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Dissertation for the degree of Doctor of Philosophy (PhD) in the specialty

"8D05108 - Geobotany"

ABSTRACT

**"Study of the Current State of *Gentiana tianschanica* and *Gentiana olivieri*
Cenopopulations in Southeastern Kazakhstan"**

General characteristics of the study

This dissertation is devoted to assessing the current state of the cenopopulations of the medicinal plants *Gentiana tianschanica* (Tianshan Gentian) and *Gentiana olivieri* (Olivier Gentian) in southeastern Kazakhstan. The study examines their distribution range, population structure, soil parameters, introduction potential, and phytochemical properties. The research results are aimed at developing conservation and sustainable use strategies for medicinal plants.

Relevance of the topic

The flora of southeastern Kazakhstan is rich in medicinal plants, among which *G. tianschanica* and *G. olivieri* stand out due to their high pharmacological value. Their chemical composition includes alkaloids, glycosides, phenolic compounds, and other biologically active substances widely used in both traditional and modern medicine.

In recent years, anthropogenic factors such as land development for agriculture, livestock grazing, and excessive exploitation of natural resources have led to a significant reduction in the natural populations of these plants. Climate change also negatively affects their distribution. The risk of extinction of rare medicinal plants is increasing, turning this issue into not only an ecological but also an economic and social problem.

Assessing the current state of natural populations of *G. tianschanica* and *G. olivieri*, identifying their ecological adaptation mechanisms, and determining rational ways of utilization are pressing issues. This research provides a scientific basis for biodiversity conservation, rational use of natural resources, and the development of new pharmacological drugs.

The ecosystem of southeastern Kazakhstan is of high value for biodiversity conservation, as it serves as a habitat for numerous endemic and rare plant species. *Gentiana* species play a crucial role in ecosystem stability, enhancing soil erosion resistance, regulating water balance, and creating favorable conditions for other plants and organisms.

Pharmaceutical importance

Bioactive compounds derived from *Gentiana* species exhibit anti-inflammatory, immunomodulatory, and antioxidant properties. In traditional medicine, preparations based on *Gentiana* are widely used to treat gastrointestinal diseases. International experience demonstrates a high demand for pharmaceutical products derived from these plants, opening new opportunities for the development of Kazakhstan's pharmaceutical industry.

Thus, this research has ecological, economic, and pharmacological significance. Its results will contribute to the development of conservation policies and strategies for the sustainable use of medicinal plants.

Object of the study

The object of this study is the populations of *G. tianschanica* and *G. olivieri*, which grow naturally in southeastern Kazakhstan and have high pharmacological significance.

Subject of the study

The subject of the study includes ecological adaptation mechanisms, population structure, biomorphological and phytochemical properties of these plants, as well as their interrelation with the ecological parameters of their distribution areas.

Research goal

The goal of this research is to study the current state of *G. tianschanica* and *G. olivieri* cenopopulations in southeastern Kazakhstan.

Research objectives

1. To characterize the cenopopulations of *G. tianschanica* and *G. olivieri* and their ecological conditions.
2. To analyze the population structure and biomorphological indicators of these plants.
3. To determine the properties of the soil where *G. tianschanica* and *G. olivieri* grow and assess their seed germination potential.
4. To investigate the biologically active compounds and anatomical structures of these plants.

Scientific novelty

For the first time, a comprehensive study of *G. tianschanica* and *G. olivieri* populations in southeastern Kazakhstan has been conducted. Their ecological, morphological, and phytochemical characteristics have been identified.

The study describes the geobotanical and ecological characteristics of their distribution areas, as well as the population structure, age composition, and viability levels. The dependence of ecological adaptation mechanisms on soil factors has been scientifically proven.

One of the key results of the study is the identification of the phytochemical composition of these plants and an evaluation of their potential for pharmaceutical drug development.

Another significant outcome is the development of scientifically based recommendations for the conservation and sustainable use of these plants, opening new opportunities for their application in pharmacy.

Theoretical and practical significance

The research results contribute to the theoretical knowledge of ecological adaptation and phytochemical composition of plants. The collected data on the population structure and distribution areas of *G. tianschanica* and *G. olivieri* enhance biological and ecological sciences.

Practically, the study results can be used for the conservation of medicinal plants, the restoration of their natural populations, and the development of new pharmaceutical products.

The obtained data can be applied in pharmaceutical production and projects aimed at improving the efficiency of medicinal plant cultivation.

Key Findings submitted for defense

1. A comprehensive study of the distribution range and population structure of *G. tianschanica* and *G. olivieri* in southeastern Kazakhstan has been conducted for the first time.

2. The ecological adaptation mechanisms of these plants and their dependence on soil factors have been scientifically proven.

3. The phytochemical composition of these plants has been identified, and their potential for pharmaceutical drug development has been assessed.

4. Scientifically grounded recommendations for the conservation and sustainable use of these plants have been developed.

Personal contribution of the dissertation author to the research presented for defense

The dissertation author independently carried out all stages of the research and made a direct contribution to its results. Field studies were conducted to determine the distribution range of *G. tianschanica* and *G. olivieri*, and their geobotanical characteristics were described. The population structure of these plants, including their age and quantitative parameters, was assessed, and their current state was evaluated based on the analysis of the obtained data. The main chemical and physical properties of the soil were studied, and their impact on the ecological adaptation of the plants was determined.

The phytochemical composition of *Gentiana* species was analyzed, bioactive components were identified, and the pharmacological potential of these plants was evaluated. The dissertation author analyzed the research results, prepared scientific articles, and presented them at international and national conferences. Based on the obtained data, recommendations for the conservation and sustainable use of these plants were developed and scientifically substantiated.

Research validation

The research results were reviewed and discussed at the international and national levels within the scientific community. The key findings of the study were presented at the following scientific conferences:

- International Scientific Conference of Students and Young Scientists "Farabi Álemi" (April 8-10, 2024, Almaty, Kazakhstan);

- 6th International Scientific Conference "Modern Scientific Technologies" (April 4-5, 2024, Stockholm, Sweden);

- 6th International Scientific Conference "Global Scientific Research" (May 9-10, 2024, Paris, France).

Based on the research findings, seven scientific articles were published, including:

Two articles in Scopus-indexed journals (percentiles 97 and 89, the author's h-index is 3);

2 articles in journals indexed in the Scopus database (percentile 97 and 89, author h-index – 3);

1 article in a national scientific journal included in the list of the Committee for Control in the Sphere of Education and Science of the Republic of Kazakhstan;

4 abstracts in the materials of international scientific conferences. The dissertation consists of 204 pages and includes an introduction, a review of domestic and international literature, a description of research objects and methods, discussion of results, and a conclusion. It also contains 194 references, 36 tables, and 38 figures.