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EFFECT OF POLLEN SUBSTITUTES FEEDING ON THE ACTIVITY OF HONEYBEE COLONIES

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ABSTRACT

The effect of pollen substitutes feeding on the activity of honeybee was investigated using F1 generation of El-Wady El-Gadid and F1 Italian honeybee. Some food materials of high protein, sugar, vitamins and minerals content available locally were used to increase colony population, pollen collection as well as honey production. The pollen substitutes were: A (agwa, sugar, soybean, melon shell, mandarin shell), B (yeast, agwa, sugar, maize, melon shell, banana shell) and C (yeast, agwa, sugar, Egyptian bean, melon shell, orange shell). The results showed that there were no significant differences between food consumption, pollen collection, area of brood rearing and honey production in the two tested strains. The data showed that there was a significant differences between all treatment; A (99.1 %), B (98.5 %) and C (91.03 %) of El-Wady El-Gadid colonies, when the food preference was studied, whereas there was no significant difference between all treatment in case of Italian colonies. There was a significant difference in honey production, sealed brood area and pollen collection among the tested pollen substitutes and control hives treatment of El-Wady El-Gadid colonies, while there were no significant differences between them in honey production and brood rearing area of F1 Italian colonies. There was no significant difference between the two hybrids and pollen substitutes in all activates with the exception of diet A in the honey production and pollen collection. The data also indicated that, there was a significant differences between the worker brood area of all diets in case of El-Wady El-Gadid colonies, where the pollen substitute (B) was the first followed by (A) and (C). On the other hand, there were no significant differences between all diets and control hives treatment in Italian colonies.

Key words: Pollen substitutes feeding, honeybee colonies.

INTRODUCTION

Brood rearing in honey bee colonies is a major factor in apiary production and affected by colony feeding in nature on nectar and pollen. However, supplementary feeding was developed by many investigators in order to increase the number of workers in the colony whenever needed to improve the productivity of commercial apiaries. Pollen, nectar and water are the usual diets of honeybee (Free, 1957). During a dearth period the number of bees colonies may decrease, adversely affecting the

production of honey in the following season. Pollen substitute are often used to produce package bees , queens, and increase the number of foraging bees (Stanger & Laidlaw, 1974). Haydak (1967) found that yeast, dry milk and soybean flour makes adequate pollen substitute, but not equal pollen as feed bees. To overcome the shortage of pollen and nectar during the dearth period , various diets are provided as pollen substitute. A pollen substitute suggested by Steve (1981) consists of soybean flour (55%), sugar (25%), yeast (5%), milk powder (5%) and water (10%). There are various supplementary diets advocated and commercially available, but most appear to be variously nutritionally poor or unpalatable and are not well tested. Based on the principles of dietetics (Jouanin, 2000; Carter, 2003; Dadant, 2000 and National Research Council, 2003). Pollen substitute have the ability to enhance the performance of honeybee colonies.

Therefore, the following study was designed to measure the effect on brood production, pollen production and honey production when honeybees were fed a pollen substitutes.

MATERIALS AND METHODS

The present study was performed during the period (22th April, to 4th August 2004) in the apiary of the Faculty of Agriculture in Al -Azhar University at Mustored farm. Two strains of honeybee (*Apis mellifera)* colonies were used, 1st hybrid of El-Wady El-Gadid and Italian bees. Twenty four colonies of honeybee about equal in strength were selected. The colonies were divided into two equal groups. Each group contains twelve colonies to evaluate the different feeding treatments (diets), three colonies were used for each substitute and three colonies were used as control fed on natural pollen. Frontal pollen traps were fitted to the entrances.

Preparation of pollen substitute :

Three pollen substitutes A ,B and C were prepared as shown in Table (1).

Table (1). Composition of pollen substitutes.

Percentages	Pollen substitute		
	A	**B**	**C**
45%	Soybean	Maize	Egyptian bean
25%	Sugar	Sugar	Sugar
10%	Melon shell juice	Melon shell juice	Melon shell juice
10%	Mandarin shell juice	Banana shell juice	Orange shell juice
5%	---	Yeast	yeast
---	Agwa (10 %)	Agwa (5 %)	Agwa (5 %)

Several food stuffs containing considerable amounts of protein and available in cheep price in the local market were chosen for this study. Flours of these stuffs were sifted using different sets of sifts with different mesh. Thereafter they were mixed with sucrose solution (1:1 w/v) making a cakes. The cakes were spread on a

plastic sheet. It was left for 24 hours to be little pit dried. It was divided into small pieces (60 g / colony). The cut was provided to each colony at 4 days interval all the experimental period. The cake was placed directly over the brood nests covered with plastic sheets to avoid draying. Control colonies fed natural available diet during that season.

Estimation of food consumption:

Each colony received each four days 60 g of tested diets during the experimental period. The unconsumed diets were collected and weight to determine the rate of consumption of each diet. The selected colonies including the control which were fed only with 500 ml sucrose solution.

Brood rearing measurement:

A typical Lang troth frame with dimensions of 17x18 inches was divided into evaluates the quantity of sealed brood. The frame was laid against side of brood comb and the area occupied by sealed brood was measured. The counts of workers brood were done at 12 days intervals (Moeller, 1967).

Pollen production:

Pollen were collected through the experimental period as orbicular pellets removed from the pollen basket on the bees hind legs as they passed through pollen traps attached to honeybee hives. The trapped pollen was collected from the pollen trays daily throughout the experimental period. The weight of fresh pollen was determined and recorded.

Honey production:

The study was carried out during for months (April – August) and at the end of this period, the number of honey frames in each colony and total honey were weighted.

RESULTS AND DISCUSSION

Colonies were usually fed substitute foods for one or more of the following reasons:

1-To ensure continued colony development in places and times of shortage of natural pollen and nectar.
2-To develop colonies with optimum populations in time for nectar flows.
3-To build colonies to high populations for queen and package-bee production.
4-To provide adequate food reserves for over wintering colonies.

The effect of pollen substitutes on food consumption:

The results of the feeding preference comparisons between the pollen substitutes on the food consumption were shown in (Table 2). By using a test of

Table (2). The food consumption by El-Wady El-Gadid and Italian colonies to A, B and C pollen substitute.

Strains	Substitutes			F- test	L.S.D
	A	B	C		
F_1 EL-Wady EL-Gadid	99.1 %	98.5 %	91.03 %	82.81	1.94
F_1 Italian	98.13	98.27	92.9	--	Ns
F -test	ns	ns	ns	--	--
LSD	--	--	--	--	--

Where: A (Agwa, sugar, soybean, melon shell, mandarin shell),
B (Yeast, agwa, sugar, maize, melon shell, banana shell),
C (Yeast, agwa, sugar, Egyptian bean, melon shell, orange shell).
NS: No significance.

multiple comparisons (L.S.D.), it was apparent that there was no significant difference between all treatment and control hives of food consumption in both strains El-Wady El-Gadid and Italian colonies, also there was no significance difference among all treatment in case of Italian colonies. Whereas, there were significant differences among all treatments; A (99.1 %), B (98.5 %) and C (91.03 %) in case of El-Wady El-Gadid colonies.

The effect of pollen substitutes on honey production:

Table (3) showed that there was a significant difference between the means of all treatment and control hives in case of honey production of El-Wady El-Gadid colonies. Whereas, there was no significant difference between the means of all treatments in case of honey production of F_1 Italian colonies. On the other hand, there was a significant difference of pollen substitute (A) and (B) in both strain honeybee colonies, while there was no significant difference between both strains in case of pollen substitute (C). In this regard, Abdellatif *et al.* (1971); Atallah (1975); Eweis and Ali (1980); Abd Al Fattah and EL-Shamy (1989) showed that in colonies given pollen supplement (yeast, agwa, sugar, can syrup, glucose, port lane and herring fish meal) honey produced was significantly greater than that of unfed ones. Abbas *et al* (1995) noticed that colonies which were found with pollen substitute containing black gram produced a high number of frames, resulting in higher production of honey compared to those fed on meal containing soybean.

The effect of pollen substitutes on pollen collections:

Table (4) demonstrates that there were significant differences between all treatment and control colonies of F_1 El-Wady El-Gadid colonies of pollen collection, while there were no significant differences between them in case of F_1 Italian colonies. The results show also no significant differences between F_1 El-Wady El-

Table (3). The effect of pollen substitute A, B and C on honey production by El-Wady El-Gadid and Italian colonies.

Strains	Control	Substitutes			F- test	L.S.D
		A	B	C		
F_1 El-Wady El-Gadid	6.9	10.08	9.08	6.33	5.5	2.62
F_1 Italian	6.16	6.42	5.75	6.5	0.86	Ns
F- test		31.74	4.66	--	--	--
LSD		2.80	ns	ns	ns	--

Table (4). The effect of pollen substitute A, B and C on Pollen production by El-Wady El-Gadid and Italian colonies

Strains	Substitutes			F- test	L.S.D
	A	B	C		
F_1 El-Wady El-Gadid	113.73	200.19	146.59	3.403	81.86
F_1 Italian	140.87	171.58	124.98	3.92	40.74
F -test	52.31	--	--	--	--
LSD	19.72	ns	ns	--	--

Gadid and F_1 Italian colonies of pollen substitute (A) and (B), while there was a significant difference in case (C).

The effect of pollen substitutes on brood rearing activity:

Table (5) showed that there was a significant difference between the means of all treatment on the worker brood area in case of F1 El-Wady El-Gadid colonies, where the pollen substitute (B) was the first followed by (A) and (C), while there was no significant differences between all treatments and control hives in F1 Italian colonies. Also, there was no significant difference between F1 El-Wady El-Gadid and F1 Italian colonies in all treatments pollen substitute (A), (B) and (C). In this respect, Abdellatif *et al.* (1971) found that the bees fed on medicinal yeast showed significant increase in brood area. It was also due to clover flow at this period. Atallah (1975) showed that agwa (cake or syrup) gave more brood, when used as pollen supplement in autumn. Nabors (2000) found that package colonies of bees fed on pollen substitute upon installation in the spring were more productive than package colonies that were not fed a pollen substitute. He was also found that treated colonies produced more drawn comb, more brood and more honey by the end of the honey flow.

Rogala and Szymaś (2004a and 2004b) found that supplementing pollen substitute with lacking amino acids to bring them up to the pollen level caused the nutritional value of the protein in the surrogate to equal that of pollen. When fed to bees, the substitute gave similar dry matter, protein and crude fat contents of bee bodies.

Table (5). The effect of pollen substitute A,B and C on brood rearing area By El-Wady El-Gadid and Italian honeybee colonies.

Strains	Control	Substitutes			F -test	L.S.D
		A	B	C		
F1 El-Wady El-Gadid	302.07	3118.47	364.7	253.93	4.55	68.68
F1 Italian	322.73	352.86	346.63	293.63	1.45	Ns
F -test	--	--	--	--	--	--
LSD	--	ns	ns	ns	--	--

The present results indicated that the newly diet and pollen were equally accepted by the bees, as highly palatable as natural pollen and easily provided as patties to colonies. We would recommend that colonies started in the spring be fed a pollen substitute for greater brood production and increase pollen and honey production .

The relationship between amount of consumed substitutes (A, B and C) and the hybrids activity in brood rearing, honey production and pollen collection:

The results (Fig. 1) showed that generally the first Italian hybrid consumed more quantities of pollen substitutes (Fig. 1a) than Al wady Algadid hybrid. There were differences in brood rearing (Fig. 1b), honey production (Fig. 1c) and the pollen collection (Fig.1d) between the two hybrids. The Italian honey bees colonies surpass El-Wady El-Gadid honey bees colonies in brood rearing (1543, 1605.33 and 1397 in^2 respectively) in all pollen substitutes A, B and C. Whereas, El-Wady El-Gadid hybrid surpass Italian hybrid in honey production (10.08, 9.08 and 6.33 kg) and pollen grains collection (1106.83, 1468.59 and 1346.06 gm). It noticed that A and B diets have greater amounts brood rearing, honey production and pollen collocation. Several studies in different countries, collecting foragers at the hive entrances, demonstrated that Africanized colonies have a greater number of pollen foragers than European colonies throughout the day and so collected a greater amount of total pollen in all cases (Pesante *et al.,* 1987). In the present study, these results observed that the amount of pollen trapping form El-Wady El-Gadid honey bees colonies was apparently greater than Italian honey bees colonies. These results supported by Khattab (1976) who found that El-Wady El-Gadid colonies were more active in

Fig (1-a):The amounts of consumed substitutes (A, B and C) by two hybrids during season 2004.

Fig (1-b): Effect of pollen substitutes (A, B and C) consumption on brood rearing activity by two hybrids during season 2004.

Fig. (1-c): Effect of pollen substitutes (A, B and C) consumption on honey production by two hybrids during clover nectar flow 2004 .

Fig. (1-d): Effect of pollen substitutes (A, B and C) on pollen collection activety by two hybrids during season 2004

gathering pollen than the Carniolan colonies during a year of the experiment they trapped 10.269 and 8.624 kg /col., respectively. Mc Lellan (1974) and Cook (1985) reported no significant effect of pollen trapping on the amount of brood reared from May to September and this also supported our results. Nelson *et al*. (1987) noticed little effect on the area of sealed brood, while Dietz *et al*. (1981) concluded that pollen trapping resulted in a significant decrease in brood area.

Nelson *et al*.(1987) claimed that, although honey production was significantly reduced by pollen trapping, gross income from honey and pollen from pollen trapped colonies was greater than the gross income obtained from untapped colonies.

In conclusion, it could be concluded that beekeepers can use diets A, B as pollen substitutes, when honey bees colonies face a dearth regions, we recommend with this diets in a dearth regions for package bees and royal gelly production to increased beekeeper income. AL-Gamali *et al*. (2005). Indicated that Cilipol and broad bean powder with sucrose solution gave the largest area of workers brood pollen grain and stored honey compared with other pollen grain alternatives.

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