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Effect of Brewer's yeast and soya bean cake on brood rearing, pollen gathering and honey yield in honey bee colonies

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Abstract

This work was conducted in the Apiary of Plant Protection Research Institute at El-Qanater El-Khiriya to study the effect of additive pollen substitute feeding of honey bee colonies on brood rearing, queen's egg laying, pollen gathering and honey production through the period of 1st March to 29th August 2012. Results revealed that feeding the honey bee colonies on additive pollen substitute and sugar syrup (1:1) make honey bee colonies have significantly more brood rearing, queen's egg laying, pollen gathering and honey production than the control colonies which fed on sugar syrup only.

Key Words: Honey bees, pollen, honey, brood rearing, soya bean cake, Brewer's yeast.

Introduction

Testing and utilization of different materials as pollen supplements have been mainly directed toward producing brood, while less attention has been given to the pollen gathering and honey production during spring and summer seasons of the year. The pollen is more attractive to bees than the other proteins **(El-Banby and Gorgui, 1970).** Various types of Brewer's yeast have found extensive application in pollen substitute formulations (**Johanson and Johanson, 1977 and Herbert *et al*., 1978)** ; Its candy type-proved the most efficient method **(Doul, 1975b a**nd **El-Banby and El-Sherif, 1987a,b)** especially for worker production and longevity. Sucrose syrup 66.6 or 50 % gave the best results for worker and drone production and longevity (**El-Sherif and El-Banby, 1989**; **El-Sherif *et al*. 1994).** The brood area of honey bee (*Apis mellifera*) colonies fed weekly with 2 liters of sugar syrup fortified with isolecucine significantly increased more than in colonies fed sugar syrup only, when colonies were in an area with adequate pollen sources, but did not do so in an area with poor pollen supplies. It also increased acceptance of grafted queen cells and cell production per colony, and decreased consumption of supplementary food (**Stace and White, 1994**). The supplementary feeding on sunflower flour, agwa (date palm), or Yeast significantly increase brood area compared to colonies fed on sugar syrup only. There was no obvious consistent preference between the three tested diets since the results varied with season **(Mishref *et al*., 1995**). The amount of stored pollen and brood rearing area in strong colonies were higher for all seasons than in weak colonies. The lowest amounts of stored pollen in both strong and weak colonies were recorded in winter, while the lowest brood activity was recorded in autumn. High correlation coefficients were found between worker brood and stored pollen in both strong and weak colonies (**Fathy, 1998)**. Feeding honey bee colonies on sugar syrup fortified with a vitamin-mineral preparation (Forssatom) or brewer's yeast during spring and autumn indicated that the greatest brood area in the spring was recorded in the group fed on sugar syrup fortified with the vitamin-mineral preparation (6.8% increase when compared to the control group). The greatest brood area in the autumn was observed in the group fed syrup fortified with yeast (25.4% increased than in the control group). In the spring, the greatest honey area was recorded in the group fed on syrup fortified with yeast (37.8% higher than the control). In the autumn, the highest values were obtained in the group fed on sugar syrup fortified with the vitamin-mineral preparation (181.7% higher than in the control hives) **(Mladenovic *et al*., 1999)**. For studying the effect of pollen or pollen substitutes on worker's brood rearing, the following materials were used: wheat germ, yeast, soybean, mung bean. The obtained results revealed that the worker brood areas in colonies fed with used materials had extended over greater areas than in the case of unfed ones where the colonies fed with mung bean, wheat germ, soybean, yeast, and *Sativa vulgaris* showed worker broad areas of 31-66, 27.96, 20.21, 15.48 and 1.56 % more than the control ones **(EL-Shaarawi, 2001**). The honey bee colonies provided with pollen substitutes of bran, yeast and check pea reared more worker's brood than in case on unfed ones (control colonies) **(EL-Waseef, 2002)**. As the winter progresses, sweet pepper flowers produce fewer pollen grains and with reduced viability, and thus greater pollinator activity is needed. By feeding on pollen supplements (500 g/week), colonies maintained in enclosures of sweet pepper over the long flowering period of the crop, could sustain stable levels of brood

production, which are needed for achieving efficient pollination (**Kalev *et al.*, 2002)**. Feeding honey bee colonies with pollen substitutes plus sugar syrup, significantly, increased the sealed brood area and egg laying rates of Queens than control colonies which were fed on plain sugar syrup (1:1) **(Ghazala, 2006)**.
This work was conducted to study the effect of pollen substitute as a source of proteins beside sugar syrup during dearth periods in the activity season from 1st March to 29th August 2012 on brood rearing, queen's egg laying rate, pollen collection and honey production in El-Qanater El-Khiriya region, Qaluobia governorate, Egypt.

Materials and Methods

The experiment was carried out under the Apiary conditions at the Plant Protection Research Institute, El-Qanater El-Khiriya, Qaluobia governorate, Egypt during the period of 1st March to 29th August 2012. Six honeybee colonies headed with F1 Carniolan open-mated queens, were selected. They were almost equal in their population density, brood rearing area, honey and pollen stores. They were divided into two groups; each consisted of 3 colonies (replicates). Each group of colonies was offered one of the following feeding treatments at 7 days' intervals.

- Treatment (A): Each colony received 100 g of pollen substitute consisting of (20% dried Brewer yeast + 40% Soybean flour + 40% sugar) mixed with honey beside 1 liter of sugar syrup (50%). Soybean flour and dried Brewer yeast contain 50.88% and 40.5% protein respectively according to **Atallah, (1975) and Hammad, (2000)**.
- Treatment (B): Each colony received 1 liter of sugar syrup only (50%), as a control.

Worker sealed brood areas were measured every 12 days with a standard frame divided to square inches before the beginning of the experiment on 1st March to and extended to 29th August 2012.
To calculate the daily number of egg laying at 12 day intervals, the following equation was used according to **Ghazala, (2006)**:

$$\text{Daily rate of egg laying} = \frac{\text{Brood area (inch}^2\text{) x 25 (number of worker's cells per inch}^2\text{)}}{\text{12 days}}$$

- Pollen gathering activity:

A pollen trap was placed at the hive entrance on each experimental colony. Traps were like those used by **Kaulfeled (1973), Bobrzecki and Wilde (1991), Cornejo (1991) and Wilde *et al.*, (1994)**.
This experiment started from 1st March to 29th August 2012. The pollen traps were fitted to the colonies 3 days only and the bees enter free 3 days, respectively. The trapped pollen was dried at 40 C° in air drier (Oven TEQ model ST-50 v), packaged in nylon (plastic) bags and stored at -5C°. The weight of dried pollen was recorded.

Honey production

The honey yield (Clover season) from tested colonies was estimated in kg/colony. In each treatment, the honey combs were taken and weight before honey extraction and weighted after honey extraction.

Statistical analysis

T- test and M. static computer analysis program was conducted according to **Sendecor and Coehran, 1973**.

Results and discussion

1- Brood rearing

Data in Table (1) illustrated by Fig. (1), showed that no significant difference was observed between the mean values of sealed brood area in the two tested groups of honey bee colonies at beginning of the experiment. The colonies fed with pollen supplements beside sugar syrup produced more worker's brood area than those fed on only sugar syrup.

Data showed that the general mean of brood area/colony/ 12 day intervals in treated colonies which fed on sugar syrup fortified with pollen substitute was significantly higher than control. Pollen substitute gave the highest area of sealed brood (654.93 inch² /colony/ 12 days) intervals while control gave the narrowest area during the period of study (287.98 inch² /colony/ 12 days). Results obtained were in agreement with **Atalla 1975; Shoreit and Hussein 1993; Hammad 2000; Nabors 2000; EL- Bassiouny 2006; Mattila and Otis 2006 and Ashour *et al.*, 2008.**

Data in Table (2) illustrated by Fig. (2) reflected that the general means of queen's egg laying/colony in colonies fed on sugar syrup fortified with pollen substitute were significantly more than control which were fed on sugar syrup (1:1) only. The pollen substitute gave the highest queen's egg laying rate (1321.74 egg/colony/12 days), while control gave the lowest queen's egg-laying late during study period (606.37 egg/colony/12 days).

Table 1. Effect of feeding on pollen substitute on the mean sealed brood area (inch^2) during 2012.

Diet Date of inspection	Pollen supplement with sugar syrup	Control (plain sugar syrup)
1st March	145.50	146.53
13th March	255.17	150.10
25th March	309.87	160.73
6th April	323.27	164.70
18th April	376.87	170.00
30th April	419.97	183.13
12th May	490.60	198.70
24th May	535.20	228.80
5th June	598.90	265.90
17th June	741.10	358.57
29th June	820.30	379.50
11th July	1051.90	398.97
23rd July	1079.40	419.87
5th August	1092.67	452.60
17th August	1112.30	446.47
29th August	1125.80	483.10
Mean	**654.93**	**287.98**

T stat = 6.51 **T table at 5% = 2.1 ; at 1% = 1.75**

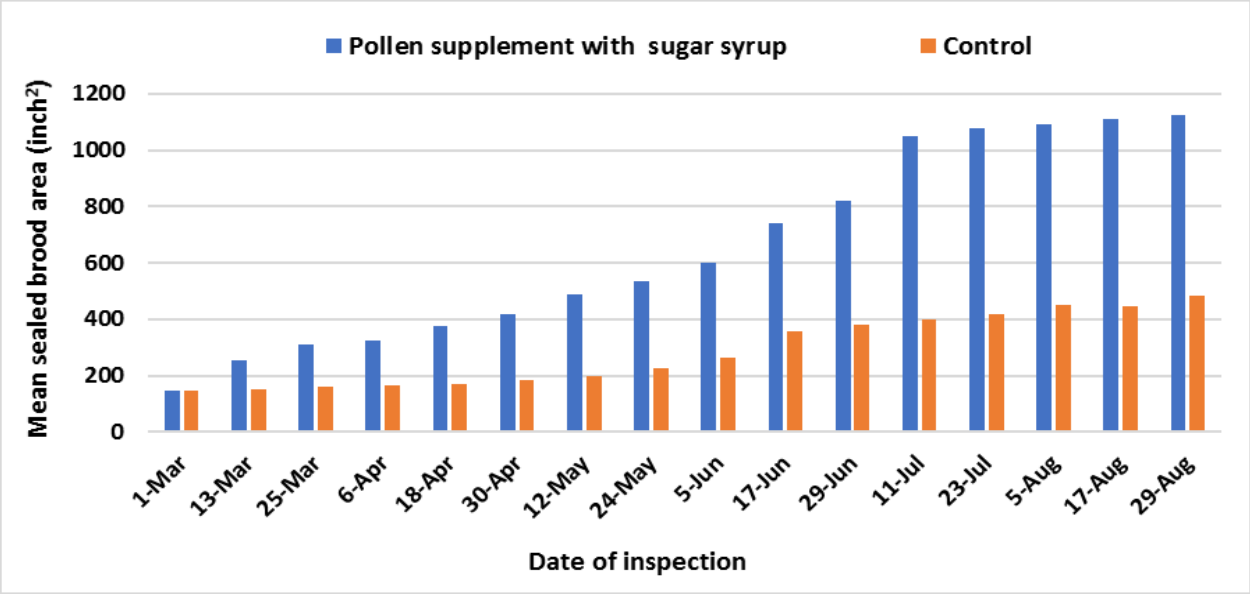

Fig. 1. Effect of feeding on pollen substitute on the mean sealed brood area (inch^2) during 2012.

Table 2. Effect of feeding pollen substitute on the mean of daily queen's egg laid in the dates of inspection in the colonies during 2012.

Diet Date of inspection	Pollen supplement with sugar syrup	Control (plain sugar syrup)
1st March	304.33	304.67
13th March	531.00	313.00
25th March	646.00	334.00
6th April	672.00	343.00
18th April	786.00	354.00
30th April	876.00	383.00
12th May	1022.00	414.00
24th May	1115.00	477.00
5th June	1248.00	553.33
17th June	1585.33	748.00
29th June	1709.00	791.00
11th July	1460.33	830.00
23rd July	2248.33	874.67
5th August	2278.33	943.00
17th August	2317.00	1033.33
29th August	2345.00	1006.00
Mean	**1321.74**	**606.37**
T state = 6.60	**T table at 5% = 2.13 ; at 1% = 1.75**	

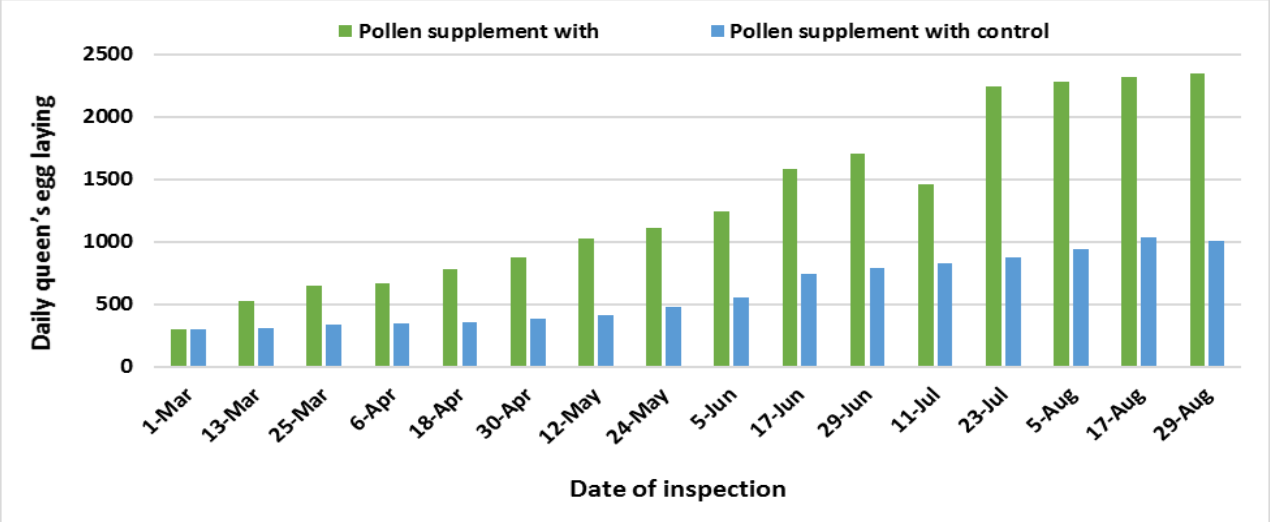

Fig. 2 Effect of feeding pollen substitute on the mean of daily queen's egg laid in the dates of inspection in the colonies during 2012.

2- Collection of pollen:

Data in Table (3) illustrated by Fig.(3) shows that, the colony feeding with pollen substitute beside sugar syrup, significantly increased the collected amounts of pollen during the different months of year 2012 with an average of 603.78 g/colony compared with the colony feeding on pollen plain sugar syrup (456.32 g/colony).

In August, during period of study, the pollen substitute, significantly gave the highest mean amount of pollen (797.9 g/colony), while control gave (691.10 g. /colony).

Table 3. Effect of feeding pollen substitute on the mean pollen yield (g. /colony) during some months of 2012.

Diets / Months		Pollen supplement with sugar syrup		Control (plain sugar syrup)		Means
March		337.4		297.1		317.3
April	Spring	450.2	1278.5	330.1	987.7	390.1
May		490.9		360.5		425.7
June		755.7		480.7		618.2
July	Summer	790.6	2344.2	578.4	1750.2	684.5
August		797.9		691.1		744.5
Mean		603.78		456.32		3180.3

T state = 4.34 **T table at 5% = 2.57 ; at 1% = 2.01**

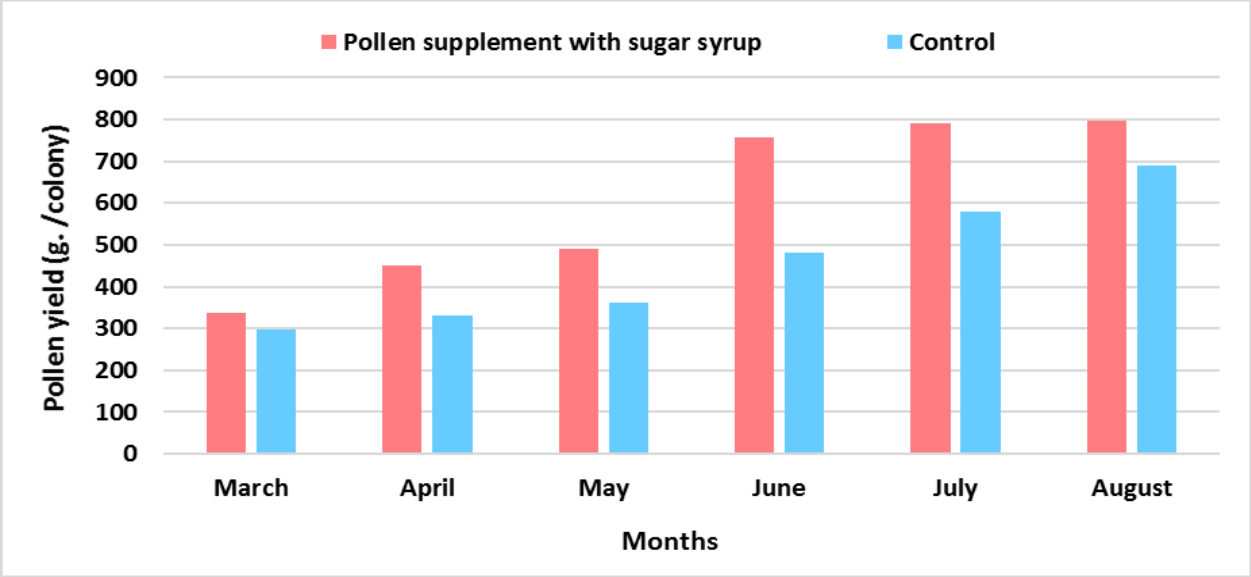

Fig. (3): Effect of feeding on pollen substitute on the mean pollen yield (g./colony) during some months of 2012.

The colony feeding with pollen supplements beside sugar syrup, significantly, increased the amount of collected pollen in spring and summer seasons during 2012 showing averages of 1278.5 and 2344.2 g/colony, respectively, compared to the feeding on plain sugar syrup only (987.7 and 1750.2 g/colony, respectively). Higher amounts of pollen occurred during the summer season in both groups of colonies fed on sugar syrup fortified with pollen substitute or on plain sugar syrup and averaged 2048.71 and 1133.09 g/colony respectively.

3-Honey production in kg/colony.

Table (4) indicated that the honey bee colonies which were fed with pollen substitute beside sugar syrup produced significantly more Clover honey yield as compared with control which was fed on sugar syrup only (averages 10.20 and 7.60 kg/colony, respectively).

Table 4. Effect of the pollen substitute on Clover honey yield in kg/colony at El-Qanater El-Khiriya during 2012 season.

Diets	Honey production (kg/colony)
Pollen substitute	**10.20**
Control	**7.60**

The obtained results were in agreement with **Hussein (1979) and Shoreit and Hussein (1993).**

Conclusion

It could be concluded that feeding colonies with pollen substitute cake beside sugar syrup during spring and summer seasons stimulates the queen adults to lay more eggs and encourages workers to rear more brood. This significant increase in brood rearing reflects a significant increase in the colony population and pollen and honey production.

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الملخص العربى

تأثير التغذية ببديل حبوب اللقاح (فول الصويا +الخميرة الجافة) على بعض أنشطة طوائف نحل العسل

نجلاء الأحمدى غزالة - الحسينى السيد نوار
قسم بحوث النحل بالقناطر - معهد بحوث وقاية النباتات – مركز البحوث الزراعية
قسم وقاية النبات – كلية الزراعة – جامعة بنها

أجرى هذا البحث خلال عام ٢٠١٢ في الفترة من ٢٠١٢/٣/١ إلى ٢٠١٢/٨/٢٩ بمحطة بحوث النحل بالقناطر الخيرية، التابعة لمعهد بحوث وقاية النباتات لدراسة تأثير استخدام بعض بدائل حبوب اللقاح (فول الصويا + الخميرة الجافة) فى تغذية طوائف نحل العسل وتشجيعها على زيادة إنتاج الحضنة وزيادة معدل وضع الملكة للبيض وبالتالي زيادة كمية حبوب اللقاح المجموعة والعسل المنتجة وذلك خلال الفترة التي تنشط فيها طوائف نحل العسل.

وقد أشارت النتائج إلى أن الطوائف التي تم تغذيتها على بدائل حبوب اللقاح المضافة إلى التغذية السكرية أدت إلى فروق معنوية بالمقارنة بطوائف الكنترول التي تم تغذيتها على بالمحلول السكرى فقط (١: ١) حيث أن استخدام بدائل حبوب اللقاح كمنشط لطوائف نحل العسل في منطقة القناطر أدت الى زيادة أعداد طوائف النحل فى فترة التجربة وزيادة معدل وضع الملكة للبيض وأيضاً زيادة كمية حبوب اللقاح المجموعة والعسل المنتجة وذلك خلال الفترة التي ينشط فيها طوائف نحل العسل. وأشارت النتائج أيضا إلى أن الطوائف التي تمت تغذيتها ببدائل حبوب اللقاح أنتجت حضنه أكثر بزيادة معنوية بالمقارنة بالطوائف التي تم تغذيتها على على المحلول السكرى فقط (الكنترول)، وكذلك أعطت أعلى معدلات لوضع الملكة للبيض وكمية حبوب اللقاح المجموعة والعسل بالمقارنة بالطوائف التي تغذت على المحلول السكري فقط.