Cercetări Agronomice în Moldova
Vol. XLVIII , No. 3 (163) / 2015

POLLEN SOURCES FOR HONEY BEE COLONIES AT LAND WITH DESERT NATURE DURING DEARTH PERIOD

H.F. ABOU-SHAARA [1]*

*E-mail: entomology_20802000@yahoo.com

Received March 29, 2015

ABSTRACT. Autumn is a critical period for honey bee colonies and the weak colonies during autumn are likely to be lost during winter. The colonies need good pollen sources during this period to be able to foster enough brood, to boost colonies survival ability during winter. The situation is worse in desert areas where few pollen sources are expected to be existed. Identifying the availability of pollen sources for honey bees at desert areas is very essential to present appropriate recommendations regarding colonies feeding and suitable plants to be cultivated in such areas. Thus, the study objective is to identify pollen sources for honey bee colonies during the autumn at El-Bostan region (a region with desert nature). Samples of bee bread were collected at different times during autumn. The samples were microscopically analyzed and pollen sources were then identified. Nine plants belong to six plant families (Pedaliaceae, Malvaceae, Poaceae, Asteraceae, Myrtaceae, Resedaceae, and Casuarinaceae) were classified as major pollen sources. The most abundant plants were casuarina and eucalyptus during autumn. Beekeepers are advised to supply their colonies regularly (each two weeks) with pollen substitutes or supplements during autumn at El-Bostan region. Honey bee workers tend to mix different pollen types together in bee bread when different pollen sources are available. The number of pollen sources in the bee bread can be used to assess the richness degree of any region with suitable pollen sources to honey bees. The identified pollen sources in this study are recommended to be cultivated in lands with similar desert nature, to provide honey bee colonies with protein feeding during this critical period of the year.

Key words: *Apis mellifera*; Feeding; Honey bees; Pollen, vegetation..

INTRODUCTION

Pollens are very important for the growth and survival of honey bee colonies. As pollens are the only natural sources for amino acids for honey bees (Huang, 2012). Honey bee colonies need large amount of pollen per year, about 13.4 and 17.8 kg of pollen have been estimated for two colonies with 10 frames, respectively

[1]Plant Protection Department, Faculty of Agriculture, Damanhour University, Damanhour, Egypt

per year (Crailsheim *et al.,* 1992). Lacking of pollen sources cause dangerous problems to honey bee colonies including; low brood production and workers mortality as reviewed by Huang (2012), especially since pollens are incorporated into larvae food (about 1.52 -2.04 mg of pollens are needed during worker larval development period) (Babendreier *et al.,* 2004), and for adult food (about 3.4 - 4.3 mg pollen are consumed per day by adult worker (Crailsheim *et al.,* 1992). Moreover, pollens are important during wax cell sealing, as workers mix beeswax with pollens to allow pupal respiration through cell cap. Pollen sources are not stable throughout the year, and the most critical period of the year is autumn where few pollen sources have been found under desert conditions (Zaitoun and Vorwohl, 2003). Honey bee colonies should have high brood rearing activity during autumn to be able to survive during winter. Thus, the existence of good pollen sources to honey bee colonies during autumn is very important.

Egyptian flora is rich with suitable pollen sources for honey bee colonies (Abou-Shaara, 2015), but honey flows are restricted mainly in three plants; citrus, clover, and cotton (Hussein, 2001). Egypt has vast desert areas and few flowering plants are existed in them. Desert reclamation is done actively in many parts of Egypt (Abou-Shaara, 2013). Honey bee colonies existed in newly reclaimed lands could suffer greatly during autumn from the shortage of pollen sources and could have low brood production as have been found by Al-Ghzawi *et al.* (2001) under desert conditions in Jordan. Therefore, the study was done in newly reclaimed region with desert nature (El-Bostan region) to identify the available pollen sources for honey bee colonies during autumn. In the light of this study, recommendations regarding colonies feeding and cultivation of specific pollen sources were suggested. The results of this study have especial importance to newly reclaimed regions because a list of suitable pollen sources to be cultivated in them is suggested. This could help in beekeeping development in areas with desert nature.

MATERIALS AND METHODS

Study location

The study was done at the experimental apiary of Faculty of Agriculture at El-Bostan, a region with desert nature, located at El-Dalangat district. This location was particularly selected because it was considered as an example of newly reclaimed lands. Assessing pollen sources during critical period of the year (autumn) at this region could help in beekeeping development in other regions with similar conditions, by recommending the cultivation of specific plants in them.

Reference of flowering plants

The study region was screened at different times during autumn 2014 to collect samples of flowering plants. These samples were then classified, and slides of their pollens were prepared and examined

under microscope to identify their shapes. These plants were used as reference guide to identify pollen sources of collected pollens by honey bee colonies, as it is explained in the next paragraphs.

Honey bee colonies

Bee bread samples were collected at different collection times mostly on weekly basis during autumn from 29 August to 29 November 2014. Six random colonies of *Apis mellifera* were used at each collection time. Five samples of bee bread were randomly collected using forceps from each colony from the lateral comb at each collection time, and were placed separately in Eppendorf tubes (total of 30 samples/collection time, and 330 samples were examined during the study period). This method can be considered appropriate to be used at desert regions where few pollen sources are existed. Pollen substitutes or supplements were not presented to honey bee colonies during the study period.

Pollen classification

Slides of collected bee bread samples were prepared for the microscopic analysis using glycerin as a mountant. The microscopic inspection was done using microscope (XSZ-1078BN, Delta Lab., China) at 400 magnification. Not more than four pollen types and mostly two or three pollen types were detected in each slide, but the major pollen type was only considered per slide (i.e. each slide was classified according to the most abundant pollen type). Because the minor pollen types in each slide indicate that the source plant is existed in very few numbers in the study location, or it is not highly attractive to honey bee workers.

Statistical analysis

To calculate percents of pollen sources per colony, the number of samples (slides) with the same major pollen type was divide by 5 (total number of samples per colony at each collection time), and multiplied by 100. Such percents were calculated to check the abundance of pollen source at the study region. Means as % of each pollen type were then calculated and compared by Duncan's multiple range test (Alpha = 0.05) using SAS 9.1.3 (SAS Institute, 2004).

RESULTS AND DISCUSSION

Pollen sources

Nine plants were classified as major pollen sources at the study region (*Table 1*). These plants belong to seven plant families. Family Asteraceae had three major plants while the other families had only one plant to each of them. Eucalyptus was the most dominant plant over the study period, followed by casuarina and reseda, then cock lebur. Some plants disappeared early in September (sesame and maize), others during October (cotton and sunflower) from honey bee colonies. Horseweed was available during October and November to the colonies. Pollens of three, eight, seven, and five plants were collected by honey bees during August, September, October, and November, respectively.

Table 1 - Pollen sources in the inspected bee bread samples during autumn at El-Bostan region

Scientific name	Common name	Order	Family	Presence period within colonies
Sesamum indicum	Sesame	Lamiales	Pedaliaceae	26Aug. to 20 Sept.
Gossypium barbadense	Cotton	Malvales	Malvaceae	26 Aug. to 11 Oct.
Zea mays	Maize	Poales	Poaceae	26 Aug. to 20 Sept.
Xanthium brasilicum	Cock lebur	Asterales	Asteraceae	2 Sept. to 8 Nov.
Helianthus annuus	Sunflower	Asterales	Asteraceae	30 Sept. to 18 Oct.
Eucalyptus sp.	Eucalyptus	Myrtales	Myrtaceae	20 Sept. to 29 Nov.
Reseda sp.	Reseda	Brassicales	Resedaceae	30 Sept. to 29 Nov.
Casuarina sp.	Casuarina	Fagales	Casuarinaceae	30 Sept. to 29 Nov.
Conyza sp.	Horseweed	Asterales	Asteraceae	11 Oct. to 29 Nov.

El-Bostan had few pollen sources (nine plants) during autumn. Such number is high if compared with other desert regions, in Jordanian desert region only three plants as pollen sources were found during September to December (Zaitoun and Vorwohl, 2003). This reflects the possibility of keeping honey bee colonies in newly reclaimed regions in Egypt, and the richness of the Egyptian flora with suitable plants to honey bee colonies during autumn. The findings of this study are highly supported by the study of Ismail *et al.* (2013) at Fayoum region in Egypt, they found that sesame pollens were available to honey bee colonies from 13 June to 6 September; maize from 30 May to 12 December; sunflower from 31 May to 12 October; casuarina from 30 August to 14 December; eucalyptus from 28 September to 29 March; cock lebur from 23 August to 27 October. Similarly, in this study, the same plants were found during September to end of November with some differences most likely due to the variations in the ecological and the agricultural nature of the two regions. The study of Ismail *et al.* (2013) was done in an agricultural region while the present study was at desert region. Family Asteraceae (or Compositae) represented the most pollen sources in the study region. In agreement with the study of Garg (1996) on pollen sources for *Apis cerana* in India during autumn, and Ismail *et al.* (2013) for pollen sources during autumn at Fayoum region while Zaitoun and Vorwohl (2003) found two families Chenopodiaceae (with two plants) and Compositae (with one plant) at Jordanian desert region. It could be said that the identified pollen sources at El-Bostan are suitable to be cultivated in desert regions to provide colonies with protein feeding during autumn.

Abundance of pollen sources

Pollen sources at El-Bostan are different in their abundance in the

studied colonies as shown in *Table 2*. Pollen sources can be arranged according to their classification as major source in the inspected samples as; casuarina, eucalyptus, sesame, reseda, cotton, cock lebur, horseweed, maize and sunflower, in a descending order, representing 24.24, 23.64, 13.03, 10.91, 7.88, 6.06, 5.45, 5.15 and 3.64% of the total number of samples, respectively. No significant differences were found between casuarina and eucalyptus, and among the other sources. Each of casuarina and eucalyptus differed significantly than the other pollen sources according to Duncan's multiple range test (Alpha = 0.05).

Table 2 - Means (%) ±S.D. of abundance rate for each plant (calculated per each colony as number of times the plant was classified as major in inspected samples divided by total number of samples = 5 and multiplied by 100). Means followed by the same letter are not statistically different according to Duncan's multiple range test (Alpha = 0.05)

Plant (common name)	Mean±S.D.	*Classification repetition
Sesame	8.48±25.55 b	43
Cotton	6.67±20.56 b	26
Maize	5.15±13.27 b	17
Cock lebur	6.06±17.17 b	20
Sunflower	3.64±11.59 b	12
Eucalyptus	23.03±25.84 a	78
Reseda	10.30±21.69 b	36
Casuarina	24.24±29.46 a	80
Horseweed	4.85±14.49 b	18

*Number of times the plant was classified as major source in inspected samples (total=330)

Casuarina and eucalyptus showed the highest abundance in inspected samples than the rest of pollen sources at El-Bostan region. This can be explained by the long flowering period of these two plants as they were found in examined samples from 30 September to 29 November for casuarina, and from 20 September to 29 November for eucalyptus. Also, may be these two plants are existed in relatively high numbers than other flowering plants. Perhaps honey bee workers have more preference to collect pollen from these two plants over other plants at El-Bostan. The other pollen sources were classified as major in relatively low numbers from 12 to 48 samples of the total 330 samples. Such low numbers can be explained by the relatively short flowering period of these plants, or their existence in few numbers at El-Bostan. May be honey bee workers have preference to collect pollen from some plants than others, the preference of forager bees to gather food from plant over another is known as reviewed by Abou-Shaara (2014).

The nutritional values of pollen sources are not similar, as protein level can be varied according to the

source plant from 8 to 40% (Malerbo-Souza, 2011) or from 2.5 to 61.7 as reviewed by Keller *et al.* (2005). It could be expected also that the nutritional value of pollen sources at El-Bostan is highly varied. Maize pollens have low protein level about 15%, but these pollens are attractive to honey bees as found by Malerbo-Souza (2011) in a study on Africanized honey bees. The consumption of pure maize pollen could led to low brood production (Höcherl *et al.,* 2012), and that can be explained by the low crude protein level. Each of sunflower and sesame when fed by honey bee workers showed no much increase in worker survival than bees fed sucrose water as found by Schmidt *et al.* (1995). They concluded that honey bee colonies in fields of sunflower and sesame should be supplied with additional feeding. This reflects the low nutritional value of them. Eucalyptus pollens have a crude protein content of 20.6 and 27.9% as found for two species; *Eucalyptus marginata* and *Eucalyptus calophylla*, respectively (Bell *et al.,* 1983), in general eucalyptus pollen are good for honey bees. In El-Bostan, there is a good interaction between the flowering periods of pollen sources, but by the mid of November casuarina and eucalyptus become the most dominant ones.

Basically, from one to four pollen types were detected in bee bread samples per colony, suggesting that honey bee colonies prefer polyfloral pollens over monofloral pollens in bee bread when pollen sources are available. Scientifically, polyfloral pollens are better than monofloral pollens in regard to brood production (Höcherl *et al.*, 2012) and bee health in case of parasitization (Di Pasquale *et al.*, 2013). Honey bee colonies at El-Bostan have a good chance to collect pollen from different sources to enrich their feeding. Under current conditions of El-Bostan, providing honey bee colonies regularly with pollen supplements or substitutes during autumn is necessary. But increasing the cultivated area with suitable pollen sources is required for El-Bostan and other regions with the same desert nature.

CONCLUSION

The study highlighted that a good number of plants can be cultivated in areas with desert nature to provide honey bee colonies with suitable protein feeding during autumn (a critical period to honey bee colonies). Nine plants were identified as major pollen sources, but two plants, casuarina and eucalyptus, showed the highest abundance during autumn at El-Bostan. Most pollen sources belong to Family Asteraceae (Compositae). Providing honey bee colonies regularly (each two weeks) with pollen substitutes or supplements during autumn at El-Bostan is essential. The examined bee bread samples had mostly a mix of different pollen types. Thus, studying the

number of pollen sources in the bee bread samples can be used to assess the richness degree of any region with suitable pollen sources to managed or feral honey bee colonies.

A**cknowledgements.** Thanks are given to Eng. Talaat Salah at El-Bostan region for his kind help in plants identification and collection, and to Mr. Hany Farag for his help during samples preparation.

REFERENCES

Abou-Shaara H.F., 2013 - Using geographical information system (GIS) and satellite remote sensing for understanding the impacts of land cover on apiculture over time. Int J Remot Sen Appli, 3 (4): 171-174.

Abou-Shaara H.F., 2014 -The foraging behaviour of honey bees, *Apis mellifera*: a review. Vet Med, 59 (1): 1-10.

Abou-Shaara H.F., 2015 - Potential honey bee plants of Egypt. Cercetări Agronomice în Moldova, 48 (2): 99-108.

Al-Ghzawi A.A., Zaitoun S.T., Shannag H.K., 2001 - Seasonal cycles of *Apis mellifera syriaca* under Jordanian desert conditions. J Apic Res, 40(2):45-51.

Babendreier D., Kalberer N., Romeis J., Fluri P., Bigler F., 2004 - Pollen consumption in honey bee larvae: a step forward in the risk assessment of transgenic plants. Apidologie, 35: 293-300.

Bell R.R., Thornber E.J., Seet J.L., Groves M.T., Ho N.P., Bell D.T., 1983 - Composition and protein quality of honeybee-collected pollen of *Eucalyptus marginata* and *Eucalyptus calophylla*. J Nutr, 113 (12):2479- 2484.

Crailsheim K., Schneider L.H.W., Hrassnigg N., Buhlmann G., Brosch U., Gmeinbauer R., Schoffmann B. 1992 -Pollen consumption and utilization in worker honeybee (*Apis mellifera carnica*): dependence on individual age and function. J Insect Physiol, 38:409-419.

Di Pasquale G., Salignon M., Le Conte Y., Belzunces L.P., Decourtye A., Kretzschmar A., Suchail S., Brunet J.-L., Alaux C., 2013 - Influence of pollen nutrition on honey bee health: do pollen quality and diversity matter?. PLoS One, 8(8): e72016. doi: 10.1371/ journal. pone. 0072016.

Garg A., 1996 - Palynocontents of bee-collected pollen loads of autumn season in Bhimdal, India. Taiwania, 41 (3) 197-207.

Höcherl N., Siede R., Illies I., Gätschenberger H., Tautz J., 2012 - Evaluation of the nutritive value of maize for honey bees. J Insect Physio,l 58: 278-285.

Huang Z., 2012 - Pollen nutrition affects honey bee stress resistance. Terr Arthro Rev, 5:175-189.

Hussein M.H., 2001 - Beekeeping in Africa: I - north, east, north-east and west african countries. Proceedings of 37th International Apicultural Congress of Apimondia, Durban, South Africa. 28 October-1 November.

Ismail A.M., Owayss A.A., Mohanny K.M., Salem R.A., 2013 - Evaluation of pollen collected by honey bee, Apis mellifera L. colonies at Fayoum governorate, Egypt. Part 1: Botanical origin. J Saudi Soc Agri Sci, 12:129-135.

Keller I., Fluri P., Imdorf A., 2005 - Pollen nutrition and colony development in honey bees-Part 2. Bee World 86: 27-34.

Malerbo-Souza D.T., 2011 - The maize pollen as a food source for honeybees. Acta Scien Agron, 33 (4):701-704.

SAS Institute, 2004 - The SAS System Version 9.1.3. SAS Institute. Cary. NC.

Schmidt L.S., Schmidt J.O., Rao H., Wang W., Xu L., 1995 - Feeding preference of young worker honey bees (Hymenoptera: Apidae) fed rape, sesame, and sunflower pollen. J Econ Entomol, 88:1591-1595.

Zaitoun S., Vorwohl G., 2003 - Major pollen plant species in relation to honeybees' activity in the Jordanian desert area. Inter J Agri Biol,, 5(4): 411-415.