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Contribution of saprotrophic and ectomycorrhizal fungi to organic P mobilization in forest soils

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In the last decades, tree nutrition in European forest ecosystems deteriorated and phosphorus (P) concentrations in tree leaves decreased. To investigate the contribution of saprotrophic (SAP) and ectomycorrhizal (EMF) fungi to P mobilization and a possible antagonistic effect between both fungal guilds, we carried out a soil tube experiment at five beech (Fagus sylvatica L.) forests in Germany. For this, 4 sets of ingrowth tubes (IGTs) were placed into the topsoil at 2.5 m distance around 5 beech trees, which were disruptively removed after 3, 6, 14 and 18 months with one control sample (undisturbed soil) (n = 300). One IGT set consisted of an open core with a micromesh window (50 μm) and a closed core without a window. The micromesh windows of the open IGTs allowed EMF to grow into the tubes, while the re-growth of EMF hyphae into the closed ITGs was inhibited. Illumina sequencing revealed a reduced relative abundance of EMF in closed tubes after 18 months of exposure mainly due to the loss of Russula and Craterellus species. In contrast, we observed a higher presence of SAP (mainly Mortierella and Solicocozyma) in closed compared to open IGTs. Thus, we found a competitive relationship between EMF and SAP fungi. The reduction of EMF in closed tubes was mirrored in diminished fungal phospholipid fatty acid (PLFA) content and phosphodiesterase activities (PDA). However, there were no significant differences in acid phosphomonoesterase activity (PMA), plant-available P (Presin) and microbial P content (Pmic) between treatments. Since phosphomonoesterases cleave P from monoester forms, such as phospholipids or nucleotides, and phosphodiesterases release P from compounds like nucleic acids, we suggest that the experimental shift in fungal community composition modified the balance between the decomposition of different organic P substrates (mono- and di-esters). Shifts in fungal community composition between treatments at a steady PMA gives indication for functional redundancy of P cycling fungi in forest ecosystems.