Nitrogen Availability Strongly Affects Carbon Cycling by Sub-Surface Microbial Communities

M. Rae DeVan[1], Rachel Hestrin[2], John M. Dunbar[1], Michaeline B. N. Albright[1], M. Francesca Cotrufo[3], Sanna Sevanto[4*] (sanna@lanl.gov)

[1] Bioscience Division, Los Alamos National Lab, Los Alamos, New Mexico
[2] Physical and Life Sciences Directorate, Lawrence Livermore National Laboratory, Livermore, California
[3] Department of Soil and Crop Science, Colorado State University, For Collins, Colorado
[4] Earth and Environmental Science Division, Los Alamos National Lab, Los Alamos, New Mexico

https://www.lanl.gov/science-innovation/science-programs/office-of-science-programs/biological-environmental-research/sfa-microbial-carbon.php

Project Goals

1. Determine the microbially-driven variation in carbon cycling of sub-surface microbial communities.
2. Quantify the impacts of nitrogen addition on carbon cycling by sub-surface microbial communities

Abstract

Soils store more carbon than plants and the atmosphere combined, and the ultimate fate of this carbon is tied to subsurface microbial communities. Yet, our fragmented understanding of how subsurface communities influence carbon cycling prohibits accurate estimates of the fate of carbon produced on the surface and future carbon storage. Because of the tight link between nitrogen and carbon cycles, nitrogen deposition has potential to drastically alter subsurface microbial composition and function. In this study, we used a common garden microcosm experiment to assess the range of subsurface microbial driven variation in carbon and nitrogen pools during root litter decomposition under fertilized (NH_4NO_3) and unfertilized conditions. We demonstrate that subsurface microbial community composition can create large variation in dissolved organic carbon (DOC, ~ 6x) and total nitrogen (TN, ~7x), and two-fold variation in CO_2. Nitrogen addition altered the balance of DOC, TN, and CO_2 in ways that were specific to the origin of microbial inoculum. These communities differed drastically in their ability to use the added nitrogen, which when consumed, was related to higher levels of CO_2 and lower levels of DOC compared to communities from the same origin without added N. Thus, we conclude that differences in subsurface microbial community composition and their response to nitrogen deposition could have far-reaching impacts on ecosystem function and feedbacks to global nutrient cycles.

*Funding Statement: This work was supported by the U.S. Department of Energy Biological System Science Division, through a Science Focus Area Grant (*2018SFAF255).