

RESEARCH ARTICLE

(Open Access)**Bee-colonies performance evaluation based on the application of two levels Feedbees' concentration**

SABAH SENA, LUMTURI SENA*, ANILA HODA

Department of Animal Production; Faculty of Agriculture and Environment; Agricultural University of Tirana, Albania

*Corresponding author e-mail: lumturisena@yahoo.com

Abstract

The effect of two different feedbee's concentrations application on the bee colonies' performance during the spring was observed and studied. For this purpose, in an apiary located in the surroundings of Tirana, 14 bee colonies were selected, being analogue as far as the strength and Queen's age is concerned. These colonies were divided into two groups respectively. In the first group (G1) 4% concentration Feedbee was applied throughout the whole period, while in the second group (G2) 10% concentration. The experiment was conducted during a three months period and was divided into two phases respectively by 1,5 months each. In both phases, the number of brooding frames/family and the size of capped brood area/frame and the colony for each group was measured and evaluated. At the end of the experiment it was concluded that the application of different Feedbees' concentration didn't show any impact on the number of brooding frames. At the end of the first phase, it was concluded that increasing the Feedbee's concentration from 4-10%, stimulated the growth of capped area with generation to an extent of 41.1%., while at the end of the second phase, only a trend to expand of capped brood area within the group that consumed 10% concentrated Feedbee was observed. Based on the results of this study, it was concluded that the appropriate Feedbee's concentration to be applied during the first phase would be 10%, while for the second phase, only 4% concentrated Feedbee can be applied, leading to almost the same results and saving 135lek/bee-colony.

Key words: Feedbee, concentration, bee-colony, capped brood area

Introduction

In early spring, when pollen sources are of a poor quality or insufficient, the bee colonies must be fed with rich in protein diet [14, 16, 10]. Feeding pollen substitutes can be a cost-effective alternative compared to feeding pollen. Studies have shown that supplementation of bee colonies with enough protein has led to a good brood development [3]. Feed consumption by bees depends on the method of its application. Rich-in soybean meal feed [1], or any other pollen substitutes will be better consumed by bees when placed on the frames in a wider area [3]. Mattilda and Otis [10] concluded in a faster growth and rapid development of the broodin area of supplementation with pollen or its substitute.

In order to make sure we have healthy bee colonies, a balanced feeding should be offered to them, especially when the apiary is located faraway of the pastures [11, 16].

Feedbee is a new recipe [13] based on the bees' requirements for nutrients, their digestive capacity and pollen consumption capability [5], the feed composition and bees' body & royal jelly's chemical composition [8].

Feed-bee is a pollen substitute that does not compromise the honey quality and affects the strength and health of the bee colony [6].

The Feedbee is efficiently used and applied in our country since more than five years. It is prepared in pulp/daw form with 0.5kg packages at different concentrations, ranging from 4% to 50% (which is prepared recently). But beekeepers often prefer to buy packages at a concentration of 4%, because they have the lowest price in the market compared to others.

The purpose of this study is to test the effect of Feedbee's application in two different concentrations (4% and 10%) in improving the performance of bee colonies during the spring.

Material and method

The effect of using the feed-bee, in different concentrations, as pollen substitute, during the spring period in an apiary near Tirana was tested and evaluated.

The bee colonies were held in standard Langstroth beehives. The bee colonies involved in the test, were equalized before starting the experiment. Based on the principle of comparative analogy of the breed, queen's age, colony's strength, etc., the 14 best colonies of the apiary were selected. These colonies, with similarities as far as the above mentioned indicators is concerned, were separated in to two groups of seven colonies each: where the first group (G.1) was fed with 4% concentrated feed-bee, while the second group (G.2) at a concentration of 10%.

The experiment was conducted from January 20th through April 30th, respectively divided into two phases. The preparatory phase lasted 10 days, while each of the test phases lasted 45 days each.

The preparatory phase started on January 20 and finished on January 31st. During this phase all bee colonies were fed with 10% concentrated feed-bee, aiming to bring all the bee colonies under the similar condition and enable them to be regenerated.

In the first phase of the experiment, which lasted from February 15th through March 15th, the differentiated group treatment with different concentrated Feedbee was applied, while during the second phase of the experiment (March 15th through April 30th) the same feeding pattern for both groups was applied. At the each stage every bee colony was supplied with 2 kg Feedbee. At the end of each stage, every single bee colony of each group was inspected.

To measure the seasonal course of brood production, the brooded without bees from each hive were photographed from both sides by a digital camera. These photos were downloaded into the computer and capped cells areas were measured via Photoshop 10 CS3, based on the Knopp et al. [9] and Berna Emsen [2] method. During this operation two figures were recorded: the number of pixels that

represents the capped brood area (A) and the number of pixels contained inside the image (B). Based on these data the size of the capped brood areas in percentage (C) towards the total area of the frame was calculated. So: $C = (A/B) \times 100\%$. While the area with capped brood in cm^2 was calculated according to the, following formula:

$$D = C \times (w \times h)$$

-Where: $w \times h$ is the size of the capped brood area in cm^2

In total, 84 pictures during the first measurement and 150 ones during the second measurement were prepared and Photoshop processed.

The recorded parameters:

- Feed consumption. Feedbee bags were placed over the frames section to facilitate its consumption by bees. The Feedbee bags were checked every 3-4 days, in order to make sure that the bees would have enough feed supply during all the time.
- The queen's age.
- The bee colonies' growth rate. Number of frames with bees at the beginning and at the end of the experimental period.
- The capped brood area /frame. The measurement was made through photographing and editing in Photoshop.

The results were subjected to statistical analysis with ANOVA method and descriptive analysis, while the for the comparisons the *t-Test* was applied.

Results and discussion

The queen's age

Out of each bee colony, the queen's age was recorded at the beginning of the experiment. Differences in the queens' age among the groups are statistically non-significant. The table 1 shows a summary of number of brooded frames in both experimental phases.

Table 1: Queen's age

Parameters	M	SD	Variance	Cv	t-Stat	t-Crit
G.1	1,36	0,556	0,310	0,409	1:2	1:2
					0,28	1,94
G.2	1,29	0,267	0,071	0,207		

Table 2: Number of brooded frames per each colony and each group during the trial. (p 0,05).

Parameters	M	SD	Variance
G.1	March	3,21	0,81
	April	5.42	3.05
G.2	March	2,79	0,57
	April	6.00	1.41

Out of both measurements, the differences among the groups are statistically non-significant for: p 0,05 (t-Crit = 1.94).

As it can be seen at the Table 2, during the first control there is a slight preponderance of the first group fed with 4% Feedbee (0.42 brooded frames, or 15.1% more) compared with the group that was fed with 10% Feedbee. During the second control, the opposite happened: the G2 had 0.58 more brooded frames or 10.7% more than the G1. After both controls, it can be concluded that the use of Feedbee in two different concentrations at the beginning of spring has shown no impact on the number of brooded frames.

We noticed a significant increase in the number of brooded frames from one control to the other one. The use of Feedbee immediately after the bees' wintering season, the most critical period for a bee colony, has shown positive effect for the recovery and strengthening of the bee colonies. This led to the

fact that the queens' increased their eggs' laying with respectively 2.21 frames in the first group and 3.21 frames in the second one. The differences for each group between the two controls are statistically significant to t-Crit = 1.78 (respectively for the G1, t-Stat = -4.48 and G2, t-Stat = -5.31). So, we can say that in colonies where bees were fed with Feedbee, the queen significantly expanded the eggs' laying area. Being a high nutritional value feed, the Feedbee has a positive impact on strengthening the bee colonies. This is also confirmed by literature sources (G Peter Kevan, 2005).

The caped brood area's size (in cm²)/frame (digitally measured)

But to judge on the impact of this factor (the Feedbee's concentration) it is important to evaluate caped brood areas on each side of the frames of each bee colony in each surveyed group.

Table 3: A summary of the brood size (in pixel cm²)

Phases	Parameters	G.1	G.2
Ph.1	Average/frame's side	14.76±10.13	28.83±11.17
	Average/colony	94.76	160.87
	Average/group	663.31	1126.10
Ph.2	Average/frame's side	68.99±5.99	69.34±3.62
	Average/colony	747.85	832.08
	Average/group	5234.96	5824.56

During the first phase, the supremacy of the group fed with 10% Feedbee compared to the group

fed the 4% Feedbee is noted: for p 0.05 (t-Stat = -2.48 and t-Crit = 1.78). So, the impact of the higher

concentration Feedbee on the expansion of the capped brood areas is clearly evidenced. Thus, increasing the Feedbee's concentration from 4% to 10% the size of the capped brood area on each side of the frame is almost doubled (48.8% more in G2 compared to G1). In G2, the size of the capped brood area was increased by 41.1% in each of the bee colonies compared to G1.

Being a high protein content feed, it positively affects the growth and strengthening the colony, early in the spring and increase the fertility of the queen.

It is clearly observed that during the second phase, the size of the capped brood area of the G2 is only 0.5% higher/one side of the frame, compared to the G1. While, as far as the "area with capped brood/colony or group" is concerned, the difference is higher in favor of G2 (10.1% more). This is because the number of frames per colony is higher in this group. However, the differences are statistically non-significant at this stage for $P > 0.05$ ($t\text{-Stat} = 0.26$ and $t\text{-Crit} = 1.94$). So, we can say that at this stage, the increase of the Feed-bee's concentration from 4% to 10% showed no effect on the expansion of the capped

brood areas. It is known that in this period the pastures are rich in nectar and pollen, which has contributed significantly to increased laying by the queen, as reflected in the increase of the brooded frames, as well as expansion of laying on each side of the frame.

Although it is highlighted a significant progress associated with capped brood areas from one measurement (phase) to the other one, in order to reach to a more accurate conclusion the t-Test was performed. For each group, the differences are statistically significant from one stage to the other one, which indicates a good performance of the bee colony in both groups during the spring period. This is because of the strengthening of bee colonies during April, associated with more favorable temperatures, abundant feed supply as well as supplementary feed (Feedbee) consumed by the bees [7]. Feedbee was easily accepted by the bees and positively influenced on their performance during the spring time [15]. This tendency in the development of the bee colonies can be graphically (fig. 1):

Table4: Comparison among the two measurements in Pixels/cm² (t-Test)

Parameters	G1	G2	T-crit
March:April	-10.26	-8.97	1,94



Figure 1: Progress of the capped brood area from one phase to the other one per each group (in pixels/cm²)

Based on the obtained results, a question arises: What would be the most appropriate dose of Feedbee to be applied during each stage/phase?

During March, since the differences between the two groups are statistically significant in favor of G2, it is necessary to make use of high concentration (10%) Feedbee. While for the month of April, although the best results were in G2, but given that the differences with the G1 were not statistically proven as significant, it would be better to apply the 4% concentrated Feedbee.

Doing just do a simple calculation - The feed- bee's price in the Albanian market by concentrations is:

- 4% Feed-bee = 1.28 €/kg
- 10% Feed-bee = 1.77 €/kg

For 2 kg/bee colony Feedbee used in the second stage were spent respectively: 2.56, 3.54 Euro/colony. Using the 4% concentrated Feedbee, would save 0.98 Euro/bee colony, or close to 135 ALL/bee colony, giving the same result for the sake of bee colonies' strengthening.

Conclusions

- The application of two different concentrations of Feedbee, did not significantly affect the increase of the number of frames with capped brood per colony, in early spring in two inspections. It resulted in a significant increase in the number of frames with capped brood from one control to the other one per each group.
- During the first phase, in the group fed with 10% Feedbee a significant increase in the capped brood area/frame/each bee colony was observed. The use of 4-10% concentrated Feedbee has encouraged/stimulated the brood's growth, making its almost double. During the second phase, the increase of Feedbee's concentration from 4% to 10%, didn't show any effect on the expansion of the capped brood area due to the abundant feed availability in nature.
- The visible progress in capped brood areas in both groups from one measurement to the other one,

shows a good trend of development of bee colonies in both groups during the spring period.

- Based on this survey's results, the most appropriate concentration of Feed-bee applied, should be 10% for the first phase. While as far as the second phase is concerned, it would be more efficient to apply the lowest concentration of 4%, giving an approximate result in the strengthening of bee colonies and saving 135 ALL /bee colony.

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