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Impacts of Pesticides on Agriculture

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Abstract - Pesticides are a category of chemicals used to eradicate an infestation or prevent further reproduction. Pesticides are often used to manage weeds or insect invasion in agricultural areas as well as other pests and disease-carrying insects in homes, workplaces, shopping malls, and on public highways. Pesticides' modes of action are not species-specific, therefore concerns have been expressed regarding the environmental harm associated with their exposure in many ways. Pesticides of all kinds have been used for crop protection for hundreds of years. Although pesticides benefit crops, they can have a harmful impact on the environment. Damage to biodiversity might result from overuse of pesticides. Injurious chemicals pose a threat to the survival of many aquatic creatures and birds. Pesticides may enter the body by oral, inhalation, or dermal exposure, and it is generally recognized that they are the primary cause of a number of illnesses include respiratory conditions, cancer, skin issues, endocrine disruption, and infertility.

Keywords - Agriculture, Cancer, Disorder, Pesticide.

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INTRODUCTION

Due to the sharp rise in human population, there is less overall arable land in the modern world. More crops must be grown in the constrained space in order to balance this problem. The introduction of disease-resistant, high-yielding varieties is being employed to manage the problem globally. Regardless of whether a crop field is growing native or hybrid kinds, pests are always unwelcome visitors. Pesticides are consequently frequently utilized in current agricultural techniques all over the world and have recently been integrated into the crop management system.[1]

Pests that impede crop development are eliminated from agricultural fields using pesticides, which are synthetic organic substances. Pesticides are chemicals used to kill or deter various pests, including insects, weeds, rodents, birds, bacteria, nematodes, and plant parasite viruses, . Pesticides assist in eliminating or delaying insect activity, saving the crop at various phases of development . Thus, pesticides assist impoverished farmers in producing a healthy crop with less labor expenditure. It decreases needless time spent looking for, clearing weeds from, or getting rid of pests' known or unknown feeding grounds. As everyone is aware, a farmer must spend a significant amount of money on pest control throughout the year. As a result, individuals have been looking for appropriate and particular substances.[2]

Decoction, combination, and fume were also referenced in historical and legendary literature as methods of insect control for plants. Around 4500 years ago, elemental sulphur dusting was used to ward off pests in ancient Mesopotamia, marking the beginning of pesticide use. The Rig Veda, a revered Hindu literature that is more than 4,000 years old, also made reference to the usage of toxic plants to ward off hazardous pests Chemicals like arsenic, mercury, or lead were utilized to eradicate pests throughout the 15th century. According to the literature, nicotine sulfate, an insecticide made from tobacco plant leaves, was regularly used in agricultural fields in the 17th century AD. Pyrethrum and rotenone, two natural insecticides, were first used in the 19th century . Pesticide usage has been increasing steadily and rapidly over the world since the latter half of the 19th century, which has resulted in a significant rise in pesticide contamination.[3]

The United States' first pesticide governing body was established by law in 1910, taking into account the effects on the environment . In reality, it surged in the first half of the 20th century, which led to the introduction of several synthetic pesticides starting in 1940 all over the globe . Thus, the 1940s to 1950s have been seen as the start of the modern age of pesticide use (Murphy, 2005). The third agricultural revolution, sometimes known as the "green revolution," started in the late 1960s as a consequence of the introduction of synthetic pesticides . This revolution included new technology, such as the use of hybrid crop

varieties together with herbicides and chemical fertilizers, as well as the usage of contemporary farm equipment. The method has enabled remarkable agricultural productivity all around the world.[4]

Prior to being made aware of their negative effects on human health and connection to certain environmental problems, people began to see pesticides as a crucial component in the food production process (Hazarika, 2010). However, the fact that pesticides are still being used in agriculture areas is concerning. The four main categories of synthetic insecticides still in use are as follows. They are the carbamate, pyrethroid, organochlorine, and organophosphate groups. These are sophisticated chemical substances that may have stimulatory, inhibitory, or neutral effects depending on their ingredients, concentration, contact duration, and treatment frequency (Maly and Ruber, 1983).[5]

The first-generation synthetic pesticide with a chlorinated hydrocarbon group is known as organochlorine. Both agricultural and nonagricultural operations often use them. Many developed nations have outlawed this class of pesticides because of its detrimental effects on human health and the environment . DDT, Endrin, Toxaphene, BHC (lindane), Mortal, Thiotax, Endosulfan, etc. are typical examples. The organophosphate group increasingly took the role of organochlorine pesticides. The first documented usage of organophosphate-based insecticides occurred in 1937. Tetraethyl pyrophosphate (TEPP) was a component in the first organophosphate insecticide, known as Blandan, which was well accepted commercially at the time. German scientist Gerhard Schrader created the pesticide Blandan in the late 1930s, and in 1944, he also produced the insecticide parathion . These include synthetic pesticides like Malathion, Monocrotophos, Durmet, Rogor, and Metasystox as well as Match, Temephos, and Fenitrothion. Due to their efficiency and broad-spectrum biological action, carbamates have been used extensively over the globe to control pests since they were first introduced in 1970. They were mostly used in soil to control nematodes and insects. The strong polarity, water solubility, and thermal instability of carbamates are their key characteristics. Examples include Temik, Propoxur, Carbofuran, and Sevin.[6]

The widespread distribution of cyanobacteria across the world, which in some ways reflects their ability to withstand environmental pressures including the poisonous effects of various manmade substances . They are ideal research materials for ecologists, physiologists, biologists, microbiologists, and bacteriologists who study many facets of life science, biotechnology, and biochemistry due to their prevalence in a variety of environments. According to the research that was available, cyanobacteria's growth, biochemical composition, rate of photosynthesis, nitrogen fixation activities, and metabolic activities. Studying the effects of these persistent and recalcitrant pesticides on all varieties of beneficial soil microorganisms has become crucial because non-targeted organisms are unintentionally affected the most by the toxic effects of pesticides, especially in tropical rice fields . In fact, we may assert that improved management of rice fields in all tropical nations, including India, is exactly the "need of the hour" at this point. Throughout the entire tropics , was chosen as the test genus to understand the systemic effects of the fixation of elementary nitrogen. This decision was made due to the great economic and ecological significance.[7]

Venkatarman (1975) & Tiwari et al. conducted thorough reviews of the contribution of the genus' members to nitrogen biofertilizer (2000). Although the diversity or distribution of Westiellopsis in various agroecosystems have received significant attention, investigations on the impact of pesticides on the genus are still few (Deka and Sarma, 2011). [8]

Due to its presence in vital compounds like proteins, amino acids, or enzymes, the nutrient nitrogen is a necessary component for all living forms, including plants. Although there is a lot of this nutrient in the air, it can be fixed by a tiny group of microbes so that plants may use it.[9]

The nitrogen cycle is a phenomena that describes how physical and biological processes in an environment change nitrogen into various chemical forms. About 70% of the nitrogen in the atmosphere is fixed biologically. Figure 1 illustrates the four processes that make up a nitrogen cycle: nitrogen fixation, ammonification, nitrification, and denitrification.[10]

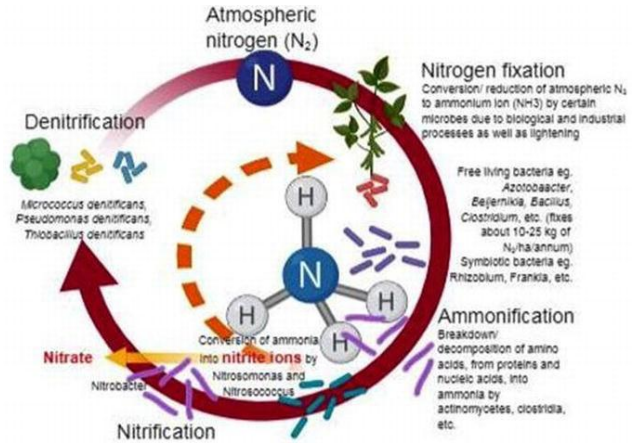

Fig. 1. Revolving around nitrogen.

Numerous biotic and abiotic factors affect nitrogen fixation. Nitrogen fixation has been shown to be sensitive to a wide range of environmental conditions, and this chapter provides a short overview of how pesticide use, temperature, and light, and the acidity, ph, salinity, phosphorus, or water content status of soils all play a role.[11]

Each environmental factor that may affect the nitrogen-fixation process has been explored in this

chapter, and new data relevant to this topic, such as the pervasive use of pesticides, has been brought to light. In most cases, soil microbiota are unaffected by pesticide usage at the authorized rate, but excessive pesticide use may have negative effects on rhizobia and bean plant development. To some extent, they also impede the symbiotic nitrogen - fixing process by stifling the biochemical communication or dialogues between legumes and rhizobial symbionts.[12]

The use of pesticides begins from the pre-sowing phase of crop development. The uncontrolled use of pesticides disrupts the soil ecosystem by influencing flora and fauna includes microflora of soil, as well as the physico-chemical characteristics of the soil like pH, salinity, alkalinity resulting to infertility of soil. (Sarnaik et al., 2006). The use of pesticides brings with it the possibility of adverse consequences on species other than those intended. Nontarget or helpful micro-organisms as well as the activities they do are negatively impacted by pesticides in the soil . The microbial biomass plays a significant function in the soil ecosystem where they perform a key role in nutrient cycling or decomposition. . Modern agriculture globally utilizes a range of pesticides including insecticides, herbicide, herbicides , fungicides to enhance crop productivity. However, consistent pesticide use may lead to soil contamination, which can disrupt microbial activities that are crucial to maintaining soil fertility.[13]

PESTICIDES AND THEIR DANGERS

Pesticides have expanded economic potential via greater food and fiber production and reduced vector-borne illness, but at a high cost to human and environmental health. At this point, there is incontrovertible proof that some of these compounds may be harmful to people and other organisms, in addition to having unintended consequences for the ecosystem . There is no safe level of pesticide exposure, and the people of poor nations and high-risk groups within each country have a disproportionate share of the responsibility for the potentially devastating health impacts of pesticide exposure. About 1 million people a year suffer from chronic illnesses and untimely deaths as a result of pesticide contamination.[14]

Workers in manufacturing, formulation, spraying, mixing, loading, and agriculture are at a heightened risk of exposure to pesticides. Manufacturing and formulation both entail non-zero risk factors. Pesticides, raw materials, poisonous solvents, and inert carriers are just some of the hazardous substances handled by employees in industrial environments.[15]

Air, lakes, seas, fish, and birds that eat fish might all be contaminated by OC compounds due to the widespread dispersion of these substances throughout the environment. According to the National Academy of Sciences of the United States, exposure to DDT and its metabolite, DDE, causes eggshell thinning, which is a major factor in the fall of the bald eagle population in the USA (Liroff, 2000). Long-term, low-dose exposure to environmental chemicals, such as pesticides, is increasingly linked to negative human health outcomes like immune suppression, reproductive problems, diminished intelligence, reproductive abnormalities, and cancer due to the chemicals' ability to mimic or antagonize the body's natural hormones, which is how they are known to elicit their adverse effects.[16]

Workers (N=356) at four units producing HCH in India had neurological symptoms (21%), which were correlated with exposure levels (Nigam et al., 1993). The level of the toxicity risk associated in the spraying of methomyl, a carbamate insecticide, under field circumstances was examined by NIOH . Electrocardiogram (ECG) alterations, increases in blood lactate dehydrogenase (LDH) levels, and decreases in cholinesterase (ChE) activities were all seen in the spraymen, showing cardiotoxic effects of methomyl. In male formulators working in the unorganized sector to create dust and liquid formulations of different pesticides , limited health surveillance observations showed a high incidence of generalized symptoms in addition to psychological, neurological, cardiorespiratory, and gastrointestinal symptoms, and low plasma ChE activit .[17]

One thousand and ten couples were studied for their exposure to pesticides during the male's work in cotton fields and its potential effects on reproduction .[18]

Malaria sprayers (N=216) were recruited for a research to examine the effects of a brief exposure to HCH in field circumstances over the course of 16 weeks .[19]

The sole impact proven with confidence as a result of dioxin creation in a study of persons afflicted by the Seveso diaster of 1976 in Italy during the manufacturing of 2,4,5 T, a herbicide, was chloracne (almost 200 instances with a clear exposure dependency). There were conflicting findings from the first health studies looking at things like liver and immunological function, neurological damage, and reproductive impacts. It was discovered that there was an increase in mortality from respiratory and cardiovascular disorders; this may be attributable to both the chemical exposure and the psychological fallout from the disaster. Diabetes was also identified in higher than normal numbers. A higher rate of cancer in the digestive tract, lymph nodes, and blood was found in the follow-up study of cancer incidence & death. Several factors, including a lack of individual-level exposure data, a very brief latency period, and a relatively small population

numbers for specific cancer types, mean that the results cannot be considered definitive. [21]

All-cause and cancer-related death rates were stable in 2001, according to a research conducted that year. The findings, however, provide credence to the theory that dioxin is carcinogenic to humans also confirm the hypothesis linking it to effects on the cardiovascular system and the endocrine system . The United States military used roughly 19 million litres of herbicide on around 3.6 million acres of land in Vietnam and Laos to clear vegetation from of the perimeters of US bases and to eliminate forest cover and damage crops. Operation Ranch Hand was implemented between the years of 1962 and 1971. 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) (2,4,5-T). During the Vietnam War, almost 3 million Americans fought in the military services there. They were among the many who were exposed to defoliant mixes including Agent Orange, including Vietnamese fighters and civilians as well as personnel of the military forces of other countries. There existed data on the cancer risk of Vietnamese people, Vietnam War veterans, and employees exposed to herbicides and dioxins on the job.[22]

CONCLUSION

When it comes to eliminating weeds & insect pests from urban landscapes, pesticides are often seen as a fast, simple, and affordable answer. However, using pesticides has a big price. Almost every aspect of our environment has been poisoned by pesticides. Pesticide usage in metropolitan areas contributes to the issue of pesticide residues in soil, air, surface, and ground water around the world. The ecosystem and non-target creatures, such as beneficial soil microbes, insects, plants, fish, or birds, are significantly at danger from pesticide pollution. Contrary to popular belief, even herbicides may have a negative impact on the environment. In reality, since they are used in quite high quantities, weed killers may be particularly hazardous. Using safer, non-chemical pest management techniques, including weed control, is the greatest way for everyone of us to contribute to reducing pesticide contamination in our environment.

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