

ANNOTATION

dissertation work of Berkimbay Khorlan Adeshkyzy on the topic: «Biological features of rice gerlotypes with colored pericarp in the conditions of the Akdala array» submitted for the degree of Doctor of Philosophy PhD in the specialty 6D080100 – «Agronomy».

1. Relevance of the research topic. Rice is the staple food for more than half of the world's population, it is grown in 108 countries, occupying an area of 145 million hectares, and ranks second after wheat. According to the Kazakh Academy of Nutrition, Kazakhstan's annual need for rice is 132.6 thousand tons per year (8.5 kg/year per 1 person).

Rice is a valuable dietary product. The absolute dry matter of the cereal contains up to 88% starch, 6-8% protein (sometimes even higher), 0.5% fat and 0.5% sugar. In terms of digestibility, rice cereal ranks first among grain crops with indicators of 96-98%.

It is known that recently more and more attention has been attracted by rice varieties with colored pericarp, having black, brown, red and pink shades of grains. Unlike white polished rice, such grains are rich in vitamins and minerals. Research has shown that black rice grains contain useful macro- and microelements, such as iron, zinc, calcium, copper and manganese.

Compounds isolated from rice pigments (anthocyanins: cyanidin-3-glucoside; pelargonidin-3-glucoside) inhibit aldose reductase activity and prevent diabetes. Black rice anthocyanins reduce cholesterol and triglyceride levels in the blood.

Black rice contains vitamins B, E, PP. In addition to the above, black rice can be added to food as a natural dye.

Black rice contains vitamins B, E, PP, trace elements - potassium, magnesium, phosphorus, zinc, manganese. In addition to the above, black rice can be added to food as a natural dye.

The red pigment of rice grains is proanthocyanidin, also called "condensed tannin". It is a powerful antioxidant that reduces the risk of atherosclerotic plaque formation.

In Kazakhstan, no studies have been conducted on rice with colored pericarp, which has led to the absence of domestic varieties of red and black rice. Imported rice with colored pericarp (in particular, "Black rice") is 5-6 times more expensive than regular white-grain rice, which makes it inaccessible to the general population. Therefore, the country's rice growing needs rice varieties with colored pericarp adapted to soil and climatic conditions. In connection with the above facts, the topic of exacerbation is relevant.

2. The purpose of the dissertation research.

Study of biological characteristics of rice with colored pericarp using traditional and molecular-associated selection to create rice varieties adapted to the soil and climatic conditions of the Akdala array.

3. The main objectives of the study:

- Screening of promising rice varieties with colored pericarp for resistance to cold and blast disease (*Pirycularia oryzae*) using molecular markers;
- Biochemical analysis of the amylose content of promising rice varieties with colored pericarp and certification using protein markers;
- Conducting phenological monitoring of promising late-generation rice varieties with colored pericarp grown in the conditions of the Akdala rice-growing array, evaluation and selection based on the main economically valuable traits; determining the technological quality of grain;
- Selection of promising genotypes of rice with colored pericarp grown in the conditions of the Akdala rice-growing array to obtain domestic exclusive varieties
- Creation of a rice variety with colored pericarp adapted to the Akdala rice cultivation area and transfer to the State Commission for Variety Testing of Agricultural Crops.

4. Research methods:

- Isolation of genomic DNA from plant material was carried out from leaves of 5-day-old seedlings using the CTAB method (cetyltrimethylammonium bromide) (Riede et al., 1996)
- Conducting laboratory screening for cold resistance in a climate chamber with a constant temperature of 14°C in a photoperiod of 16 h/day and 8 h/night with a brightness of 50 µE m⁻²C⁻¹ kilolux.
- Identification of cold resistance genes qPSST-3, qPSST-7 and qPSST-9 using closely linked microsatellite markers RM24545, RM1377, RM231, RM569.
- PCR analysis for identification of blast resistance genes using molecular markers RM 224 and RM 1233 (*Pi-1* gene), MSM6 and 9871.T7E2b (*Pi-40* gene), 195R-1 and NMSMPi-9 (*Pi-9* gene) and TRS26 and Pikh MAS (*Pi-54* gene).
- Quantitative content of amylose in rice grain was determined by the Juliano method (Juliano et al., 1971)
- Biochemical analysis of rice storage proteins was carried out using the modified Laemmli method (Laemmli et al., 1970)
- Determination of technological quality of grain with the DSZ-2M device according to SAUS 10843-73 and SAUS 10986-76.
- Observations of hybrids were carried out using the P.S. Erygin method (P.S. Erygin et al., 1965)
- Conducting structural analysis for economically valuable traits (determination of panicle length, number of grains in a panicle, weight of 1000 grains, length and width of grain).
- Statistical processing was calculated using the R-Studio program. The results obtained were mathematically processed and implemented using the method of B. A. Dospekhov (1985).

5. Main provisions submitted for defense:

– Screening of promising varieties and lines of rice with colored pericarp adapted to the Akdala rice-growing array, distinguished by high economically valuable traits for the production of domestic exclusive rice varieties, according to physiological, biochemical, molecular-genetic parameters.

– Selection of breeding-valuable genotypes of rice with colored pericarp according to resistance to cold; fungal disease (*Pyricularia oryzae*); amylose content; technological properties, grain quality.

– Creation of a rice variety with colored pericarp adapted to the Akdala rice cultivation area and transfer to the State Commission for Variety Testing of Agricultural Crops.

6. Description of the main results of the study:

1. Eight cold-resistant rice genotypes were identified using molecular markers RM231, RM569, RM24545, RM1377 closely associated with cold resistance loci (qPSST-3, qPSST-7, qPSST-9);

2. The presence of 3 genes of resistance to blast (*Pyricularia oryzae*) was established in 7 original varieties and 14 hybrid lines with colored pericarp using molecular markers closely associated with genes of resistance to blast: RM 224 and RM 1233 (*Pi-1* gene), MSM6 and 9871.T7E2b (*Pi-40* gene), 195R-1 and NMSMPi-9 (*Pi-9* gene) and TRS26 and Pikh MAS (*Pi-54* gene);

3. According to the amylose content, promising rice varieties with colored pericarp were classified into 5 groups: 25-33% – high-amylose, 20-23% – medium-amylose, 10.8-19.6% – low-amylose, 2.2-4% – very low-amylose and 0.1-2.3% – glutinous. 11 genotypes (6 parental species and 5 hybrids) with a molecular weight of 60 kDa were identified, which are the product of the *Wx* gene, which controls the high amylose content;

4. Phenological monitoring revealed mid-season (111-116 days) and late-season (125-129 days) genotypes of rice with colored pericarp in the conditions of the Akdalinsky massif compared to the standard Bakanassky variety (112-117 days);

5. Two highly productive genotypes were isolated: 1) Black rice/*Viola var.pseudovialonica Vasc.*, 2) DG3 F₂ Yir 5815/Marzhan *var.pyrocarpa Alef.* from the breeding material of the sixth and eighth generations of rice with colored pericarp according to economically valuable traits and also based on technological grain quality, the hybrid F₇ Yir 5815/Bakanassky *var.sundensis Koern* was distinguished by low filminess - 17.9%, 0% cracking and 100% vitreousness; ;

6. Red-grained, glutinous, rice variety with colored pericarp "Almavita" recommended for zoning in Almaty and Kyzylorda regions, selected from the F₅ hybrid Vita/Fatima by individual selection, was transferred to the Republican State Institution "State Commission for Variety Testing of Agricultural Crops" of the Ministry of Agriculture of the Republic of Kazakhstan for "Economic Utility" and "Patenting" as the first domestic rice variety with colored pericarp

7. Justification of the novelty and importance of the obtained results.

For the first time in Kazakhstan, the promising, red-grained, glutinous variety "Almavita", selected in the conditions of the Balkhash district of the Almaty region from the F₅ hybrid Vita/Fatima, was submitted to the Republican State Institution "State Commission for Variety Testing of Agricultural Crops" of the Ministry of Agriculture of the Republic of Kazakhstan for "Economic Utility" and "Patenting" as the first domestic rice variety with colored pericarp.

The importance of the research work is that for the first time for the Akdala rice sowing massif, screening of valuable selection genotypes of rice with colored pericarp was carried out for resistance to cold and fungal disease of rice (*Pyricularia oryzae*), for amylose content and technological quality of grain. As a result of the research, promising hybrid lines were selected based on economically valuable traits; technological quality of grain. The amylose content in grain was also determined, and storage proteins of rice were identified as a result of electrophoretic analysis. Using microsatellite markers RM24545, RM1377, RM231, RM569, lines with cold resistance genes were identified. Based on the genes *Piz-t*, *Pita*, *Pita 2*, *Pi 1*, *Pi 9*, *Pi 40*, *Pi 54*, resistant lines to blast disease were obtained.

8. Compliance with development directions or state programs.

The dissertation was completed at the Republican State Enterprise on "Institute of Plant Biology and Biotechnology" under the following programs: state registration No. 0118PK00247 "Physiological, biochemical and molecular genetic methods for breeding domestic rice varieties with colored pericarp" (AP 05132714), 2018-2020; state registration No. 0123PK00018 "Creation of a rice variety with colored pericarp resistant to blast, based on biotechnology for rice-growing regions of Kazakhstan" (BR 18574149), 2022-2024.

9. Contribution of the doctoral student to the preparation of each publication.

The main results of the dissertation work were published in 15 scientific papers, including 5 articles in journals recommended by the Committee for Control in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, 2 articles in international scientific journals with impact factors included in the Scopus database: Brazilian Journal of Biology, - 2023. - Vol. 83. - P. e280919, (Q2, 61 percentile); Brazilian Journal of Biology. - 2024. - Vol. 84. - P. e282495 (Q2, 61 percentile) and 7 articles in collections of international scientific conferences and 1 book.

In the scientific expert journal "Research-Results" (2020, No. 2, pp. 236-242), Bulletin named after L.N. Gumilyov (2022, No. 1, pp. 38-46), Bulletin of Karaganda University (2022, No. 2, pp. 118-126), in the scientific expert journal "Research-Results" (2024, No. 1, pp. 46-56), Bulletin of Al-Farabi KazNU (2024, No. 1, pp. 4-11).

10. Volume and structure of the dissertation.

The volume of the dissertation is 110 pages and consists of an introduction, main part, materials and research methods, experimental results, economic efficiency and conclusion. The work is illustrated with 22 tables, 36 figures and 5 applications. The list of references is 172.