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Biodegradation of Pesticides and Herbicides by Microfungi

Dr. Jyoti Kesaria

Department of Botany, Bipin Bihari P.G. College, Bundelkhand University, Jhansi, India
Email: kesariajyoti@gmail.com,Mob-919696766176

ABSTRACT

Pesticides and herbicides are widely used in modern agriculture to control pests and weeds, but their persistence in the environment poses serious threats to ecosystems and human health. Microfungi have emerged as effective agents for biodegradation due to their enzymatic capabilities and adaptability to various environmental conditions. This paper explores the potential of microfungi in degrading pesticide and herbicide residues, highlighting key fungal species, enzymatic pathways, and environmental factors influencing degradation efficiency. By understanding the role of microfungi in biodegradation, sustainable and eco-friendly approaches to mitigating agrochemical pollution can be developed.

Keywords: Biodegradation, Microfungi, Pesticides, Herbicides, Environmental Remediation.

1. Introduction

The extensive use of pesticides and herbicides has led to soil and water contamination, negatively impacting biodiversity and human health. Microfungi contribute to the degradation of these chemicals through enzymatic processes, providing an eco-friendly alternative to conventional remediation techniques. Understanding fungal-mediated biodegradation mechanisms is crucial for sustainable agricultural and environmental practices.

2. Literature Survey

Several studies have documented the ability of microfungi such as Aspergillus, Trichoderma, and Penicillium to degrade pesticide and herbicide residues. Research highlights enzymatic pathways including ligninolytic enzymes, cytochrome P450 monooxygenases, and hydrolases that break down toxic compounds into non-toxic metabolite.

3. Problem Definition

Persistent pesticide and herbicide residues contribute to environmental degradation and pose risks to human and animal health. Conventional remediation techniques, such as chemical degradation and physical removal, are often expensive and inefficient. There is a need for a cost-effective, eco-friendly alternative that utilizes natural microbial processes.

4. Methodology/Approach

This study evaluates the degradation potential of selected microfungi under controlled laboratory and field conditions. Pesticide and herbicide degradation rates are assessed using spectrophotometric analysis, high-performance liquid chromatography (HPLC), and microbial assays. Environmental factors influencing fungal activity, such as pH, temperature, and substrate composition, are also analyzed.

5. Results & Discussion

Findings indicate that microfungi can significantly reduce pesticide and herbicide concentrations in contaminated soils and water. Enzyme assays confirm the involvement of specific fungal enzymes in the degradation process. The potential application of microfungi in large-scale bioremediation projects is discussed, along with challenges related to field implementation.

6. Conclusion

Microfungi offer a promising approach to pesticide and herbicide biodegradation, contributing to environmental sustainability. Their ability to break down harmful agrochemicals can be harnessed to develop bioremediation technologies that reduce ecological damage and improve soil health.

7. Future Scope

Future research should focus on optimizing fungal consortia for enhanced degradation efficiency, exploring genetic engineering to improve enzyme production, and assessing field-scale applications of fungal bioremediation in diverse environmental conditions.

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