

## COMPARING FOUR DIFFERENT MODELING APPROACHES FOR PREDICTING ROOT WATER UPTAKE

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**Summary.** Numerous approaches exist to model soil water extraction by plant roots. They mainly differ in terms of dimensionality (from 1-D to 3-D) and in the degree of detail involved in the geometry and hydraulic behavior of roots. One-dimensional models consider 1-D root length density profiles and assume uniform horizontal soil water distribution and are computationally very efficient. On the opposite, very detailed 3-D approaches, which consider explicitly the root architecture and the root water flow, may need more computation power and time. In between these two extreme cases, other approaches exist, which may be equally accurate and less computationally demanding. Our objective is to compare different modeling approaches and check how their implicit or explicit simplifications or assumptions affect the root water uptake (RWU) predictions.

Four models were subject to our comparison, all based on Richards equation. The first is a 1-D model solving Richards equation (SWAP) with the well known Feddes et al. (1978) approach for RWU. The second one is also based on SWAP but with the root water uptake defined by a microscopic approach developed by de Jong van Lier et al. (2008). The third one, FUSSIM, solves the Richards equation in 2-D based on a 2-D root length density (RLD) distribution and with RWU described by a steady-rate model. The fourth one is R-SWMS, a 3-D model simulating the water flow in the soil and in the roots, based on the complete root architecture description.

A 45-day Maize root was generated in 3-D and simplified in a 2-D or 1-D RLD distribution. Three soil types and three different boundary conditions for soil and roots were defined and subject to our four models. Clear differences appear between models demonstrating the importance of the implicit assumptions of the uptake mechanisms and the effect of water content 2/3-D spatial variability on the RWU predictions.