

## ANNOTATION

**thesis work by Yerekeyeva Svetlana Zhursinbekovna on the topic: «Studying of medicinal herbs of the Northern Tien Shan to generate a collection of Kazakhstan natural flora and their in-situ and ex-situ preservation», submitted for the degree of Doctor of Philosophy (PhD) in the specialty 6D060800 – «Ecology»**

**Relevance of research topic.** When studying medicinal, food and other useful plants, the primary task is to create collections of living plants that ensure not only the preservation of the gene pool itself, but also serve as a scientific basis for conducting complex experimental research. The main activity of botanical gardens, which are entrusted with the mission of preserving plants ex-situ, is related to the mobilization and preservation of plant genetic resources.

Environmental degradation and climate change everywhere and powerfully transform the productivity of the entire vegetation cover of Kazakhstan, both from natural and introduced flora. In this regard, research on identifying and attracting from natural habitats for cultivation in culture economically useful plant species with predetermined valuable qualities is relevant.

Flora of Kazakhstan has great potential as a source of official and promising medicinal plants, represented by 1406 species from 134 families. Many years of experience in studying medicinal plants have shown that extracts from them have low toxicity and show the necessary therapeutic properties, and a variety of biologically active substances provides a wide range of pharmacological effects of herbal preparations. Nowadays, official medicine is increasingly giving priority to medicinal plants in the treatment of many diseases. Therefore, the search for and study of new sources of medicinal plant raw materials is a very urgent task.

For the rational use and conservation of natural resources, introduction plays an important role as one of the most important ways to enrich the local gene pool of plants, which allows solving theoretical and various practical problems, makes it possible to select the best species with valuable economic characteristics, to assess the introduction stability of plants of natural flora, which is an integral indicator of the biological state of plants in new conditions of existence.

One of the tasks of the introduction process is the creation and expansion of the gene pool of plants by introducing into the culture promising genera and species that have not previously been found in certain climatic conditions, or their transfer to the culture from places of natural growth. Sources for introduction can be local vegetation, flora of neighboring areas, regions, as well as various countries and even continents.

In this regard, the comprehensive study and involvement of medicinal plants of the Northern Tien Shan to form a collection of natural flora of Kazakhstan, testing and growing medicinal species in culture, identifying promising introducers for the implementation of the tasks of the «green» economy, assessment of the environmental safety of plant raw materials of cultivated species of medicinal plants, the development of scientifically based recommendations for their cultivation in the

foothill zone of Zailiysky Alatau will contribute to the restoration and sustainable use of Kazakhstan's unique genetic resources; implementation by the State Botanical Gardens of the tasks of the Global Strategy for Plant Conservation, as well as the Address of the President of the Republic of Kazakhstan to the people of Kazakhstan dated September 01, 2020 «Kazakhstan in a new reality: time for action» - VII. Ecology and protection of biodiversity.

**The purpose of the thesis research:**

The purpose of the study is to attract medicinal plants of the Northern Tien Shan to form a collection of medicinal plants of the natural flora of Kazakhstan and preserve them in situ and ex-situ.

**Research objectives:**

1 Review of the current state of introduction knowledge of medicinal plants in Kazakhstan.

2 Analysis of the species diversity of the medicinal flora of the Northern Tien Shan.

3 Identification of promising species of medicinal plants of the Northern Tien Shan in natural populations for the formation of a collection of natural flora in the Main Botanical Garden located in the foothill zone of the Zailiysky Alatau.

4 Collection of seed (or) planting material of promising species of medicinal plants of the Northern Tien Shan.

5 Attraction and testing in culture of promising species of medicinal plants of the Northern Tien Shan (determination of laboratory, field germination capacity of seeds, plant productivity, phenological indicators, success of introduction).

6 Assessment of environmental safety of plant raw materials of cultivated species of medicinal plants.

7 Development of recommendations on the peculiarities of cultivation of the most promising species of medicinal plants of the Northern Tien Shan in the foothill zone of Zailiysky Alatau.

**Objects and methods of research:** medicinal plants of the Northern Tien Shan in natural populations and in cultural conditions.

The work was carried out in 2018–2023 at the laboratory of plant resources of the Republican State Enterprise on the Right of Economic Management «Institute of Botany and Phytointroduction» of the Committee of Forestry and Wildlife of the Ministry of Ecology and Natural Resources of the Republic of Kazakhstan. Introduction studies were carried out at the collection site of medicinal plants of the Main Botanical Garden.

Expeditionary trips for the collection of planting and seed material of medicinal plants were carried out in the foothills and mountains of the Northern Tien Shan (Zailiysky Alatau, Terskey Alatau, Sogety mountains) within the Karasai, Enbekshikazakh and Kegen administrative districts of Almaty region. The work used generally accepted resource-based, geobotanical, introductory research methods. The expeditionary survey was carried out by route reconnaissance method using a cartographic basis: a small-scale (1:1000 000) administrative map of the Almaty region. The coordinates of the area where the plant material of the studied plant species was collected were determined using the «Garmin» GPS navigator. To

create cartographs on the distribution of the studied species, the coordinates obtained using the navigator were plotted on a satellite map «Google Earth». Observations of the growth and development rhythm of plants were carried out according to the method of M.N. Beideman. We used the «Recommendations for the study of the ontogenesis of introduced plants in the botanical gardens of the USSR».

Phenological studies were carried out according to the «Method of phenological observations in botanical gardens». Determination of the productivity of raw materials and seeds was carried out according to the «Methodology for studies in the introduction of medicinal plants». The method of Vainagiy I.V. was applied in the study of seed productivity of plants. For introduced species, based on long-term observations and in accordance with the vital state of collection plants, the introduction success index (ISI) of the species was calculated, varying from 1 to 6: 1 – the plant falls during the first growing season; 2 – grows, sometimes blooms, but does not produce full-fledged seeds; 3 – bears fruit when creating specific conditions; 4 – bears fruit in open ground, but not regularly; 5 – successfully grows and bears fruit; 6 – is a self-renewing or weeping species.

Species taxonomy is given according to the APG IV system. The species names of the studied plants are given by the «Plantarium» open online atlas of plants and lichens in Russia and neighboring countries and the Plants of the World online database.

#### **Main provisions submitted for defense:**

1. analysis of the species diversity and introductory knowledge of the medicinal flora of the Northern Tien Shan;
2. introduction characteristics of new attracted species of medicinal plants of the Northern Tien Shan;
3. assessment of the environmental safety of plant materials of cultivated species of medicinal plants;
4. recommendations on the peculiarities of cultivation of promising species of medicinal plants of the Northern Tien Shan in the foothill zone of Zailiysky Alatau.

#### **Description of the main results of the study.**

The dissertation presents the results of the conducted introductory study of the biological characteristics of new species of medicinal plants of the Northern Tien Shan flora for the collection, which indicate the possibility of their successful cultivation in the foothill zone of the Zailiysky Alatau.

An «Annotated list of medicinal plants of the Northern Tien Shan» has been compiled, representing 782 species belonging to 421 genera and 108 families of vascular plants, on the basis of which new species of medicinal plants of the natural flora of Kazakhstan that are promising for introduction testing have been included in the collection.

In 2018–2020, more than 90 samples of 51 species of medicinal plants of the Northern Tien Shan flora from 17 families were collected and tested, which made it possible to add 18 new species to the main collection of medicinal plants of the Main Botanical Garden.

143 samples of seeds of medicinal plants of the Northern Tien Shan were collected and transferred to the Seed Bank of the natural flora of Kazakhstan of the

Republican State Enterprise on the Right of Economic Management «Institute of Botany and Phytointroduction» of the Committee of Forestry and Wildlife of the Ministry of Ecology and Natural Resources of the Republic of Kazakhstan.

Soil and plant raw materials were analyzed for the content of toxic (Pb, Cd) and mineral (Zn, Cu) elements in 6 species of plants of the *Lamiaceae* family tested at the collection site of medicinal plants of the Main Botanical Garden (Almaty).

Recommendations on the peculiarities of cultivation in the foothill zone of the Zailiysky Alatau of 18 new species of flora of the Northern Tien Shan that have passed the introduction test are proposed.

### **Substantiation of the novelty and importance of the results obtained.**

For the first time, an «Annotated list of medicinal plants of the Northern Tien Shan» was compiled and the current state of the introduction of medicinal plants in the region was analyzed.

New information has been obtained on the biological characteristics of 18 promising species of medicinal plants of the region, cultivated in the foothill zone of the Zailiysky Alatau, which also has scientific, educational and ecological value.

For the first time, an assessment of the environmental safety of plant materials in 6 cultivated species of medicinal plants from the *Lamiaceae* family for the content of toxic (Pb, Cd) and mineral (Zn, Cu) elements was carried out, as well as an analysis of the soil of the medicinal plant collection site of the Main Botanical Garden (Almaty), indicating that the concentrations of heavy metals (Cd, Pb, Zn, Cu) in the soils of the site are within the MPC, and in the studied samples of plant materials do not exceed the MPC for food plants and biologically active additives on a plant basis.

The Seed Bank of the Natural flora of Kazakhstan of the Republican State Enterprise on the Right of Economic Management «Institute of Botany and Phytointroduction» of the Committee of Forestry and Wildlife of the Ministry of Ecology and Natural Resources of the Republic of Kazakhstan has been replenished with 143 samples of seeds of medicinal plants of the Northern Tien Shan.

The collection of medicinal plants of the natural flora of the Main Botanical Garden (Almaty) has been replenished with 18 new species.

Recommendations have been developed on the specifics of cultivating 18 species of medicinal plants of the Northern Tien Shan in the foothill zone of the Zailiysky Alatau, which will reduce the burden on natural populations, preserve them in their natural habitats and obtain a new source of herbal medicines for improving the health of the republic's population.

The results of the research will serve to replenish the genetic diversity of living plant collections and to select the most promising and stable species of medicinal plants of various life forms when adapting them to new soil and climatic conditions.

**Compliance with the directions of development of science or state programs:** the work was carried out within the framework of the research laboratory of plant resources Republican State Enterprise on the Right of Economic Management «Institute of Botany and Phytointroduction» of the Committee of Forestry and Wildlife of the Ministry of Ecology and Natural Resources of the Republic of Kazakhstan under the scientific and technical program 0.0860, budget

program 217 «Development of Science», subprogramme 101 «Programmatic and targeted financing of subjects of scientific and/or scientific and technical activities», by priority: «Rational use of natural resources, processing of raw materials and products»: No. BR05236546 "Implementation by state botanical gardens of priority for Kazakhstan scientific and practical tasks of the global strategy for plant conservation as a sustainable system for maintaining biodiversity» (2018-2020); BR10264557 "Cadastral assessment of the current ecological state of flora and plant resources of the Almaty region as a scientific basis for effective management of resource potential" (2021–2023).

**Contribution of the PhD student to the preparation of each publication.** The share of the author's personal participation in writing and preparing publications is proportional to the number of co-authors (2018-2020). The author was directly involved in expeditionary visits to collect planting and seed material, he performed introductory studies at the collection site of medicinal plants in the Main Botanical Garden (2018-2020).

On the material of the dissertation published 14 scientific papers, 4 of them - in scientific publications recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Education and Science of the Republic of Kazakhstan, 9 - in the materials of international scientific conferences, 1 article was published in a journal included in the Scopus database (Q2-3, CiteScore percentile 61%, IF = 1.8).

**Volume and structure of the dissertation:** the dissertation consists of an introduction, 4 chapters, conclusions, recommendations, a list of literature (284 titles, including 76 in a foreign language). The work is presented on 146 pages of text, includes 18 tables, 22 figures, 4 appendices.