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Persistence and Bioremediation of Endosulfan in Agricultural Soil

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Background/Objectives. The occurrence of pesticide residues in various environments isprimarily the result of the intensive use of pesticides in agriculture, pesticide industries (point source), atmospheric fall out, agricultural runoff, and industrial discharges. Among these pesticides, endosulfan is a new chemical on the Stockholm Convention (2011) on Persistent Organic Pollutants list. Endosulfan is an organochlorine pesticide under the Cyclodiene subgroup and belongs to the class of organochlorine insecticides. Its water solubility is 0.33 mg/L, and its half-life is more than a hundred years. Major reason for the persistence of endosulfan in the environment is its less water solubility and is not bioavailable for microbial degradation. Biodegradation of such less water soluble compounds in soil can be enhanced by amending synthetic or biological surfactants, but the usage of the former is restricted due to its toxicity and the later due to its cost. The persistence of many hydrophobic pesticides has been reported by various workers in various soil environments and its bioremediation is a major concern due to less bioavailability. In the present study, the pesticide residues in the surface and subsurface soil in an area of intense agricultural activity inPakkam Village of Thiruvallur District, Tamilnadu, India, and its bioremediation using a novel bacterial consortium was investigated.

Approach/Activities. Surface (0-15 cm) and subsurface soils (15-30 cm and 30-40 cm) were sampled, and pesticides in different layers of the soil were analyzed. These soil layers were subjected to bioremediation using a novel bacterial consortium a simulated soil profile condition in a lab scale soil reactor. A glass reactor of volume 4500 cm3 with height 40 cm, length 15 cm and width 10 cm was used as the experimental set up.

Results/Lessons Learned. Alpha-endosulfan and beta endosulfan concentrations ranged from 1.42 to 3.4 mg/g and 1.28 to 3.1 mg/g in the surface soil, 0.6 to1.4 mg/g and 0.3 to 0.6 mg/g in the subsurface soil (15 to 30 cm), and 0.9 to 1.5 mg/g and 0.34to 1.3 mg/g in the subsurface soil (30 to 40 cm) respectively. Residues of other persistent pesticides α BHC,γ BHC, op DDE, β cyfluthrin and chlordane isomers were also detected in minor concentrations. The complete removal of alpha and beta endosulfan was observed over 25 days. Residues of endosulfate were also detected during bioremediation, which was subsequently degraded on the 30th day. Survival of introduced bacterial consortium is confirmed using DGGE and primer based studies. This study revealed the existence of endosulfan in the surface and subsurface soils and also proved that the removal of such a ubiquitous pesticide in the surface and subsurface environments can be achieved in the field by bioaugumenting a biosurfactant producing bacterial consortium that degrades pesticides. The study on persistence of endosulfan in the field condition will be discussed during the conference.