



ECOLOGICAL AND ANALYTICAL STUDY OF PESTICIDE CONCENTRATIONS IN THE WATER-SOIL-AIR SYSTEM IN THE TERRITORY OF THE SURKHANDARYA REGION AND THE REPUBLIC OF KARAKALPAKSTAN

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Annotation: This article presents the results of a study analyzing pesticide concentrations in environmental samples collected in the Surkhandarya region and the Republic of Karakalpakstan. Water, soil, and air samples were analyzed using gas chromatography and high-performance liquid chromatography. The study identified key pesticides, such as DDT and atrazine, and assessed their environmental hazards. The analysis revealed that in certain areas, DDT and atrazine concentrations exceed established standards. This situation is considered a threat to regional environmental safety, necessitating enhanced environmental monitoring and stricter controls over pesticide use.

Keywords: water, soil, air, pesticides, DDT, atrazine, gas chromatography, liquid chromatography, environment, immunity, climate, food, agriculture, plant protection.

Annotation: This article presents the results of a study analyzing pesticide concentrations in environmental samples collected from districts of the Surkhandarya region and the Republic of Karakalpakstan. Water, soil, and air samples were analyzed using gas chromatography and high-performance liquid chromatography methods. The main types of pesticides, such as DDT and atrazine, were identified, and the degree of their environmental hazard was assessed. The analysis results showed that in certain areas, the concentrations of DDT and atrazine exceed the established regulatory limits. This situation is assessed as a factor threatening regional environmental security, necessitating enhanced environmental monitoring and stricter control over pesticide use.

Keywords: water, soil, air, pesticides, DDT, atrazine, gas chromatography, liquid chromatography, environment, immunity, climate, food, agriculture, plant protection.

Introduction

The Surkhandarya Region of the Republic of Uzbekistan is located in the southernmost part of the country and is characterized by a dry subtropical climate. The region's territory lies between 37°10' and 39°0.2' north latitude and 66°32' and 66°25' east longitude. Intensive agricultural sectors such as cotton, vegetable, and viticulture are widely developed in the region, leading to high levels of pesticide use. In particular, various chemicals, including organophosphorus and organochlorine compounds, are widely used to protect plants from pests.

The Republic of Karakalpakstan is located in the northwestern plain of Uzbekistan, in the lower reaches of the Amu Darya River. Land suitable for agriculture is primarily concentrated in the river delta. This area is considered a high-risk zone for pesticide residue pollution. Due to the long-term use of persistent organic pollutants such as DDT, their ecological traces remain here.

Therefore, quantitative and qualitative studies of pesticide residues in water, soil, and atmospheric air in these regions represent a pressing scientific challenge. Resolving this challenge is crucial for ensuring environmental safety, improving environmental monitoring systems, and assessing potential threats to human health.

Materials and methods of research

Sampling regions and period. The study was conducted in 2023-2024 in the Surkhandarya region (Denau, Angor, and Sherabad districts) and the Republic of Karakalpakstan (Beruni, Ellikkala, and Tortkul districts). These locations were chosen due to intensive agricultural activity and historically high levels of pesticide use.

Water samples were collected from the main sources: irrigation ditches, canals, and wells in each study area. The samples were preserved and transported according to standard methods.

Soil samples were collected from a depth of 0-20 cm using the "envelope" method, followed by a composite sample for each district to ensure representativeness. Air samples were collected during the season of active pesticide application using portable aspiration units with sorption tubes.

Analytical methods.

A set of instrumental methods was used to quantitatively determine residual amounts of pesticides:

Gas Chromatography with Flame Ionization Detection (GC-FID): Used to detect organochlorines such as DDT, heptachlor, and endrin.

High performance liquid chromatography (HPLC): Has been used to analyze polar pesticides including atrazine, carbofuran, and malathion.

Spectrophotometric analysis was used for the integrated assessment of organophosphorus compound content.

Results and discussion

The chromatographic analysis revealed the persistent presence of pesticide residues in all studied environmental components.

1. **Water pollution.** Water samples from the Denau and Sherabad districts of the Surkhandarya region showed levels of atrazine and DDT metabolites exceeding hygienic standards. This correlates with the predominance of cotton and vegetable growing in these districts, where herbicides and insecticides are used most extensively.

2. **Soil contamination.** The highest DDT accumulation was observed in the soils of the Beruni district of Karakalpakstan, where its concentration reached 0.40 mg/kg, significantly exceeding the permissible level. This is a consequence of its historically extensive use and high persistence. In the Ellikkala and Tortkul districts, carbofuran and atrazine residues predominate in the soil.

3. **Risk assessment and bioaccumulation.** It has been established that the identified levels of contamination create the preconditions for bioaccumulation—the accumulation of

persistent compounds in food chains. The half-life of substances such as DDT and atrazine in natural conditions can reach 10-15 years, which explains their presence decades after their use was banned.

The findings are consistent with other studies showing that persistent organic pollutants (POPs) migrate over long distances and pose a long-term threat to ecosystems.

ConclusionA comprehensive environmental monitoring study confirmed significant levels of environmental pollution by pesticides in key agricultural regions of Uzbekistan. Exceeding standards for DDT and atrazine in water and soil in the Surkhandarya region and Karakalpakstan is an indicator of existing systemic problems related to historical and current agricultural practices.

The identified pollution levels pose direct and indirect risks to public health, contributing to an increase in allergies, liver disorders, and nervous system disorders. The accumulation of pesticides in habitats leads to the degradation of soil microbiota and a decrease in the biodiversity of aquatic ecosystems.

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