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USE OF FIELD MORPHOLOGICAL RATING SYSTEM TO EVALUATE THE SOILS DEVELOPMENT OF EL-KHARGA OASIS

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ABSTRACT

This study aims to estimate and evaluate the changes of some soils of El-Kharga Oasis using the morphology rating scale introduced by Bilzi and Ciolkosz (1977). Twelve profiles were examined, seven out of them representing this study.

Soil distinctness and development were assessed using the yecent methods; Relative Horizon Distinctness (RHD) and Relative Profile Development (RPD). Also, profile index values were calculated from horizon index values using quantitative profile index methods.

The average RHD ratings of the studied profiles are 3 to 10, 7 to 20, 11 to 12, 19, 9 to 11 and 3 to 5 whereas those of RPD ratings are 9 to 14, 17 to 19, 9 to 15, 19, 12 to 16 and 3 to7 for the vertic Torriorthents, Typic Torriorthents and Typic Torripsamments, respectively. The RHD values coincide with those of RPD ratings profile index values.

Data revealed that the clear differentiation in the recent soil (vertic Torriorthents), (Typic Torriorthents) and (Typic Torripsamments).

The study occurs that the soils of vertic Torriorthents and Typic Torriorthents have developed more than the others soils of Typic Trorripsamments.

Key words: Estimate of RHD, RPD and Quantitative index, El-Kharga Oasis.

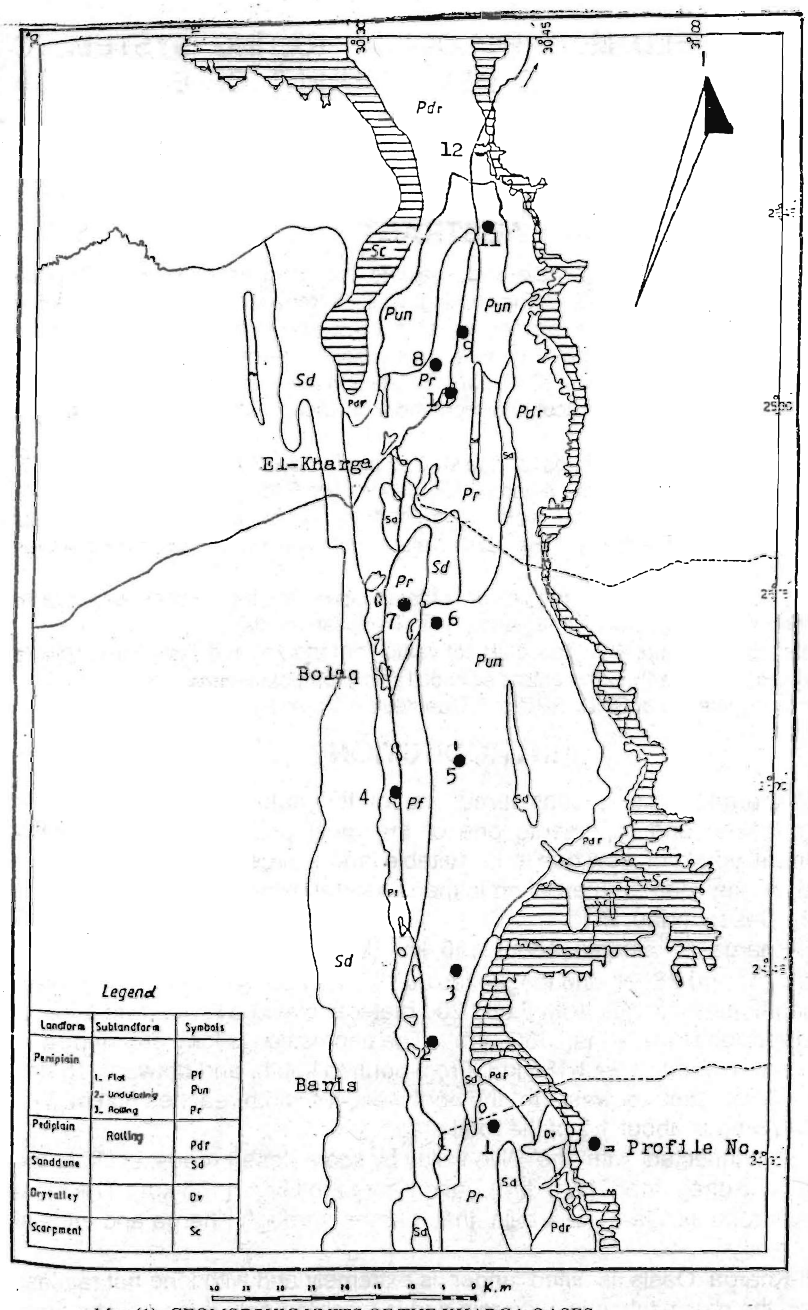
INTRODUCTION

El-Kharga Oasis is considered one of the natural depression in the western desert and represents one of the most promising soils from the agricultural point of view due to its suitable land sources. El-Kharga Oasis is located in the southern part of an immens natural excavation of the Egyptian Western Desert, (Map 1).

El-Kharga is situated about 150 km. West of the Nile valley, between latitudes 24^0 and 26° N, and longitudes 30° 27" and 30° 47" E. It is excavated to a depth that ranges from 5 and 200 meter above sea level. The area of the depression is more than 3000 km^2. The depression is long and narrow in shape, and extends about 185 km. From north to south, and between 15 and 30 km. From east to west. In the northwest, it's width reaches 80 km. The cultivated area is about 1.5 of the total area.

It is connected with the Nile valley by some desert roads, such as the Kharga to Suhag road (176 km), and Kharga to Girga (165 km). The most important road is Darb-Al Arbain that passes through Kharga and ends at Asyuit.

El-Kharga Oasis is sited under is extremely arid with long hot rainless summer, the precipitation is quite rain and is recorded only during winter time. Metrological data presented in Table (1) which represent the period from 1930 to 1980.



Map (1): GEOMORPHIC UNITS OF THE KHARGA OASES.

Table (1): The climatological normals ElKharaga Oases, average of 50 years (1930-1980) (after the climatogical survey Dept., A.R.E.).

Months	Temperature °C			Mean Total Rainfall (mm)	Relative Humidity (%)	Mean scalar Wind speed (knots/hr)	Evaporation Rate mm/day (Piche)
	Max.	Min.	Average				
Jan.	25.60	8.60	17.10	0.0	41.00	2.30	7.50
Feb.	24.20	6.60	15.40	0.0	39.00	3.10	8.80
March	30.00	13.50	21.75	Trace	32.00	3.40	12.90
April	35.10	16.60	25.85	Trace	22.00	3.20	16.20
May	39.80	22.50	31.15	0.0	23.00	3.30	19.80
June	41.20	24.90	33.05	0.0	31.00	3.30	21.50
July	45.70	22.60	34.15	0.0	25.00	2.50	20.20
August	39.90	22.40	31.15	0.0	29.00	2.20	19.20
Sep.	37.10	21.90	29.50	0.0	34.00	2.70	18.50
Oct.	31.60	16.80	24.20	0.0	41.00	2.60	15.40
Nov.	30.10	12.70	21.40	0.0	43.00	2.40	10.70
Dec.	25.20	10.70	17.95	Trace	44.00	3.30	7.70
Annual mean	33.79	16.65	25.22	Trace	33.67	2.85	14.90

The average mean annual temperature is 25-22 C^0 with great difference between summer and winter but the mean annual evaporation at El-Kharga is about 14.9 mm./day. The mean annual humidity in Kharga Oasis is 33.67% and the annual mean of surface wind velocity was 2.85 knots/day.

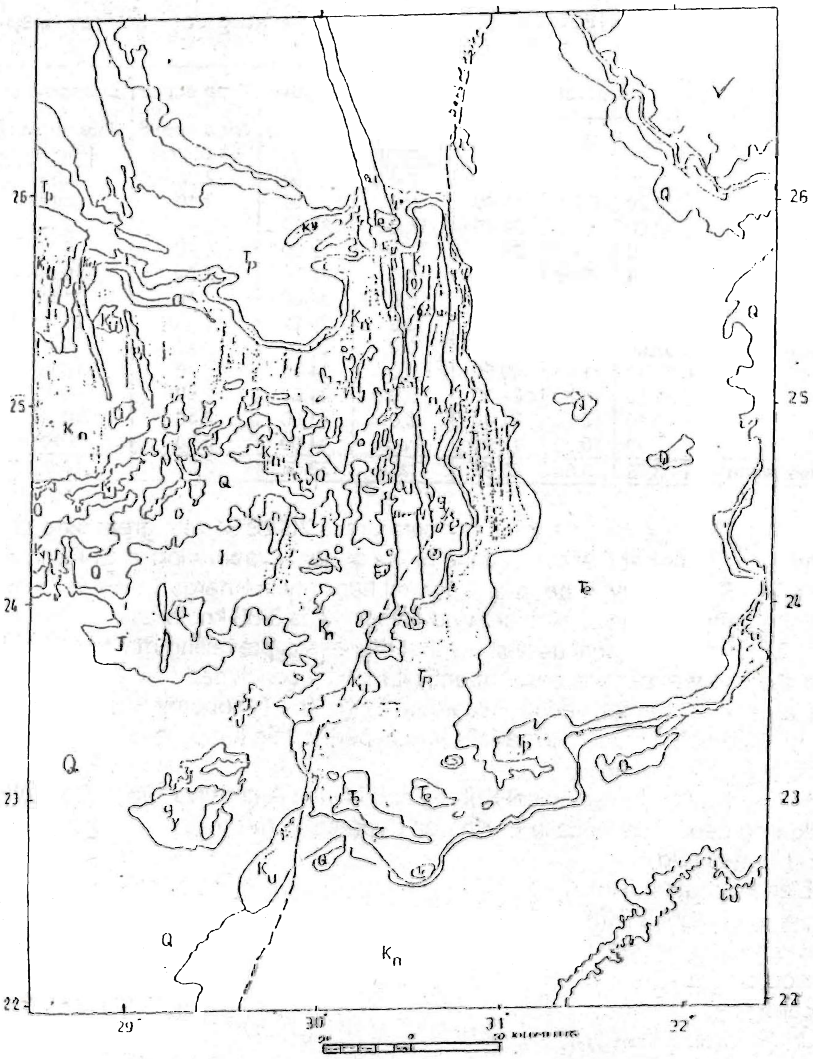
The climatological data show that dryness is prevailing most of the year and their no wet periods consequently it may be concluded that the climate of the area is extremely arid. According to the soil Taxonomy System (1975), the climate of the studied area falls into hyperthermic temperature regime and torric moisture regime .

The Egyptian Geological Survey and Mining Authority (1981), Found the Following geological units in El-Kharga depression (Map 2)

Sand Dunes (Qd).
Nubian Formation (Kn).
Upper Cretaceous (Ku).
Undivided Quaternary (Q).
Paleocene (Tp)
Eocene (Te).
Younger Graintoids (gy).
Jurassic (J).

El-Hamdi (1990) in their studies of soil classification and land suitability evaluation of an area in El-Kharga depression found that the soils are classified according to the soil Taxonomy system (1975) into seven soil sub great group (Table 2).

Characterization of the soil parent material; is necessary for a meaningaful interoperation of soil morphology and pedology (Arnold, 1968). Bilzi 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 with the a comparison of the features of



Map (2): Geological map of Kharga Oasis (after Egyptian Geological Survey and Mining Authority 1981).

Legend:

Qd	: Sand dunes	Tp	: Paleocene
Kn	: Nubian Formations	Te	: Eocene
Ku	: Upper Cretaceous	gy	: Younger Granitoids
Q	: Individed Quaternary	J	: Jurassic

discrete horizons in a pedon, are compared to scale, a comparison of the features of discrete horizon with C horizon within a pedon. Meixner 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 the 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 filed description, to improve the quantitative assessment of the degree of soil profile development.

Table (2): Soil classification of the studied soil profiles.

Order	Suborder	Great group	Sub great group	Family	Prof. No.
Entisols	Orthents	Torriorthents	TypicTorriorthents	Sand over fine loamy, mixed, hyperthermic	12
			VerticTorriorthents	Clayey, mixed hyperthermic	6
			TypicTorriorthents	Fine loamy over sand, mixed hyperthermic	2
			TypicTorriorthents	Sandy, mixed, hyperthermic	7
			TypicTorriorthents	Fine loamy, mixed, hyperthermic	4
	Psamments	Torri Psamments	TypicTorrii Psamments	Mixed, hyperthermic	11

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

MATERIALS AND METHODS

Variation in soil morphological properties of seven mapping units were studied to estimate their developments, using the field morphology rating scale methods described by Bilzi and Ciolkosz (1977). Twelve profiles were studied and seven out of them were chosen to representing different soil mapping units of the studied area of El-Kharga Oasis. Their locations are illustrated in Map (3). The profiles were examined and morphologically described according to the system outlined by FAO (1990). The most important morphological properties are texture, structure, consistence, sticky, plasticity, soil color (using the Musell color)in both dry an moist states, and the boundaries between soil horizons. Each horizon (layer) of each representative profile was sampled and kept for laboratory analyses. Samples representing of horizons were subjected to laboratory determinations e.g. ECe, pH, $CaCO_3$ and gypsum ($CaSO_4$-$2H_2O$) content, Table (3) (Richards, 1954).

Map3

Legend

Entisoks

Orthents: Typic Torriorthents

Psamments: Typic Trripsamments.

: Lithic Torripsamments.

Fluvents: Lithic Torrifluvents.

Vertisols

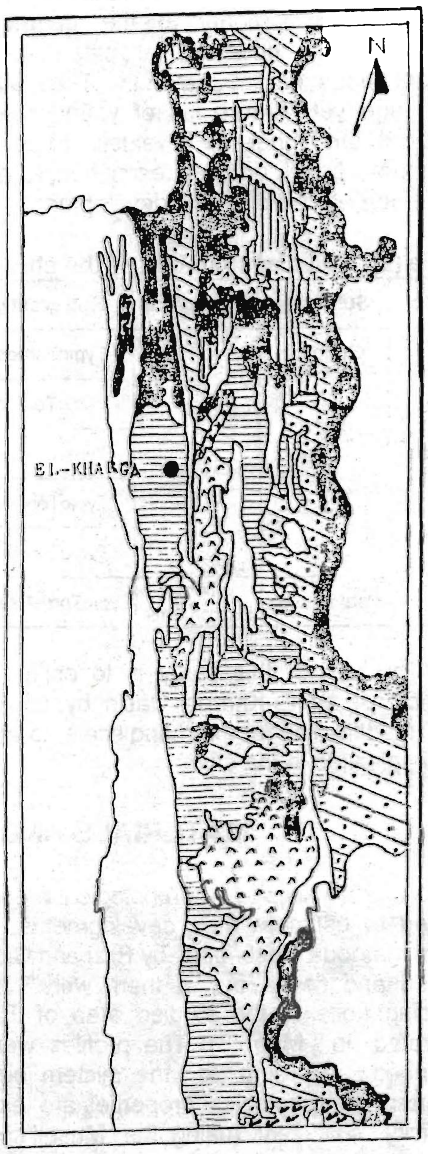
Paleustollic Torrerts.

Paleustollic Chromusterts.

Mescillaneous land Types

Rock Land.

Active sand dunes.



Map (3): Soil Map of El-Kharga Oasis (after Hamdi etal, 1982). Academy of Scientific Research & Tecnnology

Table (3): 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	$CaCO_3$ %	$CaSO_4 2H_2O$ %	Efferrescence	Boundary
			Moist	Dry			Dry	Moist	Wet							
									ST	AM						
12	C_1	0-25	10YR6/3	10YR8/4	LS	MA	HA	FR	NST	NPL	50.4	7.8	28.90	2.05	VST	ABS
	C_2	25-75	10YR6/6	10YR7/6	SCL	HA	Vha	FR	ST	PL	104.9	7.4	7.35	0.23	VSI	-
6	C_1	0-15	10YR4/3	10YR5/4	C	w.m SB	VHA	VFR	St	PL	3.0	7.4	2.41	0.17	SL	GS
	C_2	15-40	10YR3/3	10YR4/3	C	w.fine SB	VHA	VFI	VST	VPL	9.6	7.4	2.31	0.08	ST	DS
	C_3	40-60	10YR3/3	10YR4/2	C	m.fine PL	VHA	VFI	VST	VPL	11.1	7.4	1.86	2.00	SL	DS
	C_4	60-150	10YR5/8	10YR5/2	C	m.mCoPL	VHA	VFI	VST	VPL	11.8	7.7	1.26	0.62	VSL	-
2	C_1	0-15	10YR5/2	10YR6/4	SCL	MA	SHA	VER	SST	SPL	40.0	7.3	2.20	0.95	ST	DS
	C_2	15-65	10YR5/2	10YR7/2	SCL	w.m SB	HA	FR	St	PL	31.2	7.5	2.30	0.01	SL	DS
	C_3	65-80	10YR5/4	10YR6/2	SCL	within PL	SHA	VFR	SST	SPL	23.7	8.2	3.30	0.11	ST	ABW
	C_4	80-150	10YR5/2	10YR6/3	LS	MA	SO	VFR	NST	NPL	18.7	8.0	3.40	0.11	ST	-
7	C_1	0-30	10YR5/4	10YR7/6	SL	MA	SHA	VFR	SST	SPL	0.8	7.9	2.73	0.10	SL	CS
	C_2	30-60	10YR6/6	10YR7/6	LS	MA	SO	VFR	NST	NPL	1.4	7.7	4.72	0.11	ST	GW
	C_3	60-150	10YR7/8	10YR7/3	LS	MA	HA	FR	SST	SPL	0.9	7.7	5.67	0.18	VST	-
4	C_1	0-20	10YR5/4	10YR6/4	LS	MA	SO	VFR	NST	NPL	1.4	8.1	4.60	0.01	ST	GS
	C_2	20--50	10YR4/4	10YR5/4	SL	MA	SHA	VFR	SST	SPL	2.6	8.0	0.80	0.06	SL	GW
	C_3	50-80	10YR5/4	10YR6/6	LS	MA	SO	VFR	NST	NPL	4.2	7.7	1.90	0.22	SL	ABS
	C_4	80-150	10YR6/3	10YR4/3	C	m.fineAB	VHA	VFR	VST	VPL	3.3	7.8	2.40	3.39	SL	-
11	C_1	0-30	10YR7/6	10YR8/6	S	SG	LO	LO	NST	NPL	1.5	7.9	5.46	0.21	ST	DS
	C_2	60-150	10YR6/6	10YR8/6	S	MA	SO	VFR	NST	NPL	1.0	7.8	5.46	0.18	ST	GW
	C_3		10YR5/6	10YR8/6	LS	MA	SO	VFR	NST	NPL	3.0	7.6	7.06	0.07	VST	-

All abbreviations according to FAO (1990).

Texture			Structure:			Consistence				Consistence:			Boundary:		Effervescence
S	:	Sand	SG	:	Single grains	Dry:	:	Moist	:Friable		:Wet:	CS	: Clear Smooth	None	
C	:	Clay	MA	:	Massive	Lo	: Loose	FR	:Firm	ST	:Sticky	ABS	: Abrupt Smooth	SL:	Slightly
LS	:	Loamy sand	SB	:	Subangular block	So	: Soft	FI	:Very	PL	:Plastic	DS	: Diffuse Smooth	S:	Strong
SC	:	Sand clay	PL	:	Platy	HA	: Hard	V		N	Non	CW	: Clear Wavy	V:	Very
Co	:	Coarse	AB	:	Angular block	S	: Slightly					GS	: Gradual smooth		
			W	:	Weak	m	: moderately								

The rating points needed to quantify relative horizons distinctness (RHD) and Relative Profile Development (RPD) were calculated according to the methods suggested by Bilzi and Ciolkosz (1977) and Meixner & Singer (1981), respectively. Profile index values, were also calculated according to Harden (1982), In addition the soil contents of secondary formations (Carbonate, gypsum and salts) were determined according to Richards (1954).

RESULTS AND DISCUSSION

Soil classification of the studied profiles has been conducted up to family level depending on the soil taxonomy system; using the USDA keys of soil Taxonomy (1994). The soils were classified as Entisols having two suborders, namely, Psamment, profile 11 and Orthents profiles 12, 6, 2, 7 and 4. This classification is justified by the morphological description and some chemical analysis data (Table 3). Climatological data indicate that the soil temperature regime of these area is hypothermic. Table (2) shows the soil taxonomy classification up to the family level according to USDA (1994).

The soil description in Table (3) shows there exist no diagnostic horizons being of sandy, clay, sand, clay loamy and loamy sand texture down to a considerable depth. They are else characterized by a wide range of soluble salts (0.8-104.9 dSm^{-1}) having mildly alkaline pH (7.3-8.2) and moderately Calcium carbonate content (0.8-28.9%). However, gypsum was range between (0.01-3.39%).

Table (3) shows the morphological description of Seven profiles covering different soils. The soils were evaluated and prospective points were assigned as described by Meixner and Singer (1981) and the soil rating scale as applied. In addition, rating points of secondary components (carbonate, gypsum and ECe) along with pH values of the soil paste were recorded in Table (4), according to Salem et al., (1997).

Relative Horizon distinctness (RHD):

According to Bilzi and Ciolkosz (1977), the morphological ratting scale can be used to compare adjacent horizons to give a comparison of the relative distinctness of horizons (RHD). The values of the (RHD) of the studied profiles are presented in Table (5). Values are plotted at the boundary between horizons to give relative distinctness of graphical representation (Fig. 1)

It appears that the Torripsamments soils (Profile 11) have RHD ratings lie between 3 and 5 (Table 6) indicating a very slight distinctness. As very few properties are contributed to the ratings and moderately distinctness between C_2 and C_3. The RHD ratings are lower than 10 densting no depositional or parent material discontinuities is detected, (Meixner and Singer 1981).

As for profiles No. 4, 2, 12, 7 and 6 representing recent soils Typic Torriorthents having RHD ratings vary between 3 and 20 Table (5) indicates a very clear distinctness. Thus, the substratum horizons have a clear distinctness in comparison to the other horizons.

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	Values	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	Extremely 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
						Moderately acid	5.6 - 6.0	1
						Slightly acid	6.1 - 6.5	1
						Neutral	6.6 - 7.3	1
Dominant	> 80	4	Extremely saline soil	< 16	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)

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						
12	C_1/C_2	3	3	2	0	0	0	2	2	3	2	0	1	1	19
6	C_1/C_2	1	2	0	0	0	0	1	1	1	0	0	0	2	8
	C_2/C_3	0	1	0	1	0	0	0	0	0	0	0	0	1	3
	C_3/C_4	7	1	0	0	0	0	0	0	0	0	0	0	2	10
2	C_1/C_2	0	3	0	1	1	1	1	1	1	0	0	1	2	12
	C_2/C_3	2	1	0	1	1	1	1	1	1	0	0	1	1	11
	C_3/C_4	2	1	2	1	1	0	1	1	1	0	0	0	1	11
7	C_1/C_2	3	0	1	0	1	0	1	1	0	0	0	1	1	9
	C_2/C_3	3	3	0	0	1	1	1	1	0	0	0	0	1	11
4	C_1/C_2	1	1	1	0	1	0	1	1	0	0	0	0	1	7
	C_2/C_3	1	3	1	0	1	0	1	1	0	0	0	1	1	10
	C_3/C_4	2	5	4	1	1	0	3	3	0	0	0	0	1	20
11	C_1/C_2	1	0	0	1	1	1	0	0	0	0	0	0	1	5
	C_2/C_3	1	0	1	0	0	0	0	0	0	0	0	0	1	3

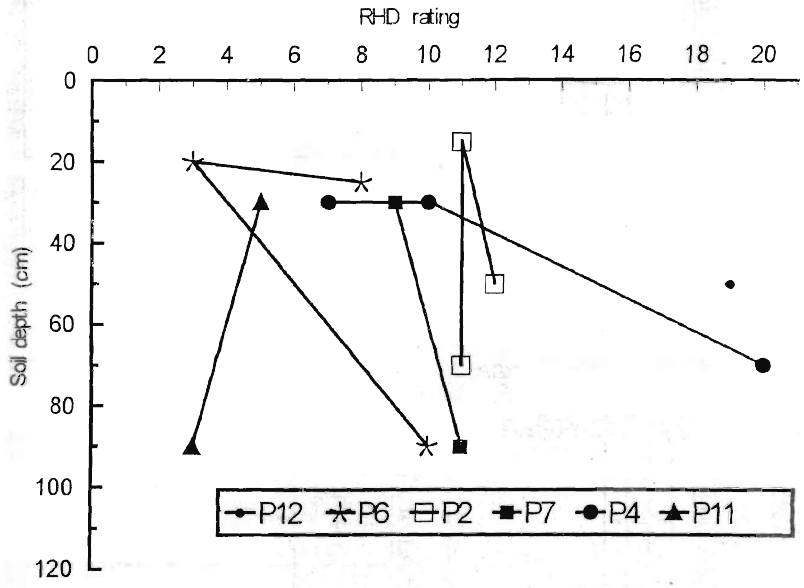


Fig. (1): Relative horizon distinctness (RHD) ratings.

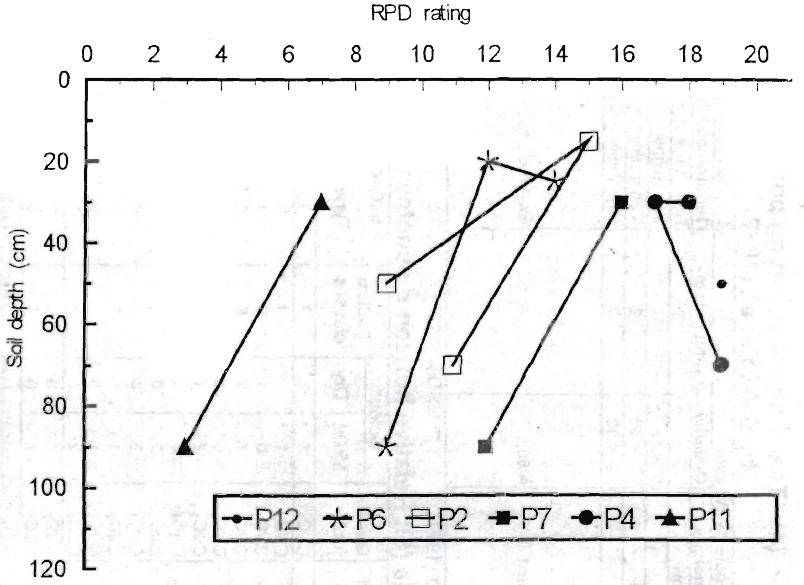


Fig. (2): Relative profile development (RPD) ratings.

Also, the distinctness was clear in Typic Torriorthents more than the lower Typic Torripsamments and all soil properties have contributed to the of RHD ratings.

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).

It appears that the soils of Torriorthents, which are represented by profiles Nos. 4, 2, 12, 7 and 6 have high RPD ratings and rary between 9 and 19 Table (6) indicating a well development which
disturbed in all horizon of profiles studied. The Typic Torriorthents and the vertic Torriorthents, represented by profiles Nos. 6 and 2 have RPD ratings ranging between 9 and 15. These soils are relatively lower developed than the other profiles.

The Typic Torripsamments soils represented by profile No.11 have RPD rating ranging between 3 and 7. These soils are relatively lower developed than the other recent soils Typic Torriorthents.

Quantitative Index Methods:

Profile development index (PDI) described by Harden (1982) were applied for seven profiles covering the different soils of El-Kharga Oasis.

At the request of such an evaluation the following considerations 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 analyses of the previously discussed RHD ratings of the morphological rating scale methods. The parent material of all soils under study was scoped to be clay or loamy sand, massive or subangular blocky structure, hard and friable when moist, non sticky and non plastic on wet consistence. The colour notations of "10YR 8/6 dry" and "10YR 5/2 moist" are used as basic colour of the parent material. pH values is 7.5, in addition to secondary formation (salts, Carbonate and gypsum) were assigned nil.

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

This number resembles other normalized property ranges from 0 to1 and is called the Horizon index. It is 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.

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	RPD
		Moist	Dry			Dry	Moist	Wet							
								ST	PL						
12	C_1/C_2	3	3	2	0	0	0	2	2	3	2	0	1	1	19
6	C_1/C_4	6	2	0	1	0	0	1	1	1	0	0	0	2	14
	C_2/C_4	7	2	0	1	0	0	0	0	0	0	0	0	2	12
	C_3/C_4	7	1	0	0	0	0	0	0	0	0	0	0	1	9
2	C_1/C_4	0	1	2	0	1	0	1	1	1	0	0	1	1	9
	C_2/C_4	0	2	2	1	2	1	2	2	1	0	0	1	1	15
	C_3/C_4	2	1	2	1	1	0	1	1	1	0	0	0	1	11
7	C_1/C_3	6	3	1	0	1	1	1	0	0	0	0	1	2	16
	C_2/C_3	3	3	0	0	2	1	1	1	0	0	0	0	1	12
4	C_1/C_4	2	3	4	1	2	0	3	3	0	0	0	0	1	18
	C_2/C_4	3	2	3	1	1	0	2	2	0	0	0	1	2	17
	C_3/C_4	2	5	4	1	1	0	3	3	0	0	0	0	0	19
11	C_1/C_3	2	0	1	1	1	1	0	0	0	0	0	0	1	7
	C_2/C_3	1	0	1	0	0	0	0	0	0	0	0	0	1	3

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

It appears from Table (8) that the horizon index values of the Entisols (vertic Torriorthents, clayey, mixed, hyperthermic) representing by profile No.6 are high: 0.37, 0.44, 0.49 and 0.52 for the C_1, C_2, C_3 and C_4 horizon respectively. The values in the substratum (C_4) are higher than the others horizons.

However, profile (4), representing recent soil Entisols has high horizon index values in all horizons (0.12, 0.18, 0.12 and 0.39 for the C_1, C_2, C_5 and C_4 respectively). Based on all investigated properties Table (8), this may be related to its soil type (Typic Torriorthents, fine loamy, mixed, hyperthermic).

Profiles 2, 12 and 7 representing Entisols have moderate horizon index values in all horizon, based on all investigating properties (Table 8).

This may be related to its soil type (Typic Torriorthents, fine loamy over sand, mixed, hypothermic), (Typic Torriorthents, sand over Fine loamy, mixed, hypothermic) and (Typic Torriorthents, sandy, mixed, hyperthermic) are (0.20, 0.28, 0.19 and 0.13), (0.12, 0.22) and (0.14, 0.13 and 0.14) for C_1, C_2, C_3, and C_4 horizons, respectively.

The horizon index values of the Entisols (Typic Torripsamments, mixed, hypothermic) representing by profile No11 are low: 0.10, 0.15 and 0.13 for the C_1, C_2, and C_3 respectively. Eaolian deposits are dominant throughout the profiles.

From the discussion presented her it may be concluded that the Entisols (Vertic Torriorthents) has an impact on the development for soil profiles. The results reflect the medium soil formation processes under the prevailing aridic conditions.

Table (7): The field properties of profile No. (6) quantified and combined into the development index.

Quantified soil field properties				
	C_1	C_2	C_3	C_4
Texture	90	90	90	90
Rubefication	20	10	20	50
Structure	30	30	45	45
Dry consistence	40	40	40	40
Moist Consistence	10	40	40	40
Melanization (value)	60	80	80	50
pH	0.5	0.5	0.5	0.2
Normalized data				
Texture	0.60	0.60	0.60	0.60
Rubefication	0.20	0.10	0.20	0.40
Structure	0.50	0.50	0.80	0.80
Dry consistence	0.40	0.40	0.40	0.40
Moist Consistence	0.10	0.40	0.40	0.40
Melanization (value)	0.75	1.00	1.00	1.00
pH	0.06	0.06	0.06	0.03
Sum normalized properties	2.61	3.06	3.46	3.63
Divided by number of properties	0.37	0.44	0.49	0.52
Multiply by horizon thickness	5.55	11.00	9.80	46.8

Sum Horizon products profile development.
Profile Development Index = dev. Ind./cm.
Profile Development Index (For 100 cm) %.
Divided by profile thickness.

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

Profile No.		Horizon Distinguished			
		C_1	C_2	C_3	C_4
12	HI	0.12	0.22	-	-
	PDI	20.7 For profile (21)			
	PDI	0.17 cm			
	PDI (For 100 cm)	17 %			
6	HI	0.37	0.44	0.49	0.52
	PDI	73.15	For profile (6)		
	PDI	0.49 cm			
	PDI (For 100 cm)	49 %			
2	HI	0.20	0.28	0.19	0.13
	PDI	28.95	For profile (2)		
	PDI	0.19 cm			
	PDI (For 100 cm)	19 %			
7	HI	0.14	0.13	0.14	-
	PDI	20.7	For profile (7)		
	PDI	0.14 cm			
	PDI (For 100 cm)	14 %			
4	HI	0.12	0.18	0.12	0.39
	PDI	38.7	For profile (4)		
	PDI	0.26 cm			
	PDI (For 100 cm)	26 %			
11	HI	0.10	0.15	0.13	-
	PDI	19.2	For profile (11)		
	PDI	0.13 cm			
	PDI (For 100 cm)	13 %			

HI = Horizon index.
PDi= Profile development index.

CONCLUSION

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

The relative horizon distinctness (RHD) ratings is increased by increasing the soil development, since the recent soils Entisols have little distinctness.

The relative profile development (RPD) ratings is else increased by increasing soil development. The RPD rating averages for the Entisols (11.7 in vertic Torriorthents), (18, 11.7, and 19 in Typic Torriorthents) and (5.5 in Typic Torripsamments).

The horizon index values of the quantitative method varied with the soil formation processes and soil development, these are 73.15 in vertic Torriorthents but 38.7, 28.95, 20.7 and 20.7 in Typic Torriorthents while 19.2 in Typic Torripsamments.

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استخدام الوصف المورفولوجى فى تقييم تطور أراضى الواحات الخارجة

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تهدف هذه الدراسة إلى تقدير وتقييم التغيرات فى بعض أراضى الواحات الخارجة باستخدام معدل التغير فى الخواص المورفولوجية والمقترح بواسطة (١٩٧٧) Bilzi and Ciolkosz (1977) وقد فحصت إثنتا عشر قطاعاً سبعه منها تمثل هذه الدراسة.

وقد قدرت درجه الوضوح النسبى للآفاق (RDH) وتطور القطاع الأرضى (RPD) كما تم حساب قيم Profile index من قيم Horizon index وذلك بطريقه المعامل الكمى للقطاع Quantitative profile.

أوضحت النتائج أن الوضوح النسبى للآفاق (RHD) فى الطبقات تراوحت ما بين ٣-١٠ و ٧-٢٠ و ١١-١٢ و ١٩ و ٩-١١ و ٣-٥ أما التطور النسبى للقطاع (RPD) فكان ٩-١٤ و ١٧-١٩ و ٩-١٥ و ١٢-١٦ و ٣-٧ فى أراضى Vertic Torriorthents وأراضى Typic Torriorthents وأراضى Typic Torripsamments على الترتيب.

وقد وجد أن قيم RHD تتوافق مع قيم RPD وقيمه Profile index التى أظهرت الإختلاف الواضح فى الأراضى الحديثة الممثلة فى أراضى

Vertiv Torriorthents, Typic Torriorthents and Typic Torripsamments

وقد أظهرت النتائج أن الأراضى Vertic Torriorthents and Typic Torriorthents عالية التطور أكبر من الأراضى الأخرى Typic Torripsamments.