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Author(s):

Jäger, Astrid ; Hartmann, Martin ; Hagedorn, Frank; Six, Johan; Solly, Emily

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Investigating the drought-prone biological interplay of soil microbial communities and Scots pine trees

Astrid Jäger¹, Martin Hartmann¹, Frank Hagedorn², Johan Six¹, and Emily Solly¹

¹ETH Zurich, Department of Environmental Systems Science, Sustainable Agroecosystems Group, Universitätsstrasse 2, 8092 Zurich, Switzerland

²Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Biogeochemistry Group, Zürcherstrasse 111, 8903 Birmensdorf, Switzerland

In forest ecosystems, microorganisms hold key functions as nutrient cyclers, decomposers, plant symbionts or pathogens and thereby regulate biogeochemical processes and forest health. These microbial dynamics are controlled by water availability in three fundamental ways: as resource, as solvent, and as transport medium. For one of the dominant tree species in Swiss forests - Scots pine (*Pinus sylvestris* L.) - high mortality rates have been observed in recent decades. In the Rhone valley of Switzerland, forest dieback appears to be primarily caused by direct effects of drought and an increasing susceptibility of trees to further constraints, such as pathogen attacks. Nonetheless, water limitation does not affect soil microbes and trees separately but rather induces a series of interconnected effects between trees and the associated soil microbiome, which could strongly alter carbon and nutrient cycling in forests. We conduct a study to investigate the effects of drought on the biological interplay between Scots pine trees and soil microbial communities. We aim to estimate how shifts in microbial community composition and functional capacity under drought may affect nutrient cycling and tree vitality potentially contributing to tree mortality. In order to understand these mechanisms, we perform greenhouse experiments with tree-soil mesocosms under controlled conditions. State-of-the art molecular methods such as metabarcoding of ribosomal markers, shotgun metagenome sequencing, and qPCR of key functional genes are used to unravel alterations in the soil microbiome and in the underlying functional metabolic potential related to drought and associated tree-mortality. Furthermore, to elucidate the impact of drought on microbial carbon dynamics, stable isotope labelling techniques have been applied to trace ¹³C labeled plant photosynthates into the soil microbial communities by analyzing ¹³C signatures of phospholipid fatty acids. Investigation of soil physicochemical properties and tree-vitality is done in parallel with the microbial assessments to understand the feedbacks on nutrient-cycling and the soil-tree continuum. The overarching aim of this study is to gain new insights into the complex relationships between soil, trees and microbes under drought.