

## ANNOTATION

thesis work by Tokenova Akerke Muratkyzy on the topic: “Phenotypic variability of the morphological organs of longitudinal onion (*Allium longicuspis* L.) in embryonic natural populations and introduction in South East of Kazakhstan”, submitted for the degree of Doctor of Philosophy ( PhD ) in the educational program 6D080100 “Agronomy”

**Relevance of the research topic.** The natural flora of Kazakhstan is rich in valuable species of useful plants, among which onions ( *Allium* L.) occupy a special place. Genus *Allium* L. is the largest in the *Amaryllidaceae* family J. St. - Hil . and includes more than 1000 species distributed in temperate latitudes of both hemispheres. Almost a third of the world's diversity of species of the genus grows in Central Asia *Allium* L., of which at least 25% of species have been introduced into culture. Recently, the attention of scientists has been attracted by representatives of the genus *Allium* L., widely used for medicinal and food purposes, as a source of biologically active substances and micronutrients that inhibit the growth of tumors and microbial cells, reduce the risk of cancer, and protect humans from cardiovascular diseases.

In the flora of Kazakhstan, according to various floristic reports, from 108 to 140 species of rivers are described. *Allium* L., growing almost everywhere - from deserts to the mountain alpine zone. According to the latest data (2024) of the open online atlas and identification of plants, the Plantarium genus *Allium* L. in the flora of Kazakhstan (floristic list) includes 130 species and the compilation of the list has not yet been completed. Medicinal properties are known for 12 Kazakhstan types of onions, which have anthelmintic, antibacterial, antifungal, tonic and other effects. 14 wild onions are eaten. Most types of onions, due to their beneficial properties, are subject to uncontrolled and predatory harvesting; already 12 species are listed in the Red Book of Kazakhstan (2014). However, many onions are still underutilized due to poor knowledge of their phytochemical composition and biological activity, as well as their biology. Similar information is available for no more than 20 Kazakh bows.

Plant introduction is an important area of work for botanical gardens, during which many practical and theoretical problems are solved. The study of the biological and morphological characteristics of the attracted plant species makes it possible to judge the changes that occur during the adaptation of the introduced species to new conditions. Wild and local specimens of species are of particular value as donors of genes for resistance to diseases, pests and adverse environmental factors.

Among wild edible onions, long onion occupies a special place. *Allium longicuspis* - a perennial geophyte that reproduces only vegetatively: by aerial bulbs, underground bulbs or parts thereof, which has valuable genetic characteristics - resistance to unfavorable environmental conditions, most used by the population, and of industrial and breeding interest.

The study, introduction into culture and practical use of wild species is an important task of experimental botany and agronomy. Studying the development and

reproduction features of wild plants will make it possible to more effectively use them in agriculture, medicine, and ornamental gardening.

In this regard, the attraction of wild onions (using the example of long onions *A. longicuspis*) into culture for the formation of a collection of natural flora of Kazakhstan and the development of scientifically based recommendations for their cultivation in the foothill zone of the Trans-Ili Alatau, are relevant and will contribute to the restoration and sustainable use of the unique genetic resources of Kazakhstan; implementation of the tasks of the Global Plant Conservation Strategy by the State Botanical Gardens.

#### **The purpose of the thesis research:**

The purpose of the research is to identify patterns of phenotypic variability in the morphological characteristics of long-awned onion (*A. longicuspis*) in natural populations of south-east Kazakhstan and evaluate their prospects under conditions of introduction.

#### **Research objectives:**

1 Characteristics of identified natural populations of long onion (*A. longicuspis*) in the southeast of Kazakhstan within the Shu-Ili mountains.

2 Identification of the specifics of intraspecific variability of *A. longicuspis* according to morphological characters in nature and during introduction in the southeast of Kazakhstan.

3 Comparative analysis of soils in the collection area of medicinal plants of the Main Botanical Garden (GBG, Almaty) and natural populations of *A. longicuspis* (Shu-Ili mountains).

4 Conducting phenological observations and biometric calculations of growth and development indicators during the introduction of the plant species under study.

5 Determination of resistance to fusarium onion (*A. longicuspis*) and varieties "Niki" and "Merey" of garlic (*A. sativum*) under introduction conditions.

6 Comparative analysis of vitamin C content in *A. longicuspis* from natural populations and varieties "Niki" and "Merey" of *A. sativum*.

7 Identification of genotypic variability in sorted populations of *A. longicuspis*.

8 Development of recommendations for growing promising forms of *A. longicuspis* in culture.

#### **Objects and methods of research**

Objects of research: long onion (*A. longicuspis*) from natural populations of the Shu-Ili mountains and under conditions of introduction in the southeast of Kazakhstan, as well as domestic varieties garlic (*A. sativum*) "Niki" and "Merey".

The work was carried out in 2018–2023 in the laboratory of plant resources of the Institute of Botany and Phytointroduction of the Ministry of Natural Resources of the Republic of Kazakhstan. When performing the work, generally accepted methods of field botanical, introduction, agrochemical, phytochemical and molecular genetic research were used.

Introduction studies were carried out at the collection site of medicinal plants of the Main Botanical Garden (Almaty), located in the foothill zone of the Trans-Ili Alatau using the methods of M.N. Beideman, "Methods of phenological observations in botanical gardens." The obtained morphometric data of *A. longicuspis* individuals (height, diameter of the bulb, teeth, inflorescences, number of bulbs, their size) were processed by generally accepted statistical methods by G.N. Zaitsev and B.A. Dospheva.

Expedition trips to identify natural populations and collect planting and herbarium material of *A. longicuspis* were carried out on the territory of the Kordai administrative district of Zhambyl region (Shu-Ili Mountains) using the route-reconnaissance method. The study of variability in natural populations of *A. longicuspis* was carried out according to the method of S.A. Mamaeva. The coordinates of the area where the plant material of the studied plant species was collected were determined using a Garmin GPS navigator.

Determination of DNA analysis in natural populations of *A. longicuspis* and varietal species *A. sativum* "Merey", "Niki" was carried out in the laboratory of molecular taxonomic research of the Botanical Garden at the University of Osnabrück (Osnabrück, Germany) using DNA fragment analysis methods based on polymerase chain reaction (PCR). 25 SCoTs were tested to evaluate genetic polymorphism primers and 12 SCoTs were selected for analysis primers. The somatic set of chromosomes was determined on pressed temporary preparations stained with acetoheмоxylin according to the method of Yu. A. Smirnov. The vitamin C content of the study subjects was determined in an accredited research laboratory for assessing the quality and safety of food products of Almaty Technological University JSC.

The taxonomy of species is given in accordance with the APG system IV.

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

1 Under conditions of introduction in the south-east of Kazakhstan, the wild species *A. longicuspis* has a wide range of phenotypic variability of vegetative characteristics, high adaptive and productive potential, which is a prerequisite for the creation of highly productive introduction populations.

2 Under the conditions of an introduction experiment, the studied species *A. longicuspis* characterized by a high content of vitamin C, which makes it possible to use it as a vegetable plant - garlic.

3 Comparative molecular genetic study of *A. longicuspis* populations and varieties "Niki" and "Merey" of *A. sativum* indicates that populations of *A. longicuspis* are a natural reservoir of genetic diversity of old local forms of garlic, preserved independently in nature.

4 Recommendations for growing promising forms of long onion in culture (*A. longicuspis*) in the foothill zone of the Trans-Ili Alatau.

#### **Justification of the novelty and practical significance of the results obtained.**

**Scientific novelty.** For the first time in the southeast of Kazakhstan, a comprehensive study of the biological characteristics of the wild species *A. longicuspis*

was carried out. Comparative data on the vitamin C content and resistance to Fusarium wilt of the studied objects were obtained. For the first time, a comparative molecular genetic study of long onion (*A. longicuspis*) and the “Niki” and “Merey” varieties of garlic (*A. sativum*) was carried out. Cluster analysis (UPGMA), based on the degree of similarity of populations based on ScoT markers, divided the study sample into two genetic groups.

#### **Scientific and practical value of the work.**

Lines of long onion (*A. longicuspis*) with promising economic properties have been identified; a comparative assessment of the degree of damage by fusarium to *A. longicuspis* and *A. sativum* is given, which makes it possible to recommend *A. longicuspis* bulbs as a resistant planting material; Recommendations for introduction cultivation have been developed to ensure the conservation of the species *in-situ* and *ex-situ*.

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

*A. longicuspis*, conducted for the first time in southeast Kazakhstan, which indicate the possibility of successful introduction of *A. longicuspis* in the foothill zone of the Trans-Ili Alatau. The soils of the experimental plots of the Main Botanical Garden are not saline; based on the content of humus and gross nitrogen in the surface horizon, they can be classified as chernozems, and they are quite suitable for the introduction of long onion (*A. longicuspis*).

The study of the phenotypic variability of the morphological organs of long onion (*A. longicuspis*) from natural populations of the Shu- Ili Mountains showed that under cultural conditions it has a wide range of phenotypic variability of vegetative characteristics, high adaptive and productive potential, which is a prerequisite for the creation of highly productive introduction populations in the south-east of Kazakhstan. The studied samples of *A. longicuspis* I population and the variety “Merey”, due to a complex of economically valuable traits and a high degree of resistance to fusarium, can be recommended as sources of stress resistance and productivity for further breeding work.

The results of the first comparative molecular genetic study of *A. longicuspis* from natural populations and varieties “Niki” and “Merey” of *A. sativum* confirm the conclusions of previous researchers that *A. longicuspis* does not differ from cultivated garlic and should be considered as wild *A. sativum*. Because wild garlic populations nevertheless show distinctive molecular traits from studied garlic cultivars, they represent a natural reservoir of genetic diversity for older local forms of garlic that have persisted independently in nature.

#### **Ph.D. student's contribution to the preparation of each publication.**

Collection, analysis and synthesis of experimental and literary data, statistical processing of results, illustrations were carried out personally by the author. The author took direct part in expeditions to collect planting and herbarium material; he carried out introduction studies; genotypic variability of onion populations was determined (*A.*

*longicuspis*) and varietal species *A. sativum* using the innuPREP kit Plant DNA; DNA sequencing results are registered on the NCBI portal.

Based on the thesis materials, 7 scientific works were published, including 1 article in publications indexed in the Scopus database, 4 articles in journals recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Education and Science of the Republic of Kazakhstan, 2 articles in international scientific materials -practical conferences.

**Compliance with the directions of scientific development or state programs:** the work was carried out within the framework of state scientific and technical programs: BR 05236546 “Implementation by state botanical gardens of priority scientific and practical tasks for Kazakhstan of the global strategy for plant conservation as a sustainable system for maintaining biodiversity” (2018–2020); BR 10264557 “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).

**Structure and scope of the thesis:** the thesis consists of an introduction, 4 chapters, a conclusion, a list of sources used (249 titles, including 78 in a foreign language), contains 23 tables and 30 figures. The total volume of the thesis is 124 printed pages (including the main text - 111 pages, appendices - 13 pages).