

Project name: AP14870270 "Molecular genetic substantiation of domestic and foreign potato varieties and hybrids resistant to main viral, nematode and late blight pathogens".

Relevance: Success in creating new varieties depends on the choice of pairs for crossing, as well as on the accuracy of subsequent selections in the hybrid population of genotypes with traits of interest to the breeder. For many years, breeders had to select material by phenotype, while the assessment of future varieties for resistance to phytopathogens depended directly on the conditions of a particular growing season. With regard to fungal diseases, this approach can justify itself in epiphytotic years, however, total infection of the source material, due to the cumulative effect of viral degeneration, can significantly undermine the potential for competitiveness of varieties, greatly complicating seed production. Therefore, the use of marker-associated selection significantly increases the accuracy of selection and reduces the time for its implementation.

Purpose: to study the resistance of highly productive domestic and foreign varieties and promising potato breeding lines to PVY, PVX, nematodes, late blight on the platform of molecular genetic marking, as well as using artificial infection with phytopathogens.

Expected and achieved results 2022: In the conditions of a slightly humid moderately warm zone of the Akmola region, in the subzone of dark chestnut soils, economically useful traits of potato breeding and genetic material will be determined: yield, ripeness group, starch and dry matter content, table and culinary qualities, an experiment will be carried out to determine the storability.

A search will be carried out for molecular markers of resistance genes to PVY, PVX and nematodes in highly productive domestic and foreign varieties and promising potato lines. The studied potato samples will be inoculated with local isolates of phytopathogens.

Abstracts of reports will be prepared within the framework of the scientific-practical conference.

Based on the results of the first year, the economic and useful features of the breeding and genetic material of potato grown in the KATU named after S. Seifullin collection were identified: productivity, group of ripeness, starch, dry substance, table and culinary qualities; an experiment was laid to determine the storability of the tuber mass during storage. The selected highly productive potato hybrids were analyzed for the presence of DNA markers of resistance to PVY, PVX, golden nematodes. The inoculation of the studied varieties of potato with PVY, PVX isolates was carried out. 3 scientific articles were published, the materials of which are reported at the International Scientific and Practical Conference "Seifullin readings 18 (2):" SCIENCE OF THE XXI CENTURY - THE ERA OF TRANSFORMATION. "

Expected and achieved results 2023: In the conditions of a slightly humid moderately warm zone of the Akmola region, a subzone of dark chestnut soils in 2023, on the basis of AF "Green Star" LLP, the determination of economically useful signs of potato breeding and genetic material was carried out: productivity, starch, dry matter, table and culinary qualities, storability. From the collection of the S. Seifullin KATRU the highest yields were found in potato varieties and breeding lines: Z872-3 (39.9 t/ha), Xisen-6 (31.6 t/ha). A high content of starch and dry matter was found in the varieties: Ilyin (21,7%), 17-223-10 (19,5%), Kostanayskie Novosti (19.5%) and Miras (19.5%). The best taste qualities were possessed by potato samples 17-213-1, Z 872-4, suitable for processing into French fries - breeding line 17-212-19, into crispy potatoes - variety Xisen 6. According to the results of determining the keeping capacity of various potato varieties, the best were: Z-872-3 – 90,8 %, Xisen 6 – 93,1%, 17-212-345 – 90,5%, Z-872-4 – 89,2 %, and Red rose – 91.6%. A clear relationship between virus resistance and the studied economically useful signs has not been established.

The genetic material of potato was used to search for molecular markers of genes for resistance to nematodes, PVY, PVX and late blight in highly productive domestic and foreign varieties and promising potato lines. Samples with specific DNA markers linked to virus resistance genes have been identified. When identifying DNA markers of PVY resistance genes, the molecular SCAR marker RYSC3 in combination with the DNA marker Ry186 and RAPD marker UHK38-530 were identified in the genetic material of 3 potato samples: Z861-1, 17-250-10, 17-204-2. In the genetic material of potato breeding lines: Z-872-3, 17-212-34, 17-243-5, the RAPD marker UHK38-530 was in complex with the DNA marker Ry186. A complex of CVC resistance genes Rx1, Nb with markers 5Rx1, 1Rx1, GM339, GM637 was noted in line 17 204-2. The combination of markers 5Rx1, GM637 was found in the genetic material: 17 214-9, Z 861-1. The marker complex 5Rx1, GM339 was identified in the material: Z 861-1, 17 223-2. A single combination of markers 1Rx1, GM339 was found in the breeding line Z 879. The Nb gene was detected in the following samples: Z 440-3, 17 243-5, 17 250-10, 17 225-12. Samples with specific DNA markers linked to genes of resistance to nematodes and late blight have been identified in the genetic material of potato. DNA marker 57 R linked to genes of resistance to golden potato nematode was detected in 20-5-2(2) B2№.10, Xisen 6, 20-1-(11) and 19-1-3. DNA marker m-R1 linked to genes of resistance to *Phytophthora infestans* was detected in Tamasha, Aksor, Zhanaisan and 17-212-34 varieties, and the marker m-GP76 in the varieties Akzhar, Ilyin, Nurli, Aksor, z872-3, 09-07-12, 17-223-6 and Xisen 3. nematodes.

The resistance of highly productive domestic and foreign varieties and promising potato breeding lines to PVY, PVX, late blight (*Phytophthora infestans*) has been studied. Inoculation of the studied potato cultivars with PVY, PVX and *Phytophthora infestans* isolates was carried out. According to the conducted studies on resistance to the main viral diseases of potato – PVY and PVX, 11 samples from 13 studied breeding lines turned out to be resistant during phytopathological assessment. During phenotypic testing after artificial virus infection, only a pair of lines 17 214-9 (systemic reaction in response to PVY

infection) and Z 861-1 showed a positive result in ELISA for PVY and PVX, respectively, visual symptoms of PVX damage were not observed on all inoculated potato plants. 11 studied breeding lines are classified as an extreme type of resistance to viral diseases. When studying the resistance of potato breeding lines to *Phytophthora infestans* by visual assessment, susceptible genotypes were established: Z-872-3, Alliance, 17-225-12, Udovitsky and resistant: Pamyati Konaeva, 17-250-10.

The article was published in the country, recommended by CQASHE (Azhimakhan M. A., Beisembina B., Khassanov V. T., Hu Baigeng. Phytopathological report on the persistence of Chinese breeding lines of potatoes to the main viruses of potatoes \ Bulletin of Korkyt Ata Kyzylorda University. Agricultural Sciences. - №3-1 (66), 2023. - pp. 215-224.).

An application for invention No. 2023/0824.1 "Method of plant inoculation and accumulation of potato Y- and X-viruses" has been submitted to the RSE "NIIP", the applicant: NJSC "S. Seifullin KATRU", authors: Beisembina B., Khassanov V.T., Sidorik A.I., Azhimakhan M.A. priority from 6.12.2023;

According to the results of the research, 1 article was accepted for publication in a peer-reviewed scientific publication with a CiteScore percentile in the Scopus database of at least 35 (thirty-five) (Azhimakhan M., Beisembina V., Kapytina A., et al. Investigating the Genetic and Biological signature of Potato Virus X circulating in Kazakhstan \ Caspian Journal of Environmental Sciences. - Vol. 21, No. 5, Special Issue 2023. Percentile 44.)

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Names of research team members (project position) with their identifiers (Scopus Author ID, Researcher ID, ORCID, if any) and links to relevant profiles

List of publications and patents published within the framework of this project: (with links to them):

1. Khairullaeva N.Kh., Khassanov V.T. The content of pigments in the breeding material of potato // Sat. material. International Scientific and Practical Conference "Seifullin readings - 18 (2):“ THE SCIENCE OF THE XXI CENTURY IS THE ERA OF TRANSFORMATION. ” Volume 2, Part 1. - Astana, 2022. - S. 6-10.

[https://kazatu.edu.kz/webroot/js/kcfinder/upload/files/%D0%BD%D0%B0%D1%83%D0%BA%D0%B0/%D0%A1%D0%A7-18\(2\)/%D0%A5%D0%B0%D0%B9%D1%80%D1%83%D0%BB%D0%BB%D0%B0%D0%B5%D0%B2%D0%B0%20%D0%9D.%D0%A5.%2C%20.pdf](https://kazatu.edu.kz/webroot/js/kcfinder/upload/files/%D0%BD%D0%B0%D1%83%D0%BA%D0%B0/%D0%A1%D0%A7-18(2)/%D0%A5%D0%B0%D0%B9%D1%80%D1%83%D0%BB%D0%BB%D0%B0%D0%B5%D0%B2%D0%B0%20%D0%9D.%D0%A5.%2C%20.pdf)

2. Beisembina B., Kuzminova O.A., Azhimakhan M.A., Khassanov V.T., Vologin S.G. International experience in the study by scientists of Kazakhstan and Tatarstan (Russian Federation) of markers of resistance genes to potato viruses // Sat. material. International scientific - practical..conf. "Seifullin Readings - 18 (2): "SCIENCE OF THE XXI CENTURY - THE AGE OF TRANSFORMATION". Volume 1, part 1. - Astana, 2022. - S. 131-135.

[https://kazatu.edu.kz/webroot/js/kcfinder/upload/files/%D0%BD%D0%B0%D1%83%D0%BA%D0%B0/%D0%A1%D0%A7-18\(2\)/%D0%91.%201%D0%91%D0%B5%D0%B9%D1%81%D0%B5%D0%BC%D0%B1%D0%B8%D0%BD%D0%B0%2C%20.pdf](https://kazatu.edu.kz/webroot/js/kcfinder/upload/files/%D0%BD%D0%B0%D1%83%D0%BA%D0%B0/%D0%A1%D0%A7-18(2)/%D0%91.%201%D0%91%D0%B5%D0%B9%D1%81%D0%B5%D0%BC%D0%B1%D0%B8%D0%BD%D0%B0%2C%20.pdf)

3. Suleiman M.A., Beisembina B., Khassanov V.T. Biotechnological science on guard of plant protection and quarantine // Sat. material. International scientific - practical..conf. "Seifullin Readings - 18 (2): "SCIENCE OF THE XXI CENTURY - THE AGE OF TRANSFORMATION". Volume 1, part 1. - Astana, 2022. - S. 88-90.

[https://kazatu.edu.kz/webroot/js/kcfinder/upload/files/%D0%BD%D0%B0%D1%83%D0%BA%D0%B0/%D0%A1%D0%A7-18\(2\)/%D0%A1%D2%AF%D0%BB%D0%B5%D0%B9%D0%BC%D0%B0%D0%BD%20%D0%9C.%20%D0%90.pdf](https://kazatu.edu.kz/webroot/js/kcfinder/upload/files/%D0%BD%D0%B0%D1%83%D0%BA%D0%B0/%D0%A1%D0%A7-18(2)/%D0%A1%D2%AF%D0%BB%D0%B5%D0%B9%D0%BC%D0%B0%D0%BD%20%D0%9C.%20%D0%90.pdf)

4. Azhimakhan M. A., Beisembina B., Khassanov V. T., Hu Baigeng. Phytopathological report on the persistence of Chinese breeding lines of potatoes to the main viruses of potatoes \ Bulletin of Korkyt Ata Kyzylorda University. Agricultural Sciences. - №3-1 (66), 2023. - pp. 215-224. https://vestnik.korkyt.kz/wp-content/uploads/2023/10/2023-%E2%84%963-1-66_new.pdf

5. Daulet D., Beisembina B., Khasanov V.T., Wu Yu., Weixing Sh. Phytopathological assessment of the resistance of promising domestic, foreign varieties and breeding lines of potatoes to late blight (*Phytophthora infestans*) \ "Phytopathological safety: threats, challenges and solutions": materials of the International scientific and practical conference dedicated to the 65th anniversary

of the founding of the institute (14- December 15, 2025, Almaty, Republic of Kazakhstan). – Almaty, 2023. – P. 243-249.

6. Azhimakhan M., Beisembina V., Kapytina A., et al. Genetic and Biological signature of Potato Virus X circulating in Kazakhstan \ Caspian Journal of Environmental Sciences. - Vol. 21, No. 5, Special Issue 2023. – P. 1151-1157. 10.22124/CJES.2023.7403 - Percentile 44.

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