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Mucilage delays drying during soil evaporation

Mohsen Zarebanadkouki, Mutez Ahmed, Pascal Bernard, and Andrea Carminati
Chair of Soil Physics, University of Bayreuth, Germany (mzareba@gwdg.de)

Plants and microorganisms exude substances that change the physical and chemical properties of their surrounding soil. The function of these exudates in the context of the availability of resources such as water and nutrients has been discussed in several studies. However, their effect on flow and transport properties remain unclear due to the difficulty of measuring fluxes at the required scale. In this study we investigated the impact of chia mucilage on the soil hydraulic conductivity. Soils of different texture were treated with varying mucilage contents (g of mucilage per g of soil). An evaporation experiment was conducted using Hyprop technique where the water flow was estimated from the change in weight and the soil matric potential was monitored at two different locations using micro tensiometers.
The results showed that mucilage reduced the evaporation losses from the soil. This effect becomes more pronounced with increasing mucilage content. As expected, the evaporation rates reduced as the soil dried (in all treatments with and without mucilage) and the magnitude of this drop in evaporation during drying was much smaller in soils mixed with mucilage. The measured profiles of soil water potential and soil water content were numerical simulated by solving Richards equation and inversely adjusting the hydraulic properties of soil. The motivation was to estimate the effect of mucilage on the unsaturated hydraulic conductivity. Mucilage reduced the hydraulic conductivity of coarse textured soil at any matric potential. In fine textured soil, mucilage decreased the hydraulic conductivity in wet conditions, but it maintained it higher compared to mucilage-free soil at more negative matric potentials.
This finding could be generalized to other biofilms in soils, such as EPS, although mucilage from different plant species showed a certain degree of variability. A region with a hydraulic conductivity that remains relatively high during drying is functional to mitigate drying stress in the surrounding of plant roots and microorganisms. In particular, presence of mucilage in the rhizosphere maintains the connectivity of the liquid phase sustaining the exchange of resources within soil, roots and microorganisms.