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Study of the transport of cadusafos in two tropical undisturbed soil columns

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The use of pesticides to control agriculture pests is a common practice on most tropical plantations whose vulnerability to pesticide pollution is very important due to the frequent heavy rains that wash pesticides from target areas. Tropical volcanic soils have been scarcely investigated in this sense and monitoring the dynamic of pesticide at column scale is of great interest for a better understanding at catchment scale and risk modelling. The objective was to study and model the transport of cadusafos (CDS) in two undisturbed soil columns from a nitisol and an andosol, representative of the major soils in agricultural areas of the FWI.

Undisturbed soil columns from andosol (sandy-loam soil) and nitisol (clay soil) from Guadeloupe Island were spiked with 14C-CDS along with 10 g of granulate Rugby®. To each soil column, 10 rain events of different intensities (20 and 40 mm/h during 4 and 2 hours, respectively) were applied with 4-7 days delay between two subsequent rain events. For the nitisol columns, the cumulated rain was halved (by decreasing duration of each rain event) since these soils occur in drier areas of Guadeloupe and because the imposed rain intensities led to the accumulation of water at the surface of the column. At the end of the leaching experiment the extractable and non-extractable remaining pesticide residues were determined along the soil profile.

The andosol presented a very high permeability attributed to the preferential flow expected in this type of soil with high macroporosity due to the allophane materials. The maximum concentration of CDS was attained during the first rainfall event while the cumulated infiltrated volume of water was much less than the pore volume of the column soil. The peak concentration levels of CDS were almost constant during the first 5 rain events and they decreased during the subsequent rain events, probably due to degradation and/or ageing processes of CDS. The nitisol showed lower permeability reflected in the accumulation of water at the soil surface and in a delay in the beggining of percolation which lasted longer than in the andosol. The concentrations in percolated water constantly increased during each rainfall event and from one rainfall event to the other, without reaching a plateau at the end of the set of events. Single and dual-porosity modelling appraoches are compared for simulating the observed water flow and CDS sorption and transport in these two soils.

In conclusion, it seems that soon after application, due to rapid flush processes, the risk of water contamination is high on andosols, whereas it is lower on nitisol where the displacement is much slower. But on the long term, given a higher availability of sorbed CDS to leaching in nitisol, cumulated water pollution by CDS stemming from nitisol percolation will be much larger than that from andosols. The modelling of these results will help to more accurately determine the predicted environmental concentrations of pesticides in ground and surface waters.