Mycorrhizal associations mediate rhizodeposition but not soil C storage in response to nitrogen availability

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Mycorrhizal fungi provide plants with nutrients in return for photosynthate, linking above and belowground processes. Forests dominated by arbuscular (AM) versus ectomycorrhizal (EcM) fungi have well-documented differences in their distributions of soil carbon (C) and nitrogen (N). However, the mechanisms driving these patterns are uncertain. Potential mechanisms include differences in leaf litter quality, rhizodeposition, fungal nutrient acquisition strategies, and fungal necromass quality. Here, we investigated the role of rhizodeposition using a greenhouse experiment wherein eight species of seedlings (four AM and four EcM) were grown in a ^{13}C-labeled atmosphere under three levels of ^{15}N-labeled fertilizer. Over one growing season, we compared how plant N uptake and rhizodeposition differed between mycorrhizal types and between the rhizosphere and hyphosphere (excluding roots). Overall rhizodeposition was greater from EcM seedlings than AM seedlings and increased with increasing N availability in EcM but not in AM seedlings, making the overall belowground C cost of N uptake greater for EcM seedlings. Despite these differences, the net effect of the seedlings on soil carbon storage was similar between mycorrhizal types. For both mycorrhizal types, over the course of the experiment, there was a net loss of soil C in the rhizosphere, while the hyphosphere experienced a net gain in soil C. These findings suggest that trees mediate belowground C investment in response to inorganic N availability differently between mycorrhizal types, and that different mechanisms account for SOM accumulation and loss in the rhizosphere and hyphosphere.