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Autoren
M. Brax[1], C. Buchmann[1], G. E. Schaumann[1]
[1]Institute for Environmental Sciences, Soil and Environmental Chemistry Group, Landau in der Pfalz

Titel
Untangle soil-water-mucilage interactions with ^{1}H NMR Relaxometry

Abstract
Mucilage is produced mainly at the root tips and has a high water holding capacity originating from highly hydrophilic gel-forming substances. The objective of the MUCILAGE project is to understand the mechanistic role of mucilage for the regulation of water supply for plants. Our subproject investigates the chemical and physical properties of mucilage as pure gel and in soil.

^{1}H-NMR Relaxometry and PFG-NMR represent non-intrusive powerful methods for quantification of the water distribution and for monitoring of the water mobility in soil pores and gel phases. NMR relaxation of the protons in gel water differs from the one in pure water due to additional interactions with the gel matrix. Mucilage in soil leads to a hierarchical pore structure, consisting of the polymeric biohydrogel network surrounded by the surface of soil particles. The objective of our study is to distinguish in situ water in gel from pore water in a simplified soil system, and to determine quantitatively how the "gel effect" affects relaxation rate and water self-diffusion coefficient in porous systems.

For this, we measured the variations of the water mobility in pure chia mucilage under different conditions by using ^{1}H-NMR relaxometry and PFG-NMR. Using model soils, the signals coming from pore water and gel water were distinguished from each other. For this, we fitted the parameters of the equations describing ^{1}H-NMR relaxation in porous systems with our experimental results, in order to describe how the presence of gel in soil affects ^{1}H-NMR relaxation. Out of this knowledge, we proposed a method, which detects in situ the presence of mucilage in soil and characterizes several gel-specific parameters of the mucilage.

Finally, we discussed the potential and limitations of ^{1}H-NMR relaxometry for following natural swelling and shrinking processes of a natural biopolymer in soil.