LOOFAH, *LUFFA AEGYPTIACA* MILL. (CUCURBITACEAE), A SOURCE OF NECTAR AND POLLEN FOR HONEY BEE *APIS MELLIFERA* L. (HYMENOPTERA: APIDAE) IN EGYPT.

EL-KAZAFY, A. TAHA[1]; MAHMOUD, E. NOUR[2] AND MOHAMED, B. SHAWER[1]

[1]Econ. Entomol. Dept., Fac. Agric. Kafr El-Sheikh Univ., Kafr El-Sheikh

[2]Plant Protection Dept., Fac. Agric. Cairo Univ., Egypt.

(Received 19-12-2006)

INTRODUCTION

The main nectar sources (honey plants) in Egypt are Egyptian clover which blooms during May, and cotton which flowers during July and August. The periods between flowering seasons of clover and cotton (June) and from cotton to faba bean season (September- December) consider the dearth periods in most regions of Egypt. Beekeepers usually feed their colonies with sugar syrup and pollen substitutes during these periods. However, no artificial foods have been found equivalent to nectar and pollen (Eisikowitch & Masad, 1980, and Mohanna, 1989).

It is very useful to propagate nectar and/or pollen plants that supply sufficient nectar and/or pollen to economize the cost of feeding and maintain the strength of the colonies during the dearth periods. There are some secondary bee plants in many regions of Egypt during these periods. Squash (*Cucurbita pepo* L.) was recorded as a source of nectar and pollen during April (the dearth period before clover season) in Kafr El-Sheikh region (Shawer *et al.*, 1981) and in Hosh Essa, El-Beheira Governorate (Taha, 2005). In Alexandria region, Mohanna (1989) reported that, Brazil pepper tree *Schinus terebinthifolius* L. is a good source of nectar and pollen and blooming from mid September up to mid October. Also, in Kafr El-Sheikh Governorate, Taha and Bayoumi (2006) concluded that, one feddan of seed watermelon *Citrullus lanatus* var. *colothynthoides* L. could produce 4.40 kg of honey per season, which is sufficient for building-up one honey bee colony during the dearth period after clover flow and early cotton flow.

In India, Suryanarayana *et al.* (1990) studied the value of coconut palm *Cocos nucifera* to honey bee. They found that coconut pollen constituted 91-100 % of the monthly total pollen collected by *Apis cerana* colonies between April and October; when few other pollen sources were available. Besides, Abrol (2003)

reported that *Antignon leptopus* is a very good source of nectar and pollen for honey bee from August to October and helps the colonies to overcome floral dearth periods. Also, Abrol (2004) reported that *Abelia grandiflora* is a useful source of both nectar and pollen for bees during the period extended from June to October (dearth periods in Kashmir). Recently, loofah (*Luffa aegyptiaca* Mill.) was cultivated in considerable areas in north Egypt, the cultivated area in Lower Egypt was 2166 feddans, in Upper Egypt was 7 feddans and in El-Noubaria, El-Beheira Governorate was 1555 feddans (Anonymous, 2005).

The present study aimed to evaluate the prominence of loofah (*L. aegyptiaca*) as a good source of nectar and pollen throughout dearth period, and study the foraging behavior of honey bees (*Apis mellifera* L.) on its flowers.

MATERIAL AND METHODS

This investigation was carried out at loofah (*Luffa aegyptiaca* Mill.) farm (100 feddans) in Motobes district, Kafr El-Sheikh Governorate, Egypt from the 1st week of June till end of November 2006 (the blooming period of the plant). Forty colonies (each have five combs covered with bees) of hybrid Carniolan honey bee were moved to the farm to estimate the following aspects:-

1- Activity of honey bees

To study the importance of loofah as a source of pollen and nectar, ten honey bee colonies were chosen. Five of them were provided with pollen traps with efficiency of 25%, and the others were left without traps as a control. The trapped pollen was collected hourly, beginning 7.00 h and ending 16.00 h, then weighted. The number of opened flowers/m^2, sex ratio, number of bees/flower/min, number of incoming bees and incoming bees carrying pollen/colony/min were counted at the same times twice weekly. Mean weight of one pollen load and total amount of trapped pollen/colony throughout the blooming period were estimated. The areas of stored pollen (/cm^2) and worker sealed brood were measured at 12 days intervals.

2- Nectar secretion and sugar concentration

Certain flowers were bagged in the evening before anthesis to prevent bees from nectar collecting. The nectar was collected by capillary tube from bottom of flowers, and sugar concentration was estimated by pocket refractometer immediately in the field. The amount of expected honey per Feddan was calculated according to the equation of Taha and Bayoumi (2006):

$$\text{Amount of expected honey/Feddan} = \frac{\text{Amount of sugar/feddan}}{\text{Sugar concentration in honey (80\%)}}$$

By the end of September, the trapped and untrapped colonies were used to determine the honey yield by measuring capped and uncapped honey areas and transformed into weight using the following formula:

$$\text{Honey yield in kg} = \frac{\text{area of honey (sq. inches)} \times 10.64 \text{ g}}{1000}$$

where 10.64 = amount of honey (g) in one square inch, based on averages calculated from unsealed and sealed honey from combs of different thickness (Shawer *et al.*, 1986).

Statistical analysis

Simple correlation was made between number of incoming bees/colony/min, number of bees/flower/min, number of incoming bees carrying pollen/colony/min and trapped pollen (g)/colony/h by using "SPSS 10.0 for windows".

RESULTS AND DISCUSSION

1- Phenology of flowering

Loofah plants start to grow in April, the blooming begins in the 1st week of June and continues until the end of November. Both male and female flowers occurred on the plant with a much greater number of male ones, with sex ratio of 1:20 (female:male). The male flowers existed in clusters. The female flowers are singular. The flowers open later in the night and stay open through the next day then closed after 16.00 h. The Blooming reached its maximum during July and August, where there can be 3.25 opened flowers/m^2. The total number of flowers /plant was 3202.92 flowers, 266.91 per m^2 and 1121022.00 flowers per feddan at the whole period of flowering. The colour of pollen loads is bright yellow and mean weight of one load averaged 7.75 mg (Table: 1). The shape of pollen grain was illustrated in fig. 1.

TABLE (I)
Phenology of flowering of loofah.

Items	Blooming period		Total number of flowers			Sex ratio	Pollen load	
	Starting	Ending	m^2	Plant	Feddan		Weight (mg)	Colour
	1/6	30/11	266.91	3202.92	1121022.0	1 : 20	7.75	Bright yellow

(26.10 kg) than in female ones (1.40 kg). This may be due to the great outnumber of male flowers (1067640.00 flowers/feddan) compared by female ones (53382.00 flowers/feddan). In respect of sugar concentration, it was higher in female flowers (25.75 %) than in male ones (24.82 %). The superiority of female flower in nectar secretion and sugar concentration may be to increase the attraction for insects to pollinate it, especially it is obligately rely on cross pollination by insects. These results are in agreement with those obtained by Collison and Martin (1979) who found that pistillate cucumber flower produced more nectar and yielded slightly more sugar. The same results were recorded on squash (Shawer *et al.*, 1981) and seed watermelon (Taha and Bayoumi, 2006).

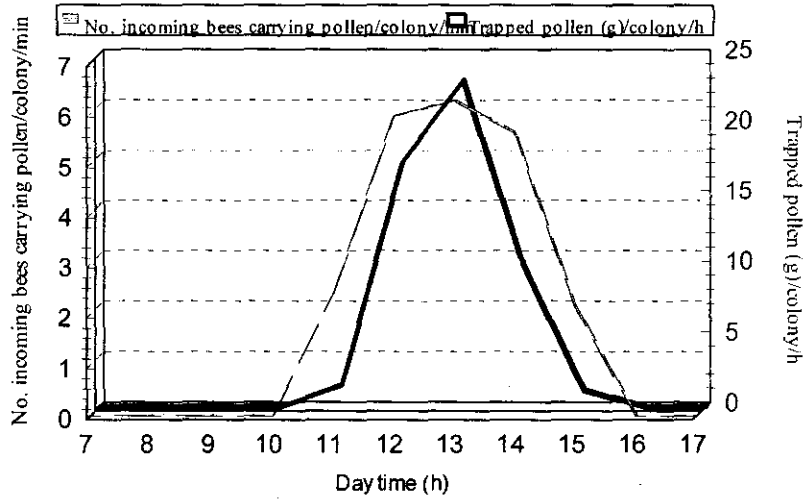

Fig. (3): Number of incoming bees carrying pollen/colony/min and trapped pollen (g)/colony/h in relation to the day time.

Gravimetrically, estimates showed that, one feddan of loofah could produce 35.44 kg nectar which contained 6.84 kg sugar and resulted in 8.55 kg honey/ feddan. Lupo and Eisikowitch (1990) studied the blooming of *Eucalyptus erythrocoris* between July and September in Israel, when sources of pollen and nectar are scarce. They reported that each flower is open for 4 days and secretes a total of 4 ml nectar with a sugar concentration of 4-14%. Sugar yield in a sparse plantation (280 trees/ha) is calculated to be 250 kg/ha. Taha and Bayoumi (2006) recorded that one feddan of seed watermelon *Citrullus lanatus* var. *colothynthoides* L. could secrete 18.98 kg nectar which contained 3.52 kg sugar and resulted in 4.40 kg honey/feddan.

TABLE (IV)

Amount of secreted nectar and its sugar concentration in loofah flowers.

Flower sex	No. flowers		Nectar (mg)/ flower	Sugar concentration (%)	Nectar (kg)/ feddan	Sugar (kg)/feddan	Expected honey (kg) /feddan
	m^2	Feddan					
Male	254.20	1067640.0	24.45	24.82	26.10	6.48	8.10
Female	12.71	53382.0	26.20	25.75	1.40	0.36	0.45
Total	266.91	1121022.0	-	-	35.44	6.84	8.55

4- Effect of pollen traps

Data summarized in Table (5) indicated that, the mean areas/colony of stored pollen and worker sealed brood throughout the blooming period of loofah were 2049.78 & 805.18 cm^2 and 6853.78 & 4016.58 cm^2 for colonies without and with traps, with reduction of 61 % and 41 %, respectively. The amount of honey yield was 4.09 and 2.82 kg/colony for colonies without and with traps, with reduction of 31 %. These results are in harmony with the findings of Shawer (1987) as he found that in colonies of honey bee fitted with pollen traps, stored pollen was reduced by 38.0%, brood area by 24.1% and weight of stored clover honey by 28.8%. Similar results were obtained by Abo-Lila and Ghoniemy (1998). The amount of total trapped pollen per colony during the whole flowering period (June – November) of loofah was 1.45 kg. These results agree with those obtained by El-Sherif *et al.* (1994) who documented that under El-Kanater El-Khayria, Qualyobia Governorate, the collected pollen during the period from June to November was 1.54 kg/colony.

TABLE (V)

Areas (cm^2) of stored pollen and worker sealed brood, and weight (kg) of honey and trapped pollen/colony in colonies without and with pollen traps during loofah flowering period at Motobes region, Kafr El-Sheikh Governorate during 2006 season.

Paramters	Pollen trap		Reduction%
	Withouet	With	
Stored pollen (cm^2)	2049.78	805.18	61
Worker sealed brood (cm^2)	6853.78	4016.58	41
Honey yield (kg)	4.09	2.82	31
Total trapped pollen (kg)/colony	-	1.45	-

Finally, it could be concluded that loofah flowers are good nectar suppliers; male blooms yield a good pollen value. The loofah's profuse and continuous blossoming during dearth periods provides excellent bee colony build-up and maintenance forage. Movement of honey bee colonies to loofah plantations during its flowering period is recommended for economizing the cost of artificial feeding, building-up the colonies and obtain honey yield.

SUMMARY

This investigation was carried out at loofah (*Luffa aegyptiaca* Mill.) farm in Motobes district, Kafr El-Sheikh Governorate, Egypt, season 2006 from the beginning of June till end of November (the blooming period of the plant), to study the role of the plant as a source of nectar and pollen. The highest mean number of bees/flower/min, number of bees/m^2/min, number of incoming bees/colony/min, number of incoming bees carrying pollen/colony/min and amount of trapped pollen/colony/h were recorded between 12.00 and 13.00 h, with highly significant correlations between them. The amount of secreted nectar and sugar concentration were higher in female flower than male one. In the colonies fitted with pollen traps, the area of stored pollen was reduced by 61 %, worker sealed brood area by 41% and honey yield by 31%. It could be recommended to move the honey bee colonies to loofah plantations during its flowering period to economize cost of the feeding, build-up the colonies and obtain honey yield.

REFERENCES

ABO-LILA, S.M. and H.A. GHONIEMY (1998): Evaluation of the role of borage *Borago officinalis* L. as a source of pollen under Dokki conditions, with observations on honey bees as pollinators. *(J. Agric. Sci. Mansoura Univ., 23 (7): 3401- 3409).*

ABROL, D.P. (2003): *Antigonon leptopus. (Bee World, 84 (3): 130- 131).*

ABROL, D.P. (2004): *Abelia grandiflora. (Bee World, 85 (3): p12).*

ANONYMOUS (2005): Annual Report of Ministry of Agriculture, Egypt.

COLLISON, C.H. and E.C. MARTIN (1979): Behavior of honey bees foraging on male and female flowers of *Cucumis sativa. (J. apic. Res., 18: 184-190).*

EISIKOWITCH, D. and Y. MASAD (1980): Nectar-yielding plants during the dearth season in Israel. *(Bee World, 61(1): 11-18).*

EL-SHERIF, M.E.; M.M. MAZEED and H.T. ABOU EL-ENAIN (1994):

Effect of pollen absence in honey bee colonies on drone and worker brood rearing activity. *(5th Conf. Agric. Dev. Res., Fac. Agric. Ain Shams Univ. Cairo, Egypt, 2: 611- 624).*

LUPO, A. and D. EISIKOWITCH (1990): *Eucalyptus erythrocoris*; a source of nectar and pollen for honey bees in Israel. *(Apidologie, 21(1): 25-33).*

MOHANNA, N.E. (1989): An important source of nectar and pollen during the dearth period in Egypt. *(Alex. J. Agric. Res., 34(2):173-182).*

SHAWER, M.B. (1987): Major pollen sources in Kafr El-Sheikh, Egypt and the effect of pollen supply on brood area and honey yield. *(J. apic. Res., 26(1): 43-46).*

SHAWER, M.B.; A.I. EL-ZAWILY; S.M. METWALLY and M.M. GHAZY (1981): The efficiency of honey bees as pollinators of summer squash (*Cucurbita pepo* L.). *(J. Agric. Res. Tanta Univ., 7(2): 225-238).*

SHAWER, M.B.; Z. SHENISHEN and N.M. EL-DAKHAKHNI (1986): Effect of colony strength on flight activity and productivity of honey bee colonies. *(Bull. Soc. ent. Egypt, 66: 65- 73).*

SURYANARAYANA, M.C.; G.M. RAO AND T.S. SINGH (1990): Coconut palm - a pollen and nectar source to honey bees. *(Indian Bee J., 52 (1-4): 41- 43).*

TAHA, E.A. (2005): Studies on honey bee (*Apis mellifera* L.). *(Unpublished Ph.D. Thesis, Tanta Univ., 143pp).*

TAHA, E.A. and Y.A. BAYOUMI (2006): The efficiency of honey bee (*Apis mellifera* L.) as pollinator of seed watermelon (*Citrullus lanatus* var. *colothynthoides* L : Cucurbitaceae). *(J. Biol. Chem. Environ. Sci., 1(4): 899-912).*