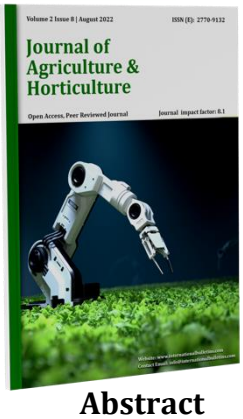

SOILS CONTAMINATED WITH PESTICIDES: ENVIRONMENTAL IMPACTS AND MEASURES

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Abstract

This article analyzes soils contaminated with pesticides and their environmental impacts. Pesticides are primarily used in agriculture to protect plants from insects and diseases, but their excessive use can negatively impact soil microbiology and its chemical properties. In recent years, research has extensively studied how pesticides affect the activity of soil microorganisms, organic matter cycling, and mineralization processes. Pesticides can also be harmful to human health. The article discusses various methods for restoring pesticide-contaminated soils, such as bioremediation and physicochemical techniques. These studies are crucial in determining necessary measures to reduce ecological risks and ensure agronomic sustainability.

Keywords: pesticides, soil microbiology, environmental impact, bioremediation, chemical properties, agriculture.

Currently, various scientific studies are being conducted in our country on the bioremediation of pesticide-contaminated soils using microorganisms. These studies aim to restore the natural fertility of soils affected by pesticides and maintain ecological balance.

Based on various scientific studies, we believe that pesticides are chemical substances used to prevent plant damage and inhibit their development or spread. They are mainly used in agriculture to control plant pests, diseases, and invasive species.

However, the excessive use of pesticides can negatively impact the ecosystem and soil microbiological activities. This article examines the environmental and agronomic impacts of pesticide-affected soils, as well as discusses methods for their restoration and risk mitigation measures.

The influence of pesticides on soil microbiology has been investigated through numerous studies. For example, the study by Harter et al. examined the impact of pesticides on soil microbial communities. According to their findings, pesticides suppress the activity of soil microorganisms and alter their species composition. This, in turn, affects soil organic matter cycling and mineralization processes.

In order to further enrich the theoretical aspects of our research, we considered it appropriate to conduct a scientific and theoretical analysis of the experiences of various advanced foreign countries and the opinions of scientists from these countries.

For example, according to American scientist T.Harter, pesticides cause changes in the soil, such as affecting the soil's organic matter and microbiological activity. According to research by US scientists, pesticides can reduce biological activity in the soil, i.e., alter the species of microorganisms and their age distribution[1]. E.K.Bünemann argues that pesticides can either facilitate the formation and development of various microorganisms or, conversely,

lead to their destruction. The decrease in microbiological activity may affect the soil's carbon cycle and accelerate its loss of organic matter [2].

D. Santos offers the following perspective on this matter. Based on his research, he suggests that pesticides can alter the soil structure and the concentration of inherent harmful elements through various chemical reactions in the soil, including changes in pH and interactions with minerals [3]. Y.Feng, on the other hand, notes that various methods have been developed to restore pesticide-contaminated soils, some of which include bioremediation and physicochemical treatment. These methods can be highly effective, but their efficacy often depends on the degree of contamination and the type of pesticide [4].

Russian scientists have paid significant attention to studying the impact of pesticides on soil microbiological activity. For example, Grebennikova et al. conducted research on how pesticides affect the activity of soil microorganisms. These studies provide data on the chemical effects of pesticides, such as reducing the species diversity of microorganisms and suppressing their productive activities. Additionally, it has been shown that pesticides, especially insecticides, can reduce biodiversity in the soil and inhibit soil functioning [5].

Several studies have been conducted on the impact of pesticides on the chemical properties of soil in Russia. Particular attention has been paid to the influence of pesticides on soil pH levels, organic matter content, and mineral cycling. Based on mathematical and ecological modeling, pesticides alter the biochemical cycling of minerals in the soil and reduce soil fertility. For example, Sevostyanov et al[6] conducted research on the effects of pesticides on the chemical and biological properties of soil. They found that pesticides change the concentrations of calcium, magnesium, and sodium in the soil.

In Kazakhstan, research on pesticide-contaminated soils is also of significant importance. Kazakh scientists have studied how pesticides affect the physical and chemical properties of soil. For instance, Kurmanova et al[7] investigated the effects of pesticides on soils in Kazakhstan and found that they alter the cycling of organic matter and negatively impact the activity of microorganisms. Additionally, they demonstrated that pesticides affect the soil structure, specifically its ability to retain sediment and absorb water.

Scientists from Russia and Kazakhstan have also studied the impact of pesticides on human health. Vakhapov et al[8] analyzed the adverse effects of pesticides when ingested by humans and animals. These studies aim to demonstrate the risks posed by pesticides to the nervous system, immune system, and gynecological health of humans and animals.

Several studies have been conducted in Kazakhstan aimed at restoring soils contaminated by pesticides. For example, in Kazakhstan, bioremediation methods were used to restore pesticide-affected soils. This method was carried out using specialized microorganisms for biodegradation or removal of pesticides[7].

From the opinions of the aforementioned scientists, it can be understood that pesticides can also alter the chemical and physical properties of soil. For instance, pesticides can reduce the concentration of organic matter in the soil and slow down the overall circulation of minerals. These conditions can lead to soil degradation and a decrease in soil fertility.

Pesticides can pose a threat not only to nature but also to human health. These chemicals can enter the body through soil, water, air, and food products. Pesticides can cause nervous system disorders, hormonal imbalances, and cancer in humans. Therefore, the use of pesticides requires caution and proper management measures. There are several methods for restoring soils contaminated by pesticides. One of these methods is bioremediation. In

bioremediation, specific microorganisms or plants are used to absorb and eliminate pesticides. Feng et al. investigated methods for restoring pesticide-contaminated soils using bioremediation. Chemical methods can also be used, such as hypercoagulation of pesticides, or physical methods, including soil screening and washing, for restoration.

When using pesticides, it is important to exercise caution and comply with legislation. There are numerous national and international standards for monitoring pesticide concentrations in soil and reducing their spread. For example, in the United States, the Environmental Protection Agency (EPA) oversees the safe use of pesticides and assesses their environmental impact.

Pesticides can have a negative impact on soil and ecosystems. Scientific research and practical measures are of great importance for the restoration and sustainable management of pesticide-affected soils. Bioremediation, physicochemical methods, and environmental monitoring can be effective approaches for reducing the environmental and agronomic effects of pesticides.

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