Ectomycorrhizal fungal community response to disturbance and host phenology

Stefan F. Hupperts

Abstract

The relationship between trees and ectomycorrhizal fungi is fundamental for tree growth and survival, particularly in the boreal forests of North America where low temperatures inhibit decomposition and consequently limit nutrient availability. The responses of ectomycorrhizal fungal communities to large-scale disturbances and host phenology are not well known, but are important for restoring and predicting carbon and nutrient cycling. To that end, I investigated the ectomycorrhizal fungal community present on roots of outplanted seedlings in sites that captured a gradient of above and belowground disturbances. Additionally, I monitored the extracellular enzyme secretions of ectomycorrhizal fungi during four phenological stages (host dormancy, leaf flush, full leaf expansion, leaf abscission) of mature *Populus tremuloides* stands to assess the potential decomposing activity of ectomycorrhizal fungi in relation to changes in tree physiology. Contrary to my prediction, there was no difference in ectomycorrhizal fungal community composition across sites that differed in extent of above and belowground disturbances; composition was instead primarily affected by the species of seedling used to assay the soils. Further, I found relatively constant levels of enzyme secretions by ectomycorrhizas across phenological stages irrespective of the amount of carbon stored in roots, suggesting the enzymes I measured may be secreted to acquire nitrogen or phosphorus locked within organic matter. Additionally, potential enzyme activity was better predicted by the foraging strategy of ectomycorrhizal fungi, highlighting the functional roles of species. These findings emphasize the importance of planting a diverse community of trees in reclaimed soils to yield a diverse community of belowground fungi. Moreover, differences in potential enzyme activity of exploration types throughout phenological stages point to unique functional roles among fungi, which may change seasonally. Consequently, this research stresses the importance of restoring functional diversity in reconstructed ecosystems.