



Modelling root exploration of structured soils

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To overcome dry spells, plant roots can use macroscopic structures in the soil to reach deeper water reservoirs. We used R-SWMS, an explicit soil- and root water uptake model and integrated different kinds of macropores within the soil domain. Root growth is based on vector addition and influenced by the local soil parameters, e.g. penetrometer resistance or nutrient availability, around a growing root tip. Root water uptake from the macropore-bulk soil interface was simulated with respect to the contact area between roots and bulk soil. The macropore was assumed to be air-filled.

A sensitivity analysis with a small domain containing a single macropore showed the influence of macropore inclination, bulk soil density, and root growth parameterisation on root system architecture. A simulation setup with a larger soil domain and a macropore structure derived from a previously grown tap-root system, showed the influence on water uptake. We could compare the simulation results with previously described experimental data from a field study.

The simulations could show the feasibility of modelling root growth and water uptake in macroporous soil structures and could give an insight in the impact on the plant water status. Furthermore we were able to show the conditions under which root growth in macropores is useful for plants. As biopores are often coated with nutrient rich material, this modelling approach can also be useful to investigate the benefits of macropores for plant nutrient uptake.