IMPORTANCE OF BANANA *MUSA* SP. (MUSACEAE) FOR HONEY BEE *APIS MELLIFERA* L. (HYMENOPTERA: APIDAE) IN EGYPT

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ABSTRACT

This work was conducted at banana (*Musa* sp.) farm in Dessouk region. Kafr El-Sheikh Governorate, Egypt during August and September (the peak of blooming period of the plant) season 2006, to estimate the interest of the plant for honey bee. The plant is a rich source of nectar, but not produces pollen in Egypt. The amounts of secretion nectar and sugar concentration were higher in female flowers than bisexual ones. One feddan of banana could produce 65.13 kg nectar which contained 13.21 kg sugar and resulted in 16.51 kg honey/feddan. Colonies located in banana farm exceed those in the apiary of the Faculty of Agriculture, Kafr El-Sheikh University by 44.68, 61.87, 60.18, 49.66, 33.33 and 100 % for foraging, foraging for pollen, stored pollen, brood rearing, bee population and honey production, respectively. It could be recommended to move the honey bee colonies to banana plantations during the dearth period to economize cost of the feeding maintain the strength of colonies and obtain good honey yield.

INTRODUCTION

The period between the end of cotton flow season till faba bean flowering season (September- December) is considered the dearth period in most regions of Egypt as mentioned in Alexandria Governorate (Mohanna, 1989), Kaft El-Sheikh (Shawer, 1987and Serag El-Dein, 1991), Qualyobia (El-Sherif *et al.*, 1994), El-Beheira (Sharaf, 1996) and Dokki (Abo-Lila & Ghoneimy, 1998)]. Long gaps in the bee forage availability affect the growth of bee colonies. During such floral dearth periods, particularly when pollen is not available, colonies become weak. Such colonies use up a major part of the forage available directly after the dearth for recouping their strength and build up of worker bee population. So, beekeepers usually feed their colonies with sugar syrup and pollen substitutes during such periods. However, no artificial foods have been found equivalent to nectar and pollen (Eisikowitch & Masad, 1980 and Mohanna, 1989). Nevertheless, if there were secondary bee plants supply sufficient nectar and/or pollen, it will be very

useful to move the colonies to such locations during the dearth periods to economize the cost of feeding and maintain the strength of the colonies (Taha & Bayoumi, 2006 and Taha *et al.*, 2006).

There are some secondary bee plants in many regions of Egypt during this period. Brazil pepper tree *Schinus terebinthifolius* L. was recorded as a good source of nectar and pollen, it blooms from mid September up to mid October in Alexandria region (Mohanna, 1989). Also, in Kafr El-Sheikh Governorate, Taha *et al.* (2006) recorded that loofah *(Luffa aegyptiaca* Mill.) plants start to bloom in the 1st week of June and continues until the end of November. One feddan of loofah could produce 35.44 kg nectar which contained 6.84 kg sugar and resulted in 8.55 kg honey/feddan.

In Israel, *Eucalyptus erythrocoris* blooms between July and September, when sources of pollen and nectar are scarce. Each flower is open for 4 days and secretes a total of 4 ml nectar with a sugar concentration of 4-14% (Lupo & Eisikowitch, 1990). 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, *Antignon leptopus* was recorded as a very good source of nectar and pollen for honey bee from August to October and helped the colonies to overcome floral dearth period (Abrol, 2003). Also, *Abelia grandiflora* was a useful source of both nectar and pollen for bees during the dearth period in Kashmir which extended from June to October (Abrol, 2004). In Nigeria, *Acacia ataxacantha* produced abundant nectar. Beekeepers obtain large crops of honey during a brief period from September to October (Dukku, 2003).

Banana (*Musa* sp.) have been grown in considerable areas in scattered locations throughout Egypt; 18905 feddans in Lower Egypt, 8111 feddans in Middle Egypt, 14934 feddans in Upper Egypt, 17 feddans in New valley and 14455 feddans in El-Noubaria, El-Beheira Governorate (Anon., 2005). The present study aimed to estimate the importance of banana *(Musa* sp.) as a honey plant and its effect on growth of honey bee *(Apis mellifera* L.) colonies throughout a considerable dearth period in Egypt.

MATERIAL AND METHODS

This investigation was carried out during August and September (the peak of blooming period) of banana *Musa* sp.) season 2006, to study the importance of the plant as a honey source for honey bee in Egypt. Twenty colonies in the same

strength (each had about 14000 bees) and stored food of hybrid Carniolan honey bee were divided into two groups. The first group was stayed in the apiary of the Faculty of Agriculture, Kafr El-Sheikh University. The second one was moved to banana farm (50 feddans) in Dessouk region, Kafr El-Sheikh Governorate, Egypt to estimate the following aspects:-

1- Nectar secretion and sugar concentration

The numbers of opened flowers per plant were counted. Certain flowers were bagged in early morning before bee foraging to prevent bees from nectar collecting. The nectar was collected by medical syringe 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 & Bayoumi (2006):

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

Air temperature and relative humidity were recorded hourly from 6.00 till 18.00 h. The effect of day time and irrigation on nectar secretion and sugar concentration were determined.

2- Importance of banana for honey bee

To study the activity of honey bee on banana flowers, the numbers of bees/ plant/min were counted hourly from 6.00 till 18.00 h. To study the importance of banana for honey bee, ten colonies of each group were used to evaluate some activities of honey bee colonies. Numbers of forager bees and pollen foragers/ colony/min were counted at 9.00 h twice weekly. The areas (cm^2) of stored pollen and worker sealed brood were measured at 12 days intervals. Bee population per colony was counted as one comb covered with bees in the two sides equals 2000 bees. By the end of September, the 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).

RESULTS AND DISCUSSION

1- Phenology of flowering

Under the environmental conditions of Egypt, banana plants are blooming all year round, while the peak of flowering period occurred during August and September. The flowers appear spirally along the axis of the inflorescence in groups of 10 to 18 flowers, covered by purplish to greenish fleshy bracts. The first flowers to emerge are functionally females (180.18 flowers/plant and 378378 flowers/ feddan), then bisexual flowers (164.40 flowers/plant and 345240 flowers/feddan). The last flowers to emerge are functionally males which may be absent or greatly reduced. In fact, the axis of the inflorescence already had cut before the male flowers emerged (Table 1).

TABLE (I)

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

Flower sex	No. flowers		Nectar mg/flower	Sugar concentration (%)	Nectar kg/feddan	Sugar kg/feddan	Expected honey kg/feddan
	Plant	Feddan					
Female	180.18	378378	91.66	20.47	34.68	7.10	8.87
Bisexual	164.40	345240	88.20	20.06	30.45	6.11	7.64
Total	374.58	786240	-	-	65.13	13.21	16.51

2- Nectar secretion and sugar concentration

Data presented in Table (1) referred that the amount of secretion nectar (mg/ flower) was higher in female flower (91.66 mg/flower) than in bisexual one (88.20 mg/flower). In respect of sugar concentration, it was higher in female flower (20.46%) than in male one (20.06 %). The superiority of female flower in nectar secretion and sugar concentration may be due to the bigger size of female flowers than others. These results are in agreement with those obtained by Shawer *et al.* (1981) who found that pistillate squash flower produced more nectar and yielded slightly more sugar. The same results were recorded on seed watermelon (Taha & Bayoumi, 2006) and loofah (Taha *et al.*, 2006).

Gravimetrically, estimates showed that, one feddan of banana could produce 65.13 kg nectar which contained 13.21 kg sugar and resulted in 16.51 kg honey/feddan. These results are agreed with the findings of Lupo & Eisikowiteh (1990) who calculated sugar yield in a sparse plantation of *Eucalyptus erythrocorn* (280 trees/ha) to be 250 kg/ha. Taha & 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. Besides,

Taha *et al.* (2006) reported 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.

3- Effect of time of the day on bee visits, nectar secretion and sugar concentration

As illustrated in Fig. (1), there were two peaks of bee visits on banana flowers; the first and highest (8.50 bees/plant/min) was recorded at 9.00 h, while the second and smallest (4.33 bees/plant/min) was recorded at 16.00 h. Similar results were recorded on cotton plants, (Serag El-Dein, 1991), *Borago officinalis* L. (Abo-Lila & Ghoneimy, 1998) and *Carum carvi* L. (Abo-Lila & Sadek, 1998).

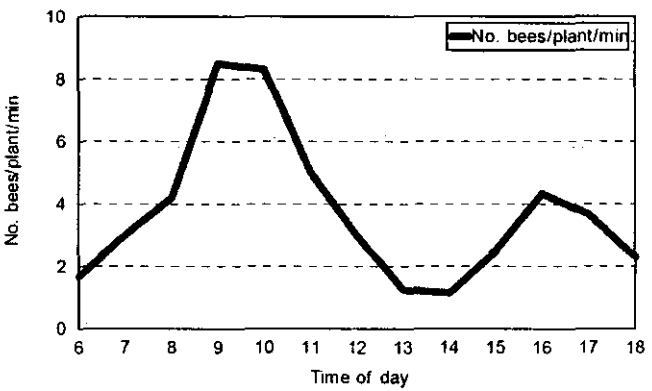

Fig. (1): Effect of time of the day on bee visits on banana flowers.

The highest amount of secreted nectar/flower (100.67 mg/flower) was recorded at 6.00 h, which coincided with the highest value of R.H. (85.00 %) and lowest value of air temperature (24.00 °C). On the other hand, the highest value of sugar concentration (20.55 %) was recorded at 12.00 h, which coincided with the lowest value (56.00 %) of R.H. and highest value (32.70 °C) of air temperature (Table 2). These results are in harmony with those obtained by El-Shemy (1980); Shawer *et al.* (1981) and Serag El-Dein (1991) as they reported that nectar secretion increased by increasing R.H. and decreasing air temperature in contrary to sugar concentration.

4- Effect of irrigation on nectar secretion and sugar concentration

The physical state of the soil at the time of blooming influenced both of nectar secretion and sugar concentration in banana flowers (Fig. 2). The mean amount of collected nectar (95.50 mg/flower) in irrigated plants was higher than that of non-irrigated plants (90.40 mg/flower). On the other hand, the concentration of sugar (20.50 %) in non-irrigated plants was higher than that of irrigated plants (19.20 %). These results are in agreement with the findings of Shawer *et al.* (1981) who found that the irrigation of squash plants increased the quantity of nectar and decreased the sugar concentration. Similar results were obtained on cotton plants (Serag El-Dein, 1991).

Table (II)

Nectar secretion (mg) and sugar concentration (%) in banana flowers in relation to air temperature and R.H. throughout the different time of the day.

Time of day	Nectar mg/ flower	Sugar concentration (%)	Air temperature °C	R.H
6	100.67	19.00	22.50	85.00
7	99.00	19.10	24.00	82.50
8	96.67	19.14	24.50	82.00
9	92.33	19.18	26.75	72.50
10	91.10	19.23	29.50	67.25
11	92.33	20.42	31.25	59.00
12	89.67	20.55	32.70	56.00
13	85.88	20.50	32.70	56.00
14	84.63	20.22	31.00	56.50
15	86.12	20.23	31.00	59.50
16	93.67	20.45	30.50	59.75
17	92.33	20.48	30.00	63.00
18	88.75	20.25	30.00	64.00

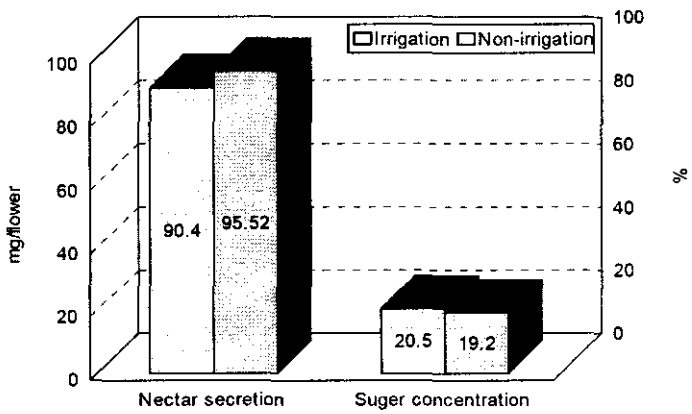

Fig. (2): Effect of irrigation on nectar secretion and sugar concentration in banana flowers.

5- Effect on some activities of honey bee colonies

Data summarized in Table (3) reveled that, colonies located in banana farm exceed those in the apiary of the Faculty of Agriculture, Kafr El-Sheikh University. The percentages of increment per colony were 44.68, 61.87, 60.18, 49.66, 33.33 and 100 % for foraging, foraging for pollen, stored pollen, worker brood rearing, bee population and honey yield/colony, respectively. These increments might be due to colony strength. The high populations of workers depend mainly on the presence of sufficient nectar gathered from banana flowers and pollen collected from surround

maize fields and other grasses in banana orchards. The decline in bee population in colonies of Kafr El-Sheikh location might be due to the over application of pesticides on cotton fields at the end of season as well as the scarcity of nectar and pollen sources during September. These results, are in harmony with the findings of Helal *et al.* (2003); Mansour *et al.* (2003) and Shawer *et al.* (2003). Mansour *et al.* (2003) reported that under the environmental conditions of Kafr El-Sheikh region, the highest amount of collected pollen (95.7& 98.3 g/day) and honey yield (9.5& 9.8 kg/colony) were obtained from colonies located in mixed fields (rice and maize), while the least ones (63.3& 58.5 g/day) and (7.4 & 7.6 kg/colony) were obtained from those in located rice fields during 2001 and 2002 seasons, respectively.

In another banana location where no pollen sources are present, bees could gather nectar and store surplus honey, but may be couldn't rear considered bee population without providing by pollen substitutes.

TABLE (III)

Some activities of honey bee colonies in two locations during banana flowering period, 2006 season.

Parameters/colony	Kafr El-Sheikh location	Banana location	Increment %
No. foragers/min	25.78	46.60	44.68
No. pollen foragers/min	4.45	11.67	61.87
Stored pollen area (cm^2)	139.66	350.75	60.18
Worker sealed brood area(cm^2)	1145.46	2275.45	49.66
Bee population (No. bees)	12000	18000	33.33
Honey yield (kg)	0.00	4.56	100.00

In general, it could be concluded that banana flowers are good nectar suppliers. The banana's profuse and continuous blossoming during dearth periods provides excellent honey yield during the peak of blossoming period and maintain the strength of colonies. Recommended is to move the apiaries to banana plantations at any time during the dearth periods for economizing the cost of artificial feeding, encouraging the growth and maintaining the strength of colonies and during August and September to obtain good honey yield.

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