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Mycorrhizal and saprotrophic fungi enhance photoassimilate allocation but affect photoassimilate distribution differently visualized by 14C phosphor imaging

Heng Gui (1,2), Jie Zhou (2), Bin Song (3), Lingling Shi (2,4), and Johanna Pausch (5)

(1) World Agroforestry Centre, Kunming, China (guiheng@mail.kib.ac.cn), (2) Biogeochemistry of Agroecosystems, Department of Crop science, Georg August University of Göttingen, 37077 Göttingen, Germany(jzhou@gwdg.de), (3) Insititute of Forest Botany and Tree Physiology, Georg August University of Göttingen, 37077 Göttingen, Germany(bsong@gwdg.de), (4) Key Laboratory for Plant Diversity and Biogeography of East Asia, Kunming Institute of Botany, Chinese Academy of Sciences, Heiongtan, 650201, Kunming, Yunnan, China(shi.ling-ling@forst.uni-goettingen.de), (5) Department of Agroecology, University of Bayreuth, 94045 Bayreuth, Germany(Johanna.Pausch@uni-bayreuth.de)

Translocation of recently photoassimilate plant carbon (C) into soil via root exudates or mycorrhizal fungi is important to understand global carbon cycling. However, it is unclear that how saprotrophic fungi or its interaction with mycorrhizal fungi will affect these process. To address this question we inoculated Picea abies with ectomycorrhizal fungi (ECM), or saprotrophic fungi (SAP), or a mixture of both (ECM- SAP) using rhizobox systems. Based on 14C labelling and phosphor imaging, we visualized the allocation of photoassimilate into roots, and estimated the spatial distribution of hotspots at the root tips. The spatial distribution of assimilate allocation was evaluated based on the 14C specific activity expressed as photostimulated luminescence (PSL) of imaging plates. Areas with high relative 14C activity were classified as hotspots. Besides, the 14C distributions in microbial biomass carbon pool and dissoluble organic pools were also quantified. The result indicated that root biomass in ECM fungi-inoculated plants were 50% lower than that in non-inoculated plants (control plant), while roots of saprotrophic fungi inoculated plants showed the same root biomass as that in non-inoculated plants. Both mycorrhizal or saprotrophic fungi inoculation show 1.7-7.5 times greater carbon allocation to the root system compare to control plant. The amounts of 14C-labeled C in the microbial biomass carbon (14C-MBC) were 40% higher in ECM plants than in control plants, whereas SAP inoculation did not change 14C-MBC. Dual inoculation with mycorrhizal and saprotrophic fungi in ECM- SAP plant reduce 14C-MBC by 28% compared with ECM inoculated plants. SAP inoculated plants have the highest 14C-labeled C in the dissolved carbon (14C-DOC), which was 50% higher than in control plants. Compare to ECM inoculated plants, dual inoculation with saprotrophic fungi indicated a significant increased 14C loss in DOC. Overall, observations in our study suggested that mycorrhizal and saprotrophic fungi both can enhance photoassimilate allocation, which might affiliate the plant to explore nutrients from soil. However, ECM inoculated plants invested photoassimilate allocation into hyphae growth, but SAP inoculated plants might enhance the release of plant root exudates. Dual inoculation with ECM and SAP demonstrated the competition interaction between both fungal, which have change the patterns for photoassimilate distribution. Such changes in rhizosphere carbon inputs might have great impacts on soil nutrients cycles, therefore, further visualization on soil enzyme activities using zymography are under further analyzation.