ABSTRACT

Pesticide residues in water bodies are considered as potentially serious environmental problem. Remediation of such problem requires thorough understanding of the behaviour (retention, mobility and persistence) of pesticides in soil by monitoring of site-specific data. Laboratory and field based investigations have been carried out to establish the behavioral parameters of two contrasting and widely used pesticides malathion and atrazine. The laboratory studies involved determination of sorption and leaching parameters of these pesticides in three different agricultural soils: loamy sand (Typic Xerosament), sandy loam (Acid Lateritic Haplustalf) and clay loam (Hyperthermic Typic Haplusterts). Whereas, field investigations comprised of comprehensive field plot and lysimetric studies in sandy loam soils of Kharagpur with malathion being applied to rice crop under saturated conditions and atrazine applied for potato crop under unsaturated conditions. The investigations aimed to study the impact of different application rates of malathion (1.0, 2.0 and 3.0 ml/l of water and control) and atrazine (1.5, 3.0 and 4.5 kg a.i./ha and control) on soil water and distribution and balance of pesticides within the root zone for two consecutive seasons. The results obtained from laboratory and field based investigations were simulated by HYDRUS 1 D model. The results of batch sorption experiments revealed that malathion had higher K_d values compared to atrazine for all soils, indicating higher leachability of atrazine than malathion. The miscible displacement experiments revealed that malathion could not leach beyond 15 cm depth whereas atrazine could leach up to 65 cm depth in the test soils under saturated conditions. The field plot experiments revealed that malathion under saturated rice field leached up to 30 cm and maximum concentration of malathion was found in surface ponded water. Under unsaturated conditions atrazine leached up to 65 cm beyond root zone only under highest rate of pesticide application. In lysimetric experiments malathion could not be detected in the drainage water of all the four treatments during the entire experiment. Atrazine leached beyond the root zone after 160 days of application but remained within the permissible limits. HYDRUS 1D model fitted the experimental breakthrough curve (BTC) well with R^2 values ranging from 0.65-0.99 and predicted the time and depth distribution of soil water (R^2 0.97-0.99) and pesticides (R^2 0.91-0.97) reasonably well.

Keywords: Malathion; Atrazine; Batch sorption; Soil column; Lysimeter; Leaching; Solute transport; HYDRUS