

ANNOTATION

on the dissertation work of Irina Zhirnova on the topic: Creation of perspective glutinous forms of proso millet using molecular genetic markers for the degree of Doctor of Philosophy PhD on the speciality 8D08101- "Genetics and breeding of agricultural crops".

Relevance of the research subject. The evolution and diversification of crops over millennia have been directed by conscious and unconscious human selection for a wide range of phenotypic traits. Human cultivated plants mainly as a source of carbohydrates and one of their goals was to change the quality of starch. [1].

From ancient times, proso millet grain has been the most important source of food production for many peoples of Asia and Europe. Apparently, this was due to the nature of this plant: large reproduction rate with the smallest seeds mass for sowing, high potential productivity, drought resistance, salt tolerance, disease resistance, simplicity of production technology of the main food product and its high culinary properties, as well as valuable forage properties of green mass and straw.

Population growth increases the pressure on food industry, therefore, it is necessary to increase the production of agricultural crops, one of which is proso millet. The cultivation of proso millet will allow to use it in both food and feed industries [2].

The world production of proso millet in the terms of sown areas is 1.7-5 % of the production of all cereal crops. The main cultivation areas are situated in developing countries of Asia and Africa. According to the FAO, proso millet is the fifth largest cereal crop after maize, rice, wheat and barley. Consumption of millet-like cereals significantly improves human and animal health [3].

Proso millet cultivation has provided food stability for many countries for a long time. Historical data show that proso millet is an important food for human nutrition, and its ability to be grown on low fertility soils under high-risk farming conditions characterizes it as a promising crop in a changing climate [4].

An important part of cereal endosperm is starch, which consists of amylose and amylopectin. Proso millet with high amylopectin content show adhesive ability, that is why it has received high demand from East Asian nations [5].

There are cereal and fodder varieties, as well as special purpose varieties, in proso millet breeding. Proso millet varieties can be developed for special purposes, for instance, varieties whose starch consists entirely of amylopectin or, on the contrary, only of amylose. Particular attention is drawn to proso millet lines and varieties whose distinguishing feature is the high-quality starch content in the grain, which consists of 100% amylopectin. Glutinous proso millet varieties are characterized by high dietary properties and are in demand in the food and processing industries. There are no glutinous proso millet varieties of domestic selection on the market. If the price of glutinous proso millet in the American and

Asian markets is ~\$4/kg, in the domestic market the price of standard proso millet is ~\$1/kg.

Proso millet also has historical interest, which should be popularised in the conditions of development of both climatic and economic situations in the country. In Kazakhstan, the genetic fund of proso millet includes samples from the CIS countries, far abroad and local varieties, such as Wilskoe local white - Bersiev proso millet. In Kazakhstan, breeding of this crop is carried out in four institutions: in «A. I. Barayev Research and Production Centre for Grain Farming» LLP (3 food and fodder varieties were created), in Aktobe Agricultural Experimental Station (7 food and fodder varieties were created, one of which is named in honour of Shaganak Bersiev, a famous proso millet plant breeder of Aktobe region, who collected a record yield of more than 200 c/ha during the war years), in Pavlodar Scientific Research Agricultural Experimental Station (2 varieties were created) and East Kazakhstan Scientific Research Agricultural Experimental Station (1 variety). There is a very limited diversity of proso millet culture in agricultural production and state system of seed inspection, so the creation of new varieties adapted to the conditions of Western, Central, Northern Kazakhstan is an urgent task for national plant breeders. Versatile use of proso millet is not its only value. In Kazakhstan, the need for proso millet as a source of high-quality amylopectin starch is increasing, so this starch can be used in various industries.

Aim and objectives of the research.

Creation of glutinous forms of proso millet on the basis of traditional plant breeding with the use of molecular genetic methods.

Research Objectives

-analysis of proso millet source materials for morphological, physiological and economically valuable traits;

-quantitative analysis of a collection of foreign and domestic proso millet varieties and accessions for grain amylose content and genotyping of *waxy alleles* using molecular markers to assess polymorphism;

-selection of parental forms of proso millet for hybridization on the basis of biochemical and molecular analysis and hybridization by traditional breeding of selected parental pairs to obtain pre-breeding material;

-hybrids analysis and identification of glutinous samples of proso millet by determining the type of inheritance of *waxy alleles* in hybrid populations based on biochemical and molecular markers;

-comparative evaluation of productivity indices of generated glutinous proso millet samples on economically valuable traits.

Scientific Novelty.

Despite the fact that glutinous proso millet has been cultivated in Asian countries for a long time, no glutinous varieties have been developed in Kazakhstan so far. Glutinous varieties of proso millet of domestic selection are completely absent on the market. Scientific novelty of the thesis is obtaining initial domestic glutinous forms of proso millet on the basis of traditional breeding with the use of molecular genetic methods.

Practical and theoretical significance of the research.

For the first time, studies of initial material of proso millet in Kazakhstan with the use of molecular markers were carried out. The collection of different ecological and geographical origins was used in the studies. The work includes the creation of source material using both classical methods and molecular genetic markers.

Approbation of the work. As a result of scientific research scientific publications, including those recommended by the COMMITTEE FOR QUALITY ASSURANCE of EDUCATION AND SCIENCE OF THE Ministry of Education and Science of the Republic of Kazakstan:

Bulletin of L.N. Gumilev Eurasian National University, Series of Biological Sciences, 2020 - No. 1(130), (Nur-Sultan, 2020);

Bulletin of Science of S. Seifullin Kazakh Agrotechnical University (interdisciplinary), 2022 - № 4 (115), (Astana, 2022);

Bulletin of Science of S. Seifullin Kazakh Agrotechnical University (interdisciplinary), 2022 - № 1(108), (Astana, 2022);

In Journals of the Scopus database:

-Ecology, Environment and Conservation. Eco. Env. & Cons.: 2019. - Vol. 25 (4), P. 1577-1584. Percentile-15 (Q4);

In Journals in the Web of Science database:

-Bulgarian Journal of Agricultural Science, 2019. - Vol. 25(5), P. 986-993. CiteScore 2022-0.7; Percentile-43 (Q4; IF 0.136);

-Chilean Journal of Agricultural research, 2021. - Vol. 81(4). P. 518-526. CiteScore 2022-3.1; Percentile- 64 (Q2; IF 0.136).

The main results of scientific research have been reported in:

-FEBS Open Bio 11, Virtual 45th FEBS Congress (2021).

-Proceedings of the XXIX International Scientific and Practical Conference. Warsaw, Poland. 2023.

-X International Scientific and Practical Conference "Challenges and problems of modern science", October 19 - 10, 2023, London, United Kingdom.

The main points to be defended:

-study and evaluation of proso millet gene pool on complex of economically valuable traits in conditions of dry-steppe zone of Kazakhstan;

-screening of domestic and global collection of proso millet for amylose content in grain and selection of glutinous samples of proso millet;

-production of perspective glutinous forms of proso millet based on traditional breeding with subsequent use of molecular markers.

Relation of the thesis to the state programs. The thesis was carried out within the framework of the scientific project AP05131622 " Obtaining of perspective low-amylose millet samples for selection based on biochemical and molecular-genetic methods" (2018-2020) under the priority «Sciences of Life» in the framework of subprogram 101 "Grant financing of scientific research". For the period 2021-2022, the research was carried out within the project "Screening of variety gene pool and perspective lines of proso millet (*Panicum miliaceum* L.) for salt and cold tolerance on the basis of physiological and biochemical methods" carried out within the framework of the program under the priority: 5 Sustainable

development of agro-industrial complex and safety of agricultural products; under the sub-priority: 5.3 Intensive farming and crop production; funded by the S. Seifullin Kazakh Agrotechnical Research University.

The volume and structure of the thesis. The thesis consists of an introduction, 4 sections, a conclusion, a list of used sources and appendices. The main text is set out on 108 pages of computer text. The list of used sources consists of 281 titles. The text of the thesis is illustrated with 15 tables, 33 figures.