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Introduction of Wild Medicinal Plants in the Botanical Garden of Osh State University

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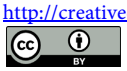

Abstract

In the conditions of the botanical garden of Osh State University, a comprehensive study of introduction of common oregano (*Origanum vulgare* L.) is carried out in order to breed stable endemic forms for further use in breeding work. The article presents the results of primary adaptation of various species of oregano imported from other regions of Kyrgyzstan and abroad. Special attention is paid to the survival rate of plants in the first year of vegetation, as well as their reaction to extreme climatic conditions of winter and spring 2024. It is shown that despite unfavorable weather factors, some of the samples showed high resistance and adaptability, which allowed to collect seed material for further multiplication. Artificial selection methods were used to improve economically valuable traits such as yield, seed productivity, winter hardiness and morphological features. The research is conducted within the framework of the National Climate Change Adaptation Plan, which emphasizes the relevance of the work in the context of sustainable development of agro-ecosystems in Kyrgyzstan. Based on the data obtained, the authors consider it necessary to conduct further experiments to study the genetic resources of new endemic forms of medicinal plants for the purpose of their selective improvement.

Keywords

Introduction, Botanical Garden, *Origanum vulgare*, *Sālvia officinālis*, *Artemisia absinthium* L.

1. Introduction

Botanic gardens play an important role in the research, conservation and sustainable use of biodiversity. They have evolved from the study of medicinal plants to

address broader social and environmental challenges. Successful implementation of medicinal plants requires imitation of the natural environment and interdisciplinary collaboration (Huang & Liao, 2022; Krishnan & Novy 2016; Portnyagina et al., 2011; Tsitsilin, 2021; Vasfilova et al., 2013; Chen, 2012).

Ethnobotanical studies, such as the one conducted in the Dharampur region of India, document the traditional knowledge and use of medicinal plants that can help in their introduction and cultivation in botanical gardens (Hazrat et al., 2010; Kumar et al., 2021).

Minyazev's article reviews the results of the introduction of 75 species of medicinal plants of the Far East in the conditions of the Botanical Garden of VILAR, analyzing their adaptation and stability (Minyazeva, 2023).

Khrynova et al. describe the experience of growing 46 species of herbaceous plants of Central Asia in the open ground of the Botanical Garden of the IBBM NNGU; their adaptive abilities are analyzed (Khrynova & Khrynova, 2023).

Studies by Ivashchenko et al. are devoted to the study of biological features and adaptive capabilities of *Fritillaria karelinii* during introduction in the conditions of the Main Botanical Garden of Almaty (Ivashchenko et al., 2023).

In the Kyrgyz Republic, scientific medicine uses about 200 species of plants, while in folk medicine their number reaches about 1000 species. From these data, it is clear that there is a wide potential for further research in the field of medicinal plants. Some studied species are able to undergo significant changes in their structure, while the basic biological processes remain stable, which opens up opportunities for their use and adaptation to human needs (Karimov et al., 2024).

In this regard, it is important to establish cooperation between scientific institutions and other organizations in the following key areas: searching for the most effective sources of biologically active substances, conducting biomedical evaluation of active components, identification of plant raw materials that can be used for the development of drugs, as well as the study of biotechnological opportunities for obtaining medicinal raw materials.

In recent years, several recreational areas for winter and summer recreation have been established in Alai district of Osh province. There is also an increase in the intensity of cattle grazing. These processes have a negative impact on the flora and fauna of the region, which leads to a decrease in the number of endemic plants.

The change of natural ecosystems in the Gulcha (Kurshab) River basin has led to the fact that some plant species have become rare or disappeared, and many others are subject to degradation. In this regard, one of the most effective ways to preserve the vegetation of the region is the cultivation of endemic, relict and medicinal plants in the botanical garden of Osh State University. This will create a reserve for species conservation and provide an opportunity to use economically valuable plants.

Thus, the development of methods of introduction of ornamental and medicinal plants occurring in the natural ecosystems of the Gulcha (Kurshab) River ba-

sin of Alai district becomes urgent. This study is part of the implementation of the National Climate Change Adaptation Plan in the Kyrgyz Republic and is in line with the UN Sustainable Development Goals, supporting sustainable and balanced development of the country taking into account climate change, environmental and socio-economic challenges.

In the course of medicinal plant research, the following system of work was developed:

- initial collection research with selection of the most valuable species;
- creation of seed plots and experimental research on species promising for further research;
- pilot cultivation of new plant species, which are proposed to be introduced into mass production.

2. Materials and Methods

The object of our study is medicinal plants distributed in the basin of the river Gulcha (Kurshab) in the Alai district of Osh oblast.

In order to conduct research on medicinal plants according to the specified system, an experiment was organized on the basis of the botanical garden of the university. The main objective of the work was to study agrobiological features of cultivation of the most valuable and promising medicinal and ornamental plants in specific environmental conditions. Seeds of 9 species of medicinal plants were prepared and experiments were conducted in accordance with the selected methodology. The area of the experimental plot was 10 m^2, counting area was 6 m^2, the experiment was repeated three times, sowing was row sowing with row spacing of 60 cm.

The following plants were studied during the experiment: *Sālvia officinālis*, *Artemisia absinthium* L., *Origanum vulgare* L., *Cárum cárvi*, *Matricāria chamomīlla*, *Codonopsis clematidea*, *Glaucium fimbrilligerum* Boiss., *Delphinium confusum* Popov, *Dictamnus angustifolius* and *Conium maculatum*.

Common reference materials such as works by N.I. Vavilov (Vavilov, 1966) and B.A. Dospekhov (Dospekhov, 1985) were used to address methodological issues.

The aim of the study was to determine the following parameters:

- survival rate of the plants under study;
- possibility of obtaining plant raw material;
- possibility of seed collection.

Agrochemical, physical and microbiological characteristics of the soil were evaluated before the experiments. After sowing the plants, phenological observations and biometric measurements were regularly conducted.

3. Results and Discussion

One of the key indicators is the survival rate of medicinal plants depending on their species composition in the first year of life. Among the crops studied, plants such as sage (*Sālvia officinālis*), bitter wormwood (*Artemisia absinthium* L.), ore-

gano (*Origanum vulgare* L.), caraway (*Cárum cárvi*), chamomile (*Matricária chamomílla*) and *Codonopsis clematidea* showed the best results. These species successfully survived the winter and showed more than 80% survival rate. At the same time, other species such as *Glaucium fimbrilligerum* Boiss. (12%), *Delphinium confusum* Popov (6%), *Dictamnus angustifolius* (18%) and *Conium maculatum* (30%), showed significantly lower survival results (Figure 1).

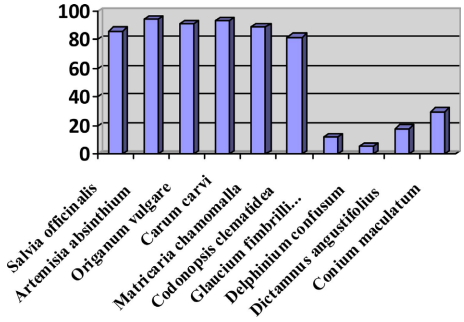

Figure 1. Survival of medicinal plants.

One of the important indicators for the studied plants is their yield on plant raw material. Of all the species studied, those that showed stable yield results were identified. For example, common caraway showed a six-year average yield of 4.8 t/ha, bitter wormwood 3.9 t/ha, common oregano 11.2 t/ha, medicinal sage 11.4 t/ha, and medicinal chamomile 13.2 t/ha.

However, among the studied species there were also those that showed low yields. In some plants, it tended to zero over time. For example, medicinal sage had a yield of 15.4 t/ha in the first year, but it disappeared in subsequent years. Common caraway showed a green mass yield of 5.0 t/ha in the first year, but in the following year, the plant did not survive the climatic conditions. *Delphinium confusum* Popov also showed green mass yield in the first three years (5.2 t/ha), after which the species disappeared (Figure 2).

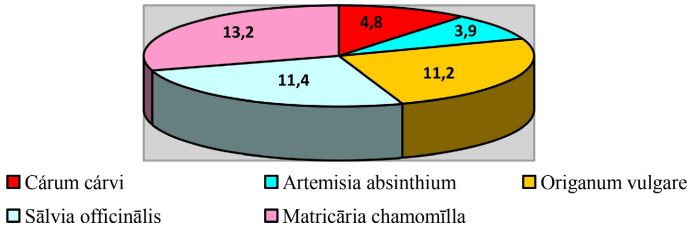

Figure 2. Yield of medicinal plants.

One of the important indicators for the study and subsequent propagation of medicinal plants is seed productivity. According to the results of the research, it was found that in some species of medicinal plants seed productivity remained stable throughout the entire period of the experiment. Such plants include bitter wormwood (0.3 t/ha), common oregano (0.2 t/ha), St. John's wort (0.1 t/ha), common caraway (0.3 t/ha), and chamomile (0.2 t/ha).

Species with low seed production were also identified, and some plants had no seed production. For example, lemon mint had a seed yield of 0.07 t/ha, while thyme creeping thyme had a seed yield of 0.06 t/ha. Sage and common anise had zero seed productivity.

The results of research on the yield of plant raw materials and seed productivity of various species of medicinal plants allow to select those plants that can be used for further research and further application in the national economy of Kyrgyzstan.

Based on the obtained results of the study of various species of medicinal plants, the work on the introduction of valuable plant species was continued. Earlier studies have shown that the basis of breeding work is the selection and creation of source material taking into account local and wild forms that have undergone natural selection in the conditions of the given natural and climatic zone and adapted to it. After initial collection study and selection of the most valuable species of medicinal plants, we focused on a more detailed study of common oregano as one of the promising species.

Today oregano is attracting more and more interest as it has a wide range of applications in cooking, medicine and agriculture. The unique natural and climatic conditions of the Alay Ridge and the proven advantages of using local varieties require breeding work directly in this region. In the future, the main goal of breeding work with common oregano is to create high-yielding varieties of intensive type, with increased winter hardiness and resistance to diseases, as well as improved quality characteristics. An important direction is breeding for early maturity, stable and high seed productivity, since seed yield of oregano varies greatly from year to year. In addition, oregano is prone to uneven ripening, which leads to seed shattering.

In the conditions of the botanical garden of Osh State University, scientific work on the development of technological elements of the creation of new endemic forms of medicinal plants for the selection of oregano (*Origanum vulgare* L.) and improvement of methods of its cultivation is carried out. For the first time, a comprehensive selection of oregano samples introduced from different regions of the Kyrgyz Republic was carried out. Seeds originating from habitats outside the country were also used.

All samples were placed on experimental plots in accordance with the methodology of the field experiment. 800 plants were used in the study, for which a soil base was prepared in advance and an experimental design was developed.

Within the framework of breeding work, methods of artificial selection aimed at improving the initial population by the main economically valuable traits were applied. Promising forms with high productivity and adaptation to the conditions of the region were selected. Scientific research is carried out on the basis of the educational and scientific laboratory "Plant Biodiversity" of Osh State University and has a long-term character.

Particular attention is paid to morphological and economic characteristics of

plants: height, number of generative shoots, yield of plant raw materials and seeds, content of biologically active substances, duration of vegetation period from the beginning of regrowth to flowering. Also analyzed are the shape of the bush, flower color, the degree of cladding and pubescence of plants.

After laying the field experiment, the ability of different forms of common oregano (*Origanum vulgare* L.) to overwinter and their behavior during the first growing season was evaluated. The winter period of 2024 was characterized by abnormally low temperatures: in January and February they steadily dropped to -20˚C, which adversely affected the condition of plants. Early spring also did not provide favorable conditions: snow storms and low temperatures were observed in April, and in May, night frosts and cold daytime temperatures delayed the start of active vegetation by two weeks.

The summer was wet and cool: the total amount of precipitation exceeded the climatic norm, while the temperature regime was below the annual average. Nevertheless, despite the difficult weather conditions, the experiment was conducted in accordance with the planned research program.

Based on the results of the field season, the forms of oregano that showed resistance to abiotic stresses were identified. The obtained seed material from the most resistant forms was used for further multiplication and inclusion in breeding programs. The work on the creation of adapted endemic forms of medicinal plants continues, and preliminary results demonstrate positive prospects in the breeding of common oregano.

The influence of climatic conditions on plant survival and productivity is also an important factor. Unusually low temperatures and late spring frosts in 2024 showed how much variation in results can occur, especially for species with low winter hardiness. To better assess plant tolerance to climate extremes, long-term studies should be conducted in different climate zones to identify more resistant varieties.

In addition, the study conducted does not take into account the influence of some other factors such as soil conditions, presence of diseases or pests that can significantly affect plant productivity and survival. Future studies will benefit from including these parameters for a more comprehensive evaluation.

These studies can serve as a basis for further work on variety improvement and application of the results in breeding other plant species. Future research should focus on a more in-depth analysis of the effects of environmental factors on yield and seed production, and on developing methods to integrate these species into the region's agricultural systems.

4. Conclusion

In the course of the study, key elements of creating new endemic forms of medicinal plants were developed, with emphasis on selection of oregano and its cultivation technologies. Selection of oregano species imported from different regions of Kyrgyzstan and outside the country was first carried out in the conditions of the

botanical garden of Osh State University. All samples were placed in the experimental field and systematically examined. The application of artificial selection methods allowed to improve the initial population by the main economically valuable traits. Long-term studies in the laboratory of "Plant Biodiversity" of Osh State University showed that the population of oregano differs in morphological and economically useful traits. Despite unfavorable climatic conditions of winter 2024, the research was successfully conducted and species that passed weather endurance tests were identified. The obtained seed material was used for further multiplication of the species of interest.

Thus, the proposed breeding methods proved their effectiveness not only at the stage of initial trials, but also in the context of adaptability and reproducibility of traits in field conditions. This indicates a high probability of their long-term effectiveness in the breeding and introduction of new stable forms of oregano into agricultural production.

Author Contributions

Writing-review and editing: Karimov Bolotbek Akimovich;
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Investigation: Dursunbaeva Aida Zhakypovna;
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Resources: Karimov Meder Bolotbekovich.

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [Karimov Bolotbek], [Dursunbaeva Aida], [Abdyrakhmanova Zhazgul] and [Karimov Meder]. The first draft of the manuscript was written by [Boronbaeva Ainazik] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data Availability Statement

The authors declare that all studies were conducted on the basis of the educational and scientific laboratory "Biodiversity of Plants" of Osh State University. Posa and all samples were placed on the experimental field of the botanical garden.

Conflicts of Interest

The authors have no relevant financial or non-financial interests to disclose.

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