

## UTILIZING IONIZING RADIATION (GAMMA AND NEUTRON) TO DEVELOP DROUGHT AND SALINITY-RESISTANT RICE VARIETIES

Ionizing radiation, including gamma rays and fast neutrons, has been widely used in plant breeding to induce mutations and develop new crop varieties with desirable traits [1, 2, 3]. Irradiation could be effective for creating drought and salinity-resistant rice varieties, which are crucial for ensuring food security in the face of climate change and soil degradation [4].

In the study M1 and M2 lines of three rice varieties (Syr Suluy, AiKerim and the Leader) were generated using gamma rays and fast neutrons irradiation, along with treatments using NaCl and sorbitol to simulate salinity and drought conditions. These rice varieties are approved for use and widely cultivated in the Kyzylorda region of the Republic of Kazakhstan. In particular, Syr Suluy and AiKerim are local varieties specifically bred for the specific soils of Kazakhstan. The  $\gamma$ -ray irradiation was conducted at ILU-10 Electron Linear Accelerator in JSC “Park of Nuclear Technologies” (Kurchatov, Republic of Kazakhstan), and neutron irradiation was performed at the EG-5 electrostatic generator at the Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research (Dubna, Russian Federation)

Out of 54 mutant lines obtained in 2022, 50 survived. Among these, 34 lines were productive, including 18 from the Syr Suluy variety, 4 from AiKerim, and 12 from the Leader variety. The remaining lines were either sterile or did not mature completely. Of the productive mutants, 17 lines were induced by gamma rays and 17 by fast neutrons. The AiKerim variety was the most vulnerable to mutagens, salinity, and drought stress, while the Syr Suluy variety exhibited the highest resistance.

Further obtained lines will be used as initial material in synthetic breeding, as well as, in the cultivation of new varieties by direct propagation of altered species.

1. Feng Li, Akemi Shimizu, Takeshi Nishio, Nobuhiro Tsutsumi, Hiroshi Kato, Comparison and Characterization of Mutations Induced by Gamma-Ray and Carbon-Ion Irradiation in Rice (*Oryza sativa* L.) Using Whole-Genome Resequencing, *G3 Genes|Genomes|Genetics*, Volume 9, Issue 11, 1 2019, 3743–3751, <https://doi.org/10.1534/g3.119.400555>
2. Elsherbiny, Heba A et al. Inducing potential mutants in rice using different doses of gamma rays for improving agronomic traits. *Chilean journal of agricultural research*, 84(3), 2024, 380-390. <https://dx.doi.org/10.4067/S0718-58392024000300380>
3. Kadam, S.T., Vishwakarma, G., Kashyap, Y. et al. Thermal neutron as a potential mutagen for induced plant mutation breeding: radiosensitivity response on wheat and rice. *Genet Resour Crop Evol* 70, 789–798, 2023. <https://doi.org/10.1007/s10722-022-01461-z>
4. Viana VE, Pegoraro C, Busanello C and Costa de Oliveira A. Mutagenesis in Rice: The Basis for Breeding a New Super Plant. *Front. Plant Sci.* 10:1326, 2019. doi: 10.3389/fpls.2019.01326

### Section

4th International Conference “Nuclear and Radiation Technologies in Medicine, Industry and Agriculture” (Section 4)

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**Track Classification:** 4th International Conference “Nuclear and Radiation Technologies in Medicine, Industry and Agriculture”(Section 4): Sub-Section 4-2 “Radiation Technologies”