Productive qualities of bees of the Central Russian and Carpathian breeds

S.A. Pashayan[1,*], *F.G.* Gizatullina[2], and *E.A.* Pshenichnaya[2]

[1]FSBEI HE State Agrarian University of the Northern Urals, Tyumen, Russia
[2]FSBEI HE South Ural State Agrarian University, Troitsk, Russia

Abstract. The study evaluates the winter hardiness, spring development, and honey production of Central Russian honey bees (Apis mellifera mellifera) and Carpathian honey bees (Apis mellifera carpatica) in the Chelyabinsk region. The research analyzes key parameters of wintering bee colonies, including colony strength in autumn, food consumption, level of chalkbrood disease, and varroa mite resistance. Results indicate that Central Russian honeybees exhibit high winter hardiness and disease resistance, contributing to their resilience during cold winter periods. Despite originating from warmer climates, Carpathian honey bees also demonstrated good winter hardiness, albeit with some susceptibility to chalkbrood disease. Both bee breeds showed comparable spring development, directly influencing overall honey production. Comparing honey productivity data revealed that Central Russian honey bees significantly outperformed Carpathian bees in terms of honey yield per harvesting period. Thus, the study underscores the importance of selecting appropriate bee breeds to ensure successful wintering and high honey productivity in harsh climates, crucial for effective beekeeping in the Chelyabinsk region and similar environments.

1 Introduction

Beekeeping has a close connection with many branches of agriculture, especially with crop production. This relationship is primarily due to the importance of bees as pollinators of agricultural crops. In Russia and the CIS countries, insect-pollinated plants include over 50% of the angiosperm flora, which need cross-pollination carried out only by honey bees. In small areas, crops can be pollinated by wild insects, but in large areas a large number of pollinators are required. Insufficient pollination of flowers can significantly reduce the yield and quality of fruits and seeds. Charles Darwin highly appreciated the role of bees in improving the biological properties of seeds [1, 2, 5]. In the conditions of the Urals and Trans-Urals, there are significant honey-bearing resources, which guarantees the possibility of developing intensive beekeeping [3, 4, 7].

It is known that beekeeping is the oldest human occupation. Honey and other products of the bee family (wax, pollen, royal jelly, propolis, and bee venom) have been highly appreciated since ancient times as food by the people, as well as in folk and scientific

* Corresponding author: pashakirak7@list.ru

medicine. In the 21st century, interest in honeybee products has increased significantly due to their proven benefits for human health and longevity [5, 7, 9]. In addition to easily digestible carbohydrates, honey contains up to 300 different components, such as enzymes, vitamins, and trace elements, which together determine its unique value, dietary and medicinal properties [4, 10]. Beeswax, unlike other bee products, is in demand in various industries, as well as in the manufacture of paper, medicine, and perfumery [12, 15]. Pollen, royal jelly, propolis, and bee venom have proven themselves well in folk medicine and are promising for scientific medicine in the prevention and treatment of various diseases [15, 16]. The centuries-old use of bee products testifies to their significant role in human health and longevity, and apitherapy has been formed for therapeutic and preventive purposes in medicine.

Bee colonies were imported to the Ural and Siberia from different regions, where bees of the Central Russian breed, characterized by high winter hardiness, came from. This feature is one of the most important for bees in a cold climate. Since the 70s of the last century, 1.5-2 thousand bee colonies of Carpathian breeds originating from the southern regions were imported annually. Over 20 years, more than 20 thousand families have been imported. Starting in 1967, warnings began to appear about the negative consequences of this importation: crossing led to a decrease in the winter hardiness of local Central Russian bees and an increase in the risk of various diseases [11, 14]. The population of the Central Russian bee (Apis mellifera L.) has mastered the European part and the eastern regions (the Urals, Western and Eastern Siberia, the Far East) thanks to immigrants during the development of new territories and natural settlement. The Central Russian breed was formed in the northern regions of the European part of the country, so these bees have a fairly high adaptation to winter frosty conditions.

The natural distribution area of the Central Russian bee includes the territories of the western, central, eastern, and northern parts of Europe, where it is an indigenous breed. The eastern boundary of the range was limited to the Urals, the western one – to the Alps, the southern one – not clearly defined, and the northern one runs along 60°N. The development strategy of bee colonies of the Central Russian breed is aimed at using a short but rapid honeyflow from strong honey plants. Due to the breed biological characteristics, the spring development of Central Russian bees begins later than that of other breeds, but takes place intensively and ends by mid-June. The queens of this breed is characterized by high fertility. The Central Russian bee is characterized by a high tendency to swarm. Bees of this breed, introduced to southern regions with dry and hot climates, such as Central Asia and the North Caucasus, do not survive for long in such conditions. Central Russian bees, especially those living in the northeastern regions of the European part of Russia and Siberia, surpass dark European bees in winter hardiness, endurance and resistance to certain diseases. The Central Russian breed stands out among other breeds in terms of honey productivity in conditions of stable honey collection from linden, buckwheat, and some other honey plants, such as heather, willow herb. The Central Russian breed uses monofloral honey collection sources more efficiently than polyfloral ones. They also surpass other bee breeds in the CIS in terms of the amount of harvested perga and wax productivity. The productivity of the bee family of the Central Russian breed is unstable, due to its strong dependence on abiotic, biotic, and anthropogenic environmental factors. Nevertheless, on average, honey productivity in bees of the Central Russian breed is 30-50 kg, wax – 1.5–2.0 kg, propolis – 180-200 g per bee family.

Carpathian bees (Apis mellifera carpatica) were formed in the Carpathian region and originate from the Carniolan bees. They were imported to Russia from Ukraine. Carpathian bees have biological features that distinguish them from Central Russian bees. The body color is pure gray without yellow shades, they are larger, peaceful. The tendency to swarm

in Carpathian bee colonies is insignificant, in warmer areas they economically consume winter feed stocks [4]. Nevertheless, the hardiness and fertility of Carpathian bees are lower, they are less resistant to nosematosis and European rot compared to Central Russian bees. Spring development in families of Carpathian bees begins early and proceeds more intensively, by the main honey harvest, the strength of families usually reaches a high level [5]. The ability of the "Carpathians" to collect a large amount of nectar from plants containing a small amount of sugar, to maximize the use of various grasses should be noted. Carpathian bees demonstrate the best results in honey productivity in conditions of a sustainable honey flow.

Every year, beekeepers of the northern regions carry out the importation of bees of the Carpathian breed. Nevertheless, there is little data in the available literature proving the high productivity of this bee breed. Therefore, it is necessary to determine the productivity of the Carpathian bee breed in the conditions of the Urals and Trans-Urals to solve this problem. In this regard, the study of the productive qualities of the Central Russian and Carpathian breeds seems relevant.

The purpose of the work was a comprehensive assessment of the productivity of bees of the Carpathian and Central Russian breeds in the conditions of the Southern Urals.

2 Materials and Methods of Research

A study to determine the productivity of bees of the Carpathian and Central Russian bee breeds was conducted from 2020 to 2023 in the conditions of the Chelyabinsk region. The work was carried out in apiaries located in two districts of the forest-steppe zone of the region. The apiaries were located at the same geographical latitude, both bee breeds were kept in the same conditions. The objects of the study were families of bees of the Carpathian and Central Russian breeds, which were located in separate apiaries at distances of 4-5 km from each other and in the same conditions of maintenance. Winter hardiness, spring development, and honey production of bees were determined. Laboratory studies were conducted at the Department of Anatomy and Physiology of the FSBEI HE State Agrarian University of the Northern Urals.

3 Research results

The winter hardiness of bees is a key aspect in beekeeping, since the successful wintering of bee families significantly affects their spring development, honey flow and the overall productivity of the bee family. To assess the winter hardiness of bee colonies, the following indicators were studied: the number of families in beeways in autumn, the amount of feed consumed, the amount of dead bees, and resistance to nosematosis (spoiled honeycombs). Studies show (Table) that the Central Russian bees (Apis mellifera mellifera) are the leaders in winter hardiness. These bees cope better with cold winters – the strength of families after wintering is 9.0±0.5. They demonstrate high endurance and resistance to diseases. Central Russian bees are distinguished by their large size and dark gray coloration, morphological and biological features, which may contribute to their better adaptation to harsh climatic conditions (Table 1).

Table 1. Productive qualities of bees of the Carpathian and Central Russian breeds (X±Sx, n=10).

Parameters	Carpathian breed	Central Russian breed
Winter hardiness		
Strength of families in beeways, in autumn	8.0±0.2	9.0±0.5
Amount of food eaten (kg)	12.0±1.0	12.0±1.0

Spoiled honeycombs	signs	-
Number of glasses of dead bees (pcs.)	1.0±0.6	1.0±0.3
Degree of infection of bee colonies with nosematosis	Weak	Absent
Spring development of bee colonies		
beeways on April 1 (pcs.)	7.0±0.5	7.0±0.5
honeycomb brood on April 1 (pcs.)	2.5±0.01	3.0±0.02
beeways on May 20 (pcs.)	15.0±0.8	16.0±0.9
honeycomb brood	8.0±0.8	9.0±0.7
Honey productivity (commercial) of bee colonies		
First year, kg	40.0±3.3	43.0±5.1
Second year, kg	26.0±4.8	32.0±2.6
Third year, kg	6.0±0.8	12.0±1.3
Fourth year, kg	35.0±4.3	39.0±5.2
Average productivity of bee colonies, kg	26.75	31.5
Average productivity of bee colonies, %	100.0	117.76

The bees of the Carpathian breed, having an origin from a milder climatic and geographical zone, overwintered slightly worse than the Central Russian bees – the strength of their families averaged 8.0±0.2. In terms of the amount of feed consumed and the dead bees level, they are not inferior to the Central Russian bees. Nevertheless, in the families of Carpathian bees, there is a slight susceptibility to nosematosis, which indicates their sensitivity to this disease (Table).

The spring development of bees has a significant impact on honey production. During this period, the number of young worker bees in families increases, ready to work on pollination and honey collection. The obtained data on the development of bee colonies show that the development of bees of the Central Russian breed was more active compared to the Carpathian bees. The slight lag of Carpathian bees in May is due to the lower egg production of queens of this breed, but by June the strength of bee colonies is almost equalized.

A four-year experiment was conducted to assess the honey productivity of Central Russian and Carpathian bees. The main measurement parameter was the amount of commercial honey received from one bee family during the honey flow period. The results showed that the Central Russian bees, adapted to local conditions, surpassed the Carpathian bees in honey productivity. These conclusions were based on data from four apiaries, which considered the average amount of honey per bee family according to the results of the spring audit. Thus, the choice of the bee breed plays a key role in achieving high rates of honey productivity in specific climatic conditions (Table).

Therefore, when choosing a breed for beekeeping in a harsh climate, it is important to consider not only winter hardiness and resistance to diseases, but also the peculiarities of the spring development of bee colonies. This will ensure successful wintering, spring development, and high honey productivity of bees.

4 Conclusion

The study assessed the winter hardiness, spring development and honey productivity of Central Russian (Apis mellifera mellifera) and Carpathian bees (Apis mellifera carpatica) in the conditions of the Chelyabinsk region. The analysis of the productive qualities of bees of two breeds was carried out for 4 years in apiaries of two districts. At the same time, a comparative assessment of such parameters as the strength of families in hives in autumn,

the amount of feed consumed, dead bees, and resistance to nosematosis was carried out. Bees of the Central Russian breed showed higher winter hardiness, which had a positive effect on their endurance and resistance to diseases. Carpathian bees, despite their origin from a warmer climatic zone, also showed good results in winter hardiness, although they were found to have some susceptibility to nosematosis. Both breeds showed similar spring development, which, in turn, affected their overall honey production. A comparison of honey productivity showed that the Central Russian bees, adapted to local conditions, significantly surpass the Carpathian bees in honey production per season. These results confirm the importance of choosing a suitable breed to ensure successful wintering and high honey productivity of bee colonies in the conditions of the Chelyabinsk region.

References

1. V.M. Zhabtsev, *Beekeeping, desk book* (Moscow, 2005) 347-450.
2. N.E. Zemskova, E.N. Melnikova, V.N. Sattarov, Beekeeping, **9,** 52-54 (2022).
3. V.N. Zubrilin, Beekeeping, textbook for student institutions of the secondary vocational education 1st ed. (Karatuzskoe, 2017) 728.
4. I. Keller, P. Flury, A. Imdorf, The World of bees, **86,** 3-10 (2005).
5. R.T. Klochka, Environmental problems of beekeeping and possible solutions, https://vikidalka.ru/2-73579.html (date of access: 02/07/2024).
6. R.B. Kozin, V.I. Lebedev, N.V. Irenkova, *Biology of the honey bee*: a textbook (St. Petersburg: Lan, 2022) 320.
7. R.B. Kozin, N.I. Krivtsov, V.I. Lebedev, V.M. Maslennikova, *Beekeeping* (Moscow: Lan, 2022) 448.
8. V.I. Komlatsky, O.V. Strelbitskaya, G.V. Komlatsky, V.A. Leshchenko, Bee activity in phacelia crops, Current trends in beekeeping and apitherapy of the XXI century: a collective monograph; edited by A.Z. Brandorf [et al.] (Rybnoye, 2022) 103-106.
9. S.A. Pashayan, Beekeeping, **1,** 10-12 (2005).
10. S.A. Pashayan, *Ecological and biological foundations determining the resistance of bees to diseases*: specialty 02/03/14 "Biological resources": dissertation for the degree of Doctor of Biological Sciences (Yekaterinburg, 2012) 271.
11. P.V. Penkin, N.E. Zemskova, A.G. Meshcheryakov, Animal husbandry and feed production, **105(4),** 208-219 (2002).
12. Obtaining high-quality young bee larvae /https://selskaja-zhizn.ru/poluchenie-kachestvennyh-molodyh-pchelinyh-lichinok.html (date of access: 02/07/2024).
13. K.A. Rozhkov, S.N. Khokhrin, A.F. Kuznetsov, *A honey bee. Maintenance, feeding, and care: a textbook* (St. Petersburg: Lan, 2023) 432.
14. Yu.A. Cherevko, G.A. Avetisyan, Beekeeping (AST, Astel, Moscow, 2003) 194-257.
15. V.V. Shishkina, S.A. Pashayan, M.V. Kalashnikova, Beekeeping, **2,** 22-23 (2016).
16. V.V. Shishkina, S.A. Pashayan, Beekeeping, **1,** 30-31 (2016).