

Brief information about the project

Name of the project	AP26101681 Study of the toxicogenetic effects of widely used pesticides in Kazakhstan (Solito, Gulliver, Rainbow) on bioobjects
Relevance	The relevance of this study is determined by the increasing use of pesticides in the agro-industrial sector of Kazakhstan and the associated environmental and biomedical risks. Despite existing regulatory frameworks, the toxic and genotoxic effects of widely used pesticides—particularly new active substances and their combinations—remain insufficiently studied. Under conditions of rice cultivation and intensive water use, the likelihood of pesticide accumulation in aquatic ecosystems and their impact on biota increases. Therefore, a comprehensive assessment of their toxicogenetic effects is required to substantiate environmental safety and to improve pesticide application practices.
Purpose	Study of the cellular mechanisms underlying the toxicogenetic effects of pesticides (Solito, Gulliver, Rainbow), widely used in Kazakhstan, using various test organisms and test systems.
Objectives	To conduct a comprehensive analysis of existing data on pesticide usage and the hydrobiological status of water bodies in Kazakhstan affected by collector-drainage runoff from rice-growing areas. As a result, data on pesticide application and the condition of aquatic organisms across different regions of Kazakhstan will be compiled and systematized, establishing a baseline understanding of current ecosystem status and identifying key directions for further research. This task serves as a foundation for subsequent stages of analysis and assessment. To investigate the effects of pesticides on populations of aquatic organisms and to assess the level of contamination in water, sediments, and soils, as well as to evaluate the abundance and condition of key animal (fish, amphibians, rodents) and plant (onion, barley) test systems. The obtained data will provide insight into how specific pesticides affect different species and ecosystem functions, enabling the identification of the most vulnerable groups and the development of recommendations for their protection. To perform laboratory experiments to assess pesticide toxicity and determine LD₅₀ (the dose causing mortality in 50% of organisms), along with other toxicity parameters for selected aquatic organisms.

	The results will allow the establishment of cause–effect relationships between pesticide exposure and its impact on the health of aquatic organisms, providing a more detailed understanding of the problem. To conduct an ecological risk assessment of pesticide use in natural ecosystems based on the results of physicochemical, biochemical, molecular-genetic, and histological analyses. The ultimate aim of this work is to develop a scientific basis for biodiversity conservation in intensively irrigated regions.
Expected and achieved results	As a result of the Project implementation, the toxicogenetic potential of the pesticides Solito, Gulliver, and Rainbow, as well as their active ingredients, will be established. Based on the results of physicochemical analyses of water and soil, along with biotesting for cyto-, embryo-, and genotoxicity in both experimental settings and natural populations of aquatic organisms and terrestrial animals, mapping of the surveyed areas surrounding rice-growing massifs in the Balkhash and Karatal districts of the Almaty region will be carried out according to the level of contamination. In 2025, a комплекс of field and experimental studies was completed. Field expeditions were conducted in selected rice-growing areas of the Balkhash and Karatal districts of the Almaty region. Common species of amphibians and rodents were captured, and laboratory test organisms were established and maintained for assessing pesticide effects. The research results were presented in the form of three abstracts at an international conference in Beijing (China). Under laboratory conditions, genotoxicity studies were performed using model organisms. The genotoxic potential of the Solito pesticide and its active ingredients—pretilachlor and pyribenzoxim—was established. Toxicity assessment was carried out using ZFET (on <i>Danio rerio</i>) and FETAX (on <i>Xenopus laevis</i>) test systems, which enabled the identification of embryo- and genotoxic effects of the studied compounds.
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Usage	Differences in the toxicogenetic effects of Solito, Gulliver, and Rainbow will enable the assessment of their relative ecological risks. This will provide a basis for informed decision-making regarding their use and the development of regulatory policies, identifying potential risks to agriculture, biodiversity, and human health, and highlighting the need for continuous monitoring of their application.
Priority compared to real-world alternatives	The advantage of this project compared to existing analogues lies in its comprehensive approach: both toxic and genotoxic effects of pesticides and their combinations are assessed simultaneously under laboratory and natural conditions. Unlike most studies, the work is focused on real agroecosystems of Kazakhstan and regionally used pesticides. In addition, modern bioassays and interdisciplinary methods are employed, which increases the reliability and practical significance of the results.
List of publications with links to them	Abstracts published in the proceedings of an international scientific conference (Beijing, China): https://academicresearchlibrary.com/proceedings/607 Toxicogenetic Assessment of a Widely Used Agro-Pesticide in Kazakhstan on Test Organisms Authors: D. Kozhakhmetova, T. Shalakhmetova, A. Lovinskaya Study of Solito-Induced Embryotoxicity and Histopathological Alterations in Zebrafish (Danio rerio) Authors: D. Chekimbayeva, A. Askhar, T. Shalakhmetova, A. Tlenshiyeva Effects of the Herbicide Solito on Animals of Natural Populations from Biotopes Near Rice-Growing Areas of the Akdala Region (Kazakhstan) Authors: T. Shalakhmetova, S. Kolumbayeva, A. Tlenshiyeva
Patents	Not planned for 2025