salinity can affect germination and seedling growth either by creating an osmotic pressure (OP) that prevents water uptake or by toxic effects of sodium and chloride ions on the germinating seed (Mehmet *et al.*, 2006). Salinization and sodication could limit the soil's productivity, leading to fertility reduction (Al- Zu'bi, 2007) and if the level of Na^+ in the soil is high, the colloidal fraction behavior will be affected. Salinization of agricultural land causes massive economic loss at the global level. Mujeeb *et al.,* (2008) found that increase NaCl concentration in soil decrease water uptake and germination of wheat. Increasing NaCl concentrations adversely affected shoot dry weight in wheat cultivars (*Triticum aestivum L*) (Akbarimoghaddam *et al.,*2011). Grain yield and water use efficiency (WUE) decreased significantly with increasing irrigation water salinity (Nagaz and Ben-Mechlia,2000). Samiha (2006) concluded that using saline water for irrigation reduced wheat yield by 4.14 and 4.38 % for variety Sakha 93. Increasing water salinity up to 4.85 dS m^{-1} reduces the grain yield by 23 % (Ragab *et al.,* 2008). Increasing salinity level of irrigation water decreased the actual evapotranspiration (ETa) and water use efficiency (WUE) values of wheat plant (Mostafa *et al*., 2004). The present work aims to study the effect of different soil salinity levels (0.2, 0.4, 0.6, 0.8, 1.0 %) on some chemical and physical soil properties as well as the grown wheat plant.

MATERIALS AND METHODS

A pot experiment was conducted under the green house condition at Fac. of Agric. , Mansoura Univ. during the winter season of 2009/2010 to investigate the effect of different soil salinity levels on some soil properties and wheat plant (*Triticum aestivum L*) . Soil (49.9% clay) having 0.2% salinity level was artificially salinized by NaCl or NaCl+$CaCl_2$ 1:1 to give four soil salinity levels i.e. 0.4, 0.6, 0.8 and 1.0%. So , the experiment included 9 treatments which replicated 5 times. Randomized complete block design was used in this study.

Surface soil samples were collected from the Experimental Farm Station of Fac. of Agric. , Mansoura Univ., air dried, ground and carefully mixed. Some physical and chemical properties of the soil are shown in Table 1 . Plastic pot 25cm diameter and 30 cm height was used.

Each pot was filled by 8.00 Kg soil (oven dry basis). Sodium chloride and calcium chloride (analytical grade) were obtained from El-Gomhoria Co. for chemicals . The initial salinity of the experimental soil of 0.2% was considered as a control treatment.The desired levels of soil salinity were obtained artificially by dissolving the calculated amounts of NaCl and

NaCl +$CaCl_2$ in a tap water amounted to reach the soil to field capacity point as shown below.

Table 1: Some physical and chemical properties of the experimental soil.

Mechanical analysis (%)	Coarse sand	2.09
	Fine sand	19.75
	Silt	28.30
	Clay	49.86
	Texture class	Clayey
E.C. $dS.m^{-1}$(soil paste extract)		4.32
pH (soil paste)		8.16
% S.P		71
% O.M.		1.13
% $CaCO_3$		2.09
CEC(meq/100g soil)		31.4
Real density g cm^{-3}		2.58
Bulk density g cm^{-3}		1.28
Soluble cations meq/100g soil	Ca^{++}	0.98
	Mg^{++}	0.30
	Na^{+}	1.82
	K^{+}	0.07
Soluble anions meq/100g soil	CO_3^{--}	0.00
	HCO_3^{-}	0.71
	Cl^{-}	1.40
	SO_4^{--}	0.61
Available (mg/kg)	N	66.4
	P	8.9
	K	301

Calculated amounts of NaCl and $CaCl_2$/pot to obtain the deliverable level of salinity.

Salt kind	Control	NaCl				NaCl+$CaCl_2$			
Treatment	T1	T2	T3	T4	T5	T6	T7	T8	T9
Salinity level%	0.2	0.4	0.6	0.8	1.0	0.4	0.6	0.8	1.0
Gram salt needed	Non	16	32	48	64	8+8	16+16	24+24	32+32

On 15th Dec. 2009, twenty seeds of Sakha 93 wheat variety were sown (5 cm depth) in each pot. One week later, germinated wheat seeds were counted periodically every 3 days. The counting was continued up to the stable count was obtained and the germination percentage was calculated as follows

*Germination percentage = germinated seeds number*100 \ sown seeds.*

On 5th Jan. 2010 wheat plant were thinned to the most suitable 10 plants per pot. Urea (46% N), superphosphate (15% P_2O_5) and potassium sulphate (48% K_2O) were the respective sources of N, P and K. The amount

of N, P_2O_5 and K_2O /pot were 1.5 , 0.62 and 0.48 gm , respectively. The added amount represent 2.5 fold of recommended (of 75 kg N /fed , 31kg P_2O_5/fed and 24 kg K_2O /fed) by the Ministry of Agric. and Soil Reclamation.
The N fertilizer was added in two equal portions, The first dose at 5 days later of thinning and the second one 15 days later of the first addition, while phosphorus and potassium fertilizers were added as one dose, 5 days later of thinning.

At boating stage (70 days after sowing) plants were taken from each pot and fresh weight was weighed. Samples were oven dried at 70º C tell constant weight was reached , then dry weight in gram/pot was recorded . The dried sample were thoroughly ground and stored for chemical analysis of N ,P ,K ,Ca and Na .Soil of each pot was turned over, mixed and representative soil sample was taken (500 gm). Soil moisture was kept at field capacity by weighing and watering to a constant weight every 5-7 days depending upon the climatologically conditions prevailing throughout the season and stage of plant growth .

Soil saturation percentage and soil organic matter were determined as described by Page,(1982). Bulk density and soil structure factor were determined following Dewis and Freitas,(1970). Mechanical analysis was determined by international pipette method (Kilmer and Alexander, 1949).Total carbonate was determined using Collin's calcimeter method (Piper, 1950**).** The cation exchange capacity and exchangeable cations were determined as described by Bower et al, (1952). EC, pH , soluble ions in soil and (N, P, K, Ca and Na)% in wheat plant were determined according to Jackson, (1967).

Statistical analysis :

Collected data were subjected to the statistical analysis, the technique of analysis variance (ANOVA) was used under costat programme .

RESULTS AND DISCUSSION

Effect of different soil salinity levels on wheat plant :

Germination :

Data of Table (2) show the effect of soil salinity levels on germination after 8, 11, 14 and 17 days from sowing .

Data in Table 2 reveal that increasing soil salinity levels decreased the final germination percentage obtained after 17 days from sowing. This trend is true under the two kinds of salinity ie. NaCl or NaCl+$CaCl_2$ 1:1 . The final germination percentage is 100% under the control treatment (0.2%) while it decreased to 91.7, 88.3, 80.0 and 60.0% when soil salinity made by NaCl salt increased to 0.4, 0.6, 0.8 and 1.0% , respectively. When the mixture of NaCl and $CaCl_2$ (1:1) was used to salinized the soil to the above mentioned soil salinity levels , the germination percentage decreased to 93.3, 90.0, 85.0 and 81.7%, respectively. All salinity levels induced by NaCl were more harmful on germination compared to those salinized by NaCl+$CaCl_2$ (1:1).

Table 2: Effect of different soil salinity levels on germination percentage

Treat. \ Germ	8 days	11 days	14 days	17 days
0.2% Control (T1)	**91.7**	**91.7**	**98.3**	**100.0**
0.4% NaCl (T2)	81.7	85.0	90.0	91.7
0.6% NaCl (T3)	36.7	83.3	88.3	88.3
0.8% NaCl (T4)	31.7	65.0	71.7	80.0
1.0% NaCl (T5)	0.0	16.7	46.7	60.0
0.4% NaCl+ $CaCl_2$ (T6)	86.7	90.0	93.3	93.3
0.6% NaCl+ $CaCl_2$(T7)	65.0	86.7	90.0	90.0
0.8% NaCl+ $CaCl_2$ (T8)	30.0	70.0	81.7	85.0
1.0% NaCl+ $CaCl_2$ (T9)	5.0	50.0	70.0	81.7

Data in Table 2 also indicate that increasing soil salinity level delayed the germination under the two kinds of salinity but salinity making by NaCl highly affected than that NaCl+$CaCl_2$. After 8 days from sowing , 91.7% from wheat seeds germinated while the percentages were 81.7, 36.7, 31.7 and 0.00% at T2, T3, T4 and T5, respectively , on the other hand germination was much better due to using NaCl+$CaCl_2$ in salinizing the soil , the percentage were 86.7, 65.0, 30.0 and 5.0 % for T6, T7, T8 and T9, respectively. The obtained results are in agreement with those of Mehamet et al., (2006) .

Fresh , dry weight and water consumption by wheat:

Data of Table (3) show the effect of salinity levels on fresh and dry weight (g) at boating stage and water consumption ml/pot by wheat plant from germination to boating stage.

Data in Table (3) reveal that fresh weight (g/pot) significantly decreased with increasing soil salinity level.The decrease is from 170.84 g/pot for control treatment(T1) to 92.12, 55.21, 26.98 and 20.96 g/pot for T2, T3, T4 and T5, respectively (NaCl), and to 100.76, 64.38, 40.27 and 28.68 g/pot for T6, T7, T8 and T9 (NaCl+$CaCl_2$), respectively. The values were lower in the treatments of NaCl than those of (NaCl+$CaCl_2$).This result may be due to high EC as well as the effect of Na ions which present in double concentration under salinization by NaCl than that of NaCl+$CaCl_2$.

Data of the same Table reveal that dry weight (g/pot), significantly decreased with increasing soil salinity level .The decrease is from 46.65 g/pot for control treatment(T1) to 25.61, 15.04, 7.35 and 5.27 g/pot for T2, T3, T4 and T5, respectively and to 28.12, 17.53, 10.77 and 7.26 g/pot for T6, T7, T8 and T9, respectively. The values were lower in the treatments of NaCl than treatments of (NaCl+$CaCl_2$).This results may be due to high EC.

Data of Table (3) show also that increasing salinity levels caused significant decrease in water consumption (ml/pot) by wheat plant until boating stage. The values were 8633, 6950, 6283 and 5883 ml/pot for T2, T3, T4 and T5, respectively and they were 8740, 7190, 6833 and 6250 ml/pot for T6, T7, T8 and T9, respectively.The highest value is found for control treatment (T1) which was 19013 ml/pot. The values were lower in the treatments of NaCl than treatments of (NaCl+$CaCl_2$). This result may be due to the decrease in fresh weight with increasing soil salinity. The present results are in agreement with those of Mujeeb *et al.,* (2008) and Mostafa *et al*., (2004).

Table 3: Effect of different soil salinity levels on fresh and dry weight (g/pot) at boating stage and water consumption(ml/pot) of wheat plant from germination to boating stage

Chra. / Treat.	Fresh weight (g/pot)	Dry weight (g/pot)	Water consumption ml/pot
0.2% Control (T1)	**170.84**	**46.65**	**10913**
0.4% NaCl (T2)	92.12	25.61	8633
0.6% NaCl (T3)	55.21	15.04	6950
0.8% NaCl (T4)	26.98	7.35	6283
1.0% NaCl (T5)	20.96	5.27	5883
0.4% NaCl+ $CaCl_2$ (T6)	100.76	28.12	8740
0.6% NaCl+ $CaCl_2$(T7)	64.38	17.53	7190
0.8% NaCl+ $CaCl_2$ (T8)	40.27	10.77	6833
1.0% NaCl+ $CaCl_2$ (T9)	28.68	7.26	6250
LSD	**5.36**	**2.07**	**181.87**

Element content of wheat plant:

Data of Table (4) show the effect of salinity levels on N, P ,K, Ca and Na content (%) in wheat plant at boating stage.

As shown in Table (4), the total N, P ,K,Ca content (%) in wheat plant at boating stage decreased gradually with increasing salt levels more than 0.4 % . The values of N, P ,K and Ca content (%) were 3.92, 0.441 ,4.15 and 0.81 % for control (T1), while the lowest values were 3.85, 0.307 ,3.04 and 0.62% for N, P ,K and Ca content%, respectively with NaCl (T5) and 2.94, 0.312, 3.18 and 0.71% for N, P , K, Ca content %, respectively with NaCl+$CaCl_2$ (T9). At 0.4 % soil salinity levels (T2 and T6) , the percentage of N, P and K increased than that of control. The values were 4.18, 0.466 and 4.38 % for N, P and K, respectively at T2 while at T6, the values were 4.22, 0.473 and 4.53 %, respectively for N, P and K. The increase in N, P and K content may be due to activation of the obsorption by roots at the low salinity level. The present results are in accordance with those of Nasr (1990) who found some decreases in K content with high increase in Na levels in shoots of plant grown in salinity conditions.

Table 4: Effect of different soil salinity levels on some element content of wheat plant at boating stage

Chra. / Treat.	Content%				
	N	**P**	**K**	**Ca**	**Na**
0.2% Control (T1)	**3.92**	**0.441**	**4.15**	**0.81**	**0.12**
0.4% NaCl (T2)	4.18	0.466	4.38	0.79	0.14
0.6% NaCl (T3)	3.55	0.411	3.73	0.74	0.20
0.8% NaCl (T4)	3.26	0.356	3.38	0.70	0.25
1.0% NaCl (T5)	3.85	0.307	3.04	0.62	0.29
0.4% NaCl+ $CaCl_2$ (T6)	4.22	0.473	4.53	0.86	0.13
0.6% NaCl+ $CaCl_2$ (T7)	3.68	0.421	3.83	0.80	0.16
0.8% NaCl+ $CaCl_2$ (T8)	3.31	0.383	3.49	0.78	0.22
1.0% NaCl+ $CaCl_2$ (T9)	2.94	0.312	3.18	0.71	0.22
LSD	**0.08**	**0.008**	**0.08**	**0.04**	**0.03**

Data of the same Table show that Na content % in wheat plant at boating stage increased gradually and significantly with increasing salt levels. The value of Na content was 0.12% for control(T1), while the highest was 0.29% for Na content with NaCl (T5) and 0.22% for Na content with $NaCl+CaCl_2$ (T9).

Element uptake by wheat plant:

Data of Table (5) shows the effect of salinity levels on N, P ,K, Ca and Na uptake (g/pot) by wheat plant at boating stage.

As shown in Table (5), the total N, P ,K, Ca and Na uptake (g/pot) by wheat plant at boating stage decreased gradually and significantly with increasing salt levels. The values of N, P , K,Ca and Na uptake were 1.83, 0.206, 1.94, 0.38 and 0.06 (g/pot) by wheat for control (T1), while the lowest values were 0.20, 0.016, 0.16, 0.03, 0.02 for N, P , K,Ca and Na (g/pot) respectively by wheat for (T5) and 0.21, 0.023, 0.23, 0.05 and 0.02 g/pot for N, P , K,Ca and Na respectively by wheat for (T9). The values of element uptake were lower in the treatments of NaCl than that of ($NaCl+CaCl_2$).

Table 5: Effect of different soil salinity levels on som element uptake by wheat plant at boating stage

Chra. / Treat.	uptake in plant (g/pot)				
	N	P	K	Ca	Na
0.2% Control (T1)	**1.83**	**0.206**	**1.94**	**0.38**	**0.06**
0.4% NaCl (T2)	1.07	0.119	1.12	0.20	0.03
0.6% NaCl (T3)	0.53	0.062	0.56	0.11	0.03
0.8% NaCl (T4)	0.24	0.026	0.25	0.05	0.02
1.0% NaCl (T5)	0.20	0.016	0.16	0.03	0.02
0.4% NaCl+ $CaCl_2$ (T6)	1.19	0.133	1.27	0.24	0.04
0.6% NaCl+ $CaCl_2$ (T7)	0.64	0.074	0.67	0.14	0.03
0.8% NaCl+ $CaCl_2$ (T8)	0.36	0.041	0.38	0.08	0.02
1.0% NaCl+ $CaCl_2$ (T9)	0.21	0.023	0.23	0.05	0.02
LSD	**0.09**	**0.009**	**0.08**	**0.02**	**0.01**

It could be concluded that uptake (g/pot) decreased significantly with the increasing salinity levels. This reduction in uptake may be due to the reduction in nutrient absorption caused by high concentration of soluble salt in the soil and the decrease in dry weight of wheat with increasing soil salinity levels (Table 3). These results are in agreement with those of Abou-Khadrah *et al.,* (1999) who illustrated that salinity in the water during the growing season significantly decreased total NPK uptake.

Effect of different soil salinity levels on some soil chemical properties

Data in Table (6) show that soil electrical conductivity increased as a result of increasing soil salinity levels. The values of EC were 8.73, 12.81, 17.15 and 20.98 dSm^{-1} for T2, T3, T4 and T5, respectively and the values were 8.62, 12.77, 17.11 and 20.89 dSm^{-1} for T6, T7, T8 and T9, respectively. The lowest value is found for control treatment(T1) was 4.36 dSm^{-1}.The values of EC were slightly higher in the treatments of NaCl than treatments of ($NaCl+CaCl_2$).This result may be due to high concentration of sodium in treatment of NaCl.

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Data of the same Table show that soil salinity affects pH in soil. pH increased as a result of increasing salinity levels. The values of pH were 8.15, 8.20, 8.21 and 8.23 for T2, T3, T4 and T5, respectively and the values were 8.16, 8.15, 8.18 and 8.20 for T6, T7, T8 and T9, respectively. The value of control (T1) was 8.15. Increasing was a marked in treatments of NaCl than NaCl+$CaCl_2$.

Data of Table (6) show that soil salinity affects on soluble ions. The concentration of soluble calcium and magnesium increased as a result of salinity levels. The calcium and magnesium ions, at T5 as compared with control one, increased from **1.02** and **0.29** (meq/100 g soil), respectively to 2.49 and 1.98 (meq/100 g soil), respectively.This increase in Ca and Mg ions may be coming from replacing the adding Na for the exchangeable Ca and Mg on soil colloids. Also T9 as compared with control (T1) , increased from 1.02 and 0.29 (meq/100 g soil), respectively to 5.86 and 2.32 (meq/100 g soil), respectively. The increase in concentration of soluble calcium and magnesium was higher in treatments of (NaCl+$CaCl_2$) than NaCl. This result may be due to high concentration of calcium in treatments of (NaCl+$CaCl_2$). The obtained results are in agreement with those of Abd-Elhady *et al.,* (2011).

Soluble sodium content in the studied soil is increased by increasing sodium content in soil salinity. The highest value is found in T5 (10.62 meq/100g) for treatments of NaCl and T9(6.79 meq/100g) treatments of (NaCl+$CaCl_2$) . While the lowest one is found in T1 (1.80 meq/100g) for control. The increase in concentration of soluble sodium was higher in treatments of NaCl than (NaCl+$CaCl_2$).

Increasing salinity levels induced the same trend for bicarbonate content in the studied soil. The highest value is found in T5(2.90 meq/100g) for treatments of NaCl and T9(2.36 meq/100g) for treatments of (NaCl+$CaCl_2$) . While the lowest one is found in T1 (0.71 meq/100g) for control. The increase in concentration of soluble bicarbonate was higher in treatments of NaCl than (NaCl+$CaCl_2$)

The content of chloride ions increase by increasing the salinity levels. The highest value is found in T5 (11.11 meq/100g) for treatments of NaCl and T9 (11.58 meq/100g) for treatments of (NaCl+$CaCl_2$) . The lowest one is found for control treatment (1.37 meq/100g). Hassanein *et al.,* (1993) found that the distribution and concentration of most cations and anions were increased with increasing salt concentration in irrigation water.

Data of Table (6) show that SAR increased with increasing soil salinity levels. The highest value is found in T5(26.03) for treatments of NaCl and T9 (12.37) for treatments of (NaCl+$CaCl_2$) . The lowest one is found for control treatment (8.36). The increase in SAR was higher in treatments of NaCl than (NaCl+$CaCl_2$). This result may be due to high concentration of sodium in treatment of NaCl. The results are in agreement with those of Mostafa *et al*., (2004) .

Data of the same Table show that the exchangeable (Na) was increased by increasing the salinity levels. The highest value is found in T5(8.82 meq/100g) for treatment of NaCl and T9 (5.39 meq/100g) for treatments of ($NaCl+CaCl_2$) . The lowest one is found for control treatment (3.88 meq/100g). The increase in exchangeable (Na) was higher in treatments of NaCl than ($NaCl+CaCl_2$). This result may be due to high concentration of soluble sodium in treatment of NaCl and high concentration of soluble calcium in treatment of ($NaCl+CaCl_2$) .

Data of Table (6) show that the exchangeable calcium was decreased by increasing the salinity levels for (NaCl) and increased by increasing the salinity levels for ($NaCl+CaCl_2$) . The values of exchangeable calcium were 17.91, 17.53, 17.19 and 16.92 meq/100g for T2, T3, T4 and T5, respectively. and the values were 18.62, 19.04, 19.27 and 19.80 meq/100g for T6, T7, T8 and T9, respectively. The value was 18,27 meq/100g for control treatment(T1).

It can be said that using NaCl in salinization the soil increased soil alkalinity where the ESP values increased from 12.36 under T1(0.2%) to 16.34, 20.0, 24.36 and 28.09% due to raising salinity level to 0.4, 0.6, 0.8 and 1.0%, respectively. Soil alkalinity was low under using $NaCl+CaCl_2$ in soil salinization . The ESP values increased from 12.36 (T1) to 13.12, 15.0, 16.21and 17.17 % at the same salinity levels mentioned above , respectively.

Results in Fig. 1 show correlation between SAR and ESP. There is a significant correlation between ESP and SAR, (r^2 = 0.9769). The relation was as following *: ESP= 0.838 SAR + 5.864* . These results are in agreement with those of Elhagwa *et al.,* (2007) who found that the correlation of ESP and SAR was high positive .

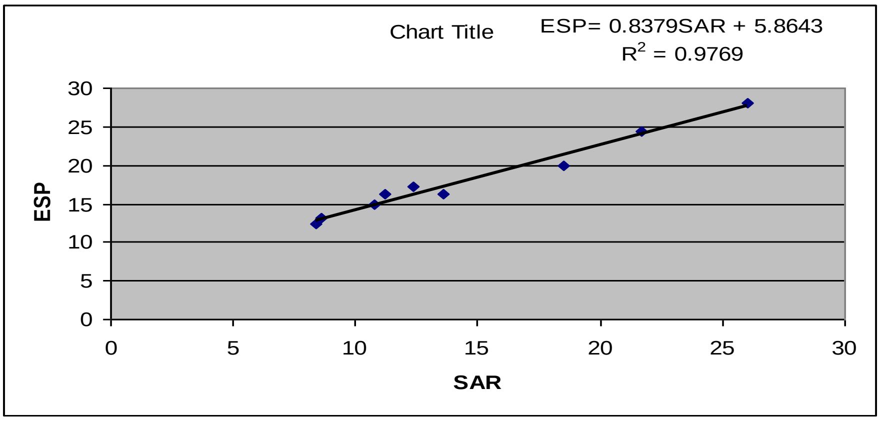

Fig.1 : correlation between SAR and ESP

Effect of different soil salinity levels on some soil physical properties

Data of Table (7) show effect of different soil salinity levels on some soil physical properties

Regarding the effect of salinity levels on bulk density (g/cm^3), data in Table (7) indicated that, increasing salinity levels increased bulk density. The values of bulk density were 1.30, 1.33, 1.34 and 1.38(g/cm^3) for T2, T3, T4 and T5, respectively and it were 1.28, 1.30, 1.31 and 1.33 (g/cm^3) for T6, T7, T8 and T9, respectively. The value was 1.29 (g/cm^3) for control treatment (T1). The increase in bulk density was higher in treatments of NaCl than

($NaCl+CaCl_2$). This result is due to high concentration of exchangeable (Na) and ESP as found in Table 6 with consideration that the values were high under NaCl salinization than the other kind of salinization.

Data of the same Table show that total soil porosity was decreased by increasing the salinity levels. The decreasing was higher in treatments of NaCl than ($NaCl+CaCl_2$). This result is due to high bulk density . These results are in agreement with those of Shakir *et al.,* (2002).

Concerning the effect of salinity levels on soil structure factor **%** data in **(**Table 7) reveal that with increasing salinity levels soil structure factor **%** decreased. The decreasing was from 59.43 % for control treatment(T1) to 55.42, 49.76, 42.55 and 39.57% for T2, T3, T4 and T5, respectively and it were 58.12, 56.45, 53.66 and 51.93% for T6, T7, T8 and T9, respectively. The decrease in soil structure factor **%** was higher in treatments of NaCl than ($NaCl+CaCl_2$). The structure factor decreased 33.4 and 12.6% due to raising salinity level from o.2% and 1.0% under NaCl and ($NaCl+CaCl_2$) salinization, respectively . This result is due to high concentration of exchangeable Na and ESP. Thease results are in agreement with those of Rengasamy (2006).

Table 7: Effect of different soil salinity levels on some soil physical properties

Treatment salinity %		Bulk density (g/cm^3)	Total soil porosity %	Soil Structure factor %	SP %
Control	**T1 0.2%**	**1.29**	**50.00**	**59.43**	**70.80**
NaCl	**T2 0.4%**	1.30	49.61	55.42	71.70
	T3 0.6%	1.33	48.45	49.76	72.90
	T4 0.8%	1.34	48.06	42.55	73.30
	T5 1.0%	1.38	46.51	39.57	74.50
NaCl + $CaCl_2$	**T6 0.4%**	1.28	50.39	58.12	71.50
	T7 0.6%	1.30	49.61	56.45	72.40
	T8 0.8%	1.31	49.22	53.66	72.90
	T9 1.0%	1.33	48.45	51.93	73.70

SP% : saturation percentage

As shown from in Table 7 SP values were increased by increasing the salinity levels . The highest value was 74.5% obtained with T5(NaCl) and 72.9% obtained with T9($NaCl+CaCl_2$),while the value was 70.8% obtained with the control. The increase in SP under NaCl compared to $NaCl+CaCl_2$ may be attributed to sodium binds more water than Ca due to the high hydration shell.

Results in Fig 2 show correlation between ESP and soil structure factor. There is a significant correlation between ESP and soil structure factor where the r^2 equals 0.9848 and the relation between the two factors is*:*

soil structure factor = -1.304 ESP + 75.446

Results in Fig 3 show correlation between ESP and porosity . There is a significant correlation between ESP and porosity (r^2= 0.9078), and relation was as following *:* *Porosity=-0.218 ESP+ 5*

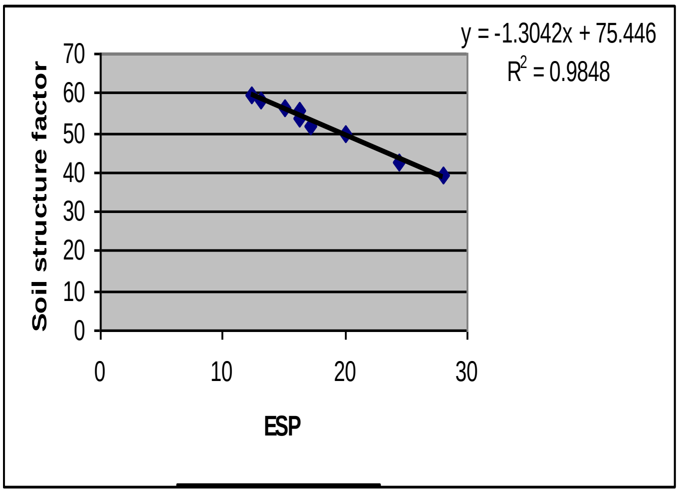

Fig. 2 : correlation between ESP and Soil structure factor

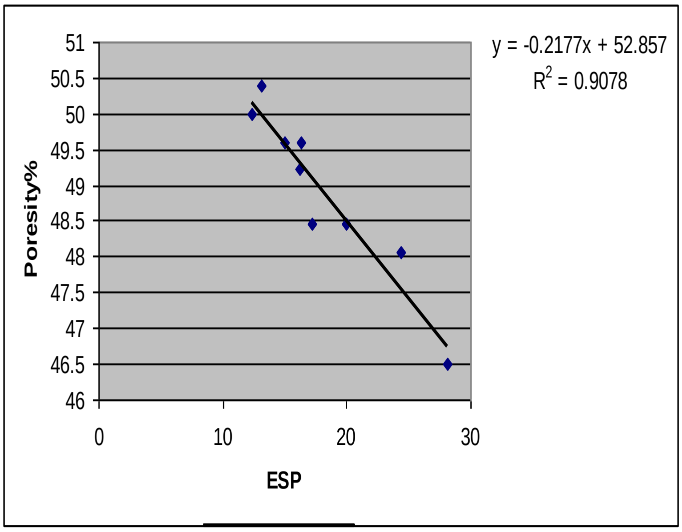

Fig. 3 : correlation between ESP and Prosity

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تأثير مستويات مختلفة من ملوحة التربة على بعض خواص التربة ونبات القمح.

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أقيمت تجربة أصص في مشتل كلية الزراعة – جامعة المنصورة لدراسة تأثير مستويات مختلفة من ملوحة التربة على بعض خواص التربة ونبات القمح 0 وقد اشتملت المعاملات على 9 مستويات ملوحة , T1 (معاملة كونترول 0.2 بدون تمليح) و T2 , T3 , T4 , T5 هي معاملات ملوحة باستخدام كلوريد الصوديوم (0.4- 0.6- 0.8- 1.0%) على التوالي 0 T6 , T7 , T8 , T9 عبارة عن معاملات ملوحة باستخدام كلوريد الصوديوم وكلوريد الكالسيوم بنسبة 1:1 في التملح لتعطي (0.4- 0.6- 0.8-1.0%) على التوالي0

وقد أوضحت النتائج مايلي :

- أدى إرتفاع ملوحة التربة إلى زيادة قيم pH و EC التربة و الكاتيونات والأنيونات الذائبة و SAR وهذه الزيادة كانت أكبر في معاملات الملوحة NaCl 0 وأيضا" أدى إرتفاع ملوحة التربة إلى زيادة كل من تركيز الصوديوم المتبادل و ESP والزيادة كانت أكبر في معاملات الملوحة NaCl بينما انخفض تركيز الكالسيوم المتبادل في معاملات الملوحة NaCl وزاد في معاملات الملوحة $NaCl+CaCl_2$0
- كما أدى إرتفاع ملوحة التربة الى زيادة كثافة التربة الظاهرية ونسبة التشبع والزيادة كانت أكبر في معاملات الملوحة NaCl, من ناحية أخرى أدت إلى نقص المسامية وعامل بناء التربة وهذا النقص كان بشكل أكبر في مستويات الملوحة المتحصل عليها باستخدام كلوريد الصوديوم.
- إرتفاع ملوحة التربة أثر بشكل ملحوظ على نمو نبات القمح حيث ظهر بوضوح نقص في وزن المادة الجافة للقمح عند مرحلة طرد السنابل وكان مقدار النقص أكبر في معاملات الملوحة NaCl, من ناحية اخرى ادى ارتفاع ملوحة التربة إلى انخفاض كمية العناصر الممتصة N,P,K ,Na,Ca من التربة والنقص كان اكبر في المعاملات NaClعن المعاملات $NaCl+CaCl_2$0

قام بتحكيم البحث

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Table 6 : Effect of different soil salinity levels on some soil chemical properties

Treatment salinity %		pH*	EC** dSm^{-1}	Soluble ions meq/100g soil								SAR	ESP %	Exchangable catios meq/100g soil		
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}			Ca	Na	K
Control	**T1 0.2%**	**8.15**	**4.36**	**1.02**	**0.29**	**1.80**	**0.07**	**-**	**0.71**	**1.37**	**1.10**	**8.36**	**12.36**	**18.27**	**3.88**	**0.89**
NaCl	**T2 0.4%**	8.15	8.73	1.38	0.78	3.78	0.13	-	1.49	3.65	0.93	13.58	16.34	17.91	5.13	0.86
	T3 0.6%	8.20	12.81	1.79	1.18	6.09	0.15	-	1.74	6.17	1.30	18.51	20.00	17.53	6.28	0.85
	T4 0.8%	8.21	17.15	2.28	1.66	8.23	0.18	-	2.05	9.10	1.20	21.66	24.36	17.19	7.65	0.82
	T5 1.0%	8.23	20.98	2.49	1.98	10.62	0.22	-	2.90	11.11	1.30	26.03	28.09	16.92	8.82	0.81
NaCl + $CaCl_2$	**T6 0.4%**	8.16	8.62	2.13	0.97	2.87	0.13	-	1.18	3.61	1.31	8.62	13.12	18.62	4.12	0.87
	T7 0.6%	8.15	12.71	3.23	1.29	4.35	0.16	-	1.42	6.34	1.27	10.75	15.00	19.04	4.71	0.84
	T8 0.8%	8.18	17.08	4.76	1.78	5.49	0.18	-	2.10	9.14	0.97	11.24	16.21	19.27	5.09	0.83
	T9 1.0%	8.20	20.85	5.86	2.32	6.79	0.21	-	2.36	11.58	1.24	12.37	17.17	19.80	5.39	0.83

*** in soil paste**
**** in soil paste extract**