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ASSESSMENT OF LAND SUITABILITY FOR CROPS AT NORTH OF WADI EL-NATRUN AREA, EGYPT

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ABSTRACT

The current study was carried out in an area north of Wadi El-Natrun, west of the Nile Delta, Egypt. It included soil classification and land suitability assessment, which are the main prerequisite steps for ensuring optimum land utilization. These information constitute the main step for any agricultural development. The study of soil characteristics provides basic information for the evaluation of the natural resource. In order to realize this objective, a number of 35 representative soil profiles were studied morphologically in the field and their physical and chemical characteristics were determined in the laboratory on representative samples. The soils are classified as; *Typic Torripsamments*, *Typic Haplocalcids* or *Typic Haplogypsids*.

The soil parameters used to estimate the suitability index for certain crops are: soil texture including gravel content, soil depth, salinity and alkalinity status, calcium carbonate status, gypsum status, natural drainage conditions, slope and nutrient status. Seventeen crops were tested for land suitability evaluation, namely; alfalfa, barley, maize, soybean, sunflower and wheat (as field crops); cabbage, carrots, green pepper, onions, potatoes and tomatoes (as vegetables crops) and banana, citrus, guava, mango and olive (as fruit crops).

The obtained results reveal that with using the nutrient and salinity status into consideration (actual land suitability) the suitability index is downgraded (it could be rich to non-suitable class). However, corrections to the nutrient conditions and soil salinity (nonpermanent properties) give what is called potential land suitability. This is done by adding organic manure, using fertilizers and leaching the excess salts to upgrade the fertility of the soil. According to the classification of FAO (1976) and Sys (1993) and after correction of nutrient conditions and soil salinity, the suitability index is upgraded. The main soil characteristics affecting land suitability are; soil texture, gravel content and calcium carbonate content (permanent properties). The studied soils are evaluated as moderately, marginally or non-suitable for these crops.

Keywords: Soil properties, soil classification, land evaluation, Wadi El-Natrun, Egypt

INTRODUCTION

The majority of the Egyptian population is concentrated in the Nile Valley and Delta whereas alluvial soils dominate in the agricultural land. In order to meet the demands of the increase of population there are two ways; the first is to increase the productivity of the old cultivated soils and the second is to expand agriculture in the desert. Agricultural expansion in the Western Desert is one of the most vital objectives of the Egyptian plan is to meet the food security requirements of the tremendous increase in population.

Soil survey, classification and land suitability for various crops are the main steps towards achieving proper land use planning under efficient

economic conditions. Cropping patterns in the investigated area is concentrated on growing fruit trees such as citrus, apples, grapes, olives and date palm, in addition to some field crops for local consumption. Other non-conventional economic crops started to draw the attention of some farmers, such as: sunflower, fodder and medical crops. The current investigation aims at estimating the suitability indices of the main crops taking into consideration the limiting soil criteria. In other words, the suitability of these soils to fit requirements of such crops is calculated.

Climatic conditions:

The meteorological data reveal that the arid climate is prevailing in the study area; the total annual precipitation is about 40 mm., the average annual temperature 20.1 °C, the maximum monthly temperature 28.3 °C, the minimum monthly temperature 13.8 °C, the total annual isolation 3549.6 hr., the mean monthly relative humidity 63.9% and the total annual potential evaporation 2545.9 mm, Table 1. According to the soil temperature, rainfall, potential evapotranspiration values; the soil moisture regime is Torric or Aridic and the soil temperature regime is Hyperthermic.

Table (1): Some climatological data of the study area (1990-1995).

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	mean
Mean T. °C	12.4	12.8	16	19.3	22.6	25.8	27.3	27.6	24.9	22.1	17.8	12.8	20.1
Max. T. °C	20.0	21.2	24.2	28.0	31.7	34.4	34.6	34.8	32.9	30.5	25.4	21.5	28.3
Min. T. °C	7.2	7.6	9.5	12.2	15.0	18.5	20.1	20.5	18.4	15.8	12.3	8.8	13.8
Rainfall (mm)	5.5	4.2	3.3	1.7	1.0	0.0	0.0	0.0	0.2	0.7	11.2	9.7	37.5
RH %	69	63	60	56	54	56	65	66	66	68	74	70	63.9
Wind .V. km/hr	11.5	11.5	13.0	12.0	10.0	10.0	9.0	8.0	7.0	7.0	8.0	9.3	9.7
Sunshine hrs./day	7.2	8.1	8.7	8.9	11.2	12.4	12.4	11.8	10.5	9.5	8.5	7.5	9.7
Evap. mm/day	4.2	5.4	6.9	8.7	9.9	10.3	8.6	7.8	7.3	6.1	4.2	4.3	7.0
Soil T. °C (5 cm)	20.2	22.3	25.0	32.1	35.3	37.7	39.3	39.3	37.2	33.4	26.9	22.0	30.9

After, Climatological Normals for Egypt. (1995).

Hydrological conditions: Several studies proved that the water storage of wells in the study area is related to the storage of the Nile Delta in three hydrostatic units; two of them in the Pleistocene Era and the third in the Pliocene Era. The depth to ground water level from the surface varies between few meters close to the Delta fringes and about 40 m close to the Wadi El-Natrun. The main aquifers in the area west of the Nile Delta relate to recent, the Pleistocene and Neogene aquifers.

Geological formation: The area under investigation was formed during the following different geological periods; a)- Quaternary period (Holocene sand, gravel and alternating sand and clay with limestone) – Pleistocene (wind blown sand, sand dune), b)- Tertiary period (Miocene –sandstone, limestone, clay and conglomerate), Oligocene (gravels, sands and limestone);Said (1962), El-Fayoumy (1964), Abdel Hady, et al. (1975), REGWA (1988) and Ministry of Industry and Mineral Resources (1981).

Geomorphology: Abdel-Aziz (1989) mentioned that erosion was able to form piedmont alluvial plains along the margins of the three rocky plateau, which constitute the Western Desert. These plains are known as (Bajadas) in arid and semi arid regions. The piedmonts merge together, and blend as well into

the cuesta walls the edges of the plateau and are thus composed of four major elements. The piedmont, usually recently formed, - the bajada found along the foot of cuests, - A transitional area between the recently – cut piedmont and the bajada is a naturally dissected area with bultes (Inselbergs) across its surface, -The upper part of the plateau, having the form of a mesa (a feature of horizontal sedimentary strata.)

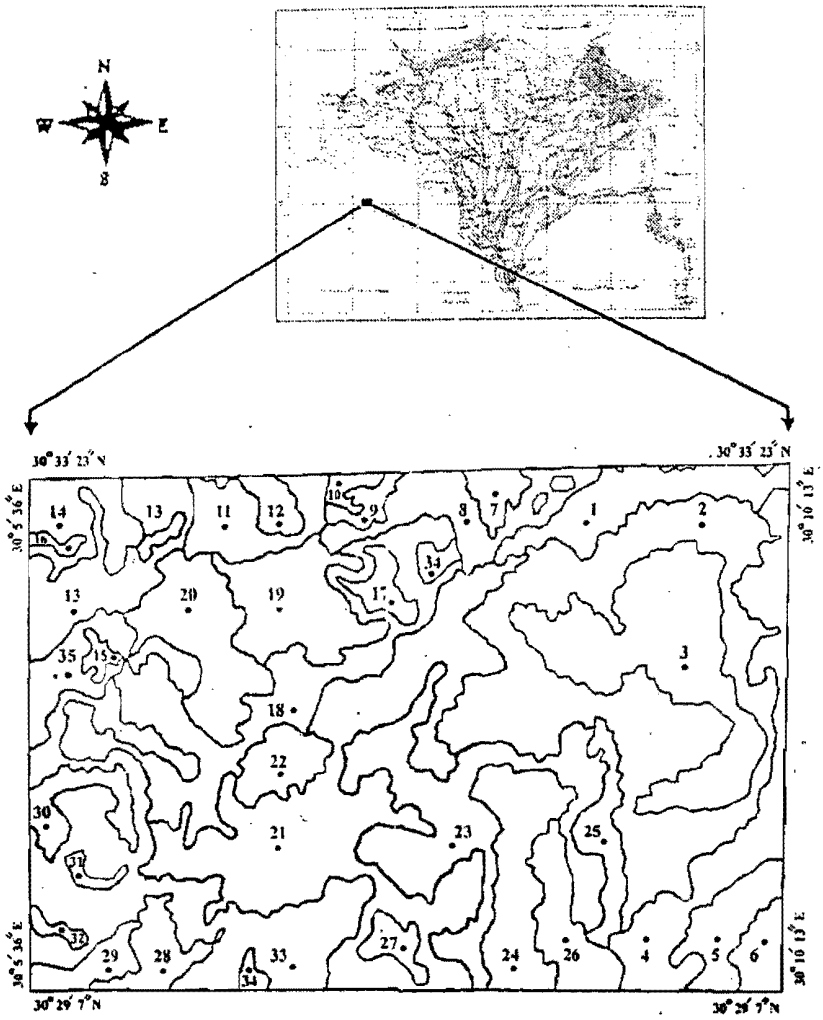
Current cropping patterns and plant requirements: The main field crops grown in the area under investigation at present are wheat, maize, Egyptian clover and sunflower on a small scale. Most important fruit crops are grapes, pears, citrus and apples. Some small areas are cultivated with vegetables i.e. tomatoes and green pepper. The essential crop requirements have been considered with regard to the various soil parameters in calculating the suitability index.

Land suitability of the studied area: According to the system of FAO (1976) and Sys et al. (1991), and the results obtained by Abdel Rahman (1989), Sanad (1995) and Ramadan (1999), the most effective parameters that influence the suitability classification in the study area are; soil texture, soil depth, gravel content, salinity and alkalinity status, calcium carbonate status, presence of calcic horizon, gypsum status, presence of gypsum horizon, drainage conditions, slope and nutrient status. The studies revealed quantitative evaluation of the actual soil parameters to realize a precise objective interpretation for the area under consideration and its suitability for a wide range of crops.

MATERIALS AND METHODS

The area under investigation is located between 30° 29′ 7″ N and 30° 33′ 23″ N latitudes and 30° 05′ 36″ E and 30° 10′ 13″ E longitudes. It is about 10,000 feddan. It is located about 5 km west the Cairo Alexandria desert road at the km 130 from Cairo north Wadi El-Natrun. A detailed soil survey of the studied area was carried out by FAO (1964) and LMP (1986). Based on surface ground elevation, which varied from 115 m a.s.l. to -6 m b.s.l. This was used as the basic source of information. Thirty five soil profiles were chosen to represent the study area, map 1. The soil profiles were dug and morphologically described according to FAO (1990).

Determination of textural class was carried out according to Trask (1950) and calcium carbonate was determined using Collin's Calcimeter according to the method described by Wright, (1939). Organic matter content was determined following the modified Walkely and Black method, Jackson (1969). Exchangeable cations and cations exchange capacity (CEC) were determined according to Jackson (1969). The chemical characteristics of the studied soil samples such as soil reaction (pH), electric conductivity in 1: soil water extract (EC), soluble cations and anions were determined according to Page, et al. (1982) and Klute (1986). Available P content was determined according to Olsen (1954). Available Zn, Fe, Mn, and Cu were determined according to Landsay and Norvell (1978).



Map (1): Location map of the study area and selected soil profiles.

The methodology used for the evaluation refers to the Sys et al. parametric method (1993), based on F.A.O land evaluation framework (1985). The methodology consists of matching land characteristics against crop needs and assigning a suitability rating to each land characteristic, Table 2. The essential crop requirements which have been considered with regard to the various soil parameters in calculating the suitability index are: gravel content (A), texture class (B), soil depth (C), salinity status (D), calcium carbonate content (E), gypsum content (F), drainage conditions (G) and slope (H). The formula used to calculate the suitability index (IS_x) of a given soil for a certain crop (x) according to FAO (1985) and Sys, et al. (1993) is;

IS_x = A.B.C.D.E.F.G.H

The degree of land suitability to certain crops depends on the reduction of the yield. Accordingly, five classes of land suitability are considered. These are shown in Table 2.

Table(2): land suitability classes as related to yield reduction and range of indices.

Index symbol	Yield reduction %	Range of index
S1 (Excellent)	no yield reduction (Optimal conditions)	0.85 – 1.00
S2 (Good)	10% yield reduction (Sub-optimal conditions)	0.75 - 0.85
S3 (Moderate)	10-25% yield reduction (50% optimal and 50% sub-optimal conditions)	0.50 – 0.75
S4 (low)	25-50% yield reduction (50% sub-optimal and 50% not suitable conditions)	0.25 – 0.50
S5 (Not Suitable)	> 50% yield reduction	< 0.25

After; FAO (1985) and Sys, *et al.* (1993)

RESULTS AND DISCUSSION

1. Soils characteristics

The parent materials of the soils in the study area are sandy and calcareous desertic deposits. The study area is characterized by gently slope, almost flat to flat surface. The soil depth is deeper than 1 m. The drainage is well and the ground water is not observed at the investigated depth. The agricultural landuse in the majority is orchards. The soil morphological features of the study area are shown in Table 3. The Chemical and physical characteristics are shown in Table 4.

The obtained data show that soil texture varied from very gravelly coarse sand to loamy coarse sand, where the total sand ranges between 76.6 and 100.0%. The gravel content is less than 15% in most studied soil profiles, except in profiles 2, 3, 4, 10, 13, 18 and 23 where it ranges between 15.0 and 25.0% and in profiles 1, 5, 9, 16 and 17 where it ranges between 25.0 and 60.0%. The soil structure generally is single grains. The pH values range from 7.6 to 8.0. Total $CaCO_3$ content in most studied soil profile is less than 5% except in profiles nos. 3, 11, 16, 17, 18, 19, 20, 24, 25, 32, 33 and 35 which have $CaCO_3$ contents ranging between 5.0 and 10.0%. Profiles nos. 8, 15 and 26 have $CaCO_3$ contents which range between 10.0 and 15.0%, while profile 29 has $CaCO_3$ contents ranging from 16.0 to 23.25%. The organic mater content is very low in all the studied soil profiles, being less than 1.0%.

Table 3 Summarized field description of the representative soil profiles for soils north of Wadi El-Natrun.

Prof. No.	Depth (cm)	Classification	Elevation (m) A.S.L.	Topography	Parent material	Agric. Landuse	Drainage	Depth of G.W. table	Colour dry	Colour wet	Texture	Structure	Consistence	Boundary	Horizon
1	0 - 30	Typic Torripsamments	112	Gently sloping	Recent	Barren	Well	Deep	10 YR 7/6	10 YR 5/4	VGCS	SG	N.N.L.	ABS	C1
	30 - 70								10 YR 6/6	10 YR 5/4	GCS	SG	N.N.L.	CS	C2
	70 - 120								10 YR 6/6	10 YR 5/6	VGCS	SG	N.N.L.		C3
2	0 - 25	Typic Torripsamments	115	Flat to almost flat	Recent	Apple	Well	Deep	10 YR 7/6	10 YR 7/3	S	SG	N.N.L.	CS	Ap
	25 - 65								10 YR 7/4	10 YR 6/4	GS	SG	N.N.L.	CS	C1
	65 - 120								10 YR 8/4	10 YR 6/3	S	SG	N.N.L.		C2
3	0 - 30	Typic Haplocalcids	100	Flat to almost flat	Recent	Barren	Well	Deep	10 YR 7/6	10 YR 6/6	CS	SG	N.N.L.	ABS	C1
	30 - 60								5 YR 6/6	5 YR 5/8	GCS	SG	N.N.L.	ABS	C2
	60 - 120								5 YR 6/8	5 YR 5/8	S	SG	N.N.L.		C3
4	0 - 20	Typic Torripsamments	86	Gently sloping	Recent	Barren	Well	Deep	10 YR 7/4	10 YR 6/8	CS	SG	N.N.L.	ABS	C1
	20 - 50								10 YR 7/4	10 YR 6/8	S	SG	N.N.L.		C2
	50 - 110								10 YR 7/3	10 YR 6/8	CS	SG	N.N.L.		C3
5	0 - 30	Typic Torripsamments	107	Gently sloping	Recent	Barren	Well	Deep	10 YR 7/6	10 YR 5/4	CS	SG	N.N.L.	CS	C1
	30 - 70								10 YR 7/8	10 YR 6/8	GCS	SG	N.N.L.	CS	C2
	70 - 120								10 YR 7/3	10 YR 6/6	VGCS	SG	N.N.L.		C3
6	0 - 25	Typic Haplogysids	84	Flat to almost flat	Recent	Grapes	Well	Deep	10 YR 6/8	10 YR 6/6	CS	SG	N.N.L.	ABS	Ap
	25 - 50								10 YR 6/6	10 YR 5/6	CS	SG	N.N.L.	ABS	C1
	50 - 120								10 YR 6/8	10 YR5/8	CS	SG	N.N.L.		C2
7	0 - 20	Typic Torripsamments	82	Gently sloping	Recent	Barren	Well	Deep	7.5 YR 7/8	7.5 YR 6/6	S	SG	N.N.L.	CS	C1
	20 - 50								7.5 YR 7/4	7.5 YR 6/6	CS	SG	N.N.L.	CS	C2
	50 - 80								7.5 YR 7/6	7.5 YR 6/6	CS	SG	N.N.L.	CS	C3
	80 - 120								7.5 YR 7/4	7.5 YR 6/4	S	SG	N.N.L.		C4
8	0 - 20	Typic Haplocalcids	60	Flat to almost flat	Recent	Barren	Well	Deep	7.5 YR 7/4	7.5 YR 6/6	GS	SG	N.N.L.	ABS	C1
	20 - 50								7.5 YR 6/6	7.5 YR 6/8	CS	SG	N.N.L.	ABS	C2
	50 - 70								7.5 YR 7/8	7.5 YR 7/3	CS	SG	N.N.L.	ABS	C3
	70 - 110								7.5 YR 7/8	7.5 YR 7/8	CS	SG	N.N.L.		C4
9	0 - 30	Typic Torripsamments	80	Gently sloping	Recent	Barren	Well	Deep	10 YR 8/3	10 YR 7/4	VGS	SG	N.N.L.	ABS	C1
	30 - 60								10 YR 7/3	10 YR 7/4	GCS	SG	N.N.L.	ABS	C2
	60 - 120								10 YR 8/5	10 YR 7/4	CS	SG	N.N.L.		C3
10	0 - 35	Typic Torripsamments	80	Gently sloping	Pleistocene & Pliocene	Barren	Well	Deep	5 YR 6/2	5 YR 5/8	CS	SG	N.N.L.	CS	C1
	35 - 70								5 YR 7/4	5 YR 7/3	S	SG	N.N.L.	CS	C2
	70 - 110								5 YR 6/4	5 YR 5/4	CS	SG	N.N.L.		C3
11	0 - 20	Typic Torripsamments	80	Flat to almost flat	Recent	Apple	Well	Deep	10 YR 7/4	10 YR 7/5	S	SG	N.N.L.	ABS	C1
	20 - 70								10 YR 7/4	10 YR 7/3	S	SG	N.N.L.	CS	C2
	70 - 120								10 YR 8/6	10 YR 5/6	S	SG	N.N.L.		C3
12	0 - 30	Typic Torripsamments	81	Flat to almost flat	Recent	Apple	Well	Deep	10 YR 7/4	10 YR 5/4	CS	SG	N.N.L.	ABS	Ap
	30 - 70								5 YR 6/5	5 YR 5/4	CS	SG	N.N.L.	ABS	C1
	70 - 110								5 YR 4/3	5 YR 4/6	CS	SG	N.N.L.		C2

Texture symbols: V= very, G= gravel, C= course, S= sand, L= loam   Structure symbols: SG= single grains; WSAB= week subangular blocky
Boundary symbols: ABS= abrupt sharp, CS= clear sharp   Consistence symbols: N.N.L= non-sticky non-plastic, Loose; SH = slightly hard;
SSNPSH= slightly sticky non-plastic, slightly hard; .

Table 3 Cont.

Prof. No.	Depth (cm)	Classification	Elevation (m) A.S.L.	Topography	Parent material	Agric. Landuse	Drainage	Depth of G.W. table	Colour dry	Colour wet	Texture	Structure	Consi-stence	Boun-dary	Hor-izon
13	0 - 20	Typic Haplogysids	80	Gently sloping	Recent	Apple	Well	Deep	10 YR 6/8	10 YR 5/6	CS	SG	N.N.L.	CS	Ap
	20 - 50								5 YR 6/8	5 YR 5/6	CS	SG	N.N.L.	ABS	C1
	50 - 80								5 YR 5/6	5 YR 5/6	CS	SG	N.N.L.	ABS	C2
	80 - 120								5 YR 6/6	5 YR 5/6	GS	SG	N.N.L.		C3
14	0 - 25	Typic Torripsamments	70	Flat to almost flat	Recent	Citrus	Well	Deep	10 YR 7/3	10 YR 7/4	S	SG	N.N.L.	ABS	Ap
	25 - 70								10 YR 7/6	10 YR 6/6	S	SG	N.N.L.	CS	C1y
	70 - 120								5 YR 7/4	5 YR 8/3	S	SG	N.N.L.		C2y
15	0 - 30	Typic Haplocalcids	58	Flat to almost flat	Recent	Crops and trees	Well	Deep	7.5 YR 6/4	7.5 YR 6/6	GS	SG	N.N.L.	CS	Ap
	30 - 60								7.5 YR 7/4	7.5 YR 6/4	CS	SG	N.N.L.	ABS	C1
	60 - 120								7.5 YR 6/8	7.5 YR 6/6	CS	CMS	N.N.L.		C2
16	0 - 25	Typic Torripsamments	64	Flat to almost flat	Recent	Apple	Well	Deep	7.5 YR 7/6	7.5 YR 6/8	GCS	SG	N.N.L.	CS	Ap
	25 - 60								7.5 YR 6/6	7.5 YR 5/4	GCS	SG	N.N.L.	CS	C1k
	60 - 120								7.5 YR 8/6	7.5 YR 7/8	GLCS	SG	N.N.L.		C2k
17	0 - 20	Typic Haplocalcids	66	Flat to almost flat	Recent	Barren	Well	Deep	7.5 YR 6/6	7.5 YR 6/8	CS	SG	N.N.L.	ABS	C1
	20 - 40								7.5 YR 6/6	7.5 YR 6/7	GCS	SG	N.N.L.	CS	C2k
	40 - 100								7.5 YR 6/6	7.5 YR 6/8	GCS	SG	N.N.L.	CS	C3k
18	0 - 30	Typic Torripsamments	60	Gently sloping	Recent	Crops	Well	Deep	5 YR 7/6	5 YR 6/8	CS	SG	N.N.L.	ABS	Ap
	30 - 60								5 YR 7/6	5 YR 6/8	CS	SG	N.N.L.	CS	C1k
	60 - 120								5 YR 7/6	5 YR 5/8	CS	SG	N.N.L.		C2k
19	0 - 30	Typic Torripsamments	55	Flat to almost flat	Recent	Citrus	Well	Deep	10 YR 7/6	10 YR 7/8	CS	SG	N.N.L.	CS	AP
	30 - 70								10 YR 7/3	10 YR 7/4	CS	SG	N.N.L.	CS	C1
	70 - 120								10 YR 6/6	10 YR 6/8	CS	SG	N.N.L.		C2
20	0 - 25	Typic Torripsamments	59	Flat to almost flat	Recent	Grapes	Well	Deep	10 YR 8/4	10 YR 7/4	CS	SG	N.N.L.	ABS	Ap
	25 - 60								10 YR 8/5	10 YR 7/4	CS	SG	N.N.L.	CS	C1
	60 - 110								10 YR 8/4	10 YR 7/4	CS	SG	N.N.L.		C2
21	0 - 20	Typic Torripsamments	56	Flat to almost flat	Recent	Olive	Well	Deep	10 YR 8/5	10 YR 6/5	GS	SG	N.N.L.	ABS	Ap
	20 - 50								10 YR 8/3	10 YR 6/4	S	SG	N.N.L.	ABS	C1
	50 - 110								10 YR 8/4	10 YR 6/4	S	SG	N.N.L.		C2
22	0 - 30	Typic Torripsamments	- 6	Flat to almost flat	Recent and Pleistocene	Barren	Well	Deep	10 YR 7/4	10 YR 6/4	GCS	SG	N.N.L.	CS	C1
	30 - 60								10 YR 7/2	10 YR 6/4	CS	SG	N.N.L.	CS	C2
	60 - 90								10 YR5/4	10 YR 4/5	CS	SG	N.N.L	CS	C3
	90 - 120								10 YR 7/3	10 YR 6/4	LCS	WAB	N.N.L.		C4
23	0 - 25	Typic Torripsamments	8	Flat to almost flat	Pleistocene &Pliocene	Olive	Well	Deep	10 YR 8/3	10 YR 3/4	GCS	SG	N.N.L.	ABS	Ap
	25 - 55								10 YR 5/4	10 YR 3/4	CS	SG	N.N.L	CS	C1
	55 - 100								10 YR 3/4	10 YR 3/4	CS	WAB	SH		C'2
24	0 - 20	Typic Haplogysids	10	Gently sloping	Recent and Pleistocene	Barren	Well	Deep	10 YR 7/6	10 YR 8/8	CS	SG	N.N.L.	ABS	C1
	20 - 50								10 YR 7/6	10 YR 5/4	CS	SG	N.N.L.	CS	C2k
	50 - 100								10 YR 6/6	10 YR 5/6	CS	SG	N.N.L.		C3k

Texture symbols: V= very, G= gravel, C= course, S= sand, L= loam **Structure symbols:** SG= single grains; WSAB= week subangular blocky
Boundary symbols: ABS= abrupt sharp, CS= clear sharp **Consistence symbols:** N.N.L= non-sticky non-plastic, Loose; SH = slightly hard; SSNPSH= slightly sticky non-plastic, slightly hard; .

Table 3 Cont.

Prof. No.	Depth (cm)	Classification	Elevation (m) A.S.L.	Topography	Parent material	Agric. Landuse	Drainage	Depth of G.W. table	Colour dry	Colour wet	Texture	Structure	Consistence	Boundary	Horizon
25	0 - 30	Typic Torripsamments	30	Flat to almost flat	Recent and Pleistocene	Crops	Well	Deep	10 YR 8/3	10 YR 7/5	CS	SG	N N L.	CS	Ap
	30 - 70								10 YR 7/6	10 YR 6/6	CS	SG	N N L.	CS	C1
	70 - 120								10 YR 7/6	10 YR 6/6	CS	Massive	SSNPSh		C2
26	0 - 20	Typic Haplocalcids	41	Flat to almost flat	Recent and Pleistocene	Grapes &Citrus	Well	Deep	10 YR 7/4	10 YR 5/4	CS	SG	N N L.	CS	Ap
	20 - 50								10 YR 8/4	10 YR 5/4	CS	SG	N N.L.	CS	C1
	50 - 110								10 YR 8/4	10 YR 6/6	CS	SG	N N.L.		C2
27	0 - 25	Typic Torripsamments	40	Gently sloping	Recent	Fruits & Sunflower	Well	Deep	10 YR 8/3	10 YR 7/4	CS	SG	N N.L.	CS	Ap
	25 - 50								10 YR 8/4	10 YR 6/6	CS	SG	N N.L	CS	C1k
	50 - 100								10 YR 8/4	10 YR 6/6	CS	SG	N N.L		C2
28	0 - 30	Typic Torripsamments	12	Flat to almost flat	Recent and Pleistocene	Olive and Data palm	Well	Deep	5 YR 6/2	5 YR 6/4	LS	WSAB	SSWH	ABS	Ap
	30 - 70								10 YR 7/4	10 YR 6/3	CS	SG	SSNPSH	ABS	C1z
	70 - 110								10 YR 7/5	10 YR 6/4	LCS	WSAB	SSNPSH		C2z
29	0 - 25	Typic Haplocalcids	35	Gently sloping	Pleistocene	Data palm	Well	Deep	10 YR 5/2	10 YR 3/2	LCS	SG	N N L.	ABS	Ap
	25 - 50								10 YR 7/3	10 YR 7/2	LCS	SG	N N L.	ABS	C1
	50 - 100								7.5 YR 6/4	7.5 YR 6/4	LCS	SG	N N.L.		C2
30	0 - 25	Typic Torripsamments	44	Flat to almost flat	Pleistocene	Olive	Well	Deep	7.5 YR 7/8	7.5 YR 6/6	CS	SG	N N L.	CS	Ap
	25 - 60								7.5 YR 6/4	7.5 YR 6/5	S	SG	N.N.L.	CS	C1
	60 - 110								7.5 YR 7/6	7.5 YR 6/8	S	SG	N.N.L.		C2
31	0 - 30	Typic Torripsamments	42	Flat to almost flat	Pleistocene	Fruits - sunflower	Well	Deep	10 YR 7/4	10 YR 5/6	CS	SG	N.N.L.	CS	Ap
	30 - 60								10 YR 8/3	10 YR 6/4	CS	SG	N.N.L.	CS	C1
	60 - 120								10 YR 7/4	10 YR 6/4	CS	SG	N.N.L		C2
32	0 - 30	Typic Torripsamments	44	Flat to almost flat	Pleistocene	Olive	Well	Deep	10 YR 6/6	10 YR 5/6	CS	SG	N N.L.	CS	Ap
	30 - 70								10 YR 5/6	10 YR 7/6	CS	SG	N N L.	CS	C1k
	70 - 120								10 YR 5/8	10 YR 6/8	CS	SG	N N.L.		C2k
33	0 - 25	Typic Torripsamments	46	Flat to almost flat	Pleistocene	Barren	Well	Deep	10 YR 8/8	10 YR 6/6	CS	SG	N N.L.	CS	C1
	25 - 60								10 YR 7/6	10 YR 6/6	LCS	SG	N N.L.	CS	C2k
	60 - 110								10 YR 8/8	10 YR 6/4	CS	SG	N N L.		C3k
34	0 - 30	Typic Torripsamments	48	Flat to almost flat	Recent	Grapes	Well	Deep	10 YR 7/4	10 YR 6/4	LCS	SG	N N L	CS	Ap
	30 - 60								10 YR 8/3	10 YR 6/3	CS	SG	N.N.L.	CS	C1k
	60 - 110								10 YR 6/6	10 YR 5/6	CS	SG	N N L		C2k
35	0 - 25	Typic Torripsamments	50	Gently sloping	Recent	Olive	Well	Deep	10 YR 773	10 YR 6/4	GLCS	SG	N N L.	ABS	Ap
	25 - 50								5 YR 5/6	5 YR 5/6	CS	SG	N N.L.	ABS	C1
	50 - 100								5 YR 5/7	5 YR 5/4	CS	SG	N.N.L.		C2

Texture symbols: V= very, G= gravel, C= course, S= sand, L= loam   Structure symbols: SG= single grains; WSAB= week subangular blocky
Boundary symbols: ABS= abrupt sharp, CS= clear sharp   Consistence symbols: N.N.L= non-sticky non-plastic, Loose; SH = slightly hard;
SSNPSH= slightly sticky non-plastic, slightly hard; .

Table(4):Some physical and chemical characteristics of analyzed samples (in 1:1 soil water extract) from the studied soil profiles.

Prof. No.	Depth cm	Gravel (%)	C. sand 2-0.5	M sand 0.5-.025	F. Sand 0.25-.05	Total sand 2-0.05	> 0.05 Silt-clay	Texture class	pH	CaCO3 %	OM %	Gypsum %	EC dS/m	CEC mq/100 g soil	ESP %	Available nutrients (ppm) P	K	Fe	Mn	Zn	Cu.
1	0 - 30	55.00	27.29	24.42	43.98	95.67	4.33	VGCS	7.90	1.98	0.56	0.11	0.76	4.30	14.21	3.75	29.12	2.68	0.75	0.78	0.31
	30 - 70	32.50	26.87	29.70	42.13	98.71	1.29	GCS	7.60	3.05	0.32	0.12	0.91	4.50	13.52	2.02	20.22	0.65	0.32	0.36	0.15
	70 - 120	59.99	37.22	33.57	28.49	99.28	0.72	VGCS	7.90	1.95	0.01	0.31	1.25	5.66	14.02	0.12	5.11	0.02	0.01	0.06	0.01
2	0 - 25	15.00	18.22	40.75	40.49	99.47	0.53	S	7.90	1.01	0.67	0.21	0.75	4.56	7.63	4.51	40.25	1.87	0.56	0.35	0.45
	25 - 65	27.00	17.14	36.19	44.79	98.12	1.88	GS	7.80	3.12	0.42	0.15	0.65	3.79	8.99	2.33	30.11	0.75	0.40	0.15	0.20
	65 - 120	13.00	22.53	48.11	28.00	98.64	1.36	S	7.80	2.02	0.03	0.17	1.60	5.35	9.02	0.01	2.45	0.02	0.02	0.01	0.05
3	0 - 30	18.00	27.67	28.27	43.57	99.51	0.49	CS	8.00	3.01	0.57	0.56	0.89	3.56	9.53	3.62	35.42	3.82	0.72	0.42	0.32
	30 - 60	25.00	32.13	35.00	32.31	99.44	0.56	GCS	7.90	16.82	0.31	0.43	0.97	3.66	10.12	1.35	10.22	1.20	0.31	0.21	0.15
	60 - 120	16.00	22.33	35.00	41.77	99.11	0.89	S	8.00	9.25	0.01	0.35	2.41	4.75	11.01	0.25	1.76	0.03	0.02	0.01	0.05
4	0 - 20	21.00	27.54	29.33	39.32	96.19	3.81	CS	7.70	1.40	0.67	0.35	0.79	5.02	11.94	4.58	30.35	2.76	0.60	0.92	0.25
	20 - 50	20.00	24.75	31.73	40.94	97.41	2.59	S	7.80	2.70	0.42	0.46	1.61	5.11	12.23	2.32	9.56	0.72	0.25	0.41	0.10
	50 - 110	24.00	28.75	29.37	38.57	96.68	3.32	CS	7.70	8.50	0.11	0.25	2.35	4.21	11.66	0.15	2.11	0.02	0.01	0.02	0.01
5	0 - 30	15.00	55.08	30.31	13.98	99.36	0.64	CS	7.50	0.72	0.73	0.62	0.64	3.20	14.06	3.25	30.61	3.75	0.80	0.51	0.52
	30 - 70	35.00	48.08	19.91	30.45	98.43	1.57	GCS	7.60	3.35	0.51	0.71	2.55	3.68	13.17	1.05	10.13	0.78	0.20	0.30	0.25
	70 - 120	50.00	51.58	20.26	25.84	97.68	2.32	VGCS	7.70	2.87	0.12	0.56	2.48	3.25	15.01	0.15	2.51	0.08	0.01	0.02	0.02
6	0 - 25	16.00	52.63	16.62	29.30	98.55	1.45	CS	7.90	0.98	0.82	0.17	1.92	5.50	11.29	4.20	75.61	6.56	0.82	0.67	0.31
	25 - 50	3.90	54.09	27.32	15.78	97.18	2.82	CS	7.80	3.78	0.42	7.50	1.02	4.78	10.35	2.02	40.20	1.35	0.20	0.25	0.15
	50 - 120	4.50	51.58	22.57	23.75	97.90	2.10	CS	7.90	1.75	0.15	4.60	1.55	5.02	12.01	0.30	5.11	0.15	0.05	0.05	0.01
7	0 - 20	20.00	24.55	22.83	47.13	94.50	5.50	S	7.90	1.78	0.63	0.19	1.50	4.20	11.33	4.35	60.20	3.15	0.98	0.56	0.29
	20 - 50	15.00	29.19	27.20	39.96	96.35	3.65	CS	7.70	2.92	0.46	0.21	1.70	4.22	12.44	2.62	30.11	1.25	0.72	0.33	0.15
	50 - 80	3.50	37.84	31.66	29.92	99.42	0.58	CS	7.80	4.89	0.21	1.00	1.75	5.01	10.91	1.01	5.02	0.51	0.06	0.15	0.05
	80 - 120	4.50	23.57	28.03	44.37	95.97	4.03	S	7.80	7.68	0.01	1.51	1.76	4.88	13.51	0.20	1.25	0.02	0.01	0.01	0.01
8	0 - 20	25.00	21.03	22.59	53.33	96.95	3.05	GS	7.80	6.20	0.75	0.15	1.42	4.23	11.13	4.56	70.31	4.25	0.98	0.68	0.26
	20 - 50	13.00	39.93	26.38	26.08	92.39	7.61	CS	7.70	7.84	0.52	0.45	1.76	5.66	12.03	2.02	20.51	1.25	0.64	0.26	0.10
	50 - 70	15.00	42.66	27.06	25.13	94.85	5.15	CS	7.90	20.30	0.31	7.71	1.86	5.82	11.95	1.01	5.25	0.75	0.35	0.12	0.05
	70 - 110	7.50	52.67	24.57	20.93	98.17	1.83	CS	7.80	10.80	0.10	4.31	1.95	3.67	13.02	0.20	1.45	0.06	0.02	0.01	0.01
9	0 - 30	55.00	23.04	43.58	30.16	96.78	3.22	VGS	7.90	1.23	0.67	0.21	2.25	5.01	8.42	5.67	30.86	2.82	0.81	0.62	0.24
	30 - 60	30.00	25.37	38.40	33.43	97.20	2.80	GCS	7.70	1.45	0.35	0.35	1.85	3.89	7.98	2.02	10.41	0.85	0.52	0.32	0.12
	60 - 120	16.00	25.92	35.06	37.43	98.40	1.60	CS	7.80	0.89	0.01	0.29	1.45	5.22	9.11	0.50	1.25	0.03	0.01	0.02	0.01
10	0 - 35	21.00	27.34	27.09	40.16	94.59	5.41	CS	7.90	1.86	0.82	0.25	2.50	4.51	13.57	5.68	40.21	5.21	1.78	1.62	0.29
	35 - 70	7.00	19.20	29.71	46.72	95.63	4.37	S	7.70	1.39	0.52	0.26	2.60	5.02	12.67	2.25	10.90	2.01	0.55	0.62	0.07
	70 - 110	20.00	32.33	36.58	27.19	96.09	3.91	CS	7.80	1.60	0.12	0.15	3.10	5.21	11.05	0.30	5.02	0.02	0.02	0.01	0.01
11	0 - 20	10.00	19.82	22.30	53.92	96.04	3.96	S	7.70	1.75	0.76	0.25	1.50	4.89	8.46	3.50	80.51	5.20	0.98	0.75	0.35
	20 - 70	3.00	10.91	42.27	37.54	90.71	9.29	S	7.60	6.10	0.46	0.31	2.90	4.56	9.21	1.55	30.20	1.25	0.62	0.45	0.12
	70 - 120	0.00	10.03	50.35	28.01	94.39	5.61	S	7.70	6.87	0.12	0.27	2.01	4.72	8.62	0.20	5.25	0.07	0.01	0.01	0.01
12	0 - 30	0.00	26.00	23.22	46.20	95.42	4.58	CS	7.80	0.83	0.68	0.26	2.86	5.02	8.15	3.90	75.21	3.56	0.99	0.86	0.35
	30 - 70	0.00	27.79	33.75	33.11	94.65	5.35	CS	7.90	2.01	0.32	0.31	2.10	5.11	9.02	1.72	20.35	1.02	0.54	0.35	0.11
	70 - 110	5.10	46.46	30.40	20.97	97.83	2.17	CS	7.70	3.20	0.02	0.27	2.20	5.21	10.11	0.20	5.01	0.01	0.01	0.01	0.01

Table 4 Cont.

Prof. No.	Depth cm	Gravel (%)	C. sand 2-0.5	M. sand 0.5-.025	F. Sand 0.25-.05	Total sand 2-0.05	> 0.05 Silt-clay	Texture class	pH	CaCO3 %	OM %	Gypsum %	EC dS/m	CEC mq/100 g soil	ESP %	Available nutrients (ppm)					
																P	K	Fe	Mn	Zn	Cu.
13	0 - 20	20.00	43.31	6.64	45.09	95.04	4.96	CS	7.80	1.87	0.73	0.18	2.92	5.12	6.38	3.85	55.23	2.12	1.13	0.98	0.41
	20 - 50	13.00	29.08	41.01	28.62	98.71	1.29	CS	7.70	3.16	0.56	4.50	3.52	5.02	7.82	1.60	20.11	0.91	0.78	0.62	0.20
	50 - 80	7.00	60.78	27.00	12.22	100.00	0.00	CS	7.80	8.67	0.32	6.30	3.90	5.11	8.78	0.90	10.01	0.20	0.32	0.13	0.11
	80 - 120	30.00	21.19	48.36	23.37	92.91	7.09	GS	8.10	2.75	0.02	1.25	3.56	4.98	9.56	0.25	2.50	0.01	0.02	0.01	0.02
14	0 - 25	20.00	24.86	25.30	49.50	99.66	0.34	S	7.80	1.01	0.62	0.11	1.85	3.21	13.67	4.02	45.23	9.23	1.32	1.26	0.35
	25 - 70	6.50	20.48	33.90	40.95	95.33	4.67	S	7.70	2.02	0.37	0.25	1.65	4.85	12.75	2.31	20.15	4.22	0.63	0.82	0.12
	70 - 120	3.00	24.08	39.69	34.85	98.62	1.38	S	7.90	3.65	0.03	0.23	3.60	5.02	11.99	0.50	3.99	0.03	0.01	0.03	0.01
15	0 - 30	25.00	34.28	22.27	41.15	97.69	2.31	GS	7.80	10.50	0.82	0.25	0.65	3.65	13.73	4.23	60.23	4.20	1.38	1.68	0.35
	30 - 60	6.50	29.78	22.76	46.05	98.59	1.41	CS	7.90	16.20	0.51	0.36	1.80	4.02	12.25	2.50	20.75	2.10	0.56	0.35	0.30
	60 - 120	4.00	38.22	26.39	29.56	94.17	5.83	CS	7.70	5.12	0.12	0.42	1.50	5.10	13.11	0.53	5.02	0.20	0.10	0.02	0.02
16	0 - 25	29.00	48.28	22.94	26.03	97.25	2.75	GCS	7.90	3.51	0.75	0.15	3.16	4.20	10.12	3.50	35.20	9.20	1.78	1.51	0.42
	25 - 60	35.00	30.94	15.63	44.00	90.57	9.43	GCS	7.80	12.51	0.43	0.26	2.29	4.11	11.33	1.40	10.76	2.11	0.67	0.35	0.30
	60 - 120	40.00	39.67	9.50	35.58	84.75	15.25	GLCS	7.70	7.21	0.10	0.31	3.01	3.75	12.12	0.32	2.35	0.62	0.13	0.11	0.01
17	0 - 20	24.00	48.66	17.28	31.01	96.95	3.05	CS	7.80	2.11	0.56	0.25	2.50	3.50	12.42	2.56	60.11	5.15	1.18	1.29	0.45
	20 - 40	26.00	43.27	23.32	29.93	96.53	3.47	GCS	7.70	17.53	0.32	0.46	1.50	3.62	13.11	0.98	30.10	2.02	0.72	0.35	0.20
	40 - 100	30.00	30.19	33.64	34.60	98.43	1.57	GCS	7.90	6.51	0.02	0.39	0.89	3.01	12.05	0.05	5.66	0.50	0.20	0.01	0.02
18	0 - 30	16.00	45.80	31.69	17.64	95.13	4.87	CS	7.80	4.23	0.72	0.46	0.98	4.23	15.02	3.52	65.12	2.67	1.22	1.50	0.29
	30 - 60	5.00	45.25	34.97	19.22	99.44	0.56	CS	7.70	6.41	0.51	0.51	2.68	5.11	14.76	1.05	20.25	1.05	0.56	0.45	0.10
	60 - 120	6.00	48.00	38.30	7.88	94.18	5.82	CS	7.90	7.15	0.03	0.32	2.68	4.65	13.24	0.25	2.23	0.32	0.06	0.05	0.01
19	0 - 30	16.00	31.05	33.23	32.04	96.31	3.69	CS	7.80	3.15	0.83	0.25	0.42	3.53	14.50	4.10	40.32	2.56	1.29	0.98	0.42
	30 - 70	0.00	35.75	26.27	30.80	92.82	7.18	CS	7.90	6.30	0.52	0.31	2.45	4.60	13.61	1.50	20.65	0.51	0.62	0.51	0.23
	70 - 120	0.00	36.26	23.67	33.61	93.54	6.46	CS	7.70	7.62	0.03	0.46	1.75	4.01	12.71	0.15	3.35	0.02	0.02	0.03	0.01
20	0 - 25	6.50	44.92	16.73	36.79	98.44	1.56	CS	7.80	6.16	0.76	0.51	0.65	5.52	14.62	4.51	99.11	3.67	1.34	0.99	0.25
	25 - 60	6.00	44.85	14.06	35.13	94.04	5.96	CS	7.70	5.56	0.37	0.46	2.50	4.02	13.55	1.90	30.51	1.52	0.35	0.21	0.15
	60 - 110	2.00	44.45	13.37	36.23	94.05	5.95	CS	7.90	6.75	0.01	0.38	3.00	3.66	10.11	0.71	5.99	0.05	0.10	0.01	0.05
21	0 - 20	27.00	17.62	22.97	57.74	98.33	1.67	GS	7.70	1.56	0.91	0.57	3.50	4.32	15.01	4.82	60.33	3.61	1.32	1.25	0.29
	20 - 50	15.00	22.59	40.80	36.51	99.89	0.11	S	7.80	2.65	0.52	0.23	3.75	3.51	14.35	2.22	20.95	1.32	0.65	0.72	0.17
	50 - 110	5.00	21.31	41.73	35.80	98.83	1.17	S	7.90	3.51	0.04	0.45	2.65	3.60	13.96	0.31	2.32	0.45	0.05	0.03	0.01
22	0 - 30	26.00	28.78	27.38	40.81	96.97	3.03	GCS	7.70	1.40	0.58	0.60	2.80	4.42	15.23	2.50	60.23	3.50	1.71	1.34	0.47
	30 - 60	13.00	31.74	34.89	29.56	96.18	3.82	CS	7.80	1.62	0.31	0.42	2.70	5.02	14.02	0.99	20.35	0.77	0.65	0.56	0.20
	60 - 90	7.00	27.68	32.96	25.92	86.56	13.44	CS	7.80	1.85	0.22	0.25	2.60	5.10	13.11	0.62	10.11	0.42	0.12	0.22	0.15
	90 - 120	7.50	33.36	22.48	26.01	81.85	18.15	LCS	7.70	7.63	0.01	0.31	2.75	5.12	12.96	0.23	5.23	0.02	0.02	0.01	0.01
23	0 - 25	25.00	31.68	22.60	44.79	99.07	0.93	GCS	7.80	1.75	0.63	0.22	2.00	4.56	9.10	3.11	75.25	2.21	0.98	0.84	0.41
	25 - 55	13.00	33.40	18.06	42.57	94.03	5.97	CS	7.80	1.67	0.26	0.31	5.01	4.02	8.97	1.01	20.76	1.05	0.32	0.41	0.20
	55 - 100	12.00	25.92	22.73	42.58	91.23	8.77	CS	7.70	1.85	0.01	0.26	7.10	5.11	7.11	0.50	3.27	0.15	0.02	0.01	0.01
24	0 - 20	22.00	27.58	25.95	36.29	89.82	10.18	CS	7.80	1.50	0.55	0.25	3.68	4.51	15.03	2.50	40.23	2.15	1.02	0.89	0.30
	20 - 50	4.00	30.02	36.99	30.75	97.76	2.24	CS	7.70	7.52	0.25	4.56	6.02	5.11	14.96	0.78	20.11	0.56	0.62	0.52	0.20
	50 - 100	4.50	30.54	34.90	29.99	95.43	4.57	CS	7.90	5.25	0.02	7.16	5.12	4.55	14.55	0.22	5.25	0.02	0.01	0.02	0.01

Table 4 Cont.

Prof. No.	Depth cm	Gravel (%)	C. sand 2-0.5	M. sand 0.5-.025	F. Sand 0.25-.05	Total sand 2-0.05	> 0.05 Silt-clay	Texture class	pH	$CaCO_3$ %	OM %	Gypsum %	EC dS/m	CEC mq/100 g soil	ESP %	Available nutrients (ppm) P	K	Fe	Mn	Zn	Cu.
25	0 - 30	2.00	28.06	34.15	35.77	97.98	2.02	CS	7.90	3.87	0.49	0.18	1.53	4.62	7.80	3.60	45.56	2.60	0.98	0.86	0.35
	30 - 70	4.50	37.57	31.63	26.22	95.42	4.58	CS	7.80	11.02	0.27	1.01	3.68	5.01	8.78	1.02	10.66	0.56	0.55	0.36	0.20
	70 - 120	5.50	36.43	35.22	27.14	98.79	1.21	CS	7.70	7.15	0.10	1.02	5.73	4.68	9.12	0.32	3.21	0.15	0.05	0.01	0.01
26	0 - 20	3.00	56.25	15.94	24.77	96.96	3.04	CS	7.80	6.15	0.75	0.32	1.60	5.25	9.75	3.50	55.16	1.75	0.97	0.69	0.30
	20 - 50	4.50	31.56	21.48	42.00	95.04	4.96	CS	7.80	18.50	0.35	0.65	1.70	4.89	10.23	1.05	20.21	0.35	0.53	0.23	0.01
	50 - 110	4.00	31.99	26.72	38.89	97.59	2.41	CS	7.80	11.02	0.02	0.57	1.79	5.01	9.56	0.42	6.30	0.10	0.03	0.02	0.01
27	0 - 25	13.00	54.22	13.45	28.97	96.63	3.37	CS	7.80	3.10	0.66	0.32	1.78	3.54	10.32	4.21	60.21	2.55	0.98	0.78	0.32
	25 - 50	4.50	39.78	31.98	24.69	96.45	3.55	CS	7.90	3.50	0.30	0.25	1.79	3.35	9.77	1.67	30.22	0.95	0.43	0.35	0.12
	50 - 100	5.50	39.93	32.40	25.04	97.37	2.63	CS	7.80	5.60	0.03	0.41	1.90	4.02	10.23	0.78	5.31	0.05	0.02	0.01	0.02
28	0 - 30	2.00	25.00	31.73	23.27	80.00	20.00	LS	7.90	1.20	0.38	0.57	23.40	5.65	6.82	2.10	100.23	2.78	1.52	1.02	0.32
	30 - 70	2.50	42.05	18.46	30.77	91.28	8.72	CS	7.80	1.10	0.20	0.66	38.50	4.02	8.11	0.98	30.11	0.56	0.22	0.35	0.15
	70 - 110	2.00	26.73	17.04	32.76	76.53	23.47	LCS	7.70	3.25	0.02	0.71	34.60	3.65	9.18	0.25	6.32	0.06	0.02	0.01	0.01
29	0 - 25	10.50	36.76	13.78	32.13	82.67	17.33	LCS	7.70	16.02	0.52	0.62	11.51	4.01	7.69	3.50	120.11	6.75	1.28	0.98	0.25
	25 - 50	4.50	35.55	12.38	33.85	81.78	18.22	LCS	7.80	18.01	0.31	0.45	12.10	4.10	8.72	0.98	30.73	2.56	0.82	0.42	0.16
	50 - 100	2.50	34.82	10.53	31.43	76.78	23.22	LCS	7.90	23.25	0.01	0.56	9.20	3.78	10.11	0.32	10.21	0.03	0.02	0.03	0.01
30	0 - 25	11.00	30.67	13.70	48.66	93.03	6.97	CS	7.80	1.47	0.56	0.35	7.01	5.56	8.93	3.11	115.21	3.50	1.20	0.98	0.35
	25 - 60	7.00	24.53	13.00	51.60	89.13	10.87	S	7.80	1.58	0.23	0.46	13.75	4.02	10.99	1.15	30.31	1.23	0.65	0.52	0.15
	60 - 110	9.00	24.60	12.86	51.77	89.23	10.77	S	7.70	1.48	0.02	0.52	14.85	5.01	11.05	0.25	5.21	0.24	0.05	0.02	0.02
31	0 - 30	7.50	40.02	32.43	24.00	96.45	3.55	CS	7.90	1.33	0.45	0.65	0.67	5.35	8.25	2.51	40.23	2.21	1.12	0.98	0.42
	30 - 60	2.00	40.65	31.33	22.06	94.04	5.96	CS	7.80	1.40	0.26	0.56	0.85	5.65	9.62	0.85	20.11	1.21	0.66	0.56	0.25
	60 - 120	1.00	38.66	30.46	26.36	95.48	4.52	CS	7.90	1.69	0.01	0.45	1.92	5.33	7.11	0.32	5.23	0.32	0.04	0.02	0.01
32	0 - 30	14.50	55.84	18.09	23.54	97.47	2.53	CS	7.80	2.75	0.62	0.35	7.50	4.50	10.22	4.02	100.12	2.02	1.05	0.98	0.35
	30 - 70	4.00	53.23	15.63	20.95	89.80	10.20	CS	7.90	6.05	0.31	0.45	7.80	3.66	12.36	1.55	30.78	0.52	0.46	0.39	0.09
	70 - 120	4.00	48.68	14.23	27.35	90.26	9.74	CS	7.70	6.71	0.02	0.54	11.21	4.02	13.76	0.32	10.11	0.02	0.03	0.01	0.01
33	0 - 25	22.00	28.51	33.45	32.85	94.81	5.19	CS	7.80	6.85	0.56	0.62	1.02	4.50	8.99	5.01	65.52	7.12	1.69	1.28	0.42
	25 - 60	5.00	26.99	26.98	30.17	84.14	15.86	LCS	7.90	6.02	0.32	0.57	1.25	5.23	10.52	2.00	10.78	2.05	0.70	0.63	0.26
	60 - 110	3.50	32.80	33.16	20.60	86.56	13.44	CS	7.70	6.75	0.03	0.58	2.80	4.97	11.33	0.87	2.35	0.50	0.10	0.03	0.01
34	0 - 30	21.00	37.66	17.08	29.94	84.67	15.33	LCS	7.90	3.52	0.62	0.51	0.98	4.50	9.32	2.53	60.75	9.01	2.25	1.82	0.32
	30 - 60	5.00	34.95	15.73	35.52	86.19	13.81	CS	7.80	3.12	0.41	0.45	0.85	5.65	10.12	0.81	20.31	2.13	0.76	0.82	0.20
	60 - 110	6.50	36.04	15.02	40.10	91.16	8.84	CS	7.80	2.81	0.04	0.52	1.35	5.10	12.22	0.21	5.75	0.09	0.02	0.03	0.02
35	0 - 25	26.00	44.11	14.36	26.08	84.55	15.45	GLCS	7.80	6.89	0.48	0.62	1.85	4.50	8.57	2.02	75.23	2.53	1.34	0.98	0.31
	25 - 50	10.00	45.77	30.39	14.23	90.39	9.61	CS	7.80	6.85	0.25	0.53	1.72	5.65	8.66	0.89	20.12	0.67	0.49	0.54	0.02
	50 - 100	2.50	48.75	28.62	14.63	91.99	8.01	CS	7.70	9.03	0.01	0.68	2.60	4.89	9.05	0.23	5.11	0.02	0.01	0.02	0.02

The gypsum content is less than 1.0% in most studied soil profiles except in profiles nos. 6, 8, 13 and 24 where it ranges between 3.0 and 5.0%. The soil salinity is low in most of the studied profiles as indicated by EC values, which are less than 4 dS/m, except for profiles nos. 23, 24 and 32 where EC values range between 5.0 and 9.0 dS/m, and in profiles nos. 28, 29 and 30 for which EC values range between 10.0 and 39.0 dS/m. The cation exchange capacity (CEC) values are less than 6.0 meq/100 g soil for all studied soil samples. The exchangeable sodium percent (ESP) is less than 15% in all studied soil profiles. The available nutrients elements (P, K, Fe, Mn, Zn and Cu) are very low, as shown in Table 4. Based on the USDA Soil Taxonomy (1998) most of the studied soil profiles are classified as *Typic Torripsamments*, while the soils represented by profiles nos. 6 and 13 are classified as *Typic haplogpysids*, and the soils represented by profiles nos. 3, 8, 15, 17, 18 and 26 are classified as *Typic haplocalcids*, Table 3.

2. Land suitability evaluation

The method includes an analysis of climatic data, i.e., radiation, temperature, rainfall, and relative humidity. Except for rainfall in the study area (due to the use of irrigation water), the climatic data are considered either "highly suitable" or "suitable" for all tested crops. The climate was considered homogeneous and suitable for all analyzed species.

Rating of soil parameters are based on the following principles:-

texture class: According to the suitability of the soil texture to plant growth, twelve soil textural classes are included in the system ranging from clayey to sandy soils (C, SiC, SiCL, Si, SiL, CL, L, SC, SL, SCL, LS, and S). In each textural classe the gravel content is considered.

Calcium carbonate content: Fifteen categories show the percentage of $CaCO_3$ and the presence of calcic horizon are considered. Also, the depth of calcic horizon is included in the rating of this parameter. The classes of $CaCO_3$ content range from < 0.3% up to more than 50%. According to the crop sensitivity to $CaCO_3$ content, the tested crops have been divided into: a)- Crops prefer lime, b)- Crops that are tolerate to certain content of lime and c)- Crops that are sensitive to lime.

Gypsum content: Sixteen classes ranging between < 0.3 to 25% of gypsum including the presence of gypsic horizon and its depth.

Salinity content: The tested crops are grouped into: a) annual crops with superficial root system, b) perennial crops with deep root system. The salinity content in the upper 40 cm depth for the crops with a superficial root system while for these of deep root systems the salinity content in 1 m depth is considered. Six degrees of salinity contents according to the effect of salts on crop yield are used.

Drainage conditions: Six levels are considered for two types of crops (annual and perennial). These levels are: 1 - Excessively drained (EXD), 2- Moderately well drained (MWD), 3- Well drained (WD), 4- Imperfectly drained (IMD), 5- Poorly drained (PD), and 6- Very poorly drained (VPD).

Soil depth: The effect of crust and hardpans depending on whether the crops have a superficial or deep root systems. Five classes are used for the evaluation according to the depth of crusts or pans within the upper 1 m depth of the soil profile.

Slope: Six degrees of slopes are applied (< 1%, 1 - 3%, 3 - 8%, 8 - 16%, 16 - 30% and > 30%).

It could be concluded that the most important soil parameters that influence suitability classification in the soils of the study area are: texture, soil depth, salinity status, gravel content, lime status, drainage conditions, slope and nutrient status.

In this study, the different suitability classifications are carried out for 17 tested crops, namely; alfalfa, barley, maize, soybean, sunflower and wheat as field crops; cabbage, carrot, green pepper, onions, potatoes and tomatoes as vegetables crops; banana, citrus, guava, mangoes, olives as fruit crops.

The results of calculating land suitability for crops are presented in Tables 5-7. By using the nutrient and salinity status for the consideration (actual land suitability) the suitability index is downgraded (it could be rich to non-suitable class), Tables 5-7. However, making corrections to the nutrient conditions and soil salinity (nonpermanent properties) results in what is called potential land suitability. This is done by adding organic manure, using fertilizers to upgrade the fertility of the soil and adding more water for salt-leaching requirements similar in practice to what the farmers do in the study area. Hence the suitability index is upgraded and it may become the "moderately suitable" classes. According to the classification of FAO (1976) and Sys (1993) and after correction of nutrient conditions and soil salinity. The main soil characteristics affecting land suitability are soil texture, gravels content and calcium carbonate content (permanent properties).

It could be said that the calculated land suitability indices reveal that:

1- The studied soils are classified, generally, as moderately suitable (S2) for cultivating carrot and green pepper, except for the areas represented by profiles nos. 1, 8, 16 and 26 which are marginally suitable (S3). The soils represented by profile no. 29 are classified as non-suitable (N) for cultivating carrot, but marginally suitable (S3) for guava green pepper.

2- The studied soils are classified as marginally suitable (S3) for cultivating alfalfa, cabbage, onions and mangoes except the areas represented by profiles nos. 28, 33 and 34 which are moderately suitable (S2). The soils represented by profile no. 29 are classified as moderately suitable (S2) for cultivating alfalfa and cabbage, but marginally suitable (S3) for onions and mangoes.

3- The studied soils are classified as marginally suitable (S3) for cultivating citrus and olive except the areas represented by profiles nos. 2, 9, 11, 14, 21, 28, 33 and 34 are moderately suitable (S2). The soils represented by profile no. 29 are classified as moderately suitable (S2) for olives, but marginally suitable (S3) for citrus.

4- The studied soils are classified as non suitable (S4) for growing of bananas, guava and potatoes except for the areas represented by profiles nos. 28, 33 & 34 which are marginally suitable (S3). The soils represented by profile no. 29 are classified as marginally suitable (S3) for guava and potatoes, but non-suitable (S4) for bananas.

5- The studied soils are classified as non suitable (S4) for cultivating tomatoes except for the areas represented by profiles nos. 2, 9, 11, 14, 21, 28, 29, 33 and 34 which are marginally suitable (S3).

Table(5): Suitability index and limiting factors of some field crops tested in the study area (in the area northwestern of Wadi El-Natrun).

Prof No.	Actual land suitability Before salinity and nutrient status corrections												Potential land suitability After correcting salinity and nutrient					
	Alfalfa		barley		Maize		Soybean		Sunflower		Wheat		Alfalf	Parl	Maiz	Soya	Sunflow	Whea
	Soil class	limitin factor	Soil class	limitin factor	Soil class	limitin factor	Soil Class	limitin factor	Soil class	limiting factor	Soil class	limitin factor						
1	4, 3, 3	N, G,T	4, 3, 4	N, G,T	4, 3,4	N, G,T	4, 3, 3	N, G, T	4, 3, 3	N, G, T	4, 3, 4	N, G,T	3	4	4	3	4	4
2	4, 2, 3	N, G,T	4, 2, 4	N, G,T	4, 2,3	N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4, 2, 4	N, G,T	3	4	3	3	3	4
3	4, 2, 3	N, G,T	4, 2, 4	N, G,T	4, 2,4	N, G,1	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4, 2, 4	N, G,T	3	4	4	3	4	4
4	4, 2, 3	N, G,T	4, 2, 4	N, G,T	4, 2,4	N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4, 2, 4	N, G,T	3	4	4	3	4	4
5	4, 2, 3	N, T	4, 2, 4	N, G,T	4, 2,4	N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4, 2, 4	N, G,T	3	4	4	3	4	4
6	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
7	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
8	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
9	4, 2, 3	N, G,T	4, 2, 4	N, G,T	4, 2,3	N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4, 2, 4	N, G,T	3	4	3	3	3	4
10	4, 2, 3	N, G,T	4, 2, 4	N, G,T	4, 2,4	N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4, 2, 4	N, G, T	3	4	4	3	4	4
11	4, 3	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, G	4, 3	N, T	4, 4	N, T	3	4	3	3	3	4
12	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
13	4, 2, 3	N, G,T	4, 2, 4	N, G,T	4, 2,4	N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	2, 4, 2, 4	S,N, G,T	3	4	4	3	4	4
14	4, 3	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	3	3	3	4
15	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
16	4, 3, 3	N, G,T	4, 3, 4	N, G,T	4, 3,4	N, G,T	4, 3, 3	N, G, T	4, 3, 3	N, G, T	4, 3, 4	N, G,T	3	4	4	3	4	4
17	4, 2, 3	N, G,T	4, 2, 4	N, G,T	4, 2,4	N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4, 2, 4	N, G,T	3	4	4	3	4	4
18	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
19	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
20	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
21	4, 3	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 3	N, T	2, 4, 4	S,N, T	3	4	3	3	3	4
22	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
23	2, 4, 2, 3	S,N, G,T	4, 2, 4	N, G,T	2, 4, 2,4	S,N, G,T	2, 4, 2, 3	S, N, G, T	2, 4, 2,3	S, N, G, T	3, 4, 2, 4	S,N, G,T	3	4	4	3	4	4
24	2, 4, 3	S,N, T	4, 4	N, T	2, 4, 4	S,N, T	2, 4, 3	S, N, T	2, 4, 3	S, N, T	3, 4, 4	S,N, T	3	4	4	3	4	4
25	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	2, 4, 4	S,N, T	3	4	4	3	4	4
26	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
27	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
28	4, 4, 2	S,N, T	2, 4, 4	S,N, T	2, 4, 3	S,N, T	4, 4, 3	S, N, T	4, 4, 3	S, N, T	4, 4, 4	S,N, T	2	4	3	3	4	4
29	3, 4, 2, 2	S,N,Ca, T	4, 4	N, T	2, 4, 3	S,N, T	3, 4, 3	S, N, T	3, 4, 2, 3	S, N, Ca, T	4, 4, 4	S,N, T	2	4	3	3	4	4
30	4, 4, 3	S,N, T	2, 4, 4	S,N, T	2, 4, 4	S,N, T	3, 4, 3	S, N, T	3, 4, 3	S, N, T	4, 4, 4	S,N, T	3	4	4	3	4	4
31	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4
32	2, 4, 3	S,N, T	4, 4	N, T	4, 4, 4	S,N, T	3, 4, 3	S, N, T	3, 4, 3	S, N, T	3, 4, 4	S,N, T	3	4	4	3	4	4
33	4, 2	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	2	4	3	3	3	4
34	4,2	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	2	4	3	3	3	4
35	4, 3	N, T	4, 4	N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4, 4	N, T	3	4	4	3	4	4

Suitability symbols: 2= moderately suitable (S2), 3= marginally suitable (S3), 4= not suitable (N)
Limitation factors: S= salinity, N= nutrient status, Ca= $CaCO_3$, G= gravel, T= texture

Table(6):Suitability index and limiting factors of some vegetable crops tested in the study area (in the area northwestern of Wadi El-Natrun).

Prof. No.	Actual land suitability Before salinity and nutrient status corrections												Potential land suitability After correcting salinity and nutrient status					
	Cabbage		Carrots		Green pepper		Onions		Potatoes		Tomatoes		Cabbage	Carrots	Green peppe	Onions	Potatoe	Tomatoe
	Soil class	limiting factor	Soil class	limiting factor	Soil class	limiting factor	Soil Class	limiting factor	Soil class	limiting factor	Soil class	limiting factor						
1	4, 3, 3	N, G, T	4, 3, 2	N, G, T	4, 3, 2	N, G,T	4, 3, 3	N, G,T	4, 4, 4	N, G,T	4, 3, 4	N, G,T	3	3	3	3	4	4
2	4, 2, 3	N, G, T	4, 2, 2	N, G, T	4, 2, 2	N, G,T	4, 2, 3	N, G,T	4, 2, 4	N, G,T	4, 2, 3	N, G,T	3	2	2	3	4	3
3	4, 2, 3	N, G, T	2,4,2, 2,2	S,N,Ca,	4, 2, 2, 2	N, Ca,	4, 2, 3	N, G,T	4, 3, 4	N, G,T	4, 2, 2, 4	N, Ca, G,T	3	2	2	3	4	4
4	4, 2, 3	N, G, T	2,4, 2,2	S,N, G,T	4, 2, 2	N, G,T	4, 2, 3	N, G,T	4, 3, 4	N, G,T	4, 2, 4	N, G,T	3	2	2	3	4	4
5	4, 2, 3	N, G, T	2,4, 2,2	S,N, G,T	4, 2, 2	N, G,T	4, 2, 3	N, G,T	4, 3, 4	N, G,T	4, 2, 4	N, G,T	3	2	2	3	4	4
6	4, 3	N, T	2,4, 2	S,N, T	4, 3, 2	N, Ca, T	4, 3	N, T	4, 2, 4	N, G,T	4, 4	N, T	3	2	3	3	4	4
7	4, 3	N, T	2,4, 2	S,N, T	4, 2	N, T	4, 3	N, T	4, 3, 4	N, G,T	4, 4	N, T	3	2	2	3	4	4
8	4, 3	N, T	2,4,3, 2	S,N,Ca, T	4, 3, 2	N, Ca, T	4, 3	N, T	4, 3, 4	N, G,T	4, 3, 4	N, Ca, T	3	3	3	3	4	4
9	4, 2, 3	N, G, T	2,4, 2,2	S,N, G,T	4, 2, 2	N, G,T	4, 2, 3	N, G,T	4, 4, 4	N, G,T	4, 2, 3	N, G,T	3	2	2	3	4	3
10	4, 2, 3	N, G, T	2,4, 2,2	S,N, G,T	4, 2, 2	N, G,T	4, 2, 3	N, G,T	4, 3, 4	N, G,T	4, 2, 4	N, G,T	3	2	2	3	4	4
11	4, 3	N, T	2,4, 2,2	S,N,Ca, T	4, 2, 2	N, Ca, T	4, 3	N, T	4, 4	N, T	4, 2, 3	N, Ca, T	3	2	2	3	4	3
12	4, 3	N, T	2,4, 2	S,N, T	4, 2	N, T	4, 3	N, T	4, 4	N, T	4, 4	N, T	3	2	2	3	4	4
13	4, 2, 3	N, G, T	2,4, 2,2	S,N, G,T	2, 4, 2, 2	S,N, G,T	4, 2, 3	N, G,T	2, 4, 3, 4	S,N, G,T	4, 2, 4	N, G,T	3	2	2	3	4	4
14	4, 3	N, T	2,4, 2	S,N, T	4, 2	N, T	4, 3	N, T	4, 3, 4	N, G,T	4, 3	N, T	3	2	2	3	4	3
15	4, 3	N, T	4, 2,2	N,Ca, T	4, 2, 2	N, Ca, T	4, 3	N, T	4, 3, 4	N, G,T	4, 2, 4	N, Ca, T	3	2	2	3	4	4
16	4, 3, 3	N, G, T	2,4,2, 3,2	S,N,Ca,	4, 2, 3, 2	N, Ca,	4, 3, 3	N, G,T	4, 3, 4	N, G,T	4, 2, 3, 4	N, Ca, G,T	3	3	3	3	4	4
17	4, 2, 3	N, G, T	4,2, 2,2	N,Ca, G,T	4, 2, 2, 2	N, Ca,	4, 2, 3	N, G,T	4, 3, 4	N, G,T	4, 2, 2, 4	N, Ca, G,T	3	2	2	3	4	4
18	4, 3	N, T	2,4, 2,2	S,N,Ca, T	4, 2, 2	N, Ca, T	4, 3	N, T	4, 2, 4	N, G,T	4, 2, 4	N, Ca, T	3	2	2	3	4	4
19	4, 3	N, T	2,4, 2,2	S,N,Ca, T	4, 2, 2	N, Ca, T	4, 3	N, T	4, 2, 4	N, G,T	4, 2, 4	N, Ca, T	3	2	2	3	4	4
20	4, 3	N, T	2,4, 2,2	S,N,Ca, T	4, 2, 2	N, Ca, T	4, 3	N, T	4, 4	N, T	4, 2, 4	N, Ca, T	3	2	2	3	4	4
21	4, 3	N, T	2,4, 2	S,N, T	2, 4, 2	S,N, T	4, 3	N, T	2, 4, 3, 4	S,N, G,T	4, 3	N, T	3	2	2	3	4	3
22	4, 3	N, T	2,4, 2	S,N, T	4, 2	N, T	4, 3	N, T	4, 3, 4	N, G,T	4, 4	N, T	3	2	2	3	4	4
23	2, 4, 2,	S,N,	3,4, 2,2	S,N, G,T	2, 4, 2, 2	S,N, G,T	2, 4, 2,	S,N, G,T	3, 4, 3, 4	S,N, G,T	2, 4, 2, 4	S,N, G,T	3	2	2	3	4	4
24	2, 4, 3	S, N, T	3,4, 2,2	S,N,Ca, T	2, 4, 2, 2	S,N, Ca,	2, 4, 3	S,N, T	2, 4, 2, 4	S,N, G,T	2, 4, 2, 4	S,N, Ca, T	3	2	2	3	4	4
25	4, 3	N, T	2,4, 2,2	S,N,Ca, T	2, 4, 2, 2	S,N, Ca,	4, 3	N, T	2, 4, 4	S,N, T	4, 2, 4	N, Ca, T	3	2	2	3	4	4
26	4, 3	N, T	2,4, 3,2	S,N,Ca, T	4, 3, 2	N, Ca, T	4, 3	N, T	4, 4	N, T	4, 3, 4	N, Ca, T	3	3	3	3	4	4
27	4, 3	N, T	2,4, 2	S,N, T	4, 2	N, T	4, 3	N, T	4, 4	N, T	4, 4	N, T	3	2	2	3	4	4
28	4, 4, 2	S, N, T	4,4, 2	S,N, T	4, 4, 2	S,N, T	4, 4, 2	S,N, T	4, 4, 3	S,N, T	4, 4, 3	S,N, T	2	2	2	2	3	3
29	4, 4, 2,	S,N,Ca,	4,4, 4,2	S,N,Ca, T	4, 4, 3, 2	S,N, Ca,	3, 4, 2,	S,N, Ca,	4, 4, 2, 3	S,N, Ca,	4, 4, 3, 3	S,N, Ca, T	2	4	3	2	3	3
30	4, 4, 3	S, N, T	4,4, 2	S,N, T	4, 4, 2	S,N, T	4, 4, 3	S,N, T	4, 4, 4	S,N, T	4, 4, 4	S,N, T	3	2	2	3	4	4
31	4, 3	N, T	4, 2	N, T	4, 2	N, T	4, 3	N, T	4, 4	N, T	4, 4	N, T	3	2	2	3	4	4
32	3, 4, 3	S, N, T	4 4, 2,2	S,N,Ca, T	4, 4, 2, 2	S,N, Ca,	2, 4, 3	S,N, T	3, 4, 4	S,N, T	3, 4, 2, 4	S,N, Ca, T	3	2	2	3	4	4
33	4, 2	N, T	2,4, 2,2	S,N,Ca, T	4, 2, 2	N, Ca, T	4, 2	N, T	4, 3, 3	N, G,T	4, 2, 3	N, Ca, T	2	2	2	2	3	3
34	4, 2	N, T	4, 2	N, T	4, 2	N, T	4, 2	N, T	4, 3, 3	N, G,T	4, 3	N, T	2	2	2	2	3	3
35	4, 3	N, T	2,4, 2,2	S,N,Ca, T	4, 2	N, T	4, 3	N, T	4, 3, 4	N, G,T	4, 2, 4	N, Ca, T	3	2	2	3	4	4

Suitability symbols: 2= moderately suitable (S2), 3= marginally suitable (S3), 4= not suitable (N)
Limitation factors: S= salinity, N= nutrient status, Ca= $CaCO_3$, G= gravel, T= texture

Table(7):Suitability index and limiting factors of some fruit crops tested in the study area (in the area northwestern of Wadi El-Natrun).

Prof. No.	Actual land suitability Before salinity and nutrient status corrections										Potential land suitability After correcting salinity and nutrient status				
	Banana		Citrus		Guava		Mango		Olive		Banana	Citrus	Guava	Mango	Olive
	Soil class	limiting factor	Soil class	limiting factor	Soil class	limiting factor	Soil class	limiting factor	Soil class	limiting factor					
1	4, 4, 3, 4	S,N, G,T	3, 4, 3,3	S,N, G,T	4, 3, 4	N, G,T	4, 3, 3	N, G, T	4, 3, 3	N, G, T	4	3	4	3	3
2	3, 4, 2, 4	S,N, G,T	2, 4, 2,2	S,N, G,T	4, 2, 4	N, G,T	4, 2, 3	N, G, T	4, 2, 2	N, G, T	4	2	4	3	2
3	3,4,2, 2, 4	S,N,Ca, G,T	2,4,2, 2,3	S,N,Ca, G,T	4, 2, 4	N, G,T	4, 2, 2, 3	N, Ca, G, T	4, 2, 3	N, G, T	4	3	4	3	3
4	3, 4, 2, 4	S,N, G,T	2, 4, 2,3	S,N, G,T	4, 2, 4	N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4	3	4	3	3
5	4, 4, 2, 4	S,N, G,T	3, 4, 2,3	S,N, G,T	4, 2, 4	N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4	3	4	3	3
6	3, 4, 4	S,N, T	2, 4, 3	S,N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4	3	4	3	3
7	3, 4, 4	S,N, T	2, 4, 3	S,N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4	3	4	3	3
8	3, 4, 2, 4	S,N, Ca, T	3, 4,3, 3	S,N,Ca, T	4, 4	N, T	4, 3, 3	N, Ca, T	4, 3	N, T	4	3	4	3	3
9	3, 4, 2, 4	S,N, G,T	2, 4, 2,2	S,N, G,T	4, 2, 4	N, G,T	4, 2, 3	N, G, T	4, 2, 2	N, G, T	4	2	4	3	2
10	4, 4, 2, 4	S,N, G,T	3, 4, 2,3	S,N, G,T	2, 4, 2, 4	S, N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4	3	4	3	3
11	3, 4, 2, 4	S,N, Ca, T	2, 4,2, 2	S,N,Ca, T	2, 4, 4	S, N, T	4, 2, 3	N, Ca, T	4, 2	N, T	4	2	4	3	2
12	3, 4, 2, 4	S,N, T	2, 4, 3	S,N, T	2, 4, 4	S, N, T	4, 3	N, T	4, 3	N, T	4	3	4	3	3
13	3, 4, 2, 4	S,N, G,T	2, 4, 2,3	S,N, G,T	3, 4, 2, 4	S, N, G,T	4, 2, 3	N, G, T	4, 2, 3	N, G, T	4	3	4	3	3
14	4, 4, 4	S,N, T	3, 4, 2	S,N, T	2, 4, 4	S, N, T	4, 3	N, T	4, 2	N, T	4	2	4	3	2
15	4, 4, 32, 4	S,N, Ca, T	3, 4,3, 3	S,N,Ca, T	4, 4	N, T	4, 2, 3	N, Ca, T	4, 3	N, T	4	3	4	3	3
16	3, 4, 2, 3, 4	S,N, Ca, G,T	2, 4,2, 3,3	S,N,Ca, G,T	2, 4, 3, 4	S, N, G,T	4, 2, 3, 3	N, Ca, G, T	4, 3, 3	N, G, T	4	3	4	3	3
17	4, 4, 2, 2, 4	S,N, Ca, G,T	2, 4,2, 3,3	S,N,Ca, G,T	4, 2, 4	N, G,T	4, 2, 2, 3	N, Ca, G, T	4, 2, 3	N, G, T	4	3	4	3	3
18	3, 4, 2, 4	S,N, Ca, T	2, 4,2, 3	S,N,Ca, T	2, 4, 4	S, N, T	4, 2, 3	N, Ca, T	4, 3	N, T	4	3	4	3	3
19	3, 4, 2, 4	S,N, Ca, T	2, 4,2, 3	S,N,Ca, T	4, 4	N, T	4, 2, 3	N, Ca, T	4, 3	N, T	4	3	4	3	3
20	2, 4, 2, 4	S,N, Ca, T	4,2, 3	N,Ca, T	2, 4, 4	S, N, T	4, 2, 3	N, Ca, T	4, 3	N, T	4	3	4	3	3
21	4, 4, 4	S,N, T	3, 4, 2	S,N, T	3, 4, 4	S, N, T	4, 3	N, T	4, 2	N, T	4	2	4	3	2
22	4, 4, 4	S,N, T	3, 4, 3	S,N, T	2, 4, 4	S, N, T	4, 3	N, T	4, 3	N, T	4	3	4	3	3
23	3, 4, 2, 4	S,N, G,T	22, 4, 2,3	S,N, G,T	4, 4, 2, 4	S, N, G,T	2, 4, 2, 3	S,N, G, T	4, 2, 3	N, G, T	4	3	4	3	3
24	4, 4, 2, 4	S,N, Ca, T	23, 4,2, 3	S,N,Ca, T	4, 4, 4	S, N, T	2, 4, 2, 3	S,N, Ca, T	4, 3	N, T	4	3	4	3	3
25	3, 4, 2, 4	S,N, Ca, T	2, 4,2, 3	S,N,Ca, T	3, 4, 4	S, N, T	4, 2, 3	N, Ca, T	4, 3	N, T	4	3	4	3	3
26	3, 4, 3, 4	S,N, Ca, T	2, 4,3, 3	S,N,Ca, T	4, 4	N, T	4, 3, 3	N, Ca, T	4, 3	N, T	4	3	4	3	3
27	3, 4, 4	S,N, T	2, 4, 3	S,N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4	3	4	3	3
28	3, 4, 3	S,N, T	42, 4, 2	S,N, T	4, 4, 3	S, N, T	4, 4, 2	S,N, T	4, 4, 2	S, N, T	3	2	3	2	2
29	3, 3, 4, 3	S,N, Ca, T	32, 4,3, 2	S,N,Ca, T	4, 4, 3	S, N, T	4, 4, 3, 2	S,N, Ca, T	2, 4, 2	S, N, T	4	3	3	3	2
30	3, 4, 4	S,N, T	42, 4, 3	S,N, T	4, 4, 4	S, N, T	4, 4, 3	S,N, T	4, 3	N, T	4	3	4	3	3
31	3, 4, 4	S,N, T	2, 4, 3	S,N, T	4, 4	N, T	4, 3	N, T	4, 3	N, T	4	3	4	3	3
32	4, 4, 2, 4	S,N, Ca, T	33, 4,2, 3	S,N,Ca, T	4, 4, 4	S, N, T	4, 4, 2, 3	S,N, Ca, T	4, 3	N, T	4	3	4	3	3
33	3, 4, 2, 3	S,N, Ca, T	2, 4,2, 2	S,N,Ca, T	4, 3	N, T	4, 2	N, T	4, 2	N, T	3	2	3	2	2
34	3, 4, 3	S,N, T	2, 4, 2	S,N, T	4, 3	N, T	4, 2	N, T	4, 2	N, T	3	2	3	2	2
35	3, 4, 2, 4	S,N, Ca, T	2, 4,2, 3	S,N,Ca, T	2, 4, 4	S, N, T	4, 3	N, T	4, 3	N, T	4	3	4	3	3

Suitability symbols: 2= moderately suitable (S2), 3= marginally suitable (S3), 4= not suitable (N)
Limitation factors: S= salinity, N= nutrient status, Ca= $CaCO_3$, G= gravel, T= texture

6- Finally the studied soils are classified as non-suitable (S4) for cultivating wheat and barley.

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تقييم مدى ملائمة الأراضي لزراعة المحاصيل فى المنطقة شمال وادي النطرون

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تمت هذه الدراسة في منطقة مساحتها حوالي ١٠٠٠٠ فدان. تمتد بين خطى عرض ٣٠° ٢٩' ٧" و٣٠° ٣٣' ٢٣" شمالا و٣٠° ٥' ٣٦" و٣٠° ١٠' ١٣" شرقا. وتقع شمال وادي النطرون وتبعد عن طريق القاهرة-الإسكندرية الصحراوي حوالي ٥ كم غربا، عند الكم ١٣٠ من القاهرة، بهدف استكشاف الخصائص البيدولوجية من خلال اختيار عدد ٣٥ قطاعا ارضيا ممثلا للوحدات الأرضية المختلفة. تم تقييم مدى ملاءمتها لبعض الزراعات. لذلك جمعت عينات التربة من طبقات القطاعات حسب الاختلافات المورفولوجية للقطاع الأرضي وتم وصف هذه القطاعات مورفولوجيا تبعا لنظام الـ FAO (١٩٩٠). كما تمت دراسة الصفات الطبيعية والكيميائية لهذه العينات معمليا لتقدير الأيونات الذائبة الأيونات المتبادلة وكذلك محتوى الجبس وكربونات الكلسيوم والمحتوى الميسر من العناصر المغذية للنبات وهى الفوسفور والبوتاسيوم والحديد والمانجنيز والنحاس والزنك. كذلك تم عمل تقييم للقدرة الإنتاجية لهذه الأراضي ومدى ملاءمتها للمحاصيل تبعا لنظامى FAO (1976) and Sys et al. (1991).

باستخدام نظام التقسيم الأمريكي (١٩٩٨) أظهرت نتائج الدراسة أن الاراضي المدروسة تقع تحت مجموعات ***Typic Torripsamments, Typic Haplocalcids, Typic Haplogypsids***

اعتبرت العوامل المحددة لمدى صلاحية الأراضي لزراعة المحاصيل هى: قوام الأرض شامل نسبة الحصى، عمق القطاع الأرضي، حالة الملوحة والقلوية، المحتوى من كربونات الكالسيوم والجبس، وحالة الصرف، وانحدار السطح والحالة الغذائية للتربة. وذلك بتطبيق نظامى Sys, (1993) و FAO (1976) لتقييم الأراضي تم عمل تقييم لمدى صلاحية الأراضي لزراعة بعض المحاصيل وعددها ١٧ محصولا، هى: البرسيم والشعير والذرة الشامية وفول الصويا وعباد الشمس والقمح (كمحاصيل حقلية)، والكرنب والجزر والفلفل الأخضر والبصل والبطاطس والطماطم (كمحاصيل خضر)، والموز والموالح والجوافة والمانجو والزيتون (كمحاصيل فاكهة).

يجدر الإشارة هنا أن العوامل غير الدائمة المحددة لصلاحية الأراضي لزراعة المحاصيل وهى التى يمكن معالجتها أو التحكم فيها في منطقة الدراسة هي الحالة الغذائية للأرض والملوحة وذلك عن طريق إضافة مواد عضوية وأسمدة لزيادة محتوى الأرض من العناصر المغذية وكذلك إضافة مقننات الغسيل مع ماء الرى لإزالة الزيادة من الأملاح. أما العوامل الدائمة المحددة والتى تتحكم فى صلاحية الأراضي لزراعة المحاصيل هي قوام الأرض الخشن والمحتوى من الحصى وكربونات الكلسيوم.

وبعد عمل تصحيح لمعامل الصلاحية (**Suitability Index**)، وبعد تجنب العوامل غير الدائمة للتحكم فيها ارتفع هذا المعامل من الدرجة غير الصالحة (**N**) الى درجات **متوسطة ومحدودة الصلاحية (S2, S3)** وذلك لأغلب المحاصيل المختبرة.