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Evaluating the Effectiveness of Soil-Derived Microbes in Degrading Pestricides using Nms Media and their Impact on Fenugreek Growth

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Abstract: Pesticide contamination in agricultural soil has become a major environmental concern, leading to soil degradation and adversely affecting plant growth. This study focuses on isolating microbial strains from pesticide-contaminated soil collected from agricultural fields in Nashik, India, and evaluating their ability to degrade pesticides. Three microbial strains (Sample A, Sample B, and Sample C) were isolated using the serial dilution and spread plate method. These microbes were inoculated into Nitrate Mineral Salts (NMS) medium containing pesticides to assess their degradation efficiency through optical density (OD) measurements. And after the successful degradation, the degraded solution was applied to fenugreek plants to observe its impact on plant growth compared to a control. The results was observed that the microbial strains efficiently degraded pesticides, significantly reducing toxicity and enhancing soil quality, which led to improved plant growth. This study it is was observed that microbial bioremediation could be a sustainable approach to reducing the pesticide toxicity in agricultural soil.

Keywords: *Pesticide Degradation, Microbial Bioremediation, Soil Microbes, Plant Growth, Optical Density.*

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I. INTRODUCTION

As we know pesticides are usually used in agriculture to protect crops from pests and increase productivity. However, excessive pesticide use will make the soil contaminate, it will negatively affect the soil fertility, can also lead to loose its original quality and can make soil barren , will affect microbial diversity, and also to plant growth. Microbial degradation is a promising bioremediation strategy that utilizes naturally occurring microorganisms to break down toxic pesticide residues into less harmful substances. This study aims to degrade the pesticide with the help of microbes which is isolated from pesticide-contaminated soil, collected from agricultural fields of Nashik city which is located in state of Maharashtra. And to degrade pesticide and to observe there effect on plants growth.

II. MATERIALS AND METHODS

A. Soil Sampling and Microbial Isolation:

Soil samples were collected from agricultural fields in Nashik, India, where pesticides had been applied. The samples were processed using serial dilution and plated on nutrient agar media. The plates were incubated at 37°C for 24 hours, allowing microbial growth. Three distinct microbial colonies were selected and labeled as Sample A, Sample B, and Sample C.

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Fig 1: Photo of the Land from which the Soil Sample was Collected for the Pesticide Degradation Study

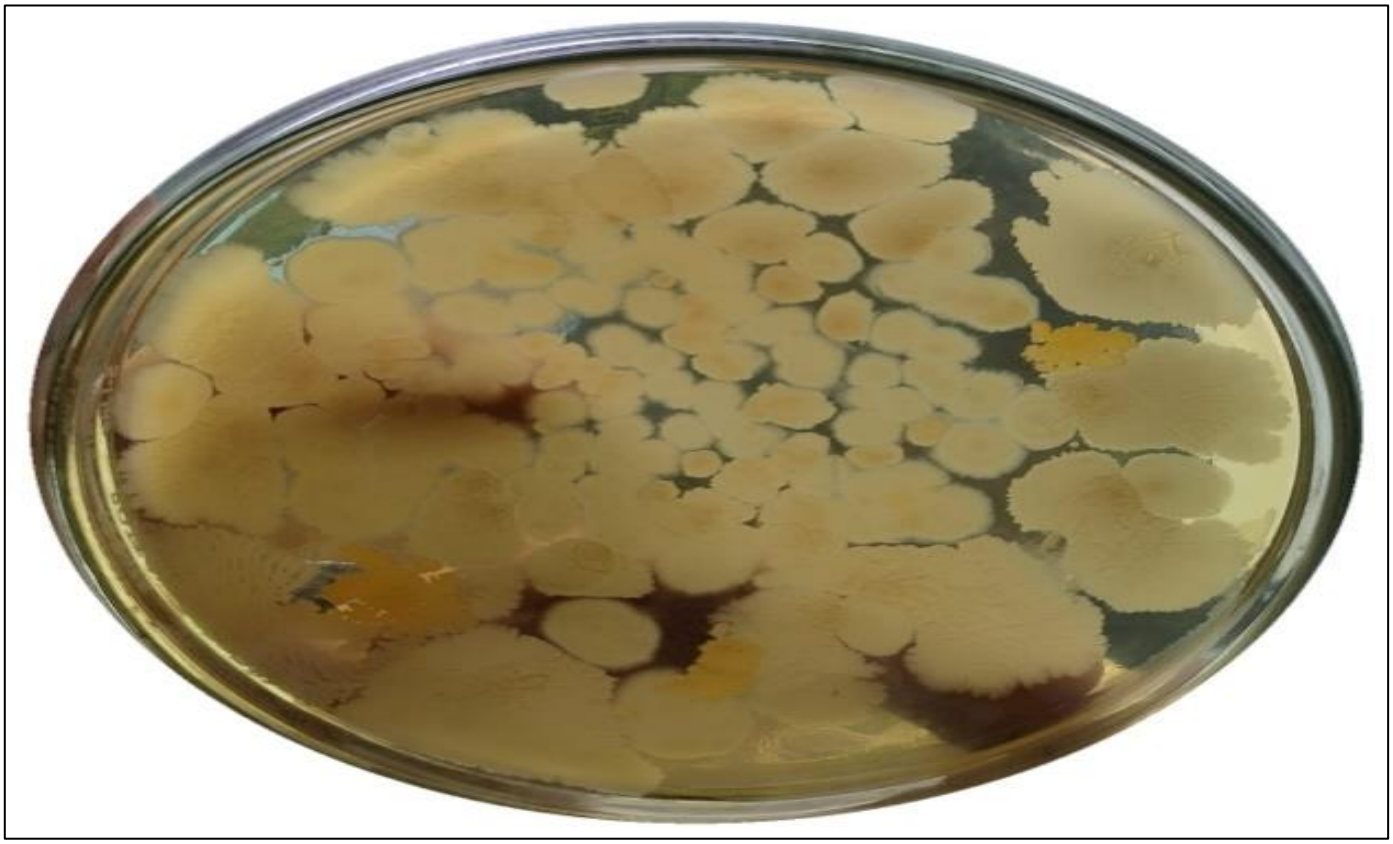

Fig 2: Photo Showing the Nutrient Agar Plates after Serial Dilution and Soil Inoculation to Isolate Microbes

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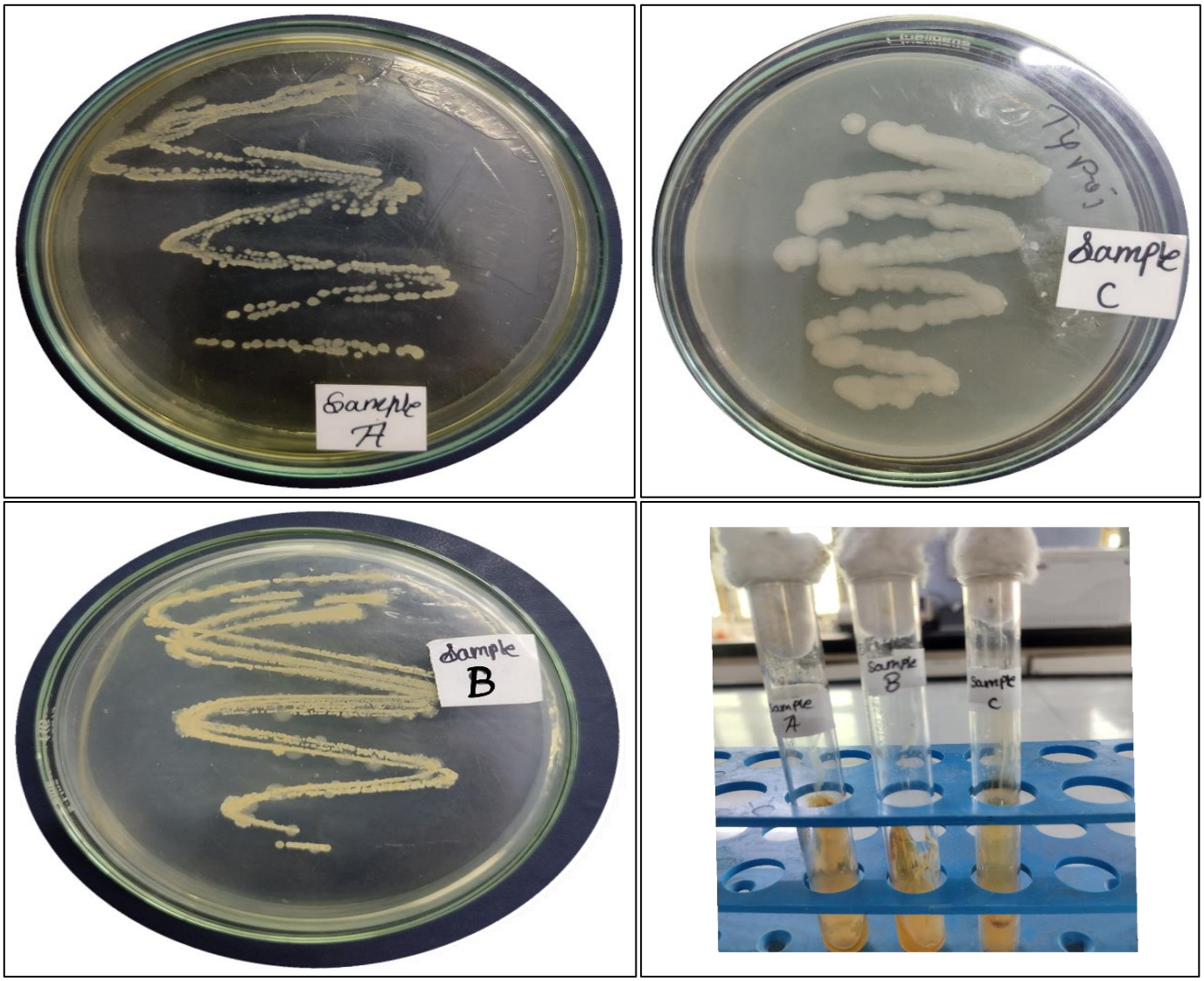

Fig 3: Image of the three microbial strains: Sample A, Sample B, and Sample C

B. Preparation of NMS Medium and Pesticide Degradation:

Nitrate Mineral Salts (NMS) medium was prepared to evaluate microbial pesticide degradation. The total 800 ml of NMS media was prepared. The composition was: Magnesium sulfate heptahydrate ($MgSO_4 \cdot 7H_2O$): 0.8 g ; Calcium chloride hexahydrate ($CaCl_2 \cdot 6H_2O$): 0.16 g ; Potassium nitrate (KNO_3): 0.8 g; Monopotassium phosphate (KH_2PO_4): 0.2176 g; Disodium hydrogen phosphate (Na_2HPO_4): 3.2 g; Ammonium chloride (NH_4Cl): 3.2 mg ; Sodium ethylenediaminetetraacetate (Na_2EDTA): 0.4 g; Iron (II) sulfate heptahydrate ($FeSO_4 \cdot 7H_2O$): 0.16 g; Boric acid (H_3BO_4): 0.024 g; Cobalt (II) chloride hexahydrate ($CoCl_2 \cdot 6H_2O$): 0.016 g; Zinc sulfate heptahydrate ($ZnSO_4 \cdot 7H_2O$): 0.008 g; Manganese chloride tetrahydrate ($MnCl_2 \cdot 4H_2O$): 2.4 mg; Sodium molybdate dihydrate ($Na_2MoO_4 \cdot 2H_2O$): 2.4 mg;Nickel (II) chloride hexahydrate ($NiCl_2 \cdot 6H_2O$): 1.6 mg; Calcium chloride dihydrate ($CaCl_2 \cdot 2H_2O$): 0.8 mg .[1]

C. Four Sets of NMS Medium were Prepared and Autoclaved

As four flasks were prepared with containing 200ml NMS media in each flask , they were lablelled as Sample A , Sample B , Sample C and Control. Then in all 4 Samples the pesticide was added and after that the isolated microbial strains was inoculated in Sample A,B,C.Not in control.

- Sample A – pesticide with Microbe Sample A
- Sample B – Pesticide with Microbe Sample B
- Sample C – Pesticide with Microbe Sample C
- Control – Pesticide with no Microbe

A specific pesticide was added to each medium, the pesticide taken was Superkiller-25. The microbial strains were inoculated into the respective media and incubated on a shaker incubator for continuous aeration. Degradation efficiency was monitored through daily optical density (OD) measurements at 600 nm using a spectrophotometer. A significant increase in OD confirmed microbial growth and active pesticide degradation.

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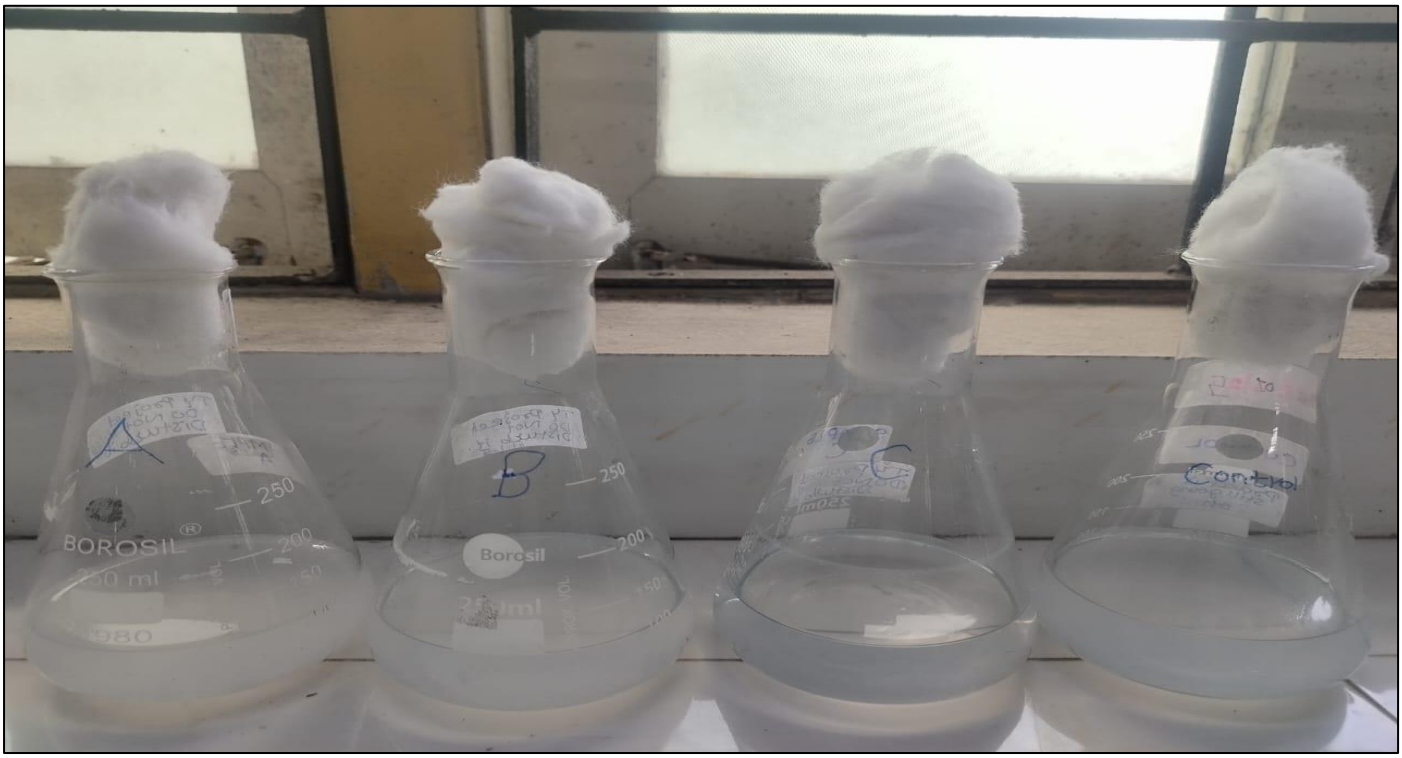

Fig 4: Image Showing NMS Medium Flasks with Microbial Strains and Control for Pesticide Degradation

D. Plant Growth Experiment

Fenugreek (Trigonella Foenum-Graecum) seeds were selected for the plant growth study. Four sets of plant growth pots were prepared, for it pesticide free soil was taken and was also autoclaved.

The setup of plant growth pots: Sample A (Treated with Microbe A Degraded Solution) Sample B (Treated with Microbe B Degraded Solution) Sample C (Treated with Microbe C Degraded Solution) Control (Only Water, No Treatment)

Fresh, pesticide-free soil was used in all pots. Seeds were planted, and each pot received its respective degraded pesticide solution. The control group was watered with only distilled water. Plant growth parameters, such as germination rate, plant height, and leaf count, were recorded over a period of 15 days.

III. RESULTS

➢ *Pesticide Degradation Efficiency:*

The OD measurements showed an increase in microbial growth in Samples A, B, and C, indicating successful pesticide degradation. Samples treated with microbes exhibited a significant reduction in pesticide concentration, confirming the effectiveness of microbial degradation. The control sample, without microbes, showed no significant OD change, demonstrating that natural breakdown was minimal.

➢ *Plant Growth Observations:*

Plants treated with degraded pesticide solutions (Samples A, B, C) exhibited higher germination rates and increased plant height compared to the control.Sample A showed the highest plant growth, followed by Sample B and Sample C. Control plants (only water) had the lowest growth, indicating that microbial degradation of pesticides contributed to improved soil fertility and plant health.

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Fig 5: Photos/Images of Fenugreek Plant Pots Showing Germination and Growth After Treatment with Degraded Pesticide

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IV. DISCUSSION

The results was observed that microbial strains from Nashik agricultural fields have the potential to biodegrade pesticides, reducing their toxicity and enhancing plant growth. The observed increase in OD values suggests active microbial metabolism, confirming efficient pesticide degradation. The improved plant growth in treated samples further supports the idea that microbial degradation neutralized pesticide toxicity, promoting better nutrient availability and plant development.

Microbial degradation provides an eco-friendly alternative to chemical-based pesticide removal methods.

V. CONCLUSION

This study demonstrated that microbial degradation of pesticides can significantly enhance plant growth. The microbial strains successfully degraded the pesticide, effectively neutralizing its harmful effects. As microbes isolated Nashik agricultural fields showed the potential towards pesticide degradation by reducing their toxicity and enhancing plant growth.

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