The Melliferous Conditions of the Valdai District of the Novgorod Region

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Abstract. The article examines the melliferous and honey-collecting conditions of the Valdai district of the Novgorod region. The area is located on the border of the northern range of natural distribution of honey bees. The climatic conditions for the life of bees and the collection of nectar by them are not easy. On the territory of the region, wild melliferous plants are widespread, secreting nectar from early spring to autumn. On the example of the territories of two apiaries of the region, the article examines the main melliferous plants that are important for obtaining marketable honey. The resources of nectar, food supply for bees have been calculated. The factors and problems on which the efficiency of collecting nectar by bees depends, taking into account local geographic and climatic factors, are considered.

1. Introduction
In beekeeping, different terms, definitions and formulations are used to indicate the conditions for the collection of nectar by honey bees in specific geographic and climatic conditions. The abundance and variety of these terms often creates confusion. This is because the collection of nectar by bees depends on numerous factors. In different studies, the authors consider more or less of these factors, the authors subjectively attach more importance to some of them, and less to others. Often this subjectivity is justified, since in different geographic and climatic conditions the influence of the factors under consideration is expressed to varying degrees [1–2].

A large number of studies by domestic and foreign authors are devoted to the process of collecting flower nectar (or honeydew - sugar-containing substances of other plant origin) by bees. In these studies and works there are both general, basic things that do not cause doubts and disagreements, and conflicting opinions about some factors affecting honey collection. All factors influencing the collection of nectar by bees, honey collection, can be divided into three large groups. The first group of factors is directly melliferous floristic conditions in the considered place (a specific apiary, district, region, region, etc.). The second group is geographic and climatic conditions, which strongly influence the first group of factors. The third group of factors is the state of bee colonies at a specific moment, calendar period, from the point of view of the possibility of effective use of nectar secreted by plants [4–5].

Let's consider the first group of factors – melliferous floristic conditions. Here, the correct and more accurate term would be “melliferous” conditions, not honey-gathering conditions. On average, bees are believed to be able to efficiently collect nectar within a 2–2.5 km radius of their location. This is approximately 1200–1600 hectares. It is understood that a particular plant species can potentially release a certain amount of nectar during the flowering period. In total, different honey plants produce an approximate amount of nectar in the selected area during the active warm period from spring to autumn.
Of course, not all of this nectar can and will be collected by bees due to the influence of the second and third groups of factors. But nevertheless, in general, melliferous conditions describe the potential for nectar production by plants "in pure form." In different calendar periods, nectar is released unevenly. In any locality there are periods of maximum nectar production by plants. This is the period when the main melliferous plants of the area bloom en masse. At the same time, everywhere and always there is a period when there is a pause in the flowering of honey plants and there is no nectar production at all. Often in this context, the term “bee food supply” is used in an apiary, district, region. There is a large number of studies on this topic [6–7].

The second group of factors – the geographical location of the apiary and the climatic conditions of the area - has a very strong influence on the first group of factors. The fodder base of an apiary depends not only on the area occupied by melliferous plants. The release of nectar by plants is influenced by the type of soil, height above sea level, and the depth of groundwater. The temperature and humidity of the air, the amount of precipitation during honey collection are extremely important. It is known that various melliferous plants have their own optimal values for the release of nectar in terms of air temperature and humidity. In some plants, the maximum nectar release occurs when there is abundant moisture in the soil and high air humidity, while others release nectar more abundantly in hot weather, they only need a minimum moisture in the soil and air. Numerous studies have been devoted to the influence of temperature and air humidity and precipitation on the activity of bees in collecting nectar. We considered these factors in relation to the conditions of the Novgorod region in one of our previous works [8–10].

The third factor, on which the efficiency of nectar collection by bees and the use of honey collection by the families largely depends, is the strength and condition of the bee colonies. This is a biological and technological aspect. The strength of families, that is, the number of bees, the mass of bees in a family increases from spring to mid-summer, then decreases. But this is in theory, in practice this is not always the case due to swarming of bees, artificial reproduction of families by beekeepers, the use of anti-fighting techniques and other features of the technology of keeping bees in a particular apiary. Of course, beekeepers are interested in making the most of the periods of strong honey harvest, therefore, as a rule, in normal conditions, the technology of keeping bees is focused on this. Roughly speaking, the stronger the colony, the more worker bees in it, the more honey it will collect in comparison with the weaker colony, all other things being equal. The third factor becomes really important when the first two have worked. No matter how strong the family is, it is capable of collecting large amounts of nectar only if strong honey plants are blooming at a given time in the apiary and favorable climatic conditions (temperature, precipitation, air humidity) for this [11–12].

In our article, we will consider the first of these factors, that is, the melliferous conditions, the so-called food supply for bees in the Valdai district of the Novgorod region, using the example of one of the apiaries. Of course, we will also touch upon the other factors described, since their influence on honey collection in the studied area will be significant. When it comes to the combination of all the factors we are considering, we can already introduce such a term as “honey collection” conditions. It implies that the collection of nectar by bees depends not only on the melliferous food base directly, but also on the ability of the bees to use it, that is, to collect nectar. For example, even if large tracts of strong honey plants are blooming, but at this time cool rainy weather is on the territory of the apiary, bees will be able to use such honey collection to a small extent, or not at all. Conversely, at optimal temperature and humidity, and the absence of heavy rains, bees will collect a certain amount of honey even from mediocre honey plants.

Valdai district is located in the southeast of the Novgorod region. The Valdai Upland of the same name begins on the territory of the district. Valdai National Park is located on the territory of the Valdai district. The vegetation, relief of the Valdai Upland is different and stands out in comparison with neighboring regions, for example, the Priilmenskaya lowland located nearby, to the west. On the territory of the Valdai district there are a large number of small lakes, hilly terrain prevails [13].

Most of the territory of the district is occupied by forests, which occupy more than 80% of the area. It should be noted that the area of forests in a given area does not decrease, as is often believed, but, on the contrary, increases. This is due to the existence of a regime of protected areas and the gradual
overgrowth of forests on former agricultural lands that are not used by humans. More than 60% are coniferous forests [14].

The climate of the Valdai district, in general, is similar to the neighboring territories of the North-West of Russia. It is distinguished by a moderate amount of heat and excess moisture. Summer is the most important time of the year for beekeeping. In the studied area, it is distinguished by cool temperatures and frequent precipitation.

Cold snaps can often drag on for several weeks. As you can imagine, such summer conditions are not very well suited for beekeeping, and for the survival of bee colonies in general. Autumn is often also with a lot of precipitation, with early frosts. Winter is long and relatively mild. It is distinguished by frequent temperature changes. Severe frosts can be abruptly replaced by thaws. Such winter conditions make it difficult for bees to winter. Spring is often late, with frequent recurrent cold weather. Strong winds are observed throughout the year.

The average annual temperature in the Valdai district is 2.5 ºС. In summer, in July, during the period of maximum heat, the average daily air temperature is +14 – +16 ºС. Annual precipitation reaches 800mm. Due to low temperatures and a significant amount of precipitation in the winter-spring period, the snow cover lasts for a long time (up to 5 months) [13].

The objective of the research was to determine the honey-collecting conditions of the studied territory of the Valdai district. First of all, outline the melliferous fodder base on the example of two apiaries of the region, analyze the influence of climatic factors on honey collection.

2. Materials and methods

The studies were carried out in 2020 in the Valdai district of the Novgorod region. The information on the presence and quantity of melliferous plants in two apiaries of the region was processed. Standard methods for counting melliferous plants were used.

The summer radius of bees was taken to be 2 – 2.5 km, which is approximately equal to the area of 1500 hectares. The amount of nectar available to bees for collection was taken equal to 50% of the total volume of nectar excretion by plants. Plants blooming up to the beginning of June inclusive were considered spring melliferous plants. Early summer – blooming from June 10 to July 10. Plants blooming after July 10 were considered summer melliferous plants.

In terms of honey resources, despite the proximity of the apiaries, there are differences between them. The territories of both apiaries are characterized by a very strong spring honey harvest, which is often not used due to bad weather. Next comes the unstable early summer honey harvest, after which comes the main summer honey harvest (second half of June – July).

The apiary in the village of Ovinchishche is located on the border of an array of garden plots. Most of the territory of the studied apiary is covered with coniferous and mixed forest. The main honey harvest occurs at the height of summer, at the end of June. The most important melliferous plants are common raspberries and narrow-leaved fireweed.

The apiary in the village of Falevo is located on former state farm hay meadows and pastures that have not been used for many years. The most important summer honey plants are common fireweed, forest raspberries and meadow cornflower.

3. Results

In the course of the research, the honey resource was calculated according to the standard method in the territories of two apiaries of the study area. The results are shown in tables 1 and 2.

**Table 1. Assessment of honey resources in the apiary in the village of Ovinchishche.**

| Plants flowering period | Melliferous plants, name | Occupied area, hectare | Nectar resource from 1 hectare, kg | Total resource of nectar, kg | Total resource for the period, kg | Nectar resources available to bees, kg |
|-------------------------|--------------------------|------------------------|-----------------------------------|----------------------------|----------------------------------|--------------------------------------|

3
| Season       | Plant Name                                           | Spring                        | Summer                                      |
|--------------|-----------------------------------------------------|-------------------------------|---------------------------------------------|
|              | Willows of different types                          | 50                            | 5                                           |
|              | Salix L.                                            | 150                           | 250                                         |
|              | Fumewort                                            | 7500                          | 6645                                        |
|              | Corydalis solida (L.) Clairv.                       | 13290                         |                                              |
|              | European bird cherry tree                           | 6620                          |                                              |
|              | Sorbus aucuparia L.                                 | 4000                          |                                              |
|              | Padus avium Mill.                                   | 3690                          |                                              |
|              | Mountain ash                                        | 1845                          |                                              |
|              | Norway maple                                        | 1                              |                                              |
|              | Acer platanoides L.                                 | 200                           |                                              |
|              | Common dandelion                                     | 5                              |                                              |
|              | Taraxacum officinale Wigg.                          | 3000                          |                                              |
|              | Apple tree                                          | 5                              |                                              |
|              | Malus domestica Borkh.                              | 600                           |                                              |
|              | Goutweed Aegopodium podagraria L.                    | 200                           |                                              |
|              | Common raspberry                                     | 600                           |                                              |
|              | Rubus idaeus L.                                     | 2000                          |                                              |
|              | Creeping trefoil                                    | 2000                          |                                              |
|              | Trifolium repens L.                                 | 400                           |                                              |
|              | Small-leaved linden                                 | 90                            |                                              |
|              | Tilia cordata Mill.                                 | 15                            |                                              |
|              | Bog crane’s bill Geranium palustre L.               | 5                              |                                              |
|              | Narrow-leaved fireweed Chamerion angustifolium L.   | 90                            |                                              |
|              | Wild angelica Angelica sylvestris L.                | 180                           |                                              |
|              | Blue cow wheat Melampyrum nemorosum L.              | 250                           |                                              |
|              | White sweet clover                                  | 250                           |                                              |
|              | Medicago albus Medik.                               | 250                           |                                              |
|              | Meadow cornflower Centaurea jacea L.                | 900                           |                                              |
|              | Canada thistle Cirsium arvense                      | 80                            |                                              |
|              | European goldenrod Solidago virgaurea L.            | 240                           |                                              |

The apiary in the village of Ovinchishche is located on the outskirts of a mature coniferous forest and summer cottages.

Vegetation, including melliferous vegetation, is typical for the area as a whole. Most of the territory is occupied by a coniferous forest, with clearings, edges, clearings, where honey plants grow. Summer cottages occupy about 20% of the territory. Meadows and meadow honey plants also occupy about 20% of the area.
Table 2. Assessment of honey resources in the apiary in the village of Falevo.

| Flowering period | Melliferous plants, name | Occupied area, hectare | Nectar resource in 1 hectare, kg | Total resource of nectar, kg | Total resource for the period, kg | Nectar resources available to bees, kg |
|------------------|--------------------------|------------------------|---------------------------------|-----------------------------|----------------------------------|---------------------------------------|
| Spring           | Willows of different types Salix L. | 50                     | 150                             | 7500                        | 14655                            | 7327                                  |
|                  | Fumewort Corydalis solida (L.) Clairv. | 5                     | 40                              | 200                         |                                  |                                       |
|                  | European bird cherry tree Padus avium Mill. | 10                    | 10                              | 100                         |                                  |                                       |
|                  | Mountain ash Sorbus aucuparia L. | 10                     | 20                              | 200                         |                                  |                                       |
|                  | Norwegian maple Acer platanoides L. | 0.5                   | 250                             | 125                         |                                  |                                       |
|                  | Common dandelion Taraxacum officinale Wigg | 130                | 50                              | 6500                        |                                  |                                       |
|                  | Apple tree Malus domestica Borkh. | 1                     | 30                              | 30                          |                                  |                                       |
| Early summer     | Goutweed Aegopodium podagraria L. | 10                    | 30                              | 300                         | 4590                             | 2295                                  |
|                  | Common raspberry Rubus idaeus L. | 15                    | 200                             | 3000                        |                                  |                                       |
|                  | Creeping trefoil Trifolium repens L. | 10                    | 120                             | 1200                        |                                  |                                       |
|                  | Bog crane’s bill Geranium palustre L. | 3                     | 30                              | 90                          |                                  |                                       |
| Summer           | Narrow-leaved fireweed Chamerion angustifolium L. | 15               | 400                             | 6000                        | 11570                            | 5785                                  |
|                  | Wild angelica Angelica sylvestris L. | 5                     | 60                              | 180                         |                                  |                                       |
|                  | White sweet clover Melilotus albus Medik. | 2                    | 250                             | 500                         |                                  |                                       |
|                  | Blue cow wheat Melampyrum nemorosum L. | 5                    | 50                              | 250                         |                                  |                                       |
|                  | Meadow cornflower Centaurea jacea L. | 60                   | 60                              | 3600                        |                                  |                                       |
|                  | Canada thistle Cirsium arvense | 10                    | 80                              | 800                         |                                  |                                       |
|                  | European goldenrod Solidago virgaurea L. | 3                    | 80                              | 240                         |                                  |                                       |

The territory of the second surveyed apiary is generally similar to the first one and is also quite typical for the region, but there are some differences. These differences, at first glance, are not very significant, not so important in general. But for the melliferous base, they are of great importance. The apiary in the village of Falevo has a large area of abandoned meadows, which gives these lands a great value, as they have a large concentration of strong honey plants.
4. Results and discussion

According to the data presented in tables 1 and 2, we see that despite the relatively small areas occupied by strong melliferous plants in a “pure” form, the melliferous resource of apiaries is quite large. It allows you to keep, in these areas, a fairly large number of bee colonies. It is enough for the development of families and for marketable honey. In fact, in practice, everything is not so good, since the weather conditions of the area often do not favor the maximum secretion of nectar and its collection by the bees. The figure of 50%, which is standardly taken as the index of nectar collection by bees, is very relative. Taking into account local climatic factors, it can probably be reduced to 40 or even 30%. Nevertheless, bee colonies in the studied apiaries annually produce marketable honey.

As you can see, spring honey collection is especially strong in the Valdai district. In early spring, in late April - early May, its main sources are trees and shrubs of various types of willows. They occupy large areas almost everywhere, bloom for a long time and produce abundant nectar. The problem is that during this time, as a rule, extremely unstable and often cold weather is observed, which prevents the bees from collecting nectar. In addition, at this time, bee colonies are in a state of development and are not ready for the most efficient use of honey collection. Therefore, in practice, honey harvesting conditions are significantly different from those of honey. The nectar collection rate from willows is not 50%, as usual, but at best 20%. Nevertheless, early spring honey collection is of tremendous importance for the growth and development of bee colonies.

The main honey plants of late spring are medicinal dandelion. It also occupies large areas in almost every area of the district. The problem of using honey from dandelion also consists in the instability of non-carotional excretion. Dandelion nectar is released only in warm, calm weather. Despite this, at this time, bee colonies are already able to productively use the honey harvest and, in favorable weather, give marketable honey.

The main early summer honey plant in the Valdai district is common raspberry. This honey plant is often underestimated. According to our observations, the climate of the area is excellent for raspberry nectar production. She is not capricious, she gives out nectar in cool weather and even in the rain. Raspberry nectar, unlike other plants, is not washed out by rain due to the special closed arrangement of the flower.

In summer, most of the region's melliferous plants bloom. The main melliferous plants of the summer and late summer period are narrow-leaved fireweed, meadow cornflower, field sow thistle. As a rule, at this time the weather is warmer, although it is often accompanied by rain. Therefore, the honey harvest from summer plants is more stable and reliable. As can be seen from the indicative data in Tables 1 and 2, narrow-leaved fireweed is the most significant summer melliferous plant. It grows, as a rule, on the border of forest and meadows. Unlike meadow plants, it does not mow, it blooms for a very long time, more than 1.5 months. Due to the duration of flowering, the honey harvest from it is stretched, there is no very strong daily weight gain.

5. Conclusion

Summing up, we can state on the basis of the results obtained, that the honey-collecting conditions of the Valdai district of the Novgorod region are quite favorable for honey bees as a biological species, for beekeeping. Despite the cool and rainy climate during the active season for bees, during the entire active period of the life of a bee colony, nectar resources are available in nature. Plants such as various types of willow trees and shrubs, common raspberries, narrow-leaved fireweed and meadow cornflower are of particular importance.

The period of the most active excretion of nectar by plants is spring. The efficiency of collecting nectar by bees at this time is low, however, even in difficult weather conditions, bees productively use spring honey collection for the development of families and, sometimes, give marketable honey. Most of the commercial honey is collected in the summer.

Separately, it should be said about the quality and environmental safety of honey in the region. There are no large industrial production facilities polluting the soil and air on the territory of the district. The area is almost entirely included in the Valdai National Park. As we can see, according to the research
results, honey collection in the region is based exclusively on wild-growing melliferous plants. There are no agricultural honey plants. Due to this, the quality and taste of the region's honey are at a high level. Honey from the region's apiaries does not cause allergic reactions and is environmentally friendly.

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