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What limits deep water uptake by deep-rooted crops?

Camilla Rasmussen[1], Eva Rosenqvist[2], Fulai Liu[2], Dorte Bodin Dresbøll[2], Kristian Thorup-Kristensen[2], and Mathieu Javaux[1,3]

[1]Earth and Life Institute, Environmental Sciences, Louvain-la-Neuve, Belgium
[2]Department of Plant and Environmental Sciences, University of Copenhagen, Denmark
[3]Institute of Bio- and Geosciences, Forschungszentrum Jülich, Jülich, Germany

Minimizing water limitation during growth of agricultural crops is crucial to unlocking full yield potentials. Crop yield losses vary according to timing and severity of water limitations, but even short-term droughts can be a major cause of yield losses. While the potential influence of deep roots on water uptake has been highlighted numerous times, the actual contribution of deep roots to water uptake is yet to be revealed. The objective of this study is to get an understanding of what limits deep water uptake by deep-rooted crops under topsoil water limitations.

We found that deep-rooted crops experience water limitations despite access to water stored in the deep soil and we hypothesize that deep water uptake by deep-rooted crops is limited by 1) the hydraulic conductivity of the deeper part of the root zone, arising from limited root length density in combination with the hydraulic resistance of the roots or 2) by a hormonal response arising from the plant sensing dry conditions in the shallow soil leading to stomata closure, to conserve water. The two hypotheses can of course not be valid simultaneously, but both might be valid under certain conditions, at certain times or for certain species.

In a large-scale semi-field setup, we grow oil seed rape and by combining measures of root development, root hydraulic conductivity, transpiration, stomatal conductance, ABA concentrations and soil water content from a large scale semi-field setup with a mechanistic 3-D root-soil modelling approach (R-SWMS), we are able to us distinguish various scenarios and to evaluate what limits deep water uptake.