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STUDY OF CORRELATION BETWEEN SOIL SALINITY AND SOIL CHEMICAL PROPERTIES IN THE NORTHERN NILE DELTA.

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ABSTRACT

According, salts in the studied soil profiles so, to conclude correlation between soil parameters and EC, where, salts affected on EC. The results revealed high significant relationship between EC and Ca^{2+}, Mg^{2+}, Na^{+}, Cl^{-} and SO_4^{2-}. Moreover, data initiate relation between EC and ESP and $CaCO_3$ and relationship between EC and CEC whereas, show simple correlation. According, to results, regression relation between EC and available Fe and Zn shows simple correlation.
Keywords: soil salinity, soluble cations and anions, ESP, $CaCO_3$, CEC, available Fe, available Zn, linear regression.

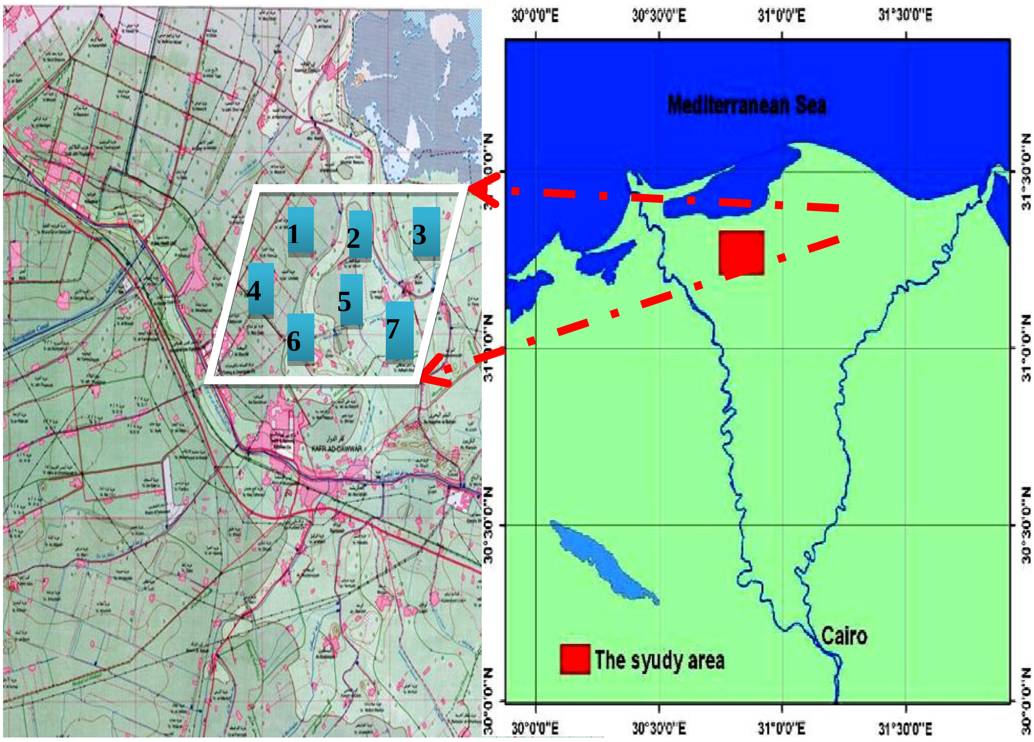
INTRODUCTION

The total cultivated area of the Nile Delta is 4354382 feddan (10363429 hectare) representing 55.5% of the cultivated land of Egypt. The Nile Delta, as well as arid land, is threatened by water logging, soil compaction, salinization and alkalinization (Gad & Abel Samei, 1998, and El Kassas, 1999). Low soil relief is an important factor affecting soil salinity and alkalinity of the large areas around the lakes in the northern parts of the Nile Delta of Egypt as the groundwater is high and consequently, the salts accumulate in these soils (Zein El Abedine *et al*., 1967 and Abou Kota, 2012). FAO, (2003) presented that land suffer from salinization problems in cultivated irrigated area in Egypt whereas, 6 % of Northern Delta region are salt-affected, 20 % of the Southern Delta and Middle Egyptian region and 25 % of the Upper Egypt region. Soil salinization is considered as one of the major and widely spread environmental problems, mainly in the arid and semiarid regions where crop water requirement is offset through irrigation using low-quality saline/ brackish water. This can be achieved either by bringing new soils to production or through reclamation of marginal saline lands, which are either giving low production or are set aside due to poor economic resources and technical know-how of farmers in dealing such soils (Hala and Assia, 2013). Shakir *et al.,* (2002) found that bulk density increase with increase in TSS and ESP but ESP effect is more. Particle density and porosity both decrease with increase in TSS and ESP then decrease is more due to ESP. High salts levels often causes poor physical soil characteristics including low aggregate stability, impervious subsoil layers, low infiltration rates, low hydraulic conductivities and soil surface crusting which in turn prevent seedling emergence and inhibit plant growth (Sharma and Minhas, 2005). El-Sodany, (2004) studied the effect of different salinity levels of irrigation water on some soil properties. The result indicated that use of high saline irrigation water lead to an increase in soil pH, EC, SAR, ESP, soluble ions (Ca^{2+}, Mg^{2+}, Na^{+}, Cl^{-} and SO_4^{2-}) and exchangeable cations (Ca^{2+} and Na^{+}) values.

The purpose of this study is to identify and quantitatively evaluate soil salinity in the northern Nile Delta region.

MATERIALS AND METHODS

The study area is located north of the Nile Delta between latitude 31^{o} 10' and 31^{0} 40' N, and longitudes 30^{o} 25' and $31^{0}20^{'}$ E. Idko drain on the east, Abou Keir drain on the west, in the north found the Idko lake, the lake found on a distance 1km from the Mediterranean Sea and in the south El-Mahmodia canal is present. Twenty-one samples (7 profiles) in depth 150cm were chosen to represent most of the variations in the study area shown in map (1).



Map (1). Location of studied area. (1:50000)
Source: Soils, Water and Environmental Res. Inst., ARC

Laboratory analysis:

Soil physical properties:

Particle size distribution was estimated using the pipette method, as described by Richards, (1954), soil bulk density was determined using metal cores for the undisturbed soil sample whereas, for the shale platy samples, the paraffin wax method was applied (Black, 1965). Hydraulic conductivity coefficient is determined using undisturbed soil cores, using Darcy law (Richards, 1954). Field capacity (FC) was measured as soil moisture content (%) at 0.10, 0.33 and 15 atm, using Pressure Membrane Apparatus Method (Klute, 1986). Available water capacity (AWC) range was calculated as the difference in moisture content (%) between field capacity and wilting point (Klute, 1986).

Soil chemical properties:

Organic matter was determined according to the method outlined by Jackson, (1967). Soil pH was measured in 1:2.5 soils water suspensions by using a pH meter (MODEL 420A) according to Van Reeuwijk, (1993). Cation exchange capacity (CEC) used method according to Bower *et al*., (1952). Gypsum was measured in the laboratory according to Schoonover, (1952). Calcium carbonate content ($CaCO_3$) according to (Wright, 1939). Sodium Adsorption ratio (SAR) used method according to Bower *et al*., (1952). Exchangeable sodium percentage (ESP) it may be calculated according to Allison *et al.,* (1954). Electrical conductivity (EC) is according to Richards, (1948) and Campbell *et al*., (1949) by using (CONDUCTANCE METER- YSI MODEL 35). Calcium and magnesium was by Titration with Ethylenediamine- tetraacetate (Versenate) according to Reitemeier, (1943). Sodium and potassium by using Flame Photometer model JENWAY PFP7 and carbonate and bicarbonate by titration with acid according to Reitemerir, (1943). Chloride was by titration with Silver Nitrate according to Page *et al*., (1982). Soluble sulfate was calculated by subtracting the total soluble anions from the total soluble cations according to (Page *et al*., 1982).

Nutrients content:

Available N was extracted by using 5.0g soil with 50mL 2M KCl Page *et al*., (1982) and determined using Kjeldahl methods Jackson, (1973). Available P in soil was extracted using *Sodium Bicarbonate* solution 0.5M at pH 8.5 according to Olsen *et al*., (1954). Available K in soil was extracted using 1N Ammonium Acetate solution" NH4OAC" at pH 7 according to Page *et al*., (1982). Available forms of Fe, Mn, Zn and Cu were extracted using DTPA method (Diethylene triamine penta acetic acid). The extracting solution was consisting of 0.005M DTPA, 0.01M $CaCl_2$ and 0.1M TEA (Triethanolamine) at pH adjusted to 7.3 using Hydrochloric Acid (1:1) according to Follet and Lindsay (1971).

Statically analysis:

SPSS (version 20) was used to determine the descriptive statistics and correlation analysis of physical and chemical soil properties. *SPSS* technology has made difficult analytical tasks easier through advances in usability and data access, enabling more people to benefit from the use of quantitative techniques in making decisions (Darren and Paul, 2013).

RESULTS AND DISCUSSION

Some soil properties in studied area.

Results of particle size distributions of the soil samples in Table (1) representing are heavy textured ranging between clay in the upper most surface layers. Moreover the percentage of clay are >79% in all samples. Similar results were also found by Ibrahim, (2001); Abou Kota, (2012) and Ahmed, (2013). Texture classes are according to USDA system Soil Survey Division Staff, (1993). Organic matter of the soil under study injunction that organic matter values in samples are low, whereas, range among 0.22 to 0.52% Mostly profiles suffered low of organic matter due to lack of attention to organic fertilization and overall dependence on nitrogen fertilization mineral in the form NH_4NO_3 33.5% and Urea 46%. This demonstrates the poverty of the soil organic matter content and thus infertility. Also, these results are expected in arid climatic conditions which are encouraging for biological activity and encourage organic matter decomposition.

Data illustrated in Table (1) reveal that calcium carbonate values in studied soils injunction that studied area being in the range of 0.41 to 1.25 %, these range (low), In addition, it could be suggested that there is relationship between $CaCO_3$ content and soil parent material. Data in table (1) show that gypsum values in studied soils ruling that studied soil in layers being in the range of 0.22 to 1.01%. The exchange characteristics of soils under study dictated that CEC values are between 32.32 to 40.00$Cmol_c$ kg^{-1}, Wang *et al.,* (2005) signified that positive correlation existed between soil CEC and soil organic content (R^2=0.34) and soil clay content (R^2=0.59).

Table 1. Particle size distribution and some chemical properties in studied area.

Profile No.	Depth (cm)	Particle size distribution (%)			Texture	Some chemical properties			
		Sand	Silt	Clay		OM (%)	CaCO3 (%)	Gypsum (%)	CEC $Cmol_c$ kg^{-1}
1	0-30	6.22	13.24	80.54	Clay	0.43	1.12	0.51	33.02
	30-60	5.45	14.00	80.55	Clay	0.52	0.97	0.87	32.52
	60-150	6.00	13.28	80.72	Clay	0.22	0.74	1.01	30.45
2	0-30	6.31	12.54	81.15	Clay	0.40	1.00	0.36	40.00
	30-60	6.30	10.25	83.45	Clay	0.40	0.66	0.48	36.36
	60-150	5.12	12.39	82.49	Clay	0.39	0.57	0.48	33.47
3	0-30	5.65	11.92	82.43	Clay	0.48	1.25	0.45	32.32
	30-60	6.00	11.00	83.00	Clay	0.37	1.01	0.45	33.00
	60-150	5.64	14.01	80.35	Clay	0.33	1.00	0.51	34.65
4	0-30	6.03	12.01	81.96	Clay	0.55	0.77	0.22	37.00
	30-60	5.70	13.00	81.30	Clay	0.50	0.71	0.34	36.36
	60-150	6.42	12.47	81.11	Clay	0.48	0.71	0.54	34.58
5	0-30	5.64	13.25	81.11	Clay	0.34	1.00	0.48	36.65
	30-60	5.69	13.20	81.11	Clay	0.37	1.11	0.55	34.65
	60-150	6.00	11.41	82.59	Clay	0.30	1.10	0.55	33.53
6	0-30	6.01	11.42	82.57	Clay	0.44	0.78	0.70	37.95
	30-60	5.56	13.00	81.44	Clay	0.41	0.77	0.70	38.82
	60-150	6.14	14.11	79.75	Clay	0.41	0.68	0.76	40.00
7	0-30	6.02	12.25	81.73	Clay	0.50	0.55	0.45	33.69
	30-60	5.51	12.32	82.17	Clay	0.47	0.54	0.56	35.36
	60-150	4.86	13.25	81.89	Clay	0.40	0.41	0.71	39.02

Having the correct pH is crucial for the healthy plant growth as it affect the amount of nutrient available to plants (Nur *et al.,* 2014). From the data in Table 2 obtainable in this study, it is clear that soil pH value between (7.77 to 8.23). Data in table (2) obtainable that soil salinity values between 2.22 to 6.66 dS m^{-1}, however, values of soil salinity (EC) indicate slightly saline or moderately saline soils. The dominant soluble cations are Na^{+}, Ca^{+2} and Mg^{+2} and the content of K^{+} are rather low in a descending order, while soluble anions are dominated with Cl^{-} and SO_4^{-2}. High concentrations of neutral salts, such as sodium chloride and sodium sulfate may interfere with the absorption of water by plants because the osmotic pressure in the soil solution is nearly as high as or higher than that in the plant cells. Distribution of soil salinity is shown in table (2). The pattern of soluble anions and cations indicates that NaCl, Na_2SO_4, $MgSO_4$ and $CaCl_2$ / $MgCl_2$ pre dominate the soluble salts in the studied soil profiles. The level of exchangeable sodium percentage ranges from 5.08 to 16.17. Soils ESP and SAR are positively related because soils solution cations and exchange cations are nearly always in equilibrium with each other (Singer and Munns, 1996). The ESP is not the only indicator of soil stability because the salt concentration of the soil solution also affects soil dispersion.

Data exhibited in Table (3) demonstrated the vertical distribution of the available N of the studied soil profiles, which epitomize in studied soils range among (76.64 to 140.00mg kg^{-1}). El Sayed, (2009) revealed that a significant positive correlation between each of clay, silt, OM and available water on one hand and available N on other hand (r=0.723**, r=0.302**, r=0.869** and r=0.737**, respectively). Data exhibited in Table (3) demonstrated the vertical distribution of the available P of the studied soil profiles are range between 1.20 to 2.00mg kg^{-1}, also, the value is low content according to the levels outlined by page *et al*., (1982) and modified to suit main conditions in soils Egypt as mentioned in outlined by Baker *et al.,* (1999); namely, low content (<5 mg kg^{-1}), medium content (5-10 mg kg^{-1}) and high content (>10 mg kg^{-1}). As indicated in Table (3) show that the available amount of K in studied soil sediments, available K is ranged among 736.89 to 771.08 mg kg^{-1}. The relatively high amounts of available K in the layers of the Nile alluvial sediments could be mainly attributed to the relatively high content of bound K-organic and K-exchangeable fractions. An interesting observation on the content of available K in relation to soil texture was noticed as, however, the clay fraction showed substantially higher concentrations (Table 3).

Table 2. Soil pH, electrical conductivity, soluble cations or anions, sodium adsorption ratio and exchangeable sodium percentage in studied area.

Profiles	Depth (cm)	pH 1:2.5 soils water suspensions	EC dS m^{-1} soil pest ext.	Soluble cations (mmolc L^{-1})				Soluble anions (mmolc L^{-1})			SAR	ESP
				Ca^{2+}	Mg^{2+}	K^{+}	Na^{+}	Cl^{-}	HCO_3^{-}	SO_4^{2-}		
1	0-30	7.81	6.66	12.34	9.34	1.22	43.70	51.00	0.59	15.01	13.27	16.17
	30-60	7.88	5.11	14.02	11.02	0.98	25.08	39.39	0.35	11.36	7.09	8.87
	60-150	8.12	5.00	15.00	12.00	1.12	21.88	40.00	0.49	9.51	5.95	7.54
2	0-30	8.00	4.98	11.25	8.25	1.40	28.90	33.52	0.77	15.51	9.26	11.43
	30-60	8.00	4.52	11.02	8.02	0.99	25.17	32.25	0.36	12.59	8.16	10.14
	60-150	8.22	4.41	11.00	8.00	1.00	24.10	34.00	0.37	9.73	7.82	9.74
3	0-30	7.77	6.05	13.00	10.00	1.12	36.38	50.00	0.49	10.01	10.73	13.17
	30-60	7.86	6.00	12.56	9.56	1.30	36.58	49.25	0.67	10.08	11.00	13.49
	60-150	8.00	5.01	12.04	9.04	1.14	27.88	44.01	0.51	5.58	8.59	10.64
4	0-30	8.00	3.22	9.52	6.52	1.98	14.18	25.52	1.35	5.33	5.01	6.42
	30-60	8.01	2.66	9.00	6.00	0.99	10.61	19.82	0.36	6.42	3.87	5.08
	60-150	8.00	2.65	8.91	5.91	0.78	10.90	18.85	0.15	7.50	4.00	5.23
5	0-30	7.91	2.69	7.00	4.00	0.64	15.26	18.25	0.01	8.64	6.51	8.19
	30-60	7.98	2.54	7.00	4.00	0.99	13.41	17.88	0.36	7.16	5.72	7.26
	60-150	7.99	2.51	8.01	5.01	1.00	11.08	18.00	0.37	6.73	4.34	5.63
6	0-30	8.00	3.00	7.11	4.11	1.52	17.26	24.52	0.89	4.59	7.29	9.11
	30-60	8.00	2.46	6.90	3.90	1.22	12.58	18.50	0.59	5.51	5.41	6.90
	60-150	8.01	2.22	4.42	1.42	1.12	15.24	18.00	0.49	3.71	8.92	11.03
7	0-30	8.11	4.00	10.00	7.00	1.36	21.64	32.21	0.73	7.06	7.42	9.27
	30-60	8.13	3.15	10.25	7.25	1.41	12.59	22.00	0.78	8.72	4.26	5.53
	60-150	8.13	3.00	9.39	6.39	1.25	12.97	23.14	0.62	6.24	4.62	5.96

No detected CO_3^{2-}

Table 3. Status of macro and micro nutrients in studied area.

Profile No.	Depth (cm)	Available Macro- Nutrients (mg kg^{-1})			Available Micro- Nutrients (mg kg^{-1})			
		N	P	K	Fe	Mn	Zn	Cu
1	0-30	84.57	1.24	744.19	0.17	0.52	0.28	0.39
	30-60	79.36	1.54	744.28	0.22	0.89	0.24	0.67
	60-150	78.85	1.90	745.85	0.27	1.03	0.19	0.78
2	0-30	110.00	1.36	749.83	0.19	0.37	0.25	0.28
	30-60	79.98	1.45	771.08	0.20	0.49	0.17	0.37
	60-150	92.00	1.78	762.21	0.25	0.49	0.14	0.37
3	0-30	99.36	2.00	761.65	0.28	0.46	0.31	0.35
	30-60	99.00	1.67	766.92	0.23	0.46	0.25	0.35
	60-150	99.01	1.74	742.43	0.24	0.52	0.25	0.39
4	0-30	140.00	1.60	757.29	0.22	0.32	0.19	0.09
	30-60	111.24	1.85	751.21	0.26	0.35	0.18	0.26
	60-150	100.42	1.22	749.46	0.17	0.55	0.18	0.42
5	0-30	100.00	1.00	749.46	0.14	0.49	0.25	0.37
	30-60	99.68	1.66	749.46	0.23	0.56	0.28	0.42
	60-150	87.52	1.34	763.13	0.19	0.56	0.28	0.42
6	0-30	100.32	1.25	762.95	0.18	0.71	0.20	0.54
	30-60	88.25	1.20	752.51	0.17	0.71	0.19	0.54
	60-150	76.64	1.22	736.89	0.17	0.78	0.17	0.59
7	0-30	72.69	1.70	755.19	0.24	0.46	0.14	0.35
	30-60	87.00	1.52	759.25	0.21	0.57	0.14	0.43
	60-150	77.82	1.43	756.66	0.20	0.72	0.10	0.55

Data presented in Table (3) show that the values of available Fe in studied soils between 0.14 to 0.27mg kg^{-1}. This confirms amphoteric features of manganese and iron oxides, where pH plays a key role in their chemical behavior, specifically related to the mineral phase of the soil (Jean *et al.,* 2014). Regarding the available amounts of Mn in the different studied soil sediments, data in Table (3) show that values of available Mn the range between 0.32 to 1.03mg kg^{-1}. Moreover, data in table (3) show that available Zn the range between 0.10 to 0.31mg kg^{-1}. Available Cu is range between 0.28 to 0.78mg kg^{-1}. Abou Kota, (2012) indicated that available amounts of Zn ranged from 0.39 to 1.23 mg kg^{-1}. Furthermore, found that the reduction in available amounts of Zn in the old lacustrine sediments may be attributed to relatively high content of $CaCO_3$ which inversely affected their availability in soils, too, initiate that Data of available Cu are given highest value was all profiles in fluvial marine plain, available copper of the studied profiles were range from 0.80 to 19.60 mg kg^{-1}.

Correlation between soil salinity and soil properties.

Results obtained from regression analysis between the electrical conductivity [EC] and some soil properties are shown in figures (1, 2 and 3). Results indicated that there is a high significant relationship between electrical conductivity and Ca^{2+}. Consequently, there is increase EC when Ca^{2+} increase, whereas, R^2=0.7351 and below equation can be an suggested y=1.6624X+3.5089 as indicated in figure (1). Results obtained from regression analysis between the level of EC and Mg^{2+} indicated that there is a significant relationship between EC and Mg^{2+}. Consequently, there is increase EC when Mg^{2+} increase, whereas, R^2=0.7351 and below equation can be suggested y=1.6624X+3.5089 as show in figure (2). Hasegawa *et al.,* (2000) illustrated that the common cations associated with salinity are Na^+, Ca^{++} and Mg^{++}while the common anions are Cl^-, SO_4^{2-} and HCO_3^-. However the Na^+ and Cl^- are considered the most important Na^+ in particular causes deterioration of physical structure of the soil and both Na^+ and Cl^- are toxic to plants. Singh and Chatratb, (2001) stated that furthermore specific ions may induce direct toxicity or due to insolubility at high pH, for instance and increase of exchangeable Na^+ in sodic soils results in a decrease of Mg^{++} and Ca^{++} thus causing a deficiency in these elements.

Also, results specified that there is a high significant relationship between electrical conductivity and Na^+. Consequently, there is increase EC when Na^+ increase, where, R^2=0.9173 and below equation can be suggested y=6.6547X+5.1064, expression figure (3). Qurirk, (2001) stated that salinity stress caused by sodium ion causes structural problem in soils treated by physical processes such as slaking, swilling and dispersion of clay as well as conditions that may cause surface crusting and hard setting. Fetter, (2001) conducted that the soil structure is destroyed as Na^+ weaken the bonds between the clay particles due to the exchangeable soil with exchangeable Na^+ ions. Finally, there is an increase in EC when Ca^{2+}, Mg^{2+} and Na^+ increase.

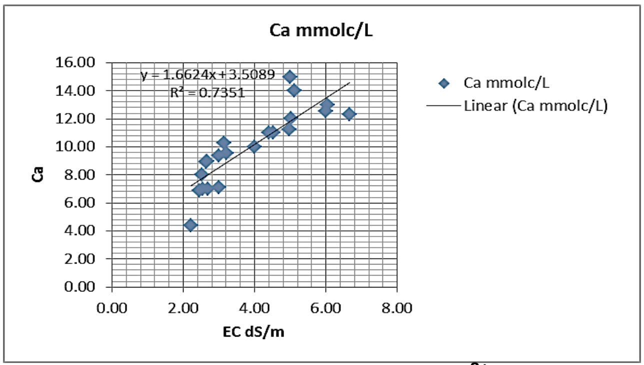


Figure (1). Regression relation between EC and Ca^{2+} in the studied soil.

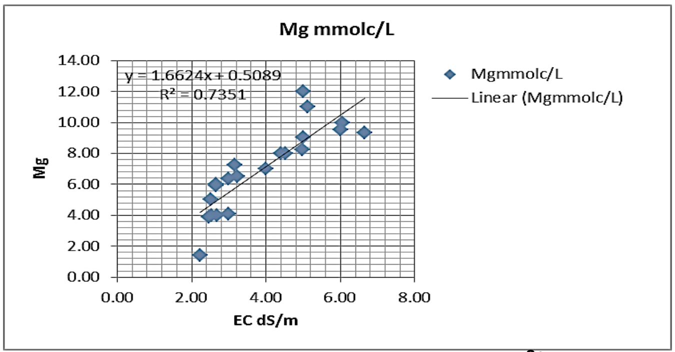


Figure (2). Regression relation between EC and Mg^{2+} in the studied soil.

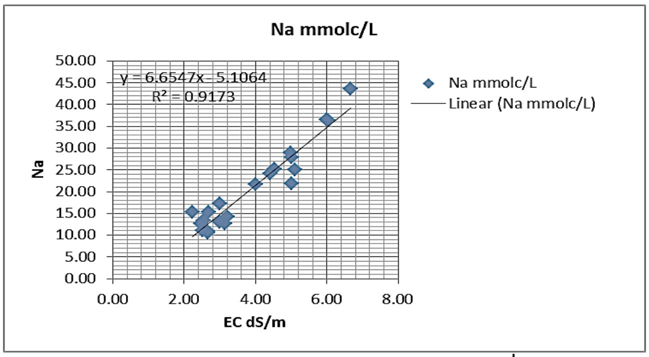


Figure (3). Regression relation between EC and Na^{+} in the studied soil.

In this regard, liner relations between these EC and soil parameter were studied. According to results, regression relation between EC and Cl^- and shows high correlation whereas, R^2=0.9659 and below equation can be suggested y=8.2995X+2.339, confirmation figure (4). According to results regression relation between EC and SO_4^{2-} and shows correlation whereas, R^2=0.5221. Consequently, there is an increase in EC when SO_4^{2-}increase and below equation can be suggested y=1.6801X+1.8805 show figure (5).

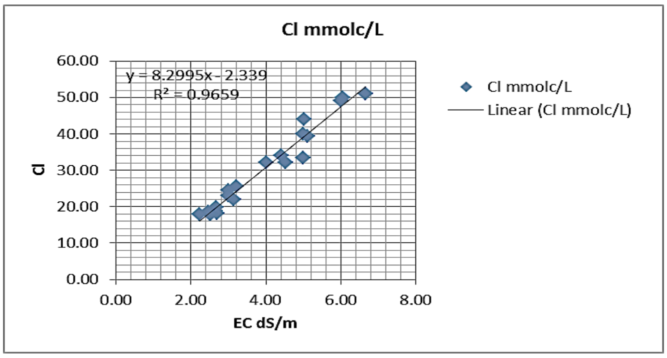


Figure (4). Regression relation between EC and Cl^- in the studied soil.

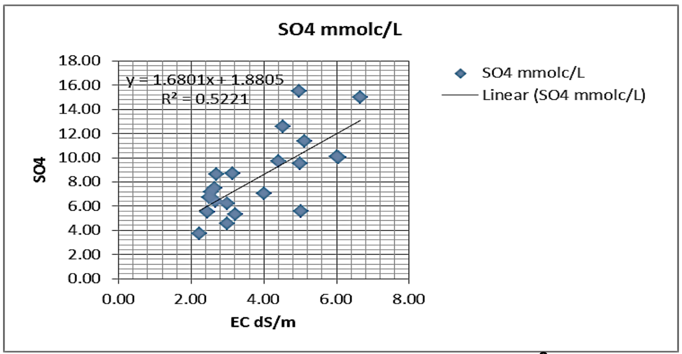


Figure (5). Regression relation between EC and SO_4^{2-} in the studied soil.

Moreover, results regression relation between EC and ESP and shows high correlation whereas, R^2=0.6772. Consequently, there is an increase in EC when ESP increase and below equation can be suggested y=2.4458X+2.8371, show figure (6). In addition, results showed regression relationship between EC and $CaCO_3$ whereas show correlation (R^2=0.1694) and below equation can be suggested y=0.0683X+0.5646, consequently, there is an increase in EC when $CaCO_3$ increase, show figure (7). Furthermore, results showed regression relationship between EC and CEC whereas show simple correlation (R^2=0.3011) and below equation can be suggested y=1.0691X+3.9566, consequently, there is an increase in EC when CEC decrease, show figure (8). Ebtisam *et al.,* (2013) established that regression equation between soil ESP as affected by soil salinity EC and soil CEC was estimated and data predicted that highly positive significant relation ($P<0.01$) were obtained with soil EC and low significant one with soil CEC and below equation can be suggested Y=0.042X+0.257 (R^2=0.627). In this regard, liner relations between these EC and soil variables were studied. According to results regression relation between EC and $CaCO_3$ and shows simple correlation whereas, R^2=0.037. Consequently, there is an increase in EC when $CaCO_3$ decrease. Ahire *et al.,* (2013) existing that results show less significant correlation between EC and $CaCO_3$ content (Rx=-0.357).

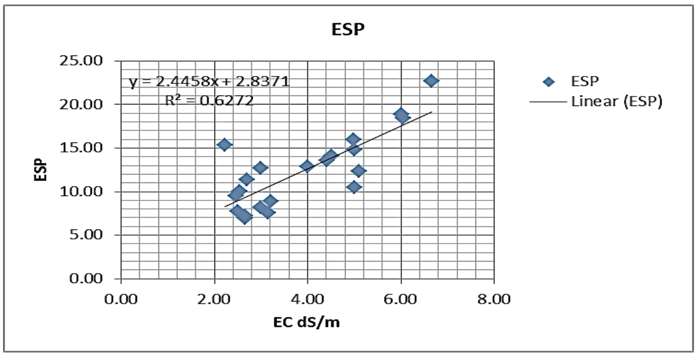


Figure (6). Regression relation between EC and ESP in the studied soil.

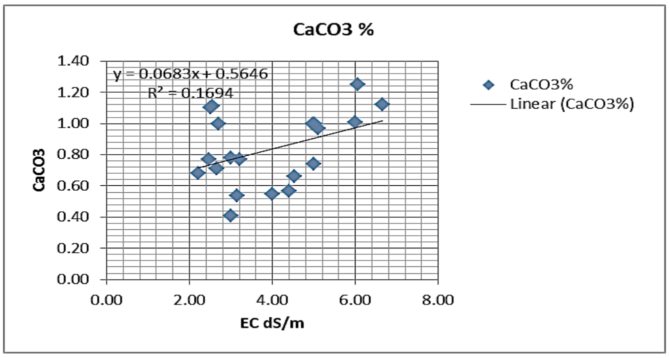


Figure (7). Regression relation between EC and $CaCO_3$ in the studied soil.

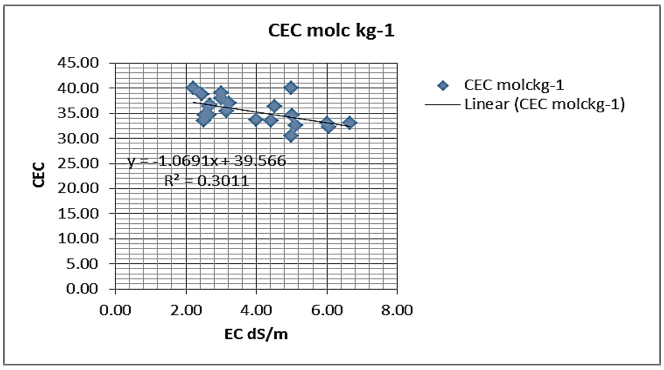


Figure (8). Regression relation between EC and CEC in the studied soil.

In this regard, liner relations between these EC and soil variables were studied. According to results, regression relation between EC and available Fe and shows correlation while, R^2=0.171. Thus, there is an increase in EC when available Fe decreases, below equation can be suggested y=0.0113X+0.1672. Moreover, according results, regression relation between EC and available Zn and shows correlation while, R^2=0.1694. Thus, there is an increase in EC when available Cu increases, below equation can be suggested y=0.0171X+0.1412 as shown figures 9 and 10.

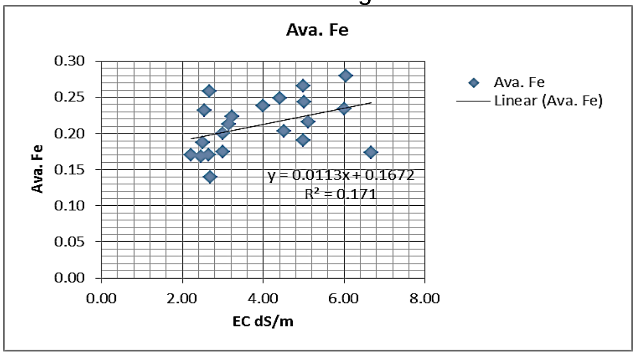


Figure (9). Regression relation among EC and available Fe in the studied soil.

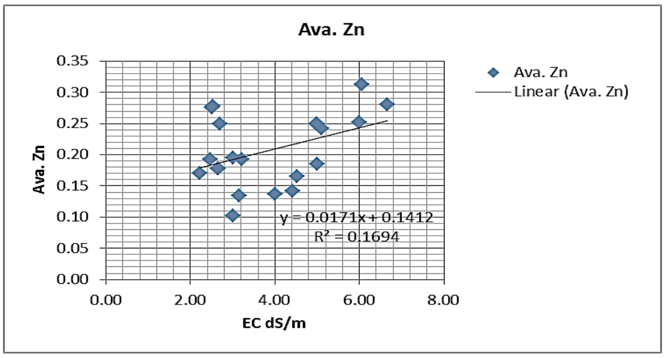


Figure (10). Regression relation mid EC and available Mn in the studied soil

CONCLUSIONS

The studied area is demonstrated some soil properties however, particle size distributions of the studied soil representing are heavy textured ranging concerning clay in the upper most surface layers**.** Moreover the percentage of clay are >79% in all samples. OM values of the soil under study injunction in samples are low, whereas, range among 0.22 to 0.52% Mostly profiles suffered low of organic matter. Data illustrated reveal that $CaCO_3$ values in studies soils injunction that studied area being in range of 0.41 to 1.25 %. Data shown gypsum values in studies soils ruling that studied soil in layers being in the range of 0.22 to 1.01%. Exchange characteristics of the soils under study dictated that CEC values are between 32.32 to 40.00Cmol$_c$ kg^{-1}. The pattern of soluble anions and cations indicates that NaCl, Na_2SO_4, $MgSO_4$ and $CaCl_2$ / $MgCl_2$ pre dominate the soluble salts in the studied soil profiles.

Data exhibited the vertical distribution of available N of the studied soil profiles, which epitomize in studied soils range among (76.64 to 140.00mg kg^{-1}), available P of the studied soil profiles are range between 1.20 to 2.00mg kg^{-1} and available K is ranged among 736.89 to 771.08 mg kg^{-1}. Else, Data show that values of available Fe in studied soils between 0.14 to 0.27mg kg^{-1}, available Mn the range between 0.32 to 1.03mg kg^{-1}, available Zn range between 0.10 to 0.31mg kg^{-1} and available Cu of profiles were range from 0.80 to 19.60 mg kg^{-1}.

According, salts in the studied soil profiles so, to conclude correlation between soil parameters and electrical conductivity, on the light, salts affected on EC. The results revealed high significant relationship between EC and Ca^{2+} and Mg^{2+} whereas, R^2=0.7351, high significant relationship between EC and Na^+ whereas, R^2=0.9173. In addition, results, regression relation between EC and Cl^- and shows high correlation whereas, R^2=0.9659, regression relation between EC and SO_4^{2-} and shows correlation whereas, R^2=0.5221. Data initiate relation between EC and ESP and shows high correlation whereas, R^2=0.6772, relationship between EC and $CaCO_3$ whereas show correlation (R^2=0.1694) and relationship between EC and CEC whereas show simple correlation (R^2=0.3011). According to results, regression relation between EC and available Fe and shows correlation whereas, R^2=0.171 and relation between EC and available Zn and shows correlation whereas, R^2=0.1694.

REFERENCES

Abou Kota, M. (2012). Distribution of salinity and nutrients in soils of Egypt and Tunisia under recently environmental changes. M. Sc. Thesis. Institute of African Research and Studies. Cairo Univ. Egypt.

Ahire, D.; Chaudhari, P.; Vidya, D. and Apatil, A. (2013). Correlation of electrical conductivity and dielectric constant with physic- chemical properties of black soils. International J. of scientific and Research Publication, Vol. 3, Issue 2.

Ahmed, S. (2013). Evaluation of the land resources for agricultural development - case study: El-Hammam canal and its extension, NW coast of Egypt. Ph. D. Thesis, zur Erlangung des Doktorgrades der Naturwissenschaften im Department Geowissenschaften der Universität Hamburg.

Allison, L.; Richards, L.; Reeve, R.; Bernstem, L.; Bower, A.; Brown, J.; Fireman, M.; Hatcher, J.; Hayward, H.; Pearson, G. and Wilcox, L. (1954). Diagnosis and improvement of saline and alkali soils. Untied staff salinity laboratory staff. L.A. Richards (Editor). Agriculture Handbook: 60. U.S. Department of Agriculture.

Baker, M.; Negm, A. and Khalial, K. (1999). Manual of soil, plant and water analysis methods. Plant Nutrition Dep. Soils, Water and Environ. Institute, Agric. Res. Center. Ministery of Agric. Determination of Soil Fertility Project.

Black, C. (1965). “Methods of Soil Analysis”, Part I. Amer. Soc. of Agronomy, Icn., Medison, Wisconsin, U.S.A.

Bower, C.; Reitemeier, R. and Fireman, M. (1952). Exchangeable cation analysis of saline and alkali soils. Soil Sci. 73:251-261, illus.

Campbell, R.; Bower, C. and Richards, L. (1949). Change of electrical conductivity with temperature and the relation of osmotic pressure to electrical conductivity and ion concentration for soil extracts. Soil Sci. Soc. Amer. Proc. (1948)13:66-69, illus.

Darren, G. and Paul, M. (2013): IBM SPSS Statistics 21 Step by Step: A Simple Guide and Reference, 13/E. Paper, 416 pp. Published 07/16/2013.

Ebtisam, I.; Abd El-Hady, M. and Zaghloul, A. (2013). Relationship between soil physical and chemical properties and hydrophsical soil properties under reuse of agriculture drainage water. American- Eurasian J. Agric. and Environ. Sci., 13 (1): 01-06.

El Kassas, M. (1999). Desertification and land degradation in arid regions. Alla, ElMorfa, Kuwait.

El Sayed, Sh. (2009). Geographic information system for nutrient requirements in El Fayoum district, El Fayoum Governorate, Egypt. M. Sc. Thesis. Fac. of Agric., Fayoum Univ., Egypt.

El-Sodany, M. (2004). Evaluation of some soil properties and barley Environ. Biol., 5(8): 2522-2526.

FAO (2003). Salt affected soils, contract. No. PR., 26897, ISCW Project Gw, 561003120. Rome.

Fetter, C. (2001). “Applied Hydrogeology”, $_4$th Edition. Prentice Hall, USA.

Follett, R. and Lindsay, W. (1971). Changes in DTPA- extractable zinc, iron, manganese and copper in soils following fertilization. Soil Sci. Soc. Amer. Proc., 35: 600-607.

Gad, A. and Abel Samei, A. (1998). Study on desertification of irrigates arable lands in Egypt,-salinization. Accepted for publication in the Egyptian J. of Soil Science, ref. 9/98, v.2000.

Hala, M. and Assia, A. (2013). Soil salinity mapping in the Sinai peninsula of Egypt using geographic information system and remote sensing techniques. Chap.7. Development in soil salinity assessment and reclamation 113-160:826. Survey Research Inst., National Water Research Center. Egypt.

Hasegawa, P.; Bressan, R; Zhu, J. and Bohnert, H. (2000). Plant cellular and molecular responses to high salinity. Annu. Rev. Plant Physoil. Plant Mol. Biol., 51: 463-499.

Ibrahim, D. (2001). Pedological studies on some soils in El-Beheira governorate. Ph. D. Thesis, Fac. of Agric., Zagazig University.

Jackson, M. (1973): Soil chemical analysis. Pretice- Hall, Inc., Englewood Cliffs, New Jersey, U.S.A.

Jackson, M. (1967). “Soil chemical analysis”. Prentic Hall, Ladia Private, LTD., New Delhi.

Jean, D.; Witold, G.; Karolina, F.; Agnieszka, D. and Milena B. (2014). Site-specific evaluation of Cu, Zn, Fe and Mn availability in arable soils. Zemdirbyste- Agriculture, vol. 101, No. 3, p. 235-242. ISSN 1392-3196.

Klute, A. (Ed.) (1986). “Methods of soil analysis”, Part 1. Physical and Mineralogical Methods, 2nd (Ed.), Amer. Soc. Agronomy, Madison, Wisconsin, U.S.A.

Nur, A.; Ezrin, M. and Aimrun, W. (2014). Relationship between soil apparent electric conductivity and pH value of Jawa series in oil palm plantation. 2nd International Conference on Agricultural and Food Engineering. Volume2. 2014, pages 199-206.

Olsen, S.; Cole, C.; Watanable, F. and Dean. L. (1954). Estimation of available phosphorus in soils by extraction with sodium bicarbonate. U.S. Dept. Agric. Circular No. 939.

Page, A.; Miller, R. and Keeney, D. (1982). “Methods of soil analysis”. Part 2. Chemical and Microbiological Properties. 2nd (Ed.). Amer. Soc. of Agronomy. Madison, Wisconsin, USA.

Quirk, J. (2001). The significance of the threshold and turbidity concentrations in relation to sodicity and microstructure. Australian J. Soil Research 39: 1185-1217.

Reitemeier, R. (1943). Semi microanalysis of saline soil solutions. Indus. and Engin. Chem., Analyt. Ed. 15:393-402, illus.

Richards, L. (1948). Porous plate apparatus for measuring moisture retention and transmission by soil. Soil Sci. 66:105-110, illus.

Richards, L. (1954). Diagnosis and Improvement of Saline and Alkaline Soils. United States Dept. of Agric., Handbook No. 60.

Schoonover, W. (1952). Examination of soils for alkali. University of California Extension Service, Berkeley, California (Mimeographed).

Shakir, M.; Hassan, A. and Razzaq, A. (2002). Effect of salts on bulk density, particle density and porosity of different soil series. Asian J. Plant Sci., 1 (1): 5-6.

Sharma, B. and Minhas, P. (2005). Strategies for management saline/alkali waters for sustainable agricultural production in South Asia. Agric. Water Mgt. 78:136-151.

Singh, K. and Chatrath, R. (2001). Chapter 8: salinity Tolerance. Extracted from Reynolds, M. P., J. I. Ortiz- Monastrio, ans A. McNab (eds.) 2001. Application of Physiology in Wheat Breeding. Mexico, D. F.: CIMMYT.

Soil Survey Division Staff. (1993). Soil survey laboratory information manual. Soil survey investigations report, No. 45. Version 1.0- 22:25.

Van Reeuwijk, L. (1993). Procedures for Soil Analysis. CIP-Gegevens Koninklijke Bibliotheek, Den Haag, Wageningen: International Soil Reference and Information Centre. Technical Paper / International Soil Reference and Information Centre. ISSN 0923-3792: No. 9. Trefw.: Bodemkunde. ISRIC. Fourth Edition.

Wang, Q.; Li, Y. and Klassen, W. (2005). Determination of cation exchange capacity on low to highly calcareous soils. Communications in Soil Sci. and Plant Analysis, 36:1479-1498.

Wright, C. (1939). “Soil Analysis”. Thomas Murby Co., London.

Zein El Abedine, A.; Fathi, A. and Abbas, R. (1967). A preliminary investigation on the main factors affecting soil salinity and alkalinity in Kafr El Shaikh governorate, Egypt .J. Soil Sci., 7 No. (3).33-44.

دراسة الارتباط بين ملوحة التربة وخواص التربة الكيميائية في شمال الدلتا

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استنتج من منطقة الدراسة بعض خواص التربة حيث كان التوزيع الحجمي للحبيات طيني ثقيل وكانت نسبة الطين تزيد عن ٧٩% في جميع العينات. وكانت المادة العضوية في منطقة الدراسة ضعيفة جدا حيث كانت النسبة ٠.٤١الي ١.٢٥%. واضافت النتائج ان نسبة كربونات الكاليسوم في التربة تتراوح بين ٠.٢٢ الي ١.٠١% وكانت نسبة السعة التبادلية الكاتيونية تتراوح بين ٣٢.٣٢ الي ٤٠.٠٠. وبناءا الكاتيونات والانيونات المتواجدة بالتربة أدت الي الآملاح السائدة هي كلوريد الصوديم، كبريتات الصوديم، كبريتات الماغنسيوم، كلوريد الكالسيوم، كلوريد الماغنسيوم. أوضحت البيانات أن التوزيع الآفقي للقطاعات بالنسبة للنتروجين الميسر ٧٦.٦٤ الي ١٤٠.٠٠ملليجرام/كجم تربة اما الفوسفور الميسر تتراوح النسبة بين ١.٢ الي ٢.٠ ملليجرام/كجم تربة وكذلك البوتاسيوم ٧٣٦.٨٩ الي ٧٧١.٠٨ ملليجرام/كجم تربة واضافت النتائج ان الحديد الميسر في التربة يتراوح نسبته بين ٠.١٤ الي ٠.٢٧ ملليجرام/كجم تربة اما الزنك تتراوح النسبة من٠.٠١ الي ٠.٣١ ملليجرام/كجم تربة اما النحاس الميسر تتراوح نسبته من ٠.٨ الي ١٩.٩ ملليجرام/كجم تربة.

بناءا علي الاملاح السائده في القطاعات لمنطقة الدراسة اتضح ان هناك علاقة بين قياسات التربة ودرجة التوصيل الكهربي. وعلي ضوء ذلك وجود الاملاح يؤثر بشكل كبير ومباشر علي درجة التوصيل الكهربي. حيث وجد ارتباط قوي بين درجة التوصيل الكهربي والكالسيوم والماغنسيوم حيث كانت(R^2=٠.٧٣٥١) وأيضا وجود ارتباط قوي بين درجة التوصيل الكهربي والصوديم حيث كانت (R^2=٠.٩١٧٣). واضافت النتائج وجود ارتباط قوي بين التوصيل الكهربي والكلوريد حيث كانت (R^2=٠.٩٦٥٩) وارتباط قوي مع الكبريتات حيث كانت (R^2=٠.٥٢٢١) وأيضا هناك علاقة قوية بين درجة التوصيل الكهربي ونسبة الصوديم المتبادل حيث كانت (R^2=٠.٦٧٧٢). وظهرت النتائج وجود ارتباط ضعيف بين درجة التوصيل الكهربي و كربونات الكالسيوم حيث كانت (R^2=٠.١٦٩٣). من النتائج المتحصل عليها وجد علاقة عكسية مع السعة التبادلية الكاتيونية ودرجة التوصيل الكهربي؛ كلما قلت درجة التوصيل الكهربي كلما زادت السعة التبادلية الكاتيونية حيث كانت (R^2=٠.٣٠١١). وبناءا علي النتائج اوضحت وجود علاقة بسيطة بين درجة التوصيل الكهربي والحديد الميسر حيث كانت (R^2=٠.١٧١٠) وايضا علاقة بسيطة بين درجة التوصيل الكهربي والزنك الميسر حيث كانت (R^2=٠.١٦٩٤)