

The dissertation work of Spatay Nuradil on the topic “Features of morphological and economically useful traits of honey bees bred in the southeastern zone of Kazakhstan”, submitted for the degree of Doctor of Philosophy (PhD) under the educational program 8D08201 - “Technology of livestock production”.

ABSTRACT

Relevance of the Research Topic

Beekeeping is an important branch of agriculture, possessing distinct biological and ecological characteristics. It is not limited to honey production alone but plays a crucial role in enhancing plant productivity through pollination. Currently, considerable efforts are being made to improve bee breeds based on morphometric and molecular-genetic studies. In this context, products such as honey, beeswax, and propolis are widely used in the food industry, medicine, and pharmaceuticals. Research conducted in the southeastern region of Kazakhstan provides a foundation for the effective development of beekeeping and the preservation of ecological balance.

One of the pressing issues hindering the development of beekeeping in the southeastern region of Kazakhstan is the preservation and improvement of the gene pool of local honey bee populations. The absence of a systematic breeding and selection program in the country's apiculture sector increases the risk of genetic degradation and the potential extinction of local populations. This situation is exacerbated by several contributing factors.

Firstly, since the 1990s, the closure of specialized scientific research institutions has significantly slowed progress in the field of bee breeding and genetic improvement, leading to a decline in the genetic diversity of honey bees.

Secondly, foreign bee breeds (e.g., from Russia and Uzbekistan) have demonstrated low adaptability to the local ecological conditions, particularly in regions with harsh climates, where their viability is significantly reduced.

Thirdly, the uncontrolled crossbreeding of imported bee breeds with local queens has resulted in the loss of genetic purity of indigenous bees, thereby threatening the uniqueness and integrity of their gene pool.

In addition, the legal and regulatory framework governing apiculture remains underdeveloped. Despite the adoption of the Law “On Beekeeping” in 2002, legislative mechanisms supporting systematic breeding and selection programs have not been adequately implemented.

To address these challenges, it is crucial to conduct genetic studies of local honey bee populations and to develop scientifically-based selective breeding programs. The integration of modern scientific and technological advancements, along with the strengthening of the link between scientific research and practical production, will enhance the efficiency of the beekeeping sector and contribute to maintaining ecological balance.

Preserving the genetic diversity of honey bees is one of the most urgent and strategically important tasks for ensuring the sustainable development of apiculture as a key component of renewable natural resources.

Research Aim:

To investigate the morphometric and economically valuable characteristics of Carpathian and Krainian bee breeds, as well as local Kazakhstani honey bee populations reared in the southeastern region of Kazakhstan, to identify their specific features and assess their performance.

Research Objectives:

To conduct a comparative assessment of the productivity and genetic parameters of honey bee breeds reared in the southeastern region of Kazakhstan and to determine their relative efficiency.

To evaluate the adaptability of honey bees raised in the southeastern region to local environmental conditions, to conduct selective breeding work, and to explore their potential applications in apicultural practices.

To investigate the potential for breed selection for beekeeping enterprises based on economically significant biological and selective-genetic characteristics.

To characterize the taxonomic composition of bees using data on the variability of morphometric parameters, including cubital and hantel indices and discoidal shift.

To identify the specific features contributing to the high productivity of Carpathian, Krainian, and Kazakhstani bee populations, to evaluate queen bees based on the quality of their progeny, and to assess the feasibility of applying individual selection methods.

To study the morphological traits and economically valuable characteristics of honey bees for apiculture and to substantiate the relationship between their productivity and the natural-climatic and geographical conditions of the southeastern region of Kazakhstan.

Research Methods:

During the course of the study, the morphological characteristics of honey bees were determined using the methods of A. Tofilski (IdentiFly) and A.B. Kartashev (“Wings of Bees”). Body size and morphometric traits, including the cubital index, hantel index, and discoidal shift, were analyzed based on the methodology of Alpatov. Wing parameters of bees, scanned and digitized using WingsDig and MorphoXL software, were measured and subjected to statistical analysis.

The degree of correlation between morphometric and economically valuable traits of bees from different regions was assessed using Spearman’s rank correlation coefficient. Pollen collection and analysis were conducted according to the method of A.N. Burmistrova. Genetic diversity and phylogenetic relationships were examined using the GeneMapper software (Applied Biosystems) and the BOLD database.

Variation between apiaries was analyzed using ANOVA and discriminant analysis, allowing for the identification of differences among populations. The

integrated application of these methods ensured high scientific accuracy and reliability of the results obtained.

Scientific Novelty:

For the first time, a range of morphological and economically significant traits of various honey bee breeds reared under the conditions of the southeastern regions of Kazakhstan were comprehensively studied. The study determined the potential for their adaptation and regional suitability in these specific environmental conditions.

Location of the Research Work:

The research was carried out in the laboratories of the Department of Beekeeping, Poultry and Fish Farming at the Kazakh National Agrarian Research University, the Kazakhstan–Japan Innovation Center, as well as at apiaries located in the Almaty region.

Practical Significance of the Research:

The research results demonstrated the high efficiency of beekeeping in various natural and climatic zones of the Almaty and Zhetysu regions. Based on morphometric and paleontological analyses conducted at local apiaries, it was established that the Carniolan (*A. m. carnica*) and Carpathian (*A. m. carpatica*) honey bee breeds are widely distributed in these areas. A comprehensive evaluation of key traits such as honey and wax productivity, winter hardiness, docility, and floral specialization confirmed the successful adaptation of these breeds to regional environmental conditions.

The study also demonstrated that morphological and economically valuable characteristics of bees are strongly correlated with their climatic and geographical adaptability and overall productivity. Moreover, the variability of morphometric indices—including the cubital, hantel, and discoidal shift indices—highlighted the necessity for targeted selective breeding programs.

Based on the collected data, specific recommendations were developed for the regional distribution (zoning) of bee breeds according to local ecological features, as well as for the effective implementation of selective breeding at apiaries. These findings provide a scientific foundation for the sustainable development of beekeeping in the southeastern regions of Kazakhstan.

Practical Significance:

This research contributes to enhancing the efficiency of beekeeping in Southeastern Kazakhstan, increasing bee productivity, and preserving their genetic potential. It enables the molecular-genetic and morphometric characterization of local bee populations in the region. The obtained data can serve as a foundation for the scientific organization of selection-associated programs and the development of gene pool conservation strategies. The practical outcomes of this study will support the effective management of beekeeping operations and ensure ecological sustainability.

Alignment with Scientific Development Directions or Government Programs:

As part of the scientific and technical program for 2021-2023, "Development of Technologies for Effective Management of the Selection Process in Beekeeping."

Scientific Propositions to be Defended:

- Morphological traits of honeybee breeds raised in the southeastern region of Kazakhstan.
- Results of a comparative analysis of economically valuable traits of various honeybee breeds raised in the southeastern region of Kazakhstan.
- Research data on the productivity of different honeybee breeds raised in the southeastern region of Kazakhstan.
- Results of the analysis of the economic efficiency of using different honeybee breeds in beekeeping enterprises of the southeastern region of Kazakhstan.

Contribution of the Doctoral Candidate to the Preparation of Each Publication:

All results and conclusions presented in the dissertation were obtained with the direct participation of the doctoral candidate as part of his individual research plan and scientifically substantiated. During the research, the doctoral candidate mastered modern methodologies and used them for processing, analyzing, and interpreting the obtained data. Moreover, the doctoral candidate actively participated in the preparation of scientific articles, their formatting for publication in national and international scientific journals, as well as in the discussion of research findings within the scientific community. The results of this research were obtained based on experiments and scientific inquiries conducted with the direct participation of the doctoral candidate. His contribution covers the collection and analysis of scientific data, the assessment of their practical significance, and their integration into scientific circulation.

Publication and Approval of Dissertation Materials

The results of the scientific research and the main provisions of the dissertation have been published in 3 articles in journals included in the list of publications recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, as well as in 1 article indexed in the Scopus database. These include: Kazakh National Agrarian University, journal Research and Results, Almaty, No. 2 (98), 2023; No. 4 (100), 2023; Western Kazakhstan Agrarian Technical University named after Zhangir Khan, journal Science and Education, No. 3(68) (2022), as well as 1 article in an international journal indexed in the Scopus database – OnLine Journal of Biological Sciences (USA, 2023).

Published Articles:

The Impact of Environment on the Morphometric Characteristics of Honeybees *Apis Mellifera Carnica* in South-East Kazakhstan // OnLine Journal of Biological Sciences, 2023, 23 (4): 520-527.

Morphometric Characteristics of Worker Bees from Breeding Apiaries in Almaty and Zhetysu Regions // Research and Results, KazNAU, No. 2 (98), 2023, pp. 51–60.

Pollen Analysis of Honeybees // Research and Results, KazNAU, No. 4 (100), 2023, pp. 5-10.

Beneficial Properties of Bee Species in Relation to the Natural and Climatic Features of South-Eastern Kazakhstan // Science and Education, Western

Kazakhstan Agrarian Technical University named after Zhangir Khan, Vol. 2, No. 3(68) (2022), pp. 112-122.

Volume and Structure of the Dissertation

The dissertation consists of an introduction, literature review, research methodology and materials, research results, conclusion, list of references, and appendices. The total volume of the dissertation is 125 pages, including 21 tables and 30 figures.