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Mycorrhizal Fungi Communities Associated with Wild Plants in a Desert Soil of Saudi Arabia

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Abstract

In most environments, plants roots are exposed to several mycorrhizal fungal species. This fact has significant ecological consequences. The ability to colonize different host genotypes and promote plant growth, and adaptation to abiotic factors that are likely to affect both the establishment and progress of a beneficial symbiosis and their dissemination in the ecosystem. Deserts cover most of Saudi Arabia lands with some meadows that depend on rainwater, despite its scarcity. Under these harsh conditions, some desert plants grow like some types of trees, shrubs, herbs and weeds. Mycorrhiza from the desert plants near Riyadh were found associated with the roots of native trees, weeds and shrubs such as *Acacia gerrardii* and *Trigonella anguina* wild. It appears that mycorrhiza of desert plants not only supply the plants with nutrients but also supply moisture during the dry season, at times taking the place of root hairs. Our results in this work show that the soils of Al-Khabiah meadow have relatively higher available Cu, Fe, Mn, Zn, P and K as well as higher soil organic matter content (1.264%) compared with the bare soil or the other studied meadows. The highest spore population was recorded with *Rhayza stricta* plants **(**1170) from Al- Masoudi meadows which was followed by *Calotropis procera* plants and *Ziziphus nummularia* plants and the lowest was recorded with *Hamada elegans* plants. The overall mycorrhizal infectivity (colonization %) of the selected wild plant species collected from different locations are varied widely and independently irrespective of plant species and locations. The spore population was higher in some soil, but the infectivity of plants was less. The percentage infection in the roots of different species with the mycorrhizal fungi varied significantly. The highest infection was at Al- Khabia meadows and there was no infection with *Launaea capitata*, *Ziziphus nummularia* and *Rhayza stricta* plants. The range of infections in Shoaib Harimla was 0- 69.08 with the highest with the *Trigonella anguina*. There was no infection with *Calotropis procera* and *Ziziphus nummularia*. In Al-Khrarah meadows three species (*Launaea capitata, Rhayza stricta* and *Ziziphus nummularia*) did not have any infection and the highest infection was recorded with *Acacia gerrardi planri* plant.

Keywords: AMF diversity, Meadows rhizosphere, Spore population, Mycorrhizal infection, Wild plants.

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1. Introduction

Deserts cover most of Saudi Arabia lands with some meadows that depend on rainwater, despite its scarcity, under these harsh conditions some desert plants grow as dispersed wild plants in meadows like some types of trees, shrubs, herbs and weeds [1]. The soil formation in Riyadh region Saudi Arabia is very much of desert type and came to be as a result of aridity and harsh climatic factors such as winds, temperature, evapotranspiration and others [2]. Rainfall in the region is about 100 mm per year with few rainy days per month during winter and spring seasons. These desert plants may obtain their needs of mineral nutrients with help of soil microorganisms, especially mycorrhizal fungi. Mutualistic arbuscular mycorrhizal (AM) fungi are functionally important plant root symbiosis and may be particularly important in drought stressed systems such as deserts [3]. Wild plants are numerous and have their own characteristics in combating desertification improving local climate, fixing sand dunes, conserving soils, preventing erosion and flood damages, producing forage and other benefits economically, environmentally, and medicinally [1].

Therefore, it is important to conserve these plants on a sustainable use basis where research and development are of main concern to improve and to diversify them. Wild plants in Riyadh region of Saudi Arabia tend to grow and live as individuals or in groups with similar characteristics such as halophytic vegetation *(Tamarix, Salsola, Suaeda, Zygophyllum*), sandy vegetation (*Haloxylon, Lepladenia,*

Calligonium) rocky and wadi vegetation (*Ziziphus, Maerua, Capparis, Acacia, Lycium*) and others [4-6]. Mycorrhizal symbiosis, a plant–fungus association, is an essential feature of biology and ecology of most terrestrial plants as plant receives some mineral nutrients and improves its vegetative growth, whereas fungus obtains carbohydrates and accomplishes its life cycle [7]. Arbuscular mycorrhizal fungi (AMF) form a near-ubiquitous mutualistic association with roots to help plants withstand harsh environments [8]. Leake *et al*. [9] stated that extraradical mycelia of mycorrhizal fungi represent a network of power, influence, because they control biogeochemical cycling, plant community composition, and agroecosystem functioning. Mycorrhizal fungi reside in rhizosphere as spores, hyphae, and propagules, and occupy rhizoplane during their interaction with the host root.

Mycorrhizal fungi are major components of the microbial soil community, mediating soil-to-plant transfer of nutrients. They are a heterogeneous group of soil fungi, which colonize the roots of about 70-90% plant species in nearly all terrestrial ecosystems [10-11]. In most ecosystems, roots are exposed to several mycorrhizal fungal species; each represented by a large population whose individuals almost invariably display some genetic diversity. This diversity has significant ecological consequences. Individual fungal populations vary in their potential range of host species, ability to colonize different host genotypes and promote plant growth, and adaptation to abiotic factors (e.g., soil pH, toxic levels of heavy metals, and the nutrient shortage) that are likely to affect both the establishment and progress of a beneficial symbiosis and their dissemination in the ecosystem. Despite early promises, inoculation by the AM fungi does not always lead to improved plant performance. Even under the controlled greenhouse conditions, failure to colonize is common.

Most of our knowledge about host responses to inoculation by AM fungi is based on domesticated cultivars [12-14]. In reality, we have a poor understanding of how inoculants take place in the natural ecosystems, especially under desert condition. The physiological status of the root is highly dependent on the creation and efficient functioning of the symbiosis. This, in turn, has a clear impact on the rhizospheric environment and the microorganisms involved through the secretion of carbohydrates, amino acids, secondary metabolites, and various ions [15]. Despite the fact that mycorrhizal fungi play an important role in N, P, and C cycling in ecosystems decomposing organic materials, the detailed function of fungi in nutrient dynamics in situ is still unknown. Mycorrhizal fungi differ in their functional abilities and the different mycorrhizas they establish thus offer distinct benefits to the host plant. Some fungi may be particularly effective in scavenging organic N and may associate it with plants for which acquisition of N is crucial; others may be more effective at P uptake and transport.

An important goal is therefore to develop approaches by which functional abilities of symbiotic guilds assessed in field [16]. Combined community and population structure and function studies applying genomics may, in the future, significantly promote our understanding of the interactions between mycorrhizal fungal species with their hosts, and with their biotic and abiotic environments. Moreover, symbiotic outcomes for wild plants may differ from domesticated cultivars, leading to differential responses to inoculation. Because wild plants generally depend more on AM fungi compared to cultivars [14]. Yet little is known about the structure and composition of AMF communities on desert environment and their native wild plants. The present study investigated the occurrence, community composition and diversity of mycorrhiza on selected local desert plants that usually found as wild flora in some meadows of Riyadh region, Saudi Arabia.

2. Materials and Methods

2.1. Screening and collection of plant types

During the period from March to April 2022, common plant types were screening and collected from four meadows in Riyadh region namely are Al-Kherarh, Al-Masoudi, Shoaib Harimlae and Al-Khabiah, characterized in the diversity of plant types and differences in environmental conditions. Nine wild plants from each meadow were chosen from herbs, shrubs and trees to carry out this study, and three replicates of each selected type. The collected fresh plant materials were air dried in the shade and the root of each plant was separated and ground using a blender, before being kept in dry and dark place for further work. The nine wild plants names and their families, genera and species of each meadow are given in Table (1).

2.2. Soil Physical and Chemical Characteristics

From the abovementioned meadows 40 composite surface soil samples (0 – 30cm) were collected under the different plant species beside the bare soils in each meadow. The collected soil samples were air dried, thoroughly mixed and crushed to pass through a 2 mm sieve and stored for the chemical and physical analysis. The pH was determined using a pH meter according to Thomas, [17] while the EC values were determined in soil paste extract using the ECmeter according to Rhodes [18]. The chemical composition of the studied samples was determined according to Rainwater and Thatcher, [19] for the determination of soluble SO_4^{2-}, Sparks *et al.*, [20]. For the determinations of (soluble (Na^+, K^+, Ca^{2+}, Mg^{2+}, HCO_3^-, CO_3^{2-} and Cl^-). The values of sodium adsorption ratio (SAR) were calculated from the following formula:

$$Sodium\ Adsorption\ Ratio\ (SAR) = \frac{Na}{\sqrt{\frac{Ca+Mg}{2}}}$$

Where: Na^+, Ca^{2+} and Mg^{2+} expressed as $meqL^{-1}$, as described by [21]. On the other hand, soil calcium carbonate contents were determined as in the method described by Loeppert and Suarez [22]. Particle size distributions were determined according to Gee and Bauder [23]. The soil organic matter content was determined according to Nelson and Sommers, [24]. The available concentrations of N, P, K, Fe, Cu, Zn and Mn in soil samples were determined as described by George *et al.,* [25]. Following extractions the content of studied metals (Fe, Cu, Zn and Mn) in the solutions were determined by ICP (Perkin Elmer, Model 4300 DV).

2.3. Mycorrhiza Infection and Colonization Percent

Roots and rhizosphere soils of different wild plants species were collected from the four meadows: Al-Khabia, Al-Khararah, Huraymila and Masudi. Nine different species from herbs, shrubs and trees of wild plants from each meadow

are given in Table 1. In the laboratory, roots were separated immediately from the soil and preserved in 50% alcohol. Soil samples were studied earlier to avoid the damage of the spores in the rhizosphere soil. From each sample, 100g soil was taken in a bucket of 10-liter capacity and 5 liters of water was mixed with the soil. The soil was mixed well with water to make a soil-water suspension. The suspension was left for five minutes for settling down insoluble and heavy particles. The suspension was passed through the ASTM-60, ASTM-100, ASTM-240 and ASTM-400 sieves gradually to extract the spores following by wet sieving and decanting method [26]. The residues of the sieves were filtered with the Whatman filter paper No-1. Squares of intersecting gridlines were drawn earlier on the filter paper for easy counting of spore.

After water filtration the paper was examined under the stereo-binocular microscope at 2.5×10 magnification and the number was recorded. Spores were separated on the basis of morphological characters and then they were observed under compound microscope mounting on Melzer's reagent and observed under digital photographic microscope 'Olympus DP72' at 10×0.10 and 10×0.25 magnification. Preserved roots were washed carefully to remove the alcohol and cut into 1 cm length for AM fungal structural analysis. Roots were heated at 80°C for 20-30 minutes in 10% KOH and thereafter left overnight in 1% HCl. Deeply pigmented roots were treated with 3% H_2O_2 to remove the lignin and to make clearer. Cleared roots were stained with trypan-blue following the method of Phillips and Hayman [27]. 20-30 segments were mounted on a slide and examined under digital photographic microscope 'Olympus DP72' at 10×0.10 and 10×0.25 magnification. Presence of mycelium, vesicles and arbuscules were observed. Mycelial colonization was regarded as total AM colonization. Percent colonization was calculated by the following formula:

$$\% \text{ Colonization} = \frac{Total\ No.of\ AM\ positive\ segments}{Total\ No.\ of\ segments\ studied} \times 100$$

PVLG was prepared following formula (INVAM-http://invam.wvu.edu/). Melzer's reagent was prepared following formula (INVAM-http://invam.wvu.edu/).

3. Results and Discussion

3.1. Soil properties as affected by plant species

Data presented in Table (2) clearly appears that the chemical properties (i.e. soil pH, EC as well as soluble cations and anions) of the studied rhizosphere soils in the studied areas were affected by the growing plant species regardless of the studied meadow location. Obviously, soil pH values were reduced in the areas covered with plants as compared with the uncovered soils (bare soil), as the *Hamada elegans* plants were most effective in this respect. In contrast, the soil salinity values (as measured as EC values) were increased in the areas covered by plants except for *Ziziphus nummularia* plants**.** This may be due to the root exudate from the growing plants resulted in reducing soil pH values. In this respect, Marschner *et al*., [28] pointed out that the rhizosphere pH is usually lower than the bulk soil in 1−2 units due to several mechanisms which are responsible of this effect such as the production of CO_2 by respiration processes, or release of organic acids by roots and microbes, and from organic matter decomposition. With respect to the effect of meadow location on soil properties, data presented in Table (3) indicated that chemical properties (i.e. soil pH, EC as well as soluble cations and anions) of studied soils in studied areas affected by meadow location regardless of studied growing plant species. Soil pH values were reduced in areas Al-Kherarh meadow compared with other meadows**.** In contrast, soil salinity values (as measured as EC values) reduced in areas Al-khabiah meadow regardless of plant species.

3.2. Available soil nutrients content as affected by plant species and meadow location

Data presented in Table (4) indicated that the nutrient content of the studied soils (Cu, Fe, Mn, Zn, N, P and K) were affected favorably either by the growing plant species and/or meadow location. Generally, the nutrients in studied soils were adequate for the available Cu, Fe, Mn, N, and P while it was marginal for available Zn and low for available K according to the classification given by George *et al.,* [25]. With respect to the role of the growing plant species on nutrients availability data presented in Table (4) clearly show that the nutrient concentrations of the studied soils (Cu, Fe, Mn, Zn, N, P and K) in the studied areas were affected favorably by the growing plant species regardless of the studied meadow. The soils of *Trigonella anguina* plants have relatively higher content of Cu, Fe, Mn, Zn, N and P as the rate of increment in such nutrients reached 150,260, 433, 240, 167 and 256 % over their content in the bare soil, respectively. The effects can vary with the soil buffer capacity and the type of plant sp., as mentioned before the pH values were reduced as a result of root exudate. Therefore, the acid conditions favor the solubilization of soil minerals (e.g., calcium phosphates) which go in line with the result reported by Bowen and Rovira [29], as well as increasing availability of micronutrients. Soils of Al-Khabiah meadow having relatively higher available Cu, Fe, Mn, Zn, P and K as well as higher soil organic matter content (1.264%) as compared either to bare soil or to other studied three meadows.

3.3. Arbuscular mycorrhizal fungi from wild plants

The total VAM in the rhizosphere and non-rhizosphere regains of wild plants from the four meadows are shown in Table (5) and Fig. (1 A&B). The percentage infection in the roots of different species with the mycorrhizal fungi varied significantly (Table 5). The overall mycorrhizal infectivity (colonization %) of the selected wild plant species collected from different locations are varied widely and independently irrespective of plant species and locations. In Al-Khrarah meadows the range of percent infections was 8.33-83.33 with the lowest in *Ziziphus nummularia* plants and the highest in *Tripleurospermum auriculatum* plants. In Al-khabia, the range of variation was 0- 54.32. The highest infection was with *Tripleurospermum auriculatum* plants and *Rhayza stricta* plants. The range of infection in Shoaib Harimla was again 0- 69.08 with highest with the *Trigonella anguina*. There was no infection with *Calotropis procera* and *Ziziphus nummularia*. In Al-Khrarah meadows three species (*Launaea capitata, Rhayza stricta* and *Ziziphus nummularia*) did not have any infection. The highest infection was recorded with *Acacia gerrardii*. The mycorrhizal colonization for the selected plant species was not studied before for their structural colonization with AMF.

Fig.1. A: *Glomus Spp*. from wild plants.

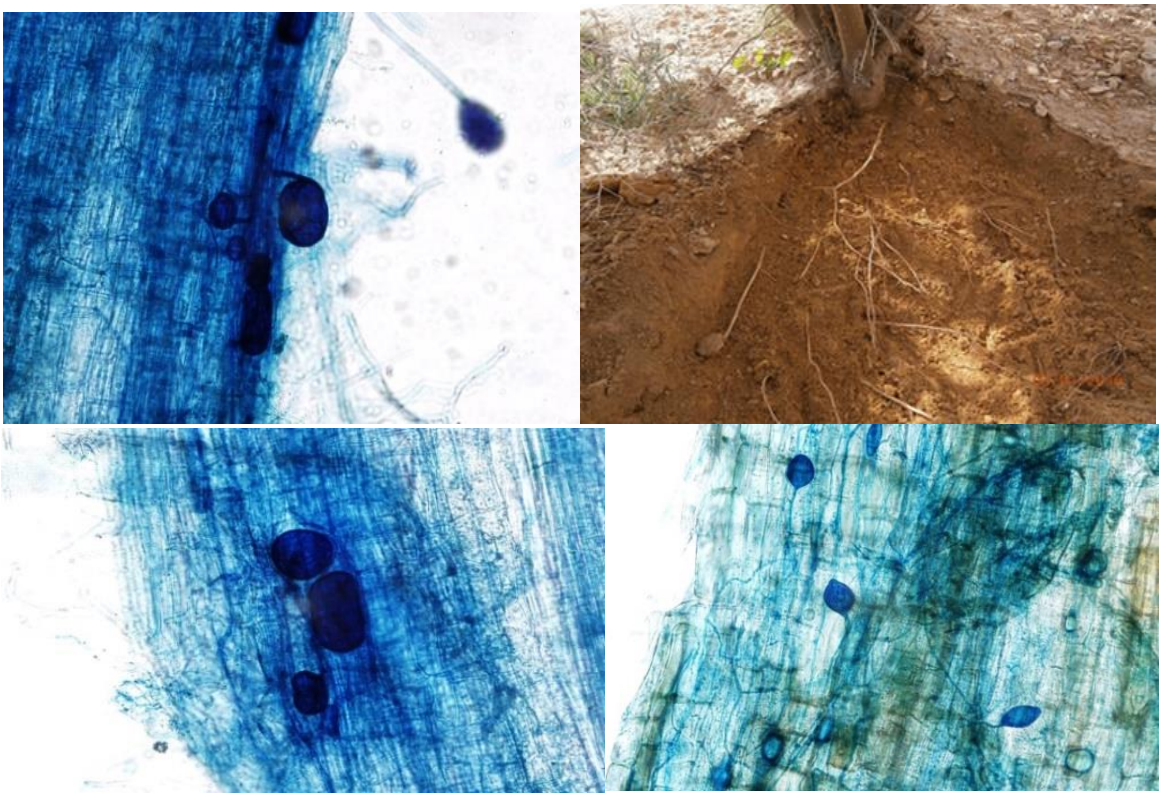

Fig.1. B: AMF colonization of roots.

Table 1. The tested wild plants in the studied meadows of Riyadh region

Scientific name of plant	Family	Type plant
Tripleurospermum auriculatum	***Asteraceae***	**Herb**
Trigonella anguina	***Papillionaceae***	**Herb**
Launaea capitata	***Asteraceae***	**Herb**
Rhayza stricta	***Apocynaceae***	**Shrub**
Hamada elegans	***Henopodiaceae***	**Shrub**
Lycium shawii	***Solanaceae***	**Shrub**
Acacia gerrardii	***Mimosaceae***	**Tree**
Ziziphus nummularia	***Rhamnaceae***	**Shrub**
Calotropis procera	***Asclepiadaceae***	**Tree**

Table 2. Impact of plant species on soil properties regardless of meadow location

Type of Plant	pH	EC (dS/m)	Cations(meq/l)				Anions(meq/l)				SAR	OM %
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^{-}	Cl^{-}	SO_4^{2-}		
Bare soil (Control)	8.0	0.6	2.6	0.7	2.8	0.1	0.0	0.6	3.1	2.5	2.1	0.2
Tripleurospermum auriculatum	7.7	1.3	5.1	1.5	5.7	0.2	0.0	1.2	6.2	5.0	2.9	1.0
Launaea capitata	7.6	1.8	7.2	2.1	8.0	0.2	0.0	1.7	8.6	7.0	3.4	0.8
Trigonella anguina	7.7	0.6	2.3	0.7	2.6	0.1	0.0	0.6	2.8	2.2	2.1	1.0
Hamada elegans	7.5	1.2	4.9	1.4	5.4	0.2	0.0	1.2	5.9	4.7	2.9	0.9
Lycium shawii	7.6	0.8	3.1	0.9	3.4	0.1	0.0	0.7	3.7	3.0	2.3	1.3
Rhayza stricta	7.6	2.3	9.2	2.7	10.2	0.3	0.0	2.2	11.1	9.0	3.6	1.0
Calotropis procera	7.6	0.8	3.1	0.9	3.4	0.1	0.0	0.7	3.7	3.0	2.4	0.7
Ziziphus nummularia	7.6	0.5	2.0	0.6	2.3	0.1	0.0	0.5	2.5	2.0	1.9	0.7
Acacia gerrardii	7.7	0.7	2.8	0.8	3.1	0.1	0.0	0.7	3.4	2.7	2.3	1.1

Table 3. Impact of meadow location on soil properties regardless of plant species.

Meadow location	pH	EC (dS/m)	Cations (meq/l)				Anions (meq/l)				SAR	OM %
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3	Cl^{-}	SO_4^{2-}		
Al-Kherarh	7.58	0.90	3.69	1.06	4.09	0.13	0.00	0.89	4.44	3.59	2.59	0.66
Al-Khabiah	7.70	0.48	1.95	0.56	2.16	0.07	0.00	0.47	2.35	1.90	1.91	1.26
Shoaib Harimlae	7.65	2.05	8.40	2.42	9.32	0.29	0.00	2.03	10.12	8.18	3.62	0.75
Al-Masoudi	7.68	0.70	2.87	0.82	3.18	0.10	0.00	0.69	3.45	2.79	2.20	0.82

Table 4. Available nutrients content in the studied meadow under different plant species.

Meadow	Type of Plant	Available macro and micronutrients (mg/kg)						
		Cu	Fe	Mn	Zn	N	P	K
Al-Kherarh	**Bare soil (Control)**	0.37	6.02	2.38	0.38	42.0	1.0	24.3
	Tripleurospermum auriculatum	0.48	10.62	10.66	1.00	77.0	8.2	13.3
	Launaea capitata	0.65	13.59	9.86	1.07	42.0	2.2	6.1
	Trigonella anguina	0.46	8.97	8.37	0.80	77.0	12.0	18.0
	Hamada elegans	0.17	6.07	3.77	0.48	112.0	3.5	21.7
	Lycium shawii	0.45	8.59	13.21	1.64	115.5	8.2	23.0
	Rhayza stricta	0.22	8.75	2.68	0.54	49.0	14.0	7.1
	Calotropis procera	0.41	10.79	9.36	0.93	59.5	3.5	14.5
	Ziziphus nummularia	0.42	7.56	9.17	1.06	94.5	6.0	18.0
	Acacia gerrardii	1.57	10.61	12.20	2.32	73.5	8.9	18.0
Al-Khabiah	**Bare soil (Control)**	0.66	7.20	3.45	0.63	42.0	0.4	25.6
	Tripleurospermum auriculatum	0.98	17.07	24.84	3.30	77.0	9.5	24.3
	Launaea capitata	1.30	21.90	10.98	1.45	77.0	9.1	72.6
	Trigonella anguina	1.39	24.96	10.26	1.52	129.5	8.9	35.6
	Hamada elegans	1.07	6.51	2.33	0.68	66.5	9.2	23.0
	Lycium shawii	1.13	19.92	11.81	2.10	81.5	9.6	28.4
	Rhayza stricta	0.91	19.98	20.44	2.42	77.0	8.2	21.7
	Calotropis procera	1.05	7.31	2.09	0.95	42.0	1.2	43.5
	Ziziphus nummularia	1.32	16.48	6.82	1.81	59.5	13.6	24.3
	Acacia gerrardii	0.94	14.23	11.44	2.26	59.5	14.2	18.0
Shoaib Harimlae	**Bare soil (Control)**	0.27	5.29	2.53	0.34	42.0	0.3	6.1
	Tripleurospermum auriculatum	0.47	9.71	7.01	0.86	94.5	20.2	35.6
	Launaea capitata	0.42	10.35	7.98	1.12	112.0	22.1	45.1
	Trigonella anguina	0.63	21.40	11.59	1.19	77.0	17.7	14.5
	Hamada elegans	0.47	7.68	6.54	1.16	115.5	3.9	14.5
	Lycium shawii	0.24	5.91	4.22	0.46	59.5	13.5	19.2
	Rhayza stricta	0.30	6.50	4.82	0.57	143.5	3.9	18.0
	Calotropis procera	0.32	7.15	5.33	0.79	59.5	6.8	34.1
	Ziziphus nummularia	0.74	6.66	5.97	0.43	24.5	14.5	11.2
	Acacia gerrardii	1.02	14.43	22.66	1.62	59.5	0.5	24.3
Al-Masoudi	**Bare soil (Control)**	0.18	7.70	2.90	0.63	42.0	0.3	8.1
	Tripleurospermum auriculatum	0.89	19.43	12.19	1.51	59.5	10.7	25.6
	Launaea capitata	0.96	17.36	10.82	1.54	59.5	18.9	21.7
	Trigonella anguina	1.66	39.62	29.42	3.33	164.5	32.6	31.2
	Hamada elegans	0.27	7.44	5.87	0.95	129.5	15.7	23.0
	Lycium shawii	1.04	17.25	14.02	1.78	24.5	20.3	43.5
	Rhayza stricta	0.17	8.76	3.96	0.41	42.0	12.0	10.1
	Calotropis procera	0.74	15.46	11.43	1.29	59.5	9.0	34.1
	Ziziphus nummularia	0.61	40.22	8.31	0.91	59.5	0.9	15.6
	Acacia gerrardii	0.54	31.76	5.13	0.69	42.0	8.2	15.6

Table 5. Spore population and percent colonization of arbuscular mycorrhizal fungi in different plants.

Type of plant	Location							
	Al Khrarah		Al -Masoudi		Shoaib Hraimla		Al -Khabiah	
	Spore No./100 g dry soil	Colonization (%)	Spore No./100 g dry soil	Colonization (%)	Spore No./100 g dry soil	Colonization (%)	Spore No./100 g dry soil	Colonization (%)
Tripleurospermum auriculatum	168	76	43	35.83	77	30.06	168	78
Launaea capitata	119	0	121	50	200	57.77	119	0
Trigonella anguina	76	22.22	92	83.33	137	69.08	75	24.22
Hamada elegans	163	30.07	13	23.56	124	20.84	167	30.10
Lycium shawii	45	23.34	260	14.29	144	26.35	49	23.44
Rhayza stricta	57	0	1170	16.67	65	54.22	57	0
Calotropis procera	123	43.16	467	52.94	119	0	123	45.36
Ziziphus nummularia	88	0	120	8.33	103	0	92	0
Acacia gerrardii	67	42.21	133	42.11	106	36.72	87	44.21

Khaliel, [30] from Riyadh, Saudi Arabia studied the soil and root infection of some plants such as *Anisosciadium lanatum, Korwoodia dicksoniae, tripleurospermum auriculatum, Anthemis deserti, Rhazya stricta* and *Panicum turgidum* and found the presence of AMF belonging to two species: *Glomus fasciculatum* and *G. mosseae*. He also mentioned that the domination of *G. mosseae* is due to the alkalinity of the soil. Also, Khaliel and Abu Heilah, [31] reported the presence of mycorrhizae with date palm growing in Qassim, Saudi Arabia the occurrence of AMF at different soils of Saudi Arabia was reported by few other researchers, [32-33]. The occurrence of spore did not follow the regular manner with the percent infection of AMF. Spore population was higher in some soil, but infectivity of plants was less. The highest spore population recorded with *Rhayza stricta* plants **(**1170) at Al-Masoudi meadows which was followed by *Calotropis procera* plants *and* the *Ziziphus nummularia* plants and the lowest was recorded with *Hamada elegans* plants. This similar to result found by Malibari *et al* [34]. The range of spore population was 31-246 in the Al-khabia. In Shoaib Huraimilla the spore population was varied from 65-200. In Al-Khrarah meadows the variation of spore number was 45-168. Al-Garni, [32] reported a wide variation among samples for spore populations with the field soils and infectivity of AMF with roots from a study at the Al- Taif soils and standing crops.

But there was no mention of structural variation with AMF in any individual plant species. Al-Whaibi [35] in a review of desert plants and mycorrhizae, mentioned occurrence and diversity of mycorrhizae in desert plants. From the present assessment of colonization and spore population study, it is important to note that most of the selected plants species were highly mycorrhizal. Generally, the plant species which have high infection in the roots have also produced a higher number of spores from the rhizosphere soils with little exceptions. As expected, desert, plants in the arid meadow in Riyadh region Saudi Arabia are well adapted to water scarcity and harsh climatic condition. They are active mainly during wet reason of the year producing a highly complex vegetation cover ranging from trees to herbs, shrubs and grasses. The shrubs and grasses prefer to grow under trees and others big plants in short period of wet season and they play an important role in organic mutter addition to meadows soils after short life cycle. *Trigonella anguina***.** In conclusion obtained result suggests that possibility of complexity micro-environmental heterogenic in rhizosphere & rhizoplane in Saudi meadows. Which should be studied extensively in future, molecular techniques can be used in microbial ecology to understand microbial-rhizosphere ecosystem.

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