Plant Carbohydrate Depletion, Mycorrhizal Networks and Vulnerability to Drought: Experimental Tests in the Field

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BER Program: ESS
Project: University Project
Project Website: N/A

Warming and drought associated with climate change are causing an increase in forest drought-induced mortality (DIM) around the world, which will have profound consequences from local to global scales. Predicting when, where and which trees will die of drought remains a challenge, in part, because the processes leading to DIM and their interactions are not fully understood. Empirical and modelling evidence indicate that most DIM occurs due to the interaction between impaired plant hydraulics and depletion of stored non-structural carbohydrates (NSC) under drought, but the mechanistic nature of this interaction is uncertain. Our prior work in the greenhouse showed that NSC storage depletion impairs plant water relations and that NSC depletion can spread through ectomycorrhizal networks. These results provide the opportunity to mechanistically quantify and model the interaction between NSC storage and plant hydraulics, and to incorporate symbiotic agents into DIM models via their effects on NSC storage and plant water relations. This project seeks to test in the field: 1) the mechanistic link between plant hydraulics and NSC storage, and 2) the potential for belowground fungal networks to affect this link and to influence forest vulnerability to drought. To this end, we are setting up a field experiment in *Pinus ponderosa* saplings, where we will manipulate carbon supply to the ectomycorrhizal network (EMN), water availability, and sapling connections to the EMN. During the fall of 2022 we set up 30 plots with three saplings each (**M**anipulated, to decrease carbon supply to the network; **R**esponse, to measure physiological responses; and **T**renched, to sever mycorrhizal connections and serve as a control). The perimeter of each plot has been trenched, and we covered half of the plots to minimize snow infiltration (drought treatment). We sampled soil around each sapling to identify common mycorrhizal species. Rain shelters will be installed later this month, and sapling manipulations and measurements will begin this spring. Our research addresses two challenges for modelling forest responses to drought: how to quantify and model the interdependency between plant hydraulics and carbohydrate availability, and how to incorporate interactions with belowground symbiotic organisms.