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Drawbacks of Insecticides: Their Impact on Human Health and the Environment

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Pesticide chemicals may induce oxidative stress leading to the generation of free radicals and alterations in antioxidants or oxygen free radical (OFR) scavenging enzymes. Despite their benefits, pesticides can be hazardous to humans and the environment. Countless chemicals are environmentally stable, prone to bioaccumulation, and toxic. Environmental contamination or occupational use can expose the general population to pesticide residues, including physical and biological degradation products present in the air, water, and food. Less than 1% of the total pesticides applied for weed and pest control reach the target pest.

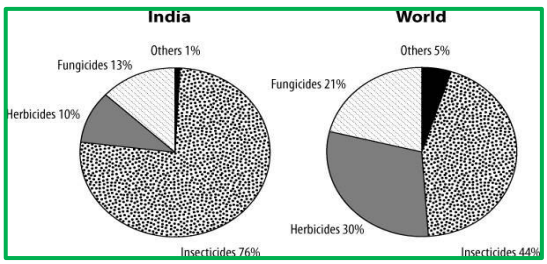
Keywords: drawbacks, pesticides, organophosphate, carbamate, new botanicals, pyrethrins

Introduction

Pesticides constitute any substance or mixture of substances intended for preventing, repelling, or mitigating any pest. They can also serve as plant regulators, defoliants, or desiccants. Chemicals have long been used to control pests. In 1962, Rachel Carson published the book "Silent Spring", in which she mentioned problems that could arise from indiscriminate use the pesticides. Pesticides as agricultural input was introduced in Bangladesh in 1957 mainly DDT and BHC. Most agricultural production relies on the use of chemicals to maintain high crop yields. The use of these chemicals in modern farming practices is viewed as an integral part of the success of the agricultural industry. However, most of the pesticides applied to agricultural lands may affect non-target organisms and contaminate soil and water media. In recent years there has been an increasing concern that pesticides constitute a risk to the general population through residues in the food supply. Pesticides benefit the crops; however, they also impose a serious negative impact on the environment. Excessive use of pesticides may lead to the destruction of biodiversity. Many birds, aquatic organisms, and animals are under the threat of harmful pesticides for their survival. Pesticides are a concern for the sustainability of the environment and global stability. The rampant use of these chemicals, under the adage, "if little is good, a lot more will be better" has played havoc with humans and other life forms.

Production and Usage of Insecticides in India

In fiscal year 2022, the pesticide production volume amounted to 299 thousand metric tons across India. The chemical industry in the country is highly diversified. With a coverage of thousands of products, the South Asian country was one of the leading producers of chemicals in the world. The pesticide industry in India is a



billion-dollar industry. There were investments of over 70 billion Indian rupees just in the financial year 2019. To enhance agricultural production and meet the food requirements of its growing population, the use of pesticides has been on the rise in the country. To increase the average crop yield per hectare, there was a rise in the per capita consumption of pesticides in India. From the financial year 2014, there was a positive annual growth rate in the production volume of pesticides in the country.

Benefits of Insecticides

The primary benefits are the consequences of the pesticides' effects – the direct gains expected from their use. For example, the effect of killing caterpillars feeding on the crop brings the primary benefit of higher yields and better quality of cabbage. The three main effects result in 26 primary benefits ranging from the protection of recreational turf to saving human lives. The secondary benefits are the less immediate or less obvious benefits that result from the primary benefits. For example, the higher cabbage yield might bring additional revenue that could be put towards children's education or medical care, leading to a healthier, better-educated population. There are various secondary benefits identified, ranging from fitter people to conserved biodiversity.

1) **Improving productivity:** Tremendous benefits have been derived from the use of pesticides in forestry, public health and the domestic sphere – and, of course, in agriculture, a sector upon which the Indian economy is largely dependent. Food grain production, which stood at a mere 50 million tons in 1948–49, had increased almost fourfold to 198 million tons by the end of 1996–97 from an estimated 169 million hectares of permanently cropped land. This result has been achieved by the use of high-yield varieties of seeds, advanced irrigation technologies and agricultural chemicals (Employment Information: Indian Labour Statistics, 1994).
2) **Protection of crop losses/ yield reduction:** In medium land, rice even under puddle conditions during the critical period warranted an effective and economic weed control practice to prevent reduction in rice yield due to weeds that ranged from 28 to 48%, based on comparisons that included control (weedy) plots (Behera and Singh, 1999). Weeds reduce the yield of dry land crops (Behera and Singh, 1999) by 37–79%. Severe infestation of weeds, particularly in the early stage of crop establishment, ultimately accounts for a yield reduction of 40%. Herbicides provided both economic and labor benefits.
3) **Vector disease control:** Vector-borne diseases are most effectively tackled by killing the vectors. Insecticides are often the only practical way to control the insects that spread deadly diseases such as malaria, resulting in an estimated 5000 deaths each day.
4) **Quality of food:** In countries of the first world, it has been observed that a diet containing fresh fruit and vegetables far outweighs the potential risks from eating very low residues of pesticides in crops. Increasing evidence (Dietary Guidelines, 2005) shows that eating fruit and vegetables regularly reduces the risk of many cancers, high blood pressure, heart disease, diabetes, stroke, and other chronic diseases.

Drawbacks/ Hazards of Insecticides

Direct impact on humans: The credits of pesticides include enhanced economic potential in terms of increased production of food and fibers and amelioration of vector-borne diseases, then their debts have resulted in serious health implications to man and his environment. No segment of the population is completely protected against exposure to pesticides and the potentially serious health effects, though a disproportionate burden, is shouldered by the people of developing countries and by high-risk groups in each country (WHO, 1990). In industrial settings, workers are at increased risk since they handle various toxic chemicals including pesticides, raw materials, toxic solvents, and inert carriers. Certain environmental

chemicals, including pesticides termed as endocrine disruptors, are known to elicit their adverse effects by mimicking or antagonizing natural hormones in the body and it has been postulated that their long-term, low-dose exposure is increasingly linked to human health effects such as immune suppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer.

The direct impact of Organophosphate on human health and environment: Long-term exposure to organophosphates can cause confusion, anxiety, loss of memory, loss of appetite, disorientation, depression, and personality changes. Other symptoms such as weakness, headache, diarrhoea, nausea, and vomiting also may occur.

Impact of carbamates on human health and environment: The presence of pesticide residues is a concern for consumers because carbamates are known to have potentially harmful effects on other non-targeted organisms than pests and diseases (*Gilden et al.*, 2010). People have environmental exposure to pesticides mainly through diet. Carbaryl residues were detected in concentration ranges of 0.22–4.91 mg/kg indicating that residues in cucumber were higher than its European Union MRL (0.05 mg/kg) value 14 days after application. They suggested that a waiting period of more than 14 days should be observed before harvesting or consumption of cucumbers, to protect consumer health.

Impact of synthetic pyrethroids on human health and environments: Pyrethroids act on voltage-gated sodium channels. The binding of the pyrethroid molecule to the α subunit of the channel causes its permanent opening and prevents it from closing. As a result, the influx of sodium ions into the nerve cells and permanent depolarization occurs. Moreover, pyrethroids reduce the enzymatic activity of acetylcholinesterase, modifying the active binding site of the substrate. They also modify the activity of the cytochrome p450 system in brain neurons and the liver. Pyrethroids are more toxic to insects than to mammals and birds due to the more sensitive sodium channels in the insect nervous system and their lower body temperature. Pyrethroids are lipid soluble, so any contact with the skin, digestive tract, and respiratory tract results in their penetration into the body. The degree of penetration is influenced by the permeability of the barrier.

Impact of neonicotinoids on human health and environment: Neonicotinoids (NEOs) are a class of broad-spectrum insecticides dominant in the global market. They were distributed extensively in the environment and occurred frequently in humans. Potential health effects of NEOs, such as neurological toxicity and diabetes in non-targeted mammals, have raised concerns. This review summarizes analytical methods of NEOs in human samples, their internal exposure levels, and composition profiles in urine, blood, hair, breast milk, saliva, and tooth samples with global comparisons, and daily NEOs exposure dose and relative health risks. NEO metabolites exhibited higher detection frequencies and levels than their parent compounds in humans, while investigations on NEO metabolites remain much limited. Current exposure assessments mainly focused on short-term urine analysis, while biomaterials for long-term monitoring, such as hair, nail, and other alternatives, should also be considered.

Impact of new botanicals on human health and environment: Crops are constantly exposed and or threatened by pests which affect their growth and water quality. To protect the crops from pest attacks, farmers usually rely on quick pest management options, mainly synthetic chemicals. Despite the efficacious attribute of synthetic pesticides, continuous usage has its challenges such as the development of pesticide-resistant pests. Overuse and misuse of synthetic pesticides can result in harmful effects on humans and the environment and toxicity to non-target organisms, thus impacting negatively on biodiversity. Constituent compounds of synthetic pesticides have been attributed to chronic human ailments either due to consumption or exposure. The current global trend is towards the consumption of food produced using safe and preferably natural plant protection products. Detection of hazardous

chemical pesticide residues in foods and increased consumer awareness of food safety has resulted in the ban of certain pesticides in agricultural production and plant-based pesticides are gaining popularity in organic agriculture.

- **Acute effects:** Acute health problems may occur in workers who handle pesticides, such as abdominal pain, dizziness, headaches, nausea, vomiting, as well as skin and eye problems. In China, an estimated half-million people are poisoned by pesticides each year, 500 of whom die. Pyrethrins, insecticides commonly used in common bug killers, can cause a potentially deadly condition if breathed in.
- **Long-term effects:**

- **Cancer:** Many studies have examined the effects of pesticide exposure on the risk of cancer. Associations have been found with leukemia, lymphoma, brain, kidney, breast, prostate, pancreas, liver, lung, stomach, esoph ageal, and skin cancers. Studies suggest an association between carbamate exposure and glioma and meningioma, glyphosate exposure and diffuse large B-cell lymphoma, as well as alachlor exposure and laryngeal cancer.
- **Neurological:** There is accumulating evidence of neurological effects secondary to pesticide exposure. Acute exposure to high levels of pesticides that affect the central nervous system can cause neurotoxicity, including cognitive and motor changes. In addition, an accumulation of chronic exposure has been associated with an increased risk of developing neurodegenerative disease later in life. There is strong evidence that chronic exposure to pesticides increases risk of developing Parkinson's disease, potentially through direct toxic effects on dopaminergic neurons (which are depleted in Parkinson's disease). In addition, there is increasing evidence that chronic exposure increases risk of Alzheimer's disease.
- **Reproductive effects:** Many pesticides act as endocrine-disrupting chemicals (EDC) or substances that interfere with normal hormonal activity. As of 2013, 101 pesticides have been listed as proven or possible endocrine disruptors. As such, high levels of and/or long-term exposure to pesticides can impact reproductive health and is associated with decreased fertility, increased rates of miscarriage, and changes in pattern of maturity. Specifically, triazines, organs-chlorine, and carbamate insecticides have anti-androgenic effects impacting males, resulting in the lack of development of male characteristics including decreases in testicular size, sperm production, and androgen production.

Conclusion

Pesticides constitute any substance or mixture of substances intended for preventing, repelling, or mitigating any pest. They can also serve as plant regulators, defoliants, or desiccants. Chemicals have long been used to control pests. There we are study about the drawbacks of insecticides which tell us how much dangerous these insecticides for human health and environment. Substances which are used to kill insects are called insecticides. Insecticides have a wide application in the field of medicine, agriculture, and industry. They have the potential to alter ecosystem components majorly and are toxic to animals as well as humans. The environmental health effect of persistent pesticides in the ecosystem, is clearly great and affect all the components of the ecosystem either directly, indirectly or both, the effects are both chronic a non-chronic and may extend to geographical zones and even to future generations. Both state and non-state actors in the chemical and agricultural industry and even the household should embrace sound practices in the management of pesticides in their daily use of the same. Studies should be extended to find alternatives of toxic persistence pesticides and as much as possible, persistent pesticides should be avoided.

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