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Transport of a nematicide in surface and ground waters in a farmed tropical catchment with volcanic substratum

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Assessment of water-pollution risks in agricultural regions requires studying pesticide transport processes in soil and water compartments at the catchment scale. In tropical regions, banana (Musa spp.) plantations are located in zones with abundant rainfalls and soils with high infiltration rates, which lead to washout and leaching of soil-applied pesticides, causing severe diffuse pollution of water resources. The aim of this paper is to determine how the nematicide cadusafos [S,S-di-sec-butyl O-ethyl phosphorodithioate], used in banana plantations, contaminates water and soils at the two scales of subcatchment and catchment. The study site was a small banana-growing catchment on the tropical volcanic island of Guadeloupe in the Caribbean (FWI). The catchment is located in pedoclimatic conditions where rainfall is abundant (> 4000 mm/year), and soil permeable (saturated hydraulic conductivity of Andosol Ks > 30 mm/h). Two campaigns of nematicide application were conducted, one in 2003 over 40% of the catchment and one in 2006 over 12%. For 100 days after application, we monitored the surface water and groundwater flows and the cadusafos concentrations in the soil and in surface and ground waters in a 2400 m^2 subcatchment and a 17.8 ha catchment. The results show that at the subcatchment scale the high retention in the A horizon of the soil limited the transport of cadusafos by runoff, whereas the lower retention of the molecule in the B horizon favoured percolation towards the shallow groundwater. The contamination levels of surface water, as well as shallow and deep groundwaters, reflected the geological structure of the Féfé catchment: i.e. a shallow aquifer in the most recent volcanic deposits that is rapidly exposed to pollution and a deeper aquifer that is relatively protected from the pollution coming from the treated fields. Comparing the losses of cadusafos at the subcatchment and at the catchment scales revealed that the nematicide re-infiltrated in the hydrographic network. Two successive phases of stream water contamination were observed, corresponding to two distinct contamination mechanisms: an event-dominated contamination phase (of less than 30 days) when transport was linked to overland flow during precipitation shortly after application, and a stabilized contamination phase when transport originated mainly from the drainage of the shallow aquifer. Lastly, comparing the losses of the two phases during 2003 and 2006 showed that shallow groundwater, which is promoted in such permeable soils under abundant tropical rainfalls, seems to be the main contributor to stream contamination.