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Wurzel-Boden-Wechselwirkung und physikalische Prozesse in der Rhizosphäre

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Titel
Measurement of the spatial distribution of mucilage around roots using infrared spectroscopy

Abstract
Mucilage is a mixture of polysaccharides and some lipids which is secreted by the root tip. It facilitates plant nutrient acquisition, stabilizes aggregates, reduces lubrication during plant growth and may increase rhizosphere water content due to its high water holding capacity. So far there is no method to measure the spatial distribution of mucilage in soil around roots. The aim of this study was to test whether infrared spectroscopy can be applied to quantify gradients of mucilage around roots in soil. The C-H to C-O ratio obtained from infrared spectroscopy measurements is an indicator of soil hydrophobicity. As Mucilage turns hydrophobic after drying we hypothesized that mucilage can be detected by the C-H to C-O ratio measured with infrared spectroscopy. We grew maize plants in rhizoboxes filled with quartz silt. Before measurement the planted containers were dried and the roots were removed from soil. Infrared spectroscopy measurements were conducted with a spatial resolution of 50x50 µm a) radially with increasing distance from the root channel center and b) axially with increasing distance from the root channel tip. In parallel, the contact angle, which also indicates soil hydrophobicity, was quantified in the same locations. Both measurements were additionally conducted on glass slides covered with quartz silt mixed with given concentrations of mucilage. The measurements on the glass slides revealed that the C-H to C-O ratio and the contact angle measurements correlated well with the mucilage concentration in soil. Similarly, the infrared spectroscopy measurements in in the rhizoboxes revealed that radial profiles of mucilage around roots can be quantified: while the C-H to C-O ratio was highest inside the root channels, it decreased to the bulk soil values 0.7 mm in radial direction from the border of the root channel. In axial direction the C-H to C-O ratio did not change significantly, indicating that those compounds causing hydrophobicity of mucilage are not easily degraded by soil microorganisms. We showed that infrared spectroscopy can be applied to measure profiles of mucilage around roots in soil. The radial profiles of mucilage were narrower than those reported for other rhizodeposits which may be explained by the viscosity of mucilage.