Assessment of Toxicogenetic Disturbances in Animals Inhabiting Rice Agroecosystems Treated with the Herbicide Gulliver

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Abstract

The sustainable development of the agro-industrial sector is essential for food security, leading to the widespread use of pesticides in agriculture. In Kazakhstan, the herbicide Gulliver, containing Azimsulfuron, is extensively applied in rice cultivation to control grassy, broadleaf, and sedge weeds. However, information regarding its biodegradation and effects on non-target organisms remains limited. A comprehensive toxicogenetic study was conducted on specimens of natural populations inhabiting biotopes adjacent to rice-growing farms of the Karatal massif, where Gulliver had been used. The investigated organisms included amphibians (*Pelophylax ridibundus, Bufo viridis*), rodents (*Rhombomys opimus, Myodes centralis, Myodes arvalis*), and fish (*Perca fluviatilis, Abramis brama*). Histological examination revealed structural disturbances in visceral organs of the studied animals. Biochemical analyses demonstrated elevated activities of alanine aminotransferase (ALT) and aspartate aminotransferase (AST), increased levels of lipid peroxidation products, and reduced activities of antioxidant enzymes, including superoxide dismutase and catalase. In rodents, increased frequencies of chromosomal aberrations and polyploidy were also detected. The findings suggest that oxidative stress may be a key mechanism underlying the toxicogenetic effects of Azimsulfuron. Its accumulation in soil and aquatic environments indicates the necessity for further long-term ecotoxicological studies.

Keywords

Azimsulfuron, oxidative stress, toxicogenetic effects, rice agroecosystems.