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A Comparison of Pesticide Transport Processes in Three Contrasting Soils using HYDRUS-2D

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Water and pesticide flow reflect various transport processes in contrasting soils. The purpose of this study was to assess the transport of the herbicide bentazone in three contrasting tile-drained cultivated field soils subject to otherwise similar experimental conditions. Observed drain discharge rates and chemical concentrations in the drainage water reflected the different transport processes at the three sites in the same area of Northeastern France: a sandy loam site (Villey), a silt loam site (Bouzule-1) and a silty clay site (Bouzule-2). The sandy loam site showed very little tile drainage (240 m^3 ha^{-1}) during the 100 day study in the spring of 2002, as well as low chemical losses in the drainage water (0.16 % of the applied amount). While little drainage was observed also for the silty clay soil (175 m^3 ha^{-1}), observed pesticide losses were considerably larger (1.25 % of the applied amount). The silt loam soil by comparison showed much more drainage (521 m^3 ha^{-1}), and the highest chemical loads in the drainage water (2.7 % of the applied amount).

Numerical simulations of drain discharge with the HYDRUS-2D variably-saturated flow and solute transport model compared well with the observed data for the relatively homogeneous sandy loam (Villey) and the silt loam (Bouzule-1) soils. The saturated hydraulic conductivity of the bottom layer in both cases was key to correctly predicting the drainage fluxes. Accurate predictions of the silty clay field data (Bouzule-2) could be obtained only when the soil hydraulic functions were modified to account for preferential flow through drying cracks near the soil surface. Chemical concentrations could be better described using a dual-porosity (mobile-immobile water type) transport model for all three soils, including the sandy loam. Results indicate that water and pesticide transport in soils is governed by site-specific processes. Optimal use of the HYDRUS-2D flow/transport model allowed a reasonable description of the field-scale pesticide processes using only a limited number of adjustable parameters. Comparison between observed and simulated data empathize the main mechanisms for contrasting soils.