

Morphologic and Taxonomic Study Based on Wild Selected Plant Species Belonged to Genus *Acacia*—Al Baha Region (Saudi Arabia)

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Abstract

This work is a taxonomic study on the genus *Acacia* in the Tehama area, Al Baha region—Saudi Arabia. It depended on a brief description of the Climate, Topography, and Geology of the study area. The total numbers of species identified were seven species, classified into two major groups depending on their differences in the vegetative, floral, and fruit characteristics. Scientific classification of the genus *Acacia* was provided. Botanical description and distribution of species on habitats were determined for all seven species. Medicinal properties and local uses for some species were obtained. All identified species have been illustrated by photos of their habitats. A taxonomic key was constructed to show the differences among the seven wild selected species. Botanical names and synonyms were updated and vernacular names have been presented.

Keywords

Morphologic, Taxonomic, *Acacia*

1. Introduction

Acacias, in general, are the most dominant tree species in Saudi Arabia and elsewhere in the Arabian Peninsula.

Acacia commonly known as thorn tree, whistling thorn, or wattle is a genus of shrubs and trees belonging to the sub-family *Mimosoideae* of the family *Fabaceae*—*Leguminosae*. Recently, about (1300) species were classified as *Acacias*, about (960) native in Australia with the remaining in tropical warm-temperate regions in Africa, Southern Asia, and America [1].

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2. Study Area

2.1. Site and Location

Al Baha region is located in the southwest of Saudi Arabia between Mecca and Aseer, it lies between longitudes (41/42 E) and latitudes 19/20N. The population of this region of about (533.001) people, it has (15,000) sq-Km **Map 1**. The capital of the province is Al Baha city.

2.2. Geology and Topography

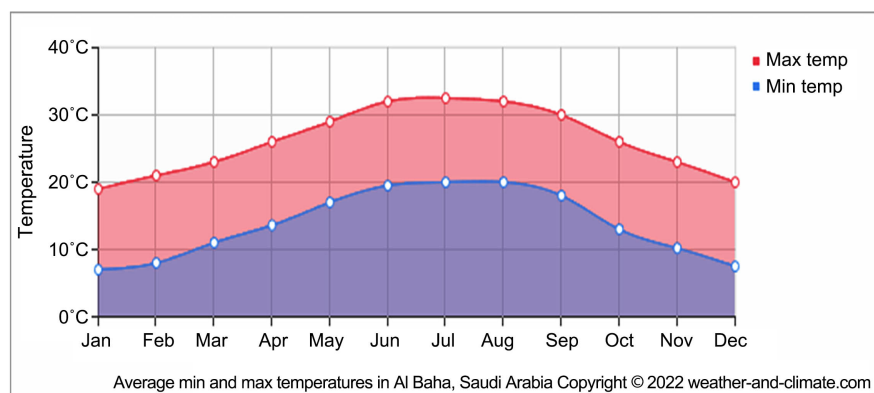
Geographically, Al Baha region is divided by huge rocky steep into three distinct parts: Sarat which contains high mountains characterized by high temperate weather and rich in plants due to relatively high annual rainfall. Tihama which is low land coastal area layed in the west of Sarat and characterized by hot and humid weather and very little rain fall average.

2.3. Climate

The climate in Tihama area is different from that in Al Sarat although they are separated by no more than (25) Km. Relative humidity varies between (52% - 67%) with maximum temperature of (23°C) and minimum temperature of (12°C). The average throughout the whole region is (100 - 250) mm. annually. The climate of Al Baha city is mild with temperature between (10°C - 40°C) due to its location at (2500) m. above the sea level. Thus, the climate is moderate in summer and cold in winter (**Graph 1**).



Map 1. Saudi Arabia with Al Baha highlighted.



Graph 1. Climate data for Al Baha.

2.4. Natural Vegetation and Land Uses

The area shows great diversity in natural vegetation due to its climate variation and topography (more than (53) forests). The area exposed wide agricultural and grazing activities due to its fertile lands.

Fabaceae or Leguminosae:

Commonly known as legume, pea or bean, it exposed a large and economic importance of flowering plants, it represents the third largest land plant family behind the *Orchidaceae* and *Asteraceae* with (730) genera and over (19,400) species. The largest genera are *Astragalus* over (2400) species, *Acacia* revealed over (950) species, *Indigofera* around (700) species, *Crotalaria* around (700) species and *Mimosa* around (500) species [2]. Plants of this family are found throughout the world growing in many different environments and climates. The *Fabaceae* was placed in the order (*Fabales*) according to the Taxonomic APG III (Angiosperm Phylogeny Group III System). The family included three sub-families, those were.

Mimosoideae: It includes (80) genera and (3200) species mostly, tropical and warm temperate, *Mimosa* and *Acacia* are genera in this sub-family. *Fabaceae* ranged in its habit from giant trees to small annual herbs with the majority being herbaceous perennial. Leaves are usually alternate and compound. Most often they are pinnately compound often trifoliolate. *Mimosoideae* and *Caesalpinioidea* commonly bipinnate, they always have stipules, leaf margins and entire or occasionally serrate.

Plants have indeterminate inflorescence, which are sometimes reduced to signal flower. The flowers have a short hypanthium and single carpels with a short genophore and after fertilization fruits were produced. The flowers often have five general fused sepals and five free petals; they are generally, hermaphrodite and have a short hypanthium, usually cup shaped. There are normally had ten stamens and one elongate superior ovary with a curved style. In *Caesalpinioidea*, the flowers are often zygomorphic species like in the genera *Senna*, asymmetric flowers with one of lower petals larger than opposing one and the style bent to one side. The calyx, corolla or stamens can be shown in this group. In the *Faboidea*, the flowers are zygomorphic and have specialized structure, the upper petals called the banner is larger and enveloped often reflexing when the flower blooms. They have two adjacent petals. The stamens are always ten and their filaments can be fused in various configurations often in a group of nine stamens plus one separate stamen.

In *Mimosoideae*, the flowers are actinomorphic and arrange in globose inflorescence, the petals and stamens are small which can be more than ten, coloured filaments. All of the flowers in florescence open at once. The ovary developed into a legume. A legume is simply dry fruit.

The number of trees species in Saudi Arabia is only 97 which is about 4.32% of the total floristic elements. Out of these, more than 80% are present in the south western and western region including Taif region. The genera *Acacia* con-

tains the highest number of 15 species followed by Commiphora (11) species. Although tree species are widely distributed in south western regions, only a few of them are forming into communities [3]. More than 134 species belonged to 57 families in mountains of Sarat and Hejaz, *Leguminosae* represents the largest family in the area containing more than 35 species of which the majority are belonged to the genus *Acacia* [4].

Species like *Acacia seyal* and *Acacia tortilis* are dominant and grow in many parts of Hejaz Mountains. *Acacia* in general, are the most dominant tree species in Saudi Arabia and elsewhere, in Peninsula because of the wide distribution of *Acacia* in arid lands and they have multiple uses such as: food, fodder, fuel and medicine beside the environmental values of soil fixation and fertility. Most of *Acacia* species represented the source of browse, fuel and pole timber, some are important commercially in gum and tannin. On the other side, *Acacia* trees used as ornamental and handicraft [5].

Acacia species from Saudi Arabia were represented in two groups, one with stipule spine and flowers on heads and other with prickles spikes or spicate inflorescences [6].

Acacia species are growing in Saudi Arabia at seedling stage. Morphological traits such as number of leaves, existed spine length, pinna length, leaf and leaflets length were subjected to statistical analysis and used for developing a taxonomical key at this stage [7]. Intra and inter-specific competition between seedlings of *Acacia etbaica* Schweinf and the grass *Hyparrhenia* (L.) was studied by Fetene [8] to evaluate the influence of perennial grass on the establishment of the tree seedlings. The results indicated that *Hyparrhenia* was competitively aggressive towards *Acacia* and may inhibit the growth of tree seedling.

The study of growth and biomass production of six *Acacia* species in the field revealed three of them were indigenous while others were exotic. The results showed both of *Acacia ampliceps* and *Acacia asak* with 100% survival while all *Acacia negrii* are died [9]. *Acacia ampliceps* attained the greatest height, diameter, relative growth rate and above-ground biomass while *Acacia asak* had the least height and diameter growth of *Acacia* species decreased between warm and cold periods of the year.

Eight *Acacia* spp. were studied by Waly [10] in Holy places in Mecca and adjusted areas along Al Hada and Al Sail roads. The results provided a preliminary interpretation of taxonomic implications of morphological and anatomical characters of these species. Anatomical features of stem undergoing secondary growth as well as details of wood anatomy. This helped us to construct a key for splitting the examined species of the genus *Acacia*.

The assessment of the growth performance and stand structure of natural cover of *Acacia* spp. in five locations in Al Baha region revealed that most of these species occurred in forest as few. Generally, the stocking density and regeneration were low probably due to illicit uses for fuel and wood grazing. Tree heights were below the average perhaps due to the low stocking density and increased natural spacing between trees. Large trees were extremely rare; however,

the remaining stumps on the forest floor suggested that they were mostly felled down probably for fuel wood or construction purposes.

3. Methodology

3.1. Equipment and Tools

- Basket, plastic bags, knife and pair of scissors were used for collecting plant material.
- A note book and pencil were used to record the information on habit, habitats, distribution and colour fruits and flowers.
- Camera was used to photograph plant samples in their habitats.
- A plant press made of alternating piece of equal size of cartons, newspapers and rope were used to press and dry plant specimens.

3.2. Plant Material

Plant samples were collected from different places in the study area through several trips, three trips per week had been done throughout the study area. Thirty five plants were collected but twenty were identified and only seven species were recorded in this study as *Acacia* trees.

The plant samples were taken to the laboratory in the faculty of the science and art in Al Mikhwa. The samples were examined using needles and hand lens.

3.3. Plant Sample Identification

Scientific names and synonyms were updated and Vernacular names were mentioned.

Key for species has been provided. The identified species were well dried and mounted in album with the card of identification included date of collection, place, habit and habitats, scientific and vernacular names and left in the laboratory as tiny herbarium.

4. Results and Discussion

4.1. Results

Scientific Classification:

Kingdom: *Plantae*.

Division: *Magnoliopyhta*.

Class: *Magnoliopsida*.

Order: *Fabales*.

Family: *Fabaceae/Leguminosae*.

Sub-family: *Mimosoidea*.

Genus: *Acacia Mill.*

4.2. Key of *Acacia* Species

A. Large trees; Flowers yellow; Pods more or less curved, *Acacia ehrenbergiana* + *Acacia seyal*.

B. Stems Brown; Thorns White; Leaves Opposite, *Acacia ehrenbergiana*.

BB. Stems Orange; Thorns Grey; Leaves Alternate, *Acacia seyal*.

AA. Small Trees or Shrubs; Flowers White; Pods Linear, Apiculate or Ovate, *Acacia johnwoodii* + *Acacia hamulosa* + *Acacia etbaica* + *Acacia laeta* + *Acacia oerfota*.

C. Inflorescence Spike, Fruits Apiculate or Ovate, *Acacia hamulosa* + *Acacia laeta*.

D. Small Trees; Thorns in Pairs, Recurved; Leaves Bipinnate; Fruits Apiculate, *Acacia laeta*.

DD. Shrubs; Thorns Three, Straight; Leaves Pinnate; Fruits Ovate, *Acacia hamulosa*.

CC. Inflorescence Capitulum, Fruits Linear Elongated, *Acacia johnwoodii* + *Acacia etbaica* + *Acacia oerfota*.

E. Thorns Presents, *Acacia etbaica* + *Acacia oerfota*.

F. Stems Pale Brown; Thorns Small, Recurved; Pods linear, *Acacia etbaica*.

FF. Stems Greyish; Thorns Long, Straight; Pods Folate Acute, At both ends, *Acacia oerfota*.

EE. Thorns Absent, *Acacia johnwoodii*.

4.3. *Acacia ehrenbergiana* Hayne. Figure 1

Synonym: *Acacia flava* (Forssk.) Schweinf.

Vernacular: Salm.

Habitat: Common in topographic depressions and along the water.

Botanical Description:

Dicot, tree. Stem erect, Branched, Green or Brown, Smooth, Shining, Peeling Bark, Thorns 4 - 6 along, White, Straight set out in axillary pairs, longer than adjacent leaves. Leaves compounds, Small Pinnate, Opposite. Inflorescence Head. Flowers globose gold-yellow. Pods dehiscent narrow to linear, 7 - 10 cm. long, more or less curved-falcate and twisted, bright-red when young. Fruits legume with numerous seeds in marginal placenta.

4.4. *Acacia johnwoodii* Boulos. Figure 2

Synonyms: not found.

Vernacular name: Syal.

Habitat: Common in topographic depression and along the water.

Botanical Description:

Dicot, Shrub or Small tree. Stem erect, Branched. Leaves compound, Bipinnate, Alternate. Inflorescence Capitulum. Flowers white, Hermaphrodite, actinomorphic, Petals five, united, tubular, stamens (5), united, epipetalous, Ovary superior with numerous ovules on marginal placenta. Fruits Legume.

4.5. *Acacia etbaica* Schweinf. Figure 3

Synonym: not found.

Vernacular name: Arrad/Qarrad.

Habitat: Occurs in dry land, thickets, Semi-desert scrub and wooded grass lands.

Botanical Description:

Dicot, Tree or Shrub; Trunk distinct with flattened or crown in older trees; Bark pale brown, brownish-black, reddish-grey or dark grey, smooth or fissured; spines in pairs at the nodes, Brownish-white; slash fibrous and creamy white; twigs red brown. Leaves have (1 - 9) pairs; leaflets in (4 - 35) pairs. Inflorescence capitated on axillary peduncles. Flowers white or creamy; Calyx (0.4 - 1) mm. along; corolla (2 - 3) mm along. Fruit legume, purple-brown to red brown, shiny, straight; seeds about (8) brown or olive-brown, flattened.



Figure 1. *Acacia ehrenbergiana* Hayne.



Figure 2. *Acacia johnwoodii* Boulos.



Figure 3. *Acacia etbaica* Schweinf.

4.6. *Acacia laeta* R.Br. ex Benth. Figure 4

Synonym: *Acacia trintigniani* A. Chev.

Vernacular name: Dhaibian.

Habitat: Common in desert.

Botanical Description:

Dicot, shrub or Small tree with a greyish-green bark looking blackish from distance. Leaves bipinnate, large, leaflets oblong. Thorn in pairs axillary prickles. Flowers fragrant white creamy. Fruit Apiculate.

4.7. *Acacia hamulosa* Benth. Figure 5

Synonym: *Acacia paradoxa* Chiov.

Vernacular name: Qitad

Habitat: Occurs in sandy or rocky land over limestone

Botanical Description:

Dicot, shrub up to (4) m. high; young branchlets grey or greyish brown. Flowers up to (4) cm. long spike. Calyx long. Corolla long. Fruit ovate, yellowish.

4.8. *Acacia oerfota* (Forssk.) Schweinf. Figure 6

Synonym: *Acacia nubica* Benth., *Acacia orfata* Auct., *Acacia merkeri* Harms., *Acacia virchoviana* Vatke.

Vernacular name: Arft.

Habitat: Found in desert.

Botanical Description:

Dicot, Small shrubs with flatted top, triangular funnel in vertical, Branches numerous and grey; spines straight, long, hard, white with brown tip, grouped in pairs. Leaves long. Flowers whitish, very fragrant, clustered in balls. Pods flat and elongated. Seeds of an olive-green.

4.9. *Acacia seyal* Del. Figure 7

Synonym: *Acacia stenocarpa* Hochst. ex Rich., *Acacia hockii* DeWild., *Acacia boboesis* Aubrev.

Vernacular name: Talih.

Habitat: Wooded grassland and stony ground at base of hill.

Botanical Description:

Dicot, slender tree. Bark usually smooth, pale green to greenish yellow when young or orange after old bark has sloughed off. Bark smooth, peeling, rust red or pale-green. Twigs with many small reddish glands and paired axillary thorns, long, narrow and straight. Leaves dark green with (4 - 12) pairs. Rachis clustered. Flowers clustered with bright yellow globose heads. Pods hanging.

5. Discussion

Leguminosae or *Fabaceae* represents the largest family in the area dominant by genus *Acacia* and that agrees with the study of Gushash [8] throughout the area.



Figure 4. *Acacia laeta* R.Br. ex Benth.



Figure 5. *Acacia hamulosa* Benth.



Figure 6. *Acacia oerfota* (Forssk.) Schweinf.



Figure 7. *Acacia seyal* Del.

The local usage of most of the identified species is agree with that was reported by Wickens [5], that the most of *Acacia* species are important sources of browse, fuel and pole timber; some are important commercial sources of gum and tannin, some can be utilize for shade, shelter, live fences, soil stabilization as well as street trees and ornamental. Many are utilized by the rural populations in local medicines and handcraft.

The importance of *Acacia* is very obvious not only ecological wise but also as medicinal plants and has an economic benefit (Table 1).

Observation on the distribution and density of *Acacia* spp. and biomass confirmed the results obtained by Aref [11] that the large trees were extremely rare. They were mostly felled down probably for fuel wood or construction purposes. Most of the identified species occurred as woodlots. Generally, the stocking density and regeneration were low probably due to illicit felling for fuel wood and grazing.

Acacia laeta and *Acacia hamulosa* are distinguished by their spike inflorescence from the other five identified species which their inflorescence is a head, this agreed with Chaudhary [6].

It is argued that *Acacia oerfota* is the correct name for the plant currently called *Acacia nubica* Benth. The Arabian species are known as present as *Acacia oerfota*. In current study we take *Acacia nubica* as a synonym for *Acacia oerfota*.

Table 1. Medicinal and local uses of *Acacia* species.

<i>Acacia</i> species	Medicinal uses	Local uses
<i>A. ehrenbergiana</i> Hayne.	-Psychoactive in human. -Defend from pets and grazing animal.	-Edible gum and firewood.
<i>A. johnwoodii</i> Boulos.	Not found	Firewood
<i>A. etbaica</i> Schweinf.	Not found	Firewood, Timber and Roof houses.
<i>A. laeta</i> R.Br. ex Benth.	Not found	Gum productions, bark uses for making ropes and repairing calabashes.
<i>A. hamulosa</i> Benth.	Not found	Edible gum and firewood.
<i>A. oerfota</i> (Forssk.) Schweinf.	Not found	Important for goats and camels browse.
<i>A. seyal</i> Del.	Leaves, gum and bark used in phytotherapy for haemorrhage, cold, diarrhea, gastro-intestinal disorders, jaundice, biliary diseases and burns.	Feeding cattle, goats and sheep during the dry season. Building material and fuel wood.

6. Conclusions and Recommendations

From the results and discussion, *Acacia* species were dominated. The seven species identified in the current study are just an example, each the identified species has a great value.

Depending on the wide range of habitats, the identified species are vital for various ecosystems and play role in maintaining the region's environmental balance, stability, stabilization slopes, improvement of soils, moderation of climate, and provision of a habitat for much of our wild fauna.

The medicinal properties of the most identified species tell us how these plants are important to be conserved. Unlike many other countries, the percentage of rare and endangered species is very high in Saudi Arabia, about (600) species are considered as rare or endangered. The loss of flora in Saudi Arabia is probably higher than in any other country in the Middle East, The kingdom of Saudi Arabia passing through a series of socio-economic changes as part of its development programs, and as a result of these developments, large areas of virgin land in the mountainous regions and the range lands in the Northern, Eastern, Central and Southern regions are turned into urban and agricultural lands. In addition to this, the dramatic fluctuation in climate which resulted in periodic drought has made it much more difficult for plants to survive in their habitats.

Therefore, the author recommended the following:

- More studies are required to identify the entire flora of the region.
- Comprehensive taxonomic studies using new techniques in the field of Ecology, Histology, Cytogenetic, Biochemistry, and Molecular Biology should be conducted to identify and conserve *Acacia* spp.
- Immediate intervention is required for the entire flora in the area to attain sustainability.
- Our laboratories must be prepared and provided with all equipment and facilities that can help the coming generation carry out good and valuable research.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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