**Knock-knock who is there – what are the dark secrets of the rhizosphere**

A key aspect of plant root physiology is that plant roots exude carbon. This exudation stimulates microbial growth around the roots, creating what is called the rhizosphere. The microbial activity in the rhizosphere influences the amount and composition of nitrogen available for uptake to the plant roots. The amount of nitrogen can be increased by microbial decomposition of organic matter (facilitation) or decrease due to microbial uptake (competition). With current knowledge it is uncertain under what circumstances availability of nitrogen is increased and decreased respectively. Since increased root exudation of carbon is expected when atmospheric $CO_2$ rises, there is an urge to reveal these uncertainties. As atmospheric $CO_2$ rises, future forest tree growth and capacity to bind carbon, will depend on the availability of nitrogen in the rhizosphere.

The scale of these events occurs, in the root-soil interface, within millimeters around the roots. Previously available methods have lacked the precision to probe phenomena specifically at this interface, measurements of compounds in bulk soil provides little information of processes, substances and microbes at the root-soil interface. My group, and collaborators, have discovered that microdialysis, a technique originally developed in neuroscience and recently adapted for monitoring nitrogen fluxes in soil, provides new opportunities to study this interface – how microbes affect plant nitrogen availability. Our studies show that microdialysis can simulate root exudation through a semi-permeable membrane with a plant fine root-like size (diameter 0.5 mm) creating a ‘probosphere’.

The aim of my research is to unravel how root exudates affect the availability of nitrogen to plant roots. More specifically the focus is to answer the questions if and how forests’ capacities to bind carbon will be limited by the availability of nitrogen. And in extension if it is achievable, in a sustainable way, to increase forests’ carbon binding capacity by fertilization with nitrogen. In my lecture, I will present what my group have learnt about carbon-nitrogen interactions in the ‘probosphere’ and how we identify the involved microbes. I will also explain our hypothesis on what role microbes play in the availability of nitrogen to plant roots from a long-term perspective and how the availability is related to different developmental stages of the plant roots, and in turn how this may buffer nitrogen leaching to surrounding environments. The future aim with the research in my group is to disentangle the underlying mechanisms to the carbon-nitrogen interactions between the plant and the microbes in the rhizosphere, such mechanisms include the gene expressions in microbes and enzyme activity in both microbes and soil. By connecting the availability of plant nitrogen to microbial gene expression, our goal is to understand what root characteristics are causing certain responses in microbes, such characteristics might be the composition and amount of root exudate as well as the carbon to nitrogen ratio. This research will contribute to sustainable forest management. A modern practice based on a deeper knowledge of the root-soil interface, of how microbial mechanisms interact in the carbon/nitrogen dynamics, and hence how forest nitrogen acquisition is key to forest production.