Title: Testing Mechanisms of How Mycorrhizal Associations Affect Forest Soil Carbon and Nitrogen Cycling

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Project Abstract: 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 and nutrient acquisition strategies. Some EcM fungi acquire N from organic matter by producing their own extracellular enzymes. This strategy may lead to the "Gadgil Effect" whereby competition between EcM fungi and saprotrophs limits decomposition. In contrast, AM fungi are limited to scavenging nitrogen from the soil solution, which may lead to increased root exudation in AM forests. We are testing how differences in litter quality or nutrient acquisition strategies affect the distribution of C and N within mineral soil using isotopic labeling experiments and updates to the CORPSE model. We are currently incubating six different types of dual ^{13}C and ^{15}N-labeled litter in soil mesocosms at forests in NH, IL, and GA where each have six plots differing in the abundance and dominant family of EcM-associated trees. We also performed 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 N fertilization to trace how mycorrhizal type and N availability affect the fate of root and hyphal exudates in soils and the priming of native soil decomposition. Thus far, we have found that the amount of new photosynthate in the soil increased with EcM plant biomass but not AM, and that soil microbial biomass decreased with increasing N availability in EcM but not AM soils. We have updated the CORPSE model to include different mycorrhizal nutrient acquisition strategies so that EcM fungi can mine soil organic matter for N, but AM fungi cannot. We used the model to explore the conditions under which EcM fungi can induce saprotrophic N limitation (i.e., the Gadgil effect). We found that the Gadgil effect is strongest in

ecosystems with high seasonality in temperature and litterfall, such as temperate deciduous and boreal evergreen forests. However, the Gadgil effect does not strongly affect soil carbon storage. This ongoing research is bringing new insights into the mechanisms driving mycorrhizal differences in soil organic matter cycling.