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Studies in simulated rice field environment: II. Investigation of kinetics of propanil degradation using electrochemical methods

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Propanil is a fast moving herbicide used in rice cultivation. Although propanil is electroinactive, its principal degraded product, 3,4-dichloroaniline (3,4-DCA), is electroactive. Detailed electrochemical investigation of 3,4-DCA in aqueous medium reveals that it shows two reduction and two oxidation peaks at +0.10 V , –0.10 V, +0.35 V and +0.75 V, Vs saturated Calomel Electrode (SCE) respectively. The most intense peak appears at +0.75 V, which is diffusion-controlled according to peak current- potential scan rate studies, and hence it is suitable for quantitative analysis. Consequently, direct detection of 3,4-DCA in the environment can be extended for investigation of the fate of propanil.

Application of propanil, with the recommended dose for rice cultivation, in three beds of equal dimensions (1.0 m in length $\times$ 1.0 m in width $\times$ 0.5 m in depth) prepared in a polytunnel, an effective simulated environment, can be used for fate studies. Determination of the concentrations of 3,4-DCA through the entire rice cultivation cycle of 4 months indicated that the concentration of 3,4-DCA initially increased up to 4 days followed by decreased up to 10 days, and finally reaching a constant concentration.

Kinetic studies performed for initial degradation of propanil, assuming that the degradation of propanil forming 3,4-DCA is the major conversion step, indicated that the degradation process is of first order with respect to propanil with the rate constant of 5.0×10^{-6} s^{-1}. The linear fit of the integrated rate equation for first order kinetics shows a regression coefficient close to one, as compared to more deviated values for the rate laws of other orders. However, further refinement of this kinetic model can be achieved by considering the quantity of propanil lost during spraying, due to volatilization, and plant and soil absorption.

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