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Variable effects of mucilage on root water uptake

Andrea Carminati and Mohsen Zarebanadkouki
Georg-August University Goettingen, Soil Hydrology, Germany (acarmin@gwdg.de)

Plants are big water movers. Without an adequate supply of water from the soil, water transpired from leaves cannot be compensated by root water uptake. Such a water shortage is a worldwide constraint to yield and food production. By exuding mucilage, roots keep the soil in their vicinity, the rhizosphere, wet and take up water more easily. However, mucilage turns hydrophobic after drying and it hinders the rewetting of the rhizosphere upon irrigation.
Here we show that the temporarily water repellency of the rhizosphere decreases root water uptake after irrigation. We used neutron radiography to trace the transport of deuterated water in soil and roots of transpiring plants. We let one soil region dry for 2 days. Then, we irrigated it. We found that root water uptake in this location did not recover after irrigation. We conclude that, after drying, the rhizosphere became a significant resistance to water flow to roots.
Mucilage has therefore dual effects on plant water relations: freshly exuded mucilage facilitates root water uptake until it dries out and it becomes a barrier to water flow. The profits of exuding mucilage depend on root traits and environmental conditions. In soils with water stored in deep regions, plants would benefit from fresh mucilage covering the deep roots segments, while dry mucilage would isolate the roots from the dry upper soil layers.
Understanding the relations between mucilage, root traits and environmental conditions will help to increase water use efficiency and yield production in arid areas.