
THE QUALITY OF BEE QUEENS OBTAINED BY DIFFERENT METHODSS

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Abstract. Honeybees can only live and work in a bee colony. There is normally only one queen bee in a standard bee colony. It is the colony's only fully matured female and the mother of a young queen, drone, and worker bees. When a bee colony loses its queen bee and is unable to reproduce a new one, it eventually dies. Timely change of queen bees every 2 years, as well as increasing and maintaining the strength of bee colonies are the main zootechnical measures to maintain optimal life of bees and get the maximum amount of products from them. The presence of the queen bee in the bee colony of honey bees fully influences their flight activity in collecting bee pollen. In its absence, the harvesting of pollen and its processing, as well as the extraction of wax and the construction of honeycombs, the cultivation of brood, and the collection of nectar are significantly slowed down and then completely stopped. With the appearance of the queen bee, all the functions of the colony as a whole biological system are restored. Therefore, the quality of queens is a determining factor in the viability and productivity of the bee colony. The aim of the study was to compare the quality of reproductive function of queen bees of *Apis mellifera sassimai* and *Apis mellifera carpatica* breeds under different methods of their obtaining and the impact on the productivity of the bee colony. To carry out the experimental work in the apiary, three control groups and two experimental groups were formed, with nine bee colonies in each group. In the first group, the queen bees were artificially raised in the nursery, in the second group – fistulous queen bees, and in the third - the swarm queen bees. The apiary is located on a 50x50 meter plot of land. Hives are used to keep bee colonies. Bees are kept in the apiary of the Ukrainian field breed. A pollinating honey area is available at the apiary. A winter house, a mobile vehicle, and a suitable chamber for honey pumping are all available at the apiary. Mustard is sown around the apiary every year. According to the study, big full-

fledged queen bees are born in a healthy, physiologically complete bee colony. When the strength of a bee colony was increased, the queen bees were born 30 mg lighter. If the bees bring nectar and pollen during the raising process, the queen bees are born large, if without the flow – small and with low economic qualities. Even with a weak supply of nectar (200-300 g of nectar and pollen per day), a positive effect on the quality of hatched queens was observed. Fistulous queen bees had higher egg production compared to swarm in the same conditions of colony development.

Keywords: bees, queen bees, productivity, reproductive function

Introduction.

Honeybees can only live and work in a bee colony. There is normally only one queen bee in a standard bee colony. It is the colony's only fully matured female and the mother of a young queen, drone, and worker bees. When a bee colony loses its queen bee and is unable to reproduce a new one, it eventually dies. The queen bees have a sting, which they use during fights with other queens and when laying eggs.

The queen bee is much larger than a worker bee and longer than a drone but not as thick as he is. Her wings are longer than those of bees and drones. The movements are slow, although if necessary, she can run very fast. Day and night, she searches for honeycombs prepared by bees and lays eggs in them. She is constantly surrounded by young bees (retinue). They feed the queen bee with milk they produce, lick it and remove or eat its excrement. The egg production by queen bees depends on the strength of the colony. In a strong colony, the queen bee is larger, feeding is better, so it produces more eggs.

The queen bee lays an egg in a honeycomb, cleaned of dust, old cocoons, and licked by young bees. She will not lay an egg in a dirty cell.

In a strong colony, where bees rebuild many cells, the queen bee can lay 2–3 thousand eggs a day. In a weak colony less, about

1–2 thousand eggs. Sometimes a good queen bee lays 2–3 eggs in a cell if there are few clean cells. In this case, the bees leave only one egg, destroying the excess.

Analysis of recent researches and publications.

The presence of the queen bee in the bee colony of honey bees fully influences their flight activity in collecting bee pollen. In its absence, the harvesting of pollen and its processing, as well as the extraction of wax and the construction of honeycombs, the cultivation of brood, and the collection of nectar are significantly slowed down and then completely stopped. With the advent of the queen bee, all the functions of the colony as a whole biological system are restored (Niño et al., 2012).

Timely change of queen bees every 2 years, as well as increasing and maintaining the strength of bee colonies are the main zootechnical measures to maintain optimal life of bees and get the maximum amount of products from them (Mishchenko et al., 2020).

Reducing the intensity of work or their complete cessation in the absence of the queen bee is an important biological adaptive response of bee colonies, which allows maintaining the strength and ability of bees to grow large numbers of brood (Rangel et al., 2016; Walsh et al., 2016).

Regarding the age of the queen bee and the harvesting activity of bees, the survey shows that the age of the queen bee and the activity of collecting bee pollen are directly related: the younger the age of the queen bee, the greater the collecting activity, the more bee pollen comes to colonies (Mishchenko et al., 2020). The species composition and weight of the pollen collected by bees are influenced by many factors, primarily the number and variety of plant pollen in nature, the formation of which depends less on climatic conditions than nectar productivity of plants (Urcan et al., 2017; Radev, 2018).

The first question that arises when choosing queens concerns the optimal timing of their use. Some believe that queens in bee colonies should be replaced every year, others suggest doing so for the 2nd or even 3rd year. However, it should be borne in mind that depending on natural conditions, in particular, the duration of the active period, as well as the strength of the bee colony, the intensity of egg-laying and breeding characteristics of queens, the timing of their effective use will be different. If the active period of life of the colony and the oviposition of the queen bee is short, the colony is weak and the queen bee lays about 75–100 thousand eggs a year, then its physiological age will come later. On the contrary, during a long active period in strong colonies, the queen bee can lay 150–200 thousand eggs per season. In this case, the body of the queen bee wears out faster and physiological old age comes earlier (Mishchenko et al., 2020).

The aim of the study was to compare the quality of reproductive function in queen bees of *Apis mellifera sossimai* and *Apis mellifera carpatica* breeds with different methods of obtaining them and the impact on the productivity of the bee colony.

Materials and methods of researches.

The apiary is located on a plot of land measuring 50x50 meters. Beehives with 20 frames are used to keep bee colonies. Bees are kept in the apiary of the Ukrainian field breed. The apiary has a honey-pollination direction. A winter house, a mobile vehicle, and a suitable chamber for honey pumping are all available at the apiary. Mustard is sown around the apiary every year.

To carry out experimental work in the apiary, three control groups and two experimental groups were formed, with nine bee colonies in each group (Table 1).

In the first group, the queen bees were artificially raised in the nursery, in the second group – fistulous queen bees, and in the third – swarm queen bees.

1. The experimental design

Group	Number of bee colonies
1 – control	9
2 – experimental	9
3 – experimental	9

Results of the research and their discussion.

Egg-laying, or queen bee reproduction, begins in March. The activity of the queen bee develops gradually. Initially, she lays several hundred eggs a day. After the overwintering of bees and their flight, the number of laid eggs increases. With the onset of warmth and natural flow, egg-laying reaches a maximum. In steppe areas, it is the end of June, in forest areas – the beginning of June. In the second half of summer, the work of the queen bee gradually slows down and with the onset of colds stops. If autumn is warm, egg-laying lasts until October. Thus, the queen bee rests only a few months a year.

The queen bee cannot live long without bees. Even under favorable temperature conditions and good feeding, she lives no more than 2–5 days. In a wooden cage with 10 bees, she lives 15–20 days, sometimes a month. In a bee colony, the queen bee lives up to 5–9 years, more than drones and bees. In the first two years, she lays the largest number of eggs, then productivity decreases. With age, she runs out of drone semen and lays more and more unfertilized eggs, from which drones are hatched, so it is impractical to keep the queen bee in industrial apiaries for more than two years. Annually, it is necessary to change at least half, and preferably 80–100% of all queens.

According to the method of obtaining, queen bees are divided into 4 groups. Bees that feed the queen bee constantly lick it. After licking the queen bee, the bee immediately begins to share the licked queen bee's substance (pheromones) with other bees. The queen bee's substance is secreted by the maxillary glands. When the queen bee takes care of itself, it spreads it all over the body. If worker bees receive a sufficient amount of royal jelly, they do not lay queen cells on the eggs and larvae of worker bees.

The queen bee's substance has also been learned to be obtained artificially. Bee colonies, in which queens were removed but given the queen bee's substance in the form of drops on paper, continued to function normally.

In an old queen bee, very little of this substance is released, and the bees begin to rebuild the bowls and the queen bee lays eggs in them. After 16 days, the young queen bee is born from an egg. After mating with drones, the young queen bee begins to lay eggs. This change of the queen bee is called quiet. At such change young and old queen bees live and lay eggs together, without showing hostility to each other.

In a colony where a quiet change of the queen bee is planned, the old queen bee secretes about 1/4 of the queen bee's substance produced by the young fertile queen bee. If placed in a weak colony, the bees will not lay queen cells to change the queen bee. Practice shows that if in the summer in a colony preparing for a quiet change, the queen cells are broken, then such a colony often does not lay them and stays to spend the winter with the old queen bee, which usually dies in the winter. The quiet change of the queen bee depends on the breed of bees. Mountain Grey Caucasian honey bees change 40% of their queen bees annually. Carpathian bees often change queens.

If the bee colony loses the queen bee, the bees begin to raise the queens from the eggs and young larvae of the worker bees. Such queens are called fistulous. Biologically, they are complete and often better than swarm.

In normal colonies, the quality of the fistulous queen bee depends on the age of the larvae from which the queen bee will be raised. Larvae up to 3 days old give full-fledged queens and larvae older than 3 days (at least 6 hours) produce transitional forms of queens with varying degrees of development of signs of worker bees (wax mirrors, baskets), with fewer ovaries and a small ovary. Larvae older than 90 hours are not able to develop into queens, they grow only as worker bees.

When the colony prepares for swarming, the bees make bowls, in which the queen bee lays eggs. After the appearance of a larvae, bees complete the bowls, turning them into queen cells. Queen bees obtained from such queen cells are called swarm.

Swarm queen cells are laid, as a rule, on the side, bottom, and middle of the cells. They look like a ripe acorn or a thimble. Swarm queen bees are not the same.

They grow best in the queen cells, which are located at the top of the cell (frame). Here they get more food, more temperature, and humidity. In the lower part of the cell, the temperature often fluctuates, as warm and cold air passes through the cell. In addition, there are fewer nursing bees at the bottom, so they feed the larvae worse and queen bees are born smaller. Queen bees from such larvae lay fewer eggs, die more often in winter, are less durable.

Nurseries produce fistulous queens, which are commonly called artificial. To do this, first, prepare a colony educator: take away her queen bee and open brood and give the larvae of worker bees of one day of age, etc.

The queen bees were taken away at the start of the major foraging season and the bees instead produced fistulous queen bees. Young queen bees were weighed after fertilization and yielded comparable findings (Table 2, 3).

During the egg-laying season, we weighed the queen bees. Queen bees were not related, yet they were of the same Carpathian breed. According to the data in Table 4, the queen bees from the nursery are smaller than the queen bees from their colonies.

Besides Carpathian breed, we also tested the Ukrainian steppe breed, comparing fistulous queen bees to swarm queen bees. The swarm queen bees are slightly heavier, as shown in Table 4, albeit this difference is not statistically significant. Fistulous queen bees, on the other hand, produce much more eggs. The brood quality was greater and higher in colonies with fistulous queen bees than in swarm queen bee colonies. As a result, swarm queen bees are not worse than fistulous. Colonies with fistulous queen bees are more convenient to work with.

The data on the weighting of swarm and fistulous queens at the beginning of egg-laying is summarized in Table 4. At the beginning of oviposition, the amount of swarm and fistulous queen bees is nearly identical. Only the difference in maximum and minimum weights is significant: 85 mg in swarm and 48 mg in fistulous. As a result, fistulous queen bees have better uniformity than swarm, which has an impact on colony productivity. Because swarm queen bees can be both good and harmful, their colonies emerge with variable levels of ability, complicating maintenance.

2. Live weight of fertile queen bees depending on the growth environment

Origin	Number of queen bees	Weight, mg
Artificial queen bees from the nursery	9	237.9 ± 7.1
Their daughters raised in their colonies during the main forage period (fistulous)	9	272.9 ± 5.9
Their granddaughters raised in their colonies at the end of the main forage period (fistulous)	9	230 ± 9.7

3. Live weight of fertile queen bees

Origin	<i>Apis mellifera</i> carpatica, mg	<i>Apis mellifera</i> sossimai, mg
The queen bee from the nursery	277.1 ± 6.0	223.6 ± 2.8
Their daughters (fistulous)	288.5 ± 5.4	238.7 ± 4.3

4. Oviposition and live weight of queen bees depending on their origin

Origin	The mass of the fertile queen bee at the beginning of oviposition, mg	Live weight during egg-laying, mg	Oviposition, pcs.
Fistulous	247.6 ± 4.0	292.2 ± 5.0	1629 ± 113.0
Swarm	249.7 ± 6.0	300.2 ± 5.8	1206 ± 94.0

July is the most favorable month for breeding and changing queens. At this time, bee colonies reach maximum strength, the hive is constantly receiving nectar and pollen, there are no sharp temperature fluctuations. All this provides the best conditions for breeding the largest bees and queen bees. It is almost impossible to create such conditions when breeding queens artificially in the nursery. Encouraging feeding (100–200 g of syrup), which is distributed to foster colonies, does not provide the colony and offspring with proper nutrition.

The quality of queens is influenced by the method of breeding and location of the queen cell in the honeycomb, the presence of fodder base in nature during their cultivation, the strength of the colony, the number of queen cells in the colony. The more queens the colony raises, the worse their quality.

The young queen bee should fly around. If she does not do this within a month, she loses the ability to mate with drones and she begins to lay unfertilized eggs, from which only drones are hatched. This queen bee is called a cobweb. A colony with such a queen bee usually dies if a beekeeper does not help it.

During a strong flow, the queen bee cannot lay many eggs because the bees fill the cells with honey. As the flow decreases and the number of free cells increases, she lays more eggs. After the end of flow season, the queen bee stops laying eggs because the bees feed them worse. In winter, they do not lay eggs.

Conclusions.

1. In a strong, biologically whole colony, large full-fledged queen bees are born. If in a similar colony strength was used, the queen bee was born 30 mg lighter.
2. If during the hatching of the queen bee bees bring nectar and pollen, the queen bee is born large, if without a flow – small, with low economic qualities. The strength of the flow does not matter, even 200–300 g of nectar and pollen a day have a positive effect on the quality of hatched queens.
3. When there is an open brood in the colony, bees feed the queen bee's larvae better and high-quality queen bees are born. Without open brood (for example, in artificial breeding), the queen bee is small, with poor economic properties.
4. The more queens the colony raises, the better their quality. At artificial removal and removal of fistulous queens, the age of larvae strongly influences their quality. During the artificial rearing of queens, the foster colony does not accept eggs for rearing, so they give her larvae. The younger the larva, the better the queen bee.

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Анотація. Медоносні бджоли можуть жити і працювати тільки в сім'ї. У нормальній бджолиній сім'ї, як правило, тільки одна матка. Це єдина цілком розвинена самка в сім'ї, мати молодих маток, трутнів і робочих бджіл. Якщо бджолина сім'я, що втратила матку, не може вивести собі нову, вона через деякий час гине. Своєчасна зміна бджолиних маток через кожні 2 роки, а також нарощування і збереження сили бджолиних сімей є основними зоотехнічними заходами для підтримання оптимальної життєдіяльності бджіл та отримання від них максимальної кількості продукції. Наявність бджолиної матки в бджолиній сім'ї медоносних бджіл повною мірою впливає на їхню льотну активність зі збору бджолиного обніжжя. За її відсутності значно сповільнюється, а потім і зовсім припиняється заготівля обніжжя та його перероблення, а також виділення воску й будівництво стільників, вирощування розплоду, збір нектару. З появою матки всі функції сім'ї як цілісної біологічної системи поновлюються. Тому, якість маток є визначальним чинником життєздатності та продуктивності бджолиної сім'ї. Метою дослідження

було порівняти якість відтворювальної функції бджолиних маток порід *Apis mellifera scossimai* та *Apis mellifera capracica* залежно від способу їх отримання, а також вплив на продуктивність бджолиної сім'ї. Для проведення досліджень на пасіці було сформовано три групи – контрольну та дві дослідні, по дев'ять бджолосімей у кожній групі. У першій групі були штучно виведені матки із розплідника, у другій – свищеві матки та в третій – ройові. Пасіка розміщена на точку розміром 50 í 50 метрів. Бджолині сім'ї утримували у вуликах-лежаках. Пасіка медово-запилювального напрямку. У результаті дослідження встановлено, що в сильної, біологічно цілісної сім'ї народжуються великі повноцінні матки. Якщо в аналогічній за силою сім'ї застосовували підсилення, то матки народжувалися на 30 мг легші. Якщо під час виведення матки бджоли приносять нектар і пилок, то матки народжуються великими, без взятку – дрібними, з низькими господарськими якостями. Навіть за слабкого надходження нектару (200–300 г нектару й пилку на добу) спостерігали позитивний вплив на якість виведених маток. Свищові матки мали вищу яйценосність у порівнянні до ройових в однакових умовах розвитку сімей.

Ключові слова: бджоли, бджолині матки, продуктивність, репродуктивна функція
