Surface layer does seem to have had decrease in $CaCO_3$ content compared with lower depths. i.e $CaCO_3$ content was decrease with the increasing soil depth. However, $CaSO_4$ content was varied in between terraces to 62 meq/100g soil. The range for the sand fraction was from 30.98 to 74.98 %. For the silt fraction, the observed range was from 17.40 to 50.40 %. The data for the clay fraction showed a range from 5.62 to 26.62%.

In conclusion, It should be remembered that, because of the presence of carbonates and gypsum, textural analysis will always be difficult and we would like to draw the attention about the problem of salinity,

REFERENCES

1- Bouyoucos, G.J. 1951. A Recalibration of the Hydrometer for making mechanical analysis of soils. Agron.J 43: 9.

2- Chapman, M, Pratt, F. 1961. Methods of Analysis for soils, plants and waters. Univ. Calif. Div. of Agric. Sci.

3- Dalal, R.C. 1989. Long Term Effects of No-Tillage, Crop Residue and Nitrogen Application on Properties of a Vertisol. *Soil Science Society of America Journal* 53, 1511-1515.

4- Elgabaly ,M,M., Fakhry,S,T. 1965. on the definition of salt affected soils with regard to depth. 1st of land Rec. Univi of Alex.UAR.

5- Greenway, H. Munns, R. 1980. Mechanism of salt tolerance in non-halophytes. Ann Rev Plant Physiol 31: 149-190.

6- Gupta. ,A R.K., A. D.K.Bhumbla & I. P. Abrol. 1984. Effect of Sodicity, PH, organic matter and calcium carbonate on the dispersion behaviour of soils. Soil Science 137, 245-251.

7- Hesse, P.R. 1971. *A Textbook of Soil Chemical Analysis*. John Murray, London.

8 - Kovda, V.A. 1973. The Principles of pedology. General theory of soil formation, first book, Nauka, Moscow.

9 - Mead, R.N., Curnow, R.N. & Hasted, A.M. 2003. *Statistical Methods in Agricultural and Experimental Biology*. 3rd Edition. Chapman and Hall/ CRC Press.

10- Rengasamy, P. 1983. Clay dispersion in relation to changes in the electrolyte composition of dialysed red-brown earths. Journal of Soil science 34,723-732.

11- Rhoades, J.D., Krueger, D.B. & Reed, M.J. 1968. The effect of soil-mineral weathering on the sodium hazard of irrigation waters. Soil Science Society of America Proceedings 32, 643-647.

12- Rimmer, D.L. & Greenland, D.J. 1976. Effects of calcium carbonate on the swelling behaviour of soil clay. *Journal of Soil Science* 27, 129-139.

13- USDA, Salinity Laboratory Staff. 1954. Diagnosis and Improvement of Saline and Alkali Soils. USDA Handbook 60.

CO_3^{--}concentrations in soil water, soluble sodium in the soil solution reacts with this anion to form sodium carbonate. As a consequence, soils become strongly alkaline, soil particles disperse, and soil becomes unfavourable for the entry and movement of water. The result is a soil unfavourable for tillage. However, HCO_3^- ion concentrations in soil water extracts were found in between 0.5 and 1.5 meq/l.

The Chloride ion concentrations in wadi Tamit EC -soil extracts were found in between 37 – 547.5 meq/l. These concentrations were parallel to sodium – ion concentrations. This is evidence to prove that the internal drainage of the soils under study is not suitable. Available Sulphate ($SO_4^=$) concentrations in table 3 confirmed that gypsum is present in appreciable amount.

Table 3:- Physico- chemical analysis of soil samples.

Parameter	Soil depth (cm)	Min Max	Mean ± s.d
PH 1:2.5 soil: water	**0 – 20**	7.70 8.30	7.88 ± 0.23
	20 – 40	8.00 8.30	8.08 ± 0.13
	40 – 60	7.90 8.10	8.00 ± 0.07
	60 – 80	7.90 8.00	7.96 ± 0.05
CaCO3 %	**0 – 20**	15.50 22.50	18.00 ± 2.87
	20 – 40	15.00 25.00	19.00 ± 3.69
	40 – 60	19.00 24.50	22.20 ± 2.51
	60 – 80	12.50 34.50	22.10 ± 8.14
Gypsum Meq/100g soil	**0 – 20**	00.00 35.00	8.60 ± 14.89
	20 – 40	00.00 62.00	12.4 ± 27.70
	40 – 60	00.00 20.00	5.00 ± 8.66
	60 – 80	00.00 36.00	8.00 ± 15.75
Sand %	**0 – 20**	48.98 62.98	54.58 ± 6.23
	20 – 40	32.98 60.98	50.58 ± 10.53
	40 – 60	34.98 72.98	57.38 ± 14.79
	60 – 80	30.98 74.98	55.78 ± 17.06
Silt %	**0 – 20**	26.40 42.40	35.40± 6.32
	20 – 40	26.40 50.40	36.20 ± 9.42
	40 – 60	19.40 42.40	29.00 ± 9.50
	60 – 80	17.40 42.40	28.20 ± 12.56
Clay %	**0 – 20**	7.62 12.62	10.02 ± 1.94
	20 – 40	5.62 16.62	11.22 ± 4.51
	40 – 60	7.62 22.62	13.62 ± 5.79
	60 – 80	7.62 26.62	16.02 ± 7.16

Date in table 3 indicated that those soils under study are strongly alkaline.

Soluble cations and anions (meq /l)	Soil depth (cm)	Min Max	Mean ± s.d
SAR calculated	0 – 20	8.22 55.08	30.13 ± 16.83
	20 – 40	10.47 39.56	27.66 ± 11.27
	40 – 60	21.36 40.07	29.36 ± 7.940
	60 – 80	19.04 47.26	31.69 ± 12.35

From the data presented in table 3. It was clear that the electrical conductivity of soil samples under study was found in between 9.84 to 75.99 mmhos/ cm. The differences in Soil salinity and in all other constituents between four soil depths under study statistically were not significant.

According to the U. S. Salinity Laboratory classification, crops begin to show adverse effects when the EC of soil saturation extract is higher than 4.0 mmhos/ cm at 25C^{o}. It can be seen from above results that those soils under study are affected by soil salinity, and only high tolerate salinity crops could be grown. Moreover, concentrations of salts in general, the deeper the soil, the higher in EC values. On the other hand, the soil salinity degradation can be easily observed in the field as well as the effect on crops (burned leaves). As a result, the establishment of the methodology to reclaim the salt affected soils in the area under study through experimentation in small pilot areas; the technique will subsequently be applied to a larger scale is highly recommended.

The concentrations of soluble Na in saturation soil extracts were ranged in between 43.5 – 489.20 meq/l. These might be due to the high salinity level. However, these soils had amount from water soluble calcium in the EC extract varied from 17 to 50 meq/l These values are reasonable , since the soils are rich in $CaCO_3$ and $CaSO_4$. The mean values of sodium adsorption ratio (SAR) were very high (Table 3), these results indicated that soils begin to show adverse effects due to high sodium concentrations, when exchangeable sodium percentages are higher than 15% (U. S. Salinity Laboratory classification). Fine textured soils are particularly more affected since soil particles become disperse, decreasing normal water infiltration rates and hydraulic conductivity.

Water soluble potassium concentrations were found in between 5.12 to 26.88 meq/l. This is a good criteria that a very high amount from available potassium is present. In addition, water soluble magnesium concentrations were found between 10 - 87 meq/l.

The $CO_3^{=}$ ion concentrations in saturated paste extracts of Wadi Tamit soils was not detectable. This might reduce the alleviation of the adverse effects of high soluble sodium concentrations in these soils. In the presence of high

Table 2- Saturation extract determinations of soil samples.

Soluble cations and anions (meq /l)	Soil depth (cm)	Min	Max	Mean ± s.d
EC (mmohs/cm at 25 C°	0 – 20	9.84	76.00	38.6 ± 24.90
	20 – 40	11.78	42.87	31.12 ± 12.62
	40 – 60	17.10	44.09	34.57 ± 10.34
	60 – 80	18.72	63.47	39.43 ± 19.11
Na^+	0 – 20	43.5	489.2٠	226.1 ± 166.2٠
	20 – 40	54.4	250.0٠	173.9 ± 82.1٠
	40 – 60	108.7	260.9٠	184.8 ± 62.0٠
	60 – 80	130.4	413.1٠	230.4 ± 124.5٠
K^+	0 – 20	5.12	26.88	16.23 ± 8.45
	20 – 40	11.52	23.04	15.10 ± 4.56
	40 – 60	8.96	15.36	11.26 ± 2.77
	60 – 80	6.40	16.64	13.06 ± 3.99
Ca^{++}	0 – 20	18.00	50.00	31.16 ± 12.65
	20 – 40	21.00	40.00	25.40 ± 8.20
	40 – 60	17.00	30.00	23.60 ± 5.68
	60 – 80	20.00	33.00	26.20 ± 5.63
Mg^{++}	0 – 20	20.00	58.00	36.80 ± 17.66
	20 – 40	10.00	34.00	24.80 ± 9.31
	40 – 60	18.00	45.00	30.60 ± 9.66
	60 – 80	26.0٠	87.0٠	47.4٠ ± 24.8٠
$CO_3^=$	0 – 20	NIL		NIL
	20 – 40	NIL		
	40 – 60	NIL		
	60 – 80	NIL		
HCO_3^-	0 – 20	0.800	1.500	1.060 ± 0.261
	20 – 40	0.700	1.000	0.880 ± 0.164
	40 – 60	0.500	1.000	0.840 ± 0.230
	60 – 80	0.500	1.000	0.800 ± 0.212
Cl^-	0 – 20	43.0	547.5	249.5 ± 191.00
	20 – 40	37.5	255.5	170.0 ± 86.50
	40 – 60	80.0	263.5	183.5 ± 73.50
	60 – 80	106.0	455.5	240.3 ± 144.50
$SO_4^=$ calculated	0 – 20	42.60	75.00	59.71 ± 12.26
	20 – 40	51.94	93.35	68.34 ± 15.73
	40 – 60	59.05	77.04	65.91 ± 8.02
	60 – 80	43.8	111.00	76.00 ± 27.6

Table 1:- Methods used for the chemical and physical analysis of the soil samples.

Determination	Method	Reference
Mechanical analysis	Hydrometer method	Bouyoucos, 1951
	1:2.5 soil to water ratio	USDA, 1954
P^H	Hydrochloric acid (Titration)	Hesse, 1971
Calcium Carbonate	Precipitation with Acetone	=
Gypsum content	Saturation Extract	USDA, 1954
Soil water extract	Standard Wheatstone bridge	=
Electrical Conductivity		
Water soluble cations	Flame Photometer	Chapman, 1961
Na^+	Flame Photometer	=
K^+	Titration with Versenate	=
Ca^{++}	Titration with Versenate	=
Mg^{++}		
Water soluble anions	Titration with H_2SO_4	=
$CO_3^=$	Titration with H_2SO_4	=
HCO_3^-	Titration with $AgNO^3$	=
Cl^-	Calculated	
$SO_4^=$		

Soil samples were analyzed and then data was prepared and tabulated in Excel. Means of observations and standard deviations of means were calculated. The significance of the difference in soil properties between different depths in all positions were tested using one way analysis of variance and the significantly different pairs of means were identified using Fisher's method (Mead *et al*., 2003).

RESULTS AND DISCUSSION

Soil Physico-Chemical Properties and Saturation Extract Determinations:-

Two tables are given. The first shows the saturation extract determinations of soil samples (Table 2). While the second provides the Soil Physico – Chemical analysis of soil samples (Table 3) absolutely essential to find ways of cultivating saline and alkali soils, whether originally saline due to their type of formation or whether they become salty as a result of mismanagement.

In many virgin saline areas in UAR, the salinity of the soil is too high to permit the growing of crops from the beginning. Under such conditions the leaching stage must precede the leaching –cropping stage to lower the initial salinity to a level that permits the growth of salt tolerant crops (Elgabaly and Fakhry, 1965).

Rhoades(1968) reported that in irrigated soils, exchangeable sodium percentage (ESP) and salinity are generally lowest at the soil surface and increase with depth through the root zone. The increased salinity with depth is usually sufficient to compensate for the increased level of ESP.

Calcium carbonate also appears to have a direct cementing effect and contributes to structural stability (Rimmer and Greenland, 1976). It has been found that lime ($CaCO_3$) dissolution affects the total electrolyte concentration of soil solution and clay dispersion (Gupta *et al*., 1984). Rengasamy (1983) observed that soil containing very small amounts of $CaCO_3$ (2 %) had very low dispersible clay, even when the ESP values were 15 and above. Crop salt tolerance is determined primarily by innate plant physiological characteristics, although salt tolerance is also affected to some extent by environmental and other factors such as humidity, temperature, growth stage and water stress (Greenway and Munns, 1980). Available water was lower in the surface soil but greater at depths (0.6 – 1.2m) under no-tillage than in tilled soil (Dalal, 1989).

Data was prepared and tabulated in Excel. Means of observations and standard deviations of means were calculated. The significance of the difference in soil properties between different depths were tested using one way analysis of variance and the significantly different pairs of means were identified using Fisher's method (Mead *et al*., 2003).

MATERIALS AND METHODS

This work was carried out in the Wadi Tamit agricultural Project area.

Soil sampling:- Soil samples were collected every 20 cm up to a depth of 80 cm. A total of 20 soil sample covered to five positions were collected from the virgin land in Tamit agricultural project. The collected soil samples were air dried, passed through 2 mm sieve and then stored for their physical and chemical analysis.

Laboratory Methods: - The following methods were used for the chemical and physical analysis of the soil samples.

Salinity evaluation of virgin land in Tamit agricultural project - Libya

▪ **DR. Khereya.A.Ben Farag***

ABSTRACT

Twenty soil samples from Tamit Agricultural project were collected to study the soil conditions and salinity problems. The Laboratory characterization for the physico-chemical properties was made. This study highlighted the following points:

1- Salinity built up is very high and the electrical conductivity varied from 9.84 to 76.0 mmhos/cm at 25C°.

2- The chloride content in the soil EC extract is found to be in between 37.50 to 547.50 meq/l.

3- Calcium carbonate percentage varied from 12.5 to 34.5 percent. In general, surface soils are comparatively less in $CaCO_3$.

4- The gypsum content varied in between traces to 62 meq/100g soil.

INTRODUCTION

Soil salinity is one of the most important problems which the cultivators of arid and semi-arid regions are facing, where the evaporation exceeds precipitation resulting in the accumulation of salts in soil layers. High salt concentrations of the soil solution are directly toxic to plants and high sodium saturation of the soil results in unfavourable physical and hydro-physical properties. These two phenomena are directly or indirectly responsible for the low fertility of salt affected soil. If the Ca^{++} reserves of saline soils are low when the salts are washed out, an appreciable proportion of the exchangeable cations in the soil colloids is replaced by Na^+. This causes a rapid deterioration in soil structure (Na^+-ion disperses the soil particles) and P^H may rise often a have 9.0.

Soil salinity may be the result of various causes. Some attributable to the origins and corresponding to what Kovda called (The continental cycle) that is, since the parent rocks from which the soils developed are saline, the soils by their very composition are naturally defective. For that reason it becomes

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