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Plant Abundance Soil Relationship of Three Annual Medicinal Plants in the Kingdom of Bahrain (Bahrain Island)

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Abstract:

The annual plants *Aizoon canariense L., Asphodelus tenuifolius Cav., and Emex spinosa Campd*. **are used in traditional medicine in Bahrain, Arabian Peninsula, and many of the west Asian countries. They are sometimes considered as weeds in United States, Australia, and South Africa. Their importance as remedies is evidenced by the many medicinal uses in various body aliments. Medicinal uses include indigestion, reduction of blood pressure, piles and constipation, purgative, and labor inducer. Accordingly, they could be sources of active ingredients in pharmaceutical industry. Understanding the ecology and distribution of these species could be useful in any cultivation activities or conservation efforts. Therefore, this study tried to determine the soil factors that affect their distribution and abundance. Multivariate analyses and Principal Component Analysis were used to test for the statistical relationships.** *Asphodelus tenuifolius* **was found predominantly in the desert sandy habitat, while** *Aizoon canariense* **and** *Emex spinosa* **were found in both desert and agriculture habitats. Specific soil factors including calcium carbonate ($CaCO_3$), electrical conductivity (EC), sand, and silt were shown to affect the abundance of the three species.**

1. Introduction

The distribution and abundance of annual species are affected by the efficiency of seed dispersal as well as the suitable safe sites that provide the appropriate environment for the successful germination and growth of seeds (Rebollo *et al*., 2001; Rivas-Arancibia *et al*., 2006).

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Amount of rain, temperature, relative humidity, and soil moisture are among some of the factors that may affect seed germination percentages (Friedman *et al*., 1977; Sarig *et al*., 1994). Other factors, such as soil water content, day length, soil organic matter availability, may affect plant development, flowering and seed yield (Gutierrez and Whitford, 1987; Fridley, 2003). In addition to the main role of water availability for the germination and growth of annual plants in desert environments, other soil factors such as depth, parental material, and texture should be taken into consideration (Clauss and Venable, 2000). Life strategies and maximization of resources utilization lead to variation in abundance and biomass of plant species. Mamolos (2006) has demonstrated a temporal differentiation in maximum biomass and nutrient accumulation rates in two existing annual plant species in Greece. Berg and Steinberger (2012) have shown that biomass, plant density, species richness, and composition values of annual plants were higher during the wet growing season in desert ecosystems. Dominance of annuals in the desert flora during the rainy seasons was reported in Kuwait (Halwagy *et al*., 1982), Bahrain (El-Oqlah and Abbas, 1992), and Egypt (Abd El-Ghani and Amer, 2003).

Many of the annuals in Bahrain and other countries in the Arabian Peninsula are used in traditional medicine. Examples of the annual medicinal plants are *Aizoon canariense* L., *Asphodelus tenuifolius* Cav., and *Emex spinosa* Campd. These species are used in the herbal medicine in Bahrain, the Arabian Peninsula, and other countries. *A. canariense* is edible (Burkill, 1985; Neuwinger, 2000), used for indigestion and flatulence (Al-Saleh *et al*., 1993), and for reducing blood pressure (Mossa *et al*., 1983). *A. tenuifolius* is edible (Rizk, 1986), used for the treatment of piles (Qureshi and Bhatti, 2008), constipation, measles, and anemia (Hammiche and Maiza, 2006), diuretic (Al-Yahya *et al*., 1987), ulcers and inflammations (Baquar, 1989), and as laxative (Abu-Rumailah, 1988). *E. spinosa* is used for constipation (El-Hilaly *et al*., 2003), purgative (AtiqurRahman *et al*., 2004), labor inducer (Al-Yahya *et al*., 1987), and for jaundice (Al-Yahya *et al*., 1987; Al-Saleh *et al*., 1993). Recent studies have shown the potential of the three plant species as a source of fatty acids: ã-linolenic acid and dihomo- ã-linolenic acid (Freije *et al*., 2013), and as antioxidants (Allaith *et al*., 2015).

A. *canariense* is a prostrate annual herb with alternate branches and leaves. The flowers are 4-8 mm in length, sessile, and solitary in leaf axis (Batanouny, 1981). Perianth segments are white green. The plant is common in Bahrain, especially in compact shallow soils, appearing after drying of rainfall. *A*. *tenuifolius* is an erect annual herb with fistulose leaves. Flowers are usually white with purple or blue bands. It is common in desert sandy shallow areas. *E. spinosa* is a glabrous erect annual plant. The leaves are petiolate-ovate. The perianth is urn-shaped, greenish red and the plant is common in depressions, especially in cultivated areas (Batanouny, 1981).

In addition to the need for biochemical and pharmaceutical studies, ecological studies are important to elucidate the environmental conditions and the factors that affect the survival and growth of plants with potential use in industry. This study attempts to find out the soil factors that control the distribution and abundance of three annual medicinal plants that occur during the rainy season in contrasting habitats in Bahrain. Specifically, the objectives of this study are (1) to determine the main groups of soil factors that explain the variability among the habitats of the three species, and (2) to determine the soil factorss that affect the abundance of each species.

Material and Methods

Study area

Bahrain is an archipelago in the Arabian Gulf 25 km off the eastern Saudi Arabian coast (Figure 1). According to Bahrain Civil Aviation Directorate data, the climate of Bahrain is characterized by a dry period extending from March to November. Rainfall is rare, scattered, and occurs in the period extending from December to February with a maximum monthly value of 17 mm and an annual value of 74 mm. According to Doornkamp *et al*. (1980), Bahrain is divided into five physiographic zones: the Central plateau and jabals (small mountains), the interior basin, the multiple escarpments, the main backslope, and the coastal lowlands. Within these zones, a number of habitats have been identified by El-Oqlah and Abbas (1992). The habitats include conglomerates, sand dunes, sabkhas (saline soils), mangrove, and others.

Preliminary survey

A preliminary survey of the occurrence of the three plant species, *Aizoon canariense* L., *Asphodelus tenuifolius* Cav., and *Emex spinosa* Campd., was carried out during the wet month of February to determine the locations where the plants are found. As a result of this survey, 10 locations were selected. They were in the west, north, and middle of the island. Each of the selected plant species was found in a number of these locations. The locations represent similar or, in some cases, different habitats. Agricultural wasteland habitat is represented by S1, S2, S4, S5, and S10. Desert habitat is represented by S3, S6, S7, S8, and S9. *Aizoon canariense* was collected from 5 locations (S1, S2, S3, S6, and S9). *Asphodelus tenuifolius* was collected from 4 locations (S6, S7, S8, and S9). *Emex spinosus* was collected from 7 locations (S2, S3, S4, S5, S6, S8, and S10). The actual survey was carried out after two weeks from the preliminary survey.

Plant sampling

Plant cover was used as an indicator of abundance. In each location the cover of the species under study was estimated based on Braun-Blanquet method (Kent and Coker, 1992). Cover was estimated in a representative stand of 100 m^2. It was expressed on a scale from 1 to 9 according to Guach (1982): 1 = $\leqslant$ 0.5%; 2 = 0.5-1%; 3 = 1-2%; 4 = 2-4%; 5 = 4-8%; 6 = 8-16%; 7 = 16-32%; 8 = 32-64%; 9 = 64-100%.

Soil sampling

The top 1-2 cm of the soil surface was first scraped and then a 1-2 kg of soil from the upper 20-30 cm was collected in a plastic bag and taken to the laboratory. A total of 3 to 9 replicates of soil samples were collected from each location.

Soil preparation and analysis

Soil samples were air-dried and sieved through a 2 mm mesh. The sieved samples were used for the physical and chemical analyses. The following analyses were carried out: soil texture, pH, electrical conductivity (EC), calcite ($CaCO_3$), gypsum ($CaSO_4.2H_2O$), chloride (Cl^-), and sulfate (SO_4^{2-}). In addition, the following elements were determined: Fe, Ca^{2+}, Mg^{2+}, K^+, and Na^+. Soil texture determination was based on the hydrometer method (Ryan *et al.*, 2001). The pH was determined using Metrohm 827 pH Lab. Electrical conductivity (EC) was determined using Jenway PWA1 water analyzer (UK). $CaCO_3$ was determined according to the titrimetric method (Ryan *et al.*, 2001). Precipitation method was used for the determination of gypsum as given by Ryan *et al.* (2001). Chloride was determined using silver nitrate titration method (Ryan *et al.*, 2001). Sulfate was determined by the turbidimetric method (Ryan *et al.*, 2001). Total Fe, Ca, Mg, K, and Na concentrations were determined in the acid digest using Inductively Coupled Plasma (Shimadzu ICPE-9000 Emission Spectrophotometer, Japan).

Statistical analysis

Descriptive statistics

Excel (Microsoft Corporation, USA) and SPSS (version 19, Chicago, IL, USA) were used for statistical analyses. Descriptive statistics were calculated for each soil variable (factor). The statistics include minimum, maximum, mean, and median. Chemical analyses of all factors were carried out for the soil of the 10 sites. For any one factor, a minimum of three replicates were made. In some sites, however, up to 9 replicates for some factors were made.

Multivariate analysis

A number of multivariate analyses were carried out to investigate the relationship between species abundance and soil factors. Initially the data of 10 locations were tested for variability to determine the core groups of soil factors that characterize the sampled sites. These analyses included factor analysis and canonical discriminant functions. This was then tested by ordination and linear multiple regression.

Factor analysis extraction for grouping and reduction of variables was conducted based on Principal Component Analysis (PCA) using SPSS software. Differences between groups and within group (components) were measured by calculating the Canonical Discriminant Functions. The obtained components were used as precursors to multiple regressions and in multivariate analysis of variance.

Linear multiple regressions were carried out to determine the variables that affect the abundance of all the three species collectively, and to predict the variables that affect the abundance of each species independently of other species.

Results

Abundance

The results reveal that *Aizoon canariense* has lowest abundance in S9 with a cover scale value of 1 ($\leqslant$ 0.5%) and has highest abundance in S3 with a cover scale value of 3 (1-2%). Asphodelus tenuifolius has lowest abundance in S6 and S8 with a cover scale value of 3 (1-2%) and has highest abundance in S7 with a cover scale value of 6 (8-16%). Emex spinosa has lowest abundance in S6 with a cover scale value of 1 ($\leqslant$ 0.5%) and has highest abundance in S2 and S5 with a cover scale value of 5 (4-8%).

Soil characteristics

The descriptive statistics minimum, maximum, mean with standard deviation, and median for the measured soil factors for each plant species are shown in Table 1. Some of the highlights of this data which reflects apparent differences among the three species are clay (maximum for *A. canariense* is 8.7% and maximum for *A. tenuifolius* and *E. spinosa* is 33.1%); median of $CaCO_3$ for *A. canariense* is 30.1% compared to 49.5 and 50.5% for *E. spinosa* and *A. tenuifolius*, respectively; median of chloride is 6.0 meql-1 for *A. tenuifolius* compared to 12.3 meql-1 for *E. spinosa*; and Fe median is 9.15 mg kg-1 for *A. tenuifolius* compared to 1370 mg kg-1 for *A. canariense*.

Multivariate analysis

The three components of factor analysis explain 58% of the total variability. The first explains 23.44%, the second 18.25% and the third 16.49%. It is apparent from the Rotated Component Matrix that component 1 contains both high positive (silt and clay) and negative (sand and pH) loadings (bipolar) and strongly reflects the loadings of soil texture and pH. The second component also contains both high positive and negative loadings (bipolar). These loadings reflect variables with anionic nature: calcium carbonate (CO_3^{2-}), calcium sulfate (SO_4^{2-}), and total sulfate (SO_4^{2-}). The third component contains four high positive loadings which are all cationic species: iron (Fe^{2+}, Fe^{3+}), potassium (K^+), magnesium (Mg^{2+}), and sodium (Na^+). The results of a high eigen value (>0.7) and a small lambda coefficient (Ô-0.2) support the variability among the three components (Table 3).

The results of the linear multivariate regression analysis, as measured by Pearson's correlation, show that the abundance of *A. canariense* is negatively correlated at the 0.01 probability level with silt (-0.389) and $CaCO_3$ (-0.346). The abundance of *E. spinosa* is negatively correlated at the 0.01 probability level with EC (-0.515) and positively correlated at the 0.01 probability level with Cl- (0.465). The abundance of *A. tenuifolius* is positively correlated at the 0.01 probability level with EC (0.461). Results of correlations among species show that there is a significant negative correlation at the 0.01 level between *A. tenuifolius and A. canariense* (-0.394) and *E. spinosa* (-0.404), respectively. Also, there is a significant negative correlation at the 0.01 level between *A. canariense* and *E. spinosa* (-0.397).

Discussion

Annual plants success in desert ecosystems is influenced by a number of factors including factors related to water availability such as rainfall, temperature, and substrate type (Rivas-Arancibia *et al*., 2006). Krueger-Mangold *et al*. (2004) demonstrated in manipulated experiments that nitrogen addition increased the native grass biomass by 50%. In a study on the desert ecosystem, Berg and Steinberger (2012) found that some annual species were more associated with the perennial shrubs while others were more associated with the open area. Hegazy *et al*. (2009) used two-way indicator species analysis and

Detrended Correspondence Analysis (DCA) to show a significant association between the floristic composition of the seed bank along altitudinal gradient in the Red Sea region and the edaphic factors such as $CaCO_3$, electrical conductivity, organic carbon and soil texture. Similarly, El-Sheikh *et al.* (2010) used DCA and Canonical Correspondence Analysis (CCA) to show that, among other factors, nutrients contents, salinity, sand and silt components affected the distribution of phytogenic hillocks in Kuwait. Also, salinity, moisture, and gravel content accounted for most of the floristic variation in semi-arid Mediterranean old fields in Spain (Cañadas *et al.*, 2010). Shoab *et al.* (2012) reported the results of laboratory seed germination experiments of *Emex spinosa*. The germination showed different values in response to a range of temperatures, light-dark cycles, and different concentrations of salinity.

Most of the studies on *E. spinosa* were biological control studies (Scott and Yeoh, 2005; Palmer *et al.*, 2010). Also, it was mentioned in a number of ethnobotanical and pharmaceutical studies (El-Hilaly *et al.*, 2003). Otherwise, it was reported as part of flora or vegetation reports (Fernández-Lugo, 2009; El-Sheikh *et al.*, 2010). Similarly, *A. tenuifolius* was reported in many studies as a medicinal plant (Hammiche and Maiza, 2006; Qureshi and Bhatti, 2008; Mosaddaegh, 2012), and as part of a flora (Jeddi and Chaieb, 2010), or an alien species (Boatwright, 2012). For its part, *A. canariese* is usually mentioned in the list of flora or vegetation in some ecological studies (1995; El-Ghanim *et al.*, 2010; Hegazy *et al.*, 2009).

Flora studies of the Arabian Peninsula region (Batanouny, 1981; El-Eisawi 1998) report that *A. tenuifolius* inhabits depressions and marginal lands; *A. canariense* inhabits compact shallow alluvial soils and depressions of deserts, and is a common weed in plantations; and *E. spinosa* inhabits fine sandy soils, and as weed in plantations. The locations from which the plants of the present study were sampled show similarity in the habitat types with those found in the region. *A. canariense* was found in agricultural wastelands and desert habitats, *A.tenuifolius* was found in desert habitats, and *E. spinosa* was mainly found as weed in agricultural areas and alluvial areas in desert. *E.*

spinosa occurred in 70% of the surveyed locations (Table 1) which are either agricultural or alluvial depressions. This distribution conforms to a number of studies which report that this is an opportunistic ruderal weed (Omar *et al.* 2005; Palmer *et al.*, 2010; Scott and Yeoh, 2005). *A. tenuifolius*, however, is restricted to 40% of the locations which are all representative of desert habitat (Table 1). Although very few studies focus on the detailed ecology of *A. tenuifolius*, it is reported to be native of Saharo Arabian -Sudanian phytogeographic region (Mandaville, 1990). It was found in desert environments and steppes of arid Mediterranean zones (Jeddi and Chaieb, 2010) and sand dunes (Rubinstein *et al.*, 2013), as well as an invasive species of sandy soils in many parts of the world (Boatwright, 2012).

In a study by Rodríguez *et al.* (2005) about plant succession and soil degradation in desertified areas in Spain, *A. canariense* was one of the short-lived therophytes that characterized halophile scrub habitat. This habitat had 163 g kg^{-1} $CaCO_3$ and 2.7 g kg^{-1} Fe. Similarly, Abdel-Fattah and Ali (2005) reported the presence of *A. canariense* in a sand plain in Saudi Arabia with 16.36% $CaCO_3$ and 7% Cl^{-1}. These values are in line with our results for $CaCO_3$ (33.9%), Fe (1370 mg kg^{-1}), and Chloride (8.6 meq l^{-1}). Shoab *et al.* (2012) reported that germination of *E. spinosa* was reduced with increased concentration of NaCl and osmotic potential. This indicates that *E. spinosa* prefers non-saline habitats. Our study shows that soil EC in which *E. spinosa* was found was relatively low with a mean of 1.32 mS cm^{-1} (Table 3).

Bahrain is a small island. The distance from the midpoint of the island, where the small mountain and plateau are located, to the east and west coasts, is around 10 km. Habitats and microhabitats are diverse. The distribution and abundance of the three studied species reflects this diversity. Table 5 shows negative correlations among the three species, particularly between *A. tenuifolius* and *E. spinosa*. The former was only found in desert habitats and the latter was mainly found in agricultural areas.

In addition to being in line with general findings by other researchers as mentioned above, our study specifically and statistically highlights the relationship between the three plants and the environmental variables. The results of the multivariate analysis (Table 3) show a positive significant correlation between *A. canariense* and sand (0.234 at 0.05 level), a negative significant correlation with silt (-0.389 at 0.01 level), and a negative correlation with $CaCO_3$ (-0.346 at 0.01 level). The abundance of *E. spinosa* shows a negative significant correlation with EC (- 0.515at 0.01 level) and a positive correlation with Cl^- (0.465 at 0.01 level). *A. tenuifolius*, which was found in desert locations in this study, has a highly significant correlation with EC (0.461 at 0.01 level).

Conclusion

The plants under study are used by many people in some geographical locations as medicinal plants especially in the Middle East and the Arabian Peninsula. Globally, many pharmaceutical industries invest millions of dollars on the process of discovering active ingredients from nature. According to correlation analyses, the main factors that seem to affect the abundance of *A. canariense* were sand, silt, $CaCO_3$, of *E. spinosa* were EC and Cl^-; and of abundance of *A. tenuifolius* was EC. Our results could help in understanding the ecological requirements by these plants for potential pharmaceutical and industrial applications.

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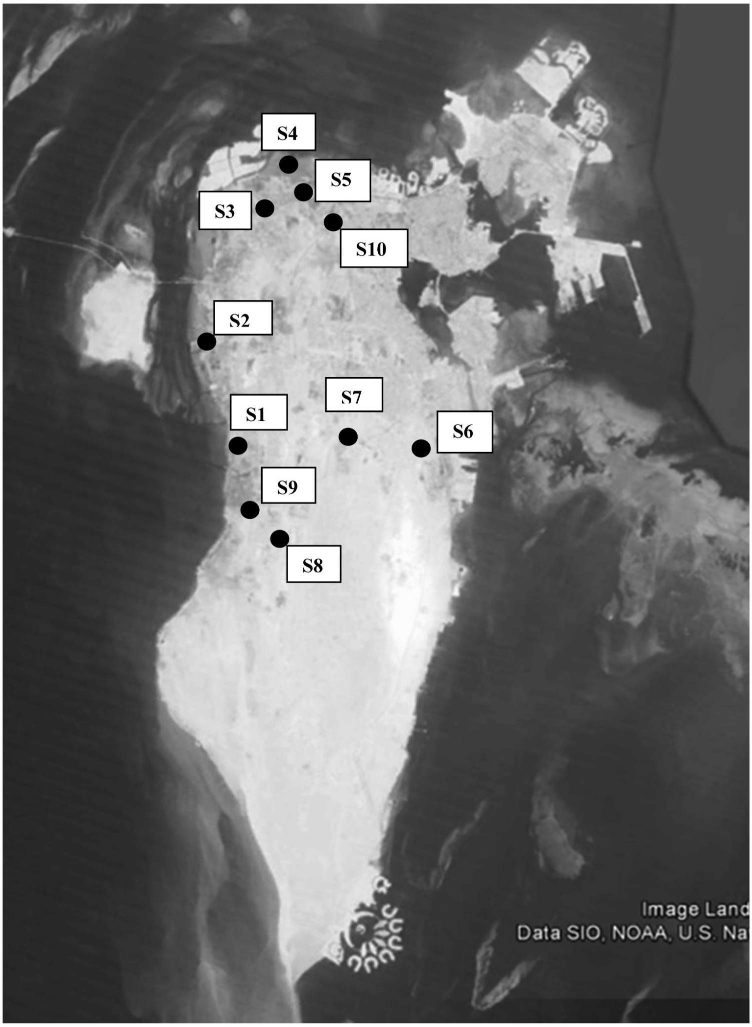

Figure (1) - Map of Bahrain showing the distribution of sampling locations.

Table (1)
Abundance of Aizoon canariense, Asphodelus tenuifolius, and Emexs pinosus in the different locations expressed as percentage cover and classification scale

Site No.	Location	Northing	Easting	Aizoon canariense		Asphodelus tenuifolius		Emex spinosa	
				Cover (%)	Scale	Cover (%)	Scale	Cover (%)	Scale
S1	Saddad	26 05 13.68	50 29 23.52	0.5-1	2	0	0	0	0
S2	Hamala	26 08 47.46	50 27 42.54	0.5-1	2	0	0	4-8	5
S3	Saar	26 11 18.36	50 28 59.28	1-2	3	0	0	1-2	3
S4	Barbar H	26 14 05.64	50 29 29.58	0	0	0	0	2-4	4
S5	Barbar G	26 13 39.42	50 30 55.86	0	0	0	0	4-8	5
S6	ALBA	26 06 14.82	50 36 03.06	0.5-1	2	1-2	3	⩽0.5	1
S7	Sakheer	26 02 31.62	50 34 28.08	0	0	8-16	6	0	0
S8	UOB South	26 02 41.09	50 31 07.66	0	0	1-2	3	0.5-1	2
S9	UOB West	26 02 40.36	50 31 34.52	⩽0.5	1	2-4	4	0	0
S10	Abu Saibaa	26 12 57.57	50 31 33.83	0	0	0	0	0.5-1	2

Table (2)

Soil characteristics from all sites for Aizoon canariense, Emex spinosa, and Asphodelus tenuifolius

	Aizoon canariense				**Asphodelus tenuifolius**				**Emex spinosa**			
	Minimum	**Maximum**	**Mean**	**Median**	**Minimum**	**Maximum**	**Mean**	**Median**	**Minimum**	**Maximum**	**Mean**	**Median**
pH	8.06	8.64	8.27	8.25	7.7	8.64	8.17	8.18	7.7	8.64	8.2	8.2
EC (mS cm^{-1})	0.52	2.58	1.62	2.03	0.52	2.58	1.41	0.99	0.5	3.07	1.32	0.99
Sand (%)	86.9	94.4	89.3	88.7	21.9	94.4	75	86.9	21.9	94.4	79.5	87.5
Silt (%)	2.5	7.5	3.4	3.1	2.5	45	14.4	6.2	0	45	10.8	5
Clay (%)	3.1	8.7	6.8	6.2	3.1	33.1	10.6	5.6	3.1	33.1	9.6	8.1
$CaCO_3$ (%)	9.1	53.3	33.9	30.1	24.5	53.3	45.1	50.5	18.5	53.3	44.5	49.5
Gypsum (meq/100g)	0.2	12.6	6.9	11.1	0.1	11.7	4.4	1.1	0.2	12.1	4.1	0.8
Chloride (meq l^{-1})	1.44	40.6	8.6	6.7	1.4	22.1	9.4	6.0	2.1	131.0	26.2	12.3
Sulphate (mg kg^{-1})	92.2	415.4	303.6	324.4	146.4	367.6	265	306.8	54	415.4	237.9	239.6
Fe (mg kg^{-1})	1.74	4706	1585	1370	2.35	4698	742	9.15	1.74	4706	849	16.3
Ca (mg kg^{-1})	280	273000	71832	4920	320	273000	43658	951	321	379000	90340	1270
Mg (mg kg^{-1})	679	20831	4938	4399	678	20831	3275	692	679	20831	3268	758
K (mg kg^{-1})	702	7410	2405	2133	1260	7410	2777	1994	874	8760	2824	2230
Na (mg kg^{-1})	293	5510	1709	856	302	4490	1211	624.5	428	6700	2044	856

Table (3)
Rotated component matrix of the soil factors.

Factors	Component		
	1	2	3
pH	-0.702	-0.367	
EC (mS cm^{-1})	0.307	0.301	
Sand (%)	-0.862		
Silt (%)	0.830		
Clay (%)	0.796		
Chloride (meq l^{-1})	0.463		
$CaCO_3$ (%)		-0.690	
Gypsum (meq/100g)		0.813	0.353
Ca (mg kg^{-1})			0.625
Fe (mg kg^{-1})			0.786
K (mg kg^{-1})		-0.495	
Mg (mg kg^{-1})			0.761
Na (mg kg^{-1})		0.306	0.643
Sulphate (mg kg^{-1})	-0.429	0.744	

Table (4)
Linear multivariate regression analyses between abundance of plant species and soil variables using transformed and fully imputed data.

	A. Canariense		E. spinosa		A. tenuifolius		All	
	Pearson's	Sign (*p*)	Pearson's	Sign (*p*)	Pearson's	Sign (*p*)	Pearson's	Sign (*p*)
pH	1.96	0.086	- 0.005	0.967	- 0.169	0.138	- 0.094	0.413
EC	0.272*	0.015	- 0.515**	0.000	0.461**	0.000	0.576**	0.000
Sand	0.234*	0.039	- 0.043	0.710	- 0.045	0.692	0.195	0.088
Silt	- 0.389**	0.001	- 0.074	0.521	0.194	0.088	0.053	0.646
Clay	- 0.112	0.328	0.097	0.397	- 0.053	0.645	- 0.087	0.449
Cl^-	- 0.183	0.108	0.465**	0.000	- 0.119	0.299	0.264*	0.019
$CaCO_3$	- 0.346**	0.002	- 0.022	0.852	0.159	0.163	- 0.055	0.630
$CaSO_4.2H_2O$	0.120	0.295	0.053	0.643	0.057	0.618	0.224*	0.049
Ca	0.025	0.830	0.096	0.405	- 0.098	0.392	0.000	0.999
Fe	0.186	0.102	- 0.040	0.725	- 0.168	0.142	- 0.141	0.220
K	0.030**	0.797	- 0.078	0.495	0.089	0.438	0.046	0.687
Mg	0.294	0.009	- 0.158	0.167	- 0.151	0.186	- 0.183	0.110
Na	0.035	0.758	0.106	0.354	- 0.074	0.519	0.052	0.650
Sulfate	0.108	0.347	- 0.083	0.472	0.098	0.393	0.108	0.347

** Correlation is significant at 0.01level
* Correlation is significant at 0.05 level

Table (5)
Correlation between the three species in all sites based on species abundance

		A. tenuifolius	A. canariense	E. spinosa
A. tenuifolius	Pearson Correlation	1	-.394**	-.404**
	Sig. (2-tailed)		.000	.000
	N	78	78	78
A. canariense	Pearson Correlation	-.394**	1	-.397**
	Sig. (2-tailed)	.000		.000
	N	78	78	78
E. spinosa	Pearson Correlation	-.404**	-.397**	1
	Sig. (2-tailed)	.000	.000	
	N	78	78	78

**. Correlation is significant at the 0.01 level (2-tailed)