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Wurzel-Boden-Wechselwirkung und physikalische Prozesse in der Rhizosphäre

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Titel
Coupled model of root water uptake, mucilage exudation and degradation

Abstract
Although the prominent role of root mucilage plays a prominent in soil-plant water relations is becoming more and more accepted, many aspects of how mucilage distribution and root water uptake interact with each other remain unexplored. The aims of this study were: i) to measure the effect of soil moisture on mucilage decomposition; ii) to develop a coupled model of root water uptake and mucilage diffusion and degradation during root growth. Mucilage decomposition was measured by adding C4 root mucilage from maize as single pulses to a C3 soil at two different moisture levels. Drought significantly suppressed mucilage mineralization. Opposed to classical solute transport models the water flow in the rhizosphere is affected by the local concentration of mucilage. The model accounts for an increased equilibrium water retention curve, a reduction of hydraulic conductivity at a given water content and a non-equilibrium water retention curve caused by swelling and shrinking dynamics of mucilage. The dispersion coefficient, on the other hand, depends on the water content. The parameters of mucilage diffusion have been fitted to observations on real plants. The model shows that mucilage exuded in wet soils diffuses far from the roots and it is rapidly degraded. On the contrary, mucilage of plants growing in dry soil is not easily degradable and it remains at higher concentrations in a narrow region around the roots, resulting in a marked increase in water content towards the roots as well as to the formation of stable rhizosheath observed in dry soils. This model shows how feedbacks between root water uptake and root exudation could result in adaptation mechanisms of plants to drought.