**Does Elevated N or P Supply Increase the Active Biomass of Microorganisms?**

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**Introduction:**

In a northern hardwood forest, there are many carbon and nitrogen cycling functions that occur. Microorganisms play an important role in these nutrient cycles. Microorganisms are the leading source of decomposition; by the process of metabolism, microorganism release enzymes that are critical nutrients for a fertile soil. Microorganisms play a key role in ecosystem carbon balance by oxidizing organic carbon to CO2. Since 90% or more of microorganisms are dormant (Blagodotskaya 2013), it is important to look at the active portion of the microbial biomass that are actually contributing to ecosystem processes. The microbial biomass is an important indicator of the health of the soil. There is still very little understood about microbial activity but it is important to investigate because it is the active portion of microorganisms that contributes to the overall nutrient cycling system.

Microbial biomass is limited by the nutrients that are taken in; the major nutrients are nitrogen, phosphorous, and carbon. Microorganisms need nitrogen to make proteins, which are essential in all aspects of metabolism. One use of nitrogen that is especially important to ecosystem processes is the production of extracellular enzymes that break down organic carbon sources into molecules small enough to be taken up and metabolized, producing CO2. Phosphorus is needed by microorganisms to make ribosomes, which are essential for protein synthesis and for the organism growth. These nutrients play an important role in how much of the biomass is active because they support the production of enzymes and proteins, which are necessary for microbial growth. The total microbial biomass is associated with the amount of nitrogen available; whereas the microbial respiration per amount of biomass is associated to the total amount of phosphorus available (Hartman & Richardson 2013). The microbial respiration per amount of biomass is thought to be an indicator of the active biomass because it represents the amount of microorganisms consuming carbon and increasing microbial growth.

Substrate-induced respiration (SIR) is a method used to estimate the size of the microbial biomass in the soil by using glucose to stimulate the microorganisms to reach a maximal respiratory response. SIR represents the respiration of the active and the potentially active microorganisms in the soil (Blagodotskaya 2013). SIR indicates the “awakening” stage of the potentially active microorganisms. This “awakening” period can be calculated by comparing the ratio of the “waking up” respiration to the basal respiration.

Studying the affects of nitrogen and phosphorus fertilization on microbial respiration allows us to determine the net carbon flux of the microbial community and to determine if elevated nitrogen or phosphorus aids or hinders the activity of the microorganisms. Since nitrogen and phosphorus promote the production of enzymes and proteins crucial for metabolism, we predict that altering the levels of nitrogen and phosphorus available to the microorganisms will impact the overall microbial growth and respiration.

**Objective:**

I will use the Substrate-Induced Respiration Method developed by Anderson and Domsch (1985) to understand:

1. How nitrogen fertilization affects microbial respiration.
2. How phosphorus fertilization affects microbial respiration.
3. If there is an affect on the microbial respiration when nitrogen and phosphorus are fertilized together.

**Hypothesis:**

The microbial respiration rates will be directly correlated to the amount of total phosphorus available since it is known that phosphorus …oops

**Field Methods:**

Our research was conducted in a northern hardwood forest located at the Bartlett Experimental Forest in Bartlett, NH. This project is associated with the Multiple Element Limitation in Northern Hardwood Ecosystems (MELNHE) project, which studies the limitations of nitrogen and phosphorus through soil nutrients additions by fertilization, which has been applied annually since the spring of 2011.

The soil was collected from 6 different stands located within the Bartlett Experimental Forest. Stands C1, C2, and C3 are young stands (21-26 years) and stands C7, C8, and C9 are mature stands (>100 years). We selected three young stands and three mature stands to see if the age of the stand has any affect on the microbial respiration. Within each stand are four treatment plots; Control, N, P, and N+P. Within each treatment plot, there are four 5m x 5m sub-plots, which is where the soil cores will come from for this study. Three soil cores will be extracted from each sub-plot and will be composited into one sample per treatment plot. From the soil core we will divide the various layers of the soil and extract ~5cm of Mineral Horizon. The soil collected will be used for substrate-induced respiration and to determine the total microbial biomass with the chloroform fumigation method.

**Lab Methods:**

To calculate the soil moisture content, we first record the soil dry mass and calculate the moisture content percentages. The moisture content will determine how much glucose and water needs to be added to every sample since the soil dry mass and moisture content will vary for each sample.

The substrate-induced microbial respiration will be estimated using a base trap incubation method. The base traps (10 ml of 0.1M NaOH) are placed in a mason jar of soil that is sealed tight. In varying intervals the base traps were removed and replaced with a new base trap. The increasing time intervals will allow us to determine the CO2 respiration values of the active microorganisms.

Once all of the time intervals are complete, the base traps will be titrated with 0.1M HCl to quantify the amount of CO2 released by the active microorganisms. Each time set will be titrated along with 3 blank base traps so that we can account for the CO2 that is not from microbial respiration.good!

**Predicted Results:**

After the “awakening period” (roughly 12 hours into incubation), I predict that there will be more microbial respiration in the samples from the phosphorus treatment plots than the samples from the nitrogen treatment plots.

**Implications:**

Microbial respiration data could be used to better understand the effects of climate change on the ecosystem and the effects of nutrient imbalances within the soil.

**References:**

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