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THE IMPACT OF PESTICIDE USE IN AGRICULTURE: THEIR BENEFITS AND HAZARDS

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ABSTRACT

Pesticides are widely used in agriculture to protect crops from pests and diseases, ensuring food security and economic stability. Despite their benefits, excessive and improper use poses serious environmental and health hazards. This article explores the historical development, production, and application of pesticides, particularly in Uzbekistan, where their use has been regulated since 1947. The study highlights the advantages of pesticides, such as increased agricultural productivity and disease control, while also addressing their harmful effects on human health and ecosystems.

Key words: Pesticides, Uzbekistan, Benefit, Hazards, Human, Environment, Air pollution.

INTRODUCTION

Pesticides have been utilized since as early as 900 AD, during a period known as the "natural products" era. These chemicals encompass a broad spectrum of substances, including insecticides, acaricides, nematicides, molluscicides, rodenticides, herbicides, fungicides, avicides, bactericides, and others. Among these, organochlorine (OC) insecticides, which were effective in controlling diseases like malaria and typhus, were banned or restricted in most developed nations after the 1960s. In the 1960s, the development of synthetic insecticides like organophosphates (OPs), followed by carbamates in the 1970s and pyrethroids in the 1980s, alongside the introduction of herbicides and fungicides, greatly enhanced pest control and agricultural productivity. Ideally, a pesticide should be lethal to pests but harmless to non-target organisms, including humans. Unfortunately, this is not always the case, and concerns about pesticide use and misuse have emerged. The widespread application of these chemicals, based on the belief that "if a little is good,

more is better," has caused significant harm to human and other life forms. They can also contaminate groundwater through leaching and pose environmental risks. Additionally, pesticides can spread through volatilization, impacting wildlife. This paper, therefore, examines both the advantages and dangers of pesticide use in agriculture.

The use of chemicals began in the 19th century, with pyrethrum being used in Europe starting from 1800 to combat pests on humans and animals. In 1825, hexachlorocyclohexane (HCH) was produced, followed by the synthetic organic compound dichlorodiphenyltrichloroethane (DDT) in 1874. However, DDT's insecticidal properties were discovered in 1934 and were recommended for use in Switzerland for the same purpose in 1942. By the mid-20th century, pesticides were widely used in many countries, not only to control pests on humans and animals but also to combat plant diseases and weeds. They are also employed in agriculture to promote plant growth, support the development of grains and fruits, and for various other purposes. Globally, crop losses due to plant diseases and weeds amount to $75 billion annually, while the total value of annual agricultural production is estimated at $140-150 billion.

Production and usage of pesticides in Uzbekistan

Pesticides have been used in Uzbekistan since 1947. By 1967, the amount of pesticide use had increased 27 times, and by 1989, it reached 850 thousand tons, with an average of 20 kg of pesticides per hectare of land. Across the republic, this figure is 3 kg per hectare. In accordance with the regulations introduced in Uzbekistan, any new pesticide intended to enhance agricultural productivity must undergo thorough toxicological testing before its use. Based on the results of this study, a decision is made on whether the substance can be utilized in agriculture.

The use of pesticides in Uzbekistan

Additionally, the conditions under which the pesticide can be used safely are determined. The permissible concentration of the chemical in the air during application, as well as the maximum allowable residue in agricultural products, is clearly defined. All these measures are implemented in accordance with relevant documents and regulations issued by the Ministry of Health and the State Sanitary and Epidemiological Surveillance Authority. Thus, the initial sanitary control over the use of toxic chemicals in agriculture is carried out in a systematic manner. This task is conducted nationwide under the plan of a special state commission on pesticide regulations, operating under the Chief Sanitary and Epidemiological Department of the Ministry of Health.

Benefits of pesticides

In global agricultural practices, chemical pesticides, despite their adverse effects, play a significant role in protecting plants from various pests and diseases. Limiting the use of chemical pesticides helps reduce these negative consequences. Instead, biological protection methods and biopreparations are used to decrease the presence of chemically active substances in the environment. These methods rely on the antagonistic properties of natural biocenoses elements.

There are three main biological control methods:

• Producer-based method – biological pesticides derived from microorganisms and their metabolic products (microbiological control method).

• Biologically active substances – compounds like pheromones that influence harmful insects and their reproduction.

• Use of entomophages– beneficial insects that serve as natural antagonists against plant pests.

Biological pesticides are classified into three types:

1. Microbiological preparations (viruses, bacteria, toxins).
2. Fungal-based preparations.
3. Antibiotics and enzymes.

Bacterial pesticides are mainly produced using different strains of Bacillus thuringiensis, isolated from diseased insects in microbiological industries (including Pseudomonas species). They are typically available in dry or wettabl powder form .Viral pesticides are derived from nuclear and cytoplasmic viruses, which infect only the nucleus and cytoplasm of living cells. They come in various formulations, such as suspensions, granules, and wettable powders. Fungal-based pesticides are produced using entomopathogenic fungi like Beauveria bassiana in dry powder

form. Antibiotics are obtained through the biological synthesis of microorganisms (bacteria and fungi) or by extracting plant-based compounds. They are usually available in dry powder form. Some well-known microbiological pesticides include Boaverin, Naturalis A, Dipel, Akotek, Entobacterin, Trichothecin, and Virins (EKS, ENSH, KSH), among others.Bacterial (microbiological) pesticides are commonly formulated as dry or wettable powders. Besides the active ingredient, they contain fillers (such as kaolin) and additives that enhance their technological properties (e.g., preventing evaporation and improving solubility).The recommended application rate ranges from 1 to 5 kg per hectare. These pesticides are primarily used as insecticides and acaricides. Residues of bacterial pesticides on harvested fruits are considered practically safe for human consumption. Under different atmospheric conditions (solar radiation, wind, and short-term weather changes), these pesticides remain on plants for 2 to 5 days. They do not disrupt soil microbiota and are considered low-resistance formulations. Additionally, they are non-pathogenic to other aquatic organisms. Microbiological pesticides are generally classified as class 4 in terms of toxicity, except for certain pesticides derived from the metabolic products of microorganisms (such as antibiotics). However, all biological pesticides possess allergenic properties. This characteristic has been identified through toxicological studies on experimental animals and individuals working in pesticide production. However, in agricultural applications, allergic reactions are relatively rare. When applied, these pesticides primarily enter the body through the respiratory tract. Absorption through the skin has not been observed, but they can have a localized irritant effect on the skin and mucous membranes, potentially causing dermatitis and conjunctivitis.

The harmful effects of pesticides on humans

During the application of pesticides, a large number of workers are involved, performing tasks such as treating seeds with pesticides, controlling pests, and ensuring the drying and shedding of plant leaves. In addition, specialists, agronomist-entomologists, civil aviation personnel, and representatives of production associations participate in the pesticide application process. Moreover, in some cases, failure to comply with quarantine regulations in designated areas may lead to workers being exposed to the harmful effects of pesticides while working in treated fields. This exposure can occur during activities such as moving among plants, irrigation, and other agricultural tasks.

Ways of pesticides entry into the body

Pesticides can enter the human body through the respiratory tract in the form of gases and vapors (volatile ones), as dust particles, or as fine droplets (fine mist

aerosols). Many pesticides, particularly those that are fat-soluble, can also penetrate the body through the skin.Pesticides can enter the body through the gastrointestinal tract mainly due to workers' failure to follow personal hygiene rules or as a result of the population consuming food products and water contaminated with pesticides.

Impact on environment

Pesticides can pollute soil, water, grass, and various plants. Besides eliminating insects or weeds, they may also be harmful to many other living organisms, such as birds, fish, helpful insects, and unintended plants. While insecticides are typically the most immediately toxic type of pesticides, herbicides can also threaten non-target species.

Effect of Pesticides on Air Pollution

Pesticide sprays can come into direct contact with unintended plants or disperse through drift or evaporation from the treated area, leading to contamination of the air, soil, and nearby vegetation. Some degree of pesticide drift occurs with every application, even when using ground-based equipment. The toxicity of Roundup is likely linked to the high toxicity of one of its inactive ingredients. Beyond immediate toxic effects, certain herbicides can cause sub-lethal impacts on fish, reducing their chances of survival and posing a threat to the overall population. Herbicides may also harm birds by destroying their natural habitat. The use of glyphosate in clear-cut areas has been shown to cause a significant decline in local bird populations.

Conclusion

Pesticides are widely used chemical substances in agriculture, serving as an effective means of combating pests. These chemicals help prevent plant diseases, increase crop yields, and contribute to food security. Certain crops, such as cotton and legumes, are difficult to cultivate effectively without pesticides. Additionally, pesticides play a crucial role in the fight against malaria. However, the excessive and improper use of pesticides can have negative effects on both the environment and human health. Their spread through air, water, and soil can harm ecosystems, eliminate beneficial organisms, and pose a threat to wildlife. Pesticides can enter the human body through the respiratory system, skin, or contaminated food, potentially causing allergic reactions, dermatitis, eye irritation, and other health issues. In Uzbekistan, pesticides have been widely used since 1947. To ensure their safe application, they must undergo toxicological testing, with permissible concentration levels clearly defined and regulated under sanitary control. Furthermore, the use of alternative methods such as biopreparations and biological control is recommended to minimize the risks associated with chemical pesticides.

In conclusion, while pesticides have both benefits and drawbacks, their safe and moderate use is essential. Greater attention should be given to alternative methods to ensure biological and environmental safety. Strengthening measures to protect the environment and safeguard human health is crucial in promoting sustainable agricultural practices.

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