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Biodegradation competence of *Streptomyces toxytricini* D2 isolated from leaves surface of the hybrid cotton crop against β cypermethrin

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ABSTRACT

The frequent application of β cypermethrin in farming activity, causing severe soil and water contamination. Thus, finding a suitable microbial agent to degrade the toxic pesticide into less or nontoxic components is vital. Hence, β cypermethrin-resistant predominant bacteria from the pesticide-exposed surface of cotton leaves were isolated and optimized the growth conditions required for the significant degradation of β cypermethrin. Six dominant bacterial cultures were isolated from pesticide exposed cotton leaf samples, and among them, COL3 showed better tolerance to 6% of β cypermethrin than others. This COL3 was identified as *Streptomyces toxytricini* D2 through the 16S rRNA analysis. The suitable growth requirements of *S. toxytricini* D2 were optimized with various essential growth parameters to degrade β cypermethrin and the results showed that a significant degradation of β cypermethrin was observed at 35 °C, pH 8.0, 1.5% of inoculum, and nutritional factors like glycerol (20 mg L^{-1}), ammonium sulfate (15 mg L^{-1}), and calcium phosphates (10 mg L^{-1}) were served as better carbon, nitrogen, and phosphate sources respectively. The degradation percentage and half-life of β cypermethrin were calculated as 80.71 ± 1.17% and 48.15 h respectively by *S. toxytricini* D2. The GC-MS analysis results showed that *S. toxytricini* D2 effectively degraded the β cypermethrin into 5 components such as methyl salicylate, phenol, phthalic acid, 3-phenoxy benzaldehyde, and 3-PBA. This is the first report, revealed that the *S. toxytricini* D2 belongs to the *Actinobacteria* has the potential to degrade the β cypermethrin into less or nontoxic metabolites under optimized conditions.

1. Introduction

The modernization in the field of agriculture, to increase the productivity to fulfill the food requirement for the growing global population is creating environmental pollution (Narayanan et al., 2020a). To attain an increased quantity of yield is being supported by frequent and excess application of pesticides and herbicides (considered as persistent organic pollutants POPs) to reduce the weeds and pests responsible for the yield reduction (El-Helow et al., 2013; Narayanan et al., 2020c). An excess application of pesticides leads to severe soil and water contamination, for example, cotton cultivated soil receive severe pesticide contamination because of the continuous application of pesticides to reach maximum productivity (Talha et al., 2018), besides that during the rainy season it transferred to the nearby water reservoir and enter into the life cycle of water flora and faunas (Narayanan and Devarajan, 2011), later it might be entered into a human through consuming foods derived from these polluted sites. Most of the pesticides used in the crop cultivations are belongs to the category of pyrethroid (cypermethrin), carbamates (Carbofuran), organophosphates (Chlorpyrifos), chlorophenoxy acids (Mecoprop), and organochlorines (Aldrin) (Kafilzadeh et al., 2015) and they are categorized as persistent organic pollutants (POPs). These pesticides initially stable on leaflets for a certain period through spraying and later its dropdown as waste foliage into the soil. There might be some bacterial species that can survive on that pesticide exposed surface of leaves, and they might attain resistance against pesticides since frequent applications. The cypermethrin is a synthetic and moderately toxic pyrethroid pesticide mostly used to control the pests in cotton, vegetable, and fruit crops to minimize the yield loss and utilization in residential and industrial buildings, too (Narayanan et al., 2020a). About 90% of fabricated cypermethrin is preferably applied for cotton crops (Hougard et al., 2002). This pesticide can cause toxicity in insects by opening sodium

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