Entomology and Applied Science Letters
Volume 8, Issue 1, Page No: 23-27

Available Online at: www.easletters.com

ISSN No: 2349-2864

Influence of Organic Stimulating Feeding on the Productive Characteristics of Bee Colonies

Alexander Ivanovich Lyubimov[1], Svetlana Leonidovna Vorobieva[1], Marina Ivanovna Vasilyeva[2], Galina Yuryevna Berezkina[3], Elena Mullanurovna Kislyakova[1], Sergey Ivanovich Kokonov[4]*

[1]Department of Feeding and Breeding of Farm Animals, Izhevsk State Agricultural Academy Russia, Izhevsk, Russia.
[2]Department of Processing Technology of Animal Production, Izhevsk State Agricultural Academy Russia, Izhevsk, Russia.
[3]Department of Technology for Processing Livestock Products, Izhevsk State Agricultural Academy Russia, Izhevsk, Russia.
[4]Department of Plant Production, Izhevsk State Agricultural Academy Russia, Izhevsk, Russia.

ABSTRACT

The article presents the results of a study on the use of organic stimulating feeding (dihydroquercetin). The obtained results prove that this preparation improves the development of bee colonies in the spring/summer period, as well as the safety during the hibernation period. It also increases marketable honey productivity and total honey productivity. The preparation has high biological properties. It increases immunity, exhibits an anti-inflammatory effect, improves the resistance of bees, and increases their biomass by the time of the main honey harvest. In bee colonies using a dose of 15 mg of dihydroquercetin, the intensity of development of bee colonies was higher than in the control group by 45.1 hundreds of cells, or 13.0% ($P \geq 0.99$). The maximum results in honey and wax productivity of bee colonies were also recorded when using a dosage of 15 mg per colony (43 kg and 4.9 sheets of comb foundation, respectively). The calculation of the economic results considering the costs of the study revealed the greatest efficiency in the group using the maximum dose of the stimulant preparation among the experimental groups. The profitability in this group was 54.9%.

Keywords: Beekeeping, Honey productivity, Dihydroquercetin, Organic production.

HOW TO CITE THIS ARTICLE: Lyubimov AI, Vorobieva SL, Vasilyeva MI, Berezkina GY, Kislyakova EM, Kokonov SI. Influence of Organic Stimulating Feeding on the Productive Characteristics of Bee Colonies. Entomol Appl Sci Lett. 2021;8(1):23-7. https://doi.org/10.51847/LT3QwZaI8o

Corresponding author: Sergey Ivanovich Kokonov
E-mail ✉ nir@izhgsha.ru
Received: 11/12/2020
Accepted: 06/03/2021

INTRODUCTION

The relevance of the problem

Interest in biologically active beekeeping products is dictated by their unique properties, which have received a special resonance in the 21st century, the century of environmental tension and high-stress loads [1-3]. The exceptional value of beekeeping products lies in the fact that the biologically active elements in their composition, balanced by nature itself, serve as bioregulators of life processes. They mobilize the body's defenses and normalize disturbed homeostasis [4-7].

The biologically inherent life resource of bee colonies, their productivity is negatively affected by the deterioration of the ecological situation and the use of toxic preparations [8-10]. Consequently, the search for such ways to increase both the resistance of the organism of honey bees and their labor productivity is becoming the most urgent task of effective beekeeping [4, 11, 12].

Over the past decades, bee colonies have been in a constant stressful situation due to antibiotic treatments and intensive feeding with sugar syrup, leading to the premature consumption of body reserve substances and a reduction in the life span of bees. In this regard, we need to create optimal conditions for bees corresponding to their biological needs. Only in this case, their vital energy will be preserved throughout the entire life cycle [1, 13-17].

Progressive methods providing high resistance of bee colonies to the effects of biotic and abiotic environmental factors and a manifestation of productive potential include the use of stimulating feeding and regulation of bee reproduction [13, 18-23].

MATERIALS AND METHODS

To increase the natural immunity of bees and increase the biomass of the bee colony, the antioxidant dihydroquercetin was used as a stimulating feeding.

The bioflavonoid dihydroquercetin (DHA, taxifolin) is a concentrate of the bark of Siberian and Dahurian larch with a wide range of physiological properties and a high biological activity [24, 25].

One of the characteristic features of dihydroquercetin is its high antioxidant activity, thanks to which this substance successfully fights free radicals. Dihydroquercetin can regulate metabolic processes at the level of cell membranes and has a strong anti-allergic and anti-inflammatory effect [26].

The study aimed to determine the influence of stimulating feeding of organic nature with an antioxidant effect on economically useful traits of honeybees (Apis mellifera L.) in the Udmurt Republic, Russia.

Field studies were carried out in 2017-2019 in the Udmurt Republic at a stationary apiary. Our research was guided by the methodological recommendations "Research methods in beekeeping". For the research, we used the Central Russian breed of bees.

To conduct experiments in the spring, a control and three experimental groups of 10 bee colonies in each were formed by the analog method. The strength of colonies, the age of the queens, the number of food reserves, and the design of the hive was considered. During the first spring revision, the hive was examined for the presence of diseases, and measures were taken to prevent the spread of bee diseases such as varroosis and ascospherosis. The conditions were the same in all experimental groups.

Hibernation was prepared by the classical method corresponding to the climatic conditions of the Udmurt Republic in a room where the constant temperature was at the level of 0 ... -3°C.

When conducting experiments to study the effect of dihydroquercetin, the control group received sugar syrup (1:1), and the experimental groups received an additional dose of the nutritional supplement dihydroquercetin with syrup at the rate of 5, 10, and 15 mg per bee colony. Dihydroquercetin is a white powder that dissolves in boiled water. After dissolving the powder in water, the resulting solution was added to sugar syrup at a concentration of 1:1. The bees were fed twice with a frequency of 12 days. The first time feeding was introduced during the first spring revision of bees in the composition of one kilogram of sugar syrup.

Against the background of the use of the organic preparation dihydroquercetin, economically useful features of bee colonies were analyzed, including winter hardiness and development of colonies, as well as the amount of total and marketable honey and wax products obtained.

The analysis of the winter hardiness of bee colonies was carried out according to the following criteria: the strength of the bee colonies when setting up for winter and during the first spring revision; the amount of feed honey during the formation of a bee nest for hibernation and its consumption in the winter, considering the calculation of the strength of the bee colony per bee way.

The dynamics of changes in the brood of a bee colony and its strength were determined by the method developed by V.V. Malkov, according to the number of cells occupied by the brood, using a grid frame (a 5x5 cm square includes 100 cells of bee brood). The count was carried out three times, starting from the first spring inspection every 21 days. The weight of the unmated and prolific queen, as well as the weight of a one-day-old bee, was determined on an analytical balance with the condition of subtracting the weight of the test tube.

Honey productivity was considered at the end of the main honey harvest. The yield of marketable honey was determined by weighing on a scale.

The total amount of honey harvest was determined by weighing the pumped-out honey and the honey left in the nest, as well as a safety stock of 5 kg per colony. The wax productivity was studied by the amount of built-up comb foundation during the summer season.

The data obtained were subjected to statistical processing by methods of variation statistics with verification of the reliability of the results.

RESULTS AND DISCUSSION

The main indicator of the readiness of bee colonies for honey harvest is their strength, which is determined by the number of bee ways occupied by worker bees, sitting tightly over the entire area of the honeycomb frame on both sides **(Table 1)**.

Table 1. Dynamics of bee brood in the spring/summer period, hundreds of cells

Measurement	Control group	Experimental group No. 1	Experimental group No. 2	Experimental group No. 3
1	131.6±5.87	132.5±8.03	130.1±5.89	131.2±7.54
2	243.6±10.31	257.2±11.6	267.8±7.09	286.5±9.81**
3	347.6±10.71	365.3±9.85	366.4±8.14	392.7±10.25**

Note: ** P≥0.99

A comparative analysis of the results on the growth of brood of bee colonies and the egg production of queen bees over two field years showed the same development trend. The average calculated data was 130.1-132.5 hundred cells.

By the second measurement, the maximum amount of brood had been recorded in bee colonies of the experimental group No. 3 (286.5 hundreds of cells), which is significantly more than in the control group, by 42.9 hundreds of cells, or 17.6%. In bee colonies of the experimental group No. 2, the amount of open and closed brood was higher than in the control, by 24.2 hundred cells, or 9.9%. In bee colonies of experimental group No. 1 the difference was 13.6 hundred cells or 5.6%.

The third measurement revealed the difference between the studied groups in the following expression. In the bee colonies of the experimental group No. 3, the maximum indicator is 392.7 hundreds of cells, which is also significantly (P≥0.99) more than the number of brood than in the control group by 45.1 hundreds of cells, or 13.0%, in bee colonies of the experimental group No. 2 by 18.8 hundred cells, or 5.4%, and experimental group No. 1 by 17.7 hundred cells, or 5.1%.

Honey bees *(Apis mellifera* L.*)*, unlike most other types of farm animals, not only collect feed for themselves but also process them for long-term storage and better digestibility by the body.

The main indicator confirming the efficiency of bee colonies is the amount of marketable and total honey obtained from one colony **(Table 2)**.

Table 2. The amount of marketable and total honey obtained per one bee colony

Groups	Marketable honey	C_v, %	Feed honey	C_v, %	Total honey	C_v, %
Control	14.2±1.28	10.3	22.4±0.76	6.1	36.6±1.22	11.2
Experimental No. 1	16.3±1.31	11.4	22.3±1.01	8.4	38.7±1.45	8.9
Experimental No. 2	17.7±0.99	8.1	22.0±0.84	7.2	39.7±1.77	9.2
Experimental No. 3	20.1±1.57**	10.8	22.9±0.63	6.9	43.0±2.02*	12.6

Note: * P≥0.95; ** P≥0.99

The analysis of honey productivity of bee colonies showed that the maximum indicators of honey productivity were recorded in experimental group No. 3 with 43.0 kg of honey in total and 201. kg of marketable honey. The difference with the control group, where dihydroquercetin was not used as a stimulating feeding, was 5.9 kg, or 41.5%, in the amount of marketable honey and 6.4 kg, or 17.4%, in total productivity (P≥0.99). The level of wax productivity of bee colonies of the experimental group No. 3 was maximal with 4.9 leaves of comb foundation, which is more than that of bees in the control group, by 16.6%, more than experimental group No. 2 by 9.5%, and more than experimental group No. 1 by 7.1%.

Thus, the use of a biological product in the composition of a sugar syrup had an indirect effect on the restoration of disturbed processes, an increase in the body's function. This, as a result, contributed to an increase in its resistance to unfavorable environmental factors and led to the activation of the nectar-collecting ability of bees.

One of the main economically useful traits is the ability of bee colonies to endure the period of hibernation. Bee colonies, depending on the use of different dosages of the antioxidant, set up for the winter with different levels of strength.

The degree of weakening of bee colonies, recorded during the first spring revision, in the experimental groups was in the range of 7.1-3.8%. At the same time, the control group had the largest number of weakened families (7.1%), and in experimental group No. 3 this indicator stopped at 3.8%.

Feed consumption per bee way in the analyzed groups did not differ greatly and amounted to 2.38-2.43 kg.

Thus, the use of the antioxidant preparation dihydroquercetin allows preserving a greater number of bees up to 3.3% during the hibernation period by reducing the intensity of oxidative processes and to obtain strong bee colonies in the spring period, ready for the development and weight gain of the colony for the main honey harvest.

Economic indicators are important characteristics of the production of any branch of agriculture, including the beekeeping industry.

The use of the antioxidant preparation dihydroquercetin made it possible to obtain a larger amount of beekeeping products, expressed in conventional honey units, and, accordingly, to increase the profit and the level of profitability in the experimental groups where this preparation was used. The profitability in experimental group No. 3 was 54.9%, which is higher than in the control group, by 23.4%, in experimental group No. 1 (37.5%), by 6.0%, and in experimental group No. 2 (45.9%), by 14.4%.

CONCLUSION

The analysis of performance indicators for the production of beekeeping products showed that the use of dihydroquercetin as part of sugar syrup in experimental group No. 3 contributed to an increase in the growth rate and development of bee colonies by 13%. It also contributed to the stable development of morphometric characteristics within the breed standard of bees and the realization of the genetic potential of bees inherent in this breed, as well as an increase in quantitative total production by 17.4%, which affected the increase in production profitability in general to 54.9%.

ACKNOWLEDGMENTS: None

CONFLICT OF INTEREST: None

FINANCIAL SUPPORT: None

ETHICS STATEMENT: Authors are aware of, and comply with, best practice in publication ethics specifically with regard to authorship (avoidance of guest authorship), dual submission, manipulation of figures, competing interests and compliance with policies on research ethics. Authors adhere to publication requirements that submitted work is original and has not been published elsewhere in any language.

REFERENCES

1. Vinober AV. Reasons for mass death of bees or how to avoid collapse in Russian beekeeping. Biosfernoe Khozyaistvo: Teoriya i Praktika. 2019;6(15):22-7. (In Russian)
2. Kardile D, Shirsat M. Synthesis and in Vitro Evaluation of Coupled Mercaptobenzimidazole Derivatives Used as a Potent Biological Agent. Int J Pharm Phytopharmacol Res. 2020;10(1):127-33.
3. Sabrina B, Samia M, Amina B, Ibtissem M. The Study of Tha Antioxidant Response of a Biological Model Paramecium Tetraurelia in the Presence of a Nanometric Substance the Zinc Oxide. Int J Pharm Res Allied Sci. 2020;9(4):69-76.
4. Aladina ON. Influence of anthropogenic factors on the health status of the honey bee. AkadEmicheskii Zhurnal Zapadnoi Sibiri. 2012;(4):57-8. (In Russian)
5. Brandorf AZ. The role of the genetic resource of honeybees of the Central Russian breed in the food and

environmental safety of Russia: a monograph]. Kirov: NIISKh Severo-Vostoka; 2016. (In Russian)
6. Humbatov Y. Current state and development of beekeeping in Azerbaijan. Compon Sci Technol Prog. 2015;3(25):24-7.
7. Neumann P. Honey bee colony losses. J Apic Res. 2010;49(1):1-6.
8. Liubimov AI. Use of environmentally safe preventive remedy against ascospherosis. In: International Scientific-Practical Conference of Agriculture and Food Security: Technology, Innovation, Markets, Human Resources (FIES 2019), 2020.
9. Ostroverkhova NV. On the monitoring of bee colonies in Russia. Biomika. 2016;8(2):178-81. (In Russian)
10. Requier F. Trends in beekeeping and honey bee colony losses in Latin America. J Apic Res. 2018;57(5):657-62.
11. Brandorf AZ. The role of the genetic resource of honeybees of the Central Russian breed in the food and environmental safety of Russia: a monograph. Kirov: NIISKh Severo-Vostoka; 2016. (In Russian)
12. Brandorf AZ. State, problems, and prospects for the development of beekeeping in Russia. Rybnoe: FGBNU FNTs Pchelovodstva; 2019. (In Russian)
13. Andrusevich MP. Improving the technology of honey production in apiaries. Grodno; 2016. (In Russian)
14. Gilioli G. Towards the development of an index for the holistic assessment of the health status of a honey bee colony. Ecol Indic. 2019;101:341-7.
15. Konstantinov AR. The value of feed and complete feeding in beekeeping. Vestnik VoronezhSkogo Gosudarstvennogo Agrarnogo Universiteta. 2014;3(42):94-102. (In Russian)
16. Mamontova YA. Fat content in the body of honey bees fed with stimulating feeding with buckwheat honey in combination with the Mikrovitam preparation. Evraziiskii Soyuz Uchenykh. 2015;5(14):27-9. (In Russian)
17. Vorobeva SL. Analysis of potential and elaboration of state regulation measures to improve the efficiency of beekeeping (a case study of the udmurt republic). Rev Incl. 2020;7(S2-1):88-98.
18. Bilash NG. Fortified inverted syrup: the best natural honey substitute for bees. Rybnoe: FGBNU NII pchelovodstva; 2015. (In Russian)
19. Ishmuratova NM. The influence of Befungin and Apisal preparations on early spring development of bees. Pchelovodstvo. 2016;(9):24-6.
20. Kengyel D. Towards swarm level optimization: The role of different movement patterns in swarm systems. Int J Parallel Emergent Distrib Syst. 2019;34(3):241-59.
21. Komlatskii VI. Spring feeding of bees. Sbornik Nauchnykh Trudov Severo-Kavkazskogo NII Zhivotnovodstva. 2017;6(2):183-6. (In Russian)
22. Mannapov AG. Stimulating feeding for bee colonies with the addition of complex amino acid and probiotic preparations. Vestnik Orenburgskogo Gosudarstvennogo Agrarnogo Universiteta. 2011;12(131):376-7. (In Russian)
23. Sadovnikova EF. Application of protein, vitamin and mineral supplements in bee feeding. Zapiski UO VGAVM. 2012;48(2):143-5. (In Russian)
24. Fomichev YP. Dihydroquercetin and arabinogalactan: natural bioregulators in human and animal life, use in agriculture and the food industry. Moscow: Nauchnaya Biblioteka; 2017. (In Russian)
25. Fomichev YP. Flavonoid-dihydroquercetin in human and animal nutrition and safety of agricultural products. Effektivnoe Zhivotnovodstvo. 2018;4(143):58-60. (In Russian)
26. Bazhenov BN. Antioxidant and electrochemical properties of dihydroquercetin monosuccinate, a new water-soluble derivative of natural flavonoid. Khimiya Rastitelnogo Syrya. 2013;(3):107-12. (In Russian)