

## **EVALUATION OF THE EFFECT OF STIMULATIVE FEEDING WITH SOME POLLEN SUBSTITUTES ON BROOD REARING ACTIVITY AND ROYAL JELLY PRODUCTION OF HONEYBEE COLONIES**

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### **ABSTRACT**

This study was carried out at the apiary of Sakha Agricultural Research Station, Kafr El-Sheikh region, Egypt during two dearth periods, the first period extended from March, 1<sup>st</sup> to April, 30<sup>th</sup> 2008, the second one from September, 1<sup>st</sup> until December, 31<sup>st</sup> 2008. Results indicated that the sealed brood area was the highest in the colonies fed on diet (B) (895 in<sup>2</sup>/group) and followed by diets (C), (A), (F), (E) and (D), the values of sealed brood area were 835, 801 725, 711 and 708 in<sup>2</sup>/group during the first period, respectively. In the second one, also the sealed brood area was highest in the colonies fed on diet (B) comparing with the other diets. Significant differences were found between the mean brood areas during the two tested periods in the colonies fed on diet (B) and the other diets. On the other hand, royal jell was highest in colonies fed on diet (B) (92 gm/group) comparing with the other diets, (C), (A), (F), (E) and (D) which were represented by 80, 68, 55, 41 and 35 g/group during the first period, respectively. Also, in the second one, the amount of royal jelly produced from colonies fed on diet (B) was highest compared with the other diets. Significant differences were found between the mean amount of royal jelly during the two tested periods in the colonies fed on diet (B) and the other tested diets. It could be suggested that beekeepers can use diet (B) and solution (F) to induce the colonies to rear more amounts of sealed workers brood and produce royal jelly during two dearth periods of flowering plants before main nectar flow of clover at Kafr El-Sheikh region.

### **INTRODUCTION**

Pollen grains are the main source of proteins, lipids, minerals and vitamins. They are necessary in feeding process of honeybee colonies for normal growth of bee workers and drones. The protein content of pollen grains ranges from 7-40% (Kleinschmidt and Kondos, 1978 & Dietz, 1979).

Protein food is consumed when bees are foreseen to rear brood for longer time period. Honey bees use protein of pollen mainly to provide structural elements of muscles, glands such as; hypopharyngeal and venom glands and other tissues (Doull, 1973; Dietz, 1975 and Szymas & Pizybyl, 1995). Royal jelly production form workers of honeybee, *Apis mellifera* L. had a potential physiological effect on honeybee colonies which reflects on bees' productivity (Szymas & Przyby, 1995). During dearth periods and when pollen grains are not available or in short supply, it is necessary to provide essential nutrients in the form of pollen substitutes or supplements (Taber and Poole, 1974). Several investigators formulated number of diets as pollen substitutes to provide colonies with sufficient brood area and royal jelly during the whole seasons (Standifer and Mills, 1977; Walter, 1980; Atallah, 1983; Shuel and

Dixon, 1986; Macicka, 1987; Nour, 1988; Awad, 1998; Serag El-Dien and Eissa, 2003; Mattila and Otis, 2006 and Hammad, 2007).

The present investigation aimed to evaluate some diets as pollen substitutes to solve the problem of short supply or low pollen availability and the amount of produced royal jelly during dearth periods of flowering plants at Kafr El-Sheikh region.

## **MATERIALS AND METHODS**

The experiments were conducted at the apiary of Sakha Agricultural Research Station, Kafr El-Sheikh region, Egypt during two dearth periods, the first from 1/3/2008 to 30/4/2008, the second from 1/9/2008 until 31/12/2008. In the test apiary, twenty eight honeybee colonies of first hybrid Carniolan bees of about equal strength containing at least five combs were randomly selected. The colonies were arranged in seven groups of four colonies each. Three diets were used in this study and mixed with sugar solution, then offered to the bees in cake form and placed directly over the brood nests covered with plastic sheets to avoid drying. Three solutions were mixed with sugar solution, then placed directly in the feeder. The control group was offered sugar solution alone (1: 1). The protein content in the mixtures ranged 20-25% resembling protein percentage in natural pollen sources.

### **The mixtures are:**

- A. 150 g dry yeast + 150 g skimmed powder milk + 350 g powder of cheek pea + 350 g powder sugar.
- B. 100 g dry yeast + 200 g date paste (Agwa) + 200 g powder milk + 300 g soybean flour + 200 g powder sugar.
- C. 100 g dry yeast + 100 g powder milk + 150 g powder of check pea + 150 g powder horse bean + 400 g powder sugar + 100 g pollen.

Each colony was fed weekly with 100 g of each tested diet during the two abovementioned dearth periods except control group that received sugar solution only.

### **The solutions were prepared as following:**

One kg of each of coriander; *Coriandrum sativum* (D), fenugreek; *Trigonella foenum gracum* (E) and fennel; *Foeniculum vulgare* (F) was boiled in two liters of water, then the boiled solution was added to ten liters of sugar solution (1: 1). Each colony was fed weekly with 500 ml/colony of this solution during the two dearth periods except control group that received only sugar solution. Sealed brood areas were measured at 12-day intervals using wire frame divided into square inches (Moeller, 1967). Statistical analysis of the obtained data was done adopting the analysis of variance and the means were compared by L.S.D. test (Fisher, 1944), and Duncan's Multiple Range Test.

## RESULTS AND DISCUSSION

### Evaluation of the effect of some diets and solutions as pollen substitutes on some biological activity of honeybee colonies:

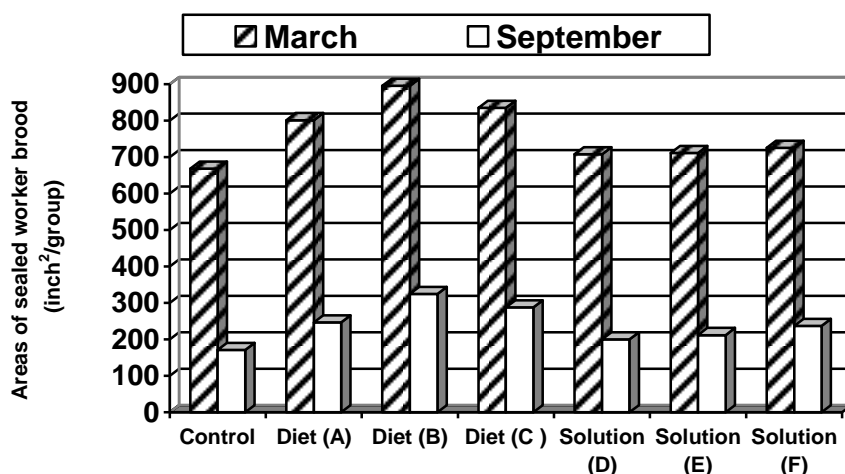
#### a. Brood rearing activity:

Data in Table (1) and Fig. (1) show the areas of sealed brood in the colonies fed with the tested pollen substitutes and sugar solution as control at the two tested periods. The first dearth period elapsed from March, 1<sup>st</sup> to April, 30<sup>th</sup> 2008. The colonies fed on diet (B) gave the highest amount of sealed brood areas (895 in<sup>2</sup>/group) followed by diets (C), (A), (F), (E) and (D) which gave by 835, 801, 725, 711 and 708 in<sup>2</sup>/group, respectively. The second period extended from September, 1<sup>st</sup> until December, 31<sup>st</sup> 2008. Also, the sealed brood area was highest in the colonies fed on diet (B) (325 in<sup>2</sup>/group) followed by diets (C), (A), (F), (E) and (D), as the values were 288, 247, 237, 212 and 200 in<sup>2</sup>/group, respectively. Significant differences were found among the mean brood areas during the two tested periods in the colonies fed on different diets. On the other hand, the colonies fed on diets (B), (C), (A), (F), (E) and (D) showed worker brood areas of 45.41, 33.85, 24.91, 14.66, 10.01 and 8.22% more than the control ones, respectively. Results agree with those obtained by El-Shaarawi (2001) who indicated that colonies fed on pollen substitutes had higher worker brood areas than the unfed ones, where the fed colonies with mung-bean, wheat germ, soybean, yeast and *Sativa vulgaris* showed worker brood areas of 31.66, 27.96, 20.21, 15.48 and 1.56% more than the control ones, respectively. Also, Mattila and Otis (2006) reported that colonies supplemented with pollen or pollen substitutes in the spring started rearing brood earlier than colonies in other treatment groups and produced the most workers by late April or early May. In this respect, Hammad (2007) showed that the liquid yeast diet (*Candida tropicalis*) at 25% conc. produced the highest area of sealed workers brood followed by the dried brewer's yeast diet and the diet containing 400 ml. liquid yeast (*Candida tropicalis*) + 200 gm soya bean (lipid free) + 300 gm bran + 100 gm corn flour + 1000 gm sugar. While the diet of [200 gm. dried brewer's yeast (*Sccharomyces* sp.) + 400 soya bean (lipid free) + 400 g. barley (apical + roots) + 1000 gm. sugar and that of sugar] syrup as control recorded the lowest values.

**Table (1): Areas of sealed worker brood (inch<sup>2</sup>/group) in honeybee colonies fed on each of three diets and solutions during the two tested periods.**

Diets & solutions Dates	Control (sugar solution)	Diet (A)	Diet (B)	Diet (C)	Solution (D)	Solution (E)	Solution (F)
March, 1 <sup>st</sup> – April, 30 <sup>th</sup> 2008	668	801	895	835	708	711	725
September, 1 <sup>st</sup> – December, 31 <sup>st</sup> 2008	171	247	325	288	200	212	237
Total	839	1048	1220	1123	908	923	962
Mean	419.5 a	524 d	610 f	561.5 e	454 b	461.5 b	481 c
L.S.D.	11.24						
% increasing	-	24.90	45.41	33.85	8.22	10.01	14.66

Means with the same letter are not significantly different at 0.05



**Fig. (1): Mean areas of sealed worker brood (inch<sup>2</sup>) in honeybee colonies fed on different diets and solutions during two tested periods; March-April & September-December, 2008.**

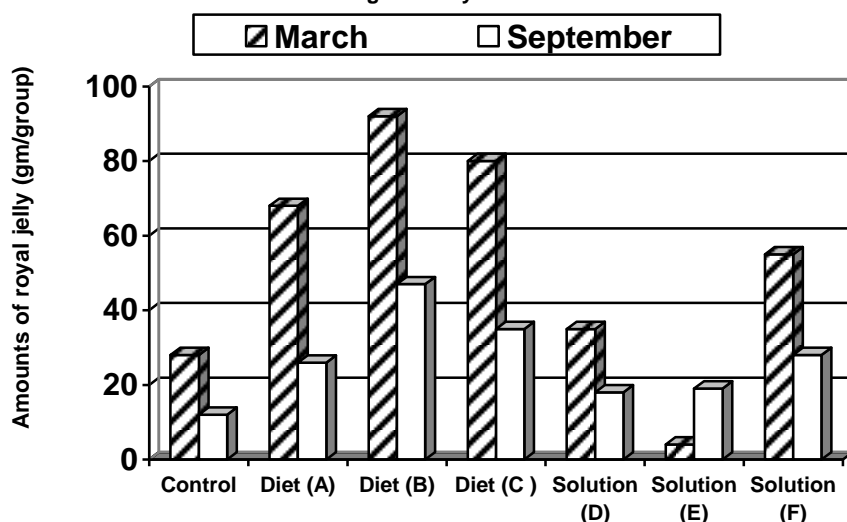
**b. Royal jelly production:**

As shown in Table (2) and Fig. (2), royal jelly produced from colonies fed on diet (B) (92 gm/group) was the highest and followed by diets (C), (A) (F), (E and (D) which were represented by 80, 68, 55, 41 and 35 g/group during the first dearth period, respectively. Also, during the second period, the amount of royal jelly was highest in the colonies fed on diet (B) (47 g/group) followed by diets (C), (F), (A), (E) and (D) which were represented by 35, 28, 26, 19 and 18 g/group; respectively. Significant differences were found among the mean amounts of royal jelly during the two tested periods in the colonies fed on different diets. Thus, the colonies fed on diet (B), (C), (A), (F), (E) and (D) indicated the amount of royal jelly of 247.5, 187.5, 135, 107.50, 50 and 32.5% more than the control, respectively. It could be noticed that measurements of each sealed brood area and royal jelly in the first period were higher than those in the second one. This may be due to the favourable weather conditions in the first period (March, 1<sup>st</sup> to April, 30<sup>th</sup> 2008) and the tendency of the colonies to build up their strength before nectar flow. In the same trend, Abd Al-Hakam (1996) mentioned that honeybee colonies feeding on sunflower meal, agwa or yeast increased the quantity of royal jelly. Spring feeding gave the highest production followed by summer, autumn and winter; respectively. El-Dakhakhni and Metwally (1995) reported that the development of the hypopharyngeal glands was promoted by high protein concentration of the diet. Also, the current results agree with those reported by Hammad (2007) who found that the amount of royal jelly was significantly higher in colonies fed an liquid yeast diet (*Candida troicalis*) at 25% conc. than in control colonies.

**Table (2): Amounts of royal jelly (gm/group) produced in honeybee colonies fed on each of three diets and solutions during the two tested periods.**

<b>Diets &amp; solutions Dates</b>	<b>Control (sugar solution)</b>	<b>Diet (A)</b>	<b>Diet (B)</b>	<b>Diet (C)</b>	<b>Solution (D)</b>	<b>Solution (E)</b>	<b>Solution (F)</b>
March, 1 <sup>st</sup> – April, 30 <sup>th</sup> 2008	28	68	92	80	35	41	55
September, 1 <sup>st</sup> – December, 31 <sup>st</sup> 2008	12	26	47	35	18	19	28
Total	40	94	139	115	53	60	83
Mean	20 a	47 e	69.5 g	57.5 f	26.5 b	30 c	41.50 d
L.S.D.	2.01						
% increasing	-	135.0	247.5	187.5	32.5	50.0	107.50

Means with the same letter are not significantly different at 0.05



**figure (2): Mean amounts of royal jelly (gm/group) produced in honeybee colonies fed on different diets and solutions during two tested periods, March-April & September-December, 2008.**

From the obtained results, it could be suggested that feeding honeybee colonies with diet (B) and solution (F) were very effective to inducing the colonies to rear more amounts of sealed workers brood and produce more amount of royal jelly during two dearth periods of flowering plants before main period of nectar flow of clover at Kafr El-Sheikh region. This may be due to the stimulative effect of those diets for increasing the different activities of individuals of bee colonies.

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### تأثير بعض بدائل حبوب اللقاح على نشاط تربية الحضنة وإنتاج غذاء الملكات في طوائف نحل العسل

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معهد بحوث وقاية النباتات - محطة البحوث الزراعية بسخا - مركز البحوث الزراعية

أجريت هذه الدراسة بمنحل محطة البحوث الزراعية بسخا - كفر الشيخ - جمهورية مصر العربية خلال فترتين حيث كانت الفترة الأولى من الأول من مارس حتى ٣٠ إبريل ٢٠٠٨م أما الفترة الثانية فكانت من الأول من سبتمبر إلى ٣١ ديسمبر ٢٠٠٨م حيث استخدمت ستة أنواع من الوجبات كبدائل لحبوب اللقاح وهي (A)، (B)، (C)، (D)، (E)، (F). أوضحت النتائج المتحصل عليها أن أعلى قياسات للحضنة المقفولة كانت في الخلايا التي غذيت على الوجبة (B) (٨٩٥ بوصة مربعة لكل مجموعة) وتلاها الخلايا التي غذيت على الوجبات (C)، (A)، (F)، (E)، (D) حيث كانت قيم قياسات الحضنة المقفولة فيها هي: ٨٣٥، ٨٠١، ٧٢٥، ٧١١، ٧٠٨ بوصة مربعة لكل مجموعة على الترتيب وذلك في الفترة الأولى على الترتيب أما في الفترة الثانية فكانت قيم الحضنة المقفولة أيضا أعلى في الخلايا التي غذيت على الوجبة (B) مقارنة بالوجبات الأخرى. أوضحت النتائج أيضا وجود فروق معنوية بين متوسط قياسات الحضنة المقفولة خلال فترتي الدراسة في الطوائف التي غذيت على الوجبة (B) مقارنة بالوجبات الأخرى. ومن ناحية أخرى كانت أعلى كمية منتجة من غذاء الملكات في الطوائف التي غذيت على الوجبة (B) (٩٢ جم لكل مجموعة) مقارنة بالوجبات الأخرى وهي: (C)، (A)، (F)، (E)، (D) حيث كانت كمية غذاء الملكات المنتجة فيها هي: ٨٠، ٦٨، ٥٥، ٤١، ٣٥ جم لكل مجموعة وذلك في الفترة الأولى على الترتيب. أيضا في الفترة الثانية كانت كمية غذاء الملكات أعلى في الخلايا التي غذيت على الوجبة (B) مقارنة بالوجبات الأخرى. أظهرت النتائج أيضا وجود فروق معنوية بين كمية غذاء الملكات المنتجة في الطوائف التي غذيت على الوجبة (B) مقارنة بالوجبات الأخرى خلال فترتي الدراسة. يمكن أن نستنتج مما سبق أن النحالين يمكن أن يستخدموا الوجبة (B) ومحلول الوجبة (F) كبديل لحبوب اللقاح وذلك خلال الفترات التي تفتقر إلى المحاصيل المزهرة لزيادة إنتاج الحضنة وغذاء الملكات في الخلايا قبل فيض رحيق البرسيم وهو الموسم الرئيسي في منطقة كفر الشيخ.