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IMPACT OF CHEMICAL PESTICIDES VS. BIOPESTICIDES ON HUMAN HEALTH AND ENVIRONMENT

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Abstract

Currently, chemical fertilizer and pesticides cause disease in human health. Still in India, in different states, 42% of districts use 85% chemical fertilizers. Due to excessive use of chemical fertilizers in Madhya Pradesh, health got deteriorated farmworkers including tingling (32.3%), muscle pain (51.6%), headache (56.5%), skin disease (19%), blurred vision (35.5%), tremor (23%), stress (24.2%), depression (15.3%), anxiety (44.7%), altered taste (21.4%), altered smell (31.4%), sleep disorder (39.5%), dizziness (66.1%), memory problems (29.4%), trouble in walking (8%), and cardiac problems (16.9%) were reported. So, we have to move toward biopesticides because biopesticides have benefits and limits for the environment, human life, or agricultural products. Biopesticide provides growers with valuable tools on both fronts by providing highly effective solution in pest and disease management, without creating negative impacts, on the environment and their active and inert ingredients are generally considered safe. As a comparison to chemical pesticides, biopesticides have supported the stability and sustainability of the agro-ecosystem because they have not negatively affected human health and the environment.

Keyword: Chemical fertilizer; biofertilizer; biopesticides; health problem; India; Agriculture

1.INTRODUCTION

India is an agricultural country; agriculture is the main source of livelihood for about 58% of the Indian population. About 65% of the total population lives in the villages and about 48.9% of its population depends directly or indirectly on agriculture to obtain their income **(Economic Survey, 2018).** Agricultural workers are moving towards the use of pesticides to maintain food security, protect crops from pests and increase yield. These pesticides are chemicals or mixtures of chemicals designed to prevent, destroy or control pests that are harmful to crops. The use of chemical pesticides per hectare in India is almost double that of developed countries **(FAO, 2018).** The use of synthetic chemical pesticides has seriously affected the abiotic and biotic components of the environment. The widespread and reckless use of pesticides in agriculture, at home, in veterinary practices and professional environments has increased the risk of human exposure and the effects associated with health **(Kori, 2016).**

Improper use of the pesticide can cause poisoning in humans, such as a residue that accumulates in food and the environment, which also leads to the development of resistance in pests. Pesticides exert their harmful effects on both humans and the environment **(Hou and Wu, 2010).** It is widely acknowledged that agricultural workers have the highest risk of occupational exposure to pesticides that face adverse health effects due to inadequate protective measures which include inadequate clothing, theft, drift spray, leaks and other defects in the spraying equipment, or other reasons **(Yassin et al., 2002; Banerjee et al., 2014; Mahantesh and Singh, 2009)** In contrast, families residing near or within the farm are exposed to pesticides through dust, air, steam, etc. and the general population is a risk of pesticide poisoning through indirect use, such as the domestic use of pesticides. Contaminated food, water, soil, air, dust or accidental poisoning **(WHO, 1990; Wesseling et al., 1997; Rohitrattana et al., 2014).** The WHO has systematically classified several pesticides based on their health risk, which consists of extremely

dangerous pesticides that do not present serious risks **(WHO, 1990).** The Food and Agriculture Organization recommended that less toxic, environmentally friendly pesticides be promoted, show fewer accumulations and require little government protection equipment in developing countries **(FAO, 2002).** Participation in absorption through the different routes of exposure (skin, respiratory tract and gastrointestinal tract) depends on the Physico-chemical properties of pesticides. Studies have also reported that exposure to pesticides in agricultural workers could be a significant risk factor for neurological disorders, such as Parkinson's and Alzheimer's **(Yadav et al., 2016; Jors et al., 2006; Jallow et al., 2017).** Personal factors such as lack of protective measures, mixing with bare hands and lack of hygiene precautions during spraying and fumigation; Environmental factors such as high temperature, windy weather; and employment conditions which consist of an inaccurate amount, incorrect timing and selection of objectives, equipment that is not properly maintained, etc. they can be factors that contribute to increasing toxicity **(Abate et al., 2000; Khan and Damalas, 2015).** In the absence of proper pesticide management, not only the health of agricultural workers is at risk, but also the health of their families **(Jallow et al., 2017; Williamson et al., 2008; Macfarlane et al., 2008).** Chronic effects on human health are likely to be due to exposure to risk pesticides that could occur in work situations. However, malnutrition, dehydration, poor health, and high temperatures, which are common in developing countries, can increase sensitivity to pesticides **(Kori et al., 2016; Parron et al., 1996).**

2.CHEMICAL PESTICIDE EFFECT ON HUMAN HEALTH (COMPLIED BY PAN INDIA, 2018)

9 type divided in the effect of chemical pesticide that causes disease in human. They may be very serious and cause the death of the human.

1. **Immunotoxity:** Impair immune system, immune supressorion, increased chances of infectious disease, auto-immune disorder, and induces allergic reaction.
2. **Respiratory disorder impacts:** Damage respiratory tract and lung tissues, pulmonary oedema, bronchitis, asthma and cancer.
3. **Reproductive Impacts:** Reproductive system defects, early puberty, abnormal menstruation cycles, reproductive sperm counts, reduced fertility, infertility, endometriosis, miscarriage, complications during pregnancy.
4. **Hormone Disruption:** Mimic naturally-occurring hormones in the body, damage glands, disrupt hormone function, affects growth and development, sexual development and reproduction, production and utilization of insulin, metabolism disorder, intelligence and behavior, response to stress.
5. **Carcinogenicity:** Damage respiratory tract and lungs tissues, pulmonary oedema, bronchitis, asthma and cancer.
6. **Acute health effects:** Inching, Burning, headache, blurred vision, nausea, vomiting, fatigue, abdominal discomfort, changes in the heart rate, difficulty breathing, convulsions, peeing and shitting without control, unconsciousness, coma and death.
7. **Neurotoxicity:** Cholinesterase inhibition, reduced eye-hand coordinator, reduced memory, lack of neuro-muscular coordination, behavioral change - ADHD, autism, learning disabilities, brain tumors, Alzheimer's disease, Parkinson diseases
8. **Developmental toxicity:** Birth defects, malformations, premature births, early infant and child development. In adulthood, reproductive systems abnormalities and relates problems, long-term degenerative diseases especially cancer and various forms of mental disorders.
9. **Prenatal origins of hormone disruption due to pesticides:** Explosion of adult diseases such as obesity, metabolic diseases, cardiovascular problems, neurological diseases, immune disorders, cancers, autism, attention deficit hyperactivity disorder, learning disabilities, early puberty, breast cancer, endometriosis, polycystic ovary syndrome.

Category of pesticides	Number of Pesticides in India
Carcinogenic potential	56
Endocrine/hormone disrupting effect	81
Immunotoxic effect	38
Source: Compiled by PAN India	

Highly hazardous pesticides that harm children in India	
HHPs harming children	**Use type**
Atrazine, Glyphosate, Paraquat	Herbicide
Carbaryl, Chlorpyriphos, Cypermethrin, DDT, Deltamethrin, Dichlorvos , Lambda-cyhalothrin , Malathion , Diazinon, Monocrotophos ,Methyl parathion, Permethrin, Propoxur	Insecticide
Chlorothalonil, Mancozeb	Fungicide

3.HUMAN HEALTH

In contrast to Americans, Indians ingest about 40 times more pesticides through food. The main cause of environmental contamination is due to the use of chemical fertilizers in the field at all levels, such as production sites or applications **(Tomkins and Bird, 2002).** When water-based fertilizers are applied to the plant, due to its watery nature, most nutrients are drained and filtered into the soil instead of being absorbed as nutrients for the plant. Nitrate lye draws even more rivers and ponds and produces the growth of organisms that, even after decomposition, cause a bad smell. Foods produced with the use of chemical fertilizers have a very negative effect on the health of humans and animals **(Järup 2003; Savci, 2012).**

- The central nervous system can be severely affected by pesticide and herbicide residues that cause respiratory diseases and gastrointestinal disorders **(Talukdar et al., 2003).**
- Some other diseases such as wheezing, nausea, and lung infections are also the result of profound inhalation and long-term exposure.
- Due to exposure to chemical residues, people come into contact with depression, insomnia, oral acetomatism, myoclonus, and hyper reflexia.
- Plants that have an excessive amount of nitrogen accumulation cause childhood diseases and methemoglobinemia, even the amines produced by N2-based fertilizers can cause cancer.
- Due to increased exposure to aluminum, asthma occurs with Alzheimer's and bone diseases.
- Other diseases such as neurological toxicity, growth retardation, cognitive delay and damage to the nervous system are due to exposure to calcium.
- Lung damage occurred due to prolonged exposure to cobalt and boron, which caused low sperm count, throat and eye irritation **(Bhat et al., 2010).**

Negative health effects in agricultural workers, such as tingling (32.3%), muscle pain (51.6%), headache (56.5%), skin diseases (19%), blurred vision (35.5 %), tremor (23%), stress (24.2%), depression (15.3%), anxiety (44.7%), taste perversion (21.4%), altered odor (31.4%), sleep disorders (39.5%), dizziness (66.1%), memory problems (29.4%), running problems (8%) and heart problems (16.9%). The effects were more important in farmers who are smokers, who reside on the farm and store pesticides at home. Furthermore, the use of protective measures was not adequate because the adverse effects were observed to be almost equal in most cases or even more in some cases that reported the use of protective measures **(Rajesh et al., 2018).**

4.BIOPESTICIDE

A biopesticide is a formulation made of natural substances that control pests with non-toxic mechanisms and in an ecological way; therefore, gaining importance throughout the world. Biopesticides can be

derived from animals (p. Is., Nematodi), plants (chrysanthemum, Azadirachta) and microorganisms (p. Is., *Bacillus thuringiensis, Trichoderma, nucleopolihedrosis* virus) and include organisms (natural enemies) that live, their products (phytochemicals), microbial products or by-products (semiochemicals) that can be used for the management of harmful organisms **(Mazid, 2011).** The time-tested use of indigenous technical knowledge (ITK) of natural materials for pest control has been very effective, but due to the introduction and use of chemical pesticides, many have forgotten ITK. Biopesticides pose a small threat to the environment and human health. In general, they are less toxic than chemical pesticides, are often specific, have little or no residual effect and are acceptable for use in organic farming.

Biopesticides are classified into three main categories: plant-based protective (PIP), biochemical and microbial pesticides. Microbial pesticides consist of microorganisms (bacteria, fungi, viruses or protozoa) as an active ingredient and have been used successfully to control insect pests. Although each active microbial ingredient is relatively specific to its target parasite, microbial pesticides can control many different types of parasites. One of the most widely used microbial pesticides is *Bacillus thuringiensis,* commonly known as Bt. The bacterium produces crystalline proteins and specifically kills one or some related insect species **(Kumar et al., 2008).** The binding of the Bt crystal protein to the intestinal insect receptor determines the target insect species. Biochemical pesticides are natural substances that control pests by non-toxic mechanisms. These examples are the sex pheromones of insects (which interfere with the mating and accumulation of the population), various aromatic extracts (which attract traps for insect pests) and some vegetable oils **(Mazid 2011; Singh et al., 2011).** The protectors incorporated in plants include substances that are naturally found in the genetic modification of plants. Such examples are the incorporation of the Bt gene, the protease inhibitor, lectins, chitinase, etc., in the plant genome so that the transgenic plant synthesizes its substance that destroys the target parasite. Transgenic plants resistant to parasites produce natural biodegradable proteins without harmful effects in animals and humans, and therefore reduce the use of dangerous pesticides. The application of PIP can be more useful and economical in developing countries around the world to help improve the safe production of food, feed, and fodder **(Koundal and Rajendran, 2003).**

The potential benefits of using biopesticides in agricultural and public health programs are considerable. Biopesticides do not have a waste problem, which is a major concern for consumers, especially for fruit and vegetables. When used as a component of MIP, the effectiveness of biopesticides can be the same as that of conventional pesticides, particularly for crops such as fruits, vegetables, nuts and flowers **(Kumar, 2012).** Combining performance and environmental safety, biopesticides behave effectively with the flexibility of minimum application restrictions and the potential for superior resistance management. Interest in biopesticides is based on the advantages associated with products that are (i) intrinsically less harmful and safer for the environment, (ii) specific objective, (iii) often effective in very small quantities, (iv) decomposable naturally and quickly and (v) usable as a component of IPM.

In the United States, The Environmental Protection Agency (EPA) encourages the development and use of biopesticides. Biopesticides and the pollution prevention division (as part of pesticide programs) were established in 1994 to facilitate the registration of biopesticides. Since biopesticides tend to present less risk than chemical pesticides, the EPA typically requires much fewer data to record a biopesticide than to register a conventional pesticide (Kumar, 2012). Data on the composition, toxicity, degradation and other characteristics of the pesticide must be presented by the registrants to the EPA to ensure that the pesticide is safe. It often takes less than a year to register a new biopesticide, compared to more than three years for a chemical pesticide. The EPA carries out rigorous reviews to ensure that pesticides have no adverse effects on human health or the environment.

In India, the Ministry of Agriculture regulates pesticide use based on the 1968 insecticide law, recently replaced by the 2008 pesticide management law. Approval for pesticide use is granted by a committee of registration, while the Ministry of Health and Family Welfare supervises and regulates pesticides. Levels of residues in food. The Government of India has recently adopted the IPM to promote biologically different biopesticides as an alternative to pesticides "persistent organic pollutants". Recognizing the harmful effects of chemical pesticides such as the development of pest resistance, the revival

of pests, the outbreak of secondary pests, pesticide residues in food, feed, fodder, soil, air and water that they translate into risks to human health and ecological imbalances in most countries (Kumar, 2012). The world has also changed its policies to minimize the use of chemical pesticides and promote the use of biopesticides.

5.CONCLUSION

In the future, organic fertilizers and pesticides will probably be the focus of attention worldwide. It is known that they are the solution for weeds, pathogens and insects. At the same time, they are less harmful to human health and the environment **(Ajmal et al., 2018).** The USEPA has found almost no negative effects of this technology and has legalized the sale and distribution. Countries are changing their policies to discourage the use of chemicals and promote biopesticides. But production costs and market barriers due to the current popularity of chemical fertilizers are becoming a problem for the industry. Another major problem that presents itself as an obstacle to the promotion of biopesticides is that their mode of action, regulatory effects and problems are still unknown to the public and policy makers. Therefore, its importance is not yet widely understood. It is necessary to raise awareness among farmers, policy makers, the government and producers to understand the importance of biological pesticides.

For the control of pests, natural substances such as grease oils, deterrents, repellents and plants have been tested (**Singh et al., 2012**). In addition, to increase the efficiency of biopesticides, recombinant DNA technology and protein fusion are tested. To promote the use of biopesticides and fertilizers in farmers, it is necessary to make them more effective and efficient so that they can play their sustainable role in the agricultural sector. Farmers should also receive instructions on the correct use of fertilizers to minimize runoff and possible adverse effects **(Ajmal et al., 2018).** Universities and research organizations should consider this aspect of agriculture a priority, as it seems to be a response to the problem of food security and environmental health. However, this technology must be researched and improved so that it shows the desired results and gains the trust of farmers. The areas that should focus on research are quantification for commercial production and voltage authentication. Biological fertilization has become an important component of precision farming, which is a way to ensure that plant nutrients for crop growth and quality are optimized. Organic tasting is a way to ensure that organisms are correctly sent to the root area, but could increase the possibility of chemical toxicity in microbes. Therefore, it requires a differentiation between the application of biological and chemical inputs. The efficiency of these fertilizers can be improved by exploring the genetic and functional diversity of plant growth rhizobacteria. Research is being done to find ways to make organic fertilizers more compatible with soils, and genetic engineering should play a vital role in combining two types of microorganisms for better efficiency **(Singh et al., 2011; Bhardwaj et al., 2014).**

The use of organic fertilizers and other methods of controlling cultural pests have been rapidly replaced by pesticides because of their easy access, rapid action and high efficiency, and this becomes the high risk factor for adverse health risks. Due to farmers' lack of awareness, the reckless use of pesticides has become a serious problem in agricultural production. Many of the agricultural workers do not have the education and training necessary in the different methods of pesticide application. The methods should be applied with caution in insurance operations to spray pesticides in agriculture to prevent agricultural workers from being exposed to pesticides. Adequate monitoring of occupational exposure by regulatory agencies is necessary to minimize the adverse health effects of pesticides. Informing agricultural workers of these findings could help them make a conscious effort to reduce the extent of pesticide use. In addition, an occupational health program could be implemented to monitor the health of farmers in this region to reduce toxicity risks.

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