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USE OF FIELD MORPHOLOGICAL RATING SYSTEM TO EVALUATE THE SOILS DEVELOPMENT OF EAST ISMAILIYA AREA IN NORTH SINAI

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ABSTRACT

The current study aims to following up the changes which may take place in some morphological and pedogenic characteristics on two soil orders, Entisols and Aridisols in East Ismailiya area in Sinai. Eight soil profiles were selected to represent seven soil mapping units.

Twenty seven profiles were examined, eight out of them representing this study. (RHD), the determination was made by a comparison of adjacent horizons the second rating scale (RPD) was made by a comparison of the last horizon, to the above horizons in the same profile. Some chemical properties such as salts, pH, calcium carbonate and gypsum were applied to calculate the points of pedogenic factors. Also Profile Development Index (PDI) values were calculated from horizon index values by using quantitative profile index methods.

The (RHD) values coincide with those of (RPD) ratings and profile index values. Data revealed that the clear differentiation between the recent soils (Typic Haplogypsids, Typic Haplosalids, Leptic Haplogypsids and Typic Aquisalids), the recent soil (Typic Torripsamments and Typic Torriorthents).

The study accurse that the soils of Aridisols had developed more than the others soils of Entisols.

Keywords: Distinctness, Evaluate, Development and quantitative Index, East Ismailiya area in north Sinai.

INTRODUCTION

The Sinai Peninsula covers about 61.000 km^2, extending between latitudes 27° 15⁻ and 31° 10⁻ north and longitudes 32° 10⁻ and 34° 30⁻ east- Map (1). Abdallah and Abou-Khadrah (1977) divided the Sinai Peninsula geomorphologically into five units. Each unit is characterized structural elements and lithologic characteristics.

I. Afro-Arabian shield.
II. Central plateau.
III. The Northern slop.
IV. The Mediterranean coastal plain.
V. The Gulf of Suez Eastern coastal plain.

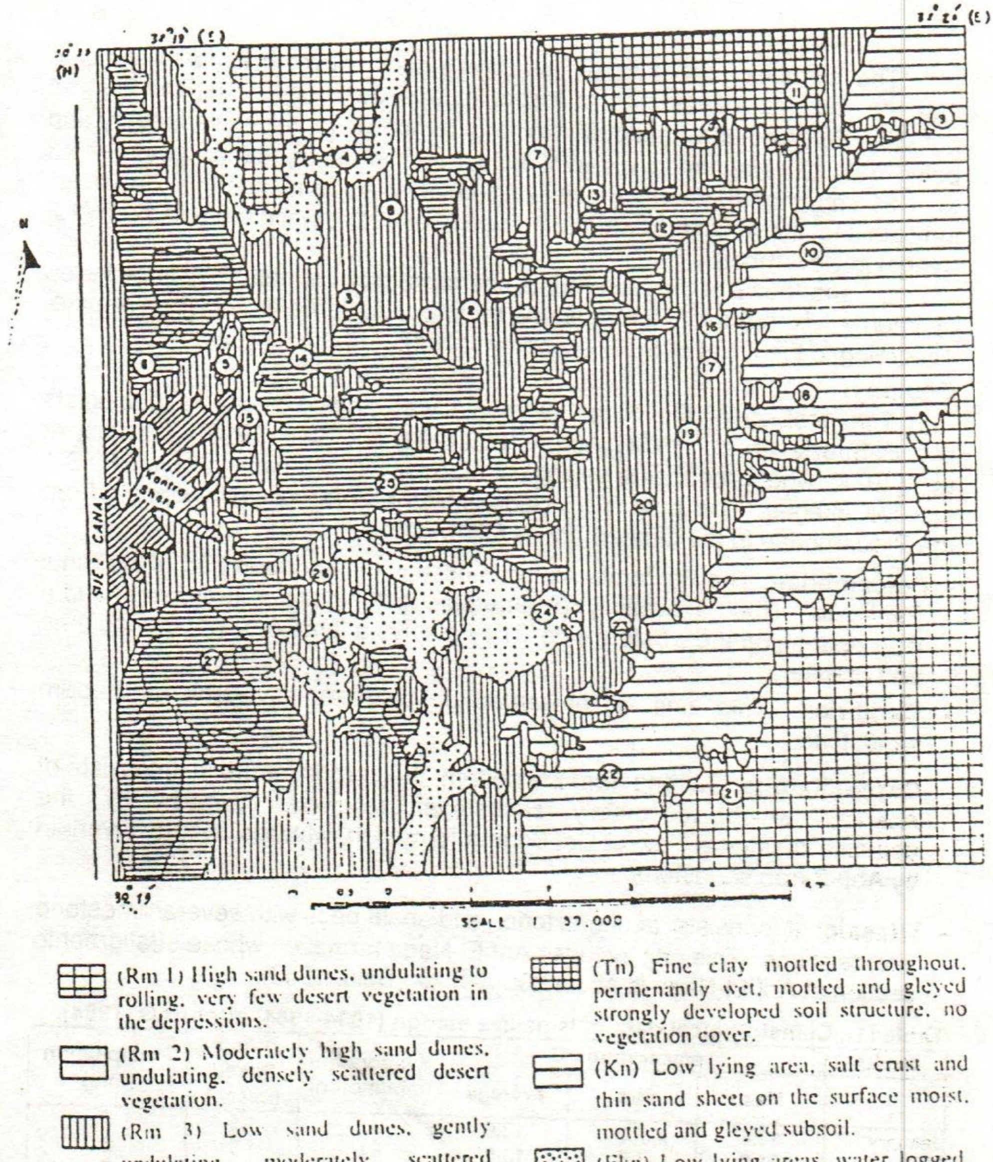
The area under study lies between longitudes 32° 14⁻ and 32° 26⁻ east and latitudes 30° 49⁻ and 30° 55⁻ north and occupied about 30.000 feddans.

Climate:

Sinai Peninsula is characterized by its desertic climate, having hot dry summer, mild winter with scare rainfall. Dust storms blow occasionally, some of them are known as khamaseen. These storms sometimes followed by heavy rain.

Map (1): Geological map of the Sinai Peninsula
(After Abu Al_Izz 1971)

1. Pre- Cambrian Rocks
2. Carboniferous
3. Triassic and Jurassic
4. Lower Cretaceous (Chalk)
5. Upper Cretaceous
6. Eocene
7. Oligocene
8. Pliocene
9. Pleistocene and Holocene



(Rm 1) High sand dunes, undulating to rolling, very few desert vegetation in the depressions.

(Rm 2) Moderately high sand dunes, undulating, densely scattered desert vegetation.

(Rm 3) Low sand dunes, gently undulating, moderately scattered vegetation.

(Gb) Almost level, covered with aeolean sand sheet, moderately scatared desert vegetaion and few shrubs.

(Tn) Fine clay mottled throughout, permenantly wet, mottled and gleyed strongly developed soil structure, no vegetation cover.

(Kn) Low lying area, salt crust and thin sand sheet on the surface moist, mottled and gleyed subsoil.

(Ekn) Low lying areas, water logged, mottled and gleyed subsoil.

Map (2): Location the studied profiles

The climatological data of Ismailiya station shown in Table (1) indicate that the maximum temperature occurs in June, July and August and Figured out 35.5 °C, and the detected minimum temperature values in January and being 7.0 °C. The annual mean of evaporation in mm/month ranges from 43 to 191 mm/month. The surface wind velocity as evidenced in Table (1) indicate that the maximum wind (2.1 m/sec) in March, while the minimum (1.2 m/sec) in November.

On the basis of the aforementioned climatological data the studied area of interrest is thermic temperature regime and torric in moisture regime. According to the limits of Soil Taxonomy (1994).

Geology:

The geology of the Sinai Peninsula was studied by several geologists like El-Shazly et al., (1974), Abu Al-Izz, (1971) and Said (1990). El-Shazly et al., (1974) who produced a geological map for Sinai Peninsula from ERTS-1 satellite images. The map (2) includes ten chronological units, starting from the Precambrian to the Quaternary as following:

- **Precambrian:** The Precambrian rocks occupy the southern part of the Sinai Peninsula. They are mainly metamorphic rocks in the central part and to a less extent, on the western side. They overlay a large mass of granodiorite and granite.
- **Cambrian:** This unit is presented on the map as Sarbit El-Khadem sandstones.
- **Carboniferous:** Starting from the bottom, the carboniferous unit consists of Adedia, which is mainly sandstone, followed upwards by the dolomitelimestome-clay of Um Bogma formation, which is, in turn. Overlain by Abu-Zarab sandstons.
- **Triassic:** It consists of sandstone and shale beds with several limestone intercalations. This unit includes Arif El-Naga formation whose stratigraphic section at Arif El-Naga is about 200 m thick (Said, 1962).

Table (1): Climatological data of Ismailiya station (1934-1984) after FAO (1984).

Month	Temperature °C			Evaporation (mm/month)	Wind Speed (m/sec)	Precipitation (mm)
	Max.	Min.	average			
January	19.8	7.0	12.6	47	1.6	7
February	21.0	7.6	13.5	61	1.8	2
March	23.8	9.8	16.3	114	2.1	7
April	28.6	13.0	20.2	153	1.9	1
May	31.1	16.0	23.1	176	1.7	5
June	35.0	19.5	26.8	185	1.4	0
July	35.0	20.8	27.3	191	1.7	0
August	35.0	21.0	27.5	174	1.6	0
September	32.7	19.1	25.3	135	1.4	0
October	30.2	16.3	22.5	101	1.4	3
November	25.6	12.7	18.5	57	1.2	10
December	21.5	8.8	14.3	43	1.4	3
Total						38
Mean	28.3	14.3	20.64	119.83	1.6	3.16

A = Port Said Station. B = El-Arish Station.

- **Jurassic:** According to El-Shazly et al., (1974), this unit includes three formations, namely; Bir Maghara shale limestone, saft sandstone coal and masadid limestone.

- **Cretaceous:** This unit includes five formations. The Malha and Lagama formations represent the Early cretaceous sandstone. The first carried important kaolin deposits. The fallig formation, which is formed of limestone, the yelleg formation is dolomitic and the sidr formation is halky.

- **Paleocene:** This unit includes only one formation; namely, Gabal Bodhiya which consists of marl, shale and limestone.

- **Eocene:** This unit includes three formations, namely, Luxor , which consists of limetons with flint and marl; Darat, consisting of shale and marl with limestone with flint bands and Tanka formation, consisting of shale and shaley limestone.

- **Miocene:** This unit is particularly important for oil as well as for gypsum-anhydrite resources.

- **Quaternary:** This unit includes one Pleistocene and ten Holocenary units. The alluvial deposits have been divided, according to their lithology, into, sandy/limey/chalky or clayey/dolomitic or undifferentiated. They also, include sabkhas and salty areas. These areas are generally difficult to drive through. The unit, also, includes the sandy soils and sand dunes of El-Arich-Rafah coastal strip. These are distinguished from the other sandy soils and sand dunes of Sinai by being semi-consolidated, due to their mixing with Wadi El-Arish alluvium.

El-Sayed Massoud (1999) in his studies of soil classification and land suitability evaluation of an area in East Ismailiya area in North Sinai found that the soils are classified according to the U.S. Soil Taxonomy System (Soil Survey Staff, 1994) into seven mapping units as follows:

Mapping unit (1)	Typic Torripsamments, Rommana high sandy dunes
Mapping unit (2)	Typic Torriorthents, Rommana moderately high sandy dunes.
Mapping unit (3)	Typic Haplogypsids, Rommana low sandy dunes.
Mapping unit (4)	Typic Haplosalids, Gelbana sandy loam.
Mapping unit (5)	Leptic Haplogypsids, Tina clay.
Mapping unit (6)	Typic Torripsamments, Kantara loam.
Mapping unit (7)	Typic Aquisalids, East Kantara sandy loam

Characterization of the soil parent material is necessary for a meaning full interperetion of soil morphology & pedology (Arnold, 1968). Bilizi and Ciolkosz (1977) presented an easy, field morphology rating system, to evaluate quantitatively the degree of soil development. The system includes two soil rating scales namely; the relative horizon distinctness (RHD) and the relative profile development (RPD). In the first scale, morphological features of two adjacent horizons, in a pedon, are compared to identify depositional or parent material discontinuities. While in the second scale, a comparison of the features of discrete horizons with the C horizon within a pedon. Meixiner and singer (1981) applied this system to a chronosequence in San Joaquin valley in California. They reported that the rating values were generally less than 10 and were proportional to degree of horizon differentiation. Values exceeding 10, however, allocated soils were observed and suspected discontinuous parent materials. They added that although RPD increased with age yet, A-Horizons of younger soils and B-horizons of older soils acquired the highest RPD values. Harden (1982) suggested a modification to this index, based on field description, to improve the quantitative assessment of the degree of soil profile development.

The aim of this study is to estimate and evaluate the soil horizons distinctness of the studied area by applying different rating scales. Also, a new modification for the rating scales, to account for secondary soil formation, was implicated in the study.

MATERIALS AND METHODS

A semi detailed soil survey of the studied area was carried out. The studied area lies between 30° 49⁻ and 30° 55⁻ north latitudes and 32° 14⁻ and 32° 26⁻ east longitude (Map 1). Twenty seven profiles were examined and eight out of them were chosen to represent the different soils in the studied area. The profiles were dug to 150 cm or less according to depth of hard pans or rocks and morphologically described according to FAO system (1977), Table (2).

Soil samples representing the subsequent morphological variation within the entire depth of each profile were collected for laboratory analyses including particle size distribution, Ece, pH and $CaCO_3$ according to the methods described by Richards (1954) were used.

Method used for evaluating profile development:

The method used for profile evaluating in the field morphology scale, which was proposed by Bilzi and Ciolkosz (1977). In this method they defined two rating scales:

A- Relative Horizon Distinctness (RHD) which is a comparison of the morphological features of two adjacent horizon.

B- Relative profile Development (RPD) which is a composition of the morphological features of each horizon with the C horizon within the profile.

The soils were evaluated and points were assigned as described by Meixner and Singer (1981) as follows:

1- Colour (dry and moist): one point is assigned for any class change in hue and for any unit change in value or chroma.

2- Texture: One point is assigned for each class change on the texture triangle.

3- Structure: One point is assigned for any change in type of aggregated structure, for each unit change in grade (1, 2, 3) and for each class change in size (vf , f , m , c , vc), irrespective of the aggregate type.

4- Consistence: One point is assigned for any class change in dry (lo, so, sh, h, vh and eh) and moist (lo, vfr, fr, fi and vfi and efi) consistence,
5- Boundaries: Points are assigned according to the distinctness of the lower or shared harizon as follows diffuse-o, gradual 1-, clear-2, abrubt-3. and very abrubt-4.
6- Clay Films: One point is assigned for each change in frequency or thickness at any single location.

Profile index values, were also calculated according to Harden (1982). Additionally the soil content of secondary formations (carbonate, gypsum and salts) were calculated according to Salem et al ., (1997).

RESULTS AND DISCUSSION

Soil classification of the studied profiles has been conducted up to the family level depending on the soil taxonomy system, using USDA keys of U.S.D.A Soil Taxonomy (1975, 1992, and 1994). The soils were classified as Aridisds and Entisol. The order Entisols having three subgroup; namely Typic Torripsamments (profiles 21 and 27), Typic torriorthents (profile 10). While the order Aridisols having five subgroup; namely, Tapic Haplogypsids, Tapic Haplosalids, leptic Haplogypsids, and Typic Aquisalids (profiles 26 , 6 , 5 , 11, 4). This classification is justified by morphological description and some chemical analyses data (Table 2).

Climatological data indicate that the soil temperature regime of these area is thermic. Table (3) shows the soil taxonomy classification up to the family level according to U.S.D.A (1975, 1992 and 1994).

The soil description in Table (2) shows that there exist no diagnostic horizons in profile 21, 10 and 27, where profiles (26 and 11), (6 , 4 and 5) have gypsic and salic horizons respectively.

Table (2): Morphological and chemical properties of the studied profiles.

Prof. No.	Hori-zons	Depth (cm)	Colour		Texture classes	Structure	Consistence				EC (dS/m)	pH 1:2.5	$CaCO_3$ %	$CaSO_4$ $2H_2O$ %	Efferre-scence	Bound-ary
			Moist	Dry			Dry	Moist	Wet ST	Wet PL						
21	C_1	0-10	10YR7/6	10YR8/6	S	SG	LO	LO	NST	NPL	1.00	7.7	0.96	1.01	SL	Gd
	C2	10-120	10YR7/4	10YR8/6	LS	SG	LO	LO	NST	NPL	3.29	7.5	0.44	0.48	None	-
10	C_1	0-10	10YR5/4	10YR6/6	S	MA	SO	VFR	NST	NPL	3.12	7.5	1.40	2.44	ST	ABS
	C2	10-40	10YR5/3	2.5YR6/4	S	MA	SO	VFR	NST	NPL	2.25	7.0	1.52	1.85	ST	ABS
	C_3	40-48	2.5YR5/2	2.5YR6/2	S	MA	SO	VFR	NST	NPL	4.33	7.2	1.05	1.49	ST	ABS
	C_4	48-120	2.5YR5/3	2.5YR6/4	S	MA	SO	VFR	NST	NPL	7.93	7.3	1.14	0.75	SL	-
26	C_1	0-40	10YR4/2	2.5YR6/2	L	MA	HA	FI	VST	VPL	141.95	7.3	2.21	3.57	SL	ABS
	C_2	40-65	10YR4/2	2.5YR6/2	LS	MA	SHA	VFR	Vst	VPL	24.30	7.2	1.44	1.28	SL	ABS
	C_3	65-100	10YR5/2	5YR5/1	SL	MA	HA	FI	VST	VPL	28.57	7.2	4.87	4.26	SL	-
6	C_1	0-26	10YR5/1	10YR6/1	SC	MA	HA	FI	VST	VPL	125.61	6.9	9.68	0.32	SL	ABS
	C_2	26-47	10YR5/2	10YR6/2	LS	MA	SO	FR	SST	SPL	38.90	7.3	0.88	1.79	ST	ABS
	C_3	47-70	10YR5/1	10YR6/1	SC	MA	SHA	VFR	VST	VPL	60.0	7.3	3.08	2.93	SL	ABS
	C_4	70-82	10YR5/1	10YR7/1	SL	MA	HA	FI	VST	VPL	67.0	7.3	3.16	2.68	ST	CW
	C_5	82-120	10YR5/1	10YR6/1	LS	MA	SO	FR	SST	SPL	49.95	7.4	1.40	2.71	SL	-
11	C_1	0-12	10YR5/3	10YR7/2	LS	MA	HA	FI	VST	VPL	57.15	6.7	5.72	26.92	SL	ABW
	C_2	12-31	5YR6/2	5YR7/2	SL	SB	SO	FR	SST	SPL	44.74	7.1	5.19	15.43	SL	CS
	C_3	31-58	2.5YR6/2	2.5YR7/2	LS	SB	SO	FR	SST	SPL	16.06	7.2	6.86	14.48	SL	CS
	C4	58-120	5YR5/2	5YR6/2	LS	MA	SO	FR	SST	SPL	13.42	7.9	9.50	13.90	SL	-

All abbreviations according to FAO (1990).

Texture
S : Sand
C : Clay
LS : Loamy sand
SC : Sand clay

Structure:
SG : Single grains
MA : Massive
SB : Subangular block
PL : Platy
AB : Angular block

Consistence
Dry: :
Lo : Loose
So : Soft
HA : Hard
S : Slightly

Moist:
FR :Friable
FI :Firm
V :Very

Consistence:
Wet:
ST : Sticky
PL : Plastic
N : Non

Boundary:
CS : Clear Smooth
ABS : Abrupt Smooth
DS : Diffuse Smooth
CW : Clear Wavy

Effervescence
None
SL: Slightly
S: Strong
V: Very

Table (2): Cont.

Prof. No.	Hori-zons	Depth (cm)	Colour		Texture Classes	Structure	Consistence				EC (dS/m)	pH 1:2.5	$CaCO_3$ %	$CaSO_4 \cdot 2H_2O$ %	Efferre-scence	Bound-Ary
			Moist	Dry			Dry	Moist	Wet ST	Wet PL						
27	C_1	0-80	10YR7/3	10YR8/5	S	MA	LO	LO	NST	NPL	1.25	7.9	1.05	1.01	SL	ABS
	C_2	80-120	10YR7/6	10YR8/6	S	SG	LO	LO	NST	NPL	3.35	7.6	0.52	0.12	VSL	-
4	C_1	0-20	2.5YR2/0	2.5YR3/0	Sc	SB	HA	VFL	VST	VPL	61.53	7.0	0.88	1.34	SL	ABS
	C_2	20-30	2.5YR4/2	2.5YR5/2	Ls	SG	HA	VFL	VST	VPL	21.90	7.5	3.96	1.11	SL	ABS
	C3	30-77	2.5YR4/2	2.5YR5/2	CL	SB	LO	LO	NST	NPL	32.33	7.5	4.04	1.49	SL	ABS
	C_1	77-100	10YR5/3	10YR6/4	S	SG	LO	LO	NST	NPL	24.71	7.5	0.88	1.54	SL	-
5	C_1	0-21	2.5YR4/2	2.5YR6/4	Ls	MA	SO	FR	SST	SPL	61.53	7.0	0.70	1.34	ST	ABS
	C_2	21-38	2.5YR5/0	2.5YR6/0	Ls	SB	SO	FR	SST	SPL	21.80	7.5	0.88	1.11	ST	CS
	C_3	38-86	2.5YR5/4	2.5YR6/4	Ls	SB	HA	FI	VST	VPL	32.40	7.5	1.84	1.49	SL	ABS
	C_4	86-120	10YR6/4	10YR8/4	S	MA	SO	FR	SST	SPL	24.70	7.5	0.70	1.54	SL	-

Table (3): Geomorphic unit, soil unit, and the representative profiles and their classification (According to Soil Taxonomy, 1994).

Geomorphic units	Soil units symbol	Soil unit	Profile No.	Soil classification	
				Order	Suborder
Mobile elevated sand dunes	Rm1	Rommana high sandy dunes	21	Entisools	Typic Torripsamments
Level terrian with aeolian sandy dunes	Rm2	Rommana moderately high sandy dunes	10	"	Typic Torriorthents
"	Rm3	Rommana low sandy dunes	26	Aridisols	Typic Haplogypsids
"	GB	Gelbana Sandy Loam	6	"	Typic Haplosalids
Individual sabkas, including wet and dry sabakhas, salt and dunes	TN	Tine clay	11	"	Leptic Haplogypsids
Level terain with aeolian sandy dunes	Kn	Kantra loam	27	Entisols	Typic Torripsamments
Individual sabkas, including wet and dry Sabakhas, salt and sand dunes.	Ekn	East Kantara Sandy Loam	4	Aridisols	Typic Aquisalids
			5	"	Typic Haplosalids

Table (4): The suggested rating points for the soil components: Carbonate, gypsum, EC and pH of the soil paste; by Salem et al. (1997).

Carbonate or gypsum			ECe (dS m^{-1})			pH values		
Terminology	Quantity	Rating points	Terminology	Quantity	Rating points	Terminology	Quantity	Rating points
Very few	< 5	0	Non-saline soil	< 2	1	Ultra acid	< 3.5	1
Few	5- < 15	1	Very slightly saline soil	2- < 4	1	Extermely acid	3.5-4.1	1
Common	15- < 40	2	Moderately saline soil	4- < 8	1	Very strongly acid	4.5 - 5.0	1
Many	40- < 80	3	Highly saline soil	8- < 16	1	Strongly acid	5.1 - 5.5	1
Dominant	> 80	4	Extremely saline soil	< 16	1	Moderately acid	5.6 - 6.0	1
						Slightly acid	6.1 - 6.5	1
						Neutral	6.6 - 7.3	1
						Slightly alkaline	7.4 - 7.8	1
						Moderately alkaline	7.9 - 8.4	1
						Strongly alkaline	8.5 - 9.0	1
						Very strongly alkaline	> 9.0	1

* FAO (1977) ** USDA (1993)

They are else characterized by wide range of soluble salts (1.00-141.95 dsm^{-1}) having a slightly acid to moderately alkaline pH (6.7-7.9) and moderately calcium carbonate (0.44-9.68%). However gypsum was ranged between (0.12-26.92%).

Table (2) shows the morphological description of eight profiles covering different soils of East Ismailiya area in North Sinai. The soils were evaluated and prospective points were assigned as descried by Meixner and Singer (1981) and the soil rating scale as applied. In addition, rating points of secondary components (carbonate, gypsum and salt) along with the pH values of the soil paste were recorded in Table (4).

Relative Horizon Distinctness (RHD)

The values of the RHD rating are listed in Table (5). Values are plotted at the boundary between horizons to give relative distinctness of graphical representation (Fig. 1).

It appears that the Aridisols soils (profiles 6 , 11 , 4 and 5) have RHD ratings vary between 6 and 18 Table (5) indicating that a very clear distinctness. Thus, the substratum horizons have a clear distinctness in comparison to the other horizons. Occasionally the surface horizon has a clear distinctness (profile 11) in comparison to other horizons. All soil properties have contributed to the RHD ratings.

The RHD ratings are lower than 10 densting no depositional or parent material discontinuities is detected (Meixner and singer, 1981).

As for profiles No. 21, 10 and 27 representing recent soils Typic Torripsamments and Typic Torriorthents having RHD rating lie between 5 and 8 (Table 5) indicating a slight distinctness. AS few properties are contributed to the ratings the subdivisions C1, C2, C3 and C4 which are suggested to minor differences.

The previous results suggested that, the soils of Typic Haplogypsids profiles 26 and 11 have moderate or slight distinctness, may be due to the gypsic horizons, which due to the natural of parent material. Also the moderate distinctness, was found in the salids soils (profile 6 , 4 and 5) which have RHD rating between 7 and 18.

Relative profile Development (RPD):

Value of RPD ratings of the studied profiles are listed in Table (6). The same values at midpoint of the horizon are plotted to give graphical representation of the relative profile development of the soils, Fig. (2).

Data revealed that the profiles No. 26, 6, 11, 4 and 5 representing the Aridisols having the highest (RPD) rating lie between 5 and 30 with an average of 7, 11.3, 12.30, 20.6 and 14.6 RPD km, based on colour, texture, and structure type properties at the lower boundary. Since all layers have the same RPD rating. The rating clearly reflected a good development of the Vertisols.

The profiles No. 21, 10 and 27 representing the Entisols (Typic Torripsamments and Typic Torriorthents having (RPD) ratings ranged between 2 and 8 with an average of 5, 4 and 8 RPD/cm, respectively.

These soils are relatively low development than the other oldest soils.

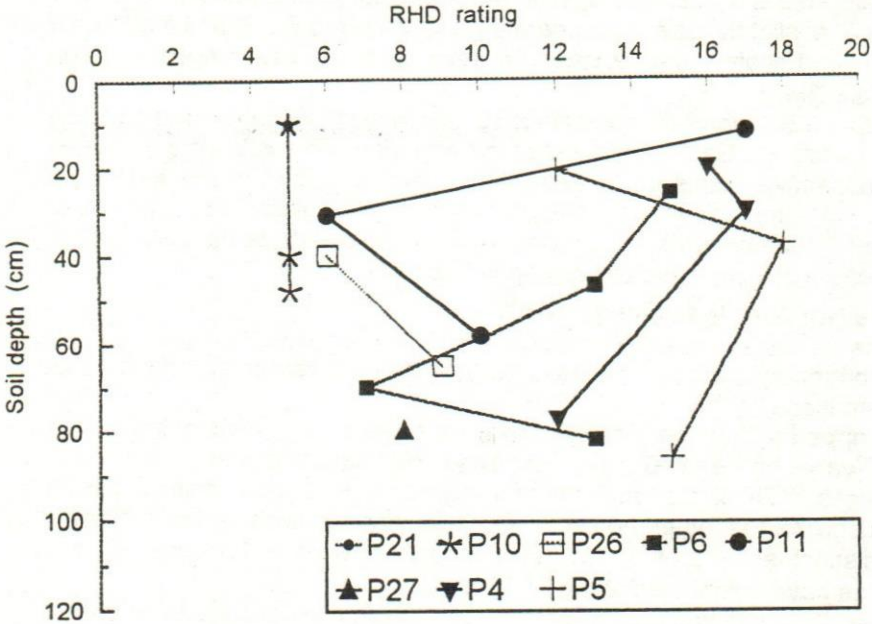


Fig. (1): Relative horizon distinctness (RHD) ratings.

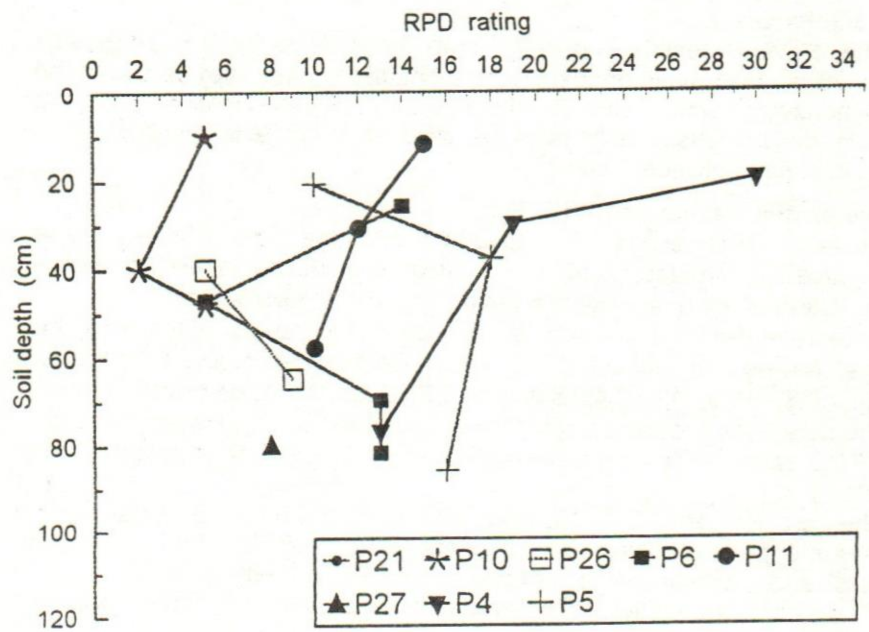


Fig. (2): Relative profile development (RPD) ratings.

Table (5): Relative horizon distinctness (RHD) rating of the studied profiles.

Prof. No.	Depth (cm)	Colour		Texture classes	Structure Type	Consistence				EC (dS/m)	$CaCO_3$ %	$CaSO_4 . 2H_2O$ %	pH	Boundary	RHD
		Moist	Dry			Dry	Moist	Wet							
								ST	PL						
21	C_1/C_2	2	0	1	0	0	0	0	0	1	0	0	0	1	5
10	C_1/C_2	1	2	0	0	0	0	0	0	1	0	0	0	1	5
	C_2/C_3	1	2	0	0	0	0	0	0	1	0	0	0	1	5
	C_3/C_4	1	2	0	0	0	0	0	0	1	0	0	0	1	5
26	C_1/C_2	0	0	1	0	1	2	0	0	1	0	0	0	1	6
	C_2/C_3	1	2	1	0	1	2	0	0	1	0	0	0	1	9
6	C_1/C_2	1	1	3	0	2	1	2	2	1	1	0	0	1	15
	C_2/C_3	1	1	3	0	1	1	2	2	1	0	0	0	1	13
	C_3/C_4	0	1	2	0	1	1	0	2	1	0	0	0	1	7
	C_4/C_5	0	1	1	0	2	1	2	2	1	0	0	1	2	13
11	C_1/C_2	2	0	1	2	2	1	2	2	1	1	2	0	1	17
	C_2/C_3	0	0	1	0	0	0	0	0	1	1	1	0	2	6
	C_3/C_4	1	1	0	2	0	0	0	0	1	1	1	1	2	10
27	C_1/C_2	3	1	0	1	0	0	0	0	1	0	0	1	1	8
4	C_1/C_2	4	4	3	2	0	0	0	0	1	0	0	1	1	16
	C_2/C_3	0	0	3	2	3	1	3	3	1	0	0	0	1	17
	C_3/C_4	2	3	2	2	0	1	0	0	1	0	0	0	1	12
5	C_1/C_2	3	4	0	2	0	0	0	0	1	0	0	1	1	12
	C_2/C_3	4	4	0	2	2	1	2	2	1	0	0	0	2	18
	C_3/C_4	1	2	1	2	2	1	2	2	1	0	0	0	1	15

Table (6): Relative profile development (RPD) rating of the studied profiles.

Prof. No.	Depth (cm)	Colour		Texture classes	Structure Type	Consistence				EC (dS/m)	$CaCO_3$ %	$CaSO_4$ $2H_2O$ %	pH	Boundary	RHD
		Moist	Dry			Dry	Moist	Wet ST	Wet PL						
21	C_1/C_2	2	0	1	0	0	0	0	0	1	0	0	0	1	5
10	C_1/C_4	1	2	0	0	0	0	0	0	1	0	0	0	1	5
	C_2/C_4	0	0	0	0	0	0	0	0	1	0	0	0	1	2
	C_3/C_4	1	2	0	0	0	0	0	0	1	0	0	0	1	5
26	C_1/C_3	1	2	1	0	0	0	0	0	1	0	0	0	1	5
	C_2/C_3	1	2	1	0	1	2	0	0	1	0	0	0	1	9
6	C_1/C_5	0	0	3	0	2	1	2	2	1	1	0	1	1	14
	C_2/C_5	1	1	0	0	0	0	0	0	1	0	0	1	1	5
	C_3/C_5	0	0	3	0	1	2	2	2	1	0	0	1	1	13
	C_4/C_5	0	1	1	0	2	1	2	2	1	0	0	1	2	13
11	C_1/C_4	1	1	0	0	2	1	2	2	1	1	2	1	1	15
	C_2/C_4	1	1	1	2	0	0	0	0	1	1	2	1	2	12
	C_3/C_4	1	1	0	2	0	0	0	0	1	1	1	1	2	10
27	C_1/C_2	3	1	0	0	0	0	0	0	1	0	0	1	1	8
4	C_1/C_4	6	7	2	2	3	1	3	3	1	0	0	1	1	30
	C_2/C_4	2	3	1	0	3	1	3	3	1	0	0	1	1	19
	C_3/C_4	2	3	3	2	0	0	0	0	1	0	0	1	1	13
5	C_1/C_4	4	2	1	0	0	0	0	0	1	0	0	1	1	10
	C_2/C_4	5	6	1	2	0	0	0	0	1	0	0	1	2	18
	C_3/C_4	1	2	1	2	2	1	2	2	1	0	0	1	1	16

Quantitative index Methods:

Profile Development Index (PDI) which described by Harzen (1982) was applied for eight profiles representing the different soil mapping units of East Ismailiya area in North Sinai. At the request of such an evaluation the following consideration were taken into account:

1. The area under study is geographically a very small one, extending only few square kilometers. All deposits were considered as belonging to the same parent material and the same geomorphic units.
2. As no geological stratification was evidenced through the morphological description or the analysis of the previously discussed RHD rating of the morphological rating scale methods.
3. The parent material of all soils under study was scoped to be sand, massive or single grains structure, loose and loose when moist, non-sticky, non-plastic on wet consistence. The colours of the "10 YR 8/6 dry" and "10YR 7/4 moist" are used as basic colours of the parent material. pH value is 7.3 . Secondary formation (salts, carbonate and gypsum) were assigned nil.

The field properties of the studied profiles, as accumulated and abbreviated from the morphological descriptions, which are described in Table (2), are quantified (step 1), and normalized (step 2). All the normalized properties are summed up for each horizon (step 3) and divided by n; whereas (n): the number of investigated properties (step 4).

This number resembles other normalized property ranges from 0 to 1 and is called the horizon index. It is of interest to note that missing data would not affect the range of this index. Each horizon index is multiplied by horizon thickness to yield index-cm of development. Summation of the index- cm of all horizons in the profile represents the final step No. (5). The resultant is the profile development index.

The field properties of the soils under study quantified and combined into the development index are given in Tables (7 and 8).

Table (7): The field properties of profile No. (26) quantified and combined into the development index.

	Quantified soil field properties		
	C_1	C_2	C_5
Texture	90	70	80
Rubefication	60	50	90
Structure	0	0	0
Dry consistence	30	20	30
Moist Consistence	30	40	30
Melanization (value)	50	50	60
PH	0.1	0.01	0
Normalized data			
Texture	0.6	0.5	0.53
Rubefication	0.46	0.38	0.69
Structure	0	0	0
Dry consistence	0.3	0.2	0.3
Moist Consistence	0.6	0.4	0.2
Melanization (value)	0.03	0.6	0.8
pH	0.01	0.01	0
Sum normalized properties	2.27	2.09	2.52
Divided by number of properties	0.32	0.30	0.36
Multiply by horizon thickness	12.8	7.5	12.6

Sum Horizon products 32.9 profile development.
Profile Development Index (For 100 cm) 33%.

Profile Development Index = 0 33 dev. Ind./cm.
Divided by profile thickness.

It appears from Table (8) that the horizon index values of the Ayidisols (Typic Haplogypsids, Typic Hoplosalids, Leptic Haplogypsids and Typic Aquisalids) representing by profiles No. 26, 6, 11, 4 and 5 are (0.32, 0.30 and 0.36), (0.40, 0.25, 0.35, 0.37 and 0.23), (0.28, 0.29, 0.25 and 0.26), (0.61, 0.38, 0.25 and 0.11) and (0.23, 0.33, 0.32 and 0.11) for C1, C2, C3, C4 and C5 horizons, respectively. These profiles have relatively moderate horizon index values in all horizon, based on all investigating properties (Table 8).

Table (8): Field properties of the studied profile quantifies and combined into the development index.

Profile No.		Horizons Distinguished				
		C_1	C_2	C_3	C_4	C_5
	HI	**0.01**	**0.01**	-	-	-
21	PDI PDI PDI (For 100 cm)	1.2 For Profile (21) 0.01 cm 1 %				
	HI	0.11	0.17	0.21	0.18	-
10	PDI PDI PDI (For 100 cm)	20.84 For Profile (10) 0.17 cm 17.4 %				
	HI	0.32	0.30	0.36	-	-
26	PDI PDI PDI (For 100 cm)	32.9 For Profile (26) 0.33 cm 33 %				
	HI	0.40	0.25	0.35	0.37	0.23
6	PDI PDI PDI (For 100 cm)	36.77 For Profile (6) 0.31 cm 31 %				
	HI	0.28	0.29	0.25	0.26	-
11	PDI PDI PDI (For 100 cm)	31.74 For Profile (11) 0.27 cm 27 %				
	HI	0.04	0.03	-	-	-
27	PDI PDI PDI (For 100 cm)	4.4 For Profile (27) 0.04 cm 4 %				
	HI	0.61	0.38	0.25	0.11	-
4	PDI PDI PDI (For 100 cm)	30.28 For Profile (4) 0.30 cm 30.1 %				
	HI	0.23	0.33	0.32	0.11	-
5	PDI PDI PDI (For 100 cm)	29.54 For Profile (5) 0.25 cm 25 %				

The horizon index of profile 26 representing Aridisols (Typic Haplogypsids) are 0.32, 0.30 and 0.36 for C1, C2 and C3 horizons respectively. The values in the substratum (C3) are higher than the others horizons.

The horizon index values of profile No., 21, 10 and 27 representing recent soil Entisols (Tipic Torripsamments and Typic Torriorthents) are (0.01 and 0.01), (0.11, 0.17, 0.21 and 0.18) and (0.04 and 0.03) for (C1 and C2) (C1, C2, C3 and C4) and (C1 and C2) horizons, respectively. These profiles have relatively lower horizon index values than those obtained for the same Aridisols. Profile No. 26.

From the discussion presented here it may be concluded that the Aridisols has an impace on the development of soil profiles, prevailing aridic conditions.

CONCLUSION

Soil development is assessed by using the recent morphology rating scale approach, and the quantitative index methods. Both methods revealed that differentiation between profiles of different soil orders (Aridisols and Entisols) was mainly related to the presence and distinctness of the formation processes and the development horizon.

The relative horizon distinctness (RHD) rating is increased by increasing the soil development since the recent soils Entisols have little distinctness more than the Aridisols.

The relative profile development (RPD) rating is else increased by the increasing the soil development. The RPD rating averages for the Aridisols are (7, 11.3, 12.3, 20.6 and 14.6) and (5, 4 and 8) for soil Entisols.

The horizon index values of the quantitative method varied with the soil formation processes and soil development, these are (36.77, 32.9, 31.74, 30.28 and 29.54) and (1.2, 20.84 and 4.4) for soil Aridisols and Entisols (profiles 6, 26, 11, 4 and 5) and (21, 10 and 27), respectively.

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استخدام الوصف المورفولوجى فى تقييم تطور أراضى شرق الاسماعلية فى شمال سيناء

فايزة سلامه على سلامه

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- تهدف الدراسة أساساً إلى تتبع التغير فى الخواص المورفولوجية والبيدوجينية فى الأراضى الحديثة Entisols وأراضى Aridisols وقد أختيرت لذلك عدد ثمانى قطاعات تغطى سبعة وحدات التربة الخرائطية بالناحية.
- فحصت سبعة وعشرون قطاع ثمانية منها تمثل هذه الدراسة وطبق عليها معدلات القياس Rating Scale وقدر بها الوضوح النسبى للأفاق (RHD) وكذلك التطور النسبى للقطاع الأرضى (RPD) ويعتمد تقدير (RHD) على مقارنة الأفق الذى يليه فى القطاع الأرضى.
- كذلك تم تقدير (RPD) على أساس مقارنة الأفاق المختلفة مع الأفق الأخير (مادة الأصل) فى القطاع الأرضى. وقد أخذ فى الاعتبار بعض الخواص الكيميائية مثل الأملاح وكربونات الكالسيوم والجبس ودرجة الـ pH عند تقدير هذا التطور. كما تم حساب قيم profile index من قيمة Horizon index وذلك بطريقة المعامل الكمى للقطاع الأرضى Quantitative profile .
- وقد وجد أن قيم RHD تتوافق مع قيم RPD وقيمة Profile index والتى أظهرت الاختلاف الواضح بين الأراضى الحديثة الممثلة فى أراضى Aridisols وتشمل:

(Typic Haplogypsids, Typic Haplosalids, Leptic Haplogysids and Typic Aquisalids)

- وقد أظهرت النتائج أن أراضى Aridisols عالية التطور أكبر من الأراضى الأخرى Entisols .