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Microbial degradation of glyphosate: Integrating first order rate in the estimation of process kinetics

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In the present study, experimental data fit of first-order kinetic model (LnC_o/C_n) was evaluated in the estimation of half-life (t½) and degradation constant (k) of glyphosate using four microbial species *including Aspergillus niger* (KC796387), *Serratia* marcescens (AJ233431), *Micrococcus* luteus (AJ536198), and *Fusarium proliferatum* (JF740779) in single inoculation and consortium. The degradation potentials of different inoculated systems were studied and compared with control (no microbial seeding). Initial glyphosate concentration of 64,281mgml^{-1} was the same in all studied microcosms at zero hours and this was respectively reduced to 7070.90 mgml^{-1} by *Aspergillus*, 9,642.20 mgml^{-1} by *Serratia*, 10,927.80 mgml^{-1} by *Micrococcus*, 12,856.60 mgml^{-1} by *Fusarium* and as low as 1,285 mgml^{-1} by the consortium after four weeks incubation. High residual glyphosate concentration of 34,068.90 mgml-1 was reported in the control at the same time and this indicated slow degradation scenario. The result showed that the microbial system involving the consortium displayed an effective rate of glyphosate biodegradation thus obtained high removal efficiency (%RE= 98%) at the end of the study. *Aspergillus* microcosm (89%) had the highest removal efficiency among the single inoculations followed by *Serratia* microcosm (%RE = 85%) then *Micrococcus* and *Fusarium* microcosms 83% and 80% respectively. Poor removal efficacy (47%) was reported in the control. Experimental data adequately fitted into the first order kinetic model and supported the optimal glyphosate utilization in the microbial consortium amended system (t½= 0.70 d, k= 0.45 ± 0.1d^{-1}, R^2 = 0.96). Model interaction with experimental data in this system generated a curve with absolute linearity than the other systems. However, all the microcosms demonstrated significant glyphosate utilization except the control (t½=4.3d, k=0.16±0.2d^{-1}, R^2=0.54).Therefore, use of high cell density (consortium) effectively metabolized glyphosate thus can be recommended for pilot scale study in glyphosate removal from the environment.

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