Thesis topic description

Does mucilage impact on plant available water?

Background:

Over the past few decades, multiple studies have advanced our comprehension of how plants alter the soil they inhabit. As a root grows, it displaces soil particles, thereby changing the soil structure in the rhizosphere. Throughout its lifespan, a root releases substances into the soil that modify the characteristics of its rhizosphere, impacting vital functions like nutrient and water cycling, carbon storage, gas transport, and temperature response. These functions are crucial for the subsequent growth of plants in that particular soil.

Problem and working hypotheses:

Examining the mechanisms through which plants modify the physical attributes of the rhizosphere via root mucilage, the concept of soil amendments using biological compounds such as polygalacturonic acid (PGA), exudates from maize roots, chia seeds, and others, to mimic the rhizosphere, has been embraced by numerous researchers including Ahmed et al., 2016; Benard et al., 2019; Brax et al., 2017; Carminati & Vetterlein, 2013; Kroener et al., 2014. However, our understanding of how water content and mucilage concentration interact in relation to changes in plant available water remains limited.
Here, we posit that amendment with chia seed mucilage leads to a higher plant available water. To test this hypothesis, a set of soil samples will be measured with increasing concentrations of mucilage in three substrates.

Methods:

The substrates (sand, loam, and clay) will be gathered from the University's Reinshof experimental site at a depth of 10 cm, excluding the organic layer. Each substrate will undergo an amendment process involving the addition of 0, 0.02, 0.2, and 2 g of dry mucilage per kg of dry soil. The soil water retention curve (SWRC) and the permanent wilting point will be determined using the HYPROP and WP4 apparatus. The optimal fit for the SWRC will be achieved through the van Genuchten-Maulem model, and the resulting fitted parameters will be utilized to estimate the plant's available water.

Requirements for candidates:

The topic requires an interest in working with data so a certain basic knowledge of data handling with programs like R or MATLAB is required. For the experimental part, careful and precise operations in the laboratory are required to ensure reliable measurements, which can be learned during the thesis.
The technical support, handling of the sensors, etc. is guaranteed, fun in independent technical work, and in the handling of measuring instruments are important. Careful experimental work in the laboratory is important. The starting date is flexible.

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Ahmed, M. A. et al., 2016. https://doi.org/10.1007/s11104-015-2749-1
Brax, M. et al., 2017. https://doi.org/10.1002/jpln.201600453
Benard, P. et al., 2019. https://doi.org/10.2136/vzj2018.12.0211
Carminati, A. et al., 2013. https://doi.org/10.1093/aob/mcs262
Kroener, E. et al., 2014. https://doi.org/10.1002/2013WR014756