Investigating mycorrhizal type impacts on coupled C and N cycling at the soil aggregate scale in an experimental reforestation site

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Mycorrhizal fungi play a crucial role in biogeochemical processes that impact nutrient cycling and soil structure. The mycorrhizal-associated nutrient economy (MANE) framework has guided in identifying differences in the coupled C and N cycling that occurs in arbuscular mycorrhizal (AM) and ectomycorrhizal (EM) dominated forests. AM forests tend to have an inorganic nutrient economy due to their rapid rates of C mineralization, and EM forests tend to have an organic nutrient economy owing to their more persistent forms of plant organic matter. Due to their role in the formation and stabilization of soil aggregates, mycorrhizal fungi also influence the residence time of below-ground C and N by promoting soil structures that occlude organic matter from decomposition within aggregates.

It is unclear how AM and EM fungi differ in their contributions to aggregate formation and how aggregation may relate to differences in their respective nutrient economies. The goal of this study is to examine C and N cycling at the soil aggregate scale in an experimental reforestation site in Oregon's Willamette Valley, USA. The site was previously a pasture dominated by AM grasses, which now serve as control plots in contrast to plots where EM tree saplings were planted 3 years ago. Preliminary results from wet sieving and calculation of the mean weight diameter (MWD) of soil aggregates revealed that aggregates from control plots were more stable than those from EM trees at the site ($p = 0.08$).

This study will build upon this investigation by examining if there has been a shift from an inorganic AM to an organic EM nutrient economy in the rhizospheres of EM Oregon White Oaks (Quercus garryana) at the site. We collected soil samples (0-10 cm, n= 20) from 3-year-old Oaks in addition to control plots. We will analyze organic and inorganic C and N concentrations within bulk samples and within soil aggregate size fractions after separation by wet sieving. These fractions include macro (> 2 mm), meso (2 > 0.25 mm), and micro (0.25 > 0.053 mm) aggregate sizes. To our knowledge, this study will be the first to test the MANE framework at the aggregate scale. With these new results, we intend to identify the temporal and spatial scale at which AM and EM nutrient economies may emerge in addition to how these differences may relate to biogeochemical processes within stable aggregates.