AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 02, Issue: 05 (May, 2025)
Available online at http://www.agrimagazine.in

Pesticides Impact on Humans Health and Environment

*Sunil Kumar Dhabhai[1], Ashok Kumar Dhabhai[2] and Heenashree Mansion[1]
[1]Department of Entomology, College of Agriculture, Agriculture University, Jodhpur, Rajasthan, India
[2]Department of Agronomy, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India
*Corresponding Author's email: sunilkumardhabhai98@gmail.com

Pesticides were developed to protect our lives from mice, mosquitoes, flies, insects, and pests. They are widely utilized around the world for agricultural, municipal, domestic, and medical uses. These compounds protect crops and agricultural commodities from pests such as weeds, insects, and diseases. They improve the efficiency of agricultural production, hence the name plant protection products. Pesticides are an important component of agricultural management since they help increase crop quality and quantity. Nevertheless, the use of pesticides has led to a rise in agricultural yields; however, their widespread, careless, excessive, and improper use has severely harmed the ecosystem, increasing environmental toxicity and pollution. The authority department should approve and pass all pesticides, as they are active compounds with dangers and hazards. Wind and water move polluted soil, impairing ecosystem processes, and additional exposure routes can harm people and other non-target organisms. These substances can pollute plants, water, soil, and the air. If they kill pests, they can also harm non-target organisms like birds, fish, beneficial insects, non-target plants, humans and animals.

Pesticides and Their Effects

Pesticides are compounds or mixtures of substances used to manage agricultural pests (insects, weeds, etc.) that are harmful to humans, animals, plants, and other organisms, as well as the environment and the health of society. Pesticides are not only beneficial, but they also pose a health risk to humans and animals due to their toxicity. They are destructive to all organisms and pollute our surroundings. Broad-spectrum insecticides manage a wide range of pest organisms but can be hazardous to both target and non-target species. Narrow-spectrum insecticides control a certain type of pest organism. It is the most effective method for using narrow-spectrum pesticides to control specific pests while minimizing the effects on natural enemies. Pesticide residues can be found in many kinds of foods and beverages, including prepared foods, water, fruits, juices, refreshments, and animal feeds. Pesticides are classified based on their chemical composition, working principles, target molecules, and potential effects on health. Pesticides without the aforementioned characteristics can be generically categorized as organochlorine pesticides, organophosphorus pesticides, carbamates pesticides, pyrethroids pesticides, biorational pesticides, microbial pesticides, growth regulators and Neonicotinoids. These compounds are often persistent in the environment; residues are found in food, plants, soil and waterways. Pesticide toxicity was categorized by the World Health Organization (WHO) and is shown in Table 1. The International Organization for Biological and Integrated Control (IOBC) estimates pesticide risk for beneficial organisms using the mortality rate. It stated that certain chemicals that kill less than 25% of useful species are harmless, but those that kill more than 75% of beneficial species are considered harmful chemicals. As a result, the IOBC divided chemicals into four

categories based on their effects on beneficial species, as shown in Table 2. The World Health Organization classified a worldwide harmonized system chemical classification. The compounds are categorized into five categories. They are shown for people's awareness collectively with their colour, signal words, and intensity. This information is shown in Table 3.

Table 1. Pesticides toxicities categories according to the world health organization

WHO class	LD50* for the rat (mg/kg body weight)	
	Oral	Dermal
Extremely hazardous	< 5	< 50
Highly hazardous	5–50	50-200
Moderately hazardous	50–2000	200-2000
Slightly hazardous	Over 2000	Over 2000
Unlikely to present acute hazard	5000 or higher	

**LD50: the lethal dose is that to kill half of a test population of animals.*

Table 2. The toxicity rate between pesticides and beneficial organisms is shown according to the IOBC), the toxicity rate represents the reduction in the ability of beneficial species tested to provide pest control and range from 1 to 4

No.	Categories of Chemicals	Kill beneficial species of insects (%)
1.	Harmless	<25%
2.	Slightly harmful	25-50%
3.	Moderately Harmful	50-75%
4.	Harmful	>75%

Table 3. The WHO classified a globally harmonized system and labeling of chemicals

Intensity	Signal words Hazard	Colour
Extremely hazardous	Very toxic	Red
Highly hazardous	Toxic	Red
Moderately hazardous	Harmful	Yellow
Slightly hazardous	Caution	Blue
Unlikely to present acute hazard in normal use	No signal word	Green

Pesticide Effects on Humans

Pesticides are consumed by humans through food, soil, water, air, plants, and animals. They distribute throughout the body via the bloodstream after being absorbed by the human body. They can be eliminated by the gastrointestinal tract (GIT), urinary tract, skin, or respiratory tract. The common entry points for pesticides into the human body are the skin, mouth, eyes, and respiratory system. Pesticides are hazardous to all living species in specific amounts. When they enter the human body, they inhibit enzyme function and disrupt the regular metabolic responses that occur. Common pesticide effects can be seen in the skin, gastrointestinal tract, respiratory system, reproductive system, central nervous system, renal system, and more. Endocrine-related disorders, mutagenicity, carcinogenicity, and teratogenicity are some of its negative effects.

Pesticide Toxicity to Plants

Herbicides come into contact with target plant species as well as non-target plants. These pesticides have an impact on non-target plant species when they are sprayed and sublethal amounts reach plants by droplet drift, vapour movement, runoff, leaching, erosion, and improper disposal. These toxicants damage plant biodiversity. Herbicides have an impact on sensitive plants at each of the four stages of growth. (1) Pesticides damage the vegetative

growth of a new plant at the seedling stage, (2) the same plants may show negative impact in later seed production, (3) the spray may have negative effects on plant reproductive organs during seed formation, and (4) the vegetative parts of the plant are frequently affected in the F1 generation. Different plant site activities and roles are represented by different herbicides. The mechanisms of action of some common herbicides include (1) inhibitors of photosynthesis, (2) inhibitors of pigment production, (3) disruptors and inhibitors of cell membranes, (4) inhibitors of fatty acid biosynthesis, (5) inhibition of cell growth, (6) auxin-like action-growth regulators, (7) inhibitors of amino acid biosynthesis, (8) inhibitors of respiration, and (9) unknown mechanisms of action.

Pesticide Toxicity to Animals

Pesticide residues in the environment damage a large number of nonhuman biota, including bees, birds, amphibians, fish, and small mammals. Pesticides further reduce the population of organisms like marine mammals, alligators, fish, and fish-eating birds. The accumulation of persistent chlorinated hydrocarbons, including dioxins, DDT, and polychlorinated biphenyls (PCBs), in the food chain is thought to have contributed to the deaths of thousands of Arctic seals. These compounds accumulate in fat and damage animals' immune systems. This hazardous chemical has been found in birds, fish, and other migratory animals.

Pesticide Toxicity to Pollinators

Pollinators are beneficial to the ecosystem. Pollination is necessary for the survival and conservation of biodiversity through seed production in cross-pollinated and self-incompatible plants. Bees participate in pollination as well as nectar collection. The pollen grains stick to the unique hair on the bee's body, so when bees move from flower to flower, they accidentally fertilize the flowers. Approximately 300 commercial crops are grown worldwide, with 84% of them being insect-pollinated, demonstrating the necessity and utility of pollinating insects. Plant biodiversity increases the population of bees and other pollinator insects, while herbicides reduce plant communities and have an impact on birds, mammals, fish, insects, amphibians, reptiles, and people. The most often used insecticides are neurotoxic, such as organophosphates, carbamates, pyrethroids, phenylpyrazoles, and neonicotinoids. These toxicants excite the neurological system, resulting in loss of coordination, paralysis, and ultimately death.

Pesticide Toxicity to Beneficial Microorganisms

Pesticides are sprayed on plants and soil to suppress pests, so they combine with soil and plant residue that is affected by the soil. Pesticides are degraded in soil through physical, chemical, and biological processes. Some chemical compounds are extremely harmful to soil-living organisms. Insecticides have been shown in various studies to have a negative impact on soil microbiology. They change organisms' enzymatic activity. For example, buprofezin has been shown to have a harmful effect on invertase in soil. The pollutants have a negative impact on microorganisms' growth. Low concentrations of both separate and combination pesticides decrease and change the microbial diversity of the community. Microorganisms play an important role in the breakdown of pesticides, including insecticides, herbicides, and fungicides, in soil and water. However, their toxicity also negatively impacts them. Many pesticides have lengthy half-lives and can cause major damage to the ecosystem. Soil contamination is caused by an increase in the use of hazardous pesticides. These compounds are used to eliminate selective pests, but they also kill unselective organisms that are crucial to soil and plant health.

References

1. Hashimi, M. H., Hashimi, R., & Ryan, Q. (2020). Toxic effects of pesticides on humans, plants, animals, pollinators and beneficial organisms. *APRJ*, *5*(4), 37-47.
2. Igbedioh, S. O. (1991). Effects of agricultural pesticides on humans, animals, and higher plants in developing countries. *Archives of Environmental Health: An International Journal*, *46*(4), 218-224.