TRENDS IN AGRICULTURE SCIENCE
Popular Article
Vol.3 Issue 03 March 2024, Page: 1586-1589

# Microbes - Mediated Pesticides Degradation

**Kumari Manorma*, Sunita Devi, Megha Sharma and Kritika Kesta**
Department of Basic Sciences, Dr YSP University of Horticulture and Forestry, Nauni, Solan-173230
https://doi.org/10.5281/zenodo.10825424

## Introduction

Pesticides are organic substances which are purportedly designed to increase agricultural yield, soil productivity, product quality while minimising the pest- mediated crop losses, and controlling insect vectors in order to halt the spread of epidemics in both humans and animals. An increase in the use of pesticides and herbicides has been noticed in the recent decades in the agriculture and food sector. More than 500 of chemical compounds have been registered and utilised as pesticides or pesticide metabolites globally. Among South Asian countries in terms of total pesticide consumption, India is the greatest pesticide consumer, accounting for 3% of global crop protection consumption.

Organophosphates, organochlorins, carbamates, pyrethrins, and neonicotiniods are among the most regularly used chemical pesticides in India. Ideally, a pesticide must be detrimental to the target pests but not to non-target species, such as people. But unfortunately, this is not the case, and therefore the debate over chemical pesticide uses and misuse has come to light. Due to their unsystematic and uncontrolled usage, only 10% of applicable pesticides reach the target organism while, the residual high proportion is deposited on non-target locations such as soil, water, and sediments, causing serious environmental damage. On the contrary, they have an impact on non-target organisms such as wild life and public health.

Annually, pesticide poisoning causes around 1 million fatalities and chronic illnesses worldwide, in accordance with Indian Council of Medical Research (ICMR) bulletin study. Owing to relatively stable and extremely poisonous nature, pesticides are the persistent polluters besides being responsible for severe pesticide toxicity. As the environmental awareness increased

An augmented in the environmental awareness than prior, it becomes imperative to expand all those controlling methods which help assisting in accurate the earlier mistakes made during the preservation of ecosystem from future pollution and exploitation (Parte et al. 2017).

## Classification of Pesticides based on chemical composition

Based on chemical composition**,** pesticides can be classified into four major classes *viz*., organochlorines, organophosphates, carbamates, and pyrethrins and pyrethroids (Figure 1).


**Published**: 16 March. 2024
**ISSN:** 2583-7850

**Organochlorine** (OC) pesticides are synthetic pesticides widely used all over the world. They belong to the group of chlorinated hydrocarbon derivatives, which have vast application in the chemical industry and in agriculture. These compounds are known for their high toxicity, slow degradation and bioaccumulation.

**Organophosphate** pesticides are considered to be one of the broad-spectrum pesticides which control wide range of pests due to their multiple functions. They are characterized with stomach poison, contact poison and fumigant poison leading to nerve poisons.

**Carbamates** are similar to organophosphates. However, they differ in their origin. Organophosphates are derivatives of phosphoric acid, while carbamates derived from carbamic acid. The working principal of carbamate pesticides is similar to organophosphate pesticides by affecting the transmission of nerve signals resulting in the death of the pest by poisoning.

**Pyrethrins** are botanical insecticides derived from chrysanthemum flowers most commonly found in Australia and Africa. They work by altering nerve function, which causes paralysis in target insect pests, eventually resulting in death.

**Pyrethroids** are synthetic chemical insecticides whose chemical structures are adapted from the chemical structures of the pyrethrins and act in a similar manner to pyrethrins. Pyrethroids are modified to increase their stability in sunlight. Most pyrethrins and some pyrethroid products are formulated with synergists, such as piperonyl butoxide and MGK-264, to enhance the pesticidal properties of the product.

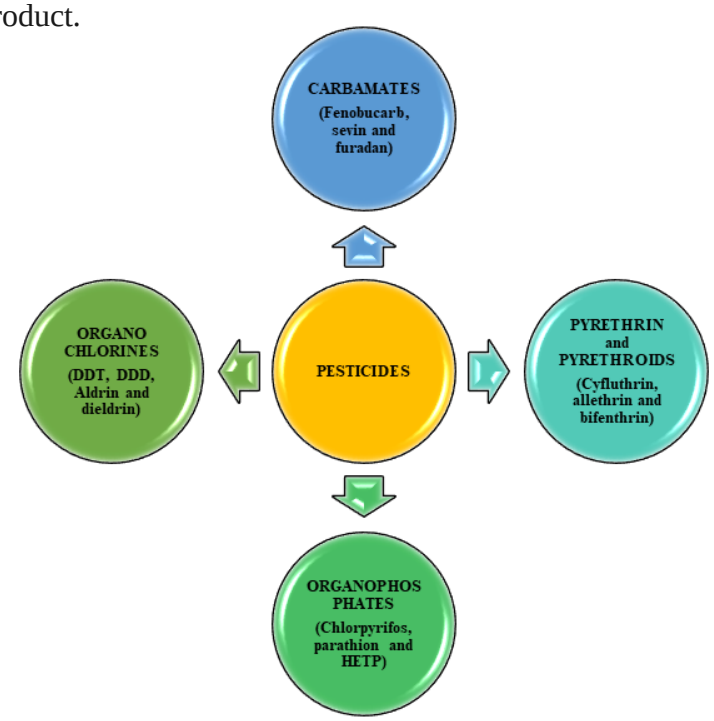


**Figure 1. Classification of pesticides**


Official Website: trendsinagriculturescience.com
e-mail Address: trendsinagriculturescience@gmail.com
**Published**: 16 March. 2024
**ISSN:** 2583-7850

**Microbes - Mediated Pesticides Degradation**

Microorganisms have the special capability to degrade the pesticides employing diverse mechanisms. Because pesticides are utilised primarily as microbial nutrients and eventually degrade into some tiny molecules, such as $CO_2$ and $H_2O$, microbial degradation has become increasingly widely used in recent years. The process is known as an enzymatic reaction, which begins with the compound entering the body of the microorganism in a specific way before going through a series of physiological and biochemical processes with the help of different enzymes, leading to the pesticide being completely degraded or broken down into smaller molecular compounds with lower or non-toxic toxicity. The whole degradation mechanism is divided into three parts as shown in Figure 2. Firstly, adsorption of target, it occurs on the surface of the cell membrane, which is a dynamic equilibrium process and is equally important. Secondly, the target enters the cell through the cell membrane surface, and the penetrated rate and efficiency are related to the molecular structure of the target isomerism. Thirdly, the membrane-based xenobiotic target quickly carried out an enzymatic reaction.

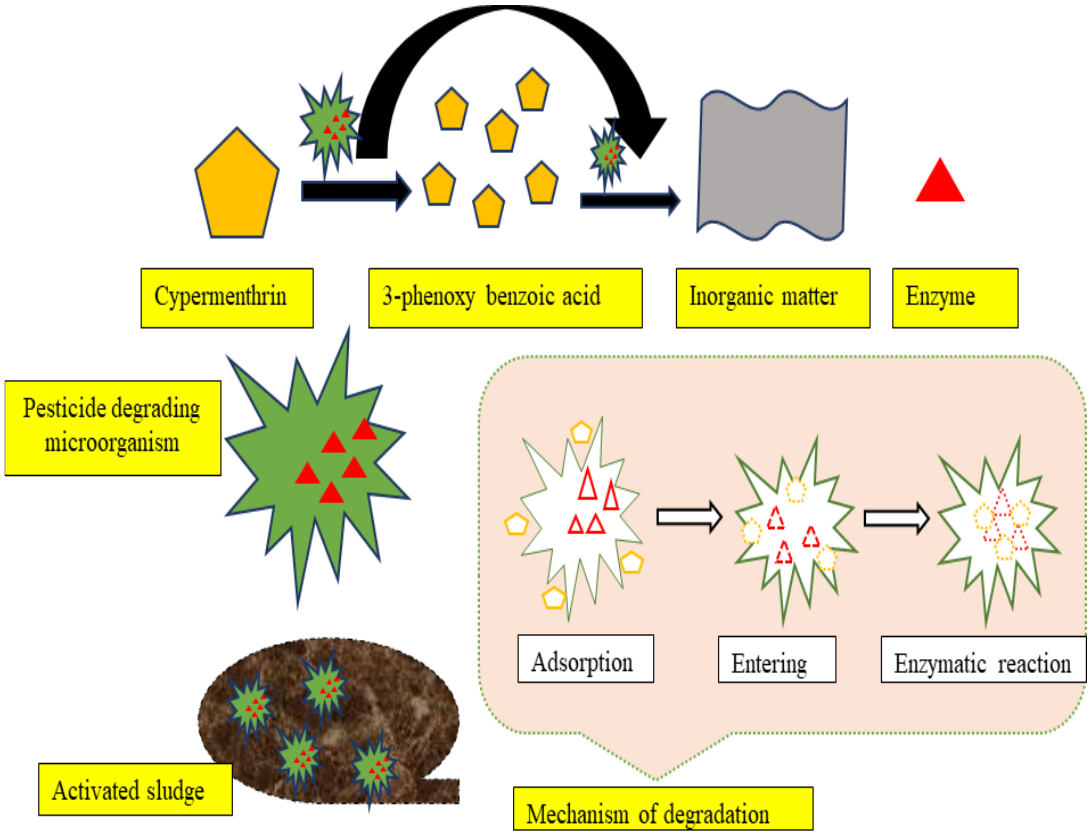


**Figure 2. Mechanism of microbial degradation of pesticides**

**Pesticide-degrading microorganism and their types**

In order to decompose pesticides, numerous researchers have recently enriched, isolated, cultivated, and screened a large number of microbial strains, including bacteria, fungus, actinomycetes, and algae. Table 1 portrays the list of different groups of microorganisms


Published: 16 March. 2024
ISSN: 2583-7850

exhibiting the ability to degrade different kinds of pesticides. The microbial enzymes dehydrogenase, ligninase, oxygenase, peroxidases, phosphodiesterase, hydrolases, dehalogenase, and organophosphorus acid anhydrolase have also been reported to be responsible for removing continual organic contaminants in the form of pesticides.

**Table 1. List of pesticide degrading microorganisms (Raj et al. 2021)**

| GROUP OF MICROORGANISMS | SPECIES | PESTICIDE DEGRADATION |
|---|---|---|
| **BACTERIA** | *Bacillus cereus, Pseudomonas aeruginosa, Burkholderia cepaeia, Arthrobacter sp., Alcaligenes eutrophus, Aerobacter aerogenes* | Aldrin, Chlorpyrifos, DDT, Diazinon, Endosulfan, Endrin, Hexachlorocyclohexan, Methyl parathion, Parathion |
| **FUNGI** | White rot fungi, *Rhizopus, Cladosporium, Aspergillus fumigatus, Penicillium, Aspergillus, Fusarium, Mucor, Trichoderma* spp, *Mortierella* spp. | Alachlor, Aldicarb, Atrazine, Carbofuran, Chlordane, Chlorpyrifos, DDT, Diuron, Endosulfan, Esfenvalerate, Fenitrothion, Fipronil, heptachlor epoxide, Lindane, Malathion, 2,4-D |
| **ACTINOMYCETES** | *Micromonospora, Actinomyces, Nocardia, Streptomyces* | Aldrin, Carbofuran, Chlorpyrifos, Diazinon, Diuron |
| **ALGAE** | *Chlorella vulgaris, Chlamydomonas pitschmannii, Scenedesmus obliquus* and Genus of diatoms | Phorate, Parathion, Atrazine, Fenvalerate, DDT, Patoran |

## Conclusion

As a potential tool for *in –situ* cleanup, the employment of natural or genetically modified organisms *viz*., bacteria, algae, yeasts, and fungi to breakdown or the removal of pesticides is important from both an economic and environmental standpoint.

## References

Parte SG, Mohekar, AD and Kharat AS. 2017. Microbial degradation of pesticide: A review. *African Journal of Microbiology Research*. 11(24):992-1012.

Raj A, Kumar A and Dames JF. 2021. Tapping the role of microbial biosurfactants in pesticide remediation: An ecofriendly approach for environmental sustainability. *Frontiers in Microbiology.*12: 791723.


**Published**: 16 March. 2024
**ISSN:** 2583-7850