



## **Impact of pore-scale wettability on rhizosphere rewetting**

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Vast amounts of water flow through a thin layer of soil around the roots, the rhizosphere, where high microbial activity takes place – an important hydrological and biological hotspot. The rhizosphere was shown to turn water repellent upon drying, which has been interpreted as the effect of mucilage secreted by roots and/or microbial exudates. The effects of such rhizosphere water dynamics on plant and microbial activity are unclear. Furthermore, our understanding of the biophysical mechanisms controlling the rhizosphere water repellency remains largely speculative. Our hypothesis is that the key to describe the emergence of water repellency lies within the microscopic distribution of wettability on the pore-scale. At a critical mucilage content, a sufficient fraction of pores is blocked and the rhizosphere turns water repellent.

Here a percolation approach is introduced to predict the flow behavior near the critical mucilage content. The wettability of glass beads and sand mixed with chia seed mucilage was quantified by measuring the infiltration rate of water drops. Drop infiltration was simulated using a simple pore-network model in which mucilage was distributed heterogeneously in the pores.

The model matched well the measured infiltration rates and captured the high variability in infiltration rates near the percolation threshold, when the samples switched from wettable to water repellent. Our study highlights the importance of pore-scale distribution of mucilage (and other biofilms) in the emergent flow behavior across the rhizosphere.