Water Movement and Chemical Characteristics of Sandy Loam Soil Affected by Nano Synthetic Conditioner under Saline Irrigation Water

A.M. A. Mokhtar [1], Sahar M. Ismail [1] and S. A. E. El-cossy[2]

ABSTRACT

A laboratory study evaluated the influence of a newly introduced Nano Synthetic Conditioner (NSC), characterized by 48.9 mg kg^{-1} organic matter and 138 cmol kg^{-1} CEC, on sandy loam soil under saline irrigation waters (0.86 and 1.6 dS m^{-1}). NSC was applied at rates of 0, 4, 6, and 8% with 24.88 mm saline water every 7 days for eight wetting/drying cycles. Results showed infiltration time significantly increased with higher NSC rates and saline water levels, leading to decreased infiltration rates. Intermittent evaporation (E) was significantly reduced with higher NSC application but generally increased with successive wetting/drying cycles. Percentage of water conserved (PWC) rose significantly with higher NSC rates and increasing soil depth, but saline water concentration had no significant effect. Soil EC, pH, ESP, OM, and CEC significantly increased with both saline water concentration and NSC application. Similarly, available NPK content was significantly influenced: increasing with saline water and NSC application but decreasing with soil depth. Findings indicate that NSC efficiently reduces evaporation and infiltration while enhancing water storage. Moreover, it significantly improves soil chemical properties and nutrient availability, particularly in the 0–30 cm surface layer. This preliminary laboratory study highlights the potential of NSC as an effective soil conditioner for sandy loam under saline irrigation, offering valuable insights for future field experiments, which may provide more comprehensive and practical evaluation despite their higher costs.

Keywords: Sandy loam, Evaporation, Infiltration rate, Nano conditioner, saline irrigation water.

INTRODUCTION

Most agriculturally important soils of arid and semiarid regions are light texture (sand, loamy sand and sandy loam). These soils are characterized by low specific surface area, low water retention, excessive deep percolation rate and that eventually caused low fertility status and water use efficiency. The above-mentioned soil constraints can conceivably be alleviated through use of soil conditioners may be act as superabsorbent that can be capable improving some soil physiochemical, reduced evaporation, decreased infiltration rate and increased water retention and nutrient availability thus can increase water supply to growing plants and improve crop water productivity (El-Hady et al., 1981 and Tayel and El-Hady. 1981). Also, soil conditioners (superabsorbent) if has contains cementing agents such as humic substances and /or polysaccharides, may cause stable aggregates or increase their stability (Chaney and Swift, 1986). Miller, (1979) noticed that ahydrolyzed starch polyacry-lonitrile graft (super sluper) polymer increase the soil swelling of treated soil surface layer and decrease infiltration rate. Al-Omran et al., (1991) and Shalaby, (1993) they found that the infiltration time increased, percentage water conserved increased and reduced evaporation of sandy soil columns with increasing Jalma rates as a gel-forming conditioner (superabsorbent) at different saline irrigation waters. Sepaskhah and Bazrafshan-Jahromi, (2006) reported that the soil conditioners may have an impact on various soil physical properties such as structure, compaction, aggregate stability, surface hardness, infiltration rate, density, and evaporation rates. Mann, et al., (2011) revealed that the soil conditioners of potassium poly-acrylate (PPA) and polyacrylamide (PAM) had the potential to enhance the soil physical, chemical, available nutrients and soil productivity. On the other hand, Sahar and El-Cossy (2023) found that the mixed of PAM plus humic acid caused the highest soil moisture content at 20-40 cm soil depth and significantly improved soil water storage and soil aggregate size distribution ($P \leq 0.01$). Also, Sahar et al., (2025) reported that the potassium poly-acrylate (PPA) and polyacrylamide (PAM) both individually and in combination with humic acid significantly improved soil pH, cation exchange capacity, organic matter content, and the availability of essential nutrients such as nitrogen, phosphorus, potassium, calcium, and magnesium. The purpose of this study was to investigate the effects of a newly introduced Nano Synthetic Conditioner on evaporation and infiltration rate**,** some chemical properties of sandy loam soil, water content, and some available nutrients distributions with soil depth as well as percentage of water conserved under saline irrigation waters.

DOI: 10.21608/esm.2025.455534

[1] Soil Chemistry and Physics Department, Water Resources and Desert Soils Division, Desert Research Center. Egypt.

2. Soil Conservation Department, Water Resources and Desert Soils Division, Desert Research Center, Egypt.

Received August 10, 2025, Accepted, September 20, 2025.

MATERIAL AND METHODS

A surface soil sample (0 – 30 cm) from non-calcareous sandy loam soil was collected from El-Bostan area in semi- arid environmental condition, Egypt. This area located at 30° 47' 30″ N, 30° 23' 45" E and altitude 16 m. The sample was air-dried and passed through a 2 mm sieve. Particle size analysis, total CaCO3 %, bulk density, soil pH & electric conductivity (EC) in soil extract (1 soil: 1 water), CEC (cation exchange capacity) well as soil organic matter (O.M) were determined using standard procedures (Klute, *et al* 1986 and Page, *et al* 1982) The available nitrogen in soil was extracted using the method by Dahnke and Johnson (1990) and quantified using the micro-Kjeldahl procedure described by Page et al. (1982). Available phosphorus and potassium in soil were extracted using 1M NH_4HCO_3 in 0.005 M DTPA as recommended by Soltanpour (1991), the phosphorus measured calorimetrically and potassium analyzed using a flame photometer, accordingly, Page *et al*. (1982). The soil was classified as sandy loam, non (79 % sand, 10 % silt and 11 % clay with 3.50 % total calcium carbonate, and 1350 kgm^{-3} bulk density). The electric conductivity of initial soil extract (EC) was 0.46 dSm^{-1} and 7.24 pH, 8.32 $cmolkg^{-1}$CEC, 0.8 $mgkg^{-1}$ O.M as well as 3.43 sodium adsorption ratio (SAR); the exchangeable sodium percentage (ESP < 15) was estimated accordingly Richard's 1954. Nano synthetic conditioner (NSC) had 1.53 dSm^{-1} EC, 6.26 SAR, 8.45 ESP and 7.40pH in extract (1NSC:1Water) as well as 48.9 $mgkg^{-1}$ O.M, 138$cmolkg^{-1}$CEC, and with 860 kgm^{-3} bulk density. Also, this conditioner was contained the function groups of carboxylate ($-COO^-$), hydroxyl (-OH), carbonyl (C=O) and phosphate ($-PO_4^{--}$ & $-OPO_3^{--}$). The applied saline irrigation waters were electrical conductivity of 0.86 and 1.56 dSm^{-1}.

Evaporation Experiment

The evaporation experiment was conducted using 50 cm long soil columns including the treated layer (0–15cm), packed into 50 cm long transparent Lucite cylinders with inside diameter of 4.8 cm and closed at one end by sheet transparent Lucite. The soil samples are packed at 5 cm increments to 1.53 g cm^{-3} bulk density. The treatments consisted of Nano synthetic conditioner at 4 rates 0, 4, 6 and 8 % (g/g) of studied soil. The corresponding quantities of Nano synthetic were thoroughly hand mixed with soil. The soil columns were placed on a bench inside a lab with controlled a day/night cycle of 14/10 hour and a constant temperature 25.0 ºC. The amount of saline irrigation waters (24.88 mm) of 550 and 1000 ppm (0.86 & 1.56 dSm^{-1}) were applied weekly at 8 wetting /drying cycles, each treatment was replicated 2 times. Mean potential evaporation from surface of free applied saline irrigation waters in similar transparent Lucite cylinders was measured. This mean is approximately 3.55 mm/day. The time of disappearance of saline irrigation waters at the first cycle was rerecorded. Cumulative evaporation versus time of measurements was determined by periodically weighing for each column. At the end of experiment (8th wetting /drying cycle), the columns were sectioned at 5 cm increments. At this section, the distribution of soil water content (SWC), EC, ESP, CEC and available NPK with soil depth of columns were determined. Also, the percentage of water conserved (PWC) was estimated by the following equation:

$$PWC = 100*(Q - E)/Q$$

Where: Q is cumulative amount of water applied, mm and E is cumulative evaporation, mm.

Statistical analyses were conducted using 3-way completely randomized designs. The Least significant difference (LSD) test was used to compare means at a significance level of $p \leq 0.05$, following the method described by Snedecor et al.,1989. All data analyses were performed using Co-Hort software, Version 6.400.

RESULTS AND DISCUSSION

For convenience, the 0, 4, 6 and 8% NSC treatments are referred to hereafter as T0, T4, T6 and T_8, respectively. The saline irrigation water used as 0.86 and 1.56 $dSm^{-1}$are denoted by S1 and S2, respectively. The wetting/drying cycle and soil depth are denoted by C and D, respectively.

1. Water Movement

Infiltration

The times required for 24.88 mm of water to infiltrate into sandy loam soil column as affected by NSC-treated surface layer (0-15cm) and saline irrigation waters were recorded at the first wetting/drying cycle of intermitted evaporation experiment, Table (1). The results revealed that the infiltration time significantly increased with increasing application of NSC rates and also, the infiltration time significantly increased with increasing application of electrical conductivity of applied saline irrigation waters, hence, the infiltration rate is decreased. This behavior may be attributed to the aggregation and swelling effect. The adding NSC rates and the applied saline irrigation waters are not sufficiently suppressed the swelling effect of NSC applications. This result confirmed with Shalaby, (1993) who found that the salt concentration of irrigation water increased > 2dSm^{-1} reduced the soil swelling and consequently increased infiltration rate. The T_8 rate at any applied saline irrigation water had obviously increased of the time infiltration into the soil column, thus the infiltration rate is decreased. The infiltration time ranked as follows: T8 > T6 > T4 > T0 and infiltration time values for T4, T6 and T8 were 3.30, 5.73 and 10.71 times those of T0.

Table 1. Time required, s, by water to infiltrate into soil columns as affected by application NSC rates % and saline irrigation water at the first cycle of intermitted evaporation

NSC rate %	Time s	NSC rate %	Time s	NSC rate %	$LSD_{0.05}$
S1		S2			
T_0	46	T_0	50	48	LSD T 18.32
T_4	152	T_4	165	158.5	
T_6	265	T_6	285	275	
T_8	503	T_8	525	514	
Mean S	241.25		256.25		LSD S 12.95

Intermittent Evaporation

The intermittent evaporation (E) vs. time relationships as influence by the application of NSC rates and saline irrigation waters at the end of 8 wetting/drying cycles is shown in Table (2) and Figure (1). The E vs. time relationships from sandy loam soil columns were significant reduced with increasing applied NSC rates, also E generally significant increased with increased numbers of wetting/drying cycle. With the exception that the E of the T4 at the end of studied wetting/drying cycles under S1 and S2, the E values at T4 decreased with the cycle number increased. While, the intermittent evaporation from sandy loam soil columns were non-significant decreased with increasing concentration of saline irrigation water. Also, the results revealed that T4 under S2 had the lowest E value (13.56) at 8th wetting/drying cycle. This value is 62.20 % decreased relatively T0 at the same saline irrigation water and the same cycle. The total cumulative evaporation values at the end of wetting/drying cycles obviously reduced with the application NSC rate increased under S1 and S2. These values for T0, T4, T6 and T8 were 165.46, 144.21, 138.47 & 117.27 and 167.17, 143.90, 135.61 & 115.81 mm, under S1 and S2, respectively, the E values ranked as follows: T0 > T4 > T6 > T8 and E values for T4, T6 and T8 were 0.87,0.82 and 0.70 those of T0. The cumulative evaporation percentage at T0, T4, T6 and T8 under S1 and S2 were 91.52, 86.16, 84.71 & 91.96 and 86.08, 83.99 & 78.99 %, respectively.

Table 2. The intermittent evaporation from sandy loam soil columns as affected by NSC application rates and applied saline irrigation waters at the end of each wetting/drying cycles

NSC (T) %	Intermittent cumulative evaporation, mm, at wetting/drying cycles								Mean
	1	2	3	4	5	6	7	8	
			S1						
1	20.49	19.41	21.01	21.40	18.91	21.01	21.01	22.22	20.68
2	17.52	18.49	17.14	18.49	17.25	17.51	17.51	20.30	18.03
3	17.14	17.39	19.35	17.39	16.45	16.45	16.45	17.86	17.31
4	16.10	15.48	14.93	14.38	13.82	14.38	14.38	13.76	14.65
S1 Mean	17.81	17.69	18.11	17.92	16.61	17.34	17.34	18.54	17.67
			S2						
1	19.96	19.96	21.01	21.01	21.01	21.01	21.40	21.80	20.90
2	18.98	15.08	17.51	17.51	17.51	17.51	19.30	20.50	17.99
3	17.86	16.45	16.45	16.45	16.45	16.45	17.66	17.86	16.95
4	15.38	14.93	14.38	14.38	14.38	14.38	14.44	13.56	14.48
S2 Mean	18.05	16.61	17.34	17.34	17.34	17.34	18.20	18.43	17.58
C Mean	17.93	17.15	17.72	17.63	16.97	17.34	17.77	18.48	17.62
LSD $_{0.05}$ S = 0.377	NS	NS	NS	NS	NS	NS	NS	NS	NS
LSD $_{0.05}$ T % = 0.533	**	**	**	**	**	**	**	**	
LSD $_{0.05}$ C = 0.754	NS	NS	NS	NS	*	NS	NS	*	
Interaction									
S*T					NS				
S*C					NS				
T*C					S				

This behavior may be attributed to the aggregation and swelling phenomena for NSC, it had contained 138cmolkg^{-1} and 48.90mgkg^{-1}, and the phenomena may affect infiltration, redistribution and capillary rise. These in turn may influence cumulative evaporation. At the end of each wetting/drying cycle, E generally decreased with application NSC rate increased and ranked as follows: T0 > T4 > T6 > T8 under S1 and S2. With exception the E of T3 at the end of third cycle was higher than T2 under S1 and E of T2 at the end of second cycle was lower than T3 under S1. The results also revealed that the increasing NSC rates would suppress E values with increased number of wetting/drying cycles under studied saline irrigation waters due to these saline waters had less than 2dSm^{-1}. Also, Al-Darby, et al. (1993) indicated that the salt solution is added the polymers higher than 2dS^{-1} did not retain water at the soil column and did not permit the water to evaporate easily compared using slightly saline water less than 1dSm^{-1}.

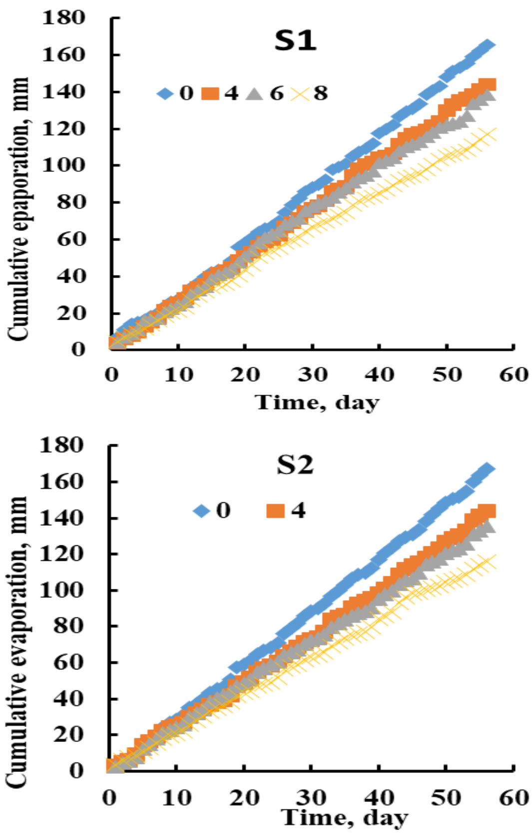

Fig.1.The intermittent cumulative evaporation from sandy loam soil columns as affected by NSC application rates and applied saline irrigation waters at the end of each wetting/drying cycles

Regression analyses indicated that the mean evaporation (E) at end of each wetting/drying cycle was liner function of the square root of time (t) ($E= At^{1/2}$), the mean evaporation constant (A) of the sandy loam affected by application NSC rates under saline irrigation waters are shown in Table (3). This linear relationship was previously suggested for the natural soils without conditioner, Black et al. (1969) is also valid for the soil conditioner of this experiment. The results indicated that the A constant and E for application NSC rates followed an order that is in agreement with the trend of the E vs. t relationships for sandy loam soil, Table (3). The same trend obtained by Mustafa et al. (1987) in his studied for E of sandy loam soil affected by gel- forming conditioner (Jalma). The results in Table (3) show the evaporation constant (A) clearly reduced with application NSC rates increased under S1 and S2 with regression coefficient (R^2) ranged from 0.0.975 – 0.949 and 0.950 – 0.926, respectively.

Table 3. The mean best fitting linear regression of the relationships between E vs. square root of time, ($E = At^{1/2}$) affected by NSC rates under studied saline irrigation waters

NSC rate %	A	Std. Error	Regression coefficient R^2
		S1	
0	10.32	± 1.07	0.949
4	8.34	± 0.60	0.975
6	8.55	± 0.81	0.958
8	7.57	± 0.76	0.953
		S2	
0	10.87	± 1.37	0.926
4	9.16	± 1.03	0.926
6	8.69	± 0.97	0.941
8	7.24	± 0.75	0.950

Soil Water conserved

The Available water conserved (AWC) values, mm, at the end of each wetting/drying cycle in soil columns non-significantly reduced with the saline water concentration increased, Table (4). While, these values at the end of each the same cycles affected by application NSC rates obviously significant increased with the increasing rates. The AWC values at the end of wetting/drying cycle numbers generally significant increased with increasing the number of cycles, except the AWC value at the end of third, 4th and 8th wetting/drying cycles reduced under S1 and the values at the end of 7th and 8th wetting/drying cycles reduced under S2, Table (4). The total AWC 33.58, 54.83, 60.57 & 81.77 mm and 31.87, 55.14, 63.43, & 83.23mm values at the end of wetting/drying cycles obviously increased with the application NSC rates of increased under S1 and S2.

Table 4. The soil water conserved (AWC) of sandy loam soil columns as affected by NSC application rates (T) and applied saline irrigation waters (S) at the end of each wetting/drying cycle (C)

NSC (T) %	AWC, mm, for different wetting/drying cycles								Mean	Total AWC
	1	2	3	4	5	6	7	8		
			S1							
1	4.39	5.47	3.87	3.48	5.97	3.87	3.87	2.66	4.20	33.58
2	7.36	6.39	7.74	6.39	7.63	7.37	7.37	4.58	6.85	54.83
3	7.74	7.49	5.53	7.49	8.43	8.43	8.43	7.02	7.57	60.57
4	8.73	9.40	9.95	10.50	11.06	10.50	10.50	11.12	10.22	81.77
Mean S1									7.21	
			S2							
1	4.92	4.92	3.87	3.87	3.87	3.87	3.48	3.08	3.98	31.87
2	5.90	9.80	7.37	7.37	7.37	7.37	5.58	4.38	6.89	55.14
3	7.02	8.43	8.43	8.43	8.43	8.43	7.22	7.02	7.93	63.43
4	9.50	9.95	10.50	10.50	10.50	10.50	10.44	11.32	10.40	83.23
Mean S2									7.30	
Mean C	6.95	7.73	7.16	7.25	7.91	7.54	7.11	6.40	7.26	
LSD $_{0.05}$ S = 0.395	NS	NS	NS	NS	NS	NS	NS	NS	NS	
LSD $_{0.05}$ T % = 0.567	**	**	**	**	**	**	**	**		
LSD $_{0.05}$ C = 0.754	NS	NS	NS	NS	NS	NS	NS	*		
Interaction										
S*T						NS				
S*C						NS				
T*C						S				

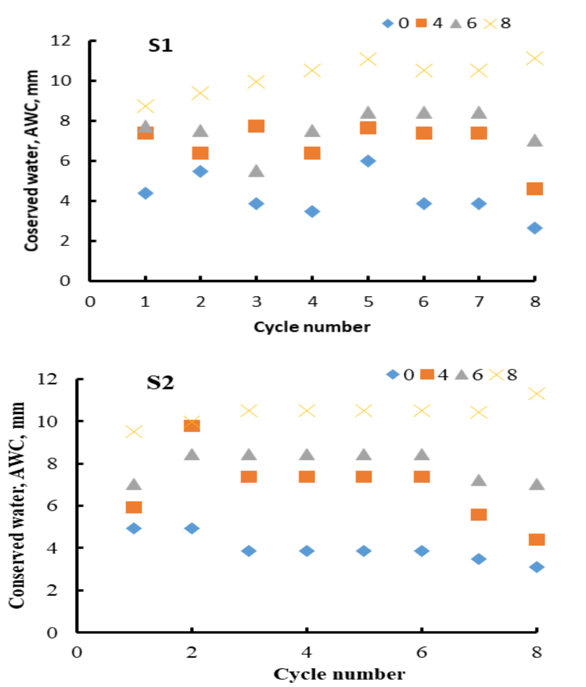

Fig.2. The soil water conserved (AWC) of sandy loam soil columns as affected by NSC application rates (T) and applied saline irrigation waters (S) at the end of each wetting/drying cycle (C)

These values for T0, T4, T6 and T8 were 33.58, 54.83, 60.57 & 81.77 and 31.87, 55.14, 63.43 & 83.23 mm, respectively, and ranked as follows: T0 < T4 < T6 < T8 under S1 and S2. The PWC at T0, T4, T6 and T8 under S1 and S2 were 16.87, 27.55, 30.43 & 41.08 and 16.01, 27.70, 31.86 & 41.81%, respectively. The PWC values affected by NSC rates ranked as follows: T8 > T6 > T4 > T0 and these values for T4, T6 and T8 were 1.68, and 1.89 and 2.52 times those of T0.

Soil water content, SWC, %, and water conserved percentage, PWC at end 8th wetting/drying cycle.

The values of soil water content, SWC, %, and water conserved percentage, PWC, %, of sandy loam soil columns at the end of the 8th wetting/drying influenced by NSC rates and soil depth under S1and S2 are illustrated in Table (5) and Figures (3). The SWC and PWC values non-significant increased affected by saline irrigation waters, while these values significantly increased with increasing applied NSC rates and soil depth increment. The results revealed that soil depth of 0-30cm were contained water especially at the 0-15cm soil depth. This behavior may be the attributed to the NSC had 138.00cmolkg^{-1} and 4.89 OM and the S1 and S2 had < 2dS^{-1}, and no effect on the soil swelling. Consequently, this conditioner had efficiency for water storage. This conclusion is agreement with Sahar and El- Cossy (2023). They found that soil ameliorants significantly improved soil water storage and soil aggregate size distribution (P ≤ 0.01) at (0-20cm) surface layer. The SWC values ranked as follows: T8 > T6 > T4 > T0 and its values for T4, T6 and T8 were 1.59, 1.79 and 2.38 times those of T0. While The PWC values affected by NSC rates ranked as follows: T8 > T6 > T4 > T0 and these values for T4, T6 and T8 were 1.68, 1. 89 and 2.52 times those of T0.

Table 5. The soil water content (SWC) and water conserved percentage (PWC) for sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle

Saline irrigation water S	T rate %	D, cm										Mean
		0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	
							SWC, %					
S1	0	8.38	7.18	6.58	5.19	4.19	3.39	2.79	2.19	2.00	2.00	4.39
	4	11.95	11.95	10.56	8.89	7.50	5.28	4.45	3.89	3.61	3.61	7.17
	6	11.71	11.46	11.46	8.91	8.15	7.13	6.11	5.60	4.84	3.82	7.92
	8	15.27	14.95	14.95	14.6	11.13	9.23	7.95	7.32	6.36	5.09	10.69
Mean S1												7.54
S2	0	7.40	7.40	6.54	5.85	4.82	4.13	3.27	2.58	2.58	2.24	4.68
	4	12.25	11.97	10.58	8.91	7.51	5.29	4.45	3.90	3.62	3.62	7.21
	6	11.14	12.05	12.05	9.37	8.57	7.77	6.43	5.89	5.62	4.02	8.29
	8	15.73	15.40	14.44	14.1	11.23	9.31	8.34	7.70	6.74	5.78	10.88
Mean S2												7.64
Mean D		11.73	11.55	10.90	9.48	7.89	6.44	5.47	4.88	4.42	3.77	
LSD 0.05 S	0.115						NS					
LSD 0.05 T	0.163						**					
LSD 0.05 D	0.258						**					
Interaction												
S* T							**					
S*D							NS					
S*D							**					
							PWC, %					
S1	0	3.22	2.76	2.53	1.99	1.61	1.30	1.07	0.84	0.77	0.77	1.69
	4	4.59	4.59	4.06	3.42	2.88	2.03	1.71	1.49	1.39	1.39	2.75
	6	4.50	4.40	4.40	3.42	3.13	2.74	2.35	2.15	1.86	1.47	3.04
	8	5.87	5.75	5.75	5.62	4.28	3.55	3.06	2.81	2.45	1.96	4.11
Mean S1												2.90
S2	0	2.84	2.51	2.25	1.85	1.59	1.26	0.99	0.99	0.86	0.86	1.60
	4	4.71	4.60	4.06	3.42	2.89	2.03	1.71	1.50	1.39	1.39	2.77
	6	4.28	4.63	4.63	3.60	3.29	2.98	2.47	2.26	2.16	1.54	3.19
	8	6.04	5.92	5.55	5.43	4.32	3.58	3.21	2.96	2.59	2.22	4.18
Mean S2												2.93
Mean D		4.51	4.40	4.15	3.60	3.00	2.43	2.07	1.88	1.68	1.45	
LSD 0.05 S	0.044						NS					
LSD 0.05 T	0.063						**					
LSD 0.05 D	0.099						**					
Interaction												
S* T							**					
S*D							NS					
S*D							**					

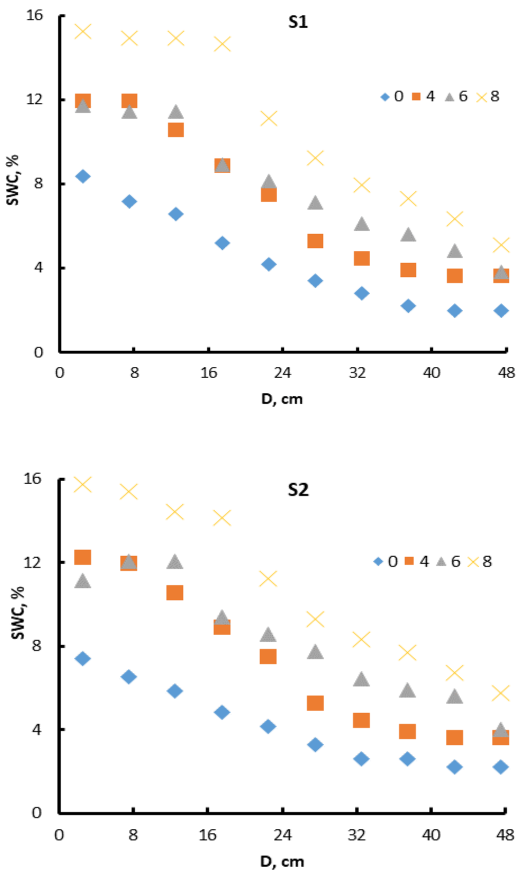

Fig.3. The soil water content (SWC) for sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle

The interaction of the SWC or PWC between saline water and NSC were significant and non–significant with soil depth. However, the interaction of the SWC or PWC between application NSC rates and soil depth were significant attributed to the effect of NSC is high.

2. Chemical properties

Soil salinity, EC

Data in Table (6) and Figure (4) is noticed that the EC values (1water:1soil extract) of sandy loam soil depth columns at the end of 8th wetting/drying cycle were significantly increased with saline irrigation water increased from 0.86 for S1 to 1.56dSm^{-1} for S2 and with the increasing of NSC rates (0, 4, 6 and 8%). While, EC values generally significant decreased with increasing the soil depth increment, except at (5-10cm) soil depth was high (1.53dSm-1), may be attributed to the leaching of relative salt movement from 0-5 to 5-10cm soil depth through wetting/drying cycles, also, the NSC had 1.53dSm^{-1} (1water:1NSC extract) resulted the increase of soluble salts in surface (0-15cm) soil depth column. The EC influence by NSC rates ranked as follows: T8 > T6 > T4 > T0 and EC values for T4, T6 and T8 were 1.07, 1.15, and 1.31 times those of T0. The interactions between studied factors were highly significant. The results indicated that T8 at (5-10cm) soil depth column under S2 is highest value.

Soil reaction, pH

The pH values (1water:1soil extract) of sandy loam soil depth columns at the end of 8th wetting/drying cycle were shown in Table (6) and Figure (5). The values of soil pH were significant decreased with increasing the concentration of saline water. While, the values were highly significant increased with increasing NSC rates this result confirmed with Sahar, et al., (2025). The pH values generally significant decreased with the soil depth columns increment. The interactions between NSC and saline water or soil depth were significant. The soil pH values influence by NSC rates ranked as follows: T8 > T6 > T4 > T0 and pH values for T4, T6 and T8 were 1.01, 1.01 and 1.1.02 times those of T0. The interaction between saline water and soil depth was non-significant. The results revealed that the variations in pH values were very low as affected by saline waters, NSC rates and soil depth column increment at the end of 8th wetting/drying cycle, wherever, the lowest pH is 7.24 at T0 under S2 and highest pH is 7.38 at T8 under S1 attributed to the buffering soil, Table (6).

Exchangeable sodium percentage, ESP

The ESP values were highly significant increased with increasing EC of saline waters and NSC rates increased and generally significantly decreased with the increasing of soil depth columns increment, except the ESP value at 5-10 cm soil depth was higher relatively than ESP at 0-5cm soil depth column could be attributed to the EC at this depth is high, consequently, the increase soluble sodium ions in soil solution, Table (6) and Figure (6).results indicated that T8 at (5-10cm) soil depth column under S2 is highest value. The ESP values affected by NSC rates ranked as follows: T8 > T6 > T4 > T0 and ESP for T4, T6 and T8 were 1.11, 1.15 and 1.23 times those of T0. The interaction between saline waters and NSC rates was significant. The interaction between saline waters and soil depth increments was highly significant also, the interaction between NSC rates and soil depth increments was highly significant, Table (6).

Table. 6. The EC, pH and ESP of sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle

Saline water S	T %	D, cm										Mean
		0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	
							EC, dSm^{-1}					
S1	0	0.97	1.01	0.88	0.80	0.75	0.67	0.65	0.62	0.60	0.58	0.75
	4	1.08	1.11	0.99	0.91	0.86	0.73	0.66	0.64	0.63	0.60	0.82
	6	1.15	1.23	1.06	0.98	0.92	0.80	0.71	0.68	0.65	0.61	0.88
	8	1.36	1.48	1.23	1.07	0.99	0.91	0.80	0.73	0.70	0.63	0.99
Mean S1												0.86
S2	0	1.46	1.58	1.33	1.21	1.13	1.01	0.98	0.94	0.91	0.88	1.14
	4	1.59	1.69	1.46	1.34	1.26	1.07	0.97	0.94	0.93	0.88	1.21
	6	1.74	1.83	1.62	1.50	1.41	1.22	1.09	1.04	0.99	0.93	1.34
	8	2.12	2.28	1.95	1.86	1.53	1.41	1.24	1.13	1.09	0.98	1.56
Mean S2												1.31
Mean D		1.43	1.53	1.31	1.21	1.11	0.98	0.89	0.84	0.81	0.76	
LSD 0.05		Interaction										
S	0.016	S* T						**				
T	0.022	S*D						**				
D	0.036	S*D						**				
						pH						
S1	0	7.25	7.26	7.25	7.27	7.26	7.26	7.27	7.25	7.26	7.27	7.26
	4	7.38	7.36	7.28	7.28	7.29	7.30	7.29	7.30	7.31	7.32	7.31
	6	7.41	7.40	7.35	7.34	7.34	7.35	7.34	7.33	7.32	7.33	7.35
	8	7.45	7.45	7.37	7.37	7.38	7.37	7.38	7.37	7.37	7.39	7.38
Mean S1												7.33
S2	0	7.21	7.22	7.22	7.23	7.22	7.23	7.22	7.23	7.23	7.25	7.24
	4	7.35	7.34	7.29	7.29	7.28	7.28	7.27	7.28	7.27	7.28	7.29
	6	7.38	7.37	7.31	7.29	7.28	7.28	7.28	7.27	7.28	7.29	7.30
	8	7.42	7.43	7.36	7.36	7.35	7.34	7.33	7.33	7.34	7.34	7.36
Mean S2												7.30
Mean D		7.25	7.26	7.25	7.27	7.26	7.26	7.27	7.25	7.26	7.27	7.26
Mean S2												
LSD 0.05		Interaction										
S	0.01	S* T						**				
T	0.01	S*D						NS				
D	0.01	S*D						**				
						ESP						
S1	0	4.98	5.14	4.65	4.51	4.32	4.17	3.97	3.82	3.86	3.70	4.31
	4	5.22	5.19	5.02	4.69	4.69	4.22	3.97	3.97	3.92	3.97	4.49
	6	5.34	5.63	5.22	4.90	4.82	4.60	4.22	4.17	3.97	3.92	4.68
	8	5.88	6.05	5.63	5.22	5.02	4.77	4.60	4.37	4.08	3.92	4.95
Mean S1												4.61
S2	0	6.11	6.30	5.78	5.53	5.41	5.02	4.90	4.82	4.77	4.73	4.73
	4	6.33	6.52	6.08	5.78	5.91	5.22	4.98	4.94	4.82	4.73	5.53
	6	6.64	6.76	6.37	6.14	5.95	5.53	5.26	5.11	5.02	4.82	5.76
	8	7.26	7.26	7.01	6.84	6.18	5.95	5.63	5.41	5.26	4.90	6.17
Mean S2												5.70
Mean D		5.97	6.11	5.72	5.45	5.29	4.94	4.69	4.58	4.46	4.34	
Mean S2												
LSD 0.05		Interaction										
S	0.034	S* T **										
T	0.049	S*D **										
D	0.077	S*D **										

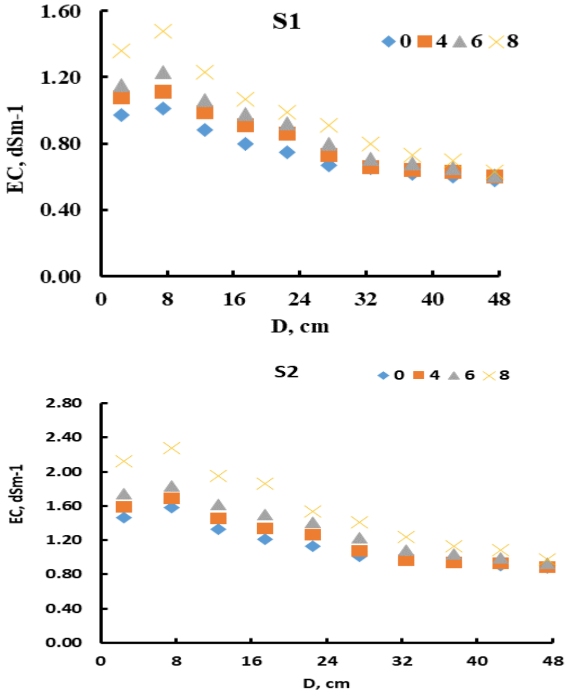

Fig. 4. The EC, dSm^{-1} of sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle

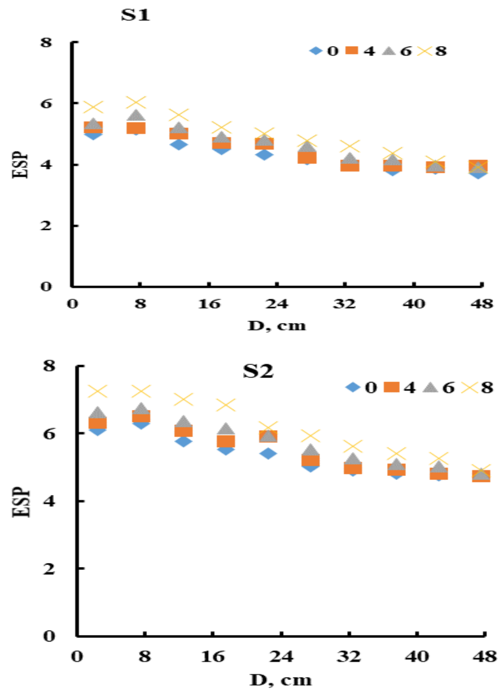

Fig. 6. The ESP of sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle

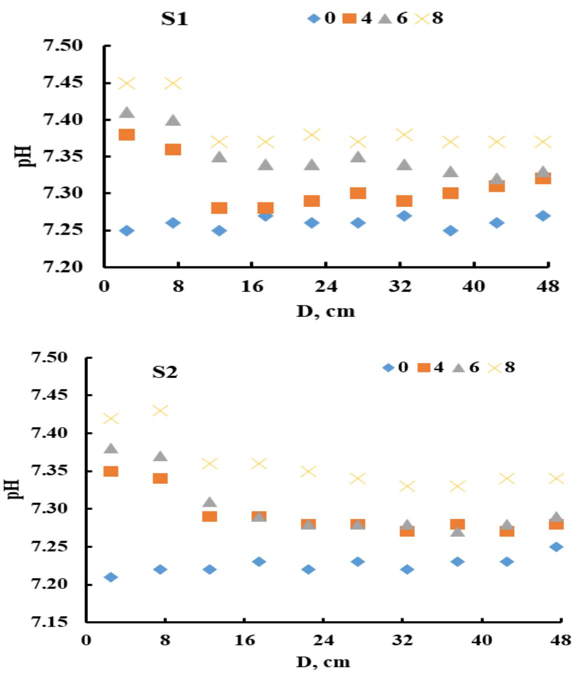

Fig. 5. The pH of sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle

Cation exchange capacity, CEC

The CEC values, **cmol**kg^{-1}, of sandy loam soil columns at the end of 8th wetting /drying cycle as affected by saline waters and applied NSC rates highly significant increased with increasing the concentration of studied saline water and NSC rates, Table (7) and Figure. (7). While, CEC values generally significant reduced with soil depth columns increment, except the CEC values at 5-10 and 10-15cm soil depth columns exhibited higher. This higher may be caused by the migration of some NSC particles high CEC (138cmolkg^{-1}) from 0-5cm depth to 5-10 and 10-15cm soil depth columns through wetting/drying cycles. The trend CEC as affected by saline waters and NSC rates is similar obtained for ESP and EC of sandy loam soil columns. The CEC affected by NSC rates ranked as follows: T8 > T6 > T4 > T0 and CEC values for T4, T6 and T8 were 1.36, 1.62 and 1.78 times those of T0. The interactions between saline waters and NSC rates or soil depth increments were significant. While, the interaction between NSC rates and soil depth increments was highly significant, Table (7).

Organic Matter, OM

The OM content values, $mgkg^{-1}$, of sandy loam soil columns at the end of 8th wetting /drying cycle as influenced by saline waters and applied NSC rates highly significant increased with the saline water concentration increased and NSC rates increased. The OM content influence by NSC rates ranked as follows: T8 > T6 > T4 > T0 and OM content for T4, T6 and T8 were 1.54, 1.1.76 and 2.27 times those of T0. However, OM values highly significant reduced with the soil depth increments, Table (7) and Figure. (8). The surface soil depth (0-15cm) had the highest OM values could be attributed to the adding of NSC (48.9mggk^{-1}) in this depth. This result similar obtained by Sahar, et al., (2025). The interaction between saline water and NSC rates was highly significant. Also, the same trend obtained between NSC rates and soil depth increments. While, interaction between saline waters and soil depth increments was non-significant, Table (7) and Figure. (8).

Table 7. The CEC cmolkg^{-1}and OM mgkg^{-1} of **sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle**

Saline irrigation water S	T %	D, cm										Mean T
		0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	
		CEC, cmolkg^{-1}										
S1	0	8.33	8.06	8.27	8.21	8.17	8.16	8.15	8.19	8.17	8.17	8.19
	4	13.32	13.52	15.58	13.04	9.00	8.41	8.23	8.18	8.17	8.15	10.56
	6	17.65	19.36	20.55	13.47	9.52	9.12	8.36	8.14	8.19	8.18	12.25
	8	20.68	22.94	23.57	13.48	9.76	9.20	8.60	8.20	8.11	8.21	13.28
Mean S1												11.07
S2	0	8.33	8.06	8.27	8.21	8.17	8.16	8.15	8.19	8.17	8.17	8.19
	4	15.84	16.23	18.46	14.08	10.03	9.81	8.54	8.22	8.20	8.13	11.75
	6	25.32	24.53	22.41	15.48	10.70	10.32	8.86	8.21	8.21	8.15	14.22
	8	30.42	27.38	27.81	19.02	10.81	10.60	8.82	8.20	8.23	8.20	15.95
Mean S2												12.53
Mean D		17.49	17.51	18.11	13.12	9.52	9.22	8.46	8.19	8.18	8.17	
LSD 0.05												
S	0.510						**					
T	0.721						**					
D	1.140											
		Interaction										
		S* T						**				
		S*D						**				
		S*D						***				
		OM, mgkg^{-1}										
S1	0	0.83	0.68	0.66	0.63	0.60	0.70	0.68	0.63	0.60	0.64	0.66
	4	1.17	1.11	1.07	1.05	0.84	0.71	0.63	0.62	0.62	0.61	0.84
	6	1.70	1.60	1.55	1.51	1.01	0.92	0.80	0.72	0.55	0.55	1.09
	8	2.90	2.40	1.90	1.51	1.01	0.94	0.89	0.84	0.76	0.73	1.39
Mean S1		1.65	1.45	1.29	1.17	0.87	0.82	0.75	0.70	0.63	0.63	1.00
Mean D												
S2	0	0.83	0.68	0.66	0.70	0.68	0.66	0.60	0.60	0.65	0.64	0.67
	4	1.90	1.70	1.80	1.30	1.06	0.92	0.89	0.87	0.85	0.83	1.21
	6	1.97	1.74	1.69	1.41	1.06	1.03	1.00	0.93	0.91	0.89	1.26
	8	2.70	3.50	2.10	1.88	1.29	1.19	1.12	0.92	0.88	0.84	1.64
Mean S2												1.20
Mean D		1.75	1.68	1.43	1.25	0.94	0.89	0.83	0.77	0.73	0.72	
LSD 0.05		Interaction										
S	0.070	S* T						**				
T	0.100	S*D						NS				
D	0.160	S*D						***				

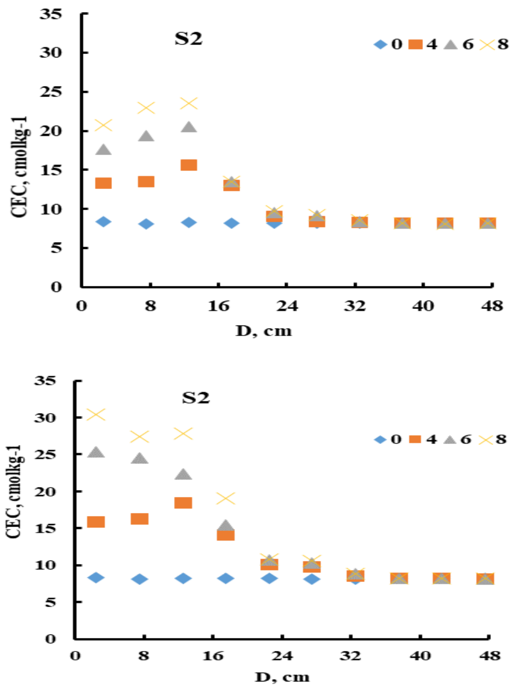

Fig.7.The CEC cmolkg^{-1}of **sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle**

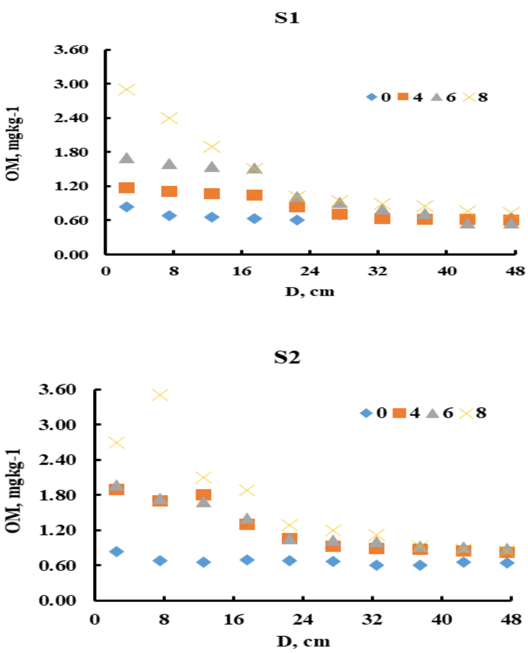

Fig. 8. The OM mgkg^{-1} of sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle.

Available NPK content

The available NPK content, mgkg^{-1}, of sandy loam soil columns as affected by saline waters, applied NSC rates and soil depth highly significant increased and highly significant reduced with the saline water concentration, NSC rates increased and soil depth increments, respectively, at the end of 8th wetting /drying cycle Table (8) and Figures. (9-11). The available N content influence by NSC rates ranked as follows: T8 > T6 > T4 > T0 and N content for T4, T6 and T8 were 1.48, 1.72 and 1.95 times those of T0. The available P content affected by NSC rates ranked as follows: T8 > T6 > T4 > T0 and P content for T4, T6 and T8 were 1.89, 2.47 and 3.33 times those of T0. The available K content affected by NSC rates ranked as follows: T8 > T6 > T4 > T0 and K content for T4, T6 and T8 were 1.11, 1.17 and 1.32 times those of T0. The results indicated that NSC rates may improve the available NPK content in surface treated soil depth, due to the NSC had 48.9 mgkg^{-1}OM and 138cmolkg^{-1} CEC. These results are in agreement with findings of Sahar, et al., (2025). The interaction for N content between saline water and NSC rates was significant. Also, the interaction for N between saline water and soil depth was highly significant. However, the interaction between NSC rates and soil depth was non- significant. The interaction for P content between saline water and NSC rates was non-significant. However, the interaction between saline water and soil depth and it's between NSC rates and soil depth was highly significant. The interaction between saline water and NSC rates and it's between saline water and soil depth was non-significant. While, the interaction between NSC rates and soil depth was highly significant.

Table 8. The available NPK mgkg^{-1} of sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle

Saline irrigation water S	T %	D, cm										Mean
		0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	
		N, mgkg^{-1}										
S1	0	23.1	17.2	15.4	13.6	12.5	11.7	11.0	10.5	10.0	9.7	13.47
	4	25.3	23.1	21.3	15.5	14.2	13.2	12.4	11.7	11.1	10.6	15.83
	6	27.2	25.7	22.7	15.8	14.5	13.5	12.7	12.0	11.5	11.0	16.66
	8	30.9	27.6	25.2	16.5	15.2	14.2	13.4	12.7	12.1	11.6	17.93
Mean S1												15.97
S2	0	23.7	17.9	17.8	14.3	13.1	12.4	11.4	10.9	10.2	10.1	14.19
	4	65.8	47.6	39.3	17.5	15.4	14.4	13.6	12.9	12.4	11.9	25.08
	6	73.3	60.9	77.0	19.0	15.7	13.4	13.2	13.1	11.8	10.8	30.83
	8	88.0	88.2	78.7	22.6	16.3	15.3	14.4	13.0	11.8	11.7	36.00
Mean S2												26.53
Mean D		44.68	38.51	37.18	16.8	14.61	13.51	12.76	12.09	11.37	10.92	
LSD 0.05		Interaction										
S		S* T										
T		S*D										
D		S*D										
		P, mgkg^{-1}										
S1	0	0.73	0.64	0.86	0.67	0.65	0.64	0.63	0.62	0.61	0.60	0.66
	4	2.16	1.90	1.64	1.12	1.12	0.86	0.88	0.80	0.74	0.68	1.19
	6	3.00	2.62	2.38	1.07	1.01	0.92	0.88	0.85	0.82	0.79	1.43
	8	4.23	5.28	4.75	1.15	1.12	0.96	0.94	0.93	0.91	0.90	2.12
Mean S1												1.35
S2	0	0.74	0.65	0.77	0.95	0.95	0.97	0.97	0.97	0.97	0.97	0.89
	4	2.67	3.61	3.41	1.37	1.13	1.10	1.08	1.06	1.05	1.03	1.75
	6	4.06	6.47	5.56	1.29	1.22	1.17	1.13	1.10	1.07	1.04	2.41
	8	6.66	8.36	7.51	1.40	1.23	1.14	1.15	1.12	1.09	1.02	3.07
Mean S2												2.03
Mean D		3.03	3.69	3.36	1.13	1.05	0.97	0.96	0.93	0.91	0.88	
LSD 0.05		Interaction										
S		S* T										
T		S*D										
D		S*D										
		K, mgkg^{-1}										
S1	0	47.14	48.51	49.89	47.6	47.10	46.67	46.31	46.00	45.73	45.48	47.05
	4	69.10	66.36	61.06	48.6	47.48	46.56	46.48	46.49	45.91	45.40	52.35
	6	74.59	69.10	63.51	53.5	50.73	48.55	46.78	47.35	46.03	46.04	54.62
	8	103.3	100.5	89.97	56.6	50.75	49.83	49.07	48.42	47.85	47.35	64.38
Mean S1												54.60
S2	0	52.14	53.51	54.89	50.6	49.60	49.17	48.91	48.60	48.33	48.08	50.39
	4	70.38	69.10	68.74	53.6	51.34	49.54	49.06	48.76	48.60	48.54	55.77
	6	80.08	78.82	73.21	57.4	55.13	53.29	51.79	50.52	49.42	48.46	54.97
	8	91.06	88.31	87.68	66.3	56.38	54.56	52.01	50.77	49.71	48.77	64.56
Mean S2												57.63
Mean D		73.48	71.78	68.62	54.3	51.06	49.77	48.80	48.36	47.70	47.27	
LSD 0.05		Interaction										
S		S* T										
T		S*D										
D		S*D										

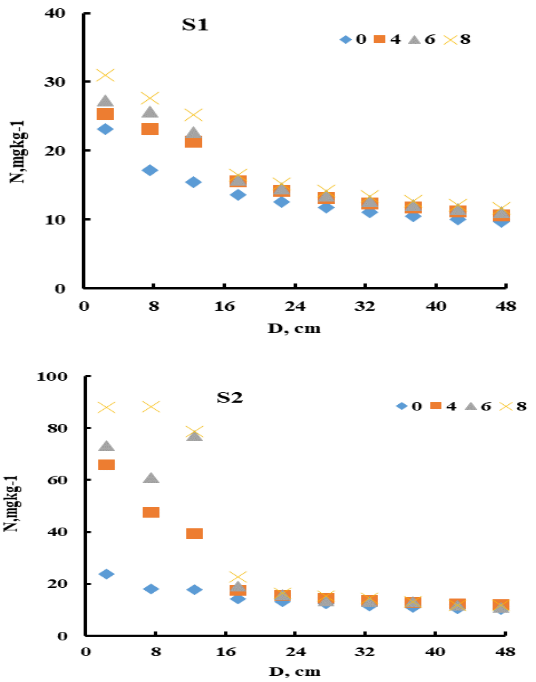

Fig.9. The available N mgkg^{-1} of sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle

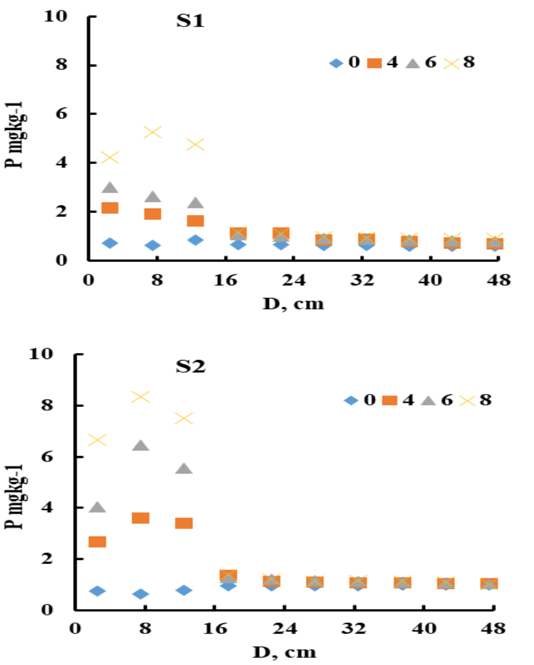

Fig.10.The available P mgkg^{-1} of sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle

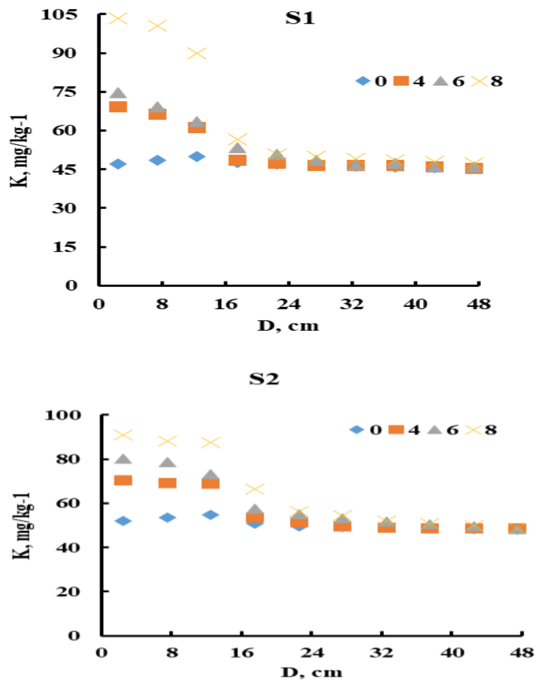

Fig.11.The available K mgkg^{-1} of sandy loam soil columns as affected by NSC application rates (T), applied saline irrigation waters (S) and soil depth increments (D) at the end of 8th wetting/drying cycle

CONCLUSION

The influence of NSC rates on water movement (infiltration & evaporation) and some chemical properties EC, pH, ESP, CEC, OM and available NPK content as well as SWC and AWC of sandy soil columns on may due to its effects on aggregation and welling. These phenomena may affect infiltration, redistribution, capillary rise and evaporation as well as enhancing chemical properties and available NPK contents. In this study, results show that NSC rates may improve aggregates stability of the surface treated depth due predominantly to cementation action of humic acid, which constitute 4.89 %. It may thus be inferred that NSC may enhance infiltration rate and consequently suppress evaporation (aggregation effect). The results revealed that the influence of NSC on evaporation was thus the result of opposing effects of aggregation and swelling. This study revealed that the essential function of NSC for enhancing the chemical properties and available NPK contents, also the role of adding NSC under saline waters was not effective in reducing evaporation and decreasing infiltration mainly of the nature of this soil conditioner. However, the role of using of saline waters on studied soil chemical properties and available NPK content generally significant effective in enhancing these soil properties.

Also, the expected outcomes will improve water use efficiency, reduce rrigation frequency, improve yield under saline irrigation waters and reduce leaching of nutrients in sandy soils.

REFERENCES

Al-Darby, A. M., A. M. Al-Omran and A. A. Shalaby. 1993. Influence of water absorption capacity of soil gel-conditioners. Journal College of Agriculture. King Saud University 5: 111-117.

Al-Omran , A. M., M.A. Mustafa, A. M. Al-Darby, A. A. Shalaby. 1991. Gel-conditioned barriers for water management of sandy soils. Irrigation Science. 12: 7-12.

Chaney, H. and R. S. Swift. 1986. Studies on aggregate stability, II: the effect of humic substances on the stability of reformed soil aggregates. Journal of Soil Science, 37: 337-343.

Dahnke, W. C. and G. V. Johnson. 1990. Testing soils for available nitrogen, in R. L. Westerman, ed., Soils Testing and Plant Analisis, 3rd., SSSA Book Series, No. 3, Soil Science Society of America, Madison, WI, USA.

Density. In A. K. Singh (Ed.), *Handbook of Soil Analysis Techniques* (pp. 45-67). Soil Science Society of America, Madison, WI.

El-Hady, O. A., M. Y. Tayel and A. A. Lotfy. 1981. Super gel as a soil conditioner. II: Its effect on plant growth, enzyme activity, water use efficiency and nutrient uptake. Acta Horiculturae 119: 257-265.

Hamblin, A. P. 1985. The influence of soil structure on water movement, crop root growth and water uptake. Advance of Agronamy. 38: 95-158.

Hillel, D. 1980. Application of Soil Physics. Academic Press, New York.

Klute, A. (ed.). 1986. Methods of Soil Analysis. Part 1. Agronomy Monograph No. 9. American Society of Agronomy, Madison, WI.

Kutilek, M., and D. R. Nielsen. 1994. Soil Hydrology. Catena-Verlag, Cremlingen-Destedt, Germany.

Lal, R. 1979. ann, K. K., A. W. Schumann, T. A.Obreza, J. B. Sartain, W. G. Harris and S. Shukla. 2011. Analyzing the efficiency of soil amendments and irrigation for plant production on heterogeneous sandy soils under greenhouse conditions. Journal of Plant Nutrition and Soil Science. 174(6): 925 932.

McNeal, B. L. 1968. Prediction of the effect of mixed salt solutions on soil hydraulic conductivity. Soil Science Society of America Journal.

Miller, D. E. 1979. Effect of H-SPAN on water retained by soils after irrigation. Soil Science Society America Journal. 43: 628-629.

Mustafa, M. A., A. M. Al-Omran, A. A. Shalaby, and A. M. Al-Darby. 1987. Horizontal infiltration of waterin soil columns as affected by a gel-forming conditioner. Soil Science Society of American Journal, 51, 1593-1599.

Page, A. L. (ed.). 1982. Methods of Soil Analysis. Part 2.. Agron. Monogr. 9. ASA and SSSA, Madison, WI.

Page, A. L., Miller, R. H., & Keeney, D. R. (1982). Methods of Soil Analysis. *Part 2: Chemical and Microbiological Properties (2nd ed.)*. Agronomy Monograph No. 9. American Society of Agronomy, Madison, WI.

Richards, L.A. (ed.). (1954). Diagnosis and Improvement of Saline and Alkali Soils. Handbook No. 60, U. S. Salinity Laboratory, California, U.S.A.

Sepaskhah, A. R. and A. R. Bazrafshan-Jahromi. 2006. Controlling runoff and erosion in sloping land with polyacrylamide under a rainfall simulator. Biosystem Engineering. 93(4): 469-474.

Snedecor, G.W. and W. G. Cohran. 1989. Statistical Method" 6th ed., Iowa State Univ. Press, Amess, Iowa, USA., p. 593.

Soltanpour, P. N. (1991). Determination of nutrient availability and elemental toxicity by AB-DTPA soil test and ICPS. *In Advances in Soil Science* (pp.165-190). Springer New York.

Sahar, M. Ismail and El-Cossy, S. A. E. 2023.The impact of adsorbent ameliorants on some physical properties and potato yield in sandy soil under deficit irrigation water. Alexandria Science Exchange Journal, Vol. 44, No.4.

Sahar, M. Ismail, Nourah Almulhim , Azza Sedky, El-Cossy, S, A. E. and Mahmoud E. 2025. Impact of soil ameliorants on soil chemical characteristics, sugar beet water productivity, and yield components in sandy soils under deficit irrigation. Sustainability 2025, 17, 1513.

Shalaby, A. A. 1993. Impact of gel –conditioned layer depth and water quality on water movement in sandy soils. Arid Soil Research and Rehabilitation, vol. 7, pp. 281-291.

Tayel, M. Y., and O. A. El-Hady. 1981.Super gel as a soil conditioner, I: its effect on some soil water relation. Acta Horiculturae 119: 247-256.

الملخص العربي

حركة المياه والخواص الكيميائية لتربة طميية رملية متأثرة بمحسن نانوى صناعى تحت مياه رى مالحة

أحمد محمد أحمد مختار – سحر محمد إسماعيل و صلاح عبد النبي الشحات القوسي

أُجريت دراسة معملية لتقييم تأثير محسن جديد نانوى صناعى (NSC) جديدة، يحتوي على ٤٨.٩ ملجم/ كجم⁻¹ من المادة العضوية و١٣٨ سنتيمول / كيلوجرام سعة تبادلية كاتيونية(CEC) ، على تربة طميية رملية تحت ريّ بمياه مالحة (٠.٨٦ و١.٦ ديسيسمنز م⁻¹). تم تطبيق الـ NSC بمعدلات ٠، ٤، ٦، و٨٪ مع إضافة ٢٤.٨٨ ملليمتر من المياه المالحة كل ٧ أيام خلال ثماني دورات ترطيب/تجفيف. أظهرت النتائج أن زمن التسرب ازداد بشكل معنوي مع زيادة معدلات NSC ومستويات ملوحة المياه، مما أدى إلى انخفاض معدلات التسرب. كما انخفض التبخر المتقطع (E) بشكل ملحوظ مع زيادة معدلاتNSC ، لكنه ارتفع عموماً مع تزايد عدد دورات الترطيب/التجفيف. أما نسبة المياه المخزنة (PWC) فقد ازدادت معنوياً مع ارتفاع معدلات NSCوزيادة عمق التربة، في حين لم يكن لتركيز الملوحة تأثير معنوي. كذلك، ارتفعت قيم التوصيل الكهربائي(EC) ، ودرجة الحموضة(pH) ، ونسبة الصوديوم المتبادل(ESP) ، والمادة العضوية(OM) ، والسعة التبادلية الكاتيونية (CEC) بشكل ملحوظ مع زيادة تركيز المياه المالحة وتطبيق NSCوبالمثل، تأثرت تركيزات المغذيات المتاحة NPK بشكل كبير؛ إذ ازدادت مع ملوحة المياه وتطبيقNSC ، لكنها انخفضت مع زيادة عمق التربة. تشير النتائج إلى أن NSCفعّال في تقليل التبخر ومعدل التسرب، مع تحسين تخزين المياه. كما أنه يُحسّن الخصائص الكيميائية للتربة وتوفر العناصر الغذائية، خاصة في الطبقة السطحية (٠–٣٠ سم). وتُعد هذه الدراسة المعملية الأولية خطوة مهمة لفهم كفاءة NSC كمُحسّن للتربة الطميية الرملية تحت ظروف الريّ بمياه مالحة، وتمهد أساساً لتصميم تجارب حقلية أكثر شمولاً وتفصيلاً لارتفاع تكلفتها.

الكلمات الدالة: طميية رملية , البخر ، معدل التسرب ، محسن نانوى ، مياه رى مالح.