

Tree functional diversity regulates the diversity of soil fungal guilds in cool temperate montane forests

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Purpose: Soil fungal communities exhibit guild structures, composed primarily of plant saprotrophs, ectomycorrhizal fungi, arbuscular mycorrhizal fungi, and plant pathogens, which are related to forest ecosystem functioning. Although the evidence is mounting that plant diversity can promote soil fungal diversity, there is a lack of knowledge about how forest plant diversity affects fungal guild diversity. Here, we examine how climate conditions, soil properties, and plant diversity affect the diversity of soil fungal taxa and guilds in cool temperate forests.

Methods: Fungal communities were investigated in 60 survey plots across elevational gradients in the University of Tokyo Chichibu Forest in central Japan. Structural equation modeling (SEM) was used to consider the causal relationships between environmental factors (i.e., climate conditions, soil properties, and plant diversity) and soil fungal diversity.

Results: The observed diversity of fungal guilds was positively correlated with tree functional diversity and the taxonomic richness of saprophytic fungi. The SEM showed that the diversity of soil fungal taxa and guilds was mainly affected by both the direct effects of soil properties and the indirect effects of climate conditions. However, in the SEM, the significant path between tree functional diversity and fungal guild diversity improved the model fit and the coefficient of determination for fungal guild diversity.

Conclusions: Our study found a vital effect of tree functional diversity on the diversity of soil fungal guilds. These results imply that an increase in the variety of plant litter might facilitate the diversity of saprotrophic fungi, which shape guild structures of soil fungi in cool temperate forests.