

Triazines mobility in sugarcane cultivated soils

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Atrazine and ametryn are pre and post-emergence herbicides, widely used in sugarcane crops in Argentina. Both herbicides are characterized by their moderate to high mobility in soil. The mobility increases with higher soil pH and lower organic matter content (OM).

Tucuman province has the main sugarcane cultivated area in the country (>65%), which lies over a shallow aquifer and drains to the Salí river. Most of the cultivated soils from the southeast of the province have a pH > 7.3 and OM < 2.5%, therefore it is expected that atrazine and ametryn would have a high risk of mobility. The aim of this study was to estimate the leaching potential of atrazine and ametryn in soils from the southeast of Tucuman under sugarcane production. Miscible displacement experiments were carried out using undisturbed topsoil cores from four production fields, by triplicate. Each column was 15 cm length and 8 cm diameter. The dose of atrazine and ametryn that was applied in the columns corresponds to the equivalent dose used in the field of 2 kg ha⁻¹ and 1.2 kg ha⁻¹ respectively. Br⁻ was used as a tracer molecule and it was applied previous to the herbicides pulse at a concentration of 150 BrK kg ha⁻¹. Displacement was made with CaCl₂ (0.01M) at a flow of 0.4 ml min⁻¹, constant temperature (21°C) and unsaturated conditions (-0,5 m). The leached water samples were analyzed by ultra performance liquid chromatography (Waters[®] ACQUITY[®] UPLC) coupled to a mass spectrometer (MS/MS Quattro Premier XE Waters). The breakthrough curves (BTCs) for each compound were estimated by the convection-dispersion equation (using CXTFIT 2.0 program) in order to estimate the transport parameters. Results showed that the hydraulic transport was in equilibrium conditions, meaning that all the soil water is involved in solute convective transport. This could be explained by a soil porosity composed mainly by micro and mesopores, due to natural conditions or by tillage and harvest practices. Water velocity and dispersion range were 0.73-1.6 cm h⁻¹ and 0.24-2.3 cm² h⁻¹ respectively. Atrazine had asymmetric BTCs, revealing chemical non-equilibrium conditions, with at least two adsorption-desorption sites participating in the process. Retardation coefficients were between 8-14 units. In contrast, ametryn concentrations in leached samples were low and inconsistent, so no BTCs could be described. Atrazine leaching potential was high in the studied soils. This herbicide is a well-known mobile molecule, found in many rural catchments and aquifers, independently of the soil type and the unsaturated properties or climatic conditions. On the contrary, ametryn had a higher potential to be sorbed and was less mobile than atrazine. This implies that there is a higher risk of contaminating groundwater with atrazine than with ametryn in the southeast soils of Tucuman.