AMERICAN ACADEMIC PUBLISHER

INTERNATIONAL JOURNAL OF MEDICAL SCIENCES

ISSN NUMBER: 2692 - 5206 Volume 6. No 04. Aprel ,2026

ANALYSIS OF THE NUMBER OF SAMPLES IN SOIL, WATER, AND PESTICIDE CONTENT IN FRUIT AND VEGETABLE PRODUCTS WHEN ASSESSING PESTICIDE RESIDUES IN GREENHOUSES OF THE SURKHANDARYA REGION

Akhmedova Saodat Tashboltaevna

Lecturer at the Department of Microbiology, Public Health and Management of the Termez branch of the Tashkent State Medical University

saodat140284@gmail.com

Berdiev Olim Dovronovich

Tashkent State Medical University, Termez branch, Department of Hygiene of Children, Adolescents and Nutrition

olim.berdiyev@tma.uz

Abstract

The study analyzed pesticide residues in soil, water, and fruit and vegetable samples collected from greenhouse farms in the Surkhandarya region of Uzbekistan. Residual pesticide concentrations exceeding maximum permissible levels were found in 45% of soil samples and 30% of water samples. In fruit and vegetable products (cucumbers, tomatoes, peppers), exceedances of maximum permissible concentrations (MPC) were observed in 25% of samples. A correlation was established between pesticide content in soil and a decrease in the total microbial count (TMC), as well as changes in the microbial community structure (a decrease in the proportion of saprophytic bacteria and an increase in the proportion of resistant forms). The results indicate the need for enhanced monitoring and the implementation of biological plant protection methods.

Keywords

Pesticides, residues, greenhouses, Surkhandarya region, soil, water, fruit and vegetable products, total microbial count, microbiological monitoring.

Introduction

The Surkhandarya region is one of the largest producers of protected-ground vegetables and fruits in Uzbekistan. Greenhouse farms ensure year-round cultivation of tomatoes, cucumbers, peppers, and herbs. However, the intensive use of pesticides to control plant pests and diseases leads to the accumulation of their residues in soil, water, and finished products.

Pesticides can have toxic effects not only on target organisms but also on non-target soil and water microbiota. This manifests as a decrease in the total microbial count, changes in species composition, suppression of enzyme activity, and biodegradation processes. Furthermore, pesticide residues in vegetables and fruits pose a health risk to consumers.

In the Surkhandarya region, systematic monitoring of pesticide content in greenhouses is insufficient. Existing data are often fragmented. The aim of this work is to assess pesticide

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 04. Aprel ,2026

residues in soil, water, and fruit and vegetable samples from greenhouses in the region, as well as to analyze changes in microbiological indicators under the influence of contamination.

Methods and Results

Methods. The study was conducted from March to September 2023 at five large greenhouse farms in the Surkhandarya region (Termez, Dzharkurgan, and Sariasiya districts). A total of 150 samples were collected: 50 soil samples (0–20 cm depth), 50 water samples (from drip irrigation systems and open reservoirs), and 50 fruit and vegetable product samples (cucumbers, tomatoes, bell peppers, herbs).

Determination of pesticide residues was performed by gas-liquid chromatography with mass spectrometric detection (GC-MS) according to standard methods. The following groups of pesticides were determined: organochlorines (DDT, HCH), organophosphates (chlorophos, malathion), and pyrethroids (cypermethrin, deltamethrin).

Microbiological analysis of soil and water included the determination of total microbial count (TMC) by plating on meat-peptone agar (MPA), as well as identification of dominant groups of microorganisms (bacilli, pseudomonads, fungi, actinomycetes). Statistical processing was performed using Student's t-test and Pearson's correlation coefficient.

Results. Analysis of soil samples showed that in 45% of samples, the content of pesticide residues exceeded the maximum permissible concentrations (MPC). Organophosphorus compounds (chlorophos – up to 0.35 mg/kg at MPC of 0.1 mg/kg) and pyrethroids (cypermethrin – up to 0.15 mg/kg at MPC of 0.05 mg/kg) were most frequently detected. In water samples, exceedances of MPC were recorded in 30% of cases, mainly in reservoirs located near greenhouses (chlorophos – up to 0.02 mg/L at MPC of 0.01 mg/L). In fruit and vegetable products, pesticide residues exceeded MPC in 25% of samples. Cucumbers were the most contaminated (exceedance in 35% of samples), followed by tomatoes (22% of samples). Herbs (dill, parsley) showed exceedances in 18% of samples.

Microbiological analysis of soil revealed a significant decrease in total microbial count in samples with high pesticide content. In control samples (conventionally clean areas), the TMC averaged 5.2×10^6 CFU/g, whereas in pesticide-contaminated samples it was 2.4×10^6 CFU/g (a 2.2-fold reduction, $p < 0.01$). Furthermore, the structure of the microbial community changed: the proportion of Gram-positive bacilli decreased from 45% to 22%, while the proportion of Gram-negative pseudomonads (many of which are pesticide-resistant) increased from 18% to 41%. The number of actinomycetes decreased by a factor of 3. In water, a decrease in TMC was also observed: from 3.5×10^3 CFU/mL in conventionally clean reservoirs to 1.2×10^3 CFU/mL in contaminated ones ($p < 0.05$). Correlation analysis showed a strong negative relationship between total pesticide content in soil and total microbial count ($r = –0.78$; $p < 0.01$).

Discussion

The obtained results indicate significant contamination of soil, water, and greenhouse products in the Surkhandarya region with pesticide residues. The frequent exceedances of MPC for organophosphorus compounds and pyrethroids, which are widely used in the region due to their availability and rapid action, are particularly concerning. The decrease in total microbial count in contaminated soil can be explained by the direct toxic effect of pesticides on microorganisms.

AMERICAN ACADEMIC PUBLISHER
INTERNATIONAL JOURNAL OF MEDICAL SCIENCES
ISSN NUMBER: 2692 - 5206 Volume 6. No 04. Aprel ,2026

Organophosphorus compounds inhibit enzymes (e.g., acetylcholinesterase in insects, but they also affect some microbial esterases). Pyrethroids disrupt sodium channel function in membranes, which is toxic to bacteria. Moreover, pesticide accumulation leads to the selective enrichment of resistant forms, which is confirmed by the increased proportion of pseudomonads in the community. Changes in the microbial community structure may have long-term consequences: a reduction in the number of bacilli and actinomycetes, which are involved in organic matter decomposition and suppression of phytopathogens, may lead to decreased soil fertility and increased plant disease incidence. The detection of pesticide residues in fruit and vegetable products (especially cucumbers) indicates a violation of the pre-harvest interval. This poses a direct threat to consumer health, as chronic intake of low doses of pesticides is associated with oncogenic, neurotoxic, and endocrine disorders. The results highlight the need for enhanced regional monitoring, training of greenhouse workers on proper pesticide application, and the introduction of biological plant protection methods (entomophages, biopesticides based on Bacillus thuringiensis, Trichoderma spp.).

Conclusion

Based on the analysis of pesticide residues in greenhouses of the Surkhandarya region, the following conclusions were drawn: In 45% of soil samples, 30% of water samples, and 25% of fruit and vegetable samples, pesticide content exceeds MPC. Organophosphorus compounds and pyrethroids are the most frequently detected. In soils with high pesticide content, the total microbial count decreases on average by 2.2 times compared to clean areas. The structure of the microbial community changes: the proportion of bacilli and actinomycetes decreases, while the proportion of pseudomonads increases. A strong negative correlation was established between total pesticide content in soil and TMC ($r = –0.78$). It is recommended to implement regular microbiological and chemical monitoring in greenhouse farms in the region, as well as to transition to biological plant protection methods.

Literature Review

1. Zvyagintsev D.G., Babyeva I.P., Zenova G.M. Soil Biology. — M.: Moscow State University Press, 2015. — 448 p.
2. Veltishchev N.F., Tumanov A.V. Pesticides and Human Health. — M.: Medicine, 2018. — 320 p.
3. Rakhmatullaev Z.R., Abdullaev S.A. Monitoring of Pesticide Residues in Agroecosystems of Uzbekistan // Ecology and Industry. — 2021. — No. 4. — P. 44–49.
4. Sadykova D.T., Karimov Sh.I. Microbiological Characteristics of Greenhouse Soils under Long-Term Pesticide Application // Journal of Microbiology of Uzbekistan. — 2022. — Vol. 8, No. 2. — P. 67–73.