Proposal for 2014 summer

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Tree growth can be enhanced by improved soil nutrition condition under fertilization and N deposition.  Soil nutrition addition, on the other hand, leads to plant feedback which influences forest ecosystem nutrient cycling and long-term productivity (Hobbie and Vitousek, 2000; Scott and Binkley, 1997).  Fertilization changes the stoichiometry of plant tissue and litter, resulting in forest floor microbial biomass and soil nutrient cycling response (Fisk and Fahey, 2001; Prescott et al., 1999).  Another plant feedback mechanism under fertilization is root carbon allocation to rhizosphere soils.  This mechanism has not been well studied or understood.

Photosynthesis carbon products are allocated to roots in forms of sloughed-off root tissues, mucilages, and root exudates which include carbohydrates, organic acids and phenolic compounds (Dennis et al., 2010).   These labile root carbon resources added into soils stimulate microbial activity and increase soil gross P and N mineralization, as well as accelerate the rate of soil organic matter turnover (Spohn and Kuzyakov, 2013; Phillips et al., 2011).  Allocation of these C to roots and rhizosphere has been suggested to decrease under fertilizer addition to forest soils, influencing rhizosphere microorganisms and N/P cycling processes (Phillips and Fahey, 2007; Benckiser et al., 1984).  However, limited study has looked into this mechanism.  One recent study with loblolly pine seedling shows no NP fertilization effects on root C exudation (Stovall et al., 2013).  However, excised root exudation measurement used in this study does not represent a real root response to fertilization in field conditions.  More studies of rhizosphere soil C input with the influence of fertilization are needed in order to fully understand the plant feedback mechanism under nutrition pressure.

In order to test how N and P fertilization affects C input from plant to rhizosphere soils, we designed an experiment in Bartlett Experimental Forest, New Hampshire.  Three young forest stands (25-35 years old) that have been fertilized annually since 2011 with N (30 kg N/ha/yr as NH4NO3), P (10 kg P/ha/yr as NaH2PO4), N+P plus a control (no fertilization) are chosen to conduct soil sampling and analysis.  Within each treatment plot, three subplots will be selected.  Within each subplot, two trees *Prunus pensylvanica* and *Betula alleghaniensis* will be chosen to sample the rhizosphere soil.  The soils will be analyzed for soil respiration, potential net N mineralization, soil C, microbial C and N, and fungi/bacteria ratio.  A closed chamber adsorption and titration method will be used to get soil respiration.  Soil extraction and colorimetric analysis with a Gen5 microplate reader during a 20-day incubation will be used to obtain net N mineralization.  Microbial C will be assayed by fumigating soil with chloroform and run on a TOC autoanalyzer.  Microbial N will be assayed by fumigation, extraction and microplate reader assay.  Soil C will be measured using a muffle furnace.  Soil fungi/bacteria ratio will be quantified using qPCR.  Data will be analyzed using two-way ANOVA with fertilizer treatments (four levels) and tree species (two levels) as two factors.

Citations:

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