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Combined Use of Microbial Consortia for the Enhanced Degradation of Type-IIx Pyrethroids

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Abstract : The unrestrained usage of pesticides to meet the burgeoning demand of enhanced crop productivity has led to the serious contamination of both terrestrial and aquatic ecosystem. The remediation of mixture of pesticides is a challenging affair regarding inadvertent mixture of pesticides from agricultural lands treated with various compounds. Global concerns about the excessive use of pesticides have driven the need to develop more effective and safer alternatives for their remediation. We focused our work on the microbial degradation of a mixture of three Type II-pyrethroids, namely Cypermethrin, Cyhalothrin and Deltamethrin commonly applied for both agricultural and domestic purposes. The fungal strains (Fusarium strain 8-11P and Fusarium sp. zzz1124) had previously been isolated from agricultural soils and their ability to biotransform this amalgam was studied. In brief, the experiment was conducted in two growth systems (added carbon and carbon-free) enriched with variable concentrations of pyrethroids between 100 to 300 mgL^{-1}. Parameter optimization (pH, temperature, concentration and time) was done using a central composite design matrix of Response Surface Methodology (RSM). At concentrations below 200 mgL^{-1}, complete removal was observed; however, degradation of 95.6%/97.4 and 92.27%/95.65% (in carbon-free/added carbon) was observed for 250 and 300 mgL^{-1} respectively. The consortium has been shown to degrade the pyrethroid mixture (300 mg L^{-1}) within 120 h. After 5 day incubation, the residual pyrethroids concentration in unsterilized soil were much lower than in sterilized soil, indicating that microbial degradation predominates in pyrethroids elimination with the half-life ($t_{1/2}$) of 1.6 d and R^2 ranging from 0.992-0.999. Overall, these results showed that microbial consortia might be more efficient than single degrader strains. The findings will complement our current understanding of the bioremediation of mixture of Type II pyrethroids with microbial consortia and potentially heighten the importance for considering bioremediation as an effective alternative for the remediation of such pollutants.

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