Contents

Summary

The calcareous soils which are oftenly salt affected cover vast areas in Egypt. Such soils represent one component of the most important land resource in Egypt. Accordingly this work was conducted in order to investigate the different soil and plant parameters that may affect the productivity of such soils and hence may lead to more suitable practices of land management for maximizing the productivity of such soils.

The area of study locates just at the west at Mersa Matrouh between longitudes from 27° 3ˉ to 27° 13ˉ East, and the latitudes from 31° 14ˉ to 31° 26ˉ North.

Fifteen locations differing in their morphological features through the area were selected for the study. The conducted profiles, representing 15 different areas, were morphologically described as well as the area to which they belong. fourty four soil samples were collected from the different profiles representing the sequence of morphological variations through these profiles. The obtained soil samples were subjected to the different physical and chemical soil analyses.

Results of soil analysis indicated that:

A- Field study lab. Analyses:

I-Soil analysis

1- Soil texture ranges from sandy to sandy loam oftenly and rarely clay loam or clay.

2- Soil content of lime was increased through the zone of coastal dunes being more than 95% but tending to be

decreased gradually away from the coast, baing about 27% in the plateau area.

3- Soil content of organic matter is extremely low around 0.05% due to arid conditions prevailing, however, it was raised up to about 2.45% in some cultivated areas.

4- Soil content of gypsum is far low being in the range of 0.11-0.23%.

5- Soil reaction is neutral to slightly alkaline (pH 6.9-7.8).

6- Soil salinity differ widely from one location to another being maximized in sabkha area represented by profiles 3&4 with EC values of 90-146dSm^{-1}, sharply decreasing with clepth.

7- Sodium ion generally dominated the soluble salts fallowed by Mg^{2+} and that by Ca^{2+} whereas K^+ was the least. As for anions Cl^- was the dominant followed by sulfate with bicarbonate at the least level.

8- Sodium adsorption ratio (SAR) calculated using the following equation: **SAR= Na / $\sqrt{Ca+ Mg/2}$** it is reneged between 2.99 to 57.5.

9- Soil exchangeable cations and exchange capacity analysis, indicate oftenly low CEC and comparable values of exchangeable Mg (1- 9.15), Ca (0.53-7.87) and (0.31-6.45) for Na, while K is ranked at the least level (0.05-0.78), in terns of me/100g soil.

10- The soil content of total (T) and available (Av) nutrients, of mounted to (3-19 T & 2-10Av.N), (11-34 T& 0.45-7.5 Av P), (33-96 T & 1.3-17.83 Av K),(21205-50216 T & 0.36 -

1.9 Av Fe),(98-151 T & 0.54-101 Av Zn), (211-383 T & 0.6-1.14 Av Mn)and (15-46 T & 0.72-0.9 Av Cu), in terms of mg. Kg^{-1}.

II- Basing on the degree of soil salinity reported by the **Richards 1954** and **Abrol et al., 1988** the investigated soils were categorized under five classes i.e. Non saline, slightly saline, moderately saline, strongly saline and highly saline.

III- Using the results of morphological features and the physical and chemical properties of soils under study was classified according to the system of soil taxonomy 1999 into two orders (Aridisols & sentisols) and therecefter into, suborders, great soil groups, subgroups, families and geomorphological units. The results revealed the presence five geomorphological umits as fallows: Oolitic sand dunes , sabkhas, Alluviral fans, Wadi bottom and Plateau (tableland).

IV- The studied area was classified according to soil properties and crop productivity by using the capability index suggested by **Sys and Verhey 1978** where.

Ci = t x w/100 xs1/100 x s2/100 x s3/100 xs4/100x n/100.

The soils were categorized under the following grades of suitability for cropping.

S2: Moderately suitable, with Ci between 50 and 75, for soil profiles No. 1,7, 12,13 and 15. The soil limitations are slight to moderately severe.

S3: Marginally suitable, with Ci is between 25 and 50, for soil profiles No. 2,3, 5,6,8,9,10 and 14. The soils has limitations which are sever.

N1: Curruntly not suitabale with limitations which can be corrected. This soils has more severely limiations, for soil profiles No. 4 and 11.

V- Irrigation water quality

The irrigation water resources in the area includes basin rain water, with EC values of 1.89-3.64 dSm^{-1}, SAR values of 7.2-12.8. and undetected RSC.

B- Salinized and Sodicated Soil Models Experiment

Samples of the non saline colcareous soils were removed and transperted to the green house. The soils were subjected to increasing additions of NaCl, CaCl2 and NaOH solutions applied individually, combined entirely at equivalent ratio to develop 7 degrees of soil salinity under each grade of which locates seven different grades of sodicity. These models of salt-affected calcareous soils were used as media for barley growth until full maturity where both grain and straw yields were evaluated and analyzed for nutrients uptake.

Statistical analyses wee run to correlate the data of soil analyses with yield of both grain and straw of barley in order to assess a reliable system suitable to be used for land evaluation. The obtained results from the green- house experiment indicate the following:

- The simple correlation matrix reveal that some soil parameters are significantly related to each other or plant parameters.
- The closest relations were those obtained for soil EC, SAR, HC with each of other:

a- Some soil parameters,

- EC Versus soil SAR   Y= 8.847+ 0.134 EC   r= 0.566***

- EC Versus HC   Y= 38.105-50588EC   r=0.554***

- HC Versus SAR   Y= 199.533-37.609HC   r= 0.889***

b- Plant parameter:

1- During the tillering stage:

EC Versus nutrient concentrations

- Y= 35.107-34.638P   r= 0.843***

- Y= 32.754-6.131 K   r= 0.956***

- Y= 6.069+5.562Na   r= 0.686***

- Y= -1.015+0.774 Ca   r= 0.680***

- Y= -8.740+24.248 Mg   r= 0.869***

- Y= 36.568-0.162 Fe   r= 0.458**

- Y= 36.565-0.594 Zn   r= 0.672***

- Y= 24.927-1.403 Cu   r= 0.388**

2- During Mature stage:

- **Straw yield versus some soil parameters:**

- Y= 33.787-0.979 EC   r= -0.953***

- Y= 25.219-0.135 SAR   r= -0.553***

- Y= 3.820+5.537 HC   r= 0.534***

- **Grain yield versus some soil parameters**

- Y= 23.808-0.773 EC   r= -0.978***

- Y= 16.990- 0.105 SAR   r= -0.559***

- Y= -5.856 + 4.363 HC   r= -0.547***

- **Grain yield Versus elemental concentrations**

- Y= -2.235+ 0.596 N   r= 0.602***

- Y= -19.576+ 11.094 P   r= 0.906***

- Y= -3.459+ 2.067 K   r= 0.567***

- Y=32.794-19086 Na   r= -0.852***

- Y= 34.981-18.970 Ca   r= -0.658***

- **Grain yield Versus elemental uptake**

- Y= 4.771+ 0.022 N   r= 0.891***

- Y= 2.421+ 0.268 P   r= 0.988***

- Y= 2.974+ 0.088 K   r= 0.972***

- Y= 1.857+ 0.108 Ca   r= 0.948***

- Y= 2.147+ 0.042 Mg   r= 0.821***

Multiple and stepwise regression analysis

Barley grain yield versus soil parameters:

- **Y = 31.780 – 1.097 EC – 0.589 HC – 0.728 pH + 0.0013 SAR + 0.021 sol. Ca + 0.345 sol. Mg + 0.0027 sol. Na** (multiple) **R= 0.963*****

- **Y= 23.808- 0.774 EC** (stepwise) **R= 0.957*****

Barley straw yield versus soil parameters (stepwise)

- **Y= 10.665- 0.927 EC + 1.752 pH + 1.555 HC R= 0.932*****

Barley grain yield versus elements uptake:

- **Y= 1.047+ 0.148 P + 0.015 Ca + 0.005 Mg + 0.021 K R= 0.989*****

Conclusion

In conclusion and in the light thrown through this study it may be recommended that:

1- The methods used for evaluation of land capability or productivity could practically determined or statistically calculated for each category of soils that are having comparable distinct properties, whereas the land units, for example, could be considered as the main base unit for unit such methods.

2- It is better if the evaluation method as run with respect to the crops that are mostly suitable from view points of land productivity, as well as the predicted income.

3- The statistical methods of correlation could be used for developing efficient equations for predicting soil productivity as well as comparing the different methods of land evaluation to define the most suitable system or systems combined together for such a target.

4- As a preliminary step on such a long way, the simple correlation matrix, multiple and stepwise regression analyses were used to define the most factors controlling the productivity of the highly calcareous soils at Mersa Matrouh area at the western north coast of Egypt, that are mostly salt affected soils, where it was suggested that soil EC was the master factor controlling the soil productivity for barley under the conditions prevailing such soils, according to the general equation: (grain yield).

Y= 23.808-0.747EC R= 0.957***

5- Comparing the results of barley yield (grain) predicted by using the different conventional systems of land evaluation and that developed herein, statistically with the actual yield showed the following R values.

Grain yield VS soil parameters (R= 0.963*,0.957***)**
Grain yield VS elements uptake (R= 0.989*)**

6- However, it may be stated that we are in urgent need to establish an efficient land evaluation system more suitable for each category of resembled soils in Egypt. Such a system could be subjected for intensive practical tests to evaluate its efficiency before application on a wide scale.