EUROPEAN ACADEMIC RESEARCH
Vol. VIII, Issue 3/ June 2020

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

The Effect of Usage of Shallow Supers as a Brood Box on the Development of the Bee Colony during Spring Time

ZYMBER BAJRAKTARI
Kosova's Beekeeepers' Association (Mitrovica)
LUMTURI SENA[1]
SABAH SENA
Animal Science Department
Faculty of Agriculture and Environment
Agricultural University of Tirana, Albania

Abstract

In the present study the effect of the use of shallow supers as a brood chamber on the bee colonies' development during the spring period was surveyed and assessed. For this purpose, in an apiary in Mitrovica area of the Republic of Kosova, it was experimented for a period of three months. 10 bee colonies, which constituted the Control Group, were kept in deep hive bodies (standard Langstroth), while the other 10 (Experiment Group) were kept in shallow supers as brood boxes. Both groups were analogous and with 1-year-old queens. To monitor the development of bee colonies, two consecutive inspections were performed every 45 days. In these inspections, the number of brooded frames/colony and capped brood areas generation per each frame and bee colony were visualy evaluated and by means of the Adobe Photoshop CS3, Version 10.0 were measured. In conclusion, it was observed that in the experimental group there were 16% more brooded frames per bee colony compared to the control group. In shallow supers a significant expansion ($P \leq 0.05$) of capped brood areas

[1] Prof Lumturi Sena is a lecturer in the above cited department since more than 20 years and teaches in three levels, i. e. Bachelor, Master and Doctor. Prof Sena is author and/or co-author of more than 50 scientific papers mainly in poultry production, beekeeping and rabbit production.
1. Since September 2013 - ongoing: Member of the Ag. University's Professors' Council;
2. October 2013 - ongoing: Head of the Teaching and Research of Animal Science Group;
3. February 2008 - April 2016: Elected twice as a Member of the Council of Agriculture & Environment Faculty's Council.
Corresponding author: lumturisena@yahoo.com

per frame was observed in both inspections (18.9% and 7.8% more than in standard beehives). The same can be said for capped brood areas/colony (pixel cm²), where also in the experimental group a more successful progressive development of the bee family (10% more) was observed compared to the control. So the use of shallow as a brood box, in addition to easier manipulation with them, promises a faster development of bee colonies during spring time.

Keywords: brood box, capped brood area, deep hive bodies, inspection, shallow

INTRODUCTION

For the evaluation of bee colonies' performance, their strength and productivity are important, factors, since they are both essential in increasing honey production (Jevtić et al. 2009; Neupane K R et al. 2012). The colony strength is related to the number of domestic workers, bee forages activity, and brood area (Pokhrel et al. 2006; Vaudo et al. 2011; Ali 2011; Delaplane et al. 2013).

In modern beekeeping, beekeepers should be introduced to the practices of seasonal bee management and use new technologies (Moses Cemurot et al, 2019).

One of the management practices in beekeeping is choosing the right beehives. Around 75% of beekeepers worldwide use standard Langstroth beehives (Hossam F. Abou-Shaaraet al, 2013, Ahmad Khaer Ja'ad, 2012).

Any size or style of hive providing flexibility for arrangement will enable the beekeeper to obtain maximum crops when enough hive units are provided and organized to meet the colony's optimum space requirements. Uniformity in hive-body size for use both as brood chambers and supers is highly desirable (Farrar C. L, 1944). Achievements around the world have been made in the use of shallow equipment, as a brood box. These hives are otherwise called shallow boxes and weigh about 2/3 of deep hive bodies. (Conrad Ross, 2014, David Cramp, 2008).

The advantage of using a shallow box super for both the hive body and for honey is because only one frame type can be used for all hives. Three shallow boxes when used for brooding boxes are the same size as the two deep hive bodies. (Conrad Ross, 2014). According to David Cramp, 2008, in addition to the above, the advantage lies in the fact that it can be replaced by the first super with the brood box to limit swarming.

Even in Kosova, the beekeepers'interest to get acquainted with new technologies, or to make innovations in equipment and tools, has increased, one of which is the use of the most suitable hives. In the apiary, where the experiment was performed, only Langstroth standard hives are used.

Based on the above, we decided to triy in our apiary the effect of using the shallow as a brood box. The aim of this study is the evaluation of the use of shallow super as a brood box versus deep hive bodies for bee colony development during spring time.

MATERIAL AND METHODS

The experiment took place in an apiary in the surroundings of Mitrovica for the period of: April 2nd -June 30th, 2016. The effect of using a shallow super as a brood box in order to improve the performance of bee colonies was surveyed and assessed.

For this purpose, at the beginning of April, two groups of 10 bee colonies each, were established in the mentioned apiary in Mitrovica. The bee colonies of the control group were kept in the Langstroth standard hives (dimensions: 510 x 423 x 242 mm), while the bee colonies of the experimental group were kept in the shallow super (510 x 423 x 155mm), with 10 frames each. For each group the same size box throughout the hive are used (two deeps for control and three shallow for experiment group).

In the apiary, before the start of the experiment, the bee colonies were equilized within each group and between the two groups. The queens of all the colonies involved in this study were 1 year old. The same food and medicinal treatments were applied to both groups.

On May 15th, the first control was carried out regarding the number of brooded frames and the size of the capped brood area in each frame. A second check, for the same indicators was performed after 45 days. The control was performed, for each colony of each group, regarding the presence of the queen and the laying rate and regularity of her. The brooded frames, from each hive were photographed on both sides with digital cameras. These photos were downloaded to the computer and the capped brood areas areas were measured with Photoshop 10 CS3 using the Knopp et al (2006) and Berna Emsen (2006) method. During this operation, two figures were marked: the number of pixels representing the capped brood area (A) and the number of pixels included in the inside of the image (B). Based on these data, the capped brood area was calculated as a percentage (C) to the total surface area of the frame.

$$C = (A / B) \times 100\%.$$

While the capped brood area in cm^2 was calculated according to the following formula:

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

Where: w x h is the surface cm^2

In total, 454 photos were prepared and processed, out of them 200 photos during the first measurement and 254 photos during the second measurement.

Recorded indicators:

- The dynamics of family growth within each group.
- Number of brooded frames in both controls.
- Capped brood area on each side of each frame.

The measurement was done with photography and processing in Photoshop. Statistically (by descriptive analysis) the values (in %) of the capped brood areas were processed to find the average per each colony and per each group(in%). We also calculated the size of the capped brood areas in cm2. For comparison reasons, the tTest was applied.

RESULTS AND DISCUSSION

1. Development of bee colonies (brooded frames)

An important criterion is the study of bee colonies' development. For this purpose, two consecutive inspections were carried out, where the number of brooded frames for each colony of each group in both measurements was recorded.

While in the first inspection the control group headed for this indicator, in the second one, the superiority of the experimental group was evidenced. Table 1 shows the average values of the number of brooded frames for both groups in both performed measurements.

Table 1: Number of brooded frames

Inspection	Control			Experiment		
	M	SD	Variance	M	SD	Variance
1	**5.2**	0.42	0.18	**4.8**	0.63	0.40
2	**5.8**	0.63	0.40	**6.9**	0.57	0.32

Although in the first inspection, in the standard hives group there was 0.4, or 7.7% brooded frame/ colony rather than in the shallow super, the differences between the groups were not significant for $P \leq 0.05$ (tCrit = 1.73 and tStat = 1.66).

While during the second check in June, the opposite was observed. The experimental group averaged 1.1 brooded frame/colony, or 16% more than the control one, and the differences were statistically significant for $P \leq 0.05$ (tStat = -4.09).

The use of shallow super has shown positive effect on the recovery and empowerment of bee colonies. The queens expanded the laid area by 1.1 more frames.

The development rate of the bee colonies of each group from one measurement to the other one was also monitored. Both in the control group and in the experimental one there was an increase in the number of brooded frames from the first inspection to the second one and the differences were significant in both groups (tCrit = 1.73, tStat control = -2.50 and tStat experiment = - 7.81). So, improving the weather conditions, abundant fodder base have given their result in the development of bee colonies. But even a more highlighted change is observed in the experimental group (shallow super hives). The queen has been able to more easily expand the laying from one frame to the other by significantly adding the size of the caped brood areas.

Figure 1 clearly shows the increase in the number of brooded frames (both sides of the frame are considered) from one measurement to the other one.

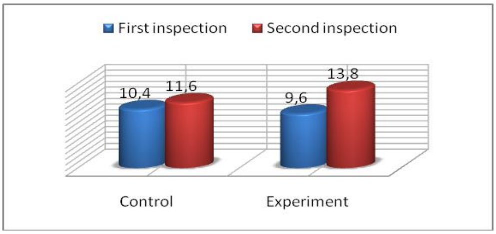

Figure 1: The average number of both sides of the frames with capped brood area in each group in both measurements.

2. Capped brood aerea/frame

In order to make the final assessment regarding this factor, we must rely on the measurement of the capped brood areas and finding the average for each frame in each group.

In both inspections the method of digital measurement of capped brood areas using the Adobe Photoshop CS3 10 (as in the methodology) was applied. After statistical processing, the values in percentage and cm2 of the capped brood areas were obtained to find the average value per colony. And finally the average value for each group was calculated.

The following table shows the size of the capped brood area (both, in % and in cm2) for each constituent colony of each group.

Table 2: Summary of the sizes of the capped brood area per frame (in % and in pixel cm2) as measured via the Adobe Photoshop CS3 10.0. (Two inspections)

Parameters	Number of inspection	Control		Experiment	
		(%)	(pixel cm^2)	(%)	(pixel cm^2)
Mean /one side of frame	1	64.03±5.46	62.18±7.26	79.12±9.50	76.69±4.70
	2	67,24±3.42	64,80±3.88	72,62±9.38	70.31±2.16
Total mean capped brood area(cm^2/colony)	1		646.67		736.22
	2		751.68		970.28

From the Table 2, in the first inspection a significant supremacy (in %) of the experiment group is observed (15.09%) for this indicator. Differences among the groups are significant for $P \leq 0.05$. The supremacy of the experiment group is observed even after the calculation of the caped brood area in pixel cm2 (18.92% more).

Even in the second inspection control, the superiority of the experimental group is clearly evidenced. It is observed that in the experimental group there is a significant expansion of the capped brood areas, up to the extent of 5.38% more. Even for the area in cm^2, the experimental group still leads with 7.84%. In both cases, the differences are statistically confirmed for $P \leq 0.05$.

So, in both measurements we face almost the same situation - the superiority of the group, in which shallow were used. In shallow (bees will either completely fill the frame with eggs and larvae, or complete with honey, because in the frame there is no space to deposit honey in the upper part of the frame, as happens in deep brood boxes.

According to Adam B. (1950), the space above the brood chamber has a negative effect on the queen's laying. The larger the capped brood area, the greater the population of future workers (Hossam F. Abou-Shaara, et al, 2013).

Based on the obtained results, we can conclude that in the experimental group, the queen has significantly expanded the laying area for each side of the frame, making a better use of its surface. In the deep hive bodies, the queen works horisontally from one frame to the other one, while in the Farrar hives the queen can work vertically, extending the brooding area. So, most colony manipulations can be made by interchanging the position of hive bodies instead of manipulating frames (Farrar C L 1947).

Capped brood aerea per bee colony is calculated by multiplying No. of brooded frames (both sides of the frame) for each group with the capped brood area on each side of the frame. It was noted that in both measurements the experimental group dominates over the control one, respectively 12.2% in the first measurement and 22.5% for the second measurement. As for the progress of each group from one measurement to another, we can say: The control group (with standard hive) had an improvement of 14%, while that of the experiment had an increase of 24.1%.

So, shallow performed better, compared to standard hives, in both inspections. In addition to this, the experimental group was better presented for its progressive development from one measurement to the other one (10% more) regarding the size of the capped brood area/colony compared to the control group. Even according to Bellet & Berhanu (2014), the adoption of supers makes beekeeping more profitable.

Conclusions

At the end of the experiment, the number of brooded frames/colony is higher in hives with shallow supers compared to standard beehives (16% more frames/bee colony). In both inspections, the experimental group was distinguished for a larger capped brood area size/frame (18.92% and 7.84% more, respectively). So the queen has made better use of the frame's area in shallow supers, significantly expanding the laying area. From one inspection to the next one, the size of the capped brood area was further increased in the group, in which shallow supers (10.1% more) were used. So the use of shallow has significantly affected the development of bee colonies, strengthening them and leading to an improved performance of bee colonies.

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