

Foliar Nutrient Concentrations of Understory Plants in a Chronically Fertilized Lowland Tropical Wet Forest in Costa Rica



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Nutrient Availability Influences Tropical Forests

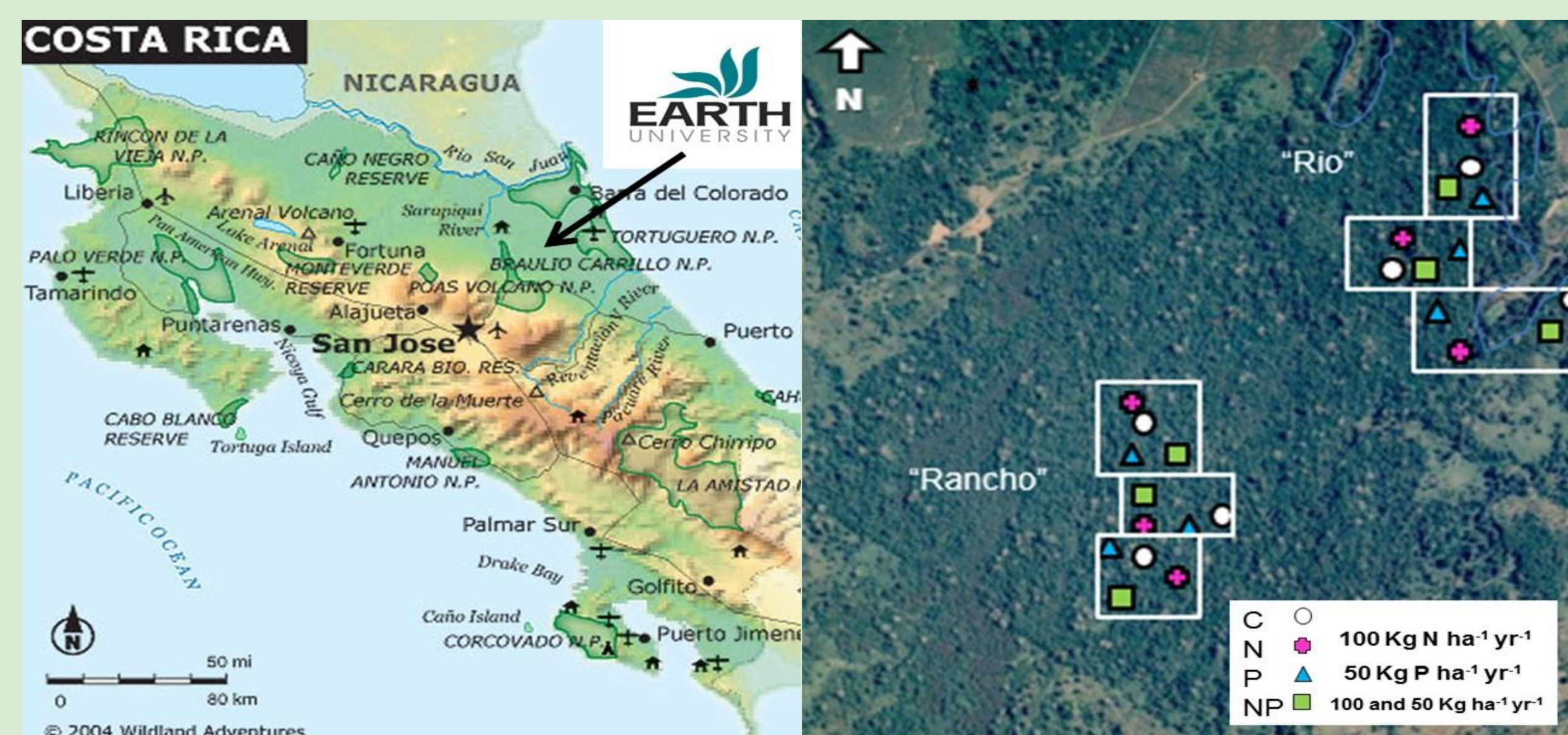
- Nutrient availability in soil influences key processes for plants in all ecosystems
 - Nitrogen (N) and phosphorus (P) are the most limiting^{1,2}
- Plant leaf (foliar) N and P concentrations and their ratios are used as indicators of plant nutritional status^{3,4,5,6}
 - Foliar N:P ratios often reflect soil nutrient availability^{7,8}
- Tropical forest plants have the highest foliar N:P globally^{9,10}
 - This reflects a greater degree of P limitation compared to other forests¹¹
- Understanding how plants in tropical forests respond to changes in nutrient availability is important to predict how they will respond to anthropogenic alterations in nutrient cycles, such as N deposition¹²

Research Questions And Hypotheses

1. How does chronic N and P fertilization affect the nutrient concentrations in the soil?
 - We hypothesize the soil would have increased P and N concentrations after chronic fertilizations.
2. How does chronic N and P fertilization affect foliar nutrient concentrations of understory plants?
 - We hypothesize understory plants would have increased foliar P and N concentrations after chronic fertilization.

EARTH Forest Fertilization Experiment (EFFEX)

24 (30 x 30 m) plots were established in 2007
N, P, and NP Fertilization Treatments (with Control)



Location of Field Site

Experimental Design

Methodology



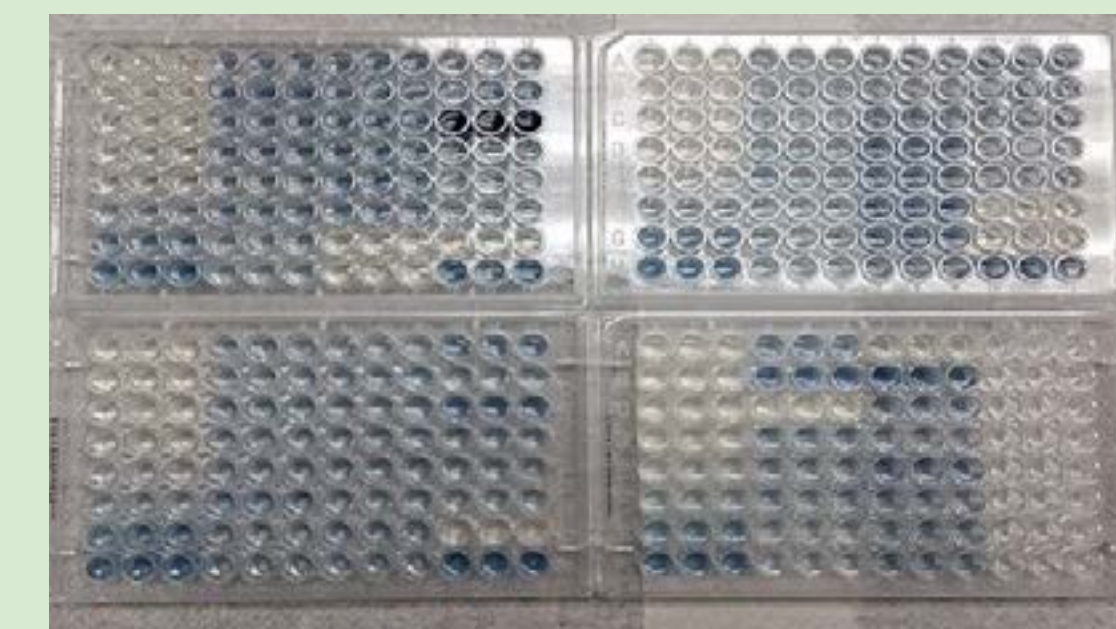
Foliar Samples Collected January 2018



Foliar P Extracted Following Dry Ashing

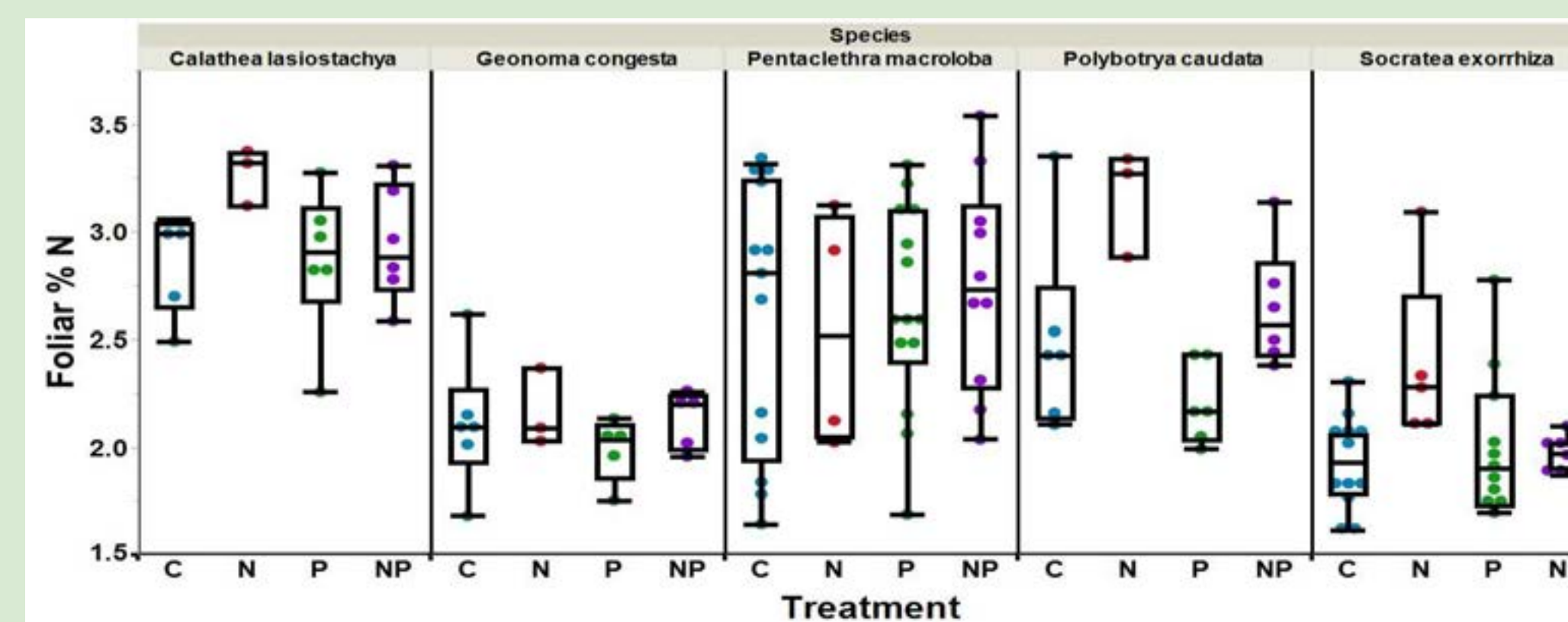


Elementar Analysis for % N



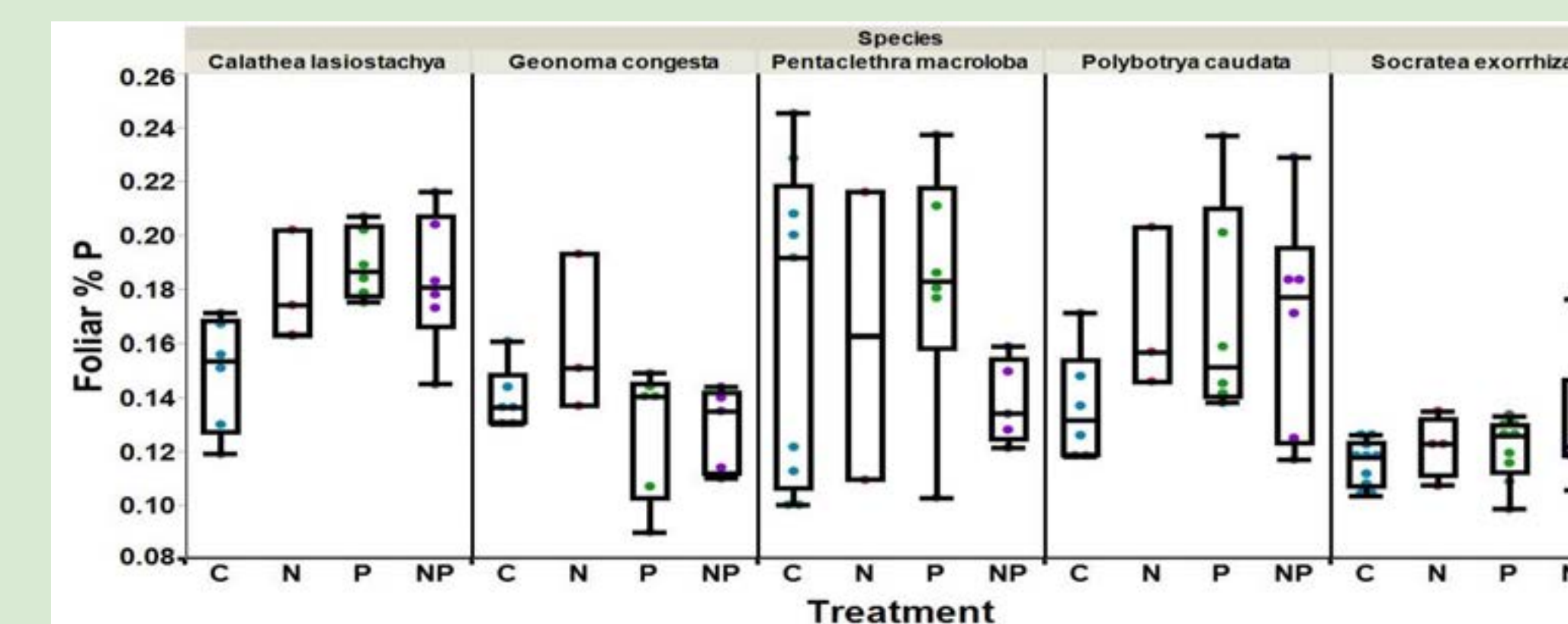
Colorimetric Assay for % P (Melich P for Soil)

Fertilization Had Mixed Effects On Foliar N And P



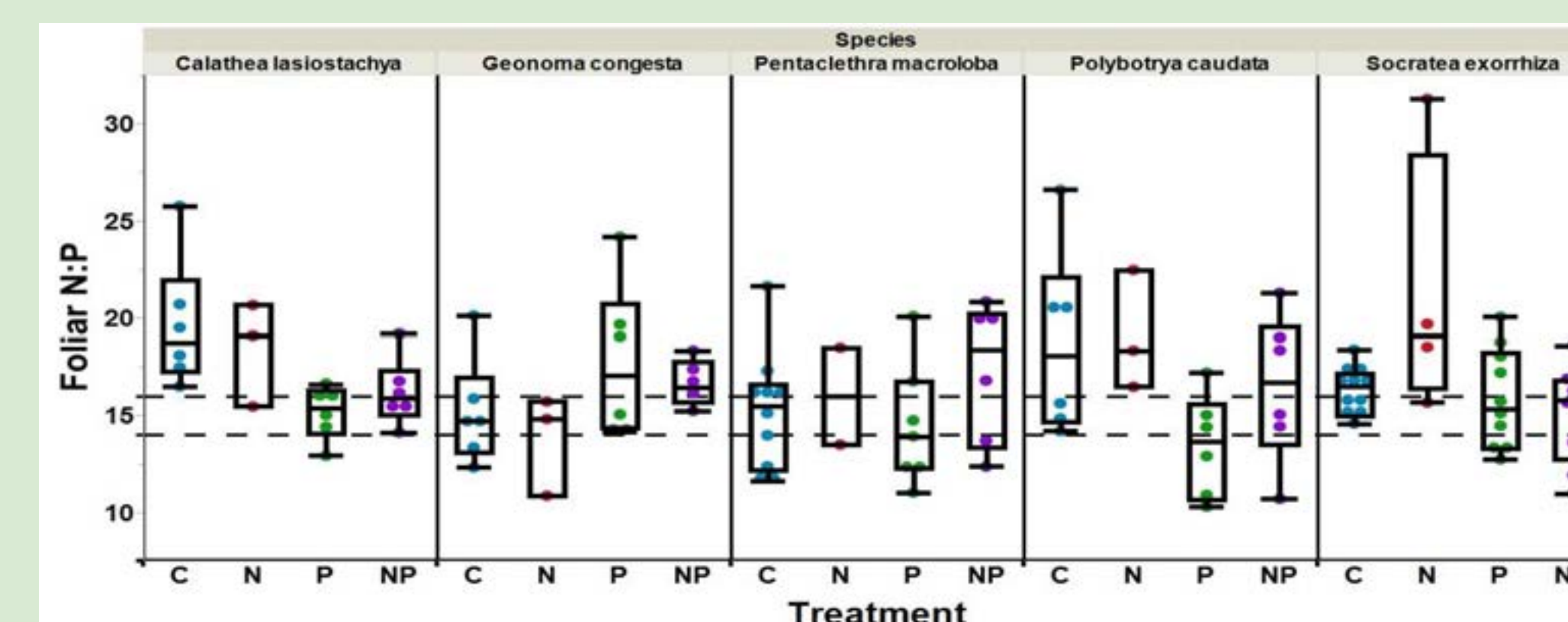
Sp P<0.0001, Trt P= 0.0146

Foliar N was affected by plant species and fertilization treatment.



Sp P<0.0001, Trt P= 0.1394

Foliar P was affected by plant species only.

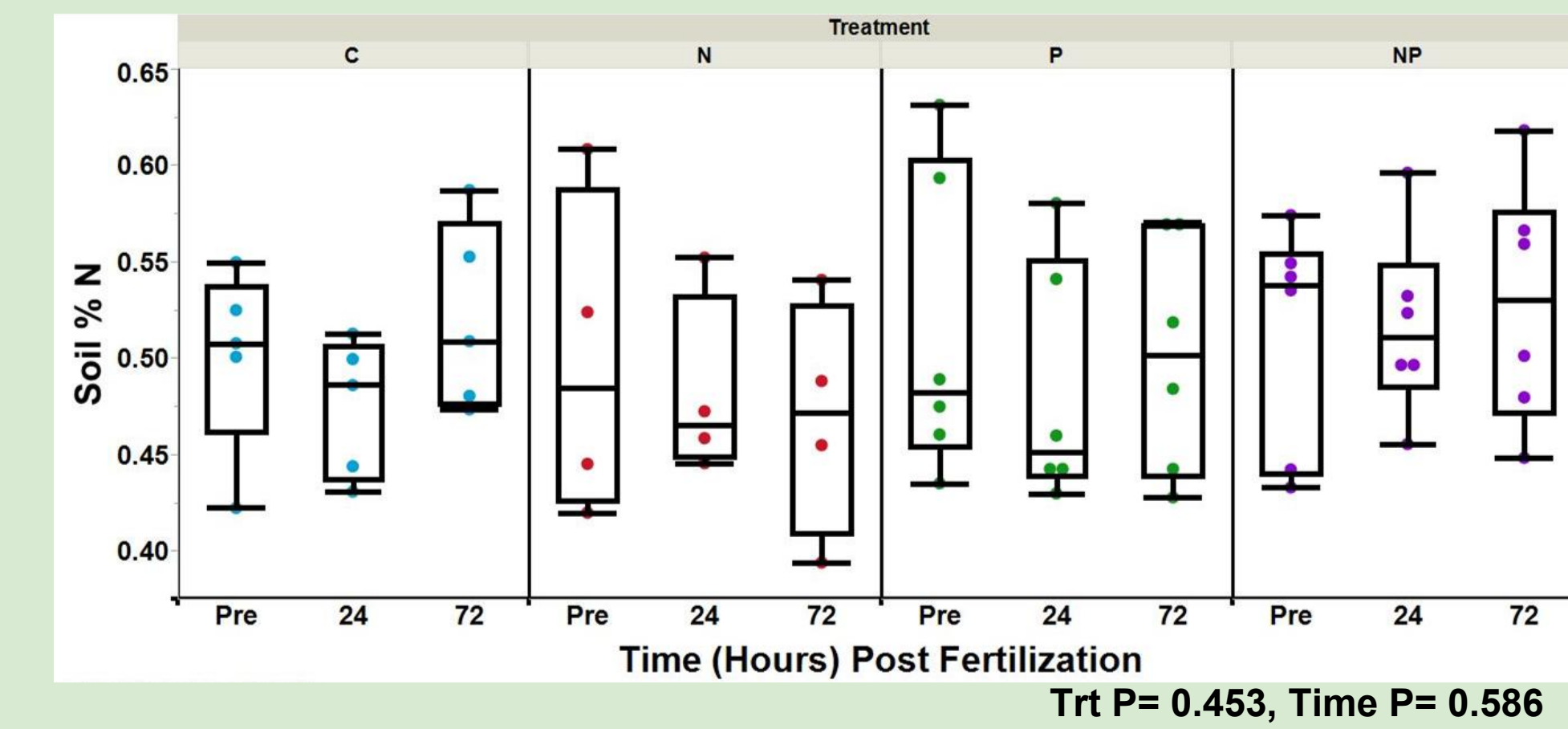


Sp P= 0.3031, Trt P= 0.0303, Sp*Trt P= 0.0274

Foliar N:P was affected by fertilization treatment and species x treatment.

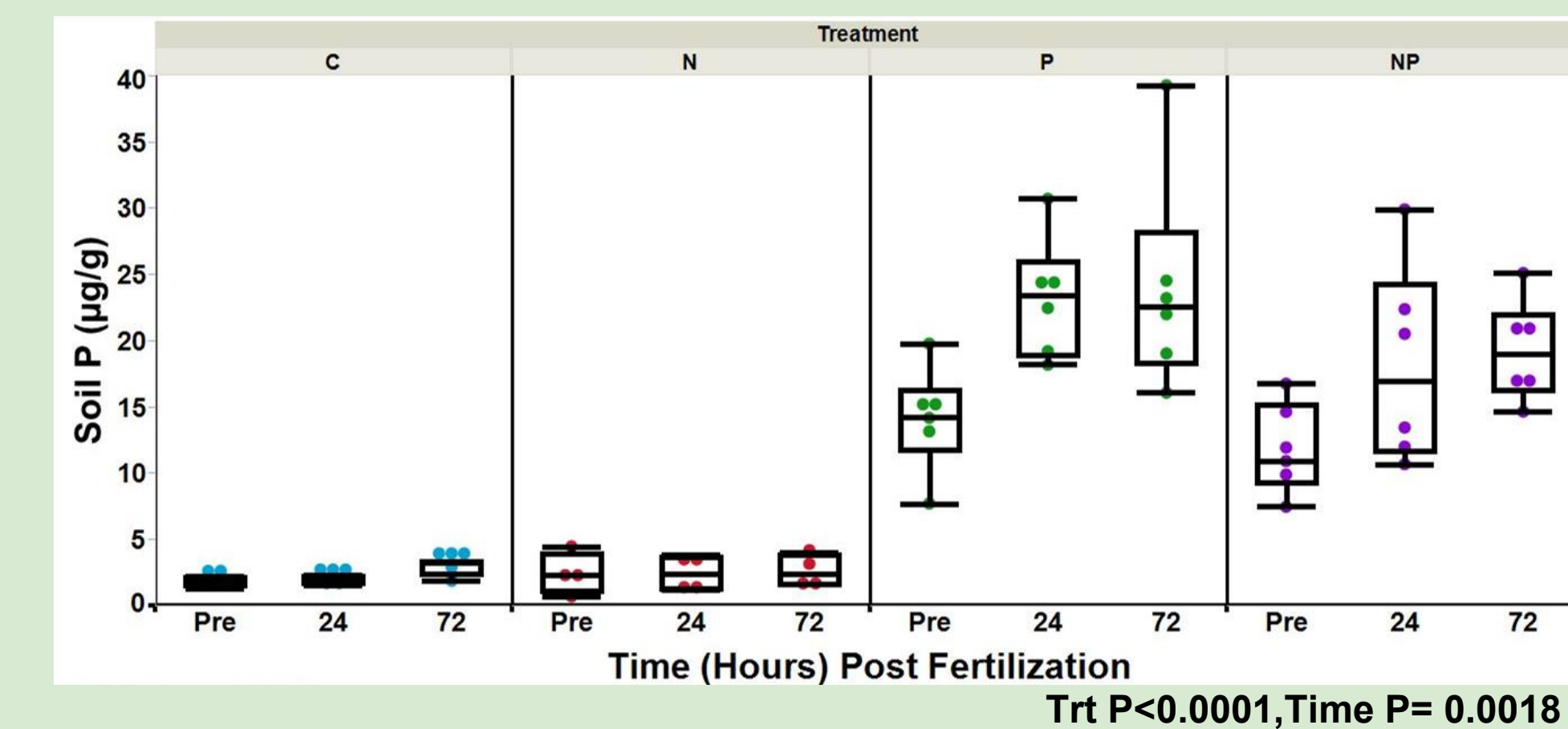
These N:P values (14-16) suggest a colimitation of N and P for our samples.

Fertilization Had An Effect on Soil P, Not N



Trt P= 0.453, Time P= 0.586

Total soil N was not affected by fertilization treatment or time.



Trt P<0.0001, Time P= 0.0018

“Available” soil P was affected by fertilization treatment & time.

P and NP treatments had the highest soil P.

Foliar Nutrient Concentrations May Not Reflect Their Soil

Hypothesis 1 Partially Supported

Chronic fertilization has resulted in higher soil P but not N. However, we did not measure bioavailable N (just total N).

Hypothesis 2 Partially Supported

Chronic fertilization has resulted in higher foliar N but not P.

- There was a species specific response to nutrient additions
- *Calathea lasiostachya* (forb) had the highest foliar N and P
- Palms had the lowest foliar P (*Socratea exorrhiza*/*Geonoma congesta*)
- We would like to explore adult tree foliar nutrient concentrations and growth rates to better predict how the forest will respond to anthropogenic alterations

References

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