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**Evaluation of Nutrient Index to Assess Soil Fertility in The South East El- Qantara, North Sinai**

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THE GOVERNMENTAL plan aims for reclamation and cultivation of about 400,000 feddans concentrated mainly in El-Tina Plain (50,000 feddans), South East El-Qantara (75,000 feddans), Rabaa (70,000 feddans), Bir El-Abd (70,000 feddans) and El-Ser and El-Qawarir (135,000 feddans) areas.. The present study revealed that there is no much variation in soil fertility status of soils developed on various landforms in the studied area as the soils have low to medium organic carbon (0.14 to 1.20 %), low available nitrogen (4.19 to 46.70 mg/kg); low to high available P (4.11 to 59.23 mg/kg) and deficient to adequate available K (34.00 to -825 mg/kg) contents. The soils of South East El-Qantara were categorized according to nutrient index into medium-low-medium-low (MLML) category based on OC, available N, available P and available K concentrations, respectively.

**Keywords:** Nutrient index, Evaluation, Soil Fertility, North Sinai

From the advent of agriculture, there has been an innate interest in soil and land quality (Carter *et al.,* 2004) and understanding changes in soil fertility resulting from agricultural intensification before they severely limit crop yields. Historically, few farmers used chemicals, but maintained soil fertility by allowing long fallow periods. Today, farmers have increased the use of chemical fertilizers and herbicides, and fallow cycles have decreased or disappeared, with the continuous use of the land becoming more frequent (Zhang and Zhang, 2007). Frequently, loss of productivity has been related to the loss of soil organic matter (SOM) and stored nutrients that result from cultivation (Juo and Manu, 1996). Hence, an understanding of the distributions of soil properties at the field scale is important for refining agricultural management practices and assessing the effects of agriculture on environmental quality (Cambardella *et al.,* 1994). Evaluating agricultural land management practices requires knowledge of soil spatial variability and understanding their relationships because of the fact that (a) spatial variability in soils occurs naturally from pedogenic factors, (b) natural variability of soil results from complex interactions between geology, topography, climate as well as soil use (Jenny, 1980 and Quine & Zahng, 2002). In addition, variability can also occur as a result of land use and management strategies, making the soil to exhibit marked spatial variability at the macro– and micro– scale (Brejda *et al.,* 2000 and Vieira & Paz-Gonzalez, 2003).

Karlen *et al.* (1997) proposed a complete definition for soil quality as ‘‘the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain biological productivity, maintain or enhance water and air quality, and promote human heath’’. But, the general consensus is that the soil quality concept should not be limited to soil productivity, but should encompass environmental quality (Karlen *et al.*, 2003). Large quantities of mineral nutrients are removed from soils due to growth and development of plant and harvesting of crops. Hence, maintaining or improving soil quality can provide economic benefits in the form of increased productivity, more efficient use of nutrients and pesticides, improvements in water and air quality, and lessening of greenhouse gas emissions (USDA-ERS, 1997). Thus, assessment of soil quality involves measuring physical, chemical, and biological soil properties and using these measured values to detect changes in soil as a result of land use change or management practices (Adolfo *et al.,* 2007)**.** Though the soil fertility, compactability and erodability are the elements of soil quality, the problem of decline in soil fertility endangers the maximum the growth in productivity (Katyal, 2003). Warren and Agnew (1988) opined that of all the threats to sustainability, the threat due to soil fertility depletion is the most serious. Depending upon the cropping pattern, leaching, erosion, etc., soil looses a considerable amount of nutrients every year. If cropping is continued over a period of time without nutrients being restored to the soil, its fertility will be reduced and crop yields will decline. Poor soil fertility conceives sparse plant cover, which promote erosion vulnerability. This happens because 90% of plant available N and S, 50-60% K, 25-30% P and almost 70% of micronutrients reside in organic matter (Stevenson, 1982).

Soil fertility fluctuates throughout the growing season each year due to alteration in the quantity and availability of mineral nutrients by the addition of fertilizers, manure, compost, mulch, and lime or sulfur, in addition to leaching. Hence, soil testing will determine the current fertility status and provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximizing crop yields and further to maintain the optimum fertility in soil year after year.

The soils in North Sinai will be provided with water through El-Salam Canal, which will pass below the Suez Canal. The Governmental plan aims for the reclamation and cultivation of about 400.000 feddans concentrated mainly in El-Tina Plain (50.000 feddans), South East El-Qantara (75.00 feddans), Rabaa (70.000 feddans), Bir El-Abd (70.000 feddans) and El-Ser and El-Qawarir (135.000 feddans) areas.

*Area of the investigations*

South East El-Qantara is located in the north western corner of Sinai Peninsula between latitudes 30º 50, and 31º 05,N, and longitudes 32º 20, and 32º

40’E. It has a triangular shape with one side about 40 km long running along the Suez Canal and another side of 35 km along the coast. The soils vary from sand to clay texture and extremely saline. Soil colour ranges from light gray to olive (dry) and greyish brown to gray (moist). Soil structure varies from single grains to strong or moderate, coarse to medium, angular to subangular blocky. The pedological features identified within profiles depth are accumulation of gypsum crystals, common salt crystals and few lime concretions.

## Materials and Methodology

The analyzed soil samples have been collected from South East El-Qantara. The landscape is almost flat. Soil parent material is a mixture of alluvium sediments, originated from old Nile branches and lacustrine deposits, and is sometimes contaminated with aecolian sand sediments. The area is barren from plant cover. Some patches are covered with some species of Halophytes. Water table in some cases is very shallow.

*Selection of representative soil series*

In order to study the background levels of nutrient index to asses' soil fertility in South East El-Qantara soils, 97 representative soils were selected from representative 12 soil groups. Soil samples representing the morphological variations throughout the entire depths of each profile were collected. Soil sampling was replicated three times at the different layers for every profile.

*Analytical procedures*

-Particle size distribution was carried out according to Klute (1986).
-The water extract components were determined in the soil paste extract, using the standard methods of analysis as described by Page *et al.* (1982).
-Organic carbon was determined following by the modified method by Page *et al* (1982).
-Available N in soil samples was chemically extracted by 2M KCl solution and determind according to Dhank and Johson (1990).
-Available P in soil samples was extracted by 0.5 *M* $NaHCO_3$, pH 8.5 solution and determined according to Page *et al.* (1982).
-Available K was extracted by ammonium acetate pH 7.0 and determined flamephotometry.
-Available micronutrients (Fe, Mn, Zn, and Cu) in soil samples were extracted using DTPA solution according to Lindsay and Norvell (1978) and measured using Flame Atomic Absorption Spectrophotometer (Page *et al*., 1982).

Physical and chemical characteristics of the studied samples are given in Table 1.

**TABLE 1. Some chemical and physical characteristics of the studied soil**

| Sample No. | O.M % | pH | EC (dS/m) | Texture Class |
|---|---|---|---|---|
| 1 | 0.76 | 8.81 | 7.30 | clay |
| 2 | 1.05 | 8.64 | 4.49 | clay |
| 3 | 0.72 | 8.61 | 1.97 | sandy clay loam |
| 4 | 0.49 | 8.47 | 0.65 | sandy loam |
| 5 | 0.65 | 8.69 | 5.34 | silty loam |
| 6 | 1.2 | 8.55 | 2.50 | clay |
| 7 | 0.58 | 8.49 | 2.50 | sandy loam |
| 8 | 0.6 | 8.19 | 2.04 | sandy clay |
| 9 | 0.72 | 8.36 | 1.93 | sandy clay loam |
| 10 | 0.69 | 8.45 | 2.65 | clay loam |
| 11 | 0.14 | 8.55 | 3.36 | clay |
| 12 | 1.01 | 8.34 | 3.58 | clay |
| 13 | 1.01 | 8.19 | 3.79 | silty loam |
| 14 | 0.72 | 8.78 | 15.22 | clay |
| 15 | 0.86 | 8.04 | 4.75 | clay |
| 16 | 0.86 | 8.52 | 7.95 | clay |
| 17 | 1.1 | 8.6 | 10.56 | clay |
| 18 | 0.68 | 8.33 | 1.46 | sandy |
| 19 | 1.01 | 8.12 | 1.70 | sandy loam |
| 20 | 1.1 | 8.27 | 1.62 | sandy |
| 21 | 1.02 | 8.32 | 1.617 | sandy |
| 22 | 0.86 | 8.18 | 1.99 | sandy loam |
| 23 | 0.43 | 8.32 | 1.79 | sandy |
| 24 | 0.47 | 8.17 | 1.58 | sandy |
| 25 | 0.33 | 8.24 | 1.912 | sandy |

**TABLE 1. Cont.**

| Sample No. | O.M % | pH | EC (dS/m) | Texture Class |
|---|---|---|---|---|
| 26 | 1.01 | 8.34 | 1.59 | sandy |
| 27 | 0.76 | 8.22 | 1.90 | sandy |
| 28 | 0.91 | 8.01 | 1.82 | sandy loam |
| 29 | 0.53 | 8.13 | 1.74 | sandy loam |
| 30 | 0.64 | 8.15 | 2.97 | sandy |
| 31 | 0.95 | 8.02 | 1.95 | sandy |
| 32 | 0.96 | 7.81 | 1.75 | loamy sand |
| 33 | 0.72 | 8.28 | 1.75 | sandy |
| 34 | 1.01 | 7.91 | 6.87 | loamy sand |
| 35 | 1.1 | 8.25 | 1.96 | sandy loam |
| 36 | 0.75 | 8.38 | 3.94 | sandy |
| 37 | 0.82 | 8.34 | 1.76 | loamy sand |
| 38 | 0.84 | 8.45 | 1.54 | sandy |
| 39 | 0.9 | 8.07 | 2.87 | sandy loam |
| 40 | 0.93 | 8.10 | 1.95 | sandy loam |
| 41 | 0.33 | 8.06 | 2.34 | loamy |
| 42 | 0.28 | 8.09 | 2.16 | sandy loam |
| 43 | 0.62 | 8.10 | 1.80 | sandy |
| 44 | 0.63 | 8.09 | 1.55 | loamy sand |
| 45 | 0.34 | 8.02 | 1.77 | loamy sand |
| 46 | 0.76 | 8.09 | 1.61 | loamy sand |
| 47 | 0.72 | 8.00 | 1.97 | loamy sand |
| 48 | 0.75 | 8.08 | 2.09 | sandy |
| 49 | 0.7 | 7.91 | 1.77 | sandy |
| 50 | 0.76 | 8.06 | 4.02 | sandy |

**TABLE 1.Cont.**

| Sample No. | OM % | pH | EC (dS/m) | Texture Class |
|---|---|---|---|---|
| 51 | 0.71 | 8.06 | 2.02 | sandy clay |
| 52 | 0.83 | 8.04 | 2.14 | loamy sand |
| 53 | 0.75 | 8.13 | 1.92 | sandy loam |
| 54 | 0.76 | 8.09 | 2.50 | clay loam |
| 55 | 0.52 | 8.11 | 3.57 | clay |
| 56 | 0.73 | 8.17 | 4.23 | sandy loam |
| 57 | 0.64 | 8.29 | 2.29 | silty loam |
| 58 | 0.37 | 8.04 | 2.60 | sandy loam |
| 59 | 0.83 | 8.35 | 1.58 | loamy sand |
| 60 | 0.57 | 8.02 | 1.79 | loamy |
| 61 | 0.64 | 8.37 | 1.91 | sandy loam |
| 62 | 0.78 | 8.40 | 1.86 | sandy loam |
| 63 | 0.73 | 8.36 | 1.79 | sandy loam |
| 64 | 0.82 | 8.33 | 1.80 | clay loam |
| 65 | 0.66 | 8.25 | 3.42 | clay loam |
| 66 | 0.74 | 8.35 | 2.57 | sandy loam |
| 67 | 0.86 | 8.26 | 1.76 | sandy loam |
| 68 | 0.47 | 8.33 | 2.09 | loamy sand |
| 69 | 0.52 | 8.27 | 1.62 | sandy |
| 70 | 0.57 | 8.28 | 1.78 | sandy |
| 71 | 0.57 | 8.23 | 1.56 | sandy |
| 72 | 0.64 | 8.24 | 1.61 | loamy sand |
| 73 | 0.43 | 8.32 | 1.66 | sandy |
| 74 | 0.76 | 7.92 | 1.57 | sandy |
| 75 | 0.85 | 8.15 | 3.87 | silty loam |

**TABLE 1. Cont.**

| Sample No. | OM % | pH | EC (dS/m) | Texture Class |
|---|---|---|---|---|
| 76 | 0.58 | 7.87 | 1.57 | sandy |
| 77 | 0.73 | 7.98 | 1.21 | sandy loam |
| 78 | 0.54 | 7.82 | 1.62 | sandy |
| 79 | 0.56 | 7.84 | 1.67 | sandy |
| 80 | 0.73 | 8.07 | 1.29 | sandy |
| 81 | 0.74 | 8.07 | 1.26 | sandy |
| 82 | 0.87 | 7.42 | 1.42 | sandy |
| 83 | 0.6 | 7.82 | 1.24 | sandy |
| 84 | 0.32 | 7.53 | 1.61 | sandy |
| 85 | 0.47 | 8.07 | 1.24 | sandy |
| 86 | 0.49 | 8.05 | 1.25 | sandy |
| 87 | 0.56 | 8.16 | 1.17 | sandy loam |
| 88 | 0.44 | 7.73 | 1.37 | sandy |
| 89 | 0.49 | 7.84 | 1.59 | sandy |
| 90 | 0.51 | 8.2 | 1.39 | sandy |
| 91 | 0.42 | 8.00 | 2.77 | sandy |
| 92 | 0.38 | 8.01 | 1.25 | sandy |
| 93 | 0.29 | 7.72 | 1.40 | sandy loam |
| 94 | 0.42 | 8.10 | 1.21 | sandy |
| 95 | 0.42 | 8.15 | 2.88 | sandy |
| 96 | 0.47 | 8.31 | 1.24 | sandy |
| 97 | 0.35 | 8.01 | 2.23 | sandy |

## Results and Discussion

*Soil texture*

The studied soil samples varied widely in their texture classes, represented by 12 soil groups (Fig. 1).The texture varied from Sandy (42.3%, 41 soil), loamy sand (11.3%, 11 soil), sandy loam (21.7%, 21 soil), sand clay loam (2.1%, 2 soil), loamy (2.1%, 2 soil), clay loam (4.1%, 4 soil), silty loam (4.1%, 4 soil), sand clay (2.1%, 2 soil), to clay (10.3%, 10 soil)

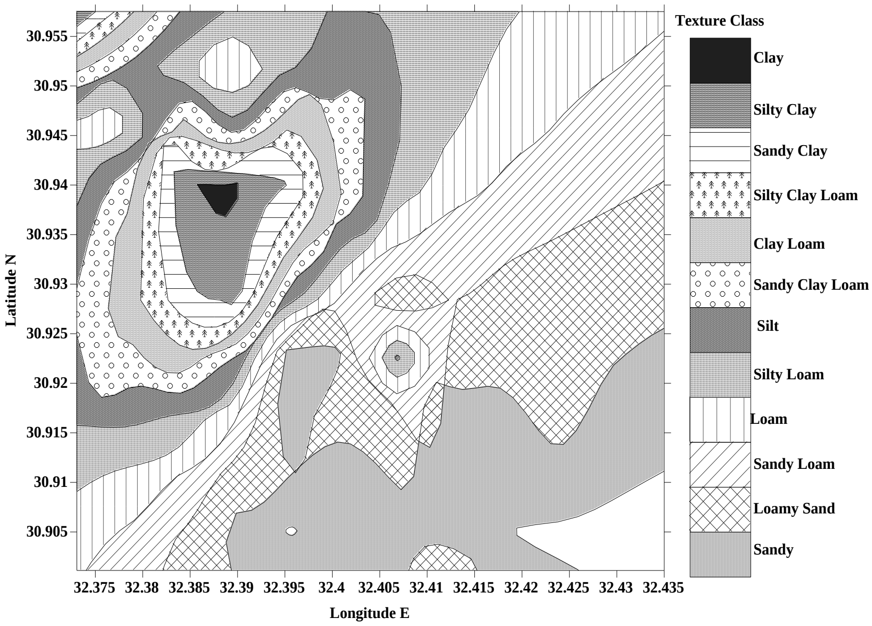


**Fig. 1. Contour for texture composition of the soil data set.**

*Soil pH*

The pH is an important parameter which helps in identification of chemical nature of the soil (Shalini *et al.*, 2003) as it measures hydrogen ion concentration in the soil to indicate its acidic and alkaline nature of the soil. In South East El-Qantara, the pH of the soil samples ranged from 7.42 to 8.81, indicating the existence of a variety of soils that are neutral to alkaline nature (Table 2 and Fig. 2).

*Electrical conductivity*

Conductivity, as the measure of current carrying capacity, gives a clear idea of the soluble salts present in the soil. It plays a major role in the salinity of soils. The lesser the EC value, the low will be the salinity value of soil and vice versa.

Even though, soil conductivity is influenced by many factors, high conductivities are usually associated with clay-rich soil and low conductivities are associated with sandy and gravelly soils. This is a result of the shape and physical properties of the particles which make up the soil. In the South East El-Qantara, the EC values varied from 0.65 to 15.22 dS/m, with the highest EC value of 15.2dS/m in sample no. 14 and the lowest value of 0.65 dS/m in sample no. 4.

Depending on the electrical conductivity of the soil, soil salinity can be classified into five classes. From the results ( Table 3) it is clear that the salinity problem is not critical in the South East El-Qantara as the saline criterion is < 0.7, indicating the good quality of soil Fig. 3 Because, the soluble salts concentration above 4 dS/m in soil inhibits the seed germination and growth of most commercial crops, which adversely affects the biomass production and economic yield.

**TABLE 2. The pH values of soil samples**

| SI | pH value | Range | Sample % |
|---|---|---|---|
| 1 | 6.50 – 7.00 | --- | --- |
| 2 | 7.00 – 7.50 | 7.42 – 7.53 | 2.06 |
| 3 | 7.50 – 8.00 | 7.72 – 8.00 | 14.43 |
| 4 | 8.00 – 8.50 | 8.01 – 8.81 | 75.26 |
| 5 | 8.50 – 9.00 | 8.55 – 8.81 | 8.24 |

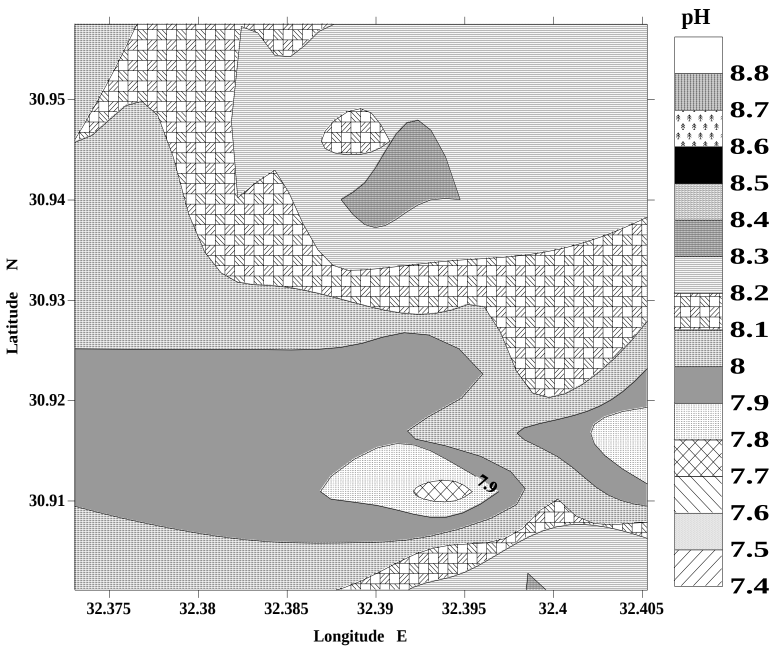


**Fig.2. Contour for class of soil reaction (pH)**

**TABLE 3. Salinity condition and categories of crops tolerance in South East El-Qantara**

| EC (dS/m) | Category | Range | Sample % |
|---|---|---|---|
| < 2.0 | All crops | 0.65 – 1.99 | 63.91 |
| 2.0 – 4.0 | Most crops | 2.02 – 3.94 | 25.77 |
| 4.0 – 8.0 | Salt tolerant crops | 4.02 – 7.95 | 8.24 |
| 8.0 – 16.0 | Most halophytes | 10.0 – 15.22 | 2.06 |
| > 16.0 | Unsuitable for most crop | --- | |

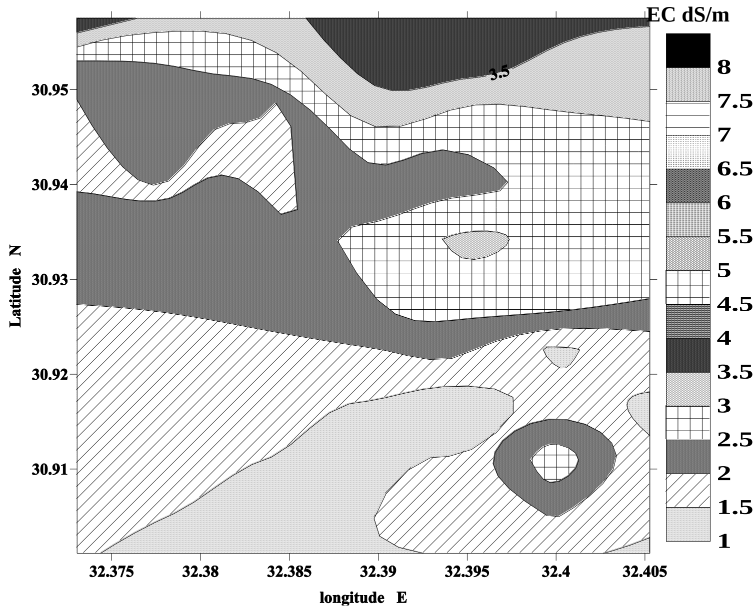


**Fig. 3. Contour for class of soil salinity**

*Organic carbon (OC)*

The importance of organic matter in the soil is implied in the definition of soil, which recognizes fertility status of the soil, as a unique feature distinguishing soil from the parent rock / other non-fertile soils. It increases the soil fertility / nutrient status and controls erosion and runoff of the soil and water, besides it is a major determinant of improved soil structure, moisture content and general nutrient status of the soil. The percentage of organic carbon of the studied soils ranged from 0.14 to 1.2% (Fig. 4). Depending on the organic carbon content (%), the quality of soil could be graded as low, medium and high. In the South East El-Qantara, 10.3 % of the samples showed low percent of organic carbon (*i.e.,* OC < 0.40). Majority of the soil samples (*i.e.,* 65 %) appear to possess low to medium percentage of organic carbon content (Table 4) and it is necessary to apply organic manure to these soils.

**TABLE 4. Classification of soil quality based on organic carbon content in South East El-Qantara**

| SI. No. | OC % | Rating | Range | Sample % |
|---|---|---|---|---|
| 1 | < 0.40 | Low | 0.14 – 0.38 | 10.30 |
| 2 | 0.4 - 0.75 | Medium | 0.42 – 0.75 | 54.65 |
| 3 | > 0.75 | High | 0.76 – 1.20 | 35.05 |

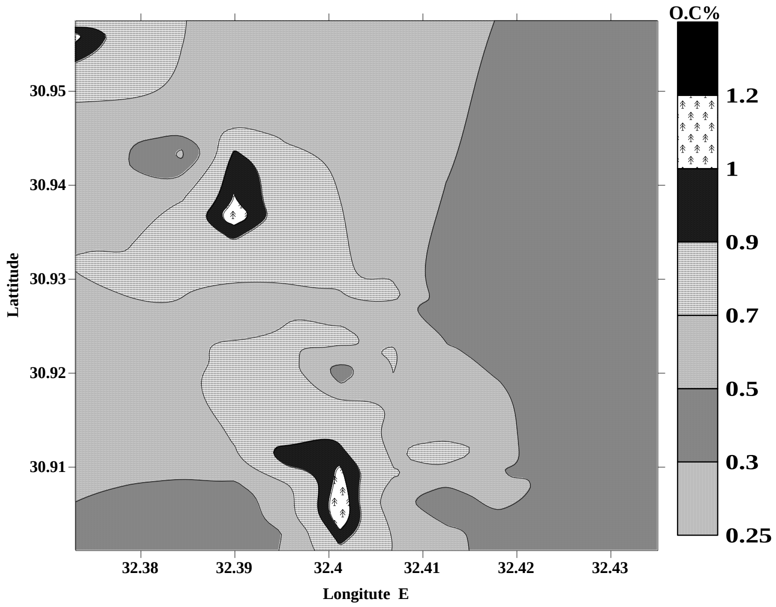


**Fig. 4. Contour for organic carbon content in the soil data set**

*Available nitrogen*

Plants take up nitrogen generally as nitrates under aerobic conditions and as ammonium ions in anaerobic conditions. Nitrogen is most often the limiting nutrient for the plant growth. Nitrogen content is too low (< 272 mg/kg) in all soil samples of the studied area (Table 5). All soil samples are having low available nitrogen content, ranging from 4.19 to 46.70 mg/kg (Fig. 5) and it is highly recommended to apply organic manure as an important source of nutrient to these soils.

**TABLE 5. Contents of available nitrogen in South East El-Qantara soils**

| SI. No. | Quantity of available N (mg/kg) | Rating | Range | Sample % |
|---|---|---|---|---|
| 1 | < 272 | Low | 4.19 - 46.70 | 100 |
| 2 | 272 to 554 | Medium | --- | ---- |
| 3 | > 554 | High | --- | --- |

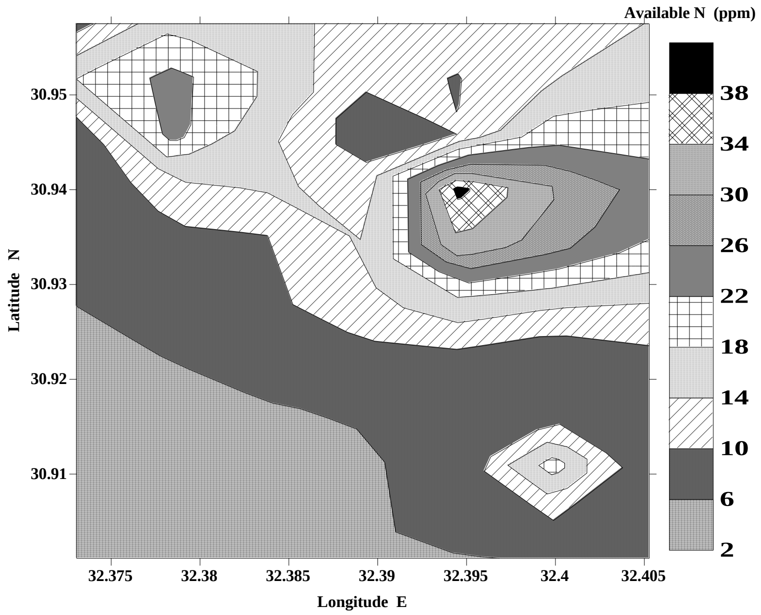


**Fig. 5. Contour for distribution of available N in the studied soils**

*Available phosphorus*

Phosphorus is the second most important macronutrient available in the biological systems, which constitutes more than 1% of the dry organic weight. It is also a second most limiting factor often affecting plant growth, which exist in the soil in both organic and inorganic forms. In the South East El-Qantara, the available phosphorus content ranged between 4.1 and 59.2 mg/kg Fig. 6 and 77.3 % of the soil samples showed low to medium quantity of available phosphorus, while remaining (22.7%) had adequate to abundant quantity of available phosphorus (Table 6) . Soils having low to medium phosphorus content in the studied area can be supplemented by applying phosphorous rich fertilizers as required for certain crop.

**TABLE 6. Contents of available phosphorus in South East El-Qantara soils**

| SI. No. | Grade | P (mg/kg) | Range | Sample % |
|---|---|---|---|---|
| 1 | Low phosphorus | < 15 | 4.11 – 14.63 | 62.90 |
| 2 | Medium phosphorus | 15 - 22 | 15.83 – 22.70 | 14.43 |
| 3 | Adequate phosphorus | 23 - 30 | 23.06 – 30.84 | 12.37 |
| 4 | Abundant phosphorus | > 30 | 31.80 – 59.23 | 10.30 |

*Available potassium (K)*

The values of available K varied from 34 to 825 mg/kg in the South East El-Qantara (Fig. 7). Majority of the soil samples in the South East El-Qantara had deficient (67.01 %), doubtful (15.46%) and adequate (17.53%) supply of potassium (Table 7). Soil samples with deficient and doubtful supply of potassium can be enriched with compost containing high content of K.

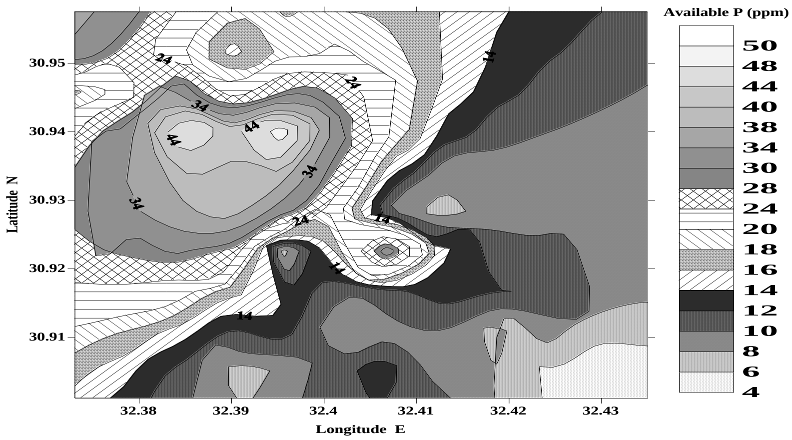


**Fig. 6. Contour for distribution of available P in the studied soils**

**TABLE 7. Contents of available K in South East El-Qantara soils**

| SI. No. | Supply of available K | Quantity (mg/kg) | Range | Sample % |
|---|---|---|---|---|
| 1 | Deficient supply of K | <113 | 34-110 | 67.01 |
| 2 | Doubtful supply of K | 113 to 280 | 113 - 255 | 15.46 |
| 3 | Adequate supply of K | > 280 | 306 - 825 | 17.53 |

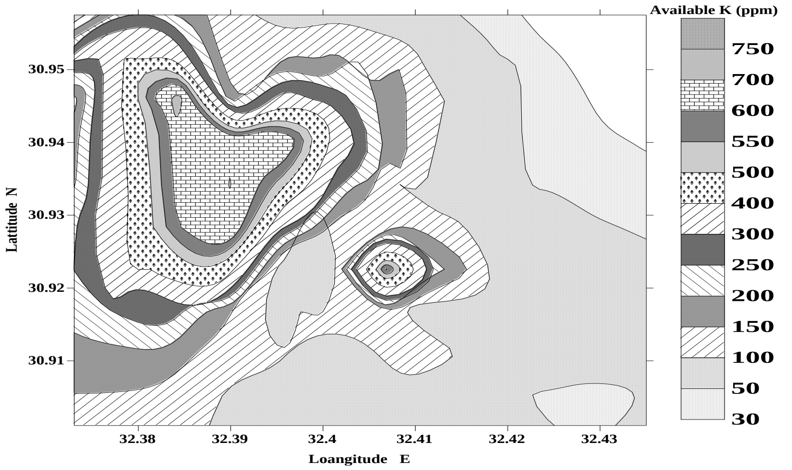


**Fig.7. Contour for distribution of available K in the studied soils.**

*DTPA- extractable iron*

In the South East El-Qantara, the available iron content ranged between 3.96 and 20.22 mg/kg. According to the critical levels reported by Lindsay and

Norvell (1978), the data in Table 8 and Fig. 8 of DTPA-extractable Fe showed that 11.3 % of the tested soils (11 samples) are suffering (<4 mg/kg), while 54.6% (53 samples) are on the margin, and 35.1% (34 samples) having adequate contents. The margin soils are those sandy in texture. The amount of DTPA extractable Fe as extracted by DTPA solution increased with increasing clay and/or silt content in soils.

**TABLE 8. Contents of DTPA extractable iron in South East El-Qantara soils**

| SI. No. | Grade | Fe (mg/kg) | Range | Sample % |
|---|---|---|---|---|
| 1 | Very low | 0 - 2 | --- | -- |
| 2 | Low | 2-4 | 3.9 – 4.0 | 11.34 |
| 3 | Medium | 4- 6 | 4.02 – 5.86 | 53.61 |
| 4 | High | 6 - 10 | 6.06 – 9.86 | 23.71 |
| 5 | Very High | >10 | 10.08 – 20.22 | 11.34 |

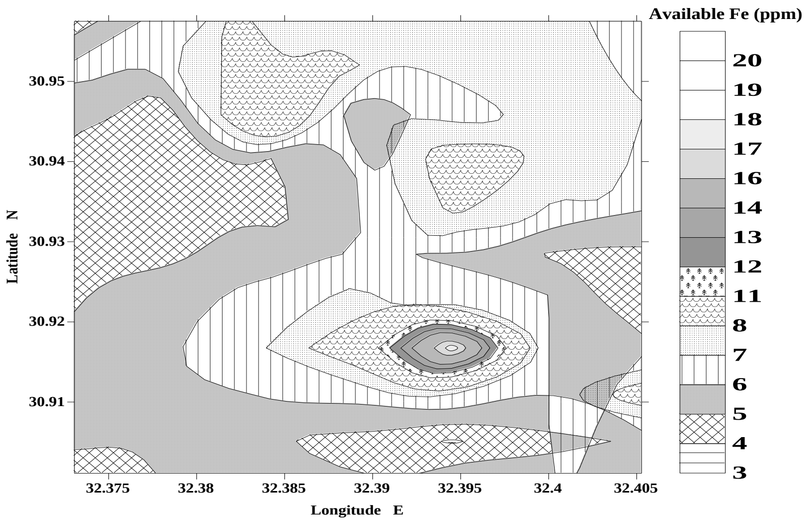


**Fig. 8. Contour for distribution of DTPA extractable Fe in the studied soils**

*DTPA- extractable manganese*

Values of DTPA extractable-Mn varied from 1.86 to 18.92 mg/kg, with an average of 6.82 mg/kg. The values of Mn are mostly higher in soil having high clay or silt content than those characterized by light textures ones. According to the critical levels reported by Lindsay and Norvell (1978) the data in Table 9 and Fig. 9 of DTPA-extractable Mn showed that 13.4 % of the tested soils (13 samples) are moderate, and the remaining 86.6% soil contained high amounts of DTPA extractable Mn.

**TABLE 9. Contents of DTPA extractable manganese in South East El-Qantara soils**

| SI. No. | Grade | Mn (mg/kg) | Range | Sample % |
|---|---|---|---|---|
| 1 | Very low | 0 – 0.5 | --- | -- |
| 2 | Low | 0.5 1.2 | -- | -- |
| 3 | Medium | 1.2 – 3.5 | 1.86 – 3.48 | 13.40 |
| 4 | High | 3.5 – 6.0 | 3.46 – 5.94 | 27.84 |
| 5 | Very High | > 6.0 | 6.10- 18.92 | 58.76 |

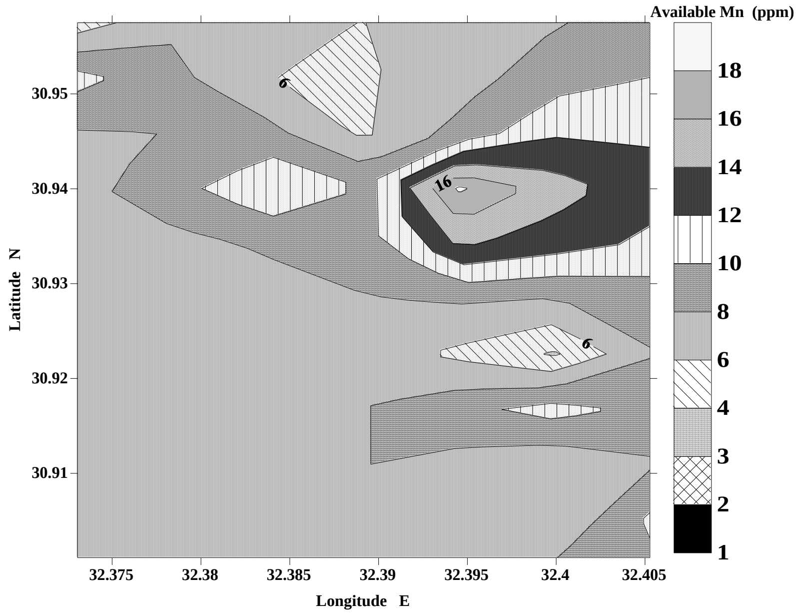


**Fig. 9. Contour for distribution of DTPA extractable Mn in the studied soils**

*DTPA- extractable zinc*

Values of DTPA- extractable Zn (Table 10) in the studied soils ranged from 0.32 to 2.72 mg/kg, with an average of 0.78 mg/kg. About 80.4% of the soil samples were Zn deficient (< 1.0 mg/kg), and 19.6% contained moderate amount of DTPA extractable Zn (1.0 – 3.0 mg/kg) (Fig. 10).

**TABLE 10. Contents concentration of available zinc in South East El-Qantara soils**

| SI. No. | Grade | Zn (mg/kg) | Range | Sample % |
|---|---|---|---|---|
| 1 | Very low | < 0.50 | 0.32 - 0.50 | 36.08 |
| 2 | Low | 0.50 – 1.0 | 0.52 - 0.98 | 44.33 |
| 3 | Medium | 1.0 - 3.0 | 1.02 - 2.72 | 19.59 |
| 4 | High | 3.0 – 5.0 | -- | -- |
| 5 | Very High | > 5.0 | -- | -- |

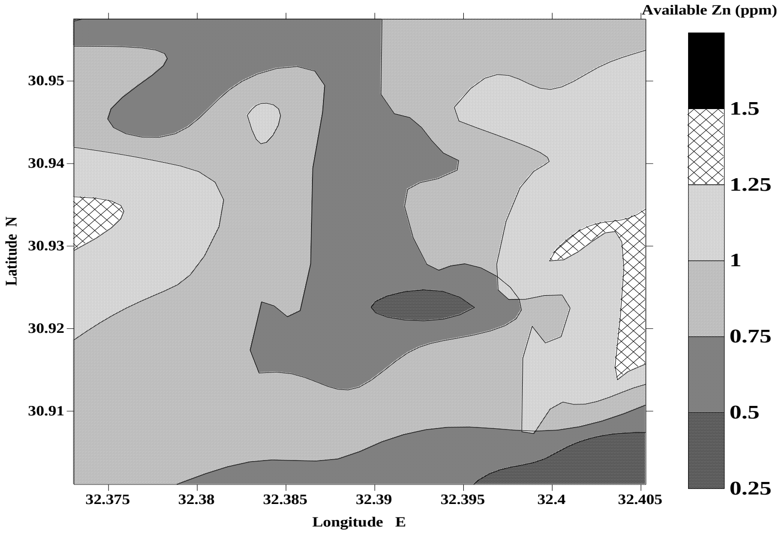


**Fig. 10. Contour for distribution of DTPA extractable Zn in the studied soils**

*DTPA- extractable copper*

The values of DTPA- extractable Cu of studied soils ranged from 0.15 to 0.96 mg/kg, with an average of 0.45 mg/kg. About 24.7% of the soils had low available Cu content, 68.0% contained moderate amount of DTPA extractable Cu, and the remaining 70.2% of soils contained high amounts of DTPA extractable Cu (Table 11) and (Fig. 11).

*Fertility status of soils*

*Nutrient index*

To evaluate the soil fertility status in the South of East El-Qantara, different indices like soil reaction index, salt and nutrient index with index respect to organic carbon, available phosphorus and available K were calculated based on the specific rating chart. Table 12 presented nutrient index with range and remarks

**TABLE 11. Contents of DTPA extractable copper in South East El-Qantara soils**

| SI. No. | Grade | Cu (mg/kg) | Range | Sample % |
|---|---|---|---|---|
| 1 | Very low | < 0.10 | -- | -- |
| 2 | Low | 0.10 - 0.30 | 0.15 - 0.30 | 24.74 |
| 3 | Medium | 0.30 – 0.80 | 0.32 – 0.80 | 68.04 |
| 4 | High | 0.80 – 3.0 | 0.85 – 0.96 | 7.22 |
| 5 | Very High | > 3.0 | -- | -- |

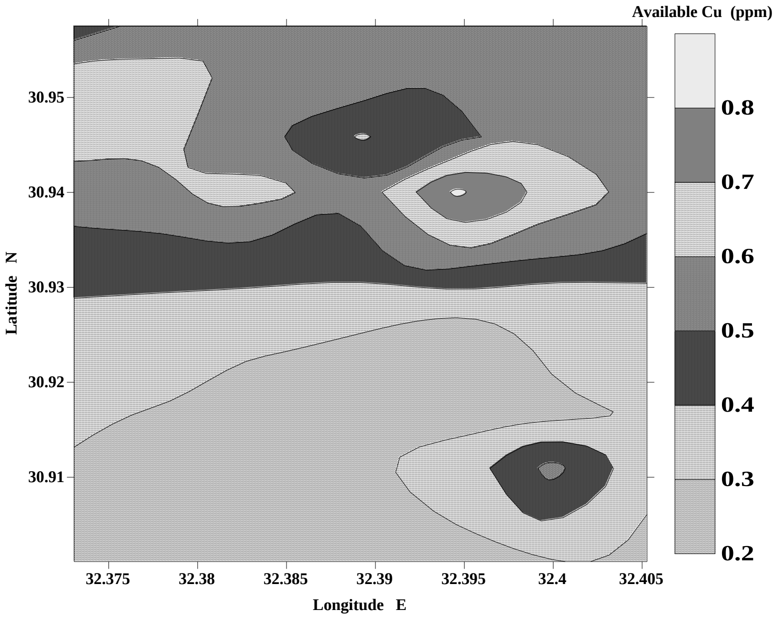


**Fig. 11. Contour for distribution of DTPA extractable Cu in the studied soils**

**TABLE 12. Nutrient index with range and remarks**

| Nutrient Index | Range | Remarks |
|---|---|---|
| I | < 1.67 | Low |
| II | 1.67 – 2.33 | Medium |
| III | > 2.33 | High |

The nutrient index in soil was evaluated for the soil samples analyzed using the following formula according to Ravikumar and Somashekar (2013).

Nutrient Index = [(1 x no. of samples in low category) + (2 x no. of samples in medium category) + (3 x no. of samples in High category)] / Total number of samples

In the South of East El-Qantara soils, the overall quality of soil in the studied area appears to be very fertile except for certain parameters. Soil pH ranged between 7.42 and 8.81, and all the samplers belong to soil reaction index IV, which indicate the neutral to slight alkaline range. The electrical conductivity of the soil samples ranged between of 0.65 and 15.22 dS/m which indicate the non-salinity to salinity range (*i.e.,* salt index-I and III) category. Organic carbon content ranged from 0.14 to 1.2 and majority of the samples indicate medium to high range as per the nutrient index. The available phosphorus values (4.11-59.23 mg/kg) are in low to high range, whereas the available nitrogen values (4.19-

46.70 mg/kg) belong to low range. It is possible to classify nutrient status of the particular area and classify each nutrient level (*i.e.*, low, medium or high) based on a rating chart using the results and nutrient indices. Based on the criteria given in Table 2, the soils of South East El-Qantara were categorized into medium-low-medium-low (MLML) category based on OC, available N, available P and available K concentrations, respectively (Table 13).

**TABLE 13. Nutrient Index values for the soil samples of South East El-Qantara .**

| Characteristics | Nutrient index values | Remarks |
|---|---|---|
| Organic carbon (OC) | 1.938 | Medium |
| Available N | 1.000 | Low |
| Available P | 1.835 | Medium |
| Available K | 1.485 | Low |

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# تقييم دليل المغذيات كمؤشر لتقدير خصوبة التربة في جنوب القنطرة شرق ، شمال سيناء

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تهدف خطة الحكومة إلى استصلاح الأراضي و زراعة حوالي 400.000 فدان تتركز أساسا في سهل الطينة (50,000 فدان) وجنوب شرق القنطرة (75,000 فدان) ورابعة (70,000 فدان)، بئر العبد (70,000 فدان) و السرو والقوارير (135,000 فدان). وكشفت هذه الدراسة عدم وجود تباين كبير في حالة خصوبة التربة التي وضعت على مختلف التضاريس في المنطقة وقد وجد ان محتوى التربة من الكربون العضوي يتراوح بين متوسط إلى مرتفع (0.14 إلى 1.20%)، و محتوى التربة من النيتروجين الميسر منخفض (4.19 إلى 46.70 جزء في المليون)؛ ومحتواها من الفوسفور الميسر يتراوح بين منخفض الى مرتفع (4.11 إلى 59.23 جزء في المليون) وتراوح محتواها من البوتاسيوم الميسر التربة تتراوح من حد الفقر إلى حد الكفاية (34.00 إلى-825 جزء في المليون). وصنفت التربة فى منطقة جنوب القنطرة شرق إلى متوسط – منخفض – متوسط - منخفض الفئة استناداً إلى دليل الخصوبة (Nutrient Index) طبقا لمحتواها من المادة العضويه و وتيسر النتروجين و الفوسفور والبوتاسيوم ، على الترتيب.