

Effect of Different Sugary Feeding on Pollen Gathering Activity of Honey Bee (*Apis mellifera* L.)

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ABSTRACT

The present investigation was carried out to study the effect of four types of sugary feeding (Glucose, Fructose, Molasses and Moringa) on pollen gathering activity of honey bee craniolan hybrid (*Apis mellifera* L.) by estimation of stored pollen amounts. The results indicated that, the average total number of square inches of stored pollen were 3116, 3132, 2825, 3552 and 2566 sq. in/ colony for those Treated with Glucose, Fructose, Molasses, Moringa and control, respectively. The highest rate of gathering pollen was observed during July and May 740 and 685 sq. in/ colony respectively. Moringa gave the highest number of stored pollen 3552 sq. in/colony a whole year than other syrups, while Treated colonies with Molasses gave the lowest number of stored pollen 285 sq. in/ colony. Also, the lowest amounts of stored pollen were observed during autumn and winter season in all treatment colonies.

INTRODUCTION

Feeding of bees is very important in bee breeding as it helps much in maintaining strong hives with sufficient brood during the whole season. Honey bee *Apis mellifera* L., colonies can be stimulated to increase in population, even in the absence of sufficient forage, by providing sugar syrup. However, colony growth and maintenance are limited by the protein available. Protein, normally in the form of pollen, is necessary for the production of bee brood (Brodtschneider and Crailsheim, 2010).

Colonies that have no access to protein and sugars during the active season have a reduced capacity to replace bees, quickly decline in population, and may eventually die. The wintering survival rates of adult bees and brood areas were positively affected by feeding and feed additives (Akyelet et al., 2006) Honeybee.

- 1- Moringa oleifera is a tropical tree possessing numerous economic applications. Plus growing international interest, Moringa tree is cultivated and used as a vegetable (leaves, green pods, flowers, roasted seeds), for spice (mainly roots), for cooking and cosmetic oil (seeds) and as a medicinal plant (all plant organs), (Rebecca et al., 2006).
- 2- Busani et al., (2011) found that the dried leaves had crude protein levels of 30.0% and 19 amino acids. The dried leaves had the following mineral contents: calcium(3.65%), phosphorus (0.3%), magnesium (0.5%), potassium (1.5%), sodium (0.164%), sulphur (0.63%), zinc (13.03% mg/kg), copper(8.25%), manganese(86.8 mg/kg), iron(490mg/kg), and selenium (363 mg/kg). The values of amino acids, minerals and vitamins profiles reflect desirable nutritional balance.

Apis mellifera L. depend mainly on nectar and pollen as sources of nutrients, where nectar provides the bees with carbohydrates while pollen supplies with the remaining dietary requirements such as proteins, lipids, vitamins and minerals. (Brodtschneider and Crailsheim 2010 and Keller et al., 2005 a & b). Sometimes, nectar and pollen grains are not available or they are in short supply.

During the shortage or complete absence of pollen, or in the presence of only poor quality pollen, beekeepers often feed colonies of honeybees with

pollen substitutes (with no pollen) or supplemented diets (with pollen), these are ideal materials that provide required nutrients to bees (Saffari et al., 2004).

The type and period of sugary feeding play an important role. Such feeding affects brood rearing and productivity of colonies, therefore, the present study was designed to evaluate the effect of such feeding on pollen gathering activity (amount of stored pollen).

MATERIALS AND METHODS

The experiment was performed in a private apiary at Smalut district, Minia Governorate from September 2015 up to August 2016.

Fifteen colonies in the same strength (6 combs) of craniolan hybrid (*Apis mellifera* L.). In the standard longstroth hives, having mated queens of the same age were selected.

This study was demonstrated by choosing four sugary diets. These colonies were divided into one group according to feeding periods (Autumn and Winter). The experiment included 12 colonies divided into four groups (each contains 3 colonies) and three colonies used as control for all experiments as follows:

- **Group A**: Unfed colonies left as control for all experiments.
- **Group B**: Glucose candy.
- **Group C**: Fructose candy.
- **Group D**: Molasses candy.
- **Group E**: Moringa candy.

Preparation of sugary feeding:

Four types of sugary feeding were used: Glucose, Fructose, Molasses, Moringa solution. All feeding types were used as candy as follows:

- 1- Glucose candy (500 g. glucose syrup + 1000 g. powder Sacarose).
- 2- Fructose candy (500 g. fructose syrup + 1000 g. powder Sacarose).
- 3- Molasses candy (500g. sugar cane syrup (Molasses) + 1000g. – powder sacarose).
- 4- Moringa candy [500 g. Moringa solution, (leaf extraction)] + 1000 g. powder Sacarose.

Untreated colony (control): (500 g. Sucrose syrup (1:1) used for all experimental colonies during the dearth of nectar at seven days interval.

Each colony was fed at intervals of 12 days, with 200 g. of the sugary diet according to feeding periods .

The feeding was introduced to bees as a pasta (candy) in small plastic cup (10 cm diameter x 6 cm. deep.) according to (Fathy, 1993). Stored pollen was measured according to time and feeding types on a whole year (2015-2016).

The quantities of food consumed by the colonies were determined at the end of 12 days intervals by weighing the feeding cups.

Estimation of Stored pollen :

In this study for estimating the amount of stored pollen for each treatment during a whole year, a typical longstroth frame was divided into square inches by means of wire .

This frame was laid against any comb in which it was desired to count the number of square inches of stored pollen . The counts were made at intervals of 12 days , this method of counting was according to Al-Tikrity *etal.*, (1971) .

The areas of stored pollen was estimated throughout one whole year (2015 -2016) .

Estimation of stored pollen :

The same previous method of brood rearing counting was at 12 days intervals , to count the number of squares inches of stored pollen .

RESULTS AND DISCUSSION

The present study indicated that the lowest amounts of stored pollen were recorded in Autumn and results are not in agreement those results obtained by Fathy (1998) who mentioned that the lowest amounts of stored pollen in both strong and weak colonies were recorded in winter.

Also, the results are in agreement with (Free and spencer (1969) mentioned that , most of the increase in pollen collection occurs during syrups feeding usually disappeared soon after feeding is discontinued .

Analysis of variance showed that there are significant differences between untreated and treated colonies with Molasses, and Moringa in Autumn , spring and summer . But no significant differences occurred between the treated colonies with Glucose, Fructose and Moringa in spring.

Pollen gathering activity :

The results in table 1 and Figs. 1 , 2 represented the average of a 12 days estimation of the amount of the stored pollen . The average total number of stored pollen (square inch per colony) over a whole year were 3116 , 3132, 2875 , 3552 and 2566 sq. in/colony for each treatment , Glucose , Fructose , Molasses, Moringa and control , respectively.

As shown in table 1 and Fig. 1, pollen gathering activity in treated and untreated colonies with different sugary feeding exhibited two peaks May and July. Gathering and storing pollen began slightly during December recording 10 sq. in (0.57%) and 23 sq. in (0.64 %) in treated colonies with Molasses, Fructose, Glucose and Moringa, respectively. Count of stored pollen increased to 347 sq. in / colony in treated colonies with Moringa while it was 234 sq. in/ colony in treated colonies with Molasses .

The peak of pollen gathering was observed during May and July in treated colonies with Fructose 749 sq. in/ colony and 556 sq. in / colony , representing 23.91 and 17.75 % , respectively, while in treated colonies with Moringa was 685 and 740 sq. in/ colony, representing 19.28 and 20.83 , respectively . The average number of stored pollen declined during September to 24 sq. in / colony , representing 0.42 % and 44 sq. in / colony (1.23%) in treated colony with Fructose and Moringa , respectively . Fig. 3 In October , the average number of stored pollen contained to decline to 32. Sq. in/ colony (1.02%) in treated colonies with Fructose and 48 sq. in / colony (1.35%) in treated colonies with Moringa.

Table 1. Monthly and Total count of stored pollen Treated colonies with different sugary feeding (Autumn and winter) during the whole year (2015 – 2016) .

Season	Month	Treatment									
		Control	%	Glucose	%	Fructose	%	Molassas	%	Moringa	%
Autumn	Sept.	56	2.18	46	1.47	29	0.92	26	0.92	44	1.23
	Oct.	50	1.94	54	1.73	32	1.02	20	0.70	48	1.35
	Nov.	65	2.53	39	3.25	50	1.59	46	4.62	64	1.80
	Total	171	6.66	139	4.46	111	3.5	87	3.08	156	4.39
Winter	Dec.	27	1.05	18	0.57	12	0.38	10	0.35	23	0.64
	Jan.	113	4.40	56	1.79	50	1.59	38	1.34	32	0.90
	Feb.	49	1.90	51	1.63	44	1.40	70	2.47	60	1.68
	Total	189	7.36	125	4.01	106	3.38	118	4.18	115	3.23
Spring	Mar.	237	9.23	290	9.30	277	8.84	234	8.28	347	0.76
	Apr.	218	8.49	293	9.40	363	11.59	304	10.76	343	9.65
	May	218	8.49	654	2.98	749	23.91	710	25.13	685	19.28
	Total	673	26.22	1237	39.69	1389	44.34	1248	44.17	1375	38.72
Summer	Jun	411	16.01	441	14.15	500	15.96	416	14.72	524	14.75
	Jul.	639	24.90	684	21.95	556	17.75	538	19.04	740	20.83
	Aug.	483	18.82	490	15.72	470	15.0	418	14.79	642	18.08
	Total	1533	59.74	1615	51.82	1526	48.75	1372	48.75	1906	53.65
Total year		2566	100	3116	100	3132	100	2825	100	3552	100

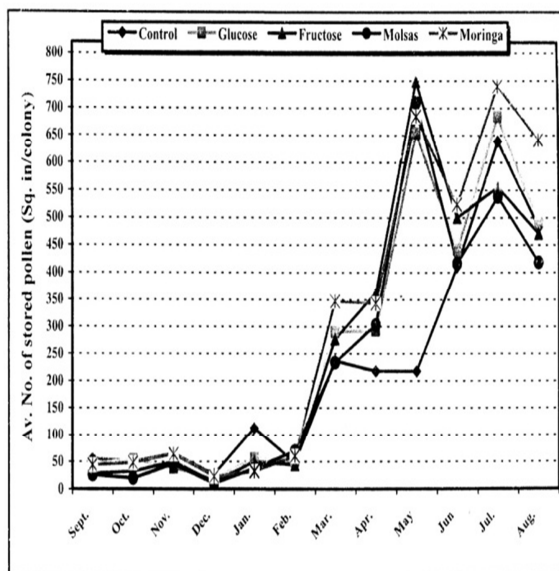


Fig. 1. Total count of stored pollen treated colonies with different sugary feeding (autumn and winter) during the whole year (2015-2016) .

The results illustrated in Fig. 1, 2 are similar to the pervious data, which proved that colonies treated with Moringa gave the highest number of stored pollen 3552 sq. in/ colony . Over a whole year. Than any other feeding , while treated colonies with Molasses, gave the lowest amounts of stored pollen reached to 2825 sq. in / colony.

Fig. 2,3 also gives comparative illustration of differences between the four sugary feeding and the control using the average number of stored pollen square inches during the experiment period . The highest amounts of stored pollen were observed during summer season gave 1906 , 1615 , 1526 and 1372 sq. in /colony represented 53.65% , 51.82% , 48.75% and 48.75 % in treated colonies Moringa , Glucose, Fructose and Molasses , respectively . Most of the pollen grains were collected in May (Fig. 1) the highest percentage of stored pollen was due to the soil ability of the ecological

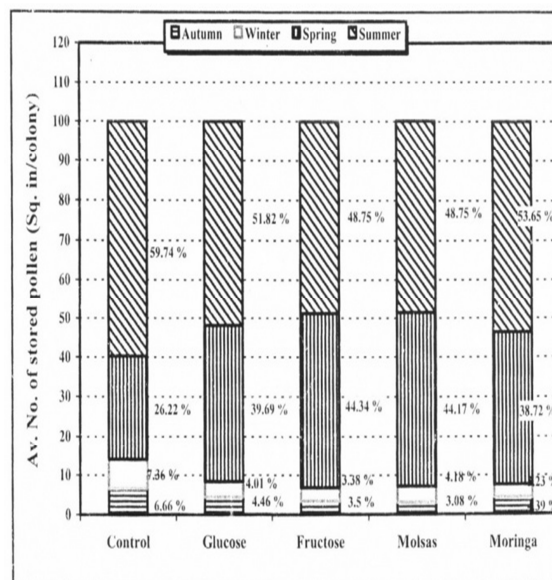


Fig. 2. Total amount and percentage (%) of stored pollen under the influence of different sugar feeding during the four seasons of the year 2015-2016 (autumn and winter) .

conditions for plant flowering and the highest population of foraging bees that could gather the pollen from the blooming plants in this period . The lowest amounts of stored pollen were during autumn and winter season is a results of the lack in pollen sources and digresses of temperature degree epically during December and January which affect the foraging activity of bees. Concerning the effect of feeding colonies with different sugary on amount of stored pollen , The obtained results indicated that treated colonies with Moringa were more active in called pollen during summer and spring season 1906 and 1375 sq. in / colony , respecting 53.65 % and 19.28 % , respectively .While treated colonies with Molasses collected during the same season , recorded. 1372 and 1248 sq. in / colony respectively and between four feeding types in winter (table : 2) .

Table 2. Statistical analysis of stored pollen treated colonies with different sugary feeding (autumn and winter) during the whole year (2015 – 2016) .

Treatments	Autumn	Winter	Spring	Summer	The whole year
Glucose	139.0 abc	125.0 b	1237.0 b	1615.0 b	3116.0 b
Fructose	111.0 bc	106.0 b	1389.0 a	1526.0 b	3132.0 b
Molsas	92.0 c	118.0 b	1248.0 b	1372.0 b	2830.0 bc
Moringa	156.0 ab	115.0 b	1375.0 a	1906.0 a	3552.0 a
Control	171.0 a	189.0 a	673.0 c	1533.0 b	2566.0 c
LSD at 0.05	15.9	12.0	20.5	83.6	31.5

The means in the same column followed by the same litters do not differ significantly at level 0.05 .

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تأثير التغذية السكرية المختلفة علي نشاط جمع حبوب اللقاح لنحل العسل
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أجري هذا البحث لدراسة تأثير أربعة أنواع من التغذية السكرية (الجلوكوز والفركتوز والعسل الأسود والمورنجا) علي نشاط جمع حبوب اللقاح لقياس كميات حبوب اللقاح المخزون . وأوضحت النتائج المتحصل عليها ما يلي : بلغ المتوسط الكلي لعدد الوحدات المربعة من حبوب اللقاح المخزونة ، الطوائف المعاملة الجلوكوز ، الفركتوز ، العسل الأسود ، والمورنجا ، الكنترول ٣١١٦ ، ٣١٣٢ ، ٢٨٢٥ ، ٣٥٥٢ ، ٢٥٦٦ *** مربعة طائفة علي التوالي . أعلي معدل لجمع حبوب اللقاح لوحظ في شهر يولييه ومايو حيث بلغت الطوائف المعاملة بالمورنجا ٧٤٠ و ٦٨٥ لعرض مربعة / طائفة علي التوالي . سجلت الطوائف المعاملة بالمورنجا أكبر كمية من حبوب اللقاح المخزونة علي مدار السنة حيث بلغ إجمالي كمية حبوب اللقاح ٣٥٥٢ لعرض مربعة / طائفة بينما سجلت الطوائف المعاملة بالعسل الأسود أقل الكميات حيث بلغت ٢٨٢٥ لعرضة مربعة / طائفة . لوحظ أن أقل الكميات من حبوب اللقاح المخزونة سجلت خلال موسمي الخريف والشتاء في كل الطوائف المعاملة .