

EFFICIENCY OF THE HERBAL PRODUCT PROBEE 41 ON THE DEVELOPMENT OF BEE COLONIES USED IN THE AUTUMN FEEDING

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Abstract

This paper aims to study the efficiency of the herbal product Probee 41 on the development of bee colonies used in the autumn feeding. The study was conducted during autumn feeding of the bee colonies at the Experimental apiary of Research Center for Stockbreeding and Agriculture – Smolyan, Bulgaria. The bee feeding was from 05.08 to 04.10.2018. The study includes 14 bee colonies separate in one control and one experimental group. The control group was fed only with sugar solution (1:1). Experimental group was fed with the product Probee 41 at a dose of 5 ml in 1 L sugar solution (1:1) per bee colony. Statistically significant differences were found in the strength of the bee colonies, amount of bee brood and quantity of bee pollen. Linear correlation was found between the amount of collected bee pollen and the amount of the sealed worker bee brood in the control group ($r=0.861$, $P<0.01$) and in bee colonies fed with Probee 41 ($r=0.846$, $P<0.01$). We can expect that this will result in an increased population of healthy worker bees for the next spring season.

Key words: *Probee 41, bee feeding, bee brood, bee strength, honey, bee pollen*

Introduction

Nutrition is an important factor that may influence the expression of stress factors, bee health, productivity and survival of honey bee colonies. Nectar and bee pollen are essential nutrients to the bee colonies. On the other site poor nutrition can interact with other stressors and exacerbate colony decline (Scofield and Mattila, 2015). Agricultural areas with crop monocultures can decrease the quantity and quality of nutrients in the bee pollen and nectar (Naug, 2009; Tosi et al., 2017). Beekeepers also reported that poor foraging conditions are responsible for the recent bee losses (Naug, 2009). Nutritional stress for honey bees is associated mainly with the expansion of monoculture agricultural areas. In all causes polyfloral pollen is needed for the bees to fulfill their nutritional requirements (Branchiccela et al., 2019). According to Di Pasquale et al. (2013) bees fed with the polyfloral pollen lived longer than bees fed with monofloral pollens. There is an exception for the protein-richest monofloral pollen. Supplementary feeding of the bee colonies with pollen substitutes, sugar products, herbal and plant extracts are important and needed. Also, plant

extracts are used very often in animal nutrition (Frankič et al., 2009; Davidović et al., 2012; Caroprese et al., 2020).

The feeding of bee colonies with protein-enriched foods with extracts of garlic (*Allium sativum*), *Echinacea purpurea*, *Ganoderma lucidum* and sage (*Salvia officinalis*) have been shown to stimulate queen brood laying activity (Pătruică et al., 2016). Bekret et al. (2015) reported that plant extract-oil mixture is effective on honey production. This plant extract contains mainly extract and oils from *Origanum vulgare*, *Myrtus communis*, *Eucalyptus globulus*, *Juglans regia*, *Laurus nobilis*, *Lavandula stoechas*, *Pinus spp.*

As can be seen the plant extracts can influence the development of the bee colonies and to protect the bees from diseases. Zhelyazkova et al. (2009) studied the stimulating effect of the plant products “Green TM” on the development of bee colonies.

This paper aims to study the efficiency of the herbal product Probee 41 on the development of bee colonies used in the autumn feeding.

Materials and methods

The study was conducted during autumn feeding of the bee colonies at the Experimental apiary of Research Center of Stockbreeding and Agriculture – Smolyan, Bulgaria. The bee feeding was from 05.08 to 04.10.2018.

The study includes 14 bee colonies, settled in Langstroth Rut hives and separated in two groups one control and one experimental. Each group is from 7 bee colonies.

The control group was fed with sugar solution (1:1) without additives – total amount of 10 L. Experimental group was fed with the product Probee 41 at a dose of 5 ml in 1 L sugar solution (1:1) until 10 L sugar solution per bee colony.

Probee 41 is a natural product. It is an aromatic herbal solution. It contains wheat, lavender, walnut, eucalyptus, juniper, avocado, rosemary and garlic oils. Manufacturers recommend Probee 41 before the honey harvest. The producers of the product do not provide information for autumn feeding of the bee colonies. Probee 41 reduces possible infection with *Varroa* before wintering of the bee colonies.

The following parameters are identified characterizing the development of the bee colonies:

- amount of bees (strength of the bee colony) in kg – approximately in number of frames occupied by bees and calculating the mass in a statement of one frame the multihull hive contains approximately 200 g of bees after control measurements;
- quantity of honey (in kg);
- quantity of bee pollen in the beehives – cm²;
- amount of sealed worker bee brood (number of cells) – in 1 cm² of honey-comb there are 4 work cells, and in each of the squares of frame area of 25 cm² the cells are 100;

Bee samples from each bee colony were taken for determination of proteins (Kjeldahl method), lipids (Soxhlet method) and mineral content (muffle furnace) at the end of the experiment.

Statistical analysis

The data were expressed as mean $\pm$ standard deviation. Significant differences were considered at $P < 0.05$ by Student's t-tests. The correlation coefficient (r) was calculated with SPSS software version 20 for Windows. Significant differences were considered at $P < 0.01$.

Results and discussion

In the present study significant differences for the strength of the bee colonies fed with Probee 41 compared to the control group were found as follows: 29.08., $P < 0.05$; 10.09., $P < 0.05$; 22.09., $P < 0.01$; 04.10., $P < 0.05$ (Fig. 1). Similarly, Zhelyazkova et al. (2009) reported significant differences ($P < 0.01$) between the strength of the bee colonies in the experimental group fed with the plant product Green TM and the control group fed only with sugar solution. The same authors presented comparable average values for the bee colony strength in the both groups.

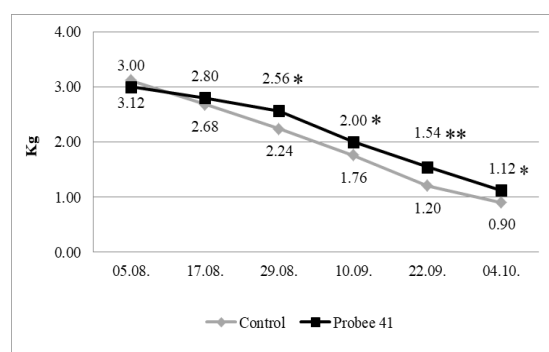


Figure 1. Average values of the strength of the bee colonies (kg)

* $P < 0.05$; ** $P < 0.01$

The results from Fig. 2 showed a gradual decrease in the number of sealed worker brood in the experimental and control group bee colonies. This is a normal process for the autumn development of honey bees due to the reduced egg-laying activity of the bee queen. In the present study significant differences for the sealed worker bee brood fed with Probee 41 and the control group were found as follows: 29.08., $P < 0.01$; 10.09., $P < 0.01$; 22.09., $P < 0.01$; 04.10., $P < 0.05$. According to Pătruică et al. (2016) the feeding of the bee colonies with protein-enriched candy with different extracts including garlic (*Allium sativum*) showed stimulating effect on queen brood laying activity. In general, the late autumn increase of the bee brood is extremely important for their better wintering.

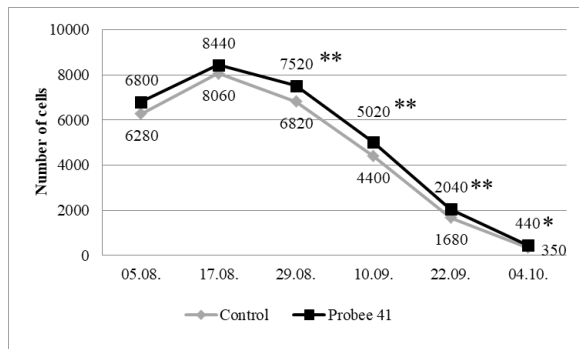


Figure 2. Average values of sealed worker bee brood (number of cells)

* $P < 0.05$; ** $P < 0.01$

Bee pollen provides proteins, lipids, vitamins and mineral elements that are required for larval development and the functions of the adult bees. Furthermore pollen is linked to the number of honeybees that a colony can rear (Scofield and Mattila, 2015). Statistically significant differences for the bee pollen received from the bee colonies fed with Probee 41 were found for the last four measurements (29.08., $P < 0.05$; 10.09., $P < 0.01$; 22.09., $P < 0.01$; 04.10., $P < 0.05$) (Fig. 3).

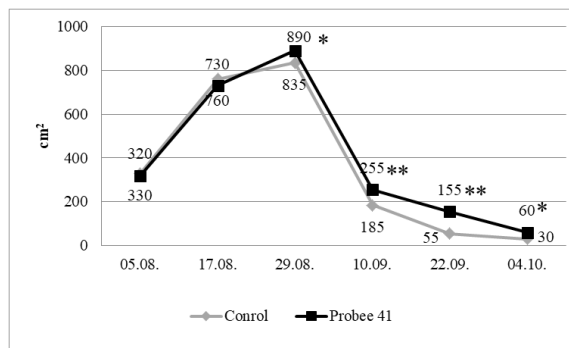


Figure 3. Average values of the bee pollen (cm²)

* $P < 0.05$; ** $P < 0.01$

Linear correlation was found between the amount of collected bee pollen and the amount of the sealed worker bee brood in the control group ($r = 0.861$, $P < 0.01$) and in bee colonies fed with Probee 41 ($r = 0.846$, $P < 0.01$). They are presented on Fig. 4.

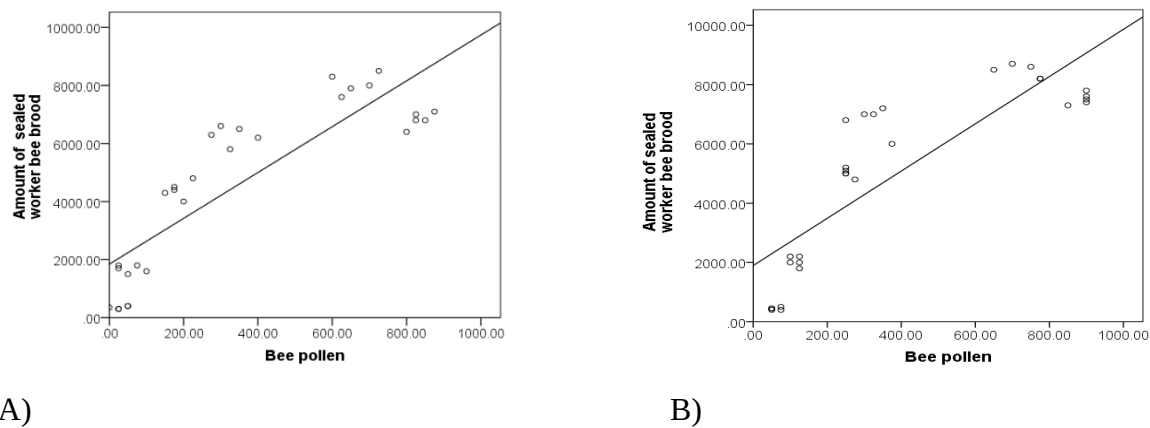


Figure 4. Linear correlation between amount of collected bee pollen and the amount of the sealed worker bee brood A) in the control group ($r=0.861$, $P<0.01$) and B) in bee colonies fed with Probee 41 ($r=0.846$, $P<0.01$)

Jevtić et al. (2009) found positive correlation ($r=0.60$) between bee brood and bee pollen in the autumn period of the bee colonies. Other authors also discovered significant positive correlation between the amount of brood reared and the honey production of ($r=0.568$; $P<0.001$) (Gąbka, 2014).

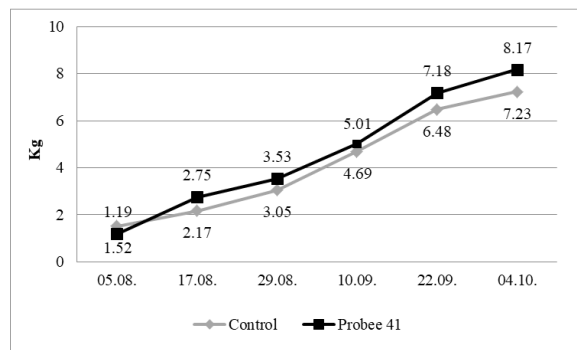


Figure 5. Average values of honey (kg)

The average values for honey are presented on Fig. 5. Abd El-Wahab et al. (2015) tested essential oils of lemon grass, cinnamon, thyme and anise and formic acid. The authors found that the bee colonies treated with essential oils at 100% concentration had higher honey yield compared to the control group.

The results for the chemical composition of the worker bees' bodies are presented in Table 1. Not statistically significant differences were found in the chemical composition of the body of worker bees. The results for lipid content in the present study are confirmed for the development of fat

body. Not significant differences for the development of fat bodies were observed in bee colonies receiving Probee 41 compared to the control group (Shumkova et al., 2019). Additional supplemented feeding can influence the chemical composition of the worker bees' bodies but in the present study is not confirmed. Statistical differences ($P<0.05$) were observed for the protein and lipid content in the bee bodies from the bee colonies fed with supplemented foods (Shumkova, 2016).

Table 1. Chemical composition of the worker bees' bodies (mean $\pm$ SD)

Parameter	Control group (n=7)	Probee 41 group (n=7)	Significance
Water content, %	59.66 $\pm$ 2.42	63.47 $\pm$ 1.06	NS
Protein, %	40.95 $\pm$ 4.69	45.57 $\pm$ 2.41	NS
Lipids, %	6.36 $\pm$ 0.79	7.94 $\pm$ 0.28	NS
Mineral content, %	2.98 $\pm$ 0.49	4.31 $\pm$ 0.31	NS

Note: NS – not significant differences

Conclusion

The combined product Probee 41 used as a supplemented food in the autumn bee feeding had an effect on stimulating the egg-laying activity of the queen bee. Statistically significant differences were found in the strength of the bee colonies, amount of bee brood and quantity of bee pollen compared to the control group. Linear correlation was found between the amount of collected bee pollen and the amount of the sealed worker bee brood in the control group ($r=0.861$, $P<0.01$) and in bee colonies fed with Probee 41 ($r=0.846$, $P<0.01$).

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