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"Concordia res parvae crescunt" or how different approaches can be combined to decrypt root water uptake

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In this study, we developed a new operation pipe showing that the combined use of computer models and in vivo experiments allows one a better analysis of the water fluxes in the soil-plant system and can help researchers to decrypt the root water uptake dynamics.

From an experimental point of view, we monitored in 2D the evolution of soil water content around roots of transpiring maize plants using a light transmission imaging (LTI) technique on a rhizotron. Subsequently, we digitized the entire root system in order to create an input file for the model RSWMS (HYDRUS-like model for soil-plant water transfers).

In the other hand, we performed a global sensitivity analysis of the modeled experiment to highlight the plant parameters that can be measured thanks to such a procedure. Then fitting the simulated changes of distributed Sink term in Richards equation to experimental data enabled us to depict the local radial and axial conductivities.

The use of the RSWMS model in association with experimental data gave us an insight on the water potential distribution in the plant and fluxes by and through individual segments during the entire duration of the experiment.

Finally, this analysis can be optimized by changing the timing and/or types of measurements included in the protocol in order to maximize the information content of the experiment. A validation of the results can also take place: the optimized conductivities of the root segments are indeed sensitive to a global conductance measurement and to other root water uptake experiments. In the future, this experimental set-up will enable us to compare genotypes hydraulic architectures in order to answer questions such as: which genotype is the best adapted to avoid a drought stress occurring at a certain time in a given environment?