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RESEARCH ARTICLE

Biological Approach for Degradation of Pesticides

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ABSTRACT

Environmental pollution is a serious concern globally. The use of pesticides in agriculture results in soil and water pollution. Pesticides cause harmful effects on humans and other living organisms. The solution for pesticide degradation is a very cheap biological approach that does not cause any pollution. The paper here mentions the biological approach for the degradation of pesticides. This will also solve the problem of soil and water pollution due to use of pesticides, which is essential.

Keywords: Agriculture, Biological, Environment, Eco-friendly, Degradation, Pesticides.

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INTRODUCTION

Agriculture is essential, where protecting plants/crops from pests, insects, rodents, etc., is essential. The farmers use pesticides to protect the plants/crops from pests.[1] The pesticides enter various water bodies and soil, causing water and soil pollution.[2] Pesticides cause harmful effects on humans as well as other living organisms.[3] The use of pesticides also affects beneficial microorganisms present in the soil. Pesticides are also sprayed on vegetables and fruits. This is a serious issue and needs an immediate solution. The use of microorganisms for the degradation of pesticides can be the solution to this.[4] The bacteria, actinobacteria and fungi are reported to degrade the pesticides.[5] This will be very cheap method and also will not cause environmental pollution. The research work describes the isolation of pesticide-degrading bacteria.

MATERIALS AND METHODS

Soil samples for isolation of pesticide-degrading bacteria

The soil samples were collected in clean plastic bags and labeled properly from two Agricultural farm areas of Pimpri Chinchwad, Maharashtra, India (Figure 1). The soil samples were used for the isolation of pesticide degrading bacteria.

Pesticide samples

The pesticide samples viz., bugicide and metarhizium were collected from Mahatma Phule Agricultural College, Pune, Maharashtra, India.

Isolation of bacteria from soil samples

The collected soil samples (1 g) each was weighed and added to 9 mL sterile distilled water (DW) and serial dilutions were made from 10^{-1} to 10^{-4}. Then 0.1 mL of 10^{-3} and 10^{-4} dilutions was spread on sterile nutrient agar (NA) [NA (g/lit): peptone- 10, NaCl- 5, pH- 7.5, agar- 30, DW- 100 mL] plates. The plates were incubated in the incubator at 37°C for 24 hrs.

Identification and characterization of the isolates

For the identification and characterization of the bacterial isolates, the morphological i.e., colony characters and biochemical tests viz., indole,[6] methyl red,[7] Voges Proskauer,[8] citrate utilization[9] and sugar fermentation tests[8] were performed. The enzymes viz., oxidase and catalase tests were also done and then compared using Bergey's Manual of Determinative Bacteriology.[10]

Degradation study of pesticides by the bacterial isolates

The NA media was prepared and supplemented with 20 ppm of pesticides, i.e., bugicide and metarhizium. The plates were made and the bacterial isolates were spot inoculated (10 µL) on these plates. The plates were then incubated in the incubator at 37°C for 24 hours and observed for the zone of degradation using Gram's iodine reagent [Gram's iodine: iodine- 1 g, potassium iodide- 3, DW- 300 mL].

RESULTS AND DISCUSSION

Total three bacterial isolates were obtained. The isolates were labeled A, B and C. Isolate A was a gram-negative rod, and

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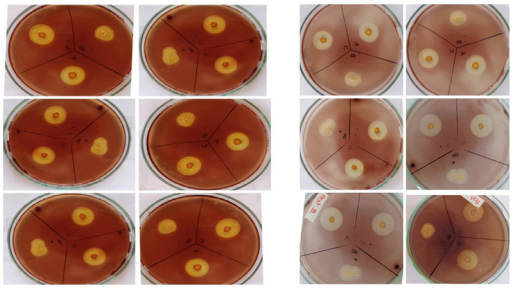
Figure 1: Agricultural farm areas of Pimpri Chinchwad, Maharashtra for collection of soil samples



A B

Figure 2: Zone of degradation of bugicide (A) and metarhizium (B) pesticides by Burkholderia, Bacillus and Streptomyces sp., respectively.

Table 1: Degradation of bugicide and metarhizium by Burkholderia, Bacillus and Streptomyces sp.

Isolates	*Zone of degradation (mm) of pesticides*	
	Bugicide	*Metarhizium*
Burkholderia sp.	10 ± 0.01	11 ± 0.01
Bacillus sp.	12 ± 0.00	10 ± 0.01
Streptomyces sp.	12 ± 0.01	11 ± 0.00

Data is average of triplicates ± standard deviation.

isolates B and C were gram-positive. All the isolates were catalase positive and isolates B and C were oxidase positive. The isolate A showed indole production. Isolate B was positive for methyl red test and also showed the ability to utilize citrate. All the isolates showed fermentation of glucose, while isolates A and B showed fermentation of lactose. By comparing with Bergey's Manual of Determinative Bacteriology, the isolates A, B and C belonged to *Burkholderia*, *Bacillus* and *Streptomyces* sp., respectively.

Degradation of pesticides by bacterial isolates

The degradation of bugicide and etarhizium by *Burkholderia, Bacillus* and *Streptomyces* sp. Is represented in Figure 2 a and b, respectively. The zone of degradation of pesticides by *Burkholderia*, *Bacillus* and *Streptomyces* sp. Is shown in Table 1.

There is a report on the degradation of pesticides by *Achromobacter* and *Diaphorobacter* sp.[11] Also, there is a report on the degradation of pesticides malathion and chlorpyrifos by *Kocuria assamensis*.[12] *Burkholderia gladioli* has been reported to degrade the pesticide profenofos.[13] The degradation of pesticides dicofol and metachlor has been reported.[14] There is a report on the mechanisms used by microorganisms and factors affecting the degradation of pesticides.[15]

CONCLUSION

The degradation of pesticides by biological approach is very economical and eco-friendly. This will also solve the environmental pollution caused due to pesticides. Further studies are needed to see the quantitative degradation of pesticides.

Conflict of interest

The authors declare there is no conflict of interest.

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