International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133, Print ISSN: 2664-7125
Received: 11-12-2024, Accepted: 10-01-2025, Published: 25-01-2025
Volume 7, Issue 1, 2025, Page No. 21-24

Types of major pesticides: Currently used and their effect on human health

Dr. Alka Misra[1*], Dr. Akanksha Srivastava[2]
[1] Assistant Professor, Department of Zoology, DSN PG College, Unnao, Uttar Pradesh, India
[2] Assistant Professor, Department of Chemistry, DSN PG College, Unnao, Uttar Pradesh, India

Abstract
Pesticides are the toxic chemical compounds which are used to kill, repel or control forms of animal and plant life, considered to damage or be a nuisance in agriculture and domestic life. Over 800 pesticides are registered for use around the world; some of them are used in large quantities and may pose risks for a variety of health problems. Common currently used pesticides are organic chemicals belonging to organochlorines, organophosphates, carbamates and pyrethroids groups. Pesticides have been linked with human health hazards from short term impacts such as headaches and nausea to chronic impacts like Parkinson's disease, diabetes, thyroid and kidney diseases, rheumatoid arthritis, shingles (Herpes zoster) and cancer among other health issues. Evidences suggest that childrens are particularly susceptible to adverse effects from exposure to pesticides, including neuro-developmental effects. In this paper, types of currently used common pesticides and their hazardous effects, caused by over and misuse, on human health has been discussed.

Keywords: Pesticides, physiological impact, human health, hazardous effects

Introduction

Pesticides are toxic chemical substances that are meant to kill pests. In general, a pesticide is a chemical or a biological agent such as virus, bacterium, antimicrobial, or disinfectant that deters, incapacitates, kills pests. It is commonly used to eliminate or control a variety of agricultural pests that can damage crops and livestock and reduce farm productivity. Pesticides after their application on target plants are disposed off in the soil; they migrate within the soil through water by the process of transportation or degradation. It may be biodegradable i.e. broken down by microbes into harmless compounds or persistent in nature. Long term use of chemical pesticides can cause adverse effects on larger parts of the ecosystem including biodiversity.

The main groups of commonly used pesticides are insecticides (insect killers), herbicides (weed or plant killers), fungicides (fungus killers), rodenticides (rodent killers) and growth regulators (Garcia *et al.*, 2012 [1], Zhang *et al.*, 2021) [2].

Pesticides have proved to be a boon for the farmers as well as people all around the world by increasing agricultural yield. In India, the use of pesticides was introduced during mid-sixties as a part of green-revolution and malaria prevention programmes (Sharma and Singhvi, 2017) [3]. While pesticides turned useful for pest control, they were, at the same time responsible for several long-term negative effects on environment and human health (Rashid *et al.*, 2010) [4]. Excessive use of pesticides poses significant risks to environment and non-target organisms ranging from beneficial soil microorganisms to insects, fishes, birds and land animals including humans, are under the threat for their survival (Mahmood *et al.*, 2016) [5]. For animals, toxicity of pesticides is associated with any or all of the reasons i.e. by ingestion of contaminated food, inhalation or absorption.

Types of pesticides currently used

Pesticides include both natural (obtained from plants) as well as synthetic in origin. Based on their chemical composition, synthetic pesticides or commonly used insecticides are generally classified into four major categories: Organochlorines, Organophosphates, Carbamates and Pyrethroids, to which most of the currently and widely used pesticides belong (Figure-1). In general, now a days commonly used pesticides are organic chemicals. However, some inorganic compounds are also used as pesticides.

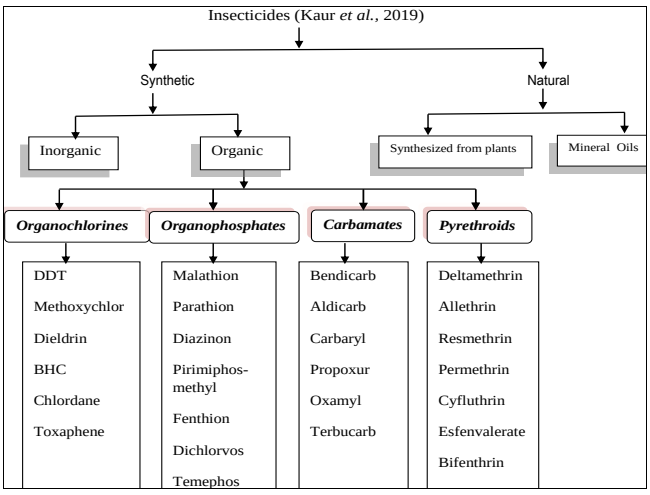

Fig 1: Classification of Pesticides (showing common types of Pesticides, currently used)

Organochlorine insecticides are organic compounds of low molecular weight, with at least one cyclic structure and multiple chlorine atoms in their molecule. In other words organochlorine pesticides include chlorinated derivatives of ethane, cyclodiene or hexa-chloro-cyclohexanes. They are very stable compounds and as they are lipophilic in nature, they remain in environment for long duration of time. In biological system they tend to accumulate in fatty tissues and hence degraded with considerable difficulty. As neurotoxicant, many Organochlorine pesticides (including most popular insecticide DDT) were banned in United

States. Despite the severe restrictions, DDT is still illegally used in several parts globally especially in developing nations including India. People can be exposed to these pesticides through accidental inhalation exposure (Sharma and Singhvi, 2017) [3].

Later Organochlorines were replaced by Organophosphates and Carbamates in the United States in 1975 (Barnhoorn *et al*., 2009) [7]. These two are most common pesticides used these days, which are preferred over Organochlorine derivatives (Asthana and Asthana, 2006) [8]. Organophosphate pesticides contains mainly a chemically reactive phosphate ester side chain, consisting of a central phosphorus atom bonded to either oxygen or sulphur atom, and single bonded to two methoxy (-OCH_3) or ethoxy (-OCH_3CH_3) groups. Carbamate insecticides are analogues of carbamic acid, which are very effective against many insects and pests. Both organophosphate and carbamate insecticides are readily degraded in the environment and in a living system; they are easily detoxified and excreted.

Pyrethroids are synthetic derivatives of naturally occurring pyrethrin insecticides isolated from the flowers of the plant *Tanacetum cineraridefolium* (former name- *Chrysanthemum cinerariaefolium* (Chrustek *et al*., 2018) [9]. These are unstable compounds that quickly decompose under the influence of light, therefore the synthesis of derivatives are more resistant to radiation. Pyrethroids are generally harmless to mammals however exhibit toxicity to insects (Soderlund, 2012) [10]. Pyrethroids are classified on the basis of their mechanism of biological action, as they do not share a common chemical structure. Many are 2, 2-dimethylcyclopropanecarboxylic acid derivatives, However, the cyclopropyl ring does not occur in all pyrethroids. Some pyrethroids have alpha- cyano group while some lacks. Similarly, some pyrethroids have ester bond while some have ether bond in its place (Fig 2).

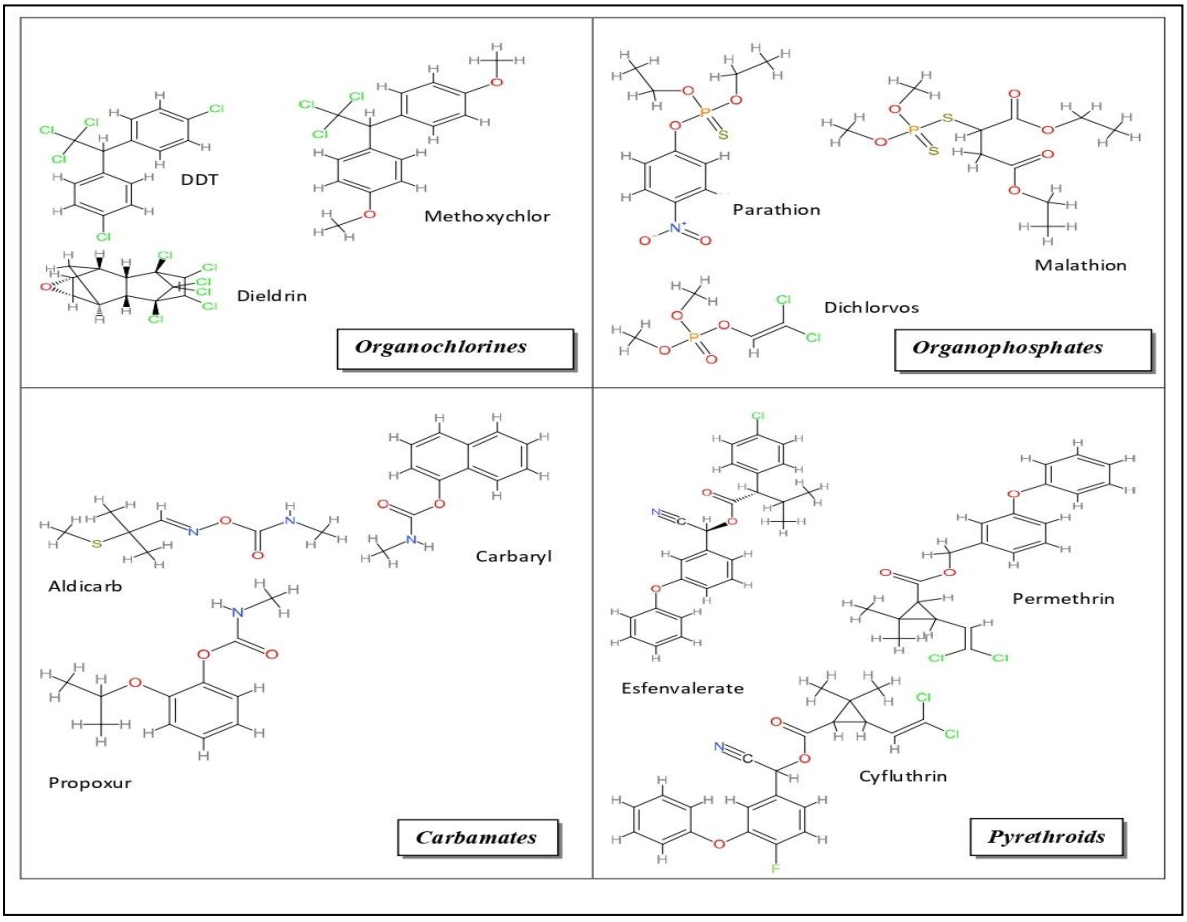

Fig 2: Chemical Structure of some common Pesticides, used widely

Physiological impact of pesticides in humans

Organochlorine derivative pesticides are stable-chemicals and have potential to deposit in adipose tissues. Ingestion of these pesticides alters enzymatic and electrophysiological activity of nerve cells (Tordoir and Sittart, 1994) [11]. Long term exposure to organochlorines may damage the liver and kidney owing the presence of chlorine atoms in their molecule; they may cause skin and mucous irritation.

Like organochlorine derivatives, most of the organophosphates and carbamates implicate the nervous system of target organism by inhibiting the activity of enzyme acetylcholinesterase which catalyses the removal of acetylcholine from the synaptic cleft after an impulse has passed through the junction. The inactivation of this enzyme causes acetylcholine to accumulate in the synaptic cleft, which as a consequence remains in a charged state blocking further transmission of nerve impulse through the cleft (Kaushal *et al*., 2021 [12], Gupta, 2014) [13].

Pyrethrins and pyrethroids act on voltage-gated sodium channels, which cause an influx of sodium ions into the nerve cells and permanent depolarization. Moreover, they also reduce the enzymatic activity of the acetylcholinesterase, modifying the active binding site of the substrate (Hedges *et al*., 2018) [14]. They also modify the activity of cytochrome p450 system in brain neurons and in the liver (Hedges *et al*., 2018) [14] (Fig 3).

Table 3: Summary on the effect of Pesticides in humans

	Physiological Effects	Symptoms	References
Organochlorines	Stable chemicals, have potential to accumulate in the adipose tissues, alter enzymatic nerve membranes and electro-physiological properties through nerve cell membranes	Damage to immune systems, hypersensitivity to senses, asthma allergies, nausea, dizziness, vomiting, nervousness, neurological disorders, often linked with cancer	Kaushal *et al*., 2021 [12] Culliney *et al*., 1992 [15]
Organophosphates	Inhibits enzyme acetylcholinesterase AchE): responsible for neurotransmission of signals	Acute neurological health effects, disrupt nervous system, difficulty breathing, convulsion, coma and death in severe cases; linked with cancer	Tordoir and Sittert, 1994 [11] Lah, 2011 [16]
Carbamates	Short term pesticides, similar to organophosphates	Similar to organophosphates	Gupta, 2014 [13]
Pyrethroids	Causes fluctuations in Na^+ cation channels in nerve cell membrane	Allergy, aggressiveness, hyper-excitation, reproductive and developmental effects, often associated with Parkinson's and Alzheimer's diseases	Soderlund, 2012 [10] Lah, 2011 [16]

Effect of pesticides on human health

The human body gets exposure to pesticides either directly or indirectly. These compounds enter inside the human body. But the majority of people get affected by intake of pesticide contaminated food (Mahmood *et al*., 2016) [5]. The severity of these pesticides depends upon the duration of concentration and exposure. Generally, these pesticides are released from the human body as urinary, biliary and secretory excretions, however, in some cases they are absorbed by the body and enters in the circulatory system (Jabbar and Mallick, 1994) [17], reach the non-target organs and causes severe hazardous health effects (Pathak *et al*., 2022) [18]. Acute or immediate effects of exposure include headache, skin irritation, rashes and blisters formation on skin, itching, eye, nose and throat irritation, dizziness, diarrhoea, vomiting, abdominal pain, nausea etc. while the chronic or long term effects are often lethal, if left untreated. In includes damage to multiple organs even in a single impairment of nervous, immune and endocrine system of the human body resulting memory loss, vision and signaling disability, enhance hypersensitivity and allergy to various antigens, asthma etc. pesticides also disrupt the activity of hormones in living organism, affects the ability of reproduction resulting miscarriage, pre-mature birth, infertility etc. some molecules of pesticide compounds also mimic insulin thereby block insulin receptor sites and the development of cause diabetes in humans.

Long term exposure of pesticides has also been associated with leukaemia, lymphoma and cancer of the reproductive organs, breast and blood. It also causes Parkinson's and Alzheimer's disease in peoples, who have suffered from frequent exposures (Dutta and Bortamuly, 2018) [19] (Fig 3).

Conclusion

Pesticides are toxic chemical substances which are used to kill harmful organisms. On the basis of their target organism killing, they are classified into various categories i.e. insecticides, algaecides, fungicides and rodenticides etc. while on the basis of their composition they are categorized into four groups named Organochlorines, organophosphates, carbamates and pyrethroids. In nature, after application, these pesticides are absorbed by soil particles or mixed with water, from where they are transported to plants as well as to animals by entering into food chain. More or less each pesticide severely affects the ecosystem by causing adverse effects on the health of environmental components (Dad *et al*., 2022) [20]. Reports regarding toxicity studies strongly suggests that the over and misuse of pesticides are always associated with hazardous health effects for environment as well as humans. In humans long term exposure leads serious health issues including neurological dysfunction, hormonal imbalance, immune system dysfunction, metabolic and blood disorders and often cancer etc. Minimizing harmful exposure to pesticides can be achieved by proper use of personal protective equipment, choosing less toxic pesticide, limiting the dose quantity, adequate reentry times into recently sprayed areas and effective product labeling for hazardous substances as per proper imposed rules and regulations. Training high-risk populations, including man power associated with agriculture, on the proper use and storage of pesticides can reduce the incidence of acute pesticide poisoning and potential chronic health effects associated with exposure.

Acknowledgement

Dr. Alka Misra expresses deep sense of gratitude to Dr. Akanksha Srivastava, Assistant Professor for her entire support, guidance and contribution in shaping the manuscript. Author also wishes to convey her sincere regards and thanks to Prof. Pradeep Gupta, Principal and Dr. P K Singh, Library In-Charge, DSN PG College Unnao for providing Journals, News papers and articles published during ms preparation.

References

1. Garcia FP, Ascencio SYC, Oyarzun JCG, Hernandez AC, Alavarado PV. Pesticides: Classification, uses and toxicity. Measures of exposure and genotoxic risks. Int. J. Environ. Sci. Toxic. Res,2012:1:279-293.
2. Zhang W, Pang S, Lin Z, Mishra S, Bhatt P and Chen S. Biotransformation of perfluoroalkyl acid precursors from various environmental systems: Advances and perspectives. Environ. Pollut,2021:272:115908.
3. Sharma N, Singhvi R. Effect of chemical fertilizers and pesticides on human health and environment: A Review. International Journal of Agriculture, Environment and Biotechnology,2017:10(6):675-679.
4. Rashid B, Husnain T, Riazuddin S. Herbicides and pesticides as potential pollutants: a global problem. Plant adaptation phytoremediation. Springer, Dordrecht, 2010, 427-447.
5. Mahmood I, Imadi SR, Shazadi K, Gul A, Hakeem KR. Effect of pesticides in environment, Researchgate Pulication, 2016, 253-269.
6. Kaur R, Mavi GK, Raghav S. Pesticides classification and its impact on environment. International Journal of

Current microbiology and applied Science,2019:8(3):1889-1897.
7. Barnhoorn IE, Bornman M, Van Rensburg CJ and Bouman H. DDT residues in water, sediment, domestic and indigenous biota from a currently DDT-sprayed area chemo,2009:77:1235-1241.
8. Asthana DK, Asthana VK. A Textbook of environmental Studies. Second Edition, 2006, 197-212.
9. Chrustek A, Holynska-Iwan I, Dziembowska I, Boguisiewicz J, Wroblewski M, Cwynar A, *et al*. Current Research on the safety of pyrethroids used as Insecticides Medicina,2018:54:61.
10. Soderlund DM. Molecular mechanisms of pyrethroid insecticide neurotoxicity: Recent advances. Arch Toxicol,2012:86:165-181.
11. Tordoir WF, Sittart NJ Van. Organochlorines Toxicology,1994:91(1):51-57.
12. Kaushal J, Khatri M, Arya SK. A treatise on Organophosphate pesticide pollution: Current strategies ad advancements in their environmental degradation and elimination. Ecotoxicology and Environmental Safety,2021:207:111483.
13. Gupta RC. Carbamate Pesticides. Encyclopedia in Toxicology (Third Edition), 2014, 661-664.
14. Hedges L, Brown S, MacLeod AK, Vardy A, Doyle E, Song G, *et al*. Metabolism of deltamethrin and cis-and trans-permethrin by human expressed cytochrome p450 and carboxylesterase enzymes. Xenobiotica,2018:49:521-527.
15. Culliney TW, Pimental D and Pimental MH. Pesticides and natural toxicants in foods. Agric Ecosyst Environ,1992:41:297-320.
16. Lah K. Effects of pesticides on human health. In: Toxipedia. Accessed, 2014.
17. Jabbar A, Mallick S. Pesticides and environment situation in Pakistan (working paper series No. 19). Available from Sustainable Development Policy Institute (SDPI), 1994.
18. Pathak VM, Verma VK, Rawat BS, Kaur B, Babu N, Sharma A, *et al.* Frontier in Microbiology, 13, 962619/http://doi.org/10.3389/fmicb2022.962619. Title Current status of pesticide effects on environment, human health and it's ecofriendly management as bioremediation: a comprehensive review, 2022.
19. Dutta N, Bortamuly M Pesticides and its effect on health and Environment. IJRAR,2018:5(4):57-59.
20. Dad K, Zhao F, Hassan R, Javed K, Nawaz H, Saleem MU, *et al.* Pesticides Uses, Impacts on environment and their possible remediation strategies- A review. Pakistan Journal of Agricultural Research,2022:35(2):274-284.