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FORAGING *APIS MELLIFERA* L. HONEY BEES ON THREE WILD FORAGE PLANT RESOURCES IN EL-GABAL EL-AKHDAR AREA, LIBYA

Salem El shatshat¹

¹Botany department,
Faculty of Science,
Benghazi University,
Benghazi, Libya

Osama Elsilini²

²Zoology department,
Faculty of Science,
Benghazi University,
Benghazi, Libya

ABSTRACT

The relationship between bees and plants as pollinators reflect the phenomenon of "Insect-Plant Interactions". Beekeeping has an ecological role while it contributes indirectly to the sustainability of plant resources through the pollination process. In Libya, the most workers in beekeeping and their production are existing in the coastal regions of the country (northern part) because of abundance and distribution of plant species in this area. In the field, honey bees are using a different numbers of plants as a forage resource. These plant species are usually have a good plant nectar production and are available in the area where the bees are foraging. In this article, we shade some light on three resources of honey and their relation to the *Apis mellifera* L. honey bees.

KEY WORDS: Libyan honey; Forage plants; *Apis mellifera*; Fabaceae.

INTRODUCTION

The relationship between bees and plants as pollinators reflect the phenomenon of "Insect-Plant Interactions". Thus, beekeeping has an ecological role while it contributes indirectly to the sustainability of plant resources through the pollination process.

The western honey bee, *Apis mellifera* L., naturally occurs in Europe, the Middle East, and Africa. This species has been subdivided into at least 20 recognized subspecies (or races). Despite of the subspecies of the western honey bee have been spread extensively, the Libyan local bees had no outside contact with other bees because Libya was historically so isolated. The native Libyan bees have been described as predominantly of the Taillan race, *A. mellifera intermissa* (Keshlaf 2014).

Honey bees are the most important insects because of their ecological and economic

impacts. They pollinate more than 200 flowering crop plants resulting in an increased yield (Keshlaf 2014). Also, honey bees provide multiple products such as honey, royal jelly, wax, venom, pollen and propolis.

During last decades, there is a growing interest among botanists, entomologists and ecologists to determine the food resources for bees and also to understand the interrelationships between bees and the plants on which they forage (Villanueva 2002). This means that the practice of beekeeping requires a basic knowledge of distribution, ecology, biology and characteristic features of honey forage plants and environmental factors influencing it.

The most workers in beekeeping and their production in Libya are existing in the coastal regions of the country (northern part) because of abundance and distribution of plant species in this area. This occurs according to the amounts of

rainfalls especially in EL-Gabal EL-Akhdar area, which receive around 700 ml/year, while most of the country (about 90%) has desert climatic conditions (Elshatshat 2015). The Libyan flora is consisting of around 1870 plant species (Quiser and El Gadi 1986). Due to the diversity of the local melliferous flora and according to literatures, notes and observations, there are more than 15 Libyan honey types which produced by foraging *Apis mellifera* L. on wild and cultivated plants. One of important Libyan honey types is *Arbutus pavarii* honey which exist only in Libya but not elsewhere (El shatshat 2017), because of the endemism of the plant forage (El shatshat 2009). Bees are using a different numbers of plants as a forage resource. These plants are usually have a good plant nectar and pollen production and are available in the area where the bees are foraging. In this article, we will shade some light on some forage plant resources for honey bees which occurred in EL-Gabal EL-Akhdar area and their relationship with *Apis mellifera* L. honey bee.

MATERIALS AND METHODS

Study area

The study area is situated on Libyan north-eastern coastal region between latitude of (30° N) and (33° N). It extends from Benghazi coast to Darnah city eastward and for a distance of about 250 km. Climatically, EL-Gabal EL-Akhdar area is located in the Mediterranean region and it has a Mediterranean climate with a mean annual precipitation rate of 660 mm, the majority of which falls between October and March (Figure 1).

The area has two seasons which reflects the main characteristics of the Mediterranean climate. Winter, the low sun period between October and April, is wet, and the summer period between May and October is dry. Only very low percent of total annual precipitation occurs during the summer period. Rainfall can vary annually from lower places to the higher, wetter reaches of the mountains. The average annual temperature is 15.7 C° and summer temperatures rise to 28 C° in July while it decreases to 10 C° in January (Figure 1).

Data collection

The data about plants and their distribution were collected from different visits to the study area, observations, literatures and direct connect with local beekeepers in the east part of Libya, especially EL-Gabal EL-Akhdar area. The data were analyzed according to the role of plants as forage resources and their relationship to the honey bees.

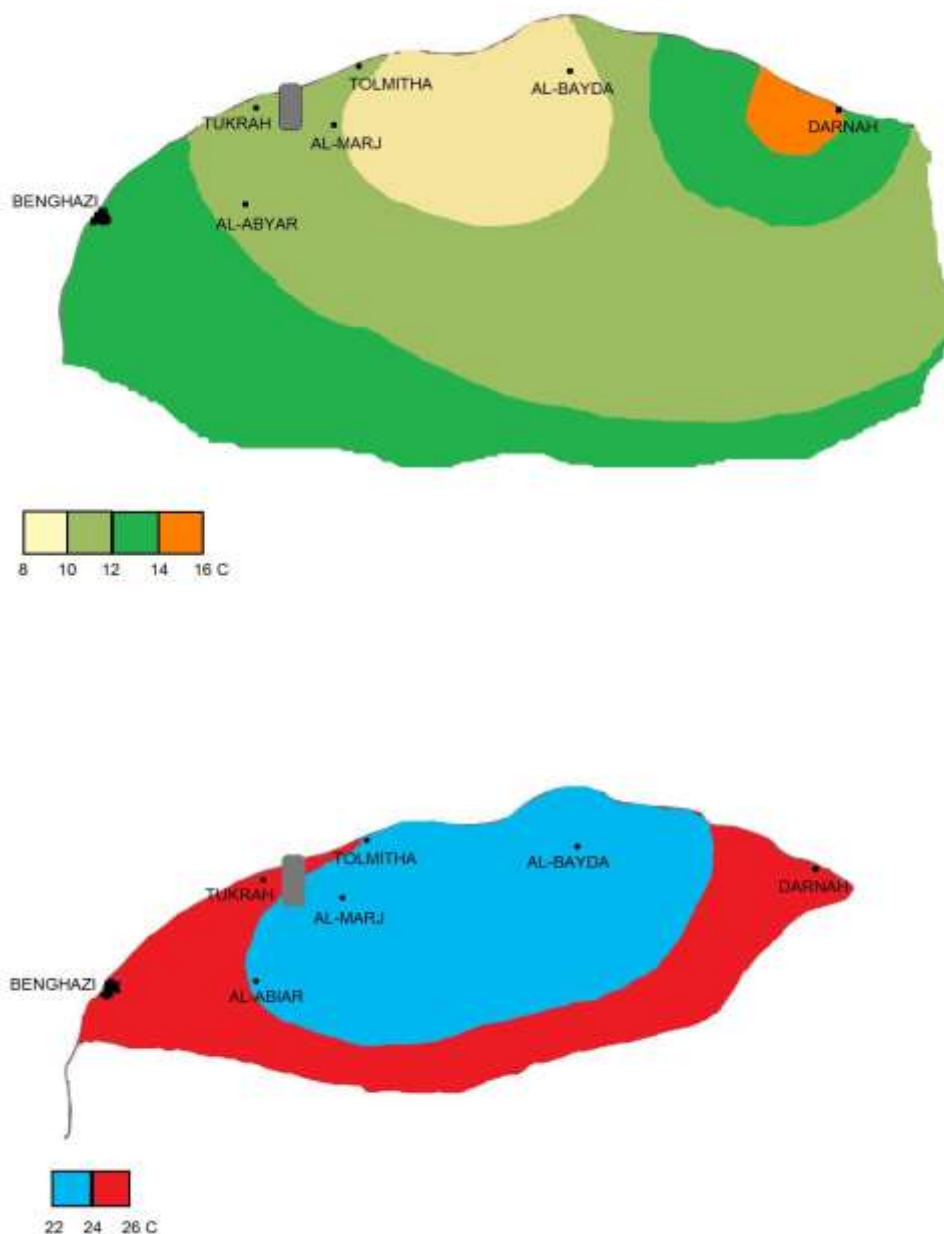


Figure 1; The temperature averages of EL-Gabal EL-Akhdar area which extended for around 250 km from north eastern borders of Benghazi city to Derna city. Note increasing and decreasing temperature levels in winter (above) and summer season (below) that depending on elevation above sea level (From Elshatshat and Mansour 2014)

RESULTS AND DISCUSSION

According to Hepburn and Radloff (1998), the forage plants using by honeybees can be identified through direct observation of foraging bee. It is clear from the observations and literatures that the honey bees forage a number of cultivated and wild plant species in the area, like *Ziziphus*

lotus (L.) Desf. and *Arbutus pavarii* Pamp. (El abidi and El shatshat 2016; 2017) and others. Here, we will focus on some wild species which distributed in EL-Gabal EL-Akhdar area according to their different flowering time, honey production and distribution and habitat. Three important wild plants were selected to be the center of this study

and they were *Thymus capitatus*, *Ceratonia siliqua* and *Cynara cornigera*. The data about these plants,

their families, and flowering time are presented in table 1.

Table 1: Scientific names and the flowering season of the three selected forage plants for honey bee in the study area.

Plant Species	Plant family	Flowering Time (months)											
		1	2	3	4	5	6	7	8	9	10	11	12
<i>Thymus capitatus</i>	Lamiaceae				■	■	■	■					
<i>Ceratonia siliqua</i>	Fabaceae									■	■	■	
<i>Cynara cornigera</i>	Asteraceae				■	■							

These three forage plant resources have different flowering season (Table 1) and botanical descriptions (Figures 2). This reflect the activity and ability of honey bees in foraging to collect pollens and nectars during different times without affecting by the climatic factors while in these flowering seasons, the days are sunny, mild and rainfalls are not available and thus, the bee workers can go outside the hive and forage these plants easily. The flowering period lasts throughout the year and varies depending on the weather and species. The structure of the nectar glands and simplicity of flower features to the honey bee, lead to use its mouth parts to suck up the nectars.

Fabaceae and Asteraceae families are very important in the bee diet (Villanueva, 2002). both

families were well represented in the study area and foraged by bees workers (Table 1). Stanley and Linskens (1974) and Jay (1986) reported that workers choose which pollen to collect not by their nutritive value, age, moisture content, or color, but on the basis of the odor and the physical configuration of the pollen grains, and here, the strong secretions which released by Kharob tree (*Ceratonia siliqua*) male flower parts (Figure 2. D), might play a role to attract the bees.

These plants were previously classified to species highly foraged (*Ceratonia siliqua*), species moderately foraged (*Thymus capitatus*) and species lowly foraged (Khabbach *et al.*, 2012). Our results were agreed with this classification

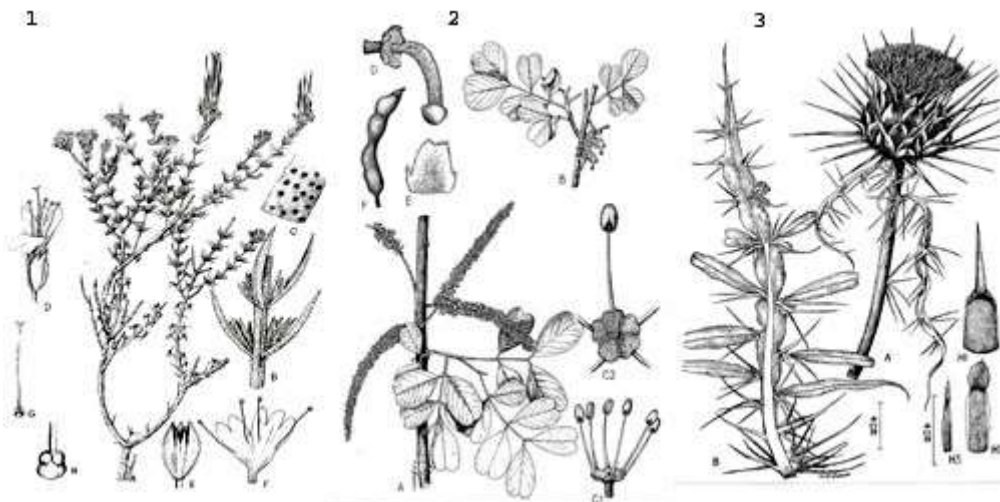


Figure 2; The botanical morphology and structure of the three forage plant species. From left to right; (1) *Thymus capitatus*, (2) *Ceratonia siliqua* and (3) *Cynara cornigera*. Note the flowers structure of each plant (From Siddiqi 1985; Jafri 1986; and Alavi 1983, respectively).

During daylight hours, cloudy or sunny days, honeybees forage different plant resources depending on their availability and distribution, in addition, exist of their flowers on plants. When the climatic conditions become extremely, like heavy rain or low temperature (below 10 C°), they stay in the hive and will not fly. The honey bees collect the most pollen during the calm and warm weather, even if it is cloudy. Light intensity changes can be also used as a limitation factor in behavior of bees. During the rapidly changes in light, they

immediately stop working and return to the hive. The moisture inhibits the bee’s ability to collect pollens. Therefore, when it lightly rains, pollen collection stops. In contrast, nectar collection is not inhibited by light rain. Wind also affects the rate of pollen collection.

This climatic conditions are available in the study area (Figure 1), and therefore, the bees visit a number of forage plants as this appeared from national honey samples not in this study but in the Libyan local market.

From our visits, observations and literatures, the climatic conditions and distribution of these three plants in the study area, in addition, their flowering seasons and structures, are optimistic for the honey bee *Apis mellifera* L., and therefore, according to feed preference concept, they prefer using these three plant species as forage plants to collect nectars and pollens even though other plants were highly distributed in the area. According to the flowering season of the three plant species, they produce their specific honey type due to the huge number of visits to each plant. The behavior of feed preference concept can be recognized when bees start foraging *Thymus capitatus*, and later, despite of the flowers of this species still exist, they change the resource using *Ziziphus lotus* Plants to collect nectar. This interference in flowering season is producing mixed honey which is consisting of two different plant resources.

The behavior in selection of the plant forage can be examined by counting the pollen grains of the plant species in each honey type using mellissopalynology method (Louveaux et al., 1978; Von Der Ohe et al., 2004). Palynological analysis of honey (Adekanmbi and Ogundipe, 2009) or analysis of pollen loads removed from returning foragers (Köppler et al., 2007), reflects to what extent that the bees were selected their plant resource to collect nectar and pollens and this was clear with these three plants according to climatic conditions in the study area and plant characteristics which described above.

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