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ENVIRONMENTAL DISTRIBUTION OF EIGHT MAJOR HONEY PLANTS IN ALBAHA REGION, SAUDI ARABIA

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ABSTRACT

The present study aimed to identify and document eight major honey plants with their environmental characteristic and density and document the flowering periods of these plants through the Year. Data on major bee flora were collected from 20 beekeepers and experienced people. The field activities were conducted in 2016 around different ecological sites to observe the major bee flora and record their density and habitat. Eight plant species belonging to 5 Genus and 4 families were identified as the major honeybee source plants, these bee flora species included *Acacia ehrenbergiana* Hayne, *Acacia etbaica* Schweinf., *Acacia origena* Asfaw, *Acacia tortilis* (Forssk.) Hayne, *Blepharis edulis* (Forssk.) Pers., *Hypoestes forskaolii,* (Vahl) Sol. ex Roem. & Schult., *Lavandula dentata* L., and *Ziziphus spina-christi* (L.) Willd. The identified trees and herbs play major role for honey production in the region. January-May and September to December are major flowering times while June-August are minor flowering periods.

Keywords: Bee forage, environmental, density, Albaha, Saudi Arabia

INTRODUCTION

Honeybee and plant have a special interdependent association. The awareness to maintain the existing bee flora and reduplication of plant species is important for its sustainability [1]. Plant types and their flowering duration differ from one place to another due to variation in topography and climate conditions, understanding the, density, frequency, flowering periods and value of honey bee flora are very important and consider as significant factors for successful and

effective bee keeping. As honey bee doesn't visit all plants for nectar and or pollen, identification of plants which supply these resources, and vegetation types are important for practical beekeeping and in evaluating the potential of an area bee keeping [2]. Bee conservation is absolutely necessary and important for the functioning of plant communities and human welfare [3]

Nectar provides heat and energy for honeybees and pollen provides protein, vitamins, fatty substances, and other nutrients [4, 5].Honeybees are valuable pollinators of both agricultural crops and natural ecosystems.

Environmental changes will affect populations of honeybees through changes to available vegetation and nesting resources, and the distribution and virulence of parasites and pathogens [6]

Production of honey depends on availability and density of bee flora, the vegetation of Albaha region contains diverse species [7] that can provide sufficient nectar and pollen to foraging bees and makes the region highly suitable for bee and beekeeping.

Studies [8, 9, 10, 11] reported 14 plant species as honey plants in Saud Arabia, which consider as plants that produce honey, these are *Acacia ehrenbergiana*, *A. etbaica, A. gerrardii, A. johnwoodii, A. oerfota, A. tortilis, A. origena, Hypoestes forskalei*, *Lavandula dentate, L. pubescens, Nepeta deflersiana, Otostegia fruticosa, Ziziphus nummularia* and *Ziziphus spina-christi*. Some 159 bee forage species belonging to 49 families in Albaha region were identified and their flowering calendars were recorded, of these*, Ziziphus spina-christi, A. tortilis, A. ehrenbergiana, A. asak , A. origena, Lavandula species & Blepharis edulis* were identified as major sources of pollen and nectar [12]. The interviewed of beekeepers in Albaha region reported that they move their colonies primarily during the flowering periods of the *Ziziphus spina-christi*, *Acacia origena*, *A. tortilis*, *A. ehrenbergiana*, *A. asak*, and *Lavandula species*, in order of importance based on their honey production potential [11].

Generally, because of the diversity of plant habitats and environmental conditions of Al Baha, such topography, climate, flowering periods and diversity of bee flora vary from place to place for the same plant [9].

The present study aims to analyse the environmental characteristic of eight major plants foraged by honeybees, to give a good knowledge of the density, locality, environmental conditions and blooming times of these plants in Albaha region so guiding beekeepers in the choice of the best suitable sites for locating their apiaries.

2. MATERIALS AND METHODS

The study area is located south west of Saudi Arabia, It is situated between longitude 41/42E and latitude 19/20N.at an altitudinal range of 50 to 2565 meter above sea level [7,13]. The present study was carried out from 2016 to 2017 covering different ecological zones of Albaha region. The study included surveys to document the plant species as well as questioning beekeepers and other group who have background on the most important bee flora that producing honey. Accordingly 20 beekeeper and expertise have been randomly selected and interviewed with structured questionnaire.

2.1. Frequency and density:

Frequency is defined as the number of times a plant species is present within a given number of sample quadrats of uniform size placed repeatedly across a stand of vegetation [14,15] Frequency = Number of sample sites in which a species occurs/ total number of sample sites.

The relative frequency of each bee flora species was calculated by determining the proportion of quadrates in which that species were encountered.

Number of individuals: Number of individuals refers to the density of each species that been recorded in the sample sites during the survey, density of individuals of a species per hectare was calculated.

To calculate the plant density, the individuals were divided by the total area of the surveyed sample sites.

$$\text{Relative frequency} = \frac{\text{Number of sample plot in which a bee flora species occured}}{\text{Total sample plots surveyed}} * 100$$

RESULTS AND DISCUSSION

Based on the availability of different plants along with their flowering time, a floral calendar has been developed for eight major bee flora of Albaha region. These bee plants were available through-out the year, but January-May and September to December were major flowering times while June-August were minor flowering periods. The best types of honey preferred by people were those produced from *Hypoestes forskalei, Lavandula dentata, Ziziphus spina-christi*, *Acacia tortilis, A. origena, A. etbaica*, *A. ehrenbergiana* respectively. As it is known different Flowers produce different type of honey, honey plants that found in the same ecological zone may bloom In the same time so they overlap in flowering season, for example in the Table (1and 2), *Acacia ehrenbergiana* and *A. tortilis* found in the same ecological zone and bloom at about the same time in April and May, *Ziziphus*

spina-christi with *Acacia etbaica* and *A. ehrenbergiana* bloom in June and July. *Hypoestes forskaolii* and *Lavandula dentata* bloom as the same time in most their flowering periods. Visiting bees different honey plants that blooming at the same period may affect the taste, the quality and color of the honey. Figure 1 shows the distribution of targeted major bee flora in Albaha region, as we notice *Acacia ehrenbergiana* and *A. tortilis* are found in areas of low elevation with dry and hot climate. *Acacia origena, Hypoestes forskaolii* and *Lavandula dentata* are found in areas of high elevation with wet and cold climate. *Acacia etbaica* is found in areas of relatively high rainfall and relatively high elevation, *Blepharis edulis* and *Ziziphus spina-christi* are widespread species found almost everywhere but in high quantities in areas characterized by hot climate and low rainfall.

Acacia ehrenbergiana and *A. tortilis* are widespread and abundant in their distribution range and are often the dominant species in arid and semi-arid regions of the world where they form communities. Both species found in the Sahel semi-desert grassland and occur on the deep sandy soils of northern Sahel where the annual rainfall is less than 250 mm and the vegetation usually consists of bushes and bushy trees and extensive areas of grassland [16, 17].

Their typically low soil–water uptake in the arid ecosystem is fundamental to their characteristic adaptations that enable them to grow successfully under limited soil and water availabilities, both species can grow and survive and have a great ability to adapt to increased water stress and tolerate the harshness of drought [18].

They grow and form communities mainly on dry the wadi beds and frequently on rocky slopes and desert of hyper-arid region and between 100 to 1700 m in areas with a low rainfall and high temperature in Najd, Saudi Arabia [19], in the wadi bed habitat characterised by silt soil and sandy loam texture in Taif region, Saudi Arabia [20] and on the desert and mountainous wadis of Hail region, Saudi Arabia [21**]**. Both species prefer areas that dominated by sand with loamy sand and Sandy loam texture [22].

Both species are recorded from almost the same ecological zones in Albaha region (Figure 2). *Acacia ehrenbergiana* woodland is common in many parts of coastal plains of Yemen in particular wadis, depressions and alluvial plains, while *A. tortilis* woodlands are common in gravelly plains of coastal areas [23, 24]. Sparse shrubland dominated by *Acacia ehrenbergiana*on flat sandy plain near cultivated fields and sand dunes area

recorded from Hadhramaut arid region, Yemen [25].

In Albaha region *A. ehrenbergiana* with *A. tortilis* form a woodland between 200 and 250 at the coastal plain, between 500 and 980 m at the Tihama foothills and between 1400 and 1600 m around Al Aqiqi and Albaha – Taif road North and North East the region [7]. The Upper elevation limit (meters) of this species in Albaha is1700 m, but it is recorded also at 1800 in Aqabat al Abna and Aqabat Huzna [7,13].

Acacia ehrenbergiana is found in the Arabian Peninsula, North Sahel and the Southern, Central Sahara and East Africa. This is an important legume species for indigenous populations mainly as forage for animals, to produce high quality honey, for charcoal, as herbal medicine, firewood, charcoal production, and as herbal medicine. At present the population is believed to be stable in its distribution range, hence it is rated by IUCN as Least Concern [26].

*Acacia tortilis*also known as umbrella thorn is drought resistant, can tolerate strong salinity this species generally forms open, dry woodland in pure stands or mixed with other species in particular north east and south west Albaha region (between 100 – 1600 m.) .The tree is widespread from Algeria to Egypt and Arabia, East Africa, southwards to S. Africa, [27], the tree preserves soil moisture by having a high proportion above-ground woody mass and low amount of foliage and grow in areas where temperatures vary from 0 to 50 degree Celsius and rainfall is anywhere from about 100–1,000 mm per year [28]. The structure of *Acacia tortilis* preserves soil moisture by having a high proportion above-ground woody mass and low amount of foliage ([29].

Acacia etbaica is a characteristic tree of East Africa (Eritrea, Ethiopia, Kenya, Somalia, Sudan, Tanzania, Uganda) and form a woodland in different ecological zones, It forms a woodland between 1500 and 1800 m, on semi-arid plain on various limestone soils (with crusts) and vertisoilsin Jijiga and Togo-vertisols regions (Ethiopia). [30]. *Acacia etbaica* woodland also a characteristic woodland on plains, plateaus, at the bottom of mountains and on moderate steep slope mountains (between 1400-1800m.) in the southern region of Yemen and on and as open woodland east on Wadis and depressions between Sa'dah near the border of Saudi Arabia to Rada' (between 1600 and 1900 m.) as well as on stony uncultivated mountains in the rain shadow areas between 1200 and 2300 m [24, 25]. In the study region *A. etbaica* found on rocky slopes and foot slopes of mountains between 550 and 2020 m. above sea level

in areas with low and relatively high rainfall. According to [7,13], the species forms a community on drainage lines, rocky foot slopes, banks of valleys and gravelly wadi, between 1560 and 1950 around Al Aqiq, Bida and BaniKabir (Figure 3).

Acacia origena is a regional endemic only recorded from highlands of Ethiopia, Eritrea, Saudi Arabia and Yemen [31, 32]. At present the population of *Acacia origena* is believed to be stable in its distribution range, hence it is rated by IUCN as Lower Risk/near threatened ver 2.3 [31]. In the study area it occurs on rocky slope mountains, terraces and neglected fields between 1800 – 2400 m. (Figure 4) and forms a woodland in several ecological sites [7,13]. In Yemen it forms an open woodland near or on cultivated fields in wadis, terraces, plains and plateaus or mountain slopes between 1600 and 2800m [23, 24, 33].

*Blepharis edulis*is found in Africa - semi-arid areas from Mauritania to Sudan, south to Tanzania, east through Arabia to Iran [34, 35], it is found in the arid regions, in habitats that are fragile and undergoing the processes of desertification and grows (Bates, 2000). In eastern Africa it grows between 20-1,900 m in sandy or rocky, granite lava on open grounds in semi desert vegetation dominated by *Acacia* spp. or *Commiphora* woodland and annual grasses. [36]. In Albaha region it is found in wide range, on Rocky slope, gravelly plain, wadi bed, between 150 and 2100 m [7,13].

*Hypoestes forskaolii*is widespread between 150–2100 m. in tropical and southern Africa, East Africa and in tropical Arabia recorded from Africa in moist habitats [34]. In Albaha region it is recorded on rocky wet slopes mainly under bushes of middle and high altitude areas (between 1400 and 2400 m.).

Lavandula dentata is a European native aromatic found in the Mediterranean, the Atlantic islands and the Arabian peninsula [7]. In Albaha region it is found in Rocky slopes fallow lands, wadi bed and drainage lines of high altitude areas (between 1800 – 2400 m.).

Ziziphus spina-christi is found in valleys in tropical and subtropical regions including North Africa, South Europe, Mediterranean, Australia, tropical America, South and East of Asia and Middle East [37, 38]. It has the ability to grow in drought conditions and to adapt to the different environmental conditions in the Kingdom of Saudi Arabia [39]. In Albaha region it is found in Wadi bed, terraces and plain, wide spread throughout the area in particular in the middle altitude and hot dry areas between 350 and 2020m.

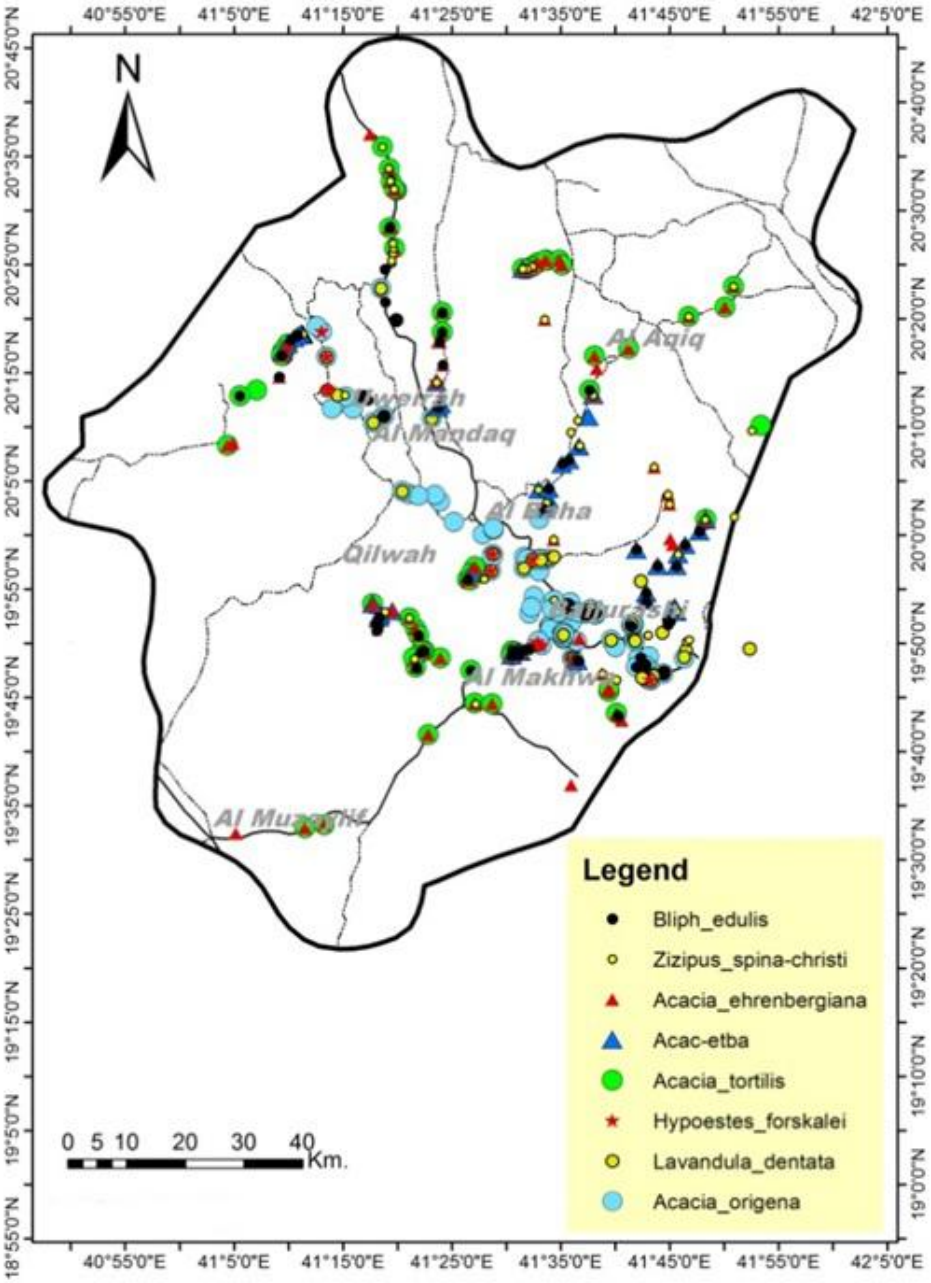


Figure 1: The distribution of eight major honey plants in Albaha region

Table 1: Bee plants and their environmental characteristic

Scientific name	Common Name	Family	Life form	density/ ha	freq %	altitude	Topography & Ecology	Associate honey species	Honey and pollen[9,40]	Distribution
Acacia ehrenbergiana Hayne	Salam	Mimosaceae	T	3.68	22.98	270- 1620 (1800m.)	Wadi bed, rocky slope of Arid areas	*Acacia tortilis, Blepharis edulis Ziziphus* spina-christi	H,P	Arabian Peninsula, North Sahel and the Southern, Central Sahara and East Africa
Acacia etbaica Schweinf.	Qaradh	Mimosaceae	T	2.24	13.98	550-1950m	Rocky slope, foot slope. Drainage line, wadi	*Blepharis edulis Ziziphus spina-christi*	H,P	East Africa (Eritrea, Ethiopia, Kenya, Somalia, Sudan, Tanzania, Uganda) and Arabia
Acacia origena Asfaw	Talh	Mimosaceae	T	4.42	27.64	1800 – 2400 m.	Old terraces Rocky slope Rocky outcrops Neglected fields of high altitude relatively wet areas	*Lavandula dentata Hypoestes forskalei*	H,P	East Africa (Ethiopia, Eritrea) and Arabia
Acacia tortilis (Forssk.) Hayne	Sumur	Mimosaceae	T	3.13	19.57	100 – 1600 m.	Wadi bed, plain, rocky slope of low altitude arid areas	*Acacia ehrenbergiana Blepharis edulis Ziziphus spina-christi*	H,P	widespread from Algeria to Egypt and Arabia, East Africa, southwards to S. Africa,
Blepharis edulis (Forssk.) Pers.	Saha	Acanthaceae	H	2.83	17.70	150 – 2100 m	Rocky slope, gravelly plain, wadi bed, wide range from low to high altitude areas	*Acacia ehrenbergiana Acacia etbaica Acacia tortilis Ziziphus spina-christi*	H,P	Africa - semi-arid areas from Mauritania to Sudan, south to Tanzania, east through Arabia to Iran
Hypoestes forskaolii(Vahl) Sol. ex Roem. & Schult.	Majra	Acanthaceae	H	0.60	3.73	1400 – 2400 m	Rocky wet slopes under bushes of middle and high altitude areas	*Acacia origena Lavandula dentata*	H,P	in tropical and southern Africa, East Africa and in tropical Arabia
Lavandula dentata L.	Dhurum	Lamiaceae	H	1.74	10.87	1800 – 2400 m.	Rocky slopes fallow lands, wadi bed and drainage lines of high altitude areas	*Acacia origena Hypoestes forskaolii*	H,P	in the Mediterranean, the Atlantic islands and the Arabian peninsula
Ziziphus spina-christi (L.) Willd.	Sidr	Rhamnaceae	T	2.93	18.32	350 – 2020 m	Wadi bed, terraces and plain, wide spread throughout the area in particular in the middle altitude and hot dry areas	*Acacia ehrenbergiana Acacia etbaica Acacia tortilis Blepharis edulis*	H,P	in tropical and subtropical regions including North Africa, South Europe, Mediterranean, Australia, tropical America, South and East of Asia and Middle East

Table 2: Blooming period of major honey Plants

name	Dec	Nov	Oct	Sep	Aug	Jul	Jun	May	Apr	Mar	Feb	Jan
Acacia ehrenbergiana												
Acacia etbaica												
Acacia origena												
Acacia tortilis												
Blepharis edulis												
Hypoestes forskaolii												
Lavandula dentata												
Ziziphus spina-christi												

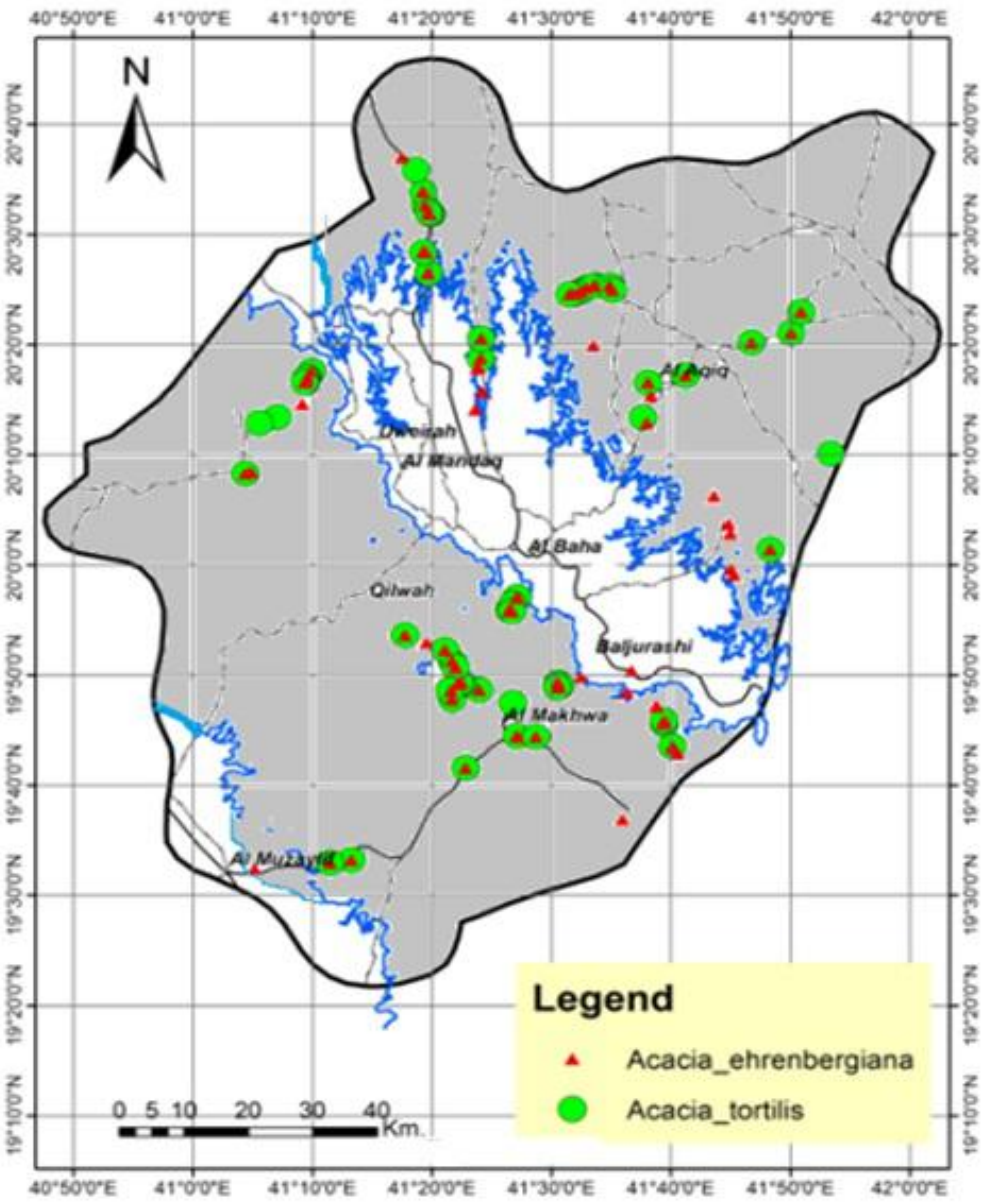


Figure 2: The distribution range of *Acacia ehrenbergiana* and *A. tortilis* in Albaha region., the grey colour shows the predicted distribution areas of both species in Albaha region

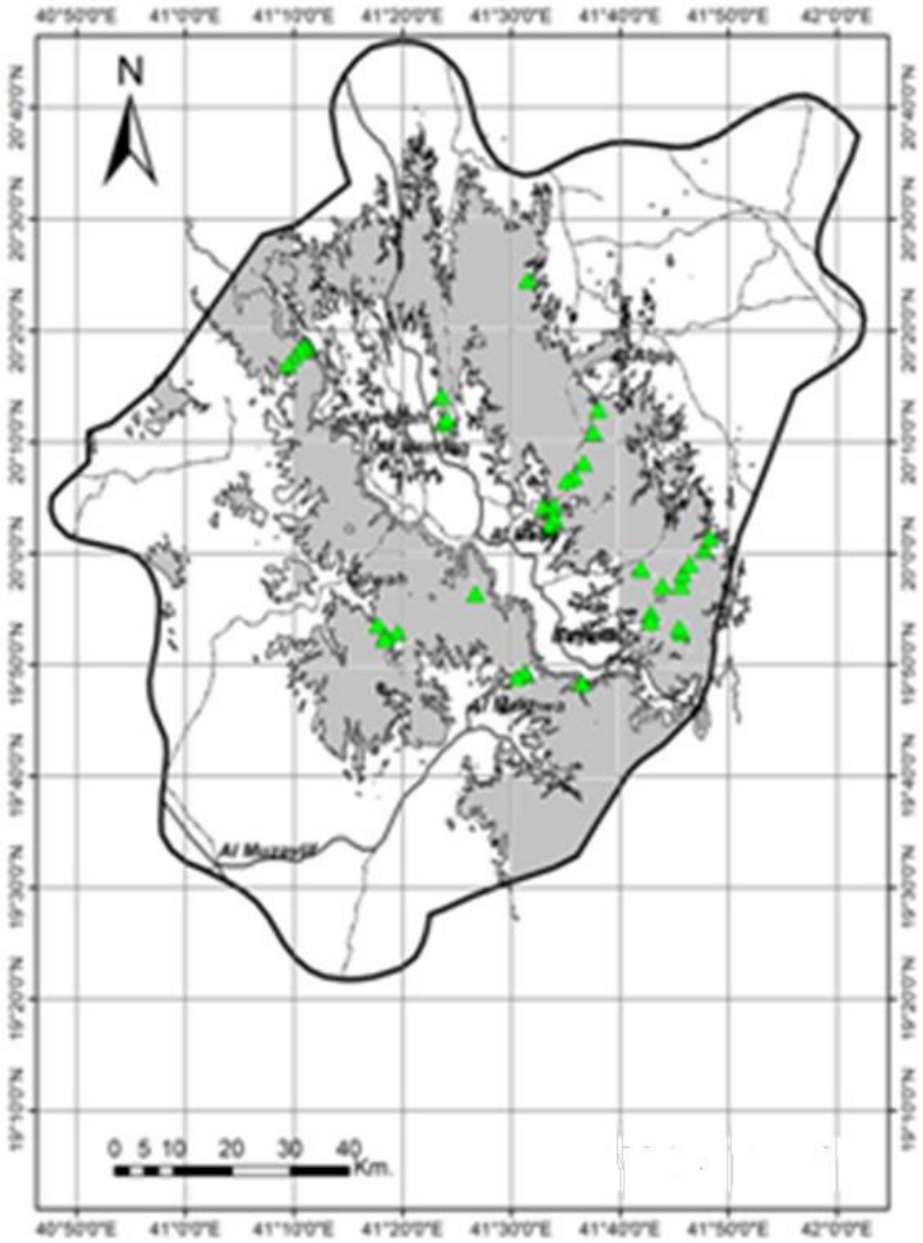


Figure 3: The distribution range of *Acacia etbaica* in Albaha region., the gray colour shows the predicted distribution areas of both species in Albaha region

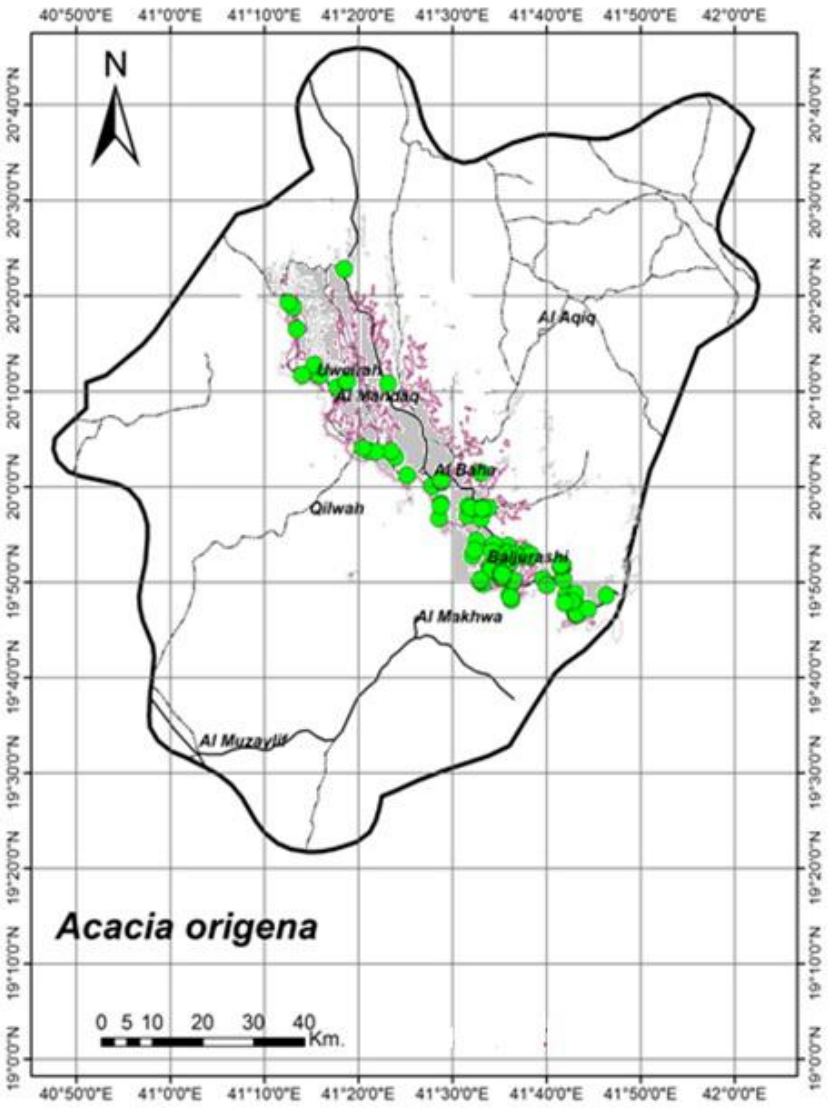


Figure 4: The distribution range of *A. origena* in Albaha region

Acacia ehrenbergiana

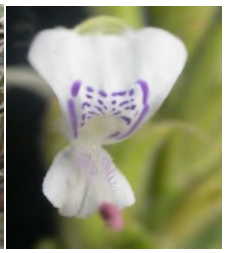
Acacia origena

Acacia tortilis

Acacia etbaica

Ziziphus spina-christi

Blepharis edulis



Hypoestes forskaolii

4. CONCLUSION

The present study finds eight most bee forage with excellent potential of honey in different geographical location of Albaha region. The knowledge of bee flora of a Albaha region enable beekeepers to utilize them at the maximum level, so that they can harvest a good yield of honey and other bee products in addition to effective pollination. Such kind of knowledge on most important bee flora help in the effective management of bee colonies. To conserve these bee forage, attention must be given to maintain and multiply the existing bee flora. The present findings would be important information of existing major bee flora and develop floral calendar for Albaha region for future workers in the field of Apiculture operations.

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REFERENCES

[1] Kumar, D., Sharma, V. and Bharti U. (2015) Mapping of medicinal flora as honey bee forage. Journal of Entomology and Zoology Studies. 3; (6):235-238.

[2] Gebretsadik, T. (2016) Assessment of major Honey bee flora resources on selected districts of Sidama and Gedeo zones of South nations nationalities and peoples regional state, Ethiopia. Journal of Agricultural Economics, Extension and Rural Development. 4; (2):368-381.

[3] Gupta, R. K. (2014) Taxonomy and Distribution of Different Honeybee Species. Springer, Vol. 1: Technological Aspects of Beekeeping. 63-103

[4] Amsalu, B., Nuru, A. and Radloff, H. (2003) Multivariate morphometric analysis of honeybees in the Ethiopian region Apidolgie. (35): 71-81

[5] Gebru, E., Berhanu, A., Hayal, L. and Solomon, A. (2016) Tsehaye A. Honey bee flora diversity and their impact on honey production in Tigray region of Ethiopia. Livestock Research for Rural Development. 28; (7).

[6] Shelley, E. R. and Hoover, T. M. (2014) Impact of Environmental Change on Honeybees and Beekeeping. Springer, Vol. 1: Technological Aspects of Beekeeping. Beekeeping for Poverty Alleviation and Livelihood Security. 463-479.

[7] Al-Khulaidi, A., Al-Sagheer, N., Qardhawi, M. and Al Ameri, S. (2016) Trees of Albaha region and

surrounding areas. FAO., Riyadh, Saudi Arabia.

[8] Al-Qarni, A. S., Awad, A. M. and Owayss, A. A. (2015) Evaluation of *Acacia gerrardii*Benth. (Fabaceae: Mimosoideae) as a honey plant under extremely hot-dry conditions: flowering phonology, nectar yield and honey potentiality. The Journal of Animal & Plant Sciences. 25; (6):1667-1674.

[9] Nuru, A., Al-Ghamdi, A., Awraris, S. G., Al-Madani, M., Ansar, M. J., Sammouda, I. and Radlof, S. E. (2016) pollination ecology, nectar secretion dynamics, and honey production potentials of *Acacia ehrenbergiana* (Hayne) and *Acacia tortilis* (Forssk.) Hayne, Leguminosae (Mimosoideae), in an arid region of Saudi Arabia. Tropical Ecology. 57; (3):429-444.

[10] Al-Ghamdi, A., Zulail, A. and Adgaba, N. (2014) Structure and Performance of the Retail Outlets of Honey in the Kingdom of Saudi Arabia. Food and Nutrition Sciences. (5); 1168-1176.

[11] Nuru, A., Al-Ghamdi, A., Tadesse, Y., Getachew, A., Awad, A. M., Ansari, M. J., Owayss, A. A., Mohammed, A. and Alqarni, A. S. (2017) Nectar secretion dynamics and honey production potentials of some major honey plants in Saudi Arabia. Saudi Journal of Biological Sciences. 24; (1):180–191.

[12] Nuru, A., shenkute, A., Alghamd, A., Sammoud, R., hegazy, S., Touir, A., Tadesse, Y. and Sharma, D. (2013) Determining temporal and spatial availability of bee forages, based on ground inventory, supported with GIS application and remote sensed satellite Image processing. The proceedings of 3rd International Apicultural Congress, Kyiv, Ukraine. (29): 216.

[13] Al-Aklabi, A., Al-Khulaidi, A., Hussain, A. and Al-Sagheer, N. (2016) Main vegetation types and plant species diversity along an altitudinal gradient of Al Baha region, Saudi Arabia. Saudi Journal of Biological Sciences. 23; (6):687-697

[14] Daubenmire, R. F. (1968) Plant communities: A textbook of plant synecology. Harper and Row, New York. 300 pp.

[15] Mueller-Dombois, D. and Spatz, G. (1975) Application of the relevé method to insular tropical vegetation for an environmental impact study. 417-429.

[16] White, F. (1983) The vegetation of Africa. A descriptive memoir to accompany the UNICCO/ Aetfat/ UNSO vegetation map of Africa. UNESCO, Paris.

[17] Wickens, G. E. (1995) Role of Acacia Species in the Rural Economy of Dry Africa and the Near East. FAO. 56 pages

[18] Aref, I. M., Ahmed, A. I., Khan, P. R., El-Atta, H. A. and Iqbal, M. (2013) Drought-induced adaptive changes in the seedling anatomy of *Acacia ehrenbergiana* and *Acacia tortilis* subsp. raddiana. Trees. (27):959–971

[19] Alatar, A., El-Sheikh., M. A. and Thomas, J. (2012) Vegetation analysis of Wadi Al-Jufair, a hyper-arid region in Najd, Saudi Arabia. Saudi Journal of Biological Sciences. (19):357–368.

[20] Farrag, H. F. (2012) Floristic composition and vegetation-soil relationships in Wadi Al-Argy of Taif region, Saudi Arabia. International Research Journal of Plant Science. 3; (8):147-157.

[21] El-Ghanim, W. M., Hassan, L. M., Galal, T. M and Badr, B. (2010) Floristic composition and vegetation analysis in Hail region north of central Saudi Arabia. Saudi Journal of Biological Sciences. (17):119–128.

[22] Al-Mefarrej, H. (2012) Diversity and frequency of Acacia spp. in three regions in the Kingdom of Saudi Arabia. African Journal of Biotechnology. 11; (52): 11420-11430.

[23] Al-Khulaidi, A. A. (2013) Flora of Yemen. The Sustainable Natural Resource, Management Project (SNRMP II), EPA and UNDP. Republic of Yemen.

[24] Wood, R. I. (1997) A Handbook of the Yemen Flora. With color illustrations by Hugo Haig-Thomas. Royal Botanic Gardens, Kew. 434 pages with 40 color plates.

[25] Al Khulaidi, A. A. (2010) Environmental and human determinates of vegetation distribution in the Hadhramaut region, Republic of Yemen. A thesis submitted for the degree of Doctor of Philosophy School of GeoSciences University of Edinburgh. 2006. This study is published also in 2010 by LAMBERT, Acadimic Publishing. Berlin, German.

[26] Contu, S. (2012). *Acacia ehrenbergiana*. The IUCN Red List of Threatened Species, e.T19892054A19997854.

[27] Beentje, H. J. (1994) Kenya trees, shrubs and lianas. National Museums of Kenya.

[28] Doran, J. C., Turnbull, J. W., Boland, D. J. and Gunn, B. V. (1983) Handbook on seeds of dry-zone acacias. A guide for collecting, extracting, cleaning, and storing the seed and for treatment to promote

germination of dry-zone acacias. Food and Agriculture organization (FAO), Rome.

[29] Ong, C. K. and Leakey, R. B. (1999) why tree-crop interactions in agroforestry appear at odds with tree-grass interactions in tropical savannahs. Agroforestry Systems. 45; (1):109-129.

[30] Le Houerou, H. N. (1980) Browse in Africa, the current status of knowledge. Papers presented at the International Symposium on Browse in Africa; Addis Ababa, International Livestock Centre for Africa. Ethiopia.

[31] World Conservation Monitoring Centre. (1998) *Acacia origena*. The IUCN Red List of Threatened Species: e.T35807A9958194.

[32] Hunde, A. (1982) Two new species of Acacia (Leguminosae–Mimosoideae) from Ethiopia and Yemen. Nordic Journal of Botany. (2): 337–342.

[33] Ghazanfar, S. A., Fisher, M. **(**Editors**)**. (1998) Vegetation of the Arabian Peninsula. Springer Science & Business Media. 363 pp.

[34] Thulin M, (Editor). Flora of Somalia. Kew Publishing, London. 1993.

[35] Stapf, O. and Hubbard, C. E. (1934). Flora of tropical Africa. Flora of tropical Africa, 9 (Pt. 6).

[36] Malombe, I., Kelbessa, E., Muasya, M. (2002) A Taxonomic Study of the *Blepharis edulis* Complex (Acanthaceae) in Eastern Africa Itambo. Journal of East African Natural History. (91): 81-90.

[37] Asgarpanah, J. and Haghighat, E. (2012) Phytochemistry and pharmacologic properties of *Ziziphus spina christi* (L.) Willd. African Journal of Pharmacy and Pharmacology, 6; (31): 2332-2339.

[38] Yossef, H. E., Khedr, A. A. and Mahran, M. Z. (2011) Hepatoprotective activity and antioxidant effects of El Nabka (*Zizyphus spina-christi*) fruits on rats hepatotoxicity induced by carbon tetrachloride. Nat. Sci. 9 (2):1-17.

[39] Moustafa, M. F., Hesham, A., Quraishi, M. S. and Alrumman, S. A. (2016) Variations in genetic and chemical constituents of *Ziziphus spina-christi* L. populations grown at various altitudinal zonation up to 2227 m height. Journal of Genetic Engineering and Biotechnology. 14; (2):349-362.

[40] Nuru, A., Al-Ghamdi, A. A., Yilma, T. T., Shenkut, A. G., Ansari, M. J. and Al-Maktary, A. (2015) floral phenology, nectar secretion dynamics, and honey production potential, of two lavender species (*lavandula dentata*, and *l. pubescens*) in southwestern Saudi Arabia. j. apic. sci. 59; (2): 135-144.