Delta J. Sci. 12 (2) 1988 650 - 675

VESICULAR-ARBUSCULAR MYCORRHIZAL ASSOCIATIONS OF SOME DESERT PLANTS ALONG THE MEDITERRANEAN COAST OF SINAI EGYPT

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Received: 11-4-1987

ABSTRACT

The natural vegetation along the Mediterranean coast of Sinai were sampled for mycorrhizal associations. Thirty-six of fifty-three species examined were colonized by vesicular-arbuscular (VA) mycorrhizal fungi. Soil sievings revealed chlamydospores of seven VA mycorrhizal Glomus spp.; G. microcarpum , G. fasciculatun, G.macrocarpum , G. mosseae, G. epigaeum, G. intraradices, and G. geosporum. At the time of sampling, the populations of VA fungal spores in the soil were low, with one to ten chlamydospores per 100 g soil sample. After invasion of the host cell (Melilotus indica) by VAM fungi (Glomus mosseae), a granulation occur at the penetration point of the cell wall. This is associated with the formation of a dense thickening or papilla on the inner cell wall.

INTRODUCTION

Vesicular-arbusscular (VA) mycorrhizal associations occur in most families of angiosperms and gymnosperms, and in many pteridophytes and bryophytes [10,27]. VA mycorrhizae have been shown to benefit the host plant by increas-

ing nutrient absorption [14,25] and by reducing internal resistance to water flow and water uptake [33,34]. The importance of VA mycorrhizal associations to agricultural and forest crops has been well documented, but associations in arid zone and wildland vegetation have received little attention (15,32,35,37,42). VA mycorrhizae may be advantageous to mycorrhizal desert plants where phosphorus exists as particularly insoluble calcium phosphate and diffusion of the ions in the soil is decreased by the low soil moisture [30]. Mycorrhizae are an important consideration in minimizing rangeland and arid-land productivity. The understanding of mycorrhizal associations of semi-arid, desert, and rangeland vegetation and the distribution of mycorrhizal fungi in the soil is necessary for wise management of these fragile habitats. Much of Egypt is arid or semi-arid [2,21] and its soils generally have low levels of nutrients, particularly phosphate [2,4,28].

Of the few surveys of mycorrhizas of plants from arid and semi-arid habitats [22,37,41] and natural communities [15,16]. To extend the information on mycorrhizal associations in the field, plants from semi-arid habitats along the Mediterranean coast of Sinai were examined for mycorrhizas.

MATERIALS AND METHODS

Description of the study area

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The study site chosen was a part of the eastern mediterranean coastal region of Egypt (coastal region of Sinai peninsula) Fig. 1. It extends for about 200 Km from Port Said to Rafah with an average depth of about 40 Km inland. A geomorphological description of the Mediterranean coastal region of Sinai peninsula characterized by two types of substrate predominate in this area, the sand and the salty soils of the salt marshes. Coarse-textured stable sand characterize the area in the west near the Suez Canal. The finer grains of sand which are constantly removed by wind accumulate in dunes of varying density, scattered throughout the sandy undulating plain [5]. These dunes move in the direction of the prevailing winds. In the coarse sand field where there is constant removal of sand by wind, the dominant plant are Convolvulus lanatus Vahl and Artemisia monosperma Del. The dominant plant of the mobile sand is grass, Stipagrostis scoparia (Trin. et Rupr.) De Winter, it grows only in sites that are continuously being covered by new sand. The most vigorus vegetation and the largest number of mesophytes are found near the base of dunes. Halophytic vegetation dominates near the Mediterranean coast and salt marshes up to 10 Km south the coast. Seasonal fluctuation in the depth of the water table and in salinity greatly. A typical salt marshes have an area outer a belt of Zygophyllum album L.f., an inner belt is dominated by Halocnemum strobilaceum

(Pallas) M.Bieb.A zone near the center contains Juncus arabicus (Asch. et Büch.) Adams plant.This species grows at sites of moderate salinity [5].

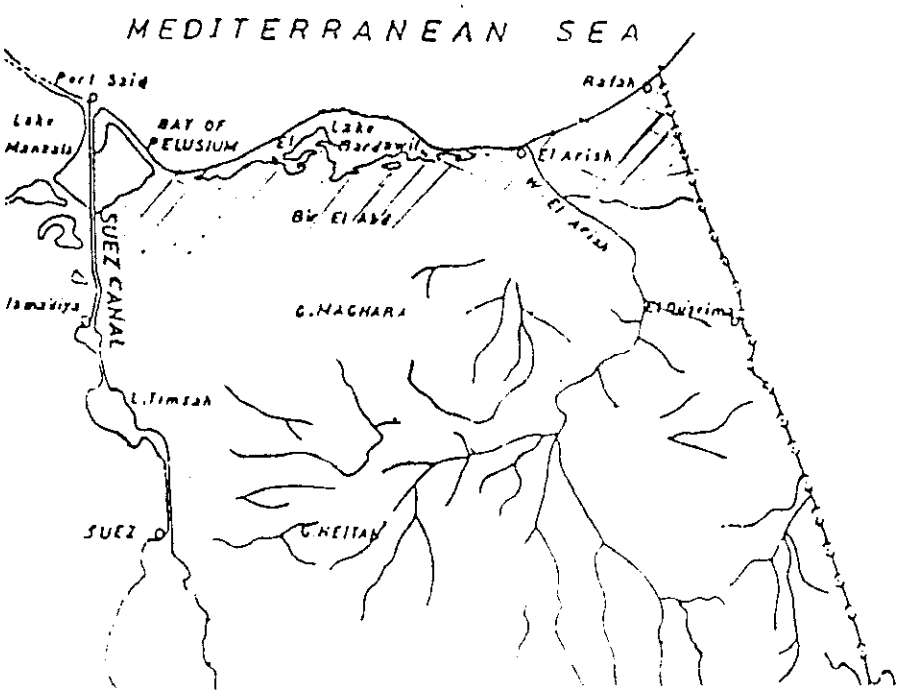

Fig. 1. Location of the study area.

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According to UNESCO/FAO [38] and El-Gabaly et al. [7] the study area comprise three soil-type, Marchy Solonchaks, Eutric Rhegosols and Dinamic Ergosols. The area between El-Arish and Rafah at the east and the area at the west near the Suez Canal, the soils are Eutric Rhegosols, the area of the salt sand near the sea are Marchy Solonchaks, in the entire area the Dinamic Ergosols are dominat (Fig.2).

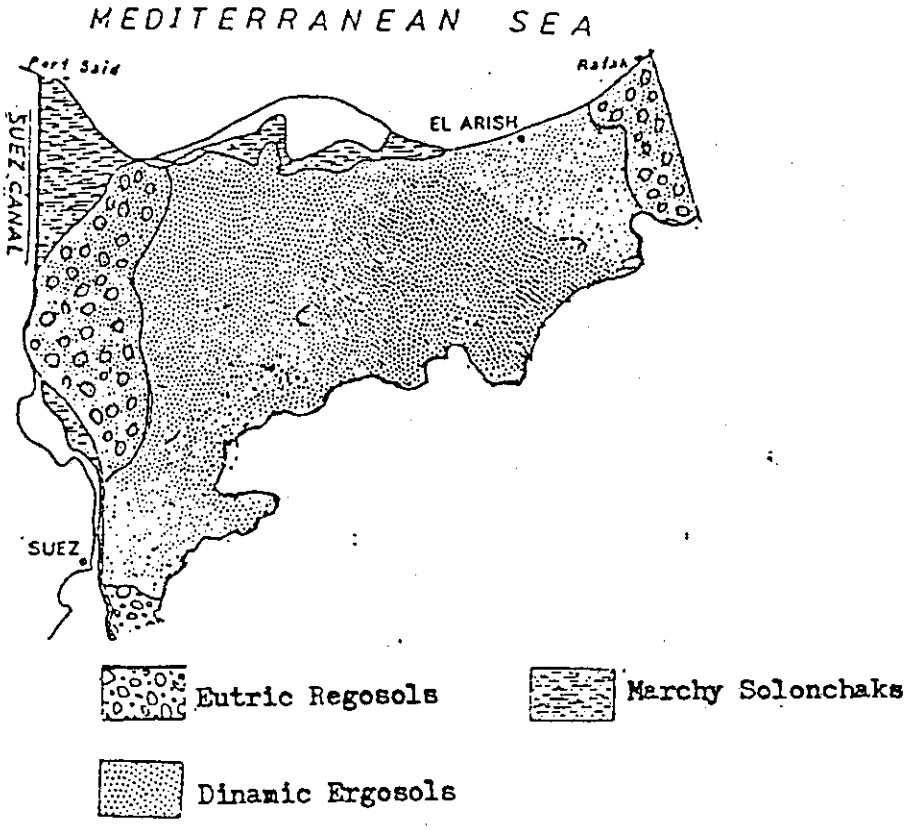

Fig. 2. The main locations of each edaphic type (Parent material of soils).

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Climate

The desert of Sinai belong to the Arabian type [23] it is characterize by arid to extremely arid climate with a Mediterranean influence, the summers are hot and dry, winter are cool, rain falls almost exclusively in winter, precipitation and relative humidity are lower than in the adjacent Mediterranean region. In the study area, mean temperature of 10° to 20°C in the coldest month and 20° to 30°C in the warmest month [8]. Mean annual rain in this area ranges from 97 mm in the eastern part (El Arish region) to 75 mm in the western part (Port Said region) [39]. Fog and dew are essential to many desert plants, especially during the summer and on dry winter days, its accumulation ranges from 26 to 36 mm with dew occuring on approximately 200 nights each year [18]. Seasonal and daily fluctuations in climatic conditions are extremely variable as well as harsh in the arid zones.

Sampling

Plant root and soil samples were collected from different plant covers of the Mediterranean coastal region of Sinai peninsula in Egypt. Roots and soil samples from under three plants of each species were collected from fourty stands 20 m x 20 m, distributed in the study area to cover the whole climatic gradient and most of the physiographic variations during the spring of 1987. Roots of

perennial and annual plants were examined. Edaphic and rhizospheric samples were taken from the habitats of 53 different plant species. Individual plant samples were taken from stand where the particular plant was dominant. Plant species were indentified according to Täckholm [36]. Main roots were traced from the crown until the youngest root were reached. Ten samples of thin roots were excised from the main laterals of each plant. Soil (100-500 g) was collected from the soil surface to a depth of 25 cm around the lateral roots and included rhizosphere soil when possible, air-dried, passed through 2 mm sieve, and packed in paper bags ready for mycorrhizal and soil analyses. Electric conductivity (EC) and soil reaction (pH) were evaluted in 1-5 soil water extract using electric conductivity-meter and a glass electrode pH-meter. Soil texture analysis was carried out by the Bouyoucos hydrometer method.

To assess mycorrhizal fungal colonization, 10 fine root segments, 1 cm in length, were excised from the lateral root specimens, washed, cleared, and differentially stained with 0.05 % trypan blue in lactic acid following the procedure of [29]. When necessary, roots were stored in 50% ethyl alcohol prior to clearing [9]. The segments were mounted in clear lactic acid and examined for vesicles, arbuscules and hyphae. A root segment was considered colonized when

hyphae and one or more of these structures were observed.

Chlamydospores of VA mycorrhizal fungi were recovered from 100 g soil subsamples from each collection site by wet sieving and decanting [11] and identified by spore characteristics [12,13]. Spore populations were calculated from 100 g soil subsamples. Total counts from the sievings were made by picking out spores under dissecting microscope illumination at 20x magnification.

Mycorrhizas were grouped as follows.
Vesicular-arbuscular mycorrhizas (VAM): characterized by the presence of arbuscules in cortical cells of the root. The arbuscules are connected to each other and the soil by aseptate hyphae. Vesicles may be present.

Vesicular associations (V): characterized by the presence in the root of intercellular vesicles that are attached by aseptate hyphae to the soil. There are no arbuscules present.

Coiling VAM (Coil VAM): VAM which also have tightly formed coils of hyphae in the epidermal and/or cortical cells of the root. Arbuscules and vesicles may appear malformed.

Nil: no mycorrhizal infection observed.

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RESULTS AND DISCUSSION

Samples were taken from 40 sites and 53 different plant species (23 families, 49 genera) and soil EC ranged from 135 mmho/cm in the soil beneath Pancratium maritimum L. and Stipagrostis scoparia (Trin. et Rupr.) De. Winter to a low of 13 mmho/cm in the soil beneath Silene succulenta Forssk. No attempt was made to correlate plant species with soil EC. Few of the soils were highly sodic, as indicated by Na concentrations in the saturation extract, with a high of 261.0 mg/100 g from the soil beneath Frankenia revoluta Forssk to a low of 7.5 mg/100 g from the soil beneath Pancratium sickenbergeri Asch. et Schweinf ex Boiss. The soil pH was alkaline in all samples except the soil beneath Stipagrostis scoparia (Trin. et Rupr.) De. Winter; Pancratium maritimum L.; and Silene succulenta Forssk were slightly acidic (6.96). The soil was sandy in all samples.

Thirty-six species (16 families, 34 genera) were VA mycorrhizal with vesicles or arbuscules and intracellular hyphae in the root cortical cells (Table 1). The cortical cell vesicles were spherical or ellipsoid, 25-65 x 20-35 um (Figs. 3&4). Chlamydospores were extracted from the soil in very low numbers (average one to ten spores/100 g soil) (Fig. 5). Chlamydospores of VA fungal species were of the genus Glomus of the Endogonaceae [12,13,40]: G. microcarpum Tul.& Tul.; G. fasciculatum (Thaxter sensu Gerd.) Gerd,&

Trappe; G. macrocarpum Tul.& Tul.; G. epigaeum Daniels & Trappe; G. mosseae (Nicol. & Gerd.) Gerd. & Trappe; G. intraradices Schenck & Smith; and G. geosporum (Nicol. & Gerd.) Walker. This is the first report of G. geosporum from desert environment.

Plants in which vesicular associations were observed all belong to groups previously believed to be free of mycorrhizas. A vesicle was observed in the cluster root of Trigonella stellata Forssk (Table 1) and adjacent areas of the root also contained hyphae and vesicles. In all cases at the study site, vesicles were observed in disentegrating rootlets with the consequent release of the vesicles (Fig. 3). This is contrary to Mc Gee [22], who observed vesicular infection in roots in which the epidermis was still intact. However, in Silene succulenta Forssk (Fig. 4), the mature vesicle was observed within the root and dictated by the host cell. In addition, no evidence was found to suggest that vesicular associations are a stage of development of VAM subsequent to the collapse of arbuscules or that growth of the host was enhanced by the association. The exact nature of vesicular associations remains uncertain. Hirrel et al. [17] suggested that the absence of arbuscules could indicate nonfunctional mycorrhizal associations or nonsymbiotic colonization by hyphae from a mycorrhizal plant growing close by. Although these plants are widely spaced,

colonization from a neighboring plant may occur. It cannot be stated with certainity whether the mycorrhizae of these species are viable or structural remnants from a once- functional association.

The grouping of mycorrhizas according to the presence or absence of coils is probably of no value until the control and the effect of coil formation are more clearly understood. The formation of coil of hyphae and the collapse of hyphal structures in the root of Cressa cretica L. were formed from branched hyphae in cortical cells, with an absence of immediate collapse of hyphal structures and the continuity of infectivity of mycorrhizal root lengths. Presence of coils may indicate variation in the physiology of the association from commonly studied VAM.

As is typical of wildland habitats and uncultivated soils, few fungal spores were recovered from the sievings. Rose [31] reported low spore densities in native shrub fields of Oregon; Mosse & Bowen [26] reported similar low spore populations under wildland perennial vegetation in Australia and England. In many soil samples in this survey no spores were found although roots growing in it and nearby contained structures indicating colonization by VA mycorrhizal fungi. Perhaps the fungal symbionts sporulate infrequently in this habitat during winter or only sporulate and germinate after rainfall sufficient to increase

the soil moisture content [30]

In rangeland conditions the VA mycorrhizal fungi fruit as single spores [37] , and their presence and number vary with season and soil moisture, between annual and perennial hosts, and between habitats. Mycorrhizal fungi persist within roots of perennial hosts over the dormant season, but annuals depend on propagules in soil for new colonization each growing season [37] .
At the time of sampling, the soils of Sinai contained few VA fungal spores. The native desert plants along the Mediterranean coast of Sinai are commonly perennial and typically widely spaced with bare regions between vegetation exceeding 10 m in width. The dominance by sparse, randomly spaced perennials may explain the lack of VA fungal propagules and the low number of VA fungal spores may in turn limit the establishment of annual plants. In communities of annuals mixed with perennials, hyphae growing from the roots of perennial plants may colonize annuals Hirrel et al. [17]. It is therefore conceivable that the soil containing low numbers of VA fungal spores is nevertheless infective.

After invasion of the host cell of Melilotus indica (L.) All. by Glomus mosseae (Nicol. & Gerd.) Gerd. & Trappe, a host-parasite interface develops resembling that in many pathogenic and non-pathogenic host-parasite associations

during their period of compatibility. At the penetration point of the cell wall, a granulation occur. Their is associated with the formation of a dense thickening (a papilla) on the inner cell wall (Figs. 6&7). Akai et al. [1] and Kaspari [19,20] presumed that the enzymes are involved in the penetration process and this is suggested by the granulation of the cell wall at the penetration point. The papilla appears to be a swelling of the cell wall Mc Keen et al. [24] rather than additional wall thickening by apposition [3,6], because the dense zone extends into the cell wall. Kaspari [19,20] observed unusual case of papilla formation at the penetration point this was the association of Glomus mosseae with tobacco roots. He believed that the papilla is a host defence reaction or delimiting structure.

REFERENCES

1- Akai, S.;O. Horino; M. Fukutomi; A. Nakata; H. Kunoh; and M. Shiraishi (1971): Cell wall reaction to infection and resulting change in cell organelles. In:Morphological and biochemical events in plant-parasite interaction (Eds. Akai,S S.; and S.Ouchi), pp. 329-344. The Phytopathological Society of Japan, Tokyo.

2- Ayyad, M.A. (1981): Soil-vegetation-atmosphere interaction. Cambridge University press.

3- Bracker, C.E. (1967): Ultrastructure of fungi. Ann.Rev. Phytopathol. 5: 343-374.

4- Danin, A. (1972): Mediterranean elements in rocks of the Negev and Sinai deserts. Roy. Bot. Gard. Edinburgh, 31: 437-440.

5- Danin, A. (1983): Desert vegetation of Israel and Sinai. Cana Publishing House, Jerusalem, Israel. pp 148.

6- Edwards, H.H.; and P.J. Allen (1970): A fine structure study of the primary infection of barley by Erysiphe graminis f.sp. hordei. Phytopathol. 60: 1504-1509.

7- El-Gabaly, M.M.; I.M. Gewaifel; M.N. Hassan; and B.G. Rosanov (1969): Soil map and land resources of U.A.R. Inst. Reclam. Res. Bull. 22: 1-14.

8- Ganor, E.; R. Markovitz; Y. Kesler; and N. Rosenan (1973): Climate of Sinai. Israel Meteorological Service, Publ. Ser. E22, pp.43.

9- Gardner, R.O. (1975): An overview of botanical clearing techniques. Stain Technology, 50: 99-105.

10- Gerdemann, J.W. (1968): Vesicular-arbuscular mycorrhiza and plant growth. Annu. Rev. Phytopathol. 6: 397-418.

11- Gerdemann, J.W.; and T.H. Nicolson (1963): Spores of mycorrhizal Endogone species extracted from soil by wet sieving and decanting. Trans. Br. mycol. Soc. 46: 235-244.

12- Gerdemann, J.W.; and J.M. Trappe (1974): The Endogonaceae of the Pacific Northwest. Mycol. Memoir, 5: 1-76.

13- Hall, I.R. (1985): Taxonomy of VA mycorrhizal fungi. In: VA Mycorrhiza. (Eds. Powell, C.Li; and D.J. Bagyara j), pp. 57-94. CRC Press, Inc. Boca Raton, Florida.

14- Harley, J.L.; and S.E. Smith (1983): MycorrhizalSymbiosis. Academic Press, New York, pp. 483.

15- Hassan, M.A.; and A. Sharaf El-Din (1987): Vesicular-arbuscular endomycorrhizal associations in dune vegetation, western desert, Egypt. Mansoura Univ. Conf. of Agric. Sci. on Food Defeciency Overcoming Through Autonomous Efforts in Egypt, 22-24 June, 1987, Vol. 1 : 72-81.

16- Hassan, M.A.; A. Sharaf El-Din; and M.K. Hassan (1987): A preliminary survey of vesicular-arbuscular mycorrhizal fungi collected from saline soils of the Mediterranean coast of Egypt. Mansoura Univ. Conf. of Agric. Sci. on Food Defeciency overcoming Through Autonomous Efforts in Egypt, 22-24 June, 1987, Vol. 1 : 45-53.

17- Hirrel, M.C.; H. Mehravaran; and J.W. Gerdemann (1978): Vesicular-arbuscular mycorrhizae in Chenopodiaceae and Cruciferae: do they occur. Can. J. Bot. 56: 2813-2817.

18- Kappen, L.; and O.L. Lange (1978): Life forms and physiology of desert lichens. Intecol 2 nd Congress abstracts, 2 : 25.

19- Kaspari, H. (1973): Elektronenmikroskopische untersuchung zur feinstruktur der endotrophen tabakmykorrhiza. Arch. Mikrobiol. 92: 201-207.

20- Kaspari, H. (1975): Fine structure of the host-parasite interface in endotrophic mycorrhiza of tobacco. In: Endomycorrhizas. (Eds. Sanders, F.E.; B. Mosse; and P.B. Tinker), pp. 325-334. Academic Press, London.

21- Kassas, M. (1953): Landforms and plant cover in the Egyptian desert. Bulletin de la Societe de geographie d' Egypte, 26: 193: 193-205.

22- Mc Gee, P. (1986): Mycorrhizal associations of plant species in a semiarid community. Aust. J. Bot. 34: 585-593.

23- Mc Ginnies, W.G.; B.J. Goldman; and P. Paylore (1968): Deserts of the world. Univ. Arizona Press, Tucson.

24- Mc Keen, W.E.; R. Smith; and P.K. Bhattacharya (1969): Alterations of the host wall surrounding the infection peg of powdery mildew fungi. Can. J. Bot. 47: 701-706.

25- Mosse, B. (1973): Advances in the study of vesicular-arbuscular mycorrhiza. Annu. Rev. Phytopathol. 11: 171-196.

26- Mosse, B.; and G.D. Bowen (1968): The distribution of Endogone spores in some Australian and New Zealand soils and in an experimental field soil at Rothamsted. Trans. Br. mycol. Soc. 51: 485-492.

27- Nicolson, T.H. (1967): Vesicular-arbuscular mycorrhiza- a universal plant symbiosis. Sci. Prog. (Oxford), 55: 561-581.

28- Noy-Meir, I. (1973): Desert ecosystem: environment and producers. Annu. Rev. Ecol. and Systematics, Vol. 4: 25-51.

29- Phillips, J.M.; and D.S. Hayman (1970) : Improved procedures for rapid assessment of infection. Trans. Br. mycol. Soc. 55: 158-163.

30- Reid, C.P.P.; and G.D. Bowen (1979): Effects of soil moisture on VA mycorrhizal formation and root development in Medicago. In: The soil-root interface. (Eds. Harley, J. L.; and R.S. Russell), pp. 211-219. Academic Press, London.

31- Rose, S.L. (1980): Mycorrhizal associations of some actinomycete-nodulated nitrogen fixing plant. Can. J. Bot. 58: 1449-1454.

32- Rose, S.L. (1981): Vesicular-arbuscular endomycorrhizal associations of some desert plants of Baja California. Can. J. Bot. 59: 1056-1060.

33- Safir, G.R.; and C.E. Nelson (1981): Water and nutrient uptake by vesicular-arbuscular mycorrhizal plants. In : Mycorrhizal associations and crop production. (Ed. R. Myers), pp. 25. New Jersey Agric. Exp. Stn. Res. Rep. R o44oo-o1-81.

34- Safir, G.R.; J.S. Boyer; and J.W. Gerdemann (1971): Mycorrhizal enhancement of water transport in soybeans. Science (Washington, D.C.), 172: 581-583.

35- Staffeldt, E.E.; and K. B. Vogt (1975): Mycorrhizae of desert plants. US/IBP Desert Biome. Rep. 1974 Prog. 3: 63-69.

36- Tackholm, V. (1974): Students'Flora of Egypt. Cairo Univ. Press.

37- Trappe, J. M. (1981): Mycorrhizae and productivity of arid and semiarid rangelands. In: Advances in food producing systems for arid and semiarid lands. (Eds. Manassah, J.T.; and E.J. Briskey), pp. 581-589. Academic Press, New York.

38- UNESCO/ FAO (1968): Definition of soil units proposed to be used for the soil map of the world. World Soil Resources Report 33.

39- Waisel, Y. (1972): Biology of halophytes. Academic Press New York.

40- Walker, C. (1982): Species in the Endogonaceae: a new species (Glomus occultum) and a new combination (Glomus geosporum). Mycotaxon, 15: 49-61

41- Warcup, J.H.; and P.A. Mc Gee (1983): The mycorrhizal associations of some Australian Asteraceae. New Phytol. 95: 667-672.

42- Williams, S.E. ; and E.F. Aldon (1976): Endomycorrhizal (vesicular-arbuscular) associations of some arid zone shrubs. Southwest. Nat. 20: 437-444.

Table 1. Vesicular-arbuscular mycorrhizal status of species and edaphic criteria of rhizosphere soil samples for the tested plant species.

Plant Host	Soil Characteristics						Mycorrhizal Associations	
	pH	EC mmhos/cm	Na mg/100g	Clay %	Silt %	Sand %	Type	VAM Fungus (Glomus)
Amaryllidaceae								
Pancratium maritimum L. **	6.96	135	21.5	6.1	3.4	90.5	Nil	-
Pancratium sickenbergeri Asch. et Schweinf ex Boiss**	7.63	17	7.5	7.1	1.0	91.9	Nil	-
Aizoaceae								
Mesembryanthemum crystallinum L. *	7.35	125	12.0	6.3	1.5	92.2	VAM	fasciculatum
Caryophyllaceae								
Herniaria hemistemon J.Gay**	8.00	14	15.0	5.4	1.3	93.3	Nil	-
Robbairea delileana Milne-Redh *	7.02	115	9.5	8.0	3.3	88.7	Nil	-
Paronychia argentea Lam *	8.00	70	11.0	7.5	2.4	90.1	Nil	-
Silene husoni Boiss *	8.00	14	15.0	5.3	1.1	93.6	V	fasciculatum
Silene succulenta Forssk **	6.96	13	21.5	6.1	3.4	90.5	V	fasciculatum
Chenopodiaceae								
Arthrocnemon glaucum (Del.) Ung. Sternb. **	7.41	20	67.5	7.1	1.2	91.7	Nil	-
Chenopodium murale L. *	8.11	14	15.2	5.0	1.1	93.9	Nil	-
Halocnemum strobilaceum (Pallas) M. Bieb. **	7.66	70	260.0	8.0	2.2	89.8	VAM	microcarpus
Kochia indica Wight *	8.00	14	15.0	5.3	1.1	93.6	V	microcarpus

Table 1. (continued)

Plant Host	Soil Characteristics						Mycorrhizal Associations	
	pH	EC mahos/cm	Na mg/100g	Clay %	Silt %	Sand %	Type	VAM Fungus (Glomus)
Cleomaceae								
Cleome africana Botsch *	7.63	125	16.5	5.1	1.4	93.5	Nil	-
Compositae								
Artemisia judaica L. **	7.71	17	10.0	5.2	1.5	93.3	VAM	epigaeum
Artemisia monosperma Del **	7.61	15	24.0	5.2	5.1	89.7	VAM	rosseae
Echinops ralalensis Schweln? **	8.00	71	11.0	7.5	2.4	90.1	VAM	fasciculatus
Iflora spicata (Forsk) Sch.-Bip *	8.37	100	11.0	8.9	2.0	89.1	VAM	rosseae
Launiea tenuiloba (Boiss) Kuntze *	7.79	110	12.0	4.2	4.0	91.8	VAM	monseae
Senecio desfontainei Druce*	7.82	115	9.5	8.0	3.3	88.7	VAM	epigaeum
Sonchus oleraceus L. *	7.00	117	9.4	8.0	3.4	88.6	VAM	epigaeum
Convolvulaceae								
Cressa cretica L. **	7.92	73	22.2	6.3	1.1	92.6	Coil VAM	fasciculatum
Cruciferae								
Eremobius aegyptiacus (Spreng.) Asch. in Boiss **	8.41	17	18.5	7.1	1.2	91.7	V	fasciculatum
Lebularia libyca (Viv) Meisan *	8.97	100	9.0	4.0	1.4	94.6	V	fasciculatum
Matesia pygmaea (Del.) O.E. Schulzin Engl *	8.00	70	12.6	6.1	1.0	92.9	Nil	-
Cyperaceae								
Cyperus capitatus Vand **	8.37	51	26.0	8.9	11.0	80.1	Nil	-
Cyperus sp.	7.81	15	24.0	5.2	5.1	89.7	VAM	fasciculatum

Table 1. (continued)

Plant Host	Soil Characteristics						Mycorrhizal Associations	
	pH	EC mmhos/cm	Na mg/100g	Clay %	Silt %	Sand %	Type	VAM Fungus (Glomus)
Euphorbiaceae								
Euphorbia sp.	8.30	75	15.5	6.1	1.0	92.9	VAM	epigaeum
Frankeniaceae								
Frankenia revoluta Forssk**	7.66	70	261.0	8.0	2.2	89.8	Nil	-
Gramineae								
Bromus sp.	7.60	73	22.5	3.6	1.1	92.6	VAM	mosseae
Cutandia memphitica (Spreng.) Benth. *	8.00	14	15.0	5.5	1.1	93.6	V	geosporus
Cynodon dactylon (L.) Pers**	8.97	110	9.0	4.0	1.4	94.6	VAM	mosseae
Hordeus vulgare L. emend. Lam *	8.88	100	9.0	4.4	1.0	94.6	VAM	mosseae
Panicus turgidus Forssk **	8.35	100	9.5	8.0	2.0	90.0	VAM	mosseae
Stipagrostis scoparia (Trin. et Rupr.) De. Winter **	6.96	135	21.5	6.1	3.4	90.5	VAM	-
Leguminosae								
Astragalus hamosus L. *	8.00	110	16.5	6.1	1.0	92.9	VAM	intraradices
Lotus halophilus Boiss. et spruz. in Boiss *	8.00	70	11.0	7.5	2.0	90.5	VAM	epigaeum
Melilotus indica (L.) All.*	8.80	14	15.0	5.3	1.1	93.6	VAM	mosseae
Ononis sicula Guss *	7.81	15	24.0	5.2	5.1	89.7	Nil	-
Trigonella stellata Forssk*	8.37	51	26.0	8.9	11.0	80.1	V	-
Liliaceae								
Asphodelus fistulosus L. *	8.00	52	25.8	8.8	11.2	80.0	VAM	fasciculatum
Dipcadi erythraeus Webb& Berth **	8.07	70	12.0	7.5	2.4	90.1	VAM	geosporus
Muscari racemosum (L.) Mill **	7.63	125	16.5	5.1	1.4	93.5	VAM	-

Table 1. (continued)

Plant Host	Soil Characteristics						Mycorrhizal Associations	
	pH	EC mmhos/cm	Na mg/100g	Clay %	Silt %	Sand %	Type	VAM Fungus (Glomus)
Urginea maritima (L.) Baker **	8.35	100	9.5	8.0	2.0	90.0	VAM	•
Malvaceae								
Malva parviflora L. *	8.00	14	15.0	5.3	1.0	93.7	VAM	fasciculatum
Neuradaceae								
Neurada procumbens L. *	7.81	15	24.0	5.2	5.1	89.7	Nil	•
Plantaginaceae								
Plantago sp.	8.00	75	11.0	7.5	2.3	90.2	VAM	geosprum
Polygonaceae								
Emex spinosus (L.) Campd*	8.00	14	15.1	5.3	1.0	93.7	Nil	•
Primulaceae								
Anagallis arvensis L. *	8.00	14	15.0	5.0	1.0	94.0	VAM	•
Ranunculaceae								
Adonis dentatus Del. *	7.79	110	12.0	4.2	4.0	91.8	Nil	•
Solanaceae								
Nicotiana glauca R.C. Grah*	7.35	125	12.0	6.3	1.5	92.2	VAM	fasciculatum
Thymelaceae								
Thymelaea hirsuta (L.) Endl **	8.00	73	11.0	7.4	2.3	90.3	Nil	•
Zygophyllaceae								
Fagonia arabica L. *	7.63	125	16.0	5.1	1.4	93.5	Nil	•
Zygophyllum album L.f. **	7.62	14	10.0	5.9	1.0	93.1	VAM	epigaeum

• indicate no soil spores recovered.

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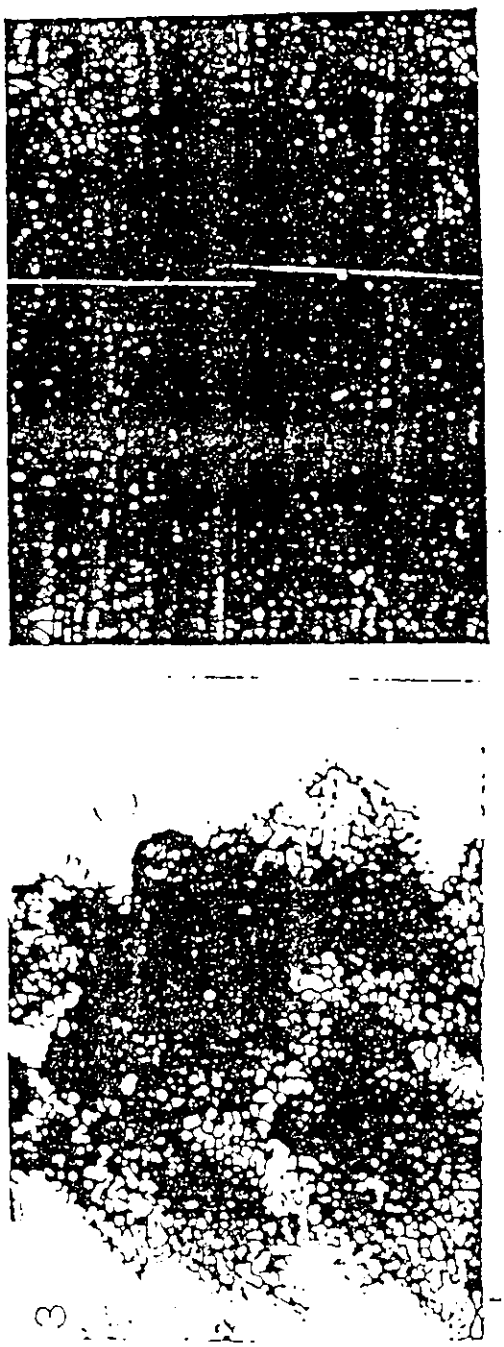

Fig. 3: Root squash preparation of Trigonella stellata showing a typical region of vesicular infection. This figure depicts a disintegrating rootlet with the consequent release of the vesicles. X 450

Fig. 4: This figure illustrates the mature vesicle within the root of Silene succulenta. The shape of the vesicle is apparently dictated by the host cell X 850

Fig. 5: This micrograph illustrates chlamydospore and subtending hypha of Glomus fasciculatum on the surface of Nicotiana glauca. X 200

Figs. 6& 7: Wall tubules "ligmitubers or pegs or papillae" enveloped by the host cell (Hellotus indica) on the inner cell wall. Fig. 6 X 350 Fig. 7 X 1500

ارتباط الميكوريزا الحوصلية ـ الشجرية ببعض النباتات الصحراوية على امتداد ساحل البحر الابيض المتوسط بمنطقة سيناء ،مصر

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تم تجميع النباتات الطبيعية المتواجده على طول ساحل البحر الابيض المتوسط بسيناء وذلك لفحص الارتباطات الميكوريزية ، ولقد وجد ست وثلاثين نوعا مصابا بفطريات الميكوريزا الحوصلية ـ الشجرية VA من ثلاث وخمسين نوعا ، كما كشفت غربلة التربه عن وجود جراثيم كلاميدية لسبعه انواع مختلفة من فطر جلوماس : جلوماس ميكروكاربام ،جلوماس فاسيكيولاتام ،جلوماس ماكروكاربام ،جلوماس موسى ،جلوماس ايبيجيام ،جلوماس انترارادیسیس ، وجلوماس جيوسبورام . ولقد تبين قلة جراثيم الفطر VA اثناء جمع العينات ، اذ تراوحت من جرثومة كلاميدية الى عشرة جراثيم كلاميدية لكل مائة جرام من التربة . كما ظهر تحبب واضح اثناء غزو خلية نبات الحندقوق بواسطة الفطر VAM جلوماس موسى وذلك عند مكان اختراق جدار خلية العائل اذ صاحبها تكوين تغليظ كثيف او حلمه على جدار الخلية الداخلى .