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**INVESTIGATION OF ENVIRONMENTAL FATE OF SOME
SELECTED PESTICIDES USING ELECTROCHEMICAL
METHODS**

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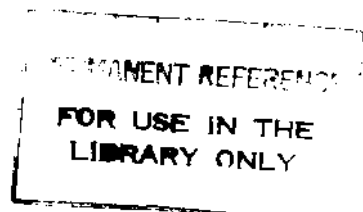
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Extensive use of pesticides has significantly affected the ecosystems. Degradation of pesticides, however, may prevent the accumulation or contamination of pesticides. Their impact on human health and the environment largely depends on the quantity applied, the toxicological and ecotoxicological properties, and the persistence in the environment, especially in soil and water. Consequently, accurate determination of the levels of pesticides, and their fate in the environment have become major issues. It is very necessary to monitor the fate of pesticides in the environment. These challenges can be successfully overcome by the use of low-cost and environmentally friendly, quantitative analytical methods.

In this context, this project involves the use of electroanalytical methods, in particular, amperometric methods, for some commonly used pesticides, such as propanil, thiram and glyphosate. If the pesticide is not active at bare electrodes, they are modified with suitable catalysts. Analytical characteristics required for quantification such as sensitivity, detection limits and linear dynamic range are determined for each pesticide.

In order to determine the fate of different pesticides in the Sri Lankan environment, different environmental conditions are simulated in the laboratory, and the levels of pesticides, and their residues and degraded products are analyzed using electroanalytical methods. However, spectroscopic methods are used whenever necessary. After addressing these issues under laboratory conditions, pesticides are introduced on plants grown under controlled conditions (i.e., in a soil bed prepared in a poly-tunnel). Different environmental conditions are simulated during the introduction of different pesticides. Quantitative determination of active ingredients and their degraded products in leachates of soil beds collected at different time intervals are used to investigate the fate of pesticides in the environment.

The herbicide paraquat (1,1-dimethyl 1-4,4'-bipyridinium dichloride) has been widely used in agriculture as a nonsystemic contact herbicide for many crops. In this study, systematic, quantitative laboratory scale experiments have been carried out to obtain preliminary data of fate studies of paraquat using three different soil types used on rice cultivation in Sri Lanka. Furthermore this study has been extended to simulate rice field environment maintained in a polytunnel.

A desorption model for paraquat under dynamic conditions is formulated based on three experimental variables: time of sampling, concentration of adsorbed paraquat on soil and flow rate. These variables are related to important aspects of kinetics, equilibrium and diffusion, respectively. Dynamic conditions are specially selected in this investigation to simulate real environmental conditions where desorption of paraquat followed by leaching through soil occurs, provided sufficiently long time periods despite the high partition coefficient of paraquat.

3,4-dichloroaniline (3,4-DCA), the major degraded product of the weedicide, propanil, is detected at stearic acid-modified electrodes, using steady-state amperometry, which provides a satisfactory minimum detection limit. This methodology is successfully extended for the detection of 3,4-DCA at ppm levels in water of a model rice bed after application of the recommended dose of propanil.

Interaction of glyphosate with platinum surfaces is also investigated. Cyclic voltammetric experiments of polycrystalline Pt electrodes in glyphosate solutions indicate the appearance of reduction and oxidation peaks. Sequential additions of glyphosate initiates a gradual decrease in the current of the peak associated with the reduction of surface platinum oxide, with concomitant appearance of a new peak at a more positive potential. The latter peak, associated with the reduction of a Pt(IV)-glyphosate complex, which occurs at a less negative potential due to electron donation groups of glyphosate. Further, a new concentration-dependent, diffusion-controlled redox couple centered beyond the H-adsorption/desorption region appears during cyclic voltammetric scans. Steady-state amperometric experiments of glyphosate result in a linear calibration curve with favorable analytical characteristics.

Detection of thiram is performed using both amperometric and spectroscopic methods. The spectroscopic method is extended for the determination of the partition coefficient (K_D) of thiram between CHCl_3 and H_2O phases, which is used to determine the apparent partition coefficient (K_D') of thiram between sieved soil and water through a solvent extraction step. The K_D' values determined for an initial thiram concentration range of 3.00 ppm to 10.00 ppm show a decreasing trend, which levels off at high concentrations, indicating the strong irreversible adsorption behavior of thiram on soil at low concentrations.