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Effect of root water uptake on water dynamics of soil with preferential pathways

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In agricultural lands has the soil moisture uptake by the root system a significant effect on the water regime of the soil profile. In texturally heavy soils, where preferential pathways are present, infiltrated precipitation and irrigation water with diluted fertilizers quickly penetrate to a significant depth and often reach an under-root zone or even the ground-water level. Such a scenario is likely to happen during long summer periods without rain followed by heavy precipitation events, when a part of the water may flow through desiccated cracks.

Since 2001 the effects of drip irrigation and nitrogen fertilization of potatoes (Solanum tuberosum L., cultivar Agria) have been monitored within the frame of a research project at the experimental site Valecov (Czech Republic). Based upon the measured data an attempt has been made to simulate the water regime of the soil, with respect to the impact of preferential flow. Previous simulations showed apparent sensitivity of simulated suction field on the shape of matrix domain sink term. Therefore time variable root zone and separated transpiration and evaporation from the surface were considered within the dual-permeability simulation model S_1D_Dual.

The soil hydraulic parameters, the root distribution function and the depth of root zone were inversely optimized using Levenberg-Marquardt method. All parameters were kept within observed boundaries. Measured and simulated pressure heads were utilized in the optimization criterion. The scaling approach was applied to simplify the description of the spatial variability of the soil profile.

The results of simulations demonstrate that during particular rainfall events the water reaches depths below the root zone via preferential pathways. The effect of the root zone is dominant during drier periods, when capillary water uptake from the layers below roots becomes important.

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