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Abstract

Biological treatment system to remove pesticide residues in canals of lemon plantation consists of 2 technologies. The first technology is Bio-augmentation, the consortium containing about 10^6 cfu was immobilized on each supporter as plastic media. The second one is bioreactor technology; a 900 liter aeration reactor containing 1,800 immobilized plastic media was settled at the 3.2 hectare of a lemon plantation in ratchaburi province. During the experiment, the residues of 18 kinds of pesticides such as chlorpyrifos, ethion, methomyl, carbendazim, imidacloprid, etc. at the change in concentrations of 0.1 to 66.3 micrograms per liter of contaminated water samples from ditches were analyzed. However, after this system was continuously operated for 1.5 years, all types of the pesticide residues in organophosphate, carbamate, herbicides and insecticides groups, was not detected. Moreover, the EC_{50} of the runoff water concentration through this bioreactor determined by *Daphnia magna* standard test OECD 202 increased from 3 percent to 100 percent within 2 years indicating the safety of water in canal of lemon plantation to the environment. These results indicate that this microbial consortium is capable of simultaneously degrading and detoxify different types of pesticide and is useful for cleaning up pesticide contaminants on site.

Introduction

Pesticides affect environment in nearly every aspects including air pollution and chemical residues in air and in water. The latter can unexpectedly impact both human and the environment. Numerous studies have reported about the impacts of pesticides on the ecosystem and overall environment in various aspects on both the aquatic plants and animals living in contaminating areas. Moreover, pesticide is an important cause of health problems of people in Thailand.

TISTR has carried out the research concerning bioaugmentation, which is an important bioremediation process for the permanent removal of toxic compounds, and obtained a group of microorganisms highly effective in degrading residue pesticides contaminated in aqueous. Then, in-situ process for removing the toxic compounds using this specific consortium has been developed. The efficiency of the process was proven by on-site experiments at agricultural plantation and at agrochemical factory. Taken all together, it is feasible that this process could be able to apply for biodegradation of pesticide residues accumulated in agricultural and industrial sites in Thailand.

Materials , Methods and Results

1. Scale up cultivation of immobilized effective consortium

2. Identification of pesticide residues at the plant site

3. Setting up the biological treatment system

4. Evaluate the efficiency of pesticides degrading consortium



❖ The EC_{50} of broth culture after degraded by effective consortium increased 4.62 to 71.40 $\mu\text{g/L}$



References

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- Nagase, H., Pattanasupong, A., Sugimoto, E., Tani, K., Nasu, M., Hirata, K., and Miyamoto, K. 2006. Effect of environmental factors on performance of immobilized consortium system for degradation of carbendazim and 2,4-dichlorophenoxyacetic acid in continuous culture. Biochem. Eng. J. 29:163-168.

Group/ Kind of pesticides	Pesticides residues ($\mu\text{g/L}$)						
	Water sample in canal		Water samples from the reactor tank (months)				
	4 months before setting system	During the test 24 months	2	6	12	18	24
Carbamate							
carbaryl	ND	0.0-1.4	ND	ND	ND	ND	ND
methomyl ^a	0.2-10.0	2.4-2.8	ND	ND	ND	ND	ND
Fungicides							
benomyl	0.5-66.3	ND	ND	ND	ND	ND	ND
difenoconazole	0.0-0.6	0.0-9.4	1.0	ND	ND	ND	ND
metalaxyl	0.1-0.2	ND	ND	ND	ND	ND	ND
prochloraz ^a	ND	1.4-3.8	ND	ND	ND	ND	ND
propiconazole ^a	ND	1.6-8.0	ND	ND	ND	1.6	1.1
Herbicides							
ametryn	0.0-2.2	ND	1.3	ND	ND	ND	ND
diuron	0.2-0.9	ND	ND	ND	ND	ND	ND
Insecticides							
imidacloprid ^a	0.2-8.0	0.0-1.1	ND	1.3	ND	ND	ND
Organophosphate							
chlorpyrifos	ND	0.0-1.1	ND	ND	ND	ND	ND
dimethoate	0.0-0.1	ND	ND	ND	ND	ND	ND
ethion ^a	ND	1.4-19.3	ND	ND	ND	ND	ND
malathion	0.0-0.3	ND	ND	ND	ND	ND	ND
profenofos	0.0-0.3	ND	ND	ND	ND	ND	ND
other group							
carbendazim ^a	NA	4.0-8.1	NA	NA	NA	ND	ND
carbosulfan ^a	0.0-0.1	ND	NA	NA	NA	ND	ND
copper oxychloride ^a	NA	0.3-11.3	NA	NA	3.5	3.4	4.3

ND mean Not Detected, NA mean Not Analyze
a mean Pesticides are used in plantation during the crops

Discussion and Conclusions

TISTR has successfully biotechnology research concerning bioaugmentation and bioreactor for degradable and detoxification pesticides contaminated in canal of lemon plantation. Moreover, this efficiency biological treatment system was proven by on-site experiments at three agricultural plantations and at two agrochemical factories.

Taken all together, it is feasible that this process could be able to apply for biodegradation of pesticide residues accumulated in agricultural and industrial sites in Thailand.