**Drivers of Tree Species Effects on Phosphorus and Cation Cycling in Plantations at La Selva Biological Station, Costa Rica**

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**Introduction**

Regenerating forests comprise a rapidly increasing proportion of humid tropical forests and can sequester large amounts of carbon, thereby playing an important role in global carbon cycling. The question becomes: How does nutrient cycling keep pace with rapid C cycling? Our focus is on the belowground drivers, using differences among four tropical tree species to evaluate mechanisms.

**Conceptual Framework & Hypotheses**

Carbon fixed during photosynthesis is transported to influence plant nutrient uptake via at least four distinct mechanisms (Fig. 1). Greater partitioning to: a) Fine root (FR) growth and FR detrital production, b) Arbuscular mycorrhizal fungi (AMF), c) Heterotrophs which support free-living microbes, d) Root exudates that support rhizosphere bacteria. (Fig. 1)

**Study Site and Methods**

**Climate**: MAP: 4000 mm; MAT: 25.8°C

**Soil**: Acidic, highly weathered Oxisol

**Site History**: Deformed in 1955, pastured until 1987. Experimental plantations established in 1988. All plots had similar climate, relief, parent material, time of development & human factors: only the tree species differed.

**Experimental Design**: Randomized complete block (RCB) 2 blocks x 3 replicates, 1 block of Mature forest = Incomplete RBC (to the right)

**Tree Species**: *Hieronyma alchorneoides* (HIAL), *Pentaclethra macroloba* (PEMA), *Virola koschnyi* (VKO), *Vochysia guatemalensis* (VOGU)

**Methods, Field & Lab**: Biomass, fine root ingrowth, BCA measured as in Russell et al. (2010). Ca, K, Mg, Mn and P concentrations in plant tissues measured by microwave-assisted acid digestion and analyzed using ICP (Kingston et al., 1997); N determined by dry combustion using a Thermo-Finnigan EA Flash.

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**Results**

**Element Stocks in Aboveground Tree Biomass**

Tree species differed significantly in stocks of magnesium, manganese, potassium, aluminum and iron (not shown) accumulated in aboveground biomass at 25 years of age (Fig. 2). However, the species did not differ (α = 0.05) in stocks of nitrogen, phosphorus or calcium.

**Mechanisms of Influence**

- **Storage capacity**: Elements stocks were not significantly correlated with aboveground tree biomass.
- **Concentrating potential**: Foliar concentrations of elements were not correlated with aboveground tree biomass, with the exception of aluminum.
- **Litterfall fluxes of elements** were not correlated with element stocks in tree mass, exc. for Al.
- **Fine root ingrowth** differed among species (Fig. 3) and was correlated with element stocks (Fig. 4).

**Conclusions**

Allocation to fine roots (Pathway 1) was correlated with differences in cation accumulation in biomass. Results indicate that differences among tree species in fine-root growth translated into differences in: Scavenging and acquisition of cations, except for Ca. Accumulation in biomass of mineral-associated nutrients, i.e., K, Mg, and Mn.

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References: