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Rhizosphere Liquid Architecture

Pascal Benard[1], Patrick Duddek[2], Florian Stoll[2], Laura Waldner[2], Norbert Kirchgessner[3], Goran Lovric[4], and Andrea Carminati[2]

[1]Swedish University of Agricultural Sciences (SLU), Faculty of Natural Resources and Agricultural Sciences, Uppsala, Sweden (pascal.benard@slu.se)

[2]Federal Institute of Technology (ETH), Physics of Soils and Terrestrial Ecosystems, Zurich, Switzerland

[3]Federal Institute of Technology (ETH), Crop Science, Zurich, Switzerland

[4]Swiss Light Source, Paul Scherrer Institute, Villigen, Switzerland

In the rhizosphere, all transport processes considered fundamental in regulating resource availability and accessibility for plants and microorganisms are controlled by water retention and its temporal dynamics in the soil pore space, the rhizosphere liquid architecture (RLA). As the soil dries, root water and nutrient uptake becomes increasingly limited as the cross-sectional area and connectivity of the pore water declines. At the same time, diffusive transport ceases, negatively affecting root exudate transport and limiting microbial activity as enzyme diffusion and activity drop. The extent to which soil structural and biological processes influence local water retention and, in turn, related transport processes in the rhizosphere remains a challenging task. This study aimed to elucidate the effect of root growth and extracellular polymeric substances (EPS) on soil water retention in the rhizosphere of maize. High-resolution X-ray tomography was used to capture gradients in water distribution as a function of rhizosphere age and distance from the root surface. This combination of techniques allows distinguishing between soil structure versus primarily biologically induced modification. This study is a step toward a better understanding of the feedbacks between plants, microorganisms, and soil in controlling rhizosphere transport properties in this complex process aimed at optimizing resource availability and acquisition.