

PLANT AND SOIL RELATIONSHIPS IN THE NORTH-EASTERN DESERT, EGYPT

Abd El-Fattah, R.I. and A.M. Dahmash

Botany Department, Faculty of Science, Zagazig University, Egypt.

The present study analysis the plant-soil relationship in the North-Eastern Desert of Egypt. Fifty stands were examined and the matrix of 15 species x50 stands based on species cover data, was classified using Two Way Indicator Species Analysis (TWINSpan) and ordinated using Detrended Correspondence Analysis (DCA). Three vegetation types were generated after the application of TWINSpan technique. These groups are named after the dominant perennial species as follows: *Alhagi maurorum* (Medio), *Tamarix nilotica* (Ehrenb) Ege, *Zygophyllum coccineum* (L), *Halocnemum strobilaceum* (M. Bieb) as well as, *Parkinsonia aculata* (L). The association of dominant perennials with certain soil variables, the sand, particles moisture content, capacity, porosity, calcium carbonate content organic carbon, pH, chlorides, sulphates, T.S.S., K^+ , Ca^{++} and Fe^{+++} were assessed. Some species are dominant in the study area namely *Alhagi maurorum*, *Cressa cretica* (L), *Zygophyllum coccineum*, *Halocnemum strobilaceum*, *Calotropis procera* (R.Br.) and *Ochradenus baccatus* (Del.). Most vegetation types occur on deep sandy deposits, with coarse and fine sands. *Halocnemum strobilaceum*, *Cressa cretica* and *Nitraria retusa* (L) dominate on saline areas. Some ecological conditions supporting the various vegetation types are described.

Keywords: eastern desert, soil, elements, soil texture, desert plants

The Eastern Desert consists essentially of back bone of high and rugged mountains running parallel to the Red Sea coast (Said, 1962 and NBU 1993).

The geology of the area to the east of Cairo was outlined by Abd El-Daiem (1971). Quaternary strata cover the major part of the area and are dominant in the Nile Valley and adjacent plains and in the courses of the main wadis. These strata have a maximum thickness of about 240 m and are developed into aeolian sands as well as into fluvial sands and gravels.

A detailed account of the vegetation types of the Red Sea coastal land of Egypt was given by Kassas and Zahran (1962, 1967 and 1971) and

Zahran (1962, 1964, 1965 and 1977). These studies show that coastal land is organized ecologically into three principal systems; coastal salt marsh, coastal desert plain and coastal mountains. Ecological conditions: tidal and wave ebb and flow movement, sea spray, salt water seepage, character of surface sediments and substratum, land relief, local, and microclimates, etc. are the main factors that limit the type and extent of the plant cover in each system.

Chamberlin (1975) demonstrates that plant community are better indicators than individual species for habitat conditions. The one distinctive feature of most plants growing in arid environments is that they accumulate an increased amount of low molecular weight water soluble solutes in their cells. This process is known as osmotic adjustment (Masarrat *et al.*, 1996). The compounds utilized for osmotic adjustment and the pattern by which their concentrations change in saline and drought-stressed plants have been discussed in a number of reviews (Stewart and Ahmad, 1983; Wyn Jones and Gorham, 1983). Smirnov and Stewart (1985) conclude that the increase in proline content in some plant species reflects increasing salt or drought stress. Moreover, Masarrat *et al.* (1996) showed that carbohydrate content varied significantly among species in the different habitats. Moreover, species growing in water stressed habitat have higher carbohydrates than those of other habitats.

The present work aims to develop data on the soil ecological ranges of some dominant plant species in the Eastern Desert of Egypt. The physiological behaviour of these species in the different habitats is demonstrated. The present study dealt with the size frequency distribution of five common shrubs in the study area. The dominant perennial plant species in the Eastern Desert (from Fayed to Al Ain El-Sokhna) is identified, using two techniques of multivariate analysis (TWINSPAN and DCA). The effect of soil factors on species diversity and bundance of the identified vegetation types are assessed.

The Study Area

The study area lies in the North Eastern Desert of Egypt (30° 30' N long. and 32° 15' E latit., Fig. 1). The Meteorological data illustrated in table (1) shows:

- 1- The mean maximum air temperatures vary from 18.5°C to 36.2°C in January and August, respectively. The mean minimum air temperatures vary from 7.5°C to 20.9°C, respectively.
- 2- The monthly mean values of relative humidity differ from 64.7% (December), to 49.6% (May).
- 3- Wind velocity in the study area is generally light. The average wind velocity ranges from 9.5 km/hr in April to 6.3 km/h in December.
- 4- Evaporation rate ranges between 6.0 mm/day in December and 13.2 mm/day in June.

- 5- Most of the rainfall occurs during November to March. Summer is virtually dry. The mean value was 6.7 mm in February while the lowest value was 2.2 mm in March.

TABLE (1). Seasonal fluctuation of climatic factors at the Suez Province. (Average of 6 years from 1983 to 1988). Data obtained from Metriological Department, Cairo.

Parameters Months	Temperature (°C)			Relative Humidity %	Wind velocity km/hr.	Evaporati on mm/day	Rainfall (mm)
	Mean Max.	Mean Min.	Mean Monthly				
January	18.5	7.5	12.88	62.50	7.80	5.70	6.73
February	19.96	7.8	13.8	56.90	8.73	7.55	2.60
March	22.90	9.85	16.29	22.45	9.40	8.46	2.15
April	27.31	13.20	20.20	49.00	9.53	11.13	0.00
May	31.55	16.70	24.09	47.60	9.13	12.64	0.00
June	34.04	19.30	26.54	50.00	9.10	13.10	0.00
July	34.28	20.24	27.05	53.13	8.07	11.80	0.00
August	36.21	20.75	27.06	28.48	8.23	10.88	0.00
September	33.00	19.70	25.64	59.83	8.45	10.30	0.00
October	28.36	15.95	21.97	26.20	7.45	8.31	0.00
November	24.11	12.60	18.28	26.60	6.50	6.58	2.60
December	19.39	8.08	13.61	64.68	6.30	5.25	5.23
Mean Ann.	33.07	17.2	24.8	54.7	9.87	11.17	1.901

MATERIALS AND METHODS

Six locations were selected in the Eastern Desert (from Fayed to Al Ain El-Sokhna) (Fig. 1). Each location has a reasonable degree of habitat and plant cover homogeneity, *i.e.* dominated by one species were chosen.

Soil Analysis

A composite soil sample was collected from each stand as a profile of 45 cm depth. Soil was air dried and passed through a 2 mm sieve and stored in paper bags. Physical and chemical analysis of soil properties were determined following Piper (1947), Rietmeire (1951), Johnson and Ulrich (1959) and Jackson (1962).

Vegetation Analysis

Fifty stands (10 x 10 m each) were distributed in the study area. These stands covered the main physiographic variations of the region. In selecting each stand, care was taken to ensure reasonable degree of physiographic and physiognomic homogeneity. Stands were located from Fayed to Al Ain El-Sokhna during the years 1997, 1998 and 1999 and mean values obtained.

A count-floristic list was carried out for each stand. Relative frequency density and relative cover for perennial species were determined by using the quadrats method (Misra, 1980). The sum of the relative

Absolute Density (A.D.) = Total Number of plant species in studied quadrats $\times$ 100 / Total Number of quadrats studied $\times$ area of quadrat.

Absolute Cover (A.C.) = Total area cover of plant species $\times$ 100 / Number of quadrats used $\times$ Area of quadrat.

Relative Frequency (R.F.) = Absolute frequency of a species $\times$ 100 / Total absolute frequency of all species.

Relative Density (R.D.) = Absolute density of a species $\times$ 100 / Total absolute density of all species.

Relative Cover (R.C.) = Absolute coverage of a species $\times$ 100 / Total absolute coverage of all species.

Importance value = Relative Frequency + Relative Density + Relative Coverage. i.e. I.V. = R.F. + R.D. + R.C.

Nomenclature was done according to Tackholm (1974). Similarity between different stands was assessed using a Two-Way Indicator Species Analysis (TWINSPAN). The Detrended Correspondance Analysis DCA was used as an ordination method following the procedure of Hill (1979b).

Plant Analysis

The plant material was collected during the years of 1997, 1998 and 1999 and was washed under running tap water, followed by distilled water. Plant shoots were divided into two portions for each year. One portion was used for determination the chlorophyll content (Metziner *et al.*, 1965), proline (Bates *et al.*, 1973) and relative water content (Turner, 1981). Water content was done using the following equations:

$$\text{Water content (\%)} = [(\text{Fresh weight} - \text{dry weight}) / (\text{dry weight})] \times 100$$

The other portion was oven dried with circulating air at 70°C and then ground. The dried powdered sample was extracted with hot ethyl alcohol-distilled water to determine the carbohydrates fractions (Naguib, 1963 and 1964). The degree of succulence was calculated as a fresh weight/dry weight ratio following Dehan and Tal (1978) and ash elemental composition (Ward and Johnson, 1962) for each year.

RESULTS

Soil Analysis

Soil characteristics exhibit a wide range of variation through different localities (Table 2), habitats classified into three groups (A, B and C) according to soil character as in table (2). Soil texture revealed that sand was the dominant fractions in all localities. Soil supporting vegetation group (A) has the highest value of porosity (53.2%), medium sand content (51.1%), water holding capacity (36.5%), coarse sand (26.3%), calcium carbonate (17.3%) and fine particles (16%) but the lowest of sulphates (0.3%). Group (B) has the lowest value of sulphates (0.2%), porosity (48.7%),

medium sand (47.6%), coarse sand (35.1%), water holding capacity (31.7%) and calcium carbonate (15.7%). Water holding capacity (41.1%), porosity (25.1%), calcium carbonate (17.5%) and K (16.5%) but the lowest value of chlorides (0.3%).

TABLE (2). Mean and standard deviation of the soil variables recorded in different TWINSpan groups.

Edaphic factors	TWINSpan group		
	A	B	C
% coarse sand	26.3±8.9	35.1±8.3	11.7±1.3
% medium sand	51.1±2.7	47.6±5.5	55.7±3.7
% fine sand	12.6±5.1	8.7±.1	22.8±5.2
% fine particles	16.0±5.3	7.0±3.3	13.5±3.8
% moisture content	8.3±1.5	10.1±5.4	11.1±6.8
% water holding capacity	36.5±4.8	31.7±10.3	41.1±2.5
% porosity	53.2±9.8	48.7±7.7	25.1±2.6
% calcium carbonate	17.3±1.6	15.7±1.1	17.5±1.5
% organic carbon	0.9±0.1	1.1±0.2	0.4±0.1
pH	7.6±0.3	7.5±0.2	7.1±0.2
% chlorides	0.4±0.2	0.5±0.3	0.3±0.1
% sulphates	0.3±0.1	0.2±0.1	0.5±0.1
% TSS	1.7±0.9	1.6±0.6	1.5±0.6
K mg/g air dry soil	8.6±2.6	13.4±4.8	16.5±2.1
Ca mg/g air dry soil	4.1±0.7	5.1±0.5	5.2±0.1
Fe mg/g air dry soil	1.5±0.6	3.5±1.6	0.9±0.2

Vegetation Analysis

Table (3) shows the floristic composition of plant communities in some localities in the Eastern Desert from Fayed to El Ain El-Sokhna (Fig. 1). Three vegetation groups (VG) were generated at the division of TWINSpan (Fig.2). The results of application of DCA indicates a reasonable segregation among these groups along the ordination plane of axes (1) and (2) as shown in fig. (3). The dendrogram resulting from the group analysis of stand representing the study area, shows three vegetation groups (Fig. 3,4,5 and Table 2). Group (A) has one stand dominated by *Alhagi maurorum* (IV=212.65/300). Group (B) compares three stands (2,3 and 4), where stand (2) dominated by *Tamarix nilotica* (IV = 175.24%), stand (3) dominated by *Zygophyllum coccineum* (IV = 236.38%) and stand (4) dominated by *Halocnemum strobilaceum* (IV = 89.8%). Group (C) has one stand dominated by *Parkinsonia aculata* (P = 100%).

TABLE (3). Average importance values (IV) (out of 300) of the perennial species in the five vegetational groups resulting from the TWINSpan technique. Repetition of some species in more than one vegetational group indicates the overlap of species distribution in the Eastern desert (from Fayed to Ain El-Sokhna) species are arranged in every group in descending order to the importance value P=presence.

Species	IV	Species	IV	Species	IV	Species	IV	P(%)
Group A		Group B		Group C				
Stand I (Group I)		Stand 2		Stand 3		Stand 4		
<i>Alhagi maurarum</i>	212.65	<i>Tamarix nilotica</i>	175.24	<i>Zygophyllum occineum</i>	236.38	<i>Halocnemum strobilaceum</i>	78.70	100
<i>Cressa cretica</i>	61.17	<i>Alhagi monrorum</i>	66.32	<i>Ochradenis baccatus</i>	57.96	<i>Alhagi maurarum</i>	89.8	80
<i>Tamarix nilotica</i>	26.32	<i>Cressa cretica</i>	50.24	<i>Acacia chrenbergiana</i>	5.47	<i>Nitraria retusa</i>	63.66	70
		<i>Zygophyllum coccineum</i>	8.22			<i>Cressa cretica</i>	34.02	70
						<i>Zygophyllum coccineum</i>	33.8	60
								50
								50
								30
								30

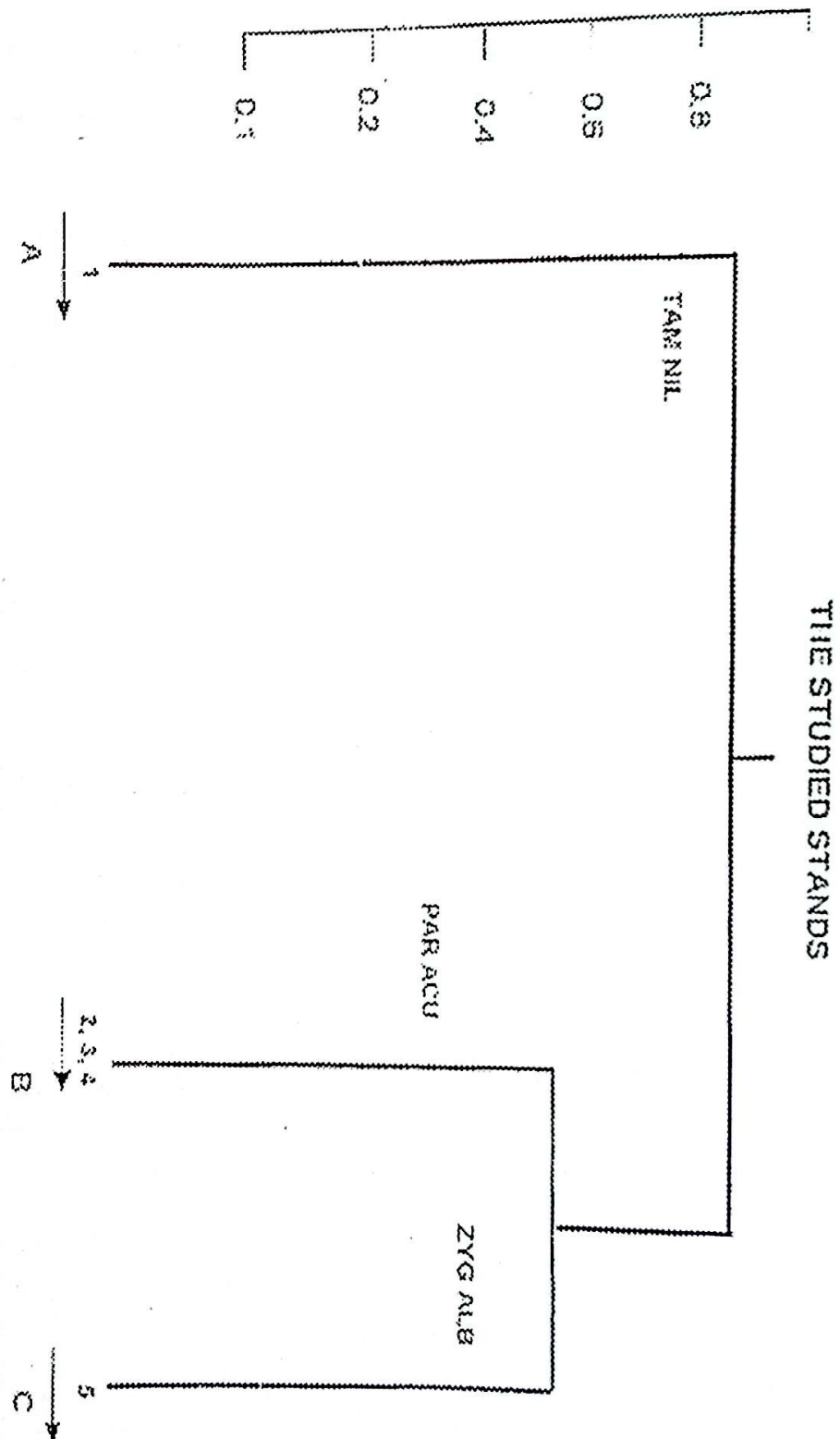


Fig. (2). TWINSpan dendrogram of the studied stands based on presence values of 15 species. Indicator species are abbreviated to the first three letters of the names.

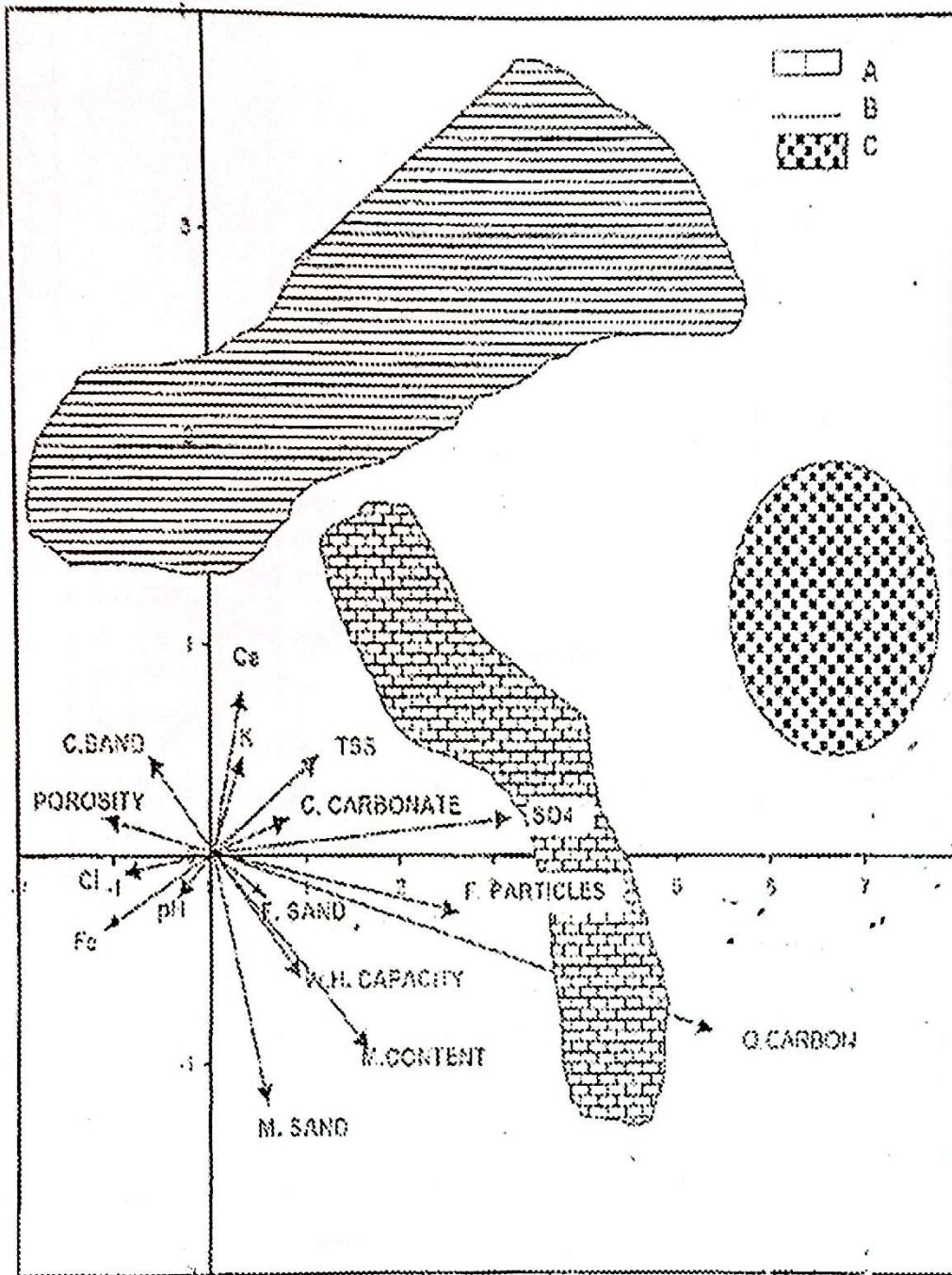


Fig. (3). DCCA ordination of the studies stands with TWINSpan groups superimposed and environmental factors.

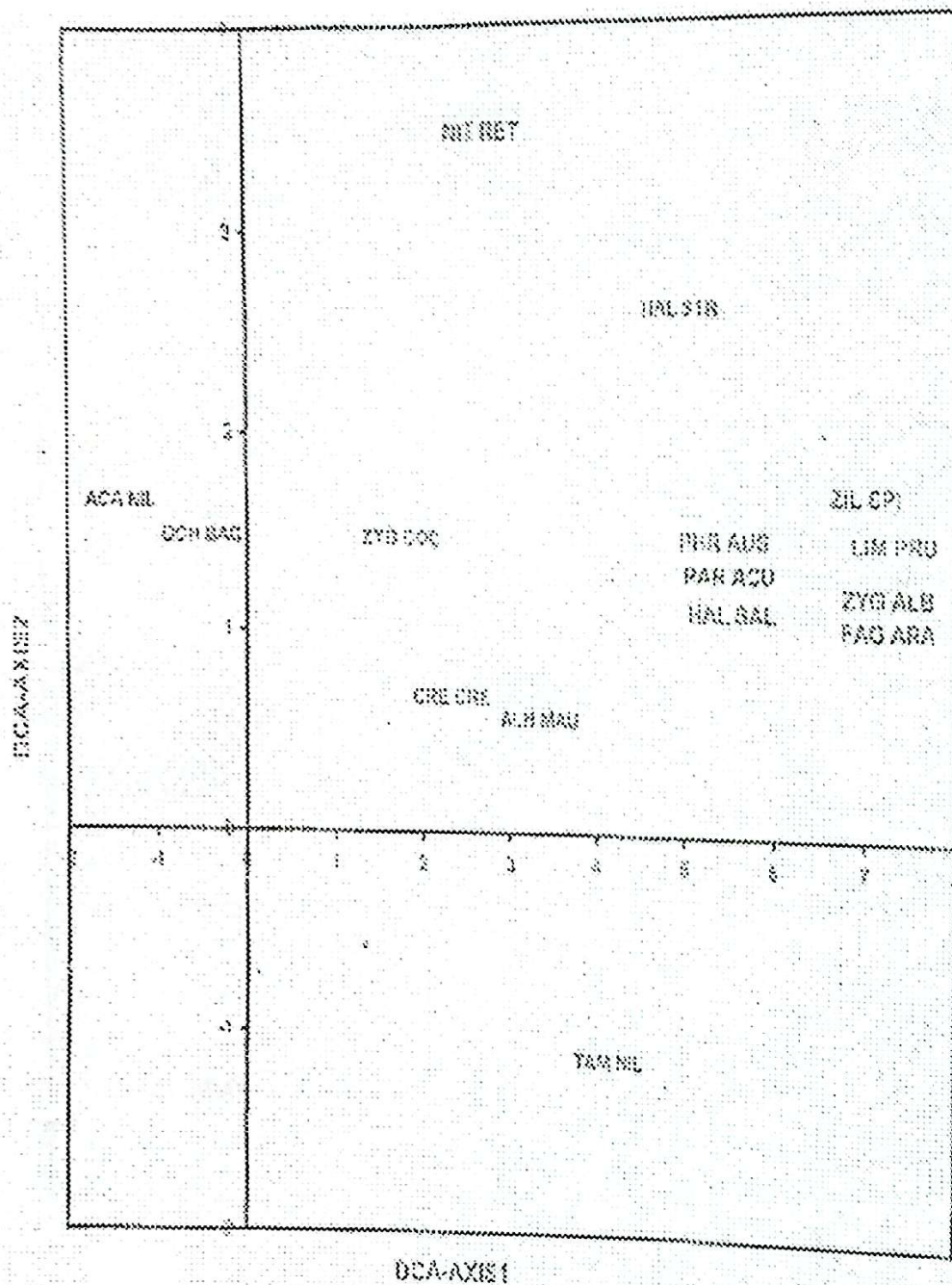


Fig. (4). DCA ordination of 15 species, with the names abbreviated to the three first letters of the genus and species.

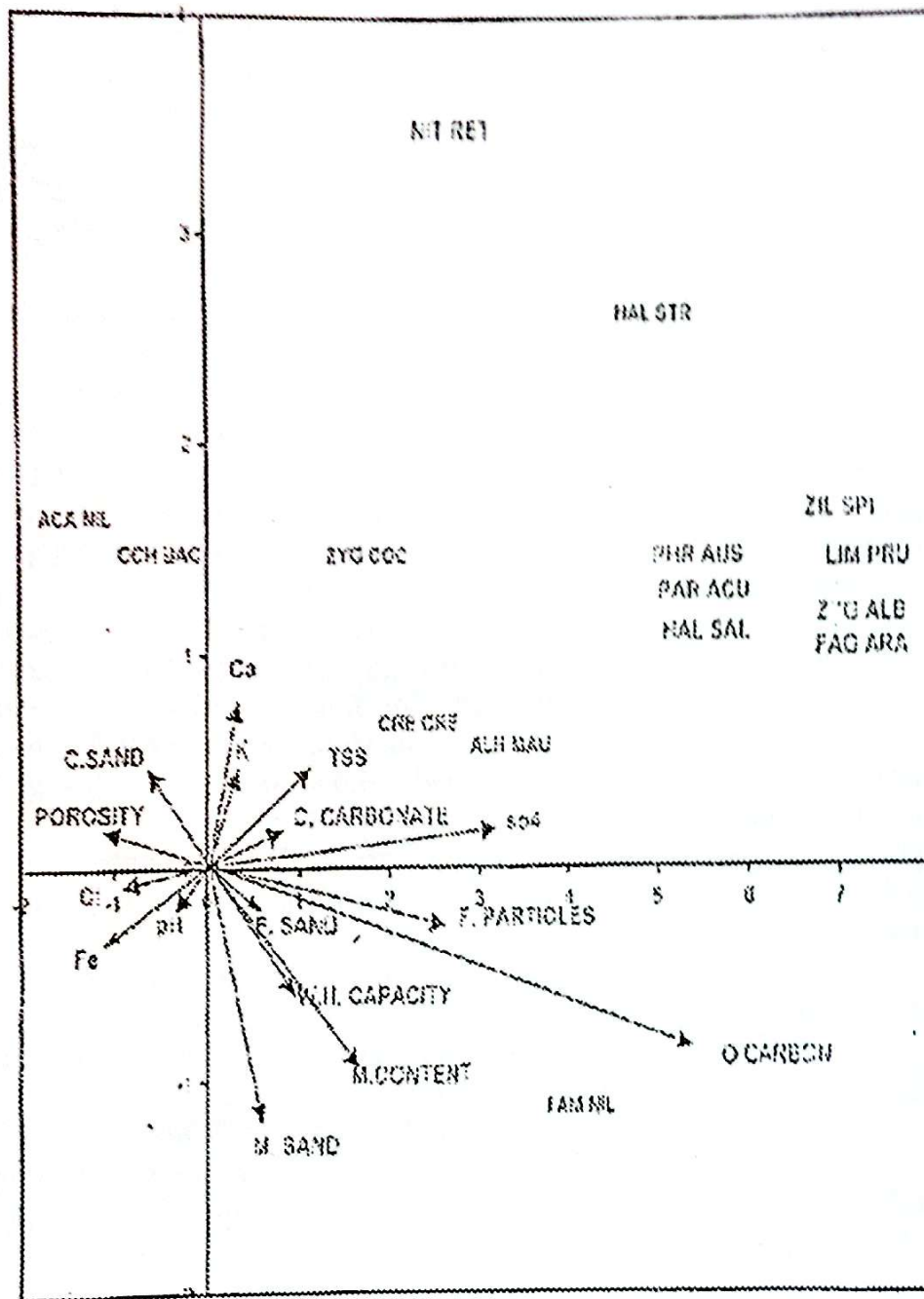


Fig. (5). DCCA species - environment biplot, with arrows and points indicating environmental factors and species respectively.

Plant Analysis

Plant analysis is shown in table (4). Results demonstrate variation in the water content, ash content and mineral ion content of shoots of the dominant species in the different habitats. Water content values ranged from 107.20 to 687.71%. The highest value of water content (687.71%) was recorded in *Calotropis procera*, while the lowest value (107.20%) was recorded in *Cressa cretica*. The relative water content varied from 56.88 to 87.09%.

The highest succulence value (7.88) was recorded in *Calotropis procera*, while the lowest succulence (2.07) was in *Cressa cretica*. The total ash content was high in the dominant species in all localities and ranged between 6.50 in *Halocnemum strobilaceum* and 33% in *Nitraia retusa*.

Chlorophyll content was generally low in most species. The pigment content varied from 0.117 to 0.299 mg/g fresh weight for chlorophyll (a) amounted. The highest value of chlorophyll (a) was 0.299 mg/g, fresh weight was recorded in *Cressa cretica*, while the lowest value of 0.117 mg/g, fresh weight was recorded in *Halocnemum strobilaceum*. The values of chlorophyll (b) ranged between 0.081 and 0.287 mg/g fresh weight. The highest value of chlorophyll (a) and (b) were recorded in *Ochradenus baccatus*, while the lowest value found in *Halocnemum strobilaceum*. The highest value of carotenoids amounted 0.048 mg/g, fresh weight was recorded in *Ochradenus baccatus* and the lowest value of 0.018 mg/g, fresh weight was found in *Zygophyllum coccineum*. The chlorophyll a/b ratio ranged between 1.04 in *Ochradenus baccatus* and 1.44 in the *Halocnemum strobilaceum*.

The total soluble sugars ranged between 1.53 and 8.98 mg/g dry weight (Table 4). The highest value of 8.98 mg/g dry weight soluble sugars was found in *Cressa cretica*, while the lowest value of soluble sugars 1.53 mg/g dry weight was found in *Zygophyllum coccineum*.

The proline content varied from 0.002 and 0.09 mg/g fresh weight. The highest level of proline content amounted 0.09 mg/g fresh weight was recorded in *Ochradenus baccatus*, while the lowest value of 0.002mg/g fresh weight was recorded in *Zygophyllum coccineum*.

DISCUSSION

Three vegetation types were generated after the application of two way indicator species analysis (TWINSPAN: Hill, 1979a) to the abundance of 15 species in 50 stands. The application of detrended correspondence analysis (DCA: Hill, 1979 b) to the same set of data supports the distinction between the three vegetation groups. Vegetation types are dominated by: *Alhagi maurorum*, *Tamarix nilotica*, *Zygophyllum coccineum*, *Halocnemum strobilaceum* and *Parkinsonia aculata*.

TABLE (4). Variations in water content (WC), relative water content (RWC), succulence, chlorophyll content, total soluble carbohydrate TSC), proline content and total ash content in leaves collected from the Eastern Desert + standard error.

Locality and species	WC%	RWC%	Succulence	Chlorophyll content mg/g fresh weight				TSC mg/g dry weight	Proline mg/g fresh weight	Total ash content %
				Chlorophyll a	Chlorophyll b	Carotenoids	Chlorophyll A/b ratio			
<i>Cressa cretica</i>	107.2 +2.5	56.85 +0.161	2.078 +0.9	0.299 +0.003	0.271 +0.001	0.060 +0.001	1.10 +0.30	8.98 +0.059	0.01 +0.0002	19.5 +0.118
<i>Zygophyllum coccineum</i>	385.60 +4.1	79.85 +1.09	4.86 +0.87	0.175 +0.0012	0.142 +0.001	0.018 +0.002	1.23 +0.12	1.53 +0.034	0.002 +0.0008	30.50 +0.271
<i>Halocnemum strobilaceum</i>	179.38 +3.2	71.63 +0.19	2.79 +0.55	0.117 +0.0013	0.081 +0.003	0.013 +0.002	1.44 +0.43	4.71 +0.042	0.006 +0.0016	33.00 +0.41
<i>Calatropis procera</i>	687.71 +5.9	87.09 +0.112	7.88 +0.68	0.198 +0.002	0.146 +0.001	0.033 +0.004	1.36 +0.20	1.56 +0.306	0.02 +0.002	13.00 +0.028
<i>Ochradenus baccatus</i>	158.31 +2.4	58.16 +0.19	2.58 +0.45	0.298 +0.0005	0.287 +0.002	0.048 +0.001	1.04 +0.25	3.89 +0.099	0.09 +0.0009	6.50 +0.066
<i>Nitraria retusa</i>	250.29 +1.9	57.37 +0.112	3.50 0.46	0.20 +0.0012	0.160 +0.0002	0.02 +0.002	1.25 +0.6	8.17 +0.033	0.018 +0.0007	6.50 +0.041

Plant communities are affected by the fine sediments which may retain seeds stem or root fragments and specialized organs such as tubers or turions (Khedr and Hegazy, 1998).

The vegetation of the Eastern Desert is less prominent as a component of the plant cover than of other phytogeographical regions of Egypt. The soil is mainly formed of coarse sand and may develop in certain localities of high salinity. The underground water is deep. The distribution of the community types within the surveyed area is mainly affected by soil attributes and the ability of species to adapt themselves against the prevailing conditions (Shams and Abd El-Fattah, 1989). Kassas and Imam (1957) stated that the desert landforms cause concentration of available water in favoured areas, where the plants may live. They added that this is one aspect of microhabitat phenomena.

Several investigators stated that the shortage in soil moisture was the most effective environmental factor affecting the pattern of plant growth in desert habitat (Johns, 1984; Watkinson, 1985; Ayyad and Ghabbour, 1986; Willams and Hobbs, 1989 and Abd El-Fattah, 1994). Microhabitats influence the local distribution of plants and floristic composition of the community types. Moreover, species of desert plants differ in their association amplitude according to microhabitat (Kassas and El-Abyad, 1962).

The study of floristic composition of plant communities in the different localities may provide an indicator of soil salinity, soil moisture content and soil reaction as well as the behavior of the dominant species in this habitat (Abd El-Fattah, 1994).

Under the conditions of the surveyed area, *Alhagi maurorum* is species of the wide ecological amplitude and sociological range. The species is recorded in 80% of community types. *Tamarix nilotica*, *Zygophyllum coccineum* and *Cressa cretica* are sub-dominant species recorded in 60% of the communities types. The other species have presence value of 20%.

It would appear from this study that species of different localities in the Eastern Desert are subjected to large variation in edaphic factors, especially CaCO_3 , moisture content and total soluble salts. These factors exhibit a wide range of variation between the different localities than other soil characteristics. Variation in these edaphic factors demonstrates species variation in different localities in arid zones (El-Ghonemy, 1966 and 1974).

It has been demonstrated by Rozema *et al.* (1983 and 1985) that the decrease in the maritime influence along the transect of the area has an impact on the vegetation composition and nature of characteristic species, and this is confirmed by the present study. However, the data also indicate that the decrease in salinity, plays a key role in the replacement of one species by another along the transect. This has also been suggested by Joenje (1978).

The present study demonstrates the highest percentage of medium sand in soils of *Parkinsonia aculata*, total soluble salts and organic carbon in soils of *Halocnemum strobilaceum*, while the lowest percentage of medium sand in soils of *Halocnemum strobilaceum*, total soluble salts in soils of *Calotropis procera*. *Cressa cretica* tends to concentrate greater amounts of certain metabolic components in shoot. This may indicate that the plant is subjected to greater environmental stress. Vegetation surveys (Abd El-Rahman and El-Monayeri, 1967) indicate that the species is confined to sandy coastal soils which are calcareous, poor in organic carbon, fairly alkaline, and with very low values of water soluble salts. Leaf water content, chlorophyll and pH were higher.

The total soluble sugars attained the highest values in *Cressa cretica* followed by *Nitraria retusa*, while the lowest value was attained in species of more xeric habitats (*Zygophyllum coccineum*).

Turner and Kramer (1980) and Pitman (1980) reported that water deficits in plants brought about by higher soil moisture tension, greatly modify their metabolic products. Increased translocation of carbohydrates into shoots or decrease in carbohydrates from shoots could also contribute to other in sugar accumulation (Munns *et al.*, 1979).

Several attempts have been made to use proline accumulation to evaluate tolerance or sensitivity of plants to stress (Stewart and Larher, 1980; Rozema *et al.*, 1983). Stress compatible solute, proline and carbohydrate contents were greater in the tissues. The habitats characterized by their high level of total soluble salts and CaCO_3 . Usually, the function of increased concentration of compatible osmotic solutes such as amino acids, proline and methylated quaternary ammonium compounds and polyols is assumed to prevent the inactivation of enzyme and other essential structures by salinity stress (Borowitzka, 1981; Wyn Jones and Storey, 1981).

It can be concluded that the plant cover used as indicator to habitat conditions as:

- a- The community dominated by *T. nilotica* associated with soil of fine particles.
- b- The community dominated by *P. aculata* associated with courser soil particles.
- c- The community dominated by *Z. album* associated with soil of high medium sand and K content.

REFERENCES

- Abd El- Daiem, A. M. A. (1971). Hydrogeological studies of Springs in the area to the East of Cairo. *M.Sc. Thesis*, Univ. of Ain Shams, Cairo, 160 pp.

- Abd El-Fattah, R.I. (1994). Plant indicators to habitat conditions in Sharkiya Province. *Egypt. J. Bot.*, 34: 177-198.
- Abd El-Rahman, A.A. and M.O. El-Monayeri (1967). Contributions to the autecology of *ononis vaginalis*. *Phyton (Austria)*, 12: 228-251.
- Ayyad, M.A. and S.I. Ghabbour (1986). In "Ecosystems of the world 12B: Hot desert of Egypt and the Sudan, Hot Desert and Arid Shrablands", (Evenari, M. et al. ed.), Elsevier, Amsterdam. 149, 202.
- Bates, L.S.; R.P. Waldern and I.D. Teare (1973). Rapid determination of free proline for water stress studies. *Plant and Soil*, 39: 205-207.
- Borowitzka, L. (1981). In "Physiology and Biochemistry of Drought Resistance in Plants: Solute accumulation and regulation of cell water activity." (Paley, L.G. and D. Aspinall, eds), Academic Press, Sydney, p.97-104.
- Chamberlin, A.C. (1975). In "Vegetation and Atmosphere: The movement of particles in plant communities". (Monteith, J.L., ed.). Academic Press, New York., Vol.1 p. 155-203.
- Dehan, K. and M. Tal (1978). Salt tolerance of the wild relatives of the cultivated tomato: Responses of *Solanum penellii* to high salinity. *Irrigation Science*, 1: 71-82.
- El-Ghonemy, A.A. (1974). Sociological studies of the natural plant communities along a desert transect, 200 km long, between Alexandria and Cairo. III. Ecological relations of vegetation on siliceous and deposit north of Wadi El-Nutrun. *Egyptian Journal of Botany*, 19: 43-62
- El-Ghonemy, A.A. (1966). Soil vegetation relationship for some major plant communities in south-western New South Wales, *Ph.D. Thesis*, University of New England, Australia.
- Hill, M.O. (1979a). DECORANA-A FORTRAN program for detrended correspondence analysis and reciprocal averaging. Cornell Univ., Ithaca, NY., 52 pp.
- Hill, M.O. (1979b). TWINSPLAN-A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Cornell Univ., Ithaca, NY, 90 pp.
- Jackson, M.L. (1962). In "Soil chemical analysis". Constable and Co. LTD. London.
- Joenje, W. (1978). Plant colonization and succession on embanked sand flats: A case study in the Lauwerzeepolder, Netherlands. *Ph.D. Thesis*, University Groningen.
- Johns, G.G. (1984). Soil water storage in a semi-arid *Eucalyptus populnea* woodland invaded by woody shrubs and the effects of shrub clearing and tree ringbarking. *Australian Rangeland J.*, 6:75.

- Johnson, C.M. and A. Ulrich (1959). In "*Analytical methods for use in plant analysis*". U.S. Dept. Agric., Calif. Univ. Agric. Inform., Bwll. 766.
- Kassas, M. and M.A. Zahran (1971). Plant life on the coastal mountains of the Red Sea Egypt. *Ind. Bot. Soc. Golden Jubilee*, 50A: 571-589.
- Kassas, M. and M.A. Zahran (1967). On the Ecology of the Red Sea littoral salt marsh, Egypt. *Ecol. Mong.*, 37 (7): 287-316.
- Kassas, M. and M.S. El-Abyad (1962). On the phytosociology of the Desert Vegetation of Egypt. *Ann. Arid Zone*, 1:54-83
- Kassas, M. and M.A. Zahran (1962). Studies on the Ecology of the Red Sea coastal land I. The district of Gebel Ataq and El-Galala El-Bahariya. *Bull. Soc. Geogr. D'Egypte*, 35: 129-175.
- Kassas, M. and M. Imam (1957). Climate and microclimate in the Cairo desert. *Bull. Soc. Geogr. de Egypte*, 3:25-37.
- Khedr. A.A. and A.K. Hegazy (1998). In "*Ecology of the rampant weed Nymphaea lotus L. Willdenow in natural and rice field habitats of the Nile delta, Egypt*". Kluner Academic Publishers Prints in the Netherland, *Hydrobiologia*, 386: 119-129.
- Masarrat, M. Migahid; Sania A. kamal and Laila A. Sadek (1996). Ecophysiological adaptation of some species in the Mediterranean Desert of Egypt. *Journal of Arid Environments*, 34: 11-21.
- Metziner, H.; H.J. Rauh and H. Senger (1965). Untersuchungen zur synchronisierbarkeit einzelner pigmentmangelmulanten von chlorella. *Planta*, 65: 186-194.
- Misra, R.C. (1980). In "*Ecology work book*". Oxford & IBH Pub. Co., New Delhi, Bombay, India.
- Munns, R.; C.J. Brady and E.W.R. Barlow (1979). Solute accumulation in the apex and leaves of wheat during water stress. *Aust J. Plant physiol.* 6:379-389.
- Naguib, M.I. (1964). Effect of serine on the carbohydrate and nitrogen metabolism during germination of cotton seeds. *Ind. J. Exp. Biol.*, 2: 149-152.
- Naguib, M.I. (1963). Colourimetric estimation of plant polysaccharides. *Zucker*, 16: 15-18.
- NBU (1993). Habitat Diversity. National Biodiversity Unit, Egyptian Environmental. Affairs Agency, No. 1.
- Piper, C.S. (1947). In "*Soil and plant Analysis*". Adelaide Univ.
- Pitman, M.G. (1980). In "*Nutrient uptake and water stress*". Academic Press. New York.
- Rietmeire, R.F. (1951). Soil potassium, *Adv. Agron.*, 3:113.
- Rozema, J.; P. Bijwaard; G. Prast and R. Brockman(1985). Ecophysiological adaptations of coastal halophytes from for edunes and salt marshes. *Vegetatio*, 62: 499-521.

- Rozema, J.; Y. Maanen; H. Vugts and A. Leusink (1983). Air-borne and soil-borne salinity and the distribution of coastal and inland species of the genus *Elytrigia*. *Acta Botanica*, 32: 447-456.
- Said, R. (1962). In "*Geology of Egypt*". Elsevier, Amsterdam, 378 pp.
- Shams, H.M. and R.I. Abd El-Fattah (1989). Ecological studies on the salt marsh ecosystem of Salhyia Area, Sharkia Province, Egypt. *Desert Inst. Bull., A.R.E.*, 39 (Supl.): 505-531.
- Smirnoff, N. and G.R. Stewart (1985). In "*Ecology of coastal vegetation: Stress metabolites and their role in coastal plants*". (Beefink, W.G.; J. Rozema and A.H.L. Huiskes eds). *Vegetatio*, 61/62: 237-278.
- Stewart, G.R. and I. Ahmad (1983). In "*Metals and Micronutrient Uptake and Utilization by Plants: Adaptation to salinity in an angiosperm halophytes*". (Robb, D.A. and W.S. Pier-point eds), Academic Press, London. p33-50.
- Stewart, G.R. and F. Larher (1980). In "*The Biochemistry of Plants: Accumulation of amino acids and related compounds in relation to environmental stress*". (Stumpf, P.K. and E.E. Conn eds), Academic Press, New York, p. 609-635.
- Tackholm, V. (1974). In "*Student's flora of Egypt*". 2nd Ed., Cairo University. Cooperative Printing company Beriut, 888pp.
- Turner, N.C. (1981). Techniques and experimental approaches for the measurement of plant water status. *Plant and Soil*, 58: 339-366.
- Turner, N.C. and P.J. Kramer (1980). In "*Adaptation of plants to water and high temperature stress*". John. Willey and Sons, New York.
- Ward, G.M. and F.B. Johnson (1962). Chemical methods of plant analysis. *Canada Dept. Agric.*, 10: 1-59.
- Watkinson, A.R. (1985). On the abundance of plants along an environmental gradient. *J. Ecol.*, 73:569.
- Williams, K. and R.J. Hobbs (1989). Control of shrub establishment by spring time soil water availability in annual grassland. *Oecologia (Berlin)*, 81: 62.
- Wyn Jones, R.G. and J. Gorham (1983). In "*Encyclopedia of Plant Physiology: Osmoregulation*". (Lange, O.L.; P.S. Nobel; C.B. Osmond and H. Ziegler, eds). Springer Verlag. New York, p.35-58.
- Wyn Jones, R.G. and R. Storey (1981). In "*Physiological and Biochemistry of Drought Resistance in Plants: Betaines*". (Paleg, L.G. and D. Aspinall, eds). Academic press. Sydney, p.171-204.
- Zahran, M.A. (1977). In "*Wet coastal Ecosystem: Africa A. wet formation of the Africana Red Sea coast*". (Chapman V.J., ed.). Elsevier Scientific Publ Comp. Amsterdam, p.215-231.
- Zahran, M.A. (1965). Distribution of Mangrove vegetation in U.A.R. (Egypt). *Bull. Desert. Inst. Egypt.*, 15 (2): 7-12.

Zahran, M.A. (1964). Contributions to the study on the Ecology of the Red Sea Coast. *Ph.D. Thesis*. Fac. Sci., Cairo University, Egypt.

Zahran, M.A. (1962). Studies on the Ecology of the Red Sea Coastal Land. *M.Sc. Thesis*, Fac. Sci., Cario Univ., Egypt.

Received:07/08/2000

Accepted:08/04/2002

علاقة النبات بالتربة فى المنطقة الشمالية للصحراء الشرقية بمصر

رجب إبراهيم عبد الفتاح - عبده محمد دهمش
قسم النبات - كلية العلوم - جامعة الزقازيق - مصر

تهدف هذه الدراسة إلى التعرف على بعض الوحدات الرئيسية للكساء النباتى الطبيعى فى الصحراء الشرقية بين فايد والعين السخنة بغرض القاء الضوء على العوامل التى يحتمل أن تكون سبباً فى التوزيع النباتى فى هذه المنطقة وقد وجد أن هناك مجتمعات نباتية رئيسية يسودها *Alhagi maurorum* *Tamarix nilotica* *Zygophyllum coccineum* *Cressa cretica* *Halocnemum strobilaceum*, *Parkinsonia aculata* *Calotropis procera* and *Ochradenus baccatus* والتربة فى هذه المنطقة ذات طبيعة رملية مختلطة وخشنة فى الغالب وتتميز بملوحة عالية نسبياً فى بعض المواقع وأن الماء الجوفى على عمق كبير. وقد أمكن التعرف على الظروف البيئية لكل عشيرة كذلك السلوك السوسيوولوجى لكل نوع نبات سائد فى العشائر المختلفة، كذلك درس السلوك التأقلمى لكل نوع سائد، حيث وجدت اختلافات جوهريّة فى محتوى النباتات المدروسة "السائدة" فى كل من المحتوى المائى والمادة الحية كذلك فى الصبغات النباتية أيضاً. قدر محتوى النباتات من بعض المواد الأيضية وظهر أن هناك اختلافات كبيرة فى محتوى النباتات من الكربوهيدرات والبرولين. كشفت المعلومات عن أنسب البيئات لكل نوع نباتى كذلك مدى تحمل النبات ظروف البيئة الذى يوجد بها.