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Editorial: Impact of Aboveground Disturbances on Rhizosphere Processes

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Editorial on the Research Topic

Impact of Aboveground Disturbances on Rhizosphere Processes

Forests are subject to a variety of disturbances. While ecosystems are adapted to natural ones, current climate models predict greater frequency and intensity of disturbances, such as insect outbreak, fire, storm, and severe drought, habitat fragmentation and trees dying. Changes aboveground may dramatically influence productivity and ecosystem carbon stability. The supply of carbohydrates to the roots and the exchange of resources with mycorrhizal fungi can be severely disrupted by what happens to the aboveground parts, affecting the characteristics of mycorrhizal fungal communities. The preponderance of work to date has focused primarily on the evolution, physiology, and identification of fungal-plant partners. Mycorrhizal fungi provide a link between plant and soil and mediate feedbacks in the terrestrial carbon cycle. Since both roots and mycorrhizal fungi are strongly interacting with the free-living soil microbial communities that are largely involved in soil organic matter decomposition (e.g., priming effect, Gadgil effect), the functional response of root and mycorrhizal fungi to aboveground disturbance are then keys to predict impacts of aboveground disturbances on the soil carbon and nutrient dynamics of global forest ecosystems.

There are two major pathways that aboveground disturbances may impact the belowground roots and mycorrhizal fungi: (1) changes in edaphic conditions under the disturbed tree canopies (abiotic pathway); (2) reduced carbon allocation to belowground organs when aboveground carbon assimilations are disturbed (biotic pathway). The response of belowground processes to aboveground disturbance may vary across forest types as trees are adapted to different local environments and differ largely in their strategies of resource allocation and resource acquisition. Furthermore, arbuscular mycorrhizal and ectomycorrhizal fungi, the two main types of mycorrhizal fungi in forest ecosystems, are distinct in their reliance on host carbon supply and their interactions with soil free-living microbes. Understanding how forest tree species composition, species-specific allocation strategies, root functional traits, mycorrhizal types, and soil environmental conditions mediate the impacts of various aboveground disturbances is critical for scaling up the hidden belowground responses of local forests to landscape or global scales.

The four present studies in the Research Topic advance our understanding of how impacts of aboveground disturbance contribute to ecosystem function through mycorrhizal fungi. A paper by Churchland et al. describes a study that sought to determine the ability of variable retention harvesting systems to maintain the structure and function of the pre-harvest

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soil microbiome. Simard et al. investigated how logging intensity, with different levels of tree retention, affected seedlings, biodiversity, mycorrhizal inoculum potential, and aboveground and belowground C resources in a deep Douglas-fir forest. The effect of fragmentation on soil abiotic properties and ectomycorrhizal (ECM) and arbuscular fungal (AMF) communities in association with the consequence of subterranean alterations on disease occurrence was studied by Sapsford et al. in an important species, *Corymbia calophylla*, found in southwestern Western Australia. The study by Mrak et al. examines the influence of drought and wildfire on the community composition and hyphal exploration types of ECM fungi associated with *Quercus pubescens* in a Sub-Mediterranean Stress-Prone Environment. Forests around the world are under threat by changes in climate, the introduction and spread of pathogens and pests, and increases in deforestation and habitat fragmentation. The studies in our Research Topic provide evidence of how disturbance from global change and management can contribute to carbon flow and belowground fungi and enhance our understanding of ecosystem processes.

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