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# INFLUENCE OF STIMULATIVE FEEDING OF NURSE BEES ON ROYAL JELLY PRODUCTION

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***Abstract.*** *The study evaluated the influence of stimulative feeding of nurse bees on royal jelly production in the absence of a maintenance nectar flow. Four groups of queenless rearing colonies were formed and administered 50% sugar syrup supplemented with the biostimulant MF-SIB-49 at doses of 1.0, 2.0 and 3.2 mL/L, while the control group received pure sugar syrup. Frames with 45, 90 and 135 grafted larvae were introduced over three production cycles, and larval acceptance, queen-cell diameter and length, queen-cell mass with larva and royal jelly, and royal jelly yield per queen cell and per colony were assessed. The best overall results were obtained in the group fed with 2.0 mL/L biostimulant, where the total amount of royal jelly reached 66.144 g over three cycles, representing 45.4% more than in the control group. The results show that the stimulative feeding can improve larval acceptance, queen-cell development and royal jelly yield, especially when administered at an optimal dose during the larval rearing period. Following the evaluation, it was found that, in the absence of a maintenance nectar flow, feeding nurse bees with a mixture of sugar syrup and biostimulant stimulates royal jelly secretion, which is necessary for the development of grafted larvae.*

***Keywords:*** *royal jelly, nurse bees, stimulative feeding, biostimulant, larval acceptance*

## INTRODUCTION

Royal jelly is a substance secreted by the hypopharyngeal and mandibular glands of young worker bees (also called nurse bees), aged between 3 and 12 days. It is used to feed larvae during the first three days of life, larvae destined to become queens throughout their entire larval development period, as well as adult queens [1, 2].

Sugar syrup [3], various nutrient compositions, alkaline pollen hydrolysate and 50% sugar syrup [4], pollen or pollen substitutes [1] are used for feeding bees.

In royal jelly production, the Nicot system is used with several components, including the cell-cup holder fixing cap, cell-cup holder and cell cup, which are used for obtaining royal jelly [5].

In practice, royal jelly can also be obtained without queenlessness of the bee colony. In this way, approximately 250 mg of royal jelly per queen cell, about 15 g per production cycle and, depending on preparation and skill, up to 1 kg per season from 8–10 bee colonies can be obtained. Royal jelly is preserved only by freezing or lyophilization [6].

The authors reported an acceptance rate of 71.86% and production indicators of 213.15 mg/queen cell and 6.88 g/colony per application, with a total of 34.40 g/colony in their production scheme [7].

It has been noted that royal jelly yield depends on the biological condition of the rearing colony, the density of nurse bees, the age of transferred larvae, the number of queen cells, the harvesting time and the available nutritional resources. Standard methods for royal jelly research recommend reporting the origin of samples, production conditions, harvesting time and quality parameters, because these factors influence both product quantity and composition [8]. A comparative analysis of royal jelly obtained from colonies fed with sugar syrup or honey showed clear differences in the carbohydrate profile: fructose reached 2.6 g/100 g in samples from syrup-fed bees, compared with 4.1 g/100 g in honey-fed bees, while sucrose was 7.5 g/100 g compared with 2.7 g/100 g [9].

The central role belongs to nurse bees, because their hypopharyngeal and mandibular glands secrete royal jelly, and the functioning of these glands depends on bee age, protein and sugar intake, as well as on the

physiological condition of the whole bee colony. It has been demonstrated that pollen diet influences both hypopharyngeal gland development and the expression of genes involved in royal jelly biosynthesis. Thus, *Brassica napus* pollen led to better development of these glands and increased expression of the mrjp1 gene. At the same time, pollen consumption increased the expression of the cyp450 6AS8 gene, associated with 10-HDA biosynthesis. Under the controlled experimental system, a positive correlation was found between the number of worker bees and the total amount of royal jelly produced [10].

The transfer of young larvae into artificial queen cells remains the main method for obtaining royal jelly under controlled conditions. In Kenya, it was reported that larval age, supplementary feeding and the interval between grafting and harvesting significantly influenced queen-cell acceptance and yield: 24-hour-old larvae showed 74.5% acceptance and 419.5 mg/queen cell, whereas in 36-hour-old larvae the values decreased to 58.5% and 356.8 mg/queen cell, respectively; in 48–60-hour-old larvae, production reached about 181.5 mg/queen cell. Supplementary feeding increased production to 6.1–6.3 g/colony, compared with 2.9 g/colony in the control [11].

It has been highlighted that harvesting time significantly influences both the quantity and mineral composition of royal jelly. Thus, the highest amount of royal jelly was obtained at 72 hours, with 318.5 mg per queen cell, compared with only 70.4 mg/queen cell at 24 hours [12].

The number of queen cells introduced into a rearing colony is an optimization factor. It was observed that in colonies specialized for royal jelly production, total production per colony increased as the number of strips with queen cells increased. At the same time, the mean amount per queen cell decreased under high loading, and the 10-HDA content decreased from 2.01% to 1.52%, confirming that overloading the colony may increase total production but may affect product quality [13]. This aspect is also supported by the experience of Chinese intensive production systems, where high yield is based on productive biological material, strong colonies, rigorous organization of queen cells and repeated harvesting cycles [14].

Feeding, larval age and queenlessness are important technological factors for royal jelly production [15], while the role of colony condition and larval origin on acceptance has also been emphasized [16]. A comparative study on bee races showed that the Italian honey bee had a maximum acceptance of 75.53% and 13.10 g royal jelly/colony, compared with 58.20% and 9.66 g in the Carniolan race; in addition, cups primed with royal jelly increased acceptance up to 81.16% and production up to 245.52 mg/queen cell in the Italian bee, compared with 26.00% in the dry control [17].

Stimulative feeding represents a particularly important technological component during periods without a maintenance nectar flow. Research has shown that feeding with honey, sugar syrups or nutritional supplements can modify larval acceptance and yield, as well as the carbohydrate, mineral and biochemical profile of royal jelly [9, 18, 19].

In comparisons between different carbohydrate sources, the effects depended on sugar type, location and available natural resources, and some studies did not identify major yield differences between sucrose, glucose and commercial syrups, although location and production conditions influenced acceptance and production [7, 20]. In addition to classical carbohydrate sources, interest remains in stimulants and additives capable of supporting the physiological activity of nurse bees; nutritional supplements and artificial diets have been associated with changes in yield and in certain quality indicators [21, 22]. In this context, the evaluation of a biostimulant administered in 50% sugar syrup is scientifically and practically justified, especially when the technology aims simultaneously to increase larval acceptance, queen-cell development and the amount of royal jelly obtained per queen cell, per production cycle and over the total number of cycles.

Studying ways to diversify biologically active substances that stimulate royal jelly production is of scientific and practical interest.

The aim of the research is to evaluate the influence of stimulative feeding of nurse bees on increasing larval acceptance for rearing, the dimensions of queen cells (diameter, length, mass of the queen cell with royal jelly

and larva), as well as the amount of royal jelly obtained from one queen cell, in one production cycle and in total over three production cycles.

## MATERIALS AND METHODS

For the experiments, four groups of rearing bee colonies were formed at the apiary in Cojușna village, Strășeni district, Republic of Moldova, using the complete queenlessness method by removing the queen and 2–3 combs with unsealed brood, thus depriving the colonies of the possibility of rearing their own queens.

In the absence of a maintenance nectar flow, which was confirmed in the current year by the lack of nectar flow from black locust and linden, the rearing bee colonies were administered one liter of a mixture of 50% sugar syrup and the biostimulant (MF-SIB-49): group I – 1.0 mL/L, group II – 2.0 mL/L, group III – 3.2 mL/L, group IV (control) – pure sugar syrup. In the first production cycle, one standard frame (435 × 300 mm) with three bars was introduced into the rearing colonies; Nicot elements (queen cells) were fixed on the bars, 45 in total, into which 8–12-hour-old larvae were grafted. In the second production cycle, two frames with 90 grafted larvae were provided, and in the third production cycle, three frames with 135 grafted larvae were provided. Nurse bees received daily one liter of a mixture of sugar syrup and biostimulant, starting from the introduction of frames with grafted larvae and for three consecutive days, until the day when the frames with queen cells were removed for royal jelly harvesting. This procedure was applied during the second and third production cycles.

During the experiments on royal jelly collection, the following indicators were studied: percentage of larval acceptance for rearing, diameter, length and mass of queen cells with royal jelly and larva, amount of royal jelly obtained from one queen cell and from one nurse colony per production cycle, as well as the total amount obtained over three production cycles.

The obtained data were processed using a computer program, applying the method of variation statistics.

## RESULTS AND DISCUSSIONS

The experimental bee colonies had 14–16 combs each, colony strength of 13–14 inter-frame spaces occupied by bees, a honey reserve of 2.0 kg and 6–7 combs with sealed brood. In the first production cycle, the nurse colonies were given one frame with 45 grafted larvae aged 10–12 hours, which was introduced between the combs with sealed brood.

The research results showed that in the first production cycle, when 45 grafted larvae were provided to the experimental rearing colonies, 32 larvae were accepted in group I and 31 larvae in group II, or 17.78% and 15.56% more than in the control group IV (Table 1).

*Table 1.*

Productive indicators of rearing colonies, number of grafted and accepted larvae, 13.06.2025 (I grafting)

| Group | No. of combs, pcs. | Colony strength, inter-frame spaces | Honey reserve, kg | No. of brood combs, pcs. | No. of larvae grafted, pcs. | No. of larvae accepted | |
|---|---|---|---|---|---|---|---|
| | | | | | | pcs. | % |
| I-Sugar syrup + biostimulant, 1.0 mL/L | 15 | 14 | 2 | 7 | 45 | 32 | 71.11 |
| II-Sugar syrup + biostimulant, 2.0 mL/L | 14 | 13 | 2 | 6 | 45 | 31 | 68.89 |

| Group | No. of combs, pcs. | Colony strength, inter- | Honey reserve, kg | No. of brood combs, pcs. | No. of larvae grafted, pcs. | No. of larvae accepted | |
|---|---|---|---|---|---|---|---|
| III-Sugar syrup + biostimulant, 3.2 mL/L | 15 | 14 | 2 | 7 | 45 | 20 | 44.44 |
| IV-Pure sugar syrup (control) | 16 | 14 | 2 | 6 | 45 | 24 | 53.33 |

It was found that the diameter of queen cells in experimental group II averaged 11.4 mm (0.9%), while queen-cell length was 30.41 mm, or 2.31 mm (8.22%) greater than in the control group IV, the difference being statistically significant – ***B3 ≥ 0.999. The mass of queen cells with larvae and royal jelly averaged 1.404 g, or 5.25% higher than in the control group (Table 2).

*Table 2.*

Queen-cell indicators and amount of royal jelly obtained, 13–16.06.2025
(I grafting, 45 larvae)

| Group | Indicators | Queen-cell diameter, mm | Length of queen cells, mm | Mass of queen cell with larva and royal jelly, g | Amount of royal jelly obtained from one queen cell, g | Total amount of royal jelly obtained, g |
|---|---|---|---|---|---|---|
| I-Sugar syrup + biostimulant, 1.0 mL/L | $\bar{X} \pm S\bar{x}$ | 10.62±0.092 | 26.6±0.928 | 1.236±0.019 | 0.407±0.010 | 13.024 |
| | V, % | 4.74 | 6.74 | 8.43 | 12.58 | - |
| II-Sugar syrup + biostimulant, 2.0 mL/L | $\overline{X} \pm S\bar{x}$ | 11.4±0.100 | 30.41±0.384 *** | 1.404±0.020 | 0.454±0.011 | 14.074 |
| | V, % | 4.02 | 5.79 | 6.58 | 10.85 | - |
| III-Sugar syrup + biostimulant, 3.2 mL/L | $\overline{X} \pm S\bar{x}$ | 11.02±0.069 | 26.68±0.454 | 1.260±0.020 | 0.433±0.011 | 8.660 |
| | V, % | 2.82 | 7.61 | 6.98 | 11.76 | - |
| IV-Pure sugar syrup (control) | $\overline{X} \pm S\bar{x}$ | 11.3±0.108 | 28.10±0.509 | 1.334±0.027 | 0.429±0.014 | 10.296 |
| | V, % | 4.29 | 8.09 | 9.18 | 14.15 | - |

*** Queen-cell length: group II / group IV – ***B3 ≥ 0.999

From one queen cell in experimental group II, an average of 0.454 g of royal jelly was obtained, or 5.83% more than in the control group. The highest amount of royal jelly was obtained from group II – 14.074 g, or 3.778 g (36.69%) more than in the control group.

The coefficient variation of the studied indicators ranged between 2.82% (queen-cell diameter) and 14.15% (amount of royal jelly obtained from one queen cell).

Thus, in the first production cycle, when one frame with 45 grafted larvae was provided and nurse bees were fed, larval acceptance increased by 15.56–17.78%, queen-cell development improved (diameter – by 0.88%, length – by 8.22%, mass of queen cells with larva and royal jelly – by 5.25%), the amount of royal jelly obtained from one queen cell increased by 5.83%, and the total amount increased by 36.69%.

In the second production cycle, two frames were introduced into the experimental colonies (45 larvae each), totaling 90 grafted larvae.

The research results showed that in the second production cycle, when a higher number of larvae (90 pcs.) was administered, 51 and 50 larvae were accepted in experimental groups I and II, respectively, representing 56.7% and 55.6% of the total number, or 2.3% and 1.2% more than in the control group (Table 3).

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*Table 3.*

Number of grafted and accepted larvae, 16–19.06.2025 (II grafting)

| Group | No. of grafted larvae, pcs. | No. of accepted larvae | |
|---|---|---|---|
| | | pcs. | % |
| I-Sugar syrup + biostimulant, 1.0 mL/L | 90 | 51 | 56.7 |
| II-Sugar syrup + biostimulant, 2.0 mL/L | 90 | 50 | 55.6 |
| III-Sugar syrup + biostimulant, 3.2 mL/L | 90 | 37 | 41.1 |
| IV-Pure sugar syrup (control) | 90 | 49 | 54.4 |

The diameter of queen cells obtained in the experimental groups averaged between 10.3 and 10.6 mm, or 2.4–5.4% greater than in the control group (*B1 ≥ 0.95 – ***B3 ≥ 0.999); length ranged from 22.40 to 24.4 mm (4.3–13.4%) and the mass of queen cells with larva and royal jelly from 0.981 to 1.097 g (4.4–16.7%) (***B3 ≥ 0.999), the difference being statistically significant.

The amount of royal jelly obtained from one queen cell in the experimental groups averaged 0.360–0.448 g, or 3.7–29.1% higher than in the control group. The total amount of royal jelly in experimental groups I and II was 20.145–22.400 g, or 3.142–5.397 g more than in the control group (Table 4). The coefficient of variation ranged between 2.64% (queen-cell diameter) and 22.92% (amount of royal jelly obtained from one queen cell).

Therefore, increasing the number of frames (2), the number of larvae (90 pcs.) and stimulating nurse bees with 50% sugar syrup supplemented with the biostimulant increased larval acceptance for rearing by 1.2–2.3%, queen-cell diameter by 2.4–5.4%, queen-cell length by 4.3–13.4%, mass of queen cells with larvae and royal jelly by 4.4–16.7%, the amount of royal jelly obtained from one queen cell by 3.7–29.1%, and the total amount of royal jelly by 3.142–5.397 g compared with the control group.

*Table 4.*

Queen-cell indicators and amount of royal jelly obtained, 16–19.06.2025
(II grafting, 90 larvae)

| Group | Indicators | Queen-cell diameter, mm | Length of queen cells, mm | Mass of queen cell with larva and royal jelly, g | Amount of royal jelly obtained from one queen cell, mg | Total amount of royal jelly obtained, g |
|---|---|---|---|---|---|---|
| I-Sugar syrup + biostimulant, 1.0 mL/L | $\bar{X} \pm S\bar{x}$ | 10.6±0.065 *** | 24.2±0.204 *** | 1.088±0.017 *** | 0.395±0.012** | 20.145 |
| | V, % | 3.34 | 4.61 | 8.75 | 16.0 | - |
| II-Sugar syrup + biostimulant, 2.0 mL/L | $\overline{X} \pm S\bar{x}$ | 10.50±0.059 *** | 24.40±0.212 *** | 1.097±0.019 *** | 0.448±0.007 *** | 22.400 |
| | V, % | 3.15 | 4.83 | 9.86 | 8.21 | - |
| III-Sugar syrup + biostimulant, 3.2 mL/L | $\overline{X} \pm S\bar{x}$ | 10.3±0.049* | 22.44±0.203 | 0.981±0.010 | 0.360±0.008 | 13.320 |
| | V, % | 2.64 | 5.03 | 5.94 | 11.94 | - |
| IV-Pure sugar syrup (control) | $\overline{X} \pm S\bar{x}$ | 10.06±0.085 | 21.52±0.477 | 0.94±0.033 | 0.347±0.016 | 17.003 |
| | V, % | 4.25 | 11.08 | 17.60 | 22.92 | - |

***Queen-cell diameter: group I / group IV – ***B3 ≥ 0.999; group II / group IV – ***B3 ≥ 0.999; group III / group IV – *B1 ≥ 0.95.
*** Queen-cell length: group I / group IV – ***B3 ≥ 0.999; group II / group IV – ***B3 ≥ 0.999.
***Mass of queen cell with larva and royal jelly: group I / group IV – ***B3 ≥ 0.999; group II / group IV – ***B1 ≥ 0.999.
*** Amount of royal jelly obtained from one queen cell: group I / group IV – **B2 ≥ 0.99; group II / group IV – ***B3 ≥ 0.999.

In the third production cycle, three frames with 45 queen cells containing grafted larvae were introduced (135 pcs. in total). It was found that, out of the total number of 135 grafted larvae provided for rearing, the highest number was accepted in group I – 107 pcs., or 79.3% of the total. As the dose increased, the percentage of accepted larvae decreased to 43.7% (group III) (Table 5).

*Table 5.*

Number of grafted and accepted larvae, 19–22.06.2025 (III grafting)

| Group | No. of grafted larvae, pcs. | No. of accepted larvae | |
|---|---|---|---|
| | | pcs. | % |
| I-Sugar syrup + biostimulant, 1.0 mL/L | 135 | 107 | 79.3 |
| II-Sugar syrup + biostimulant, 2.0 mL/L | 135 | 69 | 51.1 |
| III-Sugar syrup + biostimulant, 3.2 mL/L | 135 | 59 | 43.7 |
| IV-Pure sugar syrup (control) | 135 | 60 | 44.4 |

On the third day, queen-cell diameter in the experimental groups averaged 10.51–10.88 mm, or 2.4–6.0% greater than in the control group (*B1 ≥ 0.95 – ***B3 ≥ 0.999); queen-cell length in group II was 25.07 mm (5.9%), and the mass of queen cells with larvae and royal jelly was 1.170 g (18.7%).

The highest amount of royal jelly obtained from one queen cell was recorded in group II, where it averaged 0.430 g, or 41.9% more than in the control group, the difference being statistically significant (***B3 ≥ 0.999). Also, the highest total amount of royal jelly was obtained from group II – 29.670 g, or 63.20% more than in the control group (Table 6).

*Table 6.*

Queen-cell indicators and amount of royal jelly obtained, 19–22.06.2025

(III grafting, 135 larvae)

| Group | Indicators | Queen-cell diameter, mm | Length of queen cells, mm | Mass of queen cell with larva and royal jelly, g | Amount of royal jelly obtained from one queen cell, mg | Total amount of royal jelly obtained, g |
|---|---|---|---|---|---|---|
| I-Sugar syrup + biostimulant, 1.0 mL/L | $\overline{X} \pm S\overline{x}$ | 10.54±0.073** | 23.44±0.303 | 0.936±0.011 | 0.251±0.008 | 26.857 |
| | V, % | 4.68 | 8.68 | 7.67 | 22.51 | - |
| II-Sugar syrup + biostimulant, 2.0 mL/L | $\overline{X} \pm S\overline{x}$ | 10.88±0.066 *** | 25.07±0.307 ** | 1.170±0.029 *** | 0.430±0.013 *** | 29.670 |
| | V, % | 4.07 | 8.20 | 16.80 | 20.43 | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| III-Sugar syrup + biostimulant, 3.2 mL/L | $\overline{X} \pm S\bar{x}$ | 10.51±0.092* | 23.53±0.433 | 1.031±0.027 | 0.349±0.012** | 20.591 |
| | V, % | 4.88 | 10.24 | 14.58 | 18.38 | - |
| IV-Pure sugar syrup (control) | $\overline{X} \pm S\bar{x}$ | 10.26±0.060 | 23.68±0.423 | 0.986±0.016 | 0.303±0.010 | 18.180 |
| | V, % | 3.36 | 10.27 | 9.08 | 18.67 | - |

**Queen-cell diameter: group I / group IV – **B2 ≥ 0.99; group II / group IV – ***B3 ≥ 0.999;
group III / group IV – *B1 ≥ 0.95.
*** Queen-cell length: group II / group IV – **B2 ≥ 0.99.
**Mass of queen cell with larva and royal jelly: group II / group IV – ***B3 ≥ 0.999.
*** Amount of royal jelly obtained from one queen cell: group II / group IV – ***B3 ≥ 0.999;
group III / group IV – **B2 ≥ 0.99.

The coefficient variation of the studied indicators ranged between 3.36% (queen-cell diameter) and 22.51% (amount of royal jelly obtained from one queen cell).

It was found that the highest amount of royal jelly (29.670 g) was obtained in group II, which received a mixture of sugar syrup with 2.0 mL/L biostimulant.

Feeding nurse bees during the larval rearing period for three days with one liter of a mixture of sugar syrup and 2.0 mL/L biostimulant increased royal jelly production by 11.49 g, or 63.20% more than in the control group. The obtained data confirm that supplementary feeding ensures an increase in royal jelly obtained from one queen cell and per production cycle, showing superior results compared with previous data [23, 24].

In total, over three production cycles, the introduction into rearing colonies of frames with 45, 90 and 135 grafted larvae, 270 pcs. in total, and feeding nurse bees with a mixture of sugar syrup and biostimulant at a dose of 1.0–2.0 mL/L increased the number of grafted larvae accepted for rearing by 6.3–21.1%, or by 7.4% more than our previous data [25].

It was found that, in total over three production cycles, the queen-cell dimensions were as follows: diameter averaged 10.59–10.93 mm in the experimental groups, or 0.47–3.7% more than in the control group; length was 24.75–26.63 mm, or 1.31–9.01%, respectively; and the mass of the queen cell with larva and royal jelly was 1.224 g, or 12.6%. The highest mean amount of royal jelly obtained from one queen cell was recorded in group II, reaching 0.444 g, which represents an increase of 23.3% compared with the control group (Table 7).

*Table 7.*

Diameter, length, mass of queen cell with larva and royal jelly, and amount of royal jelly obtained from one queen cell, on average over 3 production cycles (13–16; 16–19 and 19–22.06.2025)

| **Group** | **Queen-cell diameter** | | **Length of queen cells** | | **Mass of queen cell with larva and royal jelly** | | **Total amount of royal jelly obtained from one queen cell** | |
|---|---|---|---|---|---|---|---|---|
| | mm | % | mm | % | g | % | g | % |
| I-Sugar syrup + biostimulant, 1.0 mL/L | 10.59 | +0.47 | 24.75 | +1.31 | 1.087 | 0 | 0.351 | 97.5 |
| II-Sugar syrup + biostimulant, 2.0 mL/L | 10.93 | +3.7 | 26.63 | +9.01 | 1.224 | +12.6 | 0.444 | 123.3 |
| III-Sugar syrup + biostimulant, 3.2 mL/L | 10.61 | +0.66 | 24.22 | -0.86 | 1.091 | 0 | 0.381 | 105.8 |
| IV-Pure sugar syrup (control) | 10.54 | 0 | 24.43 | 0 | 1.087 | 0 | 0.360 | 100.0 |

It was found that, over three production cycles, the total amount of royal jelly obtained from the rearing colonies in the experimental groups ranged between 60.023 g and 66.144 g, representing an increase of 32.0–

45.4% compared with the control group. It was also found that the highest amount of royal jelly (66.144 g) over the three production cycles was collected from the bee colonies in group II (Table 8).

*Table 8.*

Number of grafted larvae and amount of royal jelly obtained over three production cycles (13–16; 16–19 and 19–22.06.2025)

| Group | Number of larvae grafted per production cycle/accepted | | | Total number of larvae provided/ accepted/% | Number of larvae grafted per production cycle / amount of royal jelly obtained, g/% | | | Total amount of royal jelly obtained, g | Difference compared with the control group | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 45 | 90 | 135 | | 45 | 90 | 135 | | g | % |
| I-Sugar syrup + biostimulant, 1.0 mL/L | 32 | 51 | 107 | 270/190/70.4 | 13.024/ 126.5 | 20.145/ 118.5 | 26.857/ 147.7 | 60.026 | +14.547 | 132.0 |
| II-Sugar syrup + biostimulant, 2.0 mL/L | 31 | 50 | 69 | 270/150/55.6 | 14.074/ 136.7 | 22.400/ 131.7 | 29.670/ 163.2 | 66.144 | +20.665 | 145.4 |
| III-Sugar syrup + biostimulant, 3.2 mL/L | 20 | 37 | 59 | 270/116/43.0 | 8.660/ 84.1 | 13.320/78.3 | 20.591/ 113.3 | 42.571 | 2.900 | 93.6 |
| IV-Pure sugar syrup (control) | 24 | 49 | 60 | 270/133/49.3 | 10.296/ 100.0 | 17.003/ 100.0 | 18.180/ 100.0 | 45.479 | - | 100.00 |

It was evaluated that the optimal dose of biostimulant used in nurse-bee nutrition is 2.0 mL/L of sugar syrup. It is administered daily for three days, starting from the introduction of frames with grafted larvae until the removal of frames with queen cells for royal jelly collection. Subsequently, the procedure is repeated in three production cycles.

## CONCLUSIONS

Following the evaluation, it was found that, in the absence of a maintenance nectar flow, feeding nurse bees with a mixture of sugar syrup and biostimulant stimulates royal jelly secretion, which is necessary for the development of grafted larvae. This leads to an increase in the number of grafted larvae accepted for rearing, improvement of queen-cell development parameters (length, diameter, mass of the queen cell together with royal jelly and larva), as well as an increase in the amount of royal jelly obtained from a single queen cell, both per production cycle and in total over three production cycles. The total amount of royal jelly obtained from one bee colony over the three production cycles was 66.0 g, or 32.0–45.4% more than in the control group.

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