Ruckus in the rhizosphere: connecting exudation, microbial growth, and carbon cycling in forest soils.

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Elevated atmospheric CO_2 concentrations are predicted to increase plant productivity and the release of exudates in the rhizosphere. However, the interplay between rhizosphere exudation, microbial activities, community dynamics, and soil carbon biogeochemistry remains unclear. Here we used $^{18}O–H_2O$ quantitative stable isotope probing to investigate the effects of synthetic root exudate inputs (250, 500, and 1000 µg C g soil^{-1}) on microbial growth traits and carbon biogeochemistry in rhizosphere soils of trees associated with arbuscular mycorrhizal (AM) and ectomycorrhizal (ECM) fungi. Soil respiration increased proportionally to the amount of exudate addition in both AM and ECM soils. However, microbial biomass responses differed, increasing in AM but decreasing in ECM soils. Enhanced exudate inputs increased the relative growth rates of individual taxa, leading to enhanced community level growth and more microbial biomass production in AM rhizosphere soils. In contrast, microbes in the rhizosphere soils of ECM trees were less responsive to exudates and estimates of microbial biomass turnover increased with increasing exudate inputs. Aggregated microbial growth was predictive of soil respiration in AM rhizosphere soils, but this relationship was not observed in ECM soils, possibly due substantial microbial biomass turnover. The distinct responses of AM and ECM rhizosphere communities suggest that the impacts of enhanced rhizosphere exudation expected with higher atmospheric CO_2 may depend upon mycorrhizal association. Specifically, our results suggest future increases in rhizodeposition in response to global change may lead to greater soil organic carbon gains in AM soils than in ECM soils.