BIOREMEDIATION OF IMIDACLOPRID UNDER DIFFERENT ENVIRONMENTAL CONDITIONS: TOXICITY ASSESSMENT AND METAGENOMICS

Thesis submitted in partial fulfillment for the Award of Degree

DOCTOR OF PHILOSOPHY

by

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CONCLUSIONS AND SUGGESTIONS/ RECOMMENDATIONS

9.1. Conclusions

The present study on bioremediation of imidacloprid was performed satisfactorily. Based on experimental results obtained, the following conclusions were made:

1. The application of bacterial consortium for remediation of imidacloprid was found to be promising and may be addressed for environmental bioremediation.
2. Environmental parameters such as pH and temperature have significant effect on bioremediation.
3. Biomass growth have been found to be dose dependent.
4. The present study suggests greater imidacloprid reduction in reactor as compared to the flask study, due to higher nutrient and oxygen transfer in the reactor.
5. Kinetic analysis reveals that substrate inhibition takes place and experimental data fits well in the Edwards and Teisser kinetic models.
6. % bioluminescence inhibition was found to be maximum in case of untreated samples, indicating high toxicity of the samples. However, after biodegradation the toxicity reduces to considerable level, making it comparable to the control.
7. Exposing cells to a cytotoxic compound may result in various outcomes in the cell. Toxicity caused to cell lines after bacterial treatment is negligible in contrast to the untreated samples, where cell proliferation and viability is reduced significantly.
8. According to the data on toxicity, the metabolites that the bacterial consortium produces in the presence of imidacloprid are considerably less toxic as compared to imidacloprid. This indicates the potential application of the consortium in reducing the risk and toxicity of imidacloprid.
9. Isolated bacteria have been found to be effective in degrading imidacloprid in slurry as well as soil microcosm.
10. Metagenomic analysis reveals the shift in microflora in imidacloprid-contaminated and biologically treated soil samples as compared to the control sample.
11. Lyophilization of bacteria can be an effective method to enhance the shelf-life of bacteria, so that it can used in the future for environmental cleanup.
12. Encapsulation of lyophilized bacteria has been effective in bioremediation of imidacloprid in soil microcosms.

13. The incorporation of biostimulation in addition to bioaugmentation has been found to be very effective in imidacloprid biodegradation.

9.2. Suggestions

Based on research findings obtained from the present dissertation, the following issues can be explored in future research:

1. The present study has been conducted using individual bacterial isolates and their consortium. However, numerous microorganisms co-exist in the environment. Studies on synergistic effect of bacteria, fungi and other microflora can also be conducted
2. In the present study, a single insecticide was taken into consideration. However, different types of insecticides and herbicides are used simultaneously in agricultural fields. Further studies can be carried out using different mixtures on pesticides
3. During the preparation of consortium, the most effective bacteria were selected and mixed in equal quantities. Variation in concentration of individual species in consortium preparation can be carried out to obtain the most effective consortium
4. Whole genome sequencing can be done for detailed study of the microflora present in the samples and metagenomics approach can be useful in identification of genes involved in the bioremediation process
5. Microcosm studies in laboratory have been conducted in the present study. The studies can be scale up by application of encapsulated bacteria in agricultural fields