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Impact of varying micromorfology on water flow and solute transport

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The impact of varying soil micromorphology on soil hydraulic properties and consequently on water flow and herbicide transport is demonstrated on three soil types: Haplic Luvisol (parent material loess), Greyic Phaeozem (parent material loess) and Haplic Cambisol (parent material orthogneiss). Micromorphological properties characterizing soil porous structure were studied on soil thin sections prepared from the large soil aggregates. The micromorphological image of humic horizon of Haplic Luvisol shows higher order aggregates. The majority of detectable pores (diameter larger than 40 micrometers) corresponding to a matric potential range between -0.2 and -7 kPa are highly connected. Higher order peds with intrapedal small pores separated by interpedal lager pores represent possible zones of immobile water. The micromorphological image of humic horizon of Greyic Phaeozem shows the relatively homogeneous matrix structure with many pores less than 100 micrometers and a system of larger pores. Detectable larger pores (matric potential range between -0.2 and -7 kPa) are separated and affected additionally by clay coatings and infillings that control the water flow interaction and solute transport between the larger pores and pores of the matrix structure. Preferential flow through larger size capillary pores may appear in such pore system. Aggregates in humic horizon of Haplic Cambisol are purely developed. Pore system does not show intrapedal and interpedal pore system. Pores are developed along the gravel particles. The macropores (gravitational pores) create possible preferential pathways.

Soil hydraulic properties were studied in the laboratory. Soil water retention curves

were determined using the sand tank and pressure plate apparatus. The saturated hydraulic conductivities were measured using the constant head test. The multi-step outflow method was applied to estimate soil water retention curves and unsaturated hydraulic conductivity curves via numerical inversion. The points of the soil water retention curves were also obtained from water volume balance in the soil sample. The soil water properties reflect the pore-size distribution studied using the image analysis.

The transport of chlorotoluron in the soil profile was studied under field conditions in 2004. The herbicide Syncuran was applied on a four square meter plot using an application rate of 2.5 kg/ha of active ingredient. Soil samples were taken after 5, 13, 21 and 35 days to study the residual chlorotoluron distribution in the soil profile. The chlorotoluron mobility in the monitored soils increases as follows: Haplic Luvisol $<$ Haplic Cambisol $<$ Greyic Phaeozem. Mobility corresponds to soil porous system and atmospheric conditions. Chlorotoluron was regularly distributed in highly connected larger pore domain of Haplic Luvisol and then penetrated into the aggregates (zones of immobile water). The highest mobility in Greyic Phaeozem was caused by larger capillary pore pathways and sufficient rainfall filling up those large capillary pores. Chlorotoluron was less regularly distributed in Haplic Cambisol. Preferential flow slightly affected the herbicide transport. Large gravitational pores that may transport water under saturated conditions were not active during the monitored period. This hypothesis was proved by experiments that were performed during following years and described by numerical simulations using the single-porosity, dual-porosity and dual-permeability models in HYDRUS-1D (Simunek et al, 2005).

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