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Floristic composition and vegetation analysis of wild legumes in Taif district, Saudi Arabia

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Abstract

Fabaceae (leguminous species) is the third-largest family of angiosperms. Floristical and vegetation analysis studies of wild leguminous species in Taif, Saudi Arabia were the prime aims of the current work. General survey of the studied area resulted to the selection of three different locations (Alshafa area (with its different habitats), Wadi seesed and Taif Hawia road (cutting many small wadies)) to study wild legumes in Taif. Twenty-six legume species with their chorology, life forms and associated species in various sites of Taif district were recorded. Soil analyses showed slight alkaline reaction with pH values (7.90- 8.02) and electric conductivity ranged between 0.84 and 7.31 (mmhos/cm). Soil mechanical analyses of the studied sites showed the appearance of sandy texture in most cases with exception of Wadi Seesed site. *Acacia gerrardii* was the most common species; it recorded in all localities of variable ecological conditions. Life forms of plants were dominated by phanerophytes. TWINSPAN classification of the associated species indicated eight different groups. Five new taxa recorded as naturalized in Taif district, *Parkinsonia aculeata*, *Leucaena leucocephala, Pithecellobium dulce*, *Acacia saligna* and *A. melanoxylon*. The study increases the knowledge of wild legume ecology in the studied area to maximize its use.

Keywords: Leguminous species, Soil analysis, Life form, Naturalized species, Taif district.

INTRODUCTION

Legumes ("Fabaceae") are the third-largest family of angiosperms, including ca. 730 genera and ca. 19,400 species (Lewis et al., 2005). It has played a very important role in human culture; it includes many useful plants such as crops, vegetables, ornamentals, medicinal and timber plants (Van der Maesen and Somaatmadja, 1992; Gepts et al., 2005; Brink and Belay, 2006; Saslis-Lagoudakis et al., 2011). In addition, it is well known that many legume species are symbiotic with nodule-forming bacteria with nitrogen fixation ability, and as such, support important ecosystem functions (Sprent, 2009). Nitrogen intake and conquest is second to photosynthesis in terms of importance for plant growth and development. Nitrogen fixation by legumes, play an important role in sustaining crop productivity and increasing land fertility of the semi-arid areas (Serraj et al., 2004). Hence, improving our knowledge about the ecological distribution of wild legumes is a matter of utmost importance to better understand how to keep it and increase their significance. Examination and selection of wild species, especially legumes, of economic importance with the ability to endure adverse ecological conditions is a basic goal to supply the demands of over population in many countries (Al Sherif, 2009, 2014). The Kingdom of Saudi Arabia extends across large areas of land comprising several geographical regions differ topographically, climatically and environmentally in general. This explain the high plant diversity in Saudi Arabia, especially in the southwestern region, which covered with natural forests. Collenette (1999) recorded that flora of Saudi Arabia includes 201 legume species and recently it reached 217 species.

Taif, the target study area, is a part of the south-western region of the kingdom of Saudi Arabia (21° 16″

58.33" N and 40° 24' 58.43" E), characterized by

mountainous terrain disseminated with arable lands and receives seasonal rains in the summer as well as continental rain in the winter with an average annual rainfall 119 mm/day. These areas are dominated by a sparse tree cover consists primarily of juniper trees in addition to other species such as Acacia, wild olive, and others. Mosalem (2007) recorded 17 legume species from Sudera (45 km southern east of Taif Governorate). Farrag (2012) estimated 7 species in Wadi Al-Argy, one of the important wadis of Taif region. The aim of the present study was to investigate the floristic composition, life forms and associated species of wild legume species in Taif province in different locations.

MATERIALS AND METHODS

Study area

Taif constitutes an extended part of the western Arabian Shield (21° 16'58.33" N and 40° 24' 58.43" E), which is covered by Neoproterozoic rocks consisting of various types of volcanics with several varieties of intrusive. Tertiary and Quaternary lavas and sediments cover these rocks. According to climatic data of Taif, a mean minimum temperature of 8.4 ºC in January and a mean maximum temperature of 35.1 ºC characterize the study area in Jun. with an annual mean temperature of 22.4 ºC. The rainfall in the region is erratic and irregular, the high precipitation occurs in May (30.6 mm/day) and in November (21.5 mm/day), however precipitation is scarce throughout the other months. The average annual rainfall is 119.4 mm/day. The mean monthly relative humidity ranges between 23% in June and 60% in January.

Vegetation analysis

The present study was carried out from June 2012 through June, 2014.
Three different locations namely Alshafa area (with its different habitats), Wadi seesed and Taif Hawia road (cutting many wadies), were selected after general survey of the studied area. Quadrate Transect techniques were used to study vegetation within the selected three locations. A sampling site was selected systematically according to the presence of legume species, habitats differences and the vegetation homogeneity. Numbers of stands were determined according to different habitats in each location. The area of each stand was 20 x 20 m, the present species were recorded and their cover was evaluated visually as percentage of the ground surface in 10 randomly sampled quadrats of area (5 x 5m each). The vegetation parameters included listing of all species and life forms. Species identification and nomenclature followed Chaudhary (1999, 2000 and 2001) and Boulos (1999, 2000, 2002 and 2005). Plant cover was estimated and the Specimens of each species were collected, identified and supplemented in Taif University Herbarium (TUH).

Vegetation classification

Vegetation classification technique was employed; the stand-species data matrix was classified into groups using the importance values of species by means of the Two Way Indicator Species Analysis (TWINSPAN) computer program (Hill, 1979).

Soil samples and analyses

Soil samples were collected from three different locations; three soil samples were collected from profile (0-50 cm depth) of each site, and then mixed well to form a composite soil sample. Soil texture was determined by Bouyoucos hydrometer method. Soil porosity was determined as described by Zahran (1987). Organic carbon was determined using Walkely and Black rapid titration method described by Piper (1947). Soil water extracts of 1:5 were prepared for determinations of soil reaction using pH meter Model HI 8519, and soil salinity (EC) using CMD 830 WPA conductivity meter. Calcium carbonate, Soluble chlorides, Sulphates, and bicarbonates and Soluble carbonates were determined according to Jackson (1962). The extractable sodium and potassium cations were estimated using flame photometer (Allen et al., 1986). While, extractable calcium and magnesium cations were determined using EDTA (0.01N) as described by Jackson (1962).

Data analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS ver.12). Means were separated using Duncan's multiple range test at a *P* value of 0.05.

RESULTS

Survey of many sites in Taif district revealed the presence of twenty-six legume species in three localities (Table 1); *Papilionoideae* is the largest subfamily (13 species belong to 11 genera); *Mimosoideae* has 11 species belong to 3 genera and *Caesalpinoideae* has two species. *Acacia* was the largest genus (represented by 9 species) followed by *Astragalus* (represented by 4 species, while *Medicago* and *Indigofera* (represented by 2 species). *Acacia gerrardii* was the most common

.

Table 1. List of legume species recorded form different sites in Taif district.

Species	Chorology	Life forms	Locations		
			A	B	C
Anagyris foetida L.	M, I-T	Ch	+	-	-
*Argyrolobium arabicum** (Decne) Jaub.&Spach	Sa-Si, I-T	H	+	-	-
Astragalus abyssinicus Steud. Ex.A. Rich.	Sa-Si, S-Z	H	+	-	-
Astragalus seiberi DC.	Sa-Si	H	-	-	+
Astragalus tribuloides Del.	Sa-Si, I-T	Th	+	-	-
Indigofera spinosa Forssk.	Sa-Si, S-Z	Ch	+	+	-
Indigofera coerulea Roxb.	Sa-Si, S-Z	Ch	-	+	-
Lotononis platycarpa (Viv.) Pic. Serm.	Sa-Si	Th	+	-	+
*Lotus glaber** Mill.	Cosm	H	+	-	-
*Medicago polymorpha** L.	M, I-T	Th	+	-	-
Melilotus indicus (L.) All.	Sa-Si, I-T, M	Th	+	-	-
*Onobrychis potlemica** (Delile) DC.	Sa-Si, I-T	H	-	+	-
*Taverniera aegyptiaca** DC.	Sa-Si	Ch	-	+	-
Acacia asak (Forssk.) Willd	Sa-Si, S-Z	Ph	-	+	-
Acacia ehrenbergiana Hayne	Sa-Si, S-Z	Ph	-	+	+
Acacia gerrardii Benth.	Sa-Si	Ph	+	+	+
Acacia etbaica Schweinf.	S-Z	Ph	+	+	-
*Acacia laeta** R.Br.	Sa-Si	Ph	-	-	+
*Acacia melanoxylon*** R.Br.	Australia	Ph	-	+	-
Acacia origena Hunde	Sa-Si, S-Z	Ph	+	-	-
*Acacia saligna*** (Labill.) H.L.Wendl	Australia	Ph	+	-	+
Acacia tortilis (Forssk.) Hayne	S-Z	Ph	-	+	+
*Leucaena leucocephala*** (Lam.) De Wit	Pantrop	Ph	+	+	+
*Pithecellobium dulce** (Roxb.) Benth.	Pantrop	Ph	-	+	-
*Parkinsonia aculeata** L.	Pantrop	Ph	-	-	+
Senna italic Mill.	S-Z	Ch	-	+	+

A = Alshafa, B = Wadi seesed, C = Taif–Hawia road. (*) = New record to Taif district and (**) = New record to Saudi Arabia

species; it was recorded in all localities of variable ecological conditions. *Leucaena leucocephala* was widespread in humid habitats. Five species were restricted to the humid elevated El-Shafa site viz. *Anagyris foetida, Argyrolobium arabicum, Astragallus abyssinicus, Acacia etbaica* and *A. origena*. *Lotus glaber*, *Medicago polymorpha* and *Melilotus indicus* were recorded in a small area of saturated fertile soil with very dense vegetation cover in the downstream of wadi El-Diek (Alshafa). In other sites, they were restricted to the sites reclaimed by man in the parks of transported soil. Life forms of plants were dominated by phanerophytes (12 species) and five species for each of therophytes, chamaephytes and hemicryptophytes. Species of Saharo-Sindian element are dominant, they were represented by 16 species (5 are mono-regional, 6 extend to Sudano-Zambezian domain, 5 extend to Irano-Turanian domain and one pluri-regional species). Sudano- Zambezian elements are common; four mono-regional species belong to this domain. Irano-Turanian

Table 2. The mean ± standard deviation of soil variable of the different studied sites

	Alshafa	Wadi seesed	Taif–Hawia Road
Organic carbon (%)	1.8^{a}±0.04	1.3^{b}±0.05	0.2^{a} ±0.05
pH value	7.92 ^{a} ±0.14	7.90 ^{a} ±0.17	8.02^{a} ±0.25
EC (mmhos/cm)	2.39^{a} ±0.007	2.10^{b} ±1.33	0.48 ^{a} ±0.006
Cl^{-} (%)	19.2^{b} ±1.24	6.7 ^{b} ±1.77	6.1 ^{a} ±0.85
SO_4^{--} (%)	68.1^{b} ±2.57	14.25 ^{a} ±0.04	1.24 ^{a} ±0.003
Soluble CO_3^{--} (%)	0.04 ^{a} ±0.001	0.06 ^{a} ±0.01	0.02 ^{a} ±0.001
HCO_3^{-} (%)	2.41^{b} ±0.03	1.37 ^{b} ±0.05	0.65^{a} ±0.003
Sodium (meq./L.)	18.9 ^{c} ±0.14	8.49 ^{c} ±0.5	3.9 ^{b} ±0.07
Potasium (meq./L.)	3.14 ^{b} ±0.04	0.39^{a}±0.005	0.55 ^{a} ±0.02
Calcium (meq./L.)	9.35^{b} ±0.67	10.6^{b} ±1.07	1.91 ^{a} ±0.004
Magnesium (meq./L.)	12.1^{c}±1.09	3.56 ^{b} ±0.09	1.48^{a} ±0.02
Coarse sand (%)	23.6^{a} ±0.18	4.2^{a} ±0.052	40.3 ^{a} ±1.29
Fine sand (%)	35.6^{a} ±2.62	26.1^{a} ±1.43	47.8 ^{a} ±2.42
Silt (%)	24.5^{a} ±2.24	34.1 ±2.25	10.4^{b} ±0.08
Clay (%)	16.3^{a} ±0.09	35.6 ^{a} ±1.65	1.5 ^{b} ±0.015
Porosity (%)	37^{a} ±2.68	54^{b} ±1.84	26.6^{b} ±0.75
Soil texture	Sandy clay	Loamy clay	Sandy
Elevation (m ASL)	1800	1560	1530

Values in a row sharing the same letter are not significantly different at the 0.05 level of probability

and Mediterranean elements were represented by two species; there are three Pantropical and two Australian species.

Soil analyses

The soil variables of the three studied sites indicated considerable variation in the edaphic factors among the different locations (Table 2). Organic carbon ranged between a maximum value of 1.8 % in the studied (Alshafa) and a minimum value reached 0.2 % in roadsides. Soil of the different sites showed slight alkaline reaction with pH values (7.9- 8.02). Electric conductivity showed wide range of values and recorded the maximum value in Alshafa (7.31 mmhos/cm), while Taif Hawia road attained the minimum value (0.48 mmhos/cm). Chlorides and sulphates intern follow the same trend as it recorded maximum values in Alshafa site while minimum values were recorded in Taif Hawia road. Similarly, Bicarbonates, Sodium, Potassium, Calcium and Magnesium follow the same trend. The given data in Table 2 showed that soluble carbonate recorded minimal values among other different soil variables. Soil mechanical analyses of the studied sites showed the appearance of sandy texture in most cases with exception of Seesed site.

Vegetation analysis for associated species

Field study revealed that 79 species were associated with the recorded wild legumes in Taif Governorate. The most common associated species were *Cynodon dactylon*, *Ochradenus baccatus* and *Pulicaria crispa* , while the least associated species were *Urtica pilulifera*, *Polygonum equisetiforms* and *Imperata cylindrica*. TWINSPAN resulted eight different groups for the associates' species (Figure 1), group A contained *Indigofera caerulea* and *Onobrychis potlemica* this group dominated by *Atriplex subercta* and with *polypogon monspeliensis* as codominant. Group B recorded in the main bed of wadi Seesed behind the dam where the soil is fertile and humid in the dry season. *Medicago polymorpha, Melilotus indicus* and *Lotus glaber*, the dominant species in this group was *cynodon dactylon*. Habitats of this group were a small area of saturated fertile soil with very dense vegetation cover in the

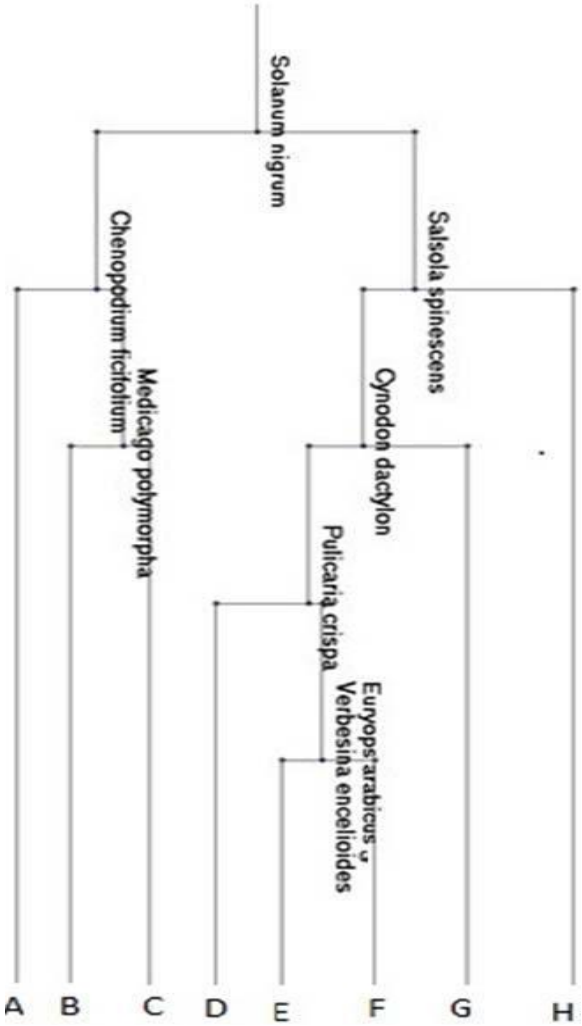

Figure 1. Dendogram of the eight groups identified after the application of TWINSPAN

downstream of wadi El-Diek (Alshafa). Group C was restricted to the road sides, rocky slopes and plateau in Alshafa. Group C was dominated by *Osteospermum vaillantii* and included Astragallus *abyssinicus*, *Acacia saligna, Leucaena leucocephala* and *Parkinsonia aculeate* with *A. gerradii* as codominant. In group D, *Pennisetum setaceum* was the dominant species with *p. divisum* and *stipagrostis plumose* as codominants. This group included *Taverniera aegyptiaca, Acacia asak, A. ehrenbergiana*, and *Pithecellobium dulce* and was recorded on the rocky slpoes of wadi Seesed and its tributaries. Group E included only one legume species, *A. melanoxylon* and was restricted in cultivated lands on the road sides of wadi Seesed. Group F *Astragalus seiberi, A. vogelii, Acacia asak*and *Lotononis platycarpa* were recorded in this group with *Pulicaria crispa* as a dominant in the main bed of wadi Shorieb (Taif Hawia road). Group G dominated by *Euryops arabicus* and *Argyrolobium arabicum* included *Astragalus seiberi*, A. *tribuloides, Lotononis platycarpa, Acacia etbaica, A. laeta,* and *A. origena* grow on the rocky slopes in Alshafa Highlands. Group H was dominated by the legume *A. tortilis* and included *I. spinosa*, *A*. *gerrardii, A. tortilis and Senna italica* in the wadi beds of tributaries of wadi Seesed.

DISCUSSION

The dominance of Saharo-Sindian elements can be attributed to the location of Taif district in the south west of Saudi Arabia, in the middle of great desert belt around the world which affects greatly its floristic composition. Because the studied area is near to the east region of

Africa, the Sudano-Zambezian elements are common. The presence of few Irano-Turanian and Mediterranean species can be caused by the high elevation (1500 – 2500m ASL) in AlShafa location. The presence of three Pantropical and two Australian species indicates the close habitat affinity and the wide ecological amplitude of our district and the active transitions between Saudi Arabia and these remote countries. The variations in species composition among the different habitat types may be attributed to the difference in soil characteristics (Hegazy et al., 2008; Al-Mefarrej, 2012). Organic carbon and Electric conductivity were two important ecological gradients affecting vegetation distribution (Farrag, 2012). In this respect, and in accordance with many studies in the arid and semiarid habitats, this study recorded maximum organic carbon in the wadi Seesed site as compared to others. The recorded electric conductivity of the main runnel site of Wadi Seesed was tripled or more as compared to other sites (Yang et al., 2006; Mosalam, 2007; Al-Mefarrej, 2012, Alsherif et al., 2013). This can be attributed to the high salt content in the main runnel as compared to the other studied habitat types and this was reported in other similar studies (Hegazy et al., 2004; Härdtle et al*.,* 2006). The positive correlation between species richness and organic carbon of the studied habitat types is in accordance with other studies (Yang et al., 2006; Farrag et al*.,* 2013). Consequently, the vegetational groups in the Wadi Seesed habitats of the present study were more diverse than those of the Taif Hawia road. Life form spectra provide information, which may help in assessing the response of vegetation to different environmental factors of diverse habitats (Ayyad and El-Ghareeb, 1982). On the other hand, rainy seasons provide better chance for the appearance of a considerable number of annuals, which give a characteristic physiognomy to their vegetation (Shaltout et al., 2010; Alatar et al*.,* 2012; Farrag, 2012). The vegetation is featured into associations where the dominant perennial species give the permanent character of plant cover in each habitat. In addition, the rather scanty rainfall in desert ecosystem is not adequate for the appearance of many annuals. Accordingly, the present study indicated the predominance of phanerophytes (including different *Acacia* spp.) in the vegetation of Taif Hawia road, Wadi Seesed and Al Shafa. Furthermore, elevation gradients among the studied sites create varied climates, which combined with resultant soil differences, and both can promote diversification of plants (Brown, 2001). Species restricted to Alshafa (*Acacia origena*, *Astragalus abyssinicus* , *Anagyris foetida* and *Argyrolobium arabicum*) or to Wadi Seesed (*Acacia trotilis, A. asak, A. ehrenbergiana , Indigofera coerulea, Onobrychis potlemica* and *Taverniera aegyptiaca*) are controlled by elevation. The current study increases our knowledge of wild legume vegetation in the studied area to maximize its use.

REFERENCES

Al Sherif EA (2014). Unconventional fodders from Khulais, Western Saudi Arabia. Bothalia J. 44 (4): 127-136.

Al Sherif EA (2009). *Melilotus indicus* (L.) All., a salt-tolerant wild leguminous herb with high potential for use as a forage crop in salt-affected soils. Flora. 204: 737–746

Alsherif, EA, Ayesh AM, Rawi SM (2013). Floristic composition, life form and chorology of plant life at khulais region, western Saudi Arabia. Pak. J. Bot. 45: 29-38.

Alatar A, El-Sheikh MA, Thomas J (2012. Vegetation analysis of Wadi Al-Jufair, a hyper-arid region in Najd, Saudi Arabia. Saudi J. Biol. Sci. 19: 43–54.

Allen SE, Grimshaw HM, Parkinson JA, Quarmby C, Roberts JD (1986). *Methods in plant ecology*. 2nd edition (Ed. by Moore, P. D. and Chapman, S. B.) Blackwell Scientific Publications, Oxford, 411-466.

Al-Mefarrej H (2012). Diversity and frequency of *Acacia* spp. in three regions in the Kingdom of Saudi Arabia. Afri. J. of Biotech. 11(52): 11420-11430.

Ayyad MA, El-Ghareeb REM (1982). Salt marsh vegetation of the western Mediterranean desert of Egypt. *Vegetatio*. 49: 3-19.

Boulos L (1999). Flora of Egypt, Vol. 1. Azollaceae- Oxalidaceae. Al Hadara Publishing, Cairo, 417pp.

Boulos L (2000). Flora of Egypt. Al Hadara, Cairo, Egypt.

Boulos L (2002). Flora of Egypt. Al Hadara, Cairo, Egypt.

Boulos L (2005). Flora of Egypt. Al Hadara, Cairo, Egypt.

Brink M, Belay GE **(**2006). Plant resources of tropical Africa: Conclusions and recommendations based on PROTA 1; Cereals and pulses. Leiden: Backhuys.

Brown J (2001). Mammals on mountainsides: elevational patterns of diversity. Glob. Ecol. Biogeogr. 10(1):101-109.

Chaudhary S (1999). Flora of the Kingdom of Saudi Arabia. Vol. 1, Ministry of Agri .and Water, Riaydh. 691p.

Chaudhary S (2000). Flora of the Kingdom of Saudi Arabia. Vol. 1, Ministry of Agri .and Water, Riyadh. 432p.

Chaudhary S (2001). Flora of the Kingdom of Saudi Arabia. Vol. III, Ministry of Agri. and Water, Riyadh.

Collenette S (1999). Wild Flowers of Saudi Arabia. NCWCD (National commission for Wildlife Conservation and Development, Publication), Saudi Arabia. 799 pp.

Farrag HF (2012). Floristic composition and vegetation-soil relationships in Wadi Al-Argy of Taif region, Saudi Arabia. Int. Res. J. of Pl. Sci. 3(8): 147-157.

Farrag HF, Sliai AM, Mhmas TF (2013). Allelopathic potentiality of two *Heliotropium* species on germination and protein expression of some plants. Int. Res. J. Biotech. 4(3): 47-60.

Gepts P, Beavis WD, Brummer EC, Shoemaker RC, Stalker HT, Weeden NF, Young ND (2005). Legumes as a model plant family: Genomics for food and feed report of the cross legume advances through genomics conference. Plant Physiol. 137: 1228–1235.

Härdtle W, Redecker B, Assmann TT, Meyer H (2006). Vegetation responses to environmental conditions in flood plain grasslands: Prerequisites for preserving plant species diversity. Basic. and Appl. Ecol. 7: 280-288.

Hegazy AK, Fahmy GM, Ali MI, Gomaa NH (2004) . Vegetation diversity in natural and agro-ecosystems of arid lands. Comm. Ecol. 5: 163-176.

Hegazy AK, Mussa SAI, Farrag HF (2008). Invasive Plant Communities in the Nile Delta Coast. Glob. J. Environ. Res. 2(1): 53-61.

Hill MO (1979). TWINSPAN- A FORTRAN program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Section of Ecology and Systematics. Cornell University, Ithaca, New York. http://dx.doi.org/10.1371/journal.pone.0022275

Jackson ML, 1962. *Soil Chemical Analysis*. Constable and Co. Ltd., London.

Lewis G, Schrire B, Mackinder B, Lock M (eds.), 2005. *Legumes of the World*. Royal Botanic Gardens, Kew.

Mosalam H (2007). Comparative Study on the Vegetation of Protected and Non protected Areas, Sudera, Taif, Saudi Arabia. Int. J. Agric. Biol. 9(2): 202-214.

Piper CS (1947). *Soil and Plant Analysis*. Interscience Publishers, Inc., New York.

Saslis-Lagoudakis CH, Klitgaard BB, Forest F, Francis L, Savolainen V, Williamson EM, Hawkins (JA**) (**2011). The use of phylogeny to interpret cross-cultural patterns in plant use and guide medicinal plant discovery: An example from *Pterocarpus* (Leguminosae). *PloS One* 6: e22275.

Serraj R, Adu-Gyamfi J, Rupela OP, Drevon JJ (2004). Improvement of legume productivity and role of symbiotic nitrogen fixation in cropping systems: overcoming the physiological and agronomic limitations. In: Symbiotic nitrogen fixation: prospects for enhanced application in tropical agriculture. Serrah, R. (ed.), pp 67-97.

Shaltout KH, Sheded MG, Salem AM (2010). Vegetation spatial heterogeneity in a hyper arid Biosphere Reserve area in north Africa. *Acta Botanica Croatea*, 69(1): 31–46.

Sprent J (2009). *Legume Nodulation. A Global Perspective*. Wiley-Blackwell, Ltd., Publication. 220pp.

Van der Maesen LJG, Somaatmadja SE **(**1992). *Plant resources of South East* Asia (PROSEA), no. 1, Pulses. Wageningen: Pudoc.

Yang H, Lu Q, Wu B, Zhang J, Lin Y (2006). Vegetation diversity and its application in sandy desert revegetation on Tibetan Plateau. J. Arid Environ. 65: 619-631.

Zahran MA (1987). Comparative ecophsiological studies on *Puccinella maritima* and *Festuca rubra,* bank end coastal marsh, Irish Sea, England. J. Coastal Res. 3(3): 359-369.