

Effect of some pollen substitutes on brood rearing activity in honeybee colonies

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ABSTRACT

Commercially available pollen substitute diets for honey bees (*Apis mellifera*) were evaluated for brood rearing activity, it was carried at the apiary of Gemmiza Agric. Res. Station, Gharbia Governorate, as well as Menofia Governorate, Egypt. Two trials were conducted, the first period from December 2014 to Feb 2015 and the second period from Aug. to Dec. 2015. The pollen substitute were four diets, Diet 1 (Feed bee), Diet 2 (Soya bean flour + brewer's yeast + (agwa) + sugar + water), Diet 3 (Soya bean flour + brewer's yeast + Skimmed powder milk + sugar + water) and Diet 4 (brewer's yeast + (Agwa) + defatted Soyabean flour + skimmed powder milk, + sugar + water). The results showed that there was a significant differences between all pollen substitutes on brood rearing, at the first period at Gharbia Governorate (December – Feb. 2014/2015). The period of (Feb 23) was the highest period on brood rearing activity. Also there was a significant differences among all diets on brood rearing activity, where the pollen substitute Diet 1 was the highest effect. The second period of Gharbia Governorate (Aug. 21 – Dec. 19 - 2015), the period of (Dec. 19) was the highest period on brood rearing activity, and the pollen substitute (Diet 1) was the highest effect. Also there was a significant differences among all period and control colonies of brood rearing area at the first period of Menofia Governorate. The period of (Feb 23.) was the highest effect, also there was a significant differences among all diets on brood rearing activity, where the pollen substitute (Diet 1) was the highest effect. The results apparent that there was a significant differences among all period and control colonies of brood rearing area at the second period of Menofia Governorate (Aug. 21 – Dec. 07 - 2015) . The period of (Dec. 07) was the highest period on brood rearing activity. Also there was a significant differences among all diets on brood rearing activity, where the pollen substitute (Diet 1) was the highest effect. It could be concluded that all diets can be used as pollen substitute during two dearth period of flowering plants to build up brood areas of colonies before main nectar flow and before divided 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 diet of honeybee (Free, 1957). Haydac and Dietz (1979) found that during a dearth period the number of colonies of bees may decrease, adversely affecting the production of honey in the following season. Pollen substitutes are often used to produce package bees, queens, and increase the number of foraging bees. Yeast, dry milk and soya bean flour makes adequate pollen substitutes, 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 soya bean 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), knowledge of pollen chemistry and biochemistry. Pollen substitutes have the ability to enhance the performance of honeybee colonies.

Pollen grains are the main source of protein, fat, vitamins and minerals. The protein content of pollen ranges from 7- 40% (Johanson & Johnson 1977). There are several investigations for mulcted number of pollen substitutes as it helps much in maintaining colonies with sufficient brood area during the whole season, i.e., Mohanna, 1977; Abd El-Aziz 1992; Awadi 1998;

Mohammad 2002, pollen insures the growth of colonies because it provides protein to adult bees and stimulants brood rearing (Hoffman *et al.* 2008)

The present investigation aimed to evaluate some pollen substitute to help the beekeeper to solve the problem of short supply or low pollen availability during dearth period of flowering plants.

MATERIALS AND METHODS

The present study was conducted in Gemmiza Res., station, Gharbia Governorate, Egypt. And in a private apiary Menofia Governorate, during tivo dearth periods, the first period from December to February. the second period from August to December 2015.

Honeybee (*Apis mellifera* L.) colonies was used, 1st hybrid of carniolan bees. Twenty five colonies of honeybee about equal in strength were selected. The colonies were divided into five equal groups. Four groups were suitable to evaluate the different feeding treatments (diets), and one group was used as control (untreated).

Preparation of pollen substitute:

- Diet 1 : (Feed bee Cake) (Potein 44.81% , Fat 3.9% , Carbohydrate 44.09% , Fiber 4.2% , Ash 2.2% , Acid insoluble ach 1.8% , Minerals 0.204% and Moisture 4.0% .
- Diet 2: One part brewer's yeast + one part date past (agwa) + 3parts Sugar powder+ Water+3part defatted soya bean flour
- Diet 3: One part brewer's yeast + 5 part defatted soya bean flour + one Part Water Skimmed powder milk+ 3 parts sugar+
- Diet 4: One part brewer's yeast + one part date paste (Agwa) + 5 parts defatted Soya bean flour + one part skimmed powder milk, + 2parts sugar +water Several food stuffs containing

considerable amounts of protein and available in cheap 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 (100 g. / colony). The cut was provided to each colony at 7 days interval through 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.

1-Brood rearing measurement:

A typical langstroth frame with dimensions of 17x18 inches was divided into square inches (sq.in) evaluate the quantity of sealed brood. The frame was laid against side of brood comb and the area occupied by sealed worker brood was measured. The counts of workers brood were done at 12 days intervals.

2-Statistical analysis

Data of all treatments were analyzed according to (Sendecor and Cochran, 1980).

RESULTS AND DISCUSSION

Colonies were usually fed pollen substitute for one or more reason, ensure continued colony development in places and times of shortage of natural pollen and nectar, develop colonies with optimum populations in time for nectar flows, build colonies to high populations for queen and package-bee production, and provide adequate food reserves for overwintering colonies.

The results of the feeding preference comparisons between the pollen substitutes on brood rearing area were shown in Table (1). By using a test of multiple comparisons (LSD.), it was apparent that there was a significant differences among all period time and control hives of brood rearing area (LSD=3.38, P = 0.000) at the first period of Gharbia Governorate (December – Feb.2014). The period of (Feb23) was the highest period on brood rearing activity (372.3 sq.in) ,while period of (Jan 06) was the lowest brood rearing activity (274.8 sq.in).Also there was a significant differences among all diets on brood rearing activity (LSD=5.373, P = 0.000) ,where the pollen substitute treatment (Diet 1) was the highest effect (428.0 sq.in) ,whereas the pollen substitute treatment (2) was the lowest effect (249 sq.in).

Table (1) Areas of worker sealed brood (sq.in) in honey bee's colonies, first period (December, Feb-2014) at Gharbia Governorate)

Date	pollen substitutes				Mean	control
	Diet1 (sq.in)	Diet2 (sq.in)	Diet3 (sq.in)	Diet4 (sq.in)		
December	401	245	252	282	296 d	188
Jan-06	430	189	215	265	274.75 f	168
Jan-18	413	236	225	273	286.8 e	210
Jan-30	398	251	310	325	321 c	203
Feb. 11	430	277	298	372	344.25 b	250
Feb. 23	496	296	301	396	372.3 a	300
Mean	428 a	249 d	266.8 c	318.8 b	315.7	219.8

The effect of pollen substitutes on brood rearing area were shown in Table (2) In the second one statistical analysis revealed significant differences between the mean brood areas among all period times and control colonies (LSD=1.413, P = 0.000) at Gharbia Governorate (Aug.21 – Decem.19- 2015) , the period of (Dec19.) was the highest period on brood rearing activity (348 sq.in) ,while period of (Sept.27) was the lowest brood rearing activity (130.5 sq.in) .Also there was a significant differences among treatments on brood rearing activity (LSD=1.730, P = 0.000) ,where the pollen substitute treatment (Diet 1) was the highest effect (275.6 sq.in) ,whereas the pollen substitute treatment (Diet 2) was the lowest effect (197 sq.in).

Table (2) Areas of worker sealed brood (sq.in) in honey bee's colonies, second Period (August- December - 2015), at Gharbia Governorate.

Date	pollen substitutes				Mean	control
	Diet1 (sq.in)	Diet2 (sq.in)	Diet3 (sq.in)	Diet4 (sq.in)		
Aug-21	243	192	210	203	212 h	170
Septemper 3	186	151	186	205	182 i	155
Septemper 15	259	189	206	245	224.8 d	165
Septemper 27	163	105	126	128	130.5 k	86
Oct-08	241	200	186	230	214.3 g	150
Oct-20	269	207	198	215	222.3 e	155
Nov-01	230	145	130	165	167.5 j	115
Nov-13	296	188	208	178	217.5 f	138
Nov-25	347	205	240	246	259.5 c	160
Dec-07	396	265	305	301	316.8 b	201
Dec-19	402	320	320	350	348 a	240
Mean	275.6 a	197 d	210.5 c	224.2 b	226.8	157.7

The results of the feeding preference comparisons between the pollen substitutes on brood rearing area were shown in Table (3). By using a test of multiple comparisons (LSD.), it was apparent that there was a significant differences among all period time and control hives of brood rearing area (LSD=12.69, P = 0.000) at the first period of Menofia Governorate (December25 – Feb.29 -2014). The period of (23Feb.) was the highest period on brood rearing activity (409.3 sq.in) ,while period of (Dec.25) was the lowest brood rearing activity (246.3 sq.in).Also there was a significant differences among treatment on brood rearing activity (LSD=12.01, P = 0.000) ,where the pollen substitute treatment (Diet 1) was the highest effect (385 sq.in) ,whereas the pollen substitute treatment (Diet 3) was the lowest effect (275.1 sq.in).

Table (3) Areas of worker sealed brood (sq.in) in honey bee's colonies first period at Menofia Governorate.

Date	pollen substitutes				Mean	control
	Diet1 (sq.in)	Diet 2 (sq.in)	Diet 3 (sq.in)	Diet 4 (sq.in)		
Dec-25	304	222	219	240	246.3 e	160
Jan-06	339	238	219	256	263 d	170
Jan-18	401	289	283	310	320.8 c	210
Jan-30	398	285	287	310	320 b	210
Feb. 11	364	269	273	297	300.8 c	198
Feb. 23	396	283	283	307	317.3 b	210
Feb. 29	493	376	362	406	409.3 a	270
Mean	385 a	280.3 c	275.1 c	303.7 b	311.0	204.0

The results indicated differences of the feeding preference comparisons between the pollen substitutes on brood rearing area Table (4). It was apparent that there was a significant differences among all period time and control colonies of brood rearing area (LSD=2.678, $P = 0.000$) at the second period of Menofia Governorate (Aug.21 –Dec.07- 2015). The period of (Dec.07) was the highest period on brood rearing activity (429.8 sq.in), while period of (Oct.8) was the lowest brood rearing activity (172.81 sq.in). On the other hand, there was a significant differences among all diets on brood rearing activity (LSD=2.567, $P = 0.000$), where the pollen substitute treatment (Diet 1) was the highest effect (318.9 sq.in), whereas the pollen substitute treatment (Diet 2) was the lowest effect (230.3 sq.in).

Table (4) Areas of sealed worker brood (sq.in) in honey bee's colonies second Period at Menofia governorate.

Date	pollen substitute				Mean control	
	Diet 1 (sq.in)	Diet 2 (sq.in)	Diet 3 (sq.in)	Diet 4 (sq.in)		
Aug-21	316	227	231	247	255.3	d 165
Septemper 3	295	213	217	232	239.3	f 155
Septemper 15	312	226	232	245	253.8	d 165
Septemper 27	218	158	161	172	177.3	h 115
Oct-08	214	154	156	167	172.8	i 110
Oct-20	248	179	190	191	202	g 130
Nov-01	308	219	224	240	247.8	e 160
Nov-13	337	240	252	268	274.3	c 180
Nov-25	389	287	283	305	316	b 210
Dec-07	552	400	401	432	446.3	a 290
Mean	318.9	a 230.3	d 234.7	c 249.9	b 258.5	168

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, 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 pollen substitute upon installation in the spring were more productive than package colonies that were not fed a pollen substitute. It 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. Sena *et al* (2012) concluded that the use of Feed bee, had a remarkable effect on the number of frames with brood, contributing in the strength of the bee colonies.

Vikas and Promod (2009) Among the 4 pollen substitutes, soya bean flour with skimmed milk powder, dried yeast and honey, was the most preferred by the bees, which may be due to high protein content (41-45%) in soyabean flour. Hoffman *et al* (2008) found that when some pollen was being collected by colonies, pollen substitutes did not differ from pollen cake in brood or adult population growth. Sharma and Gupta (2006) found that the substitute diet had no negative effect on brood development and mortality. The weight

of newly emerged worker bees in pollen substitute-fed colonies was significantly more than those from control colonies.

Our results indicated that the pollen substitute 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 so increase package bees, pollen and honey production.

It could be concluded that we can use some pollen substitute during two dearth period 1st before flowering plants to build up brood areas of colonies 2nd after main nectar flow and extraction of honey for brood rearing activity.

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تأثير بعض بدائل حبوب اللقاح على نشاط تربية الحضنة في طوائف نحل العسل اسماء انور عبد الخالق عيسى ، محمد على ابراهيم عبدالعظيم و اماتى سعد مصطفى ابوليله قسم بحوث النحل – معهد بحوث وقاية النباتات – مركز البحوث الزراعية – دقى – جيزة – مصر

يهدف البحث الى معرفة مدى تأثير بدائل حبوب اللقاح على نشاط تربية الحضنة في اوقات عدم وجود حبوب اللقاح الطبيعية . اجريت هذه التجربة في منحل محطة البحوث الزراعية بالجميزة – محافظة الغربية وكذلك في منحل خاص بمحافظة المنوفية في الفترة من ديسمبر ٢٠١٤ الى فبراير ٢٠١٥ والفترة من اغسطس الي ديسمبر ٢٠١٥ . استخدمت ٤ وجبات من بدائل حبوب اللقاح لتغذية الطوائف عليها وتكونت البدائل من: البديل الاول منتج مستورد يعرف باسم (Feed bee) يتكون من (بروتين ٤٤.٨١ % ، دهون ٣.٩ % ، كربوهيدرات ٤٤.٠٩ % ، ألياف ٤.٢ % ، رماد ٢.٢ % ، معادن ٠.٢٠٤ % ، رطوبة ٤ % . البديل الثانى يتكون من: ا جزء خميرة طيبه+ ا جزء عجوة+ ٣ جزء سكر بودرة+ ا جزء صويا+ ماء. البديل الثالث يتكون من: ا جزء خميرة طيبه+ ٥ جزء دقيق صويا+ ٣ جزء لبين بودرة+ ٣ جزء سكر+ ماء. البديل الرابع يتكون من: ا جزء خميرة طيبه+ ا جزء عجوة+ ٥ جزء دقيق صويا+ ٣ جزء لبين بودرة+ ٣ جزء سكر+ ماء. اوضحت النتائج المتحصل عليها وجود فروق معنوية في انتاج الحضنة بين المعاملات الاربعه وذلك مقارنة بالكنترول . بالنسبة لتجارب محافظة الغربية بلغت متوسطات مساحة الحضنة ٤٢٨،٣١٨،٨، ٢٦٦،٨، ٤٩،٢٦٦،٨ / طائفه للبديل ١، ٢، ٣، ٤، ١ على الترتيب في فترة ديسمبر - فبراير وبلغت ٢٧٥.٦، ٢٢٤.٢، ٢١٠.٥، ١٩٧.١ / طائفه للبديل السابق على الترتيب في فترة اغسطس - ديسمبر. وبالنسبه لتجارب محافظة المنوفيه بلغت متوسطات مساحة الحضنة ٣٠٣.٧، ٢٨٠.٣، ٢٨٠.١، ٢٧٥.١ / طائفه للبديل ١، ٢، ٣، ٤، ١ على الترتيب من ديسمبر - فبراير وبلغت ٣١٨.٩، ٢٤٩.٩، ٢٣٤.٤، ٢٣٠.٣ / طائفه لمحافظة الغربية والمنوفيه لنفس الفترات السابقه على الترتيب. وتخلص النتائج الى ضرورة الاهتمام بتغذية طوائف النحل على بدائل حبوب اللقاح خاصة البدائل ١، ٤، في اوقات ندرة اوقلة مصادر حبوب اللقاح الطبيعيه وذلك لزيادة نشاط تربيته الحضنه.