

FEEDING EFFICIENCY OF POLLEN SUBSTITUTES IN A HONEY BEE COLONY

Lumturi SENA*, Sabah SENA, Anila HODA

Faculty of Agriculture and Environment, Agricultural University of Tirana, Albania

(Corresponding author: lumturisena@yahoo.com)

Abstract

The effect of use of two alternative feed supplies on brood rearing and honey production from the bee colonies during the spring season was tested. Two groups of 9 bee colonies each were established, where the control group was fed with *Bee Food*, as a source of energy, while the experiment group was fed with *Feedbee*, as a pollen substitute. The bee colonies, were almost similar as far as their strength and queen's age (two years old queens). The following indicators were recorded and monitored: brooding rate, capped brooding cells per frame/per group and the respective honey production as well. At the end of the trial's period, it was concluded that the use of *Feedbee*, had a remarkable effect on the number of frames with brood, contributing in the strenght of the bee colonies. During the main inspection in Spring, the supremacy of the group fed on *Feedbee*, over the one fed on *Bee Food*, was easily seen (62.18 cm^2 vs. 59.77 cm^2) as far as the capped brood area/frame (cm^2), per $P < 0.05$. Feeding the bee colonies with *Feedbee*, starting at the end of winter period, showed a slight effect on the quantity of produced honey per colony (as an average: 630g more honey per colony).

Keywords: *Bee food, bees, Feedbee, honey production, pollen substitute.*

Introduction

Honey bees use pollen as their only source of protein. Nurseries have high demands for protein, since they are producing the high quality protein secretion – the Royal Jelly (Schmickl & Crailsheim, 2001). Honey bees consume abundant protein, to prepare for their function as brood raisers. This protein is stored in the form of vitellogenin in the fat cells (Amdam et al, 2003).

In early spring before pollen and nectar are available or at other times of the year when these materials are in short supply, supplementary feeding may help the colony survive or make it more populous and productive (Standifer L.N, 1977).

The recently developed bee production technologies, pay a much higher attention towards use of manmade, "artificial" protein sources and pollen substitutes. These substitutes content a wide range of components, mainly soybean based products (Kulinčević et al, 1982), yeast micelle and in a lot of cases powder milk (Zaytoon et al, 1988, Ranna et al, 1996). Chemically, these substances might satisfy the bees' requirements for nutrients (for brood production, colony's strengthening and honey production), but they have shown to be inefficient in comparison with pollen (Saffari et al, 2010).

The new diet, named Feedbee, is claimed by the manufacturers (Bee Processing Enterprises Ltd., Toronto, Ontario, Canada) to be constituted as a practically balanced diet based on several factors. These factors include: knowledge of the nutritional requirements, digestive capacity, and pollen consumption by honeybees (Herbert, 2000; Cohen, 2004), nutritional composition of animal feed stuffs (NRC, 1994; Novus International, 1994), chemical content of a honeybee's body and royal jelly (Knecht and Kaatz, 1990), availability

of the ingredients in the market, animal and insect feeds and feeding (Jouanin et al., 1998; Wilson et al., 2005; Cheek, 2005; Macdonald et al., 2002), palatability and anti-nutritional issues (Baumont, 1995; Burgess et al., 1996; Pham-Delègue et al., 2000), pollen chemistry (Somerville, 2001), and production cost.

Based on the above mentioned statements, in order to test the efficiency of this new product within the common situation of normal honey bee colonies activity during the spring time, the following study was carried out.

The aim of the research was to test and prove the effect of pollen substitutes (Feedbee) use aiming the improvement of bee colonies performance.

Material and methods

The experiment was performed in an apiary with 30 bee colonies in the surroundings of Tirana within the time frame February –April 2011.

The targeted bee colonies were kept in standard Langstroth beehives with 10 frames. For the purpose of this study, 18 colonies, very much equal to each-other as far as the queen's age and strength were concerned, were selected (2 years old): 9 colonies were dedicated to the Control treatment and were fed with Bee Food (energy food), while the other 9 colonies were put under the Experimental treatment and were fed with Feedbee (as pollen substitute).

During the trial period, the control treatment colonies were fed with 2 kg of bee food and 2.5 kg of sugar syrup (1:1 concentration)/colony. While the ones of the experiment treatment, were fed with 3 kg of Feedbee/colony. Two different kinds of Feedbee were used in this trial, each of them having a specific formula (38.28% and 35% Feedbee). For both treatments the feed was given in a thick patty form. Patty was made by mixing powdered Feedbee with sugar syrup and honey (Standifer et al, 1978). The patties were wrapped with kitchen wax paper to prevent rapid moisture loss. Patties were 1cm thick and 15-20cm in diameter and weighed 500g. After the Feedbee sacks (500g/sack) were placed on the top of frames, they were inspected every 3-4 days. After these sacks were used they were replaced with other ones, avoiding having the bees without feed even for a few hours.

The recorded parameters:

- The colony growth rate (for each individual colony in both treatments). The number of frames with brood during the trial.
- The total area of capped brooding cells in the colony. Measurement of capped brooding cells determined by measuring sealed brood to the nearest cm² using Adobe Photoshop CS3, Version 10.0. This method based estimating capped and uncapped brood (Knopp et al, 2006; Berna Emsen, 2006). Through this operation, two figures were captured: number of pixels which represents the capped brood area (A) and the number of pixels which are included within the image (B), meaning that within the same picture both capped and uncapped parts were selected. Based on these data, the total amount of the capped brood area was calculated and given as a percentage (C) of the total frame's area ($C = (A/B) \times 100\%$).
- Honey production per each colony of each group during the first honey harvesting.

All the recorded results were statistically processed and tested through ANOVA and descriptive analyses, while the comparisons were done through the *t Test*.

Results and discussion

Bee colonies' development (bee population and brooded frames)

Table 1 gives a clear picture on the bee colonies' development between the four inspections. Although the number of brooded frames during the first inspection of the

experimental group fed with Feedbee is only 0.65 more, the differences are significant ($P \leq 0.05$). The application of Feedbee immediately after the wintering period, gave its positive impact on the revival and strengthening of the bee colonies. This situation pushed the queens to increase the number of the laid eggs in an average of four frames. During the other two consecutive inspections a light tendency of increased number of capped brood frames can be seen. During the last inspection, the supremacy of the experimental group can be clearly evidenced. The queen has expanded the laid eggs in 0.72 frames more, or in an area which is 8.8% bigger. So, it can be stated that in the colonies fed with Feedbee, the queen has clearly expanded the laying area; a fact which is confirmed by the literature sources as well (Kevan, 2005). But, in order to be able to draw a final conclusion in relation with this factor, it is necessary to measure the average capped brooded areas in each frame of each colony in each group.

Table 1. Number of brooded frames per each colony and each group during the trial

Parameters		M \pm SD	Variance	T stat	T crit
Control	I	3.4 \pm 0.52	0.27	2.18	1.83
	II	5.7 \pm 1.95	3.79	0.56	1.83
	III	5.7 \pm 1.83	3.34	0.84	1.78
	IV	7.5 \pm 0.76	0.57	-1.86	1.75
Experiment	I	4.05 \pm 0.60	0.36	2.18	1.83
	II	6.1 \pm 0.88	0.77	0.56	1.83
	III	6.22 \pm 0.67	0.44	0.84	1.78
	IV	8.22 \pm 0.83	0.69	-1.86	1.75

The capped brood area (in cm²)/frame (digitally measured)

An alternative method of measuring the capped brood area is digital photography. The capped brood area is presented with cm²/one side of frame in each colony and per group.

On the Table 2, it can be marked the supremacy of the experimental group (4.03% more) related to the size of the area occupied by the capped brood area within the frame and 13.52% more for colony. The mean capped brood area of colonies treated with feedbee were significantly higher ($P \leq 0.05$) than the colonies fed with bee food (tCrit = 1.65, tStat = 1.83).

According to the literatures' recommendations, Feedbee encourages brood-rearing (Kevan, 2005)

Table 2. Total mean capped brood area (cm²/one side of frame and cm²/colony) as measured via the Adobe Photoshop CS3 10.0

No.	Control			Experiment		
	M	SD	Variance	M	SD	Variance
1	64.62	2.60	6.76	59.09	8.77	76.97
2	62.80	13.09	171.23	64.31	9.51	90.60
3	60.32	6.11	37.36	61.00	7.28	52.93
4	67.00	14.87	221.08	68.82	8.45	71.32
5	58.94	9.32	86.87	63.98	10.66	113.53
6	59.75	8.92	79.57	62.00	4.15	17.21
7	54.74	7.96	63.35	55.62	10.70	114.55
8	51.45	4.96	24.59	67.44	8.57	73.57
9	55.82	4.16	17.29	61.22	7.11	50.48
Mean (cm ² /one side of frame)	59.77	9.88	97.55	62.18	9.38	87.98
Total (cm ² /colony)	681.38			773.52		

Honey Production in each group

Honey was harvested on July 30. It should be noted that this year was not a very good year for honey production all over the country, just because of the inappropriate weather conditions. The large amount of precipitations starting in February, March and especially in May and besides this inappropriate temperatures i. e. low temperature during March and a long draught and hot July, caused an abnormal use of natural feed resources by the bees.

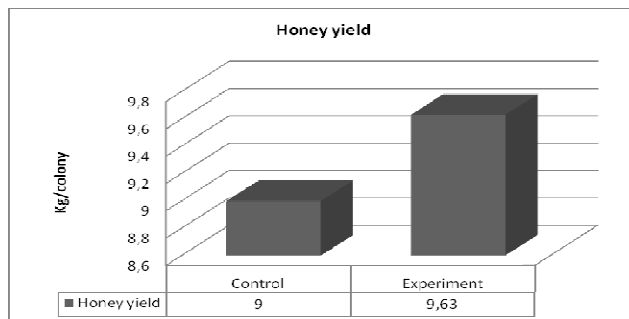


Figure 1. Honey yield by the treatments (Kg/colony)

Referring to the figure 1, it can be seen that the experimental treatment (fed with Feedbee) produced, in average, 630g (6.6%) more honey/colony. Anyhow, there are no statistically significant differences between the two treatments for this indicator.

Feeding supplemental pollen to honey bee colonies improved their performance, as would be expected, but the similar results obtained from feeding Feedbee indicate its high potential for improving colony maintenance, build up and production during a shortage of natural pollen (A Saffari, P G Kevan, J L Atkinson, 2010).

Conclusions

Feedbee was easily accepted by the bees and positively influenced on their performance of the following indicators, during the Spring time:

- Feeding with Feedbee had an indicative effect on the increase of brooded frames/colony at the beginning of Spring season (evidenced during the first inspection) influencing on the colonies' revival. Even during the last inspection, the queens of the experimental group expanded the brooding area at a rate of 8.8% more compared with the control treatment.
- The use of Feedbee has stimulated the increase of the capped brood area size.
- Feeding the beecolonies with Feedbee, starting in early Spring, showed a slight effect on the amount of honey produced/colony.

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