BIODEGRADATION OF CARBOFURAN BY BACTERIA ISOLATED FROM THE SOILS WITHIN NZOIA RIVER BASIN, KENYA

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ABSTRACT

Carbofuran (2,3-dihydro-2,2-dimethylbenzofuran-7-yl methylcarbamate) has become of environmental concern because it is acutely toxic, carcinogenic and recalcitrant. Therefore detoxification of carbofuran contaminated soil sites is of great importance. In this study, the carbofuran degradation capacity of native bacteria in soils from Nzoia River Drainage Basin (NRDB), having a history of repeated carbofuran applications, was investigated through selective enrichment liquid culture experiments. A gram positive, rod shaped bacteria capable of degrading carbofuran was isolated from the sampled soils. The strain was shown to metabolize standard carbofuran at concentrations of 50, 75 and 100 $\mu g\ mL^{-1}$ to carbofuran phenol in minimal salt medium (MSM) at 32°C within 10 days in which the pesticide was the only source of carbon and/or nitrogen. Carbofuran degradation and its main biodegradation metabolite, carbofuran phenol, were monitored using high performance liquid chromatography (HPLC) which was calibrated using reference standards. Gas chromatography – mass spectrometry (GC/MS) was used to confirm the biodegradation product formed. Carbofuran biodegradation kinetics best fitted the first-order rate model, $C = C_0e^{-kt}$, where k (the rate constant) was 0.7054, 0.6173 and 0.5140 day^{-1} for 50 $\mu g\ mL^{-1}$, 75 $\mu g\ mL^{-1}$ and 100 $\mu g\ mL^{-1}$ of initial carbofuran concentrations, respectively with good correlation (R^2) above 0.9. Physical and morphological characteristics as well as DNA sequencing of 16S rRNA gene sequence analysis confirmed the bacterial isolate to be a member of *Bacillus* species. These results indicate that this strain of *Bacillus sp.* could be considered as *Bacillus cereus* or *Bacillus thuringiensis* with bootstrap value of 100 % similarity of the 16S rRNA gene sequences. The biodegradation capability of the native strains in this study indicates they have great potential for application in bioremediation of carbofuran-contaminated soils sites.