Foliar Analysis of Five Northern Hardwood Species Indicates Nutrient Limitation

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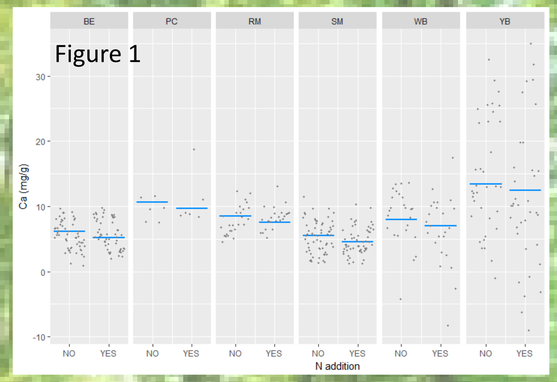
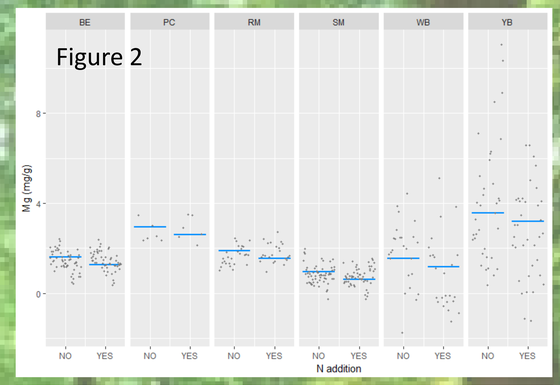
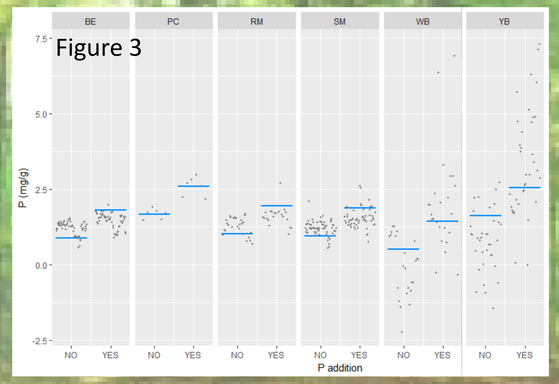
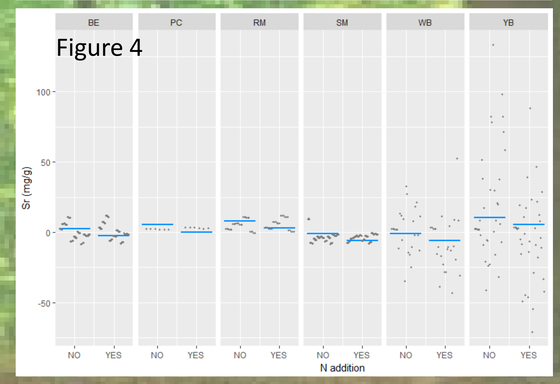
INTRODUCTION

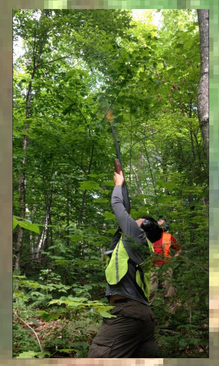
- As two primary macronutrients for plant growth, nitrogen and phosphorus have been considered to be limiting, affecting the productivity of ecosystems. However, due to the change in nutrient inputs by anthropogenic activities, we must investigate further into these limitations and their consequences.
- Recent studies have revealed a synergistic ecosystem response to the addition of multiple nutrients together (N and P), suggesting multiple element limitation and coupling of nutrient cycling (Davidson and Howarth, 2007; Elser et al. 2007). And other studies have found that plants allocate nutrients so as to remain simultaneously co-limited by multiple resources (Bloom et al. 1985).
- Foliar nutrient concentrations are good indicators of growth, soil fertility, and forest health. They can provide a snapshot of how trees allocate their nutrients under different conditions, such as elevated levels of N and P.
- In this study, we investigated how the additions of N and P affect the nutrient status of the green leaves of different northern hardwood species. We hypothesize that the leaves would have different concentrations of nutrients when N and P are added.











SITE DESCRIPTION

- Our experimental stands in Bartlett Experimental Forest, Hubbard Brook Experimental Forest and Jeffers Brook have well-drained acid Spodosols of sandy-loam texture developed from glacial till where the temperature and precipitation averages 5°C and 1400 mm per year.
- N (30 kg N/ha/yr as NH_4NO_3), P (10 kg P/ha/yr as NaH_2PO_4), and N+P (same amount) were applied annually to plots in the stand beginning in spring 2011.

SAMPLING METHOD

- We collected green leaves of five species American beech (*Fagus grandifolia*), Pin cherry (*Prunus pensylvanica*), red maple (*Acer rubrum*), white birch (*Betula papyrifera*) and yellow birch (*Betula alleghaniensis*) in August of 2013, 2014, 2015, or 2016 using a shotgun. Only the trees that were shot once were examined in this study.

CHEMICAL ANALYSES

- An Optima 5300 DV inductively coupled plasma optical emission spectroscopy (ICP-OES, Perkin-Elmer) was used to determine the concentrations of foliar Ca, K, Mg, Mn, Na, P, and Sr after samples were ground, ashed and hot plate-digested with 6N nitric acid.

STATISTICAL ANALYSES

- Treatment effects were evaluated using a nested (stand/age/site) analysis of variance (ANOVA), with N treatment, P treatment, N+P interaction, species, and year as predictor variables. A linear mixed-effects model was used in R.

RESULTS

- Ca concentrations were lower under N-addition ($p<0.05$). Species varied ($p<0.05$) where YB was the highest, followed by PC, RM, WB, BE and SM, respectively (Figure 1).
- Mg concentrations were lower under N-addition ($p<0.05$). Species varied ($p<0.05$) where YB was the highest, followed by PC, RM, BE, WB and SM, respectively (Figure 2).
- P concentrations were higher under P-addition ($p<0.05$). Species varied ($p<0.05$) where PC was the highest, followed by YB, RM, SM, BE and WB, respectively (Figure 3).
- Sr concentrations were lower under N-addition ($p<0.05$). Species varied ($p<0.05$) where YB was the highest, followed by RM, PC, BE, WB and SM, respectively (Figure 4).

FUTURE PLANS

- Analyze nitrogen and carbon.
- Include calcium addition plots.
- Compare green leaves with fresh litter to look at resorption proficiency and efficiency.

LITERATURE CITED

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