Porta Universorum | Vol. 2 No. 5 (2026): Gegužė | ISSN 3030-2234
https://doi.org/10.69760/portuni.26050003

The Role of Alternative Plants in the Development Cycle of Beekeeping: A Case Study of Lavender (Lavandula angustifolia) and ProbeePlus Feed Supplement

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How to cite: Seyidzadeh, G., & Rasulova, Z. (2026). The role of alternative plants in the development cycle of beekeeping: A case study of lavender (*Lavandula angustifolia*) and ProbeePlus feed supplement. *Porta Universorum*, 2(5), 20-26. https://doi.org/10.69760/portuni.26050003

ABSTRACT

This study examines the characteristics of the non-traditional lavender plant (Lavandula angustifolia Mill.) with high nectar yield and its role in the development cycle of beekeeping. The agroecological characteristics of this plant, its flowering periods, and the mechanisms of its influence on bee productivity were analyzed from a scientific perspective. Studies show that the lavender field has a significant impact on the expansion of the food base of bee colonies, the extension of the nectar collection period, and the improvement of honey quality indicators. During the research period, the effect of applying a complex biologically active feed supplement (ProbeePlus) to the feed supply of Caucasian (Apis mellifera caucasica) honey bee colonies placed in a lavender field was studied in relation to the development dynamics and honey yield of the bees. The ProbeePlus feed supplement was added to the daily food base of the experimental group of bee colonies, and the brood area and honey yield of the colonies were analyzed comparatively using the Liebefeld method. The results demonstrate that the combined use of lavender as a nectar base and ProbeePlus as a biologically active supplement significantly enhances both colony development and honey productivity.

Keywords: Beekeeping; lavender; ProbeePlus; Liebefeld method; biodiversity; honey yield; ecosystem; *Apis mellifera caucasica*; nectar plants; feed supplement

1. INTRODUCTION

The agricultural sector, as one of the strategically important sectors of the national economy, plays an important role in ensuring food security for the population, increasing employment, and efficiently using natural resources. Beekeeping, one of the important and promising areas of livestock farming, is not limited to the production of honey and other bee products, but also plays an important role in increasing the productivity of agricultural crops by ensuring their pollination (Hajiyeva, 2019). In many countries, beekeeping is considered an area of great importance from both an economic and ecological perspective, as the activity of bees is strategically significant in terms of preserving the natural ecological balance, increasing biodiversity, and ensuring high agricultural productivity (Tahirov et al., 2019).

In recent years, habitat destruction has negatively affected crop and livestock production, becoming a serious problem for pollinators and resulting in a decrease in the floral resources available to bees. The widespread use of monocultures has significantly limited the diversity of flowering plant species within the feeding range of bees. Mass-flowering monocultures serve only as a short-term food source, and such limited food resources lead to a disruption of balanced nutrition in bees, a weakening of the immune system, and a deterioration in overall colony health (Bryś et al., 2021).

Therefore, the integration of non-traditional plants with high nectar potential into agricultural landscapes is of great importance for the sustainable development of beekeeping and for increasing productivity. Plants with the ability to bloom for a long time and consistently play an important role in providing bee colonies with a stable food source throughout the season. The natural and geographical conditions of the Republic of Azerbaijan and its rich floristic diversity create favorable conditions for the widespread distribution of nectar-bearing and pollen-bearing plants. The vegetation of the Nakhchivan Autonomous Republic is particularly notable for its richness, owing to the close connection of the local flora with that of the Caucasus, Central Asia, Western Asia, and Iran, as well as the presence of vertical zonation resulting in diverse climatic zones and landscape types (Tahirov et al., 2019).

The Caucasian honey bee (Apis mellifera caucasica) is widely used in beekeeping in Azerbaijan as one of the main breeds well adapted to local climatic conditions. This breed is distinguished by its high honey yield, calm behavior, relative disease resistance, and ability to efficiently utilize various nectar sources owing to its long proboscis (Cınbırtoğlu et al., 2019). Lavender (Lavandula angustifolia Mill.) is considered a particularly promising non-traditional plant for beekeeping, as its high nectar and pollen content stimulates bee flight activity. Lavender blooms primarily during the summer season (June–July), secreting large amounts of nectar over an extended period and supporting sustainable colony development. According to published studies, honey yields of up to 150–200 kg per hectare of cultivated lavender have been reported, varying with weather conditions, soil conditions, and harvest timing (Seyidzade, 2024). The main objective of the present study is to investigate the effect of lavender cultivation and the application of a biologically active feed supplement (ProbeePlus) on the development cycle and honey yield of Caucasian honey bee colonies.

2. MATERIALS AND METHODS

The research material comprised colonies of the Gray Caucasian honey bee (Apis mellifera caucasica), characterized by high productivity indicators, maintained at the lavender experimental field of the Academician Hasan Aliyev Nakhchivan Agricultural Scientific Research Institute.

To evaluate the development of bee colonies and honey productivity, various doses of the ProbeePlus feed additive were applied and brood area was measured using the Liebefeld method. Experimental and control groups were formed that were closely matched in terms of colony size, age structure, and strength at the start of the study. Two bee colonies included in the control group were placed in an area supporting traditional honey plants, and four bee colonies in the experimental group were divided into two sub-groups and placed in a 0.7 ha lavender experimental plot maintained by the Institute.

During the study, a stimulating feed supplement (ProbeePlus) was added to the feed ration of two of the four experimental colonies in early spring. This supplement contains lavender oil, grape seed oil, wheat germ oil, and various plant extracts. Bee colonies in both groups were kept under the same conditions, with identical feeding and veterinary care provided throughout. The only differentiating factors between the groups were the placement of experimental colonies in the lavender field and the addition of ProbeePlus (5 ml per 1 litre of sugar syrup) to the feed ration of the supplement subgroup.

This approach enabled a comparative assessment of the effects of both the lavender nectar base and the feed supplement on colony development and honey yield.

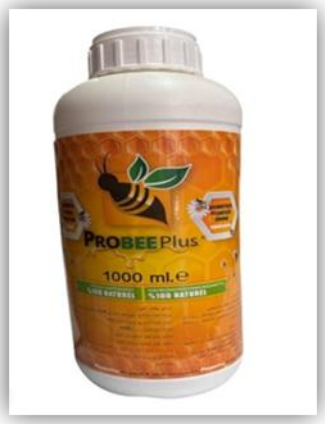

Figure 1. ProbeePlus biologically active feed supplement (1000 mL) used in the experiment.

Figure 2. Experimental bee colonies placed in the lavender field at the Nakhchivan Agricultural Research Institute.

The study was conducted over 30 days. Development indicators of bee colonies in both groups were measured using the Liebefeld method, with open and closed brood areas recorded a total of three times at 10-day intervals. Flight activity, intensity of orientation to lavender flowers, and the general biological condition of colonies were also assessed through visual observation. Honey yield was determined based on the weight of honey extracted from each colony at the end of the season.

3. RESULTS

Table 1. Brood area dynamics measured by the Liebefeld method over the 30-day study period

Measurement Period	Control Group Total Brood Area (cm²)	Experimental Group Total Brood Area (cm²)	Difference	Note
Beginning of study	14	14	0	Colonies equal at start
Day 10	16	19	+3	Increased activity in experimental group
Day 20	18	23	+5	Queen egg-laying increased
Day 30	19	26	+7	Brood area expanded rapidly

Note: Brood areas expressed as number of occupied frames assessed by the Liebefeld method. Experimental group received ProbeePlus (5 ml/L sugar syrup) and was placed in the lavender field.

Table 1 shows that at the start of the study, brood areas were equal across both groups (14 cm² equivalent). By Day 10, the experimental group recorded a brood area 3 units greater than the control, indicating an early stimulatory effect of both the lavender nectar base and the ProbeePlus supplement on queen egg-laying activity and colony development. By Day 20, the difference increased to 5 units, with significantly increased queen egg-laying noted in the experimental group. By Day 30, the experimental group showed a brood area 7 units greater than the control (26 vs. 19), confirming a marked and progressive enhancement of colony development under the combined treatment. Statistical evaluation confirmed that the ProbeePlus biologically active feed additive had a significant positive effect on the morpho-physiological development indicators of bee colonies.

Table 2. Comparison of honey productivity of bee colonies under different field conditions

Group	Area and Conditions	No. of Colonies	Honey per Colony (kg)	Average Yield (kg)
Control	Traditional honey plants	2	4–5	4.5
Experiment 1	0.7 ha lavender + feed supplement (ProbeePlus)	2	8–10	9.0
Experiment 2	0.7 ha lavender only	2	6–7	6.5

Note: Honey yield determined by weight of honey extracted at the end of the season. Experiment 1 = lavender field + ProbeePlus supplement; Experiment 2 = lavender field only; Control = traditional honey plant area.

Table 2 presents the comparative honey productivity data across the three groups. The control group, maintained on traditional honey plants, produced an average honey yield of 4.5 kg per colony. Experiment 2 colonies, placed in the lavender field without feed supplementation, achieved an average yield of 6.5 kg per colony—a 44% increase over the control. Experiment 1 colonies, which received both the lavender nectar base and the ProbeePlus supplement, achieved the highest average yield of 9.0 kg per colony—a 100% increase over the control and a 38% increase over the lavender-only group.

These results demonstrate that the lavender plant possesses high nectar and pollen potential, and its integration into beekeeping operations improves both development indicators and productivity by increasing the availability of quality food resources for bee colonies. The additional enhancement observed in Experiment 1 confirms that the ProbeePlus supplement acts synergistically with the lavender nectar base to further stimulate colony development and honey yield (Radev, 2023; Hajiyev & Seyidova, 2024).

4. DISCUSSION

The results of this study are consistent with the growing body of literature demonstrating the beneficial effects of integrating non-traditional, high-value nectar plants into beekeeping operations (Gurbanov & Mammadov, 2025; Seyidzade, 2024). The significant improvement in brood area observed in the experimental group under the combined lavender–ProbeePlus treatment reflects enhanced queen productivity and improved nutritional status of the colony, both of which are known to be positively influenced by the availability of diverse, high-quality pollen and nectar sources (Bryś et al., 2021; Cınbırtoğlu et al., 2019).

Lavender offers several properties that make it particularly well-suited as a supplementary nectar plant in the Nakhchivan context. Its extended flowering period (June–July), high nectar secretion rates, and nutritionally valuable pollen provide colonies with a stable and sustained food source during the critical summer period when traditional honey plants may already be declining. The linalool and linalyl acetate compounds in lavender essential oil, which confer its medicinal and aromatic properties, may also contribute to improved colony health through antimicrobial effects (Radev, 2023; Seyidzade, 2024). The ProbeePlus supplement, containing lavender oil, grape seed oil, wheat germ oil, and plant extracts, appears to complement the field-derived nutrition by providing concentrated biologically active compounds that further stimulate queen egg-laying and colony metabolism.

The magnitude of the observed productivity gains—a 100% increase in average honey yield in the combined treatment group compared to the control—suggests that the integration of lavender cultivation with targeted nutritional supplementation represents a highly cost-effective strategy for improving beekeeping outcomes. These findings have practical implications for beekeeping operations in the Nakhchivan Autonomous Republic and similar agroecological contexts, where the diversification of agricultural landscapes with high-value nectar plants could simultaneously support pollinator populations, enhance agricultural productivity through improved crop pollination, and increase the economic returns of beekeeping enterprises (Tahirov et al., 2019; Hajiyeva, 2019).

5. CONCLUSION

This study demonstrates that the combined application of lavender (Lavandula angustifolia Mill.) as a non-traditional honey plant and the ProbeePlus biologically active feed supplement significantly enhances the development cycle of bee colonies and improves honey productivity in Caucasian honey bees (Apis mellifera caucasica). The experimental results show that bee colonies placed in lavender fields and supplemented with ProbeePlus achieved a 100% increase in average honey yield compared to control colonies maintained on traditional honey plants, and a 38% increase compared to colonies placed in the lavender field without supplementation.

Brood area measurements using the Liebefeld method confirmed a progressive and statistically significant increase in colony development in the experimental groups, indicating enhanced queen egg-laying activity and improved nutritional status. The findings underscore the importance of expanding non-traditional, high-value nectar plant cultivation in agricultural landscapes as a strategy for

supporting sustainable beekeeping development. This approach increases ecological sustainability by expanding food base diversity for bee colonies, extends the effective nectar collection period, and improves the quality and quantity of honey production.

The integration of lavender cultivation with targeted nutritional supplementation is recommended as a practical and economically viable strategy for beekeeping operations in the Nakhchivan Autonomous Republic and analogous agroecological contexts. Future research should investigate optimal lavender cultivation densities, the long-term effects of extended ProbeePlus supplementation, and the potential contribution of lavender cultivation to broader ecosystem services including crop pollination and biodiversity enhancement.

DECLARATIONS

Conflict of Interest Statement: The authors declare that there is no conflict of interest in the conduct and reporting of this study.

Funding Statement: This research received no external funding from any public, commercial, or not-for-profit funding agency.

Authors' Contributions: Gunel Seyidzadeh: conceptualization, experimental design, data collection, analysis, writing – original draft, and final editing. Zeynab Rasulova: data collection, laboratory procedures, and writing. Both authors have read and approved the final version of the manuscript.

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Received: 8 February 2026
Accepted: 30 April 2026
Published: 1 May 2026