# Nutrient Dynamics (and Limitations) of *Quercus petraea L.* Under Experimental Canopy Nitrogen Deposition

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## Introduction

- Nitrogen (N) deposition **rates are still increasing** on the global scale.
- Shifts in N availability may impact ecosystem health, creating issues such as **soil acidification** and **loss of biodiversity**.
- In addition, it may induce further nutrient imbalances, **Phosphorus (P) deficiencies** in particular.

## Objective

- Add N to **gather indications for possible consequences of elevated N deposition rates** in the future.
- **Assess the N & P state** of our Sessile oak forest ecosystem through leaves and soil analysis.

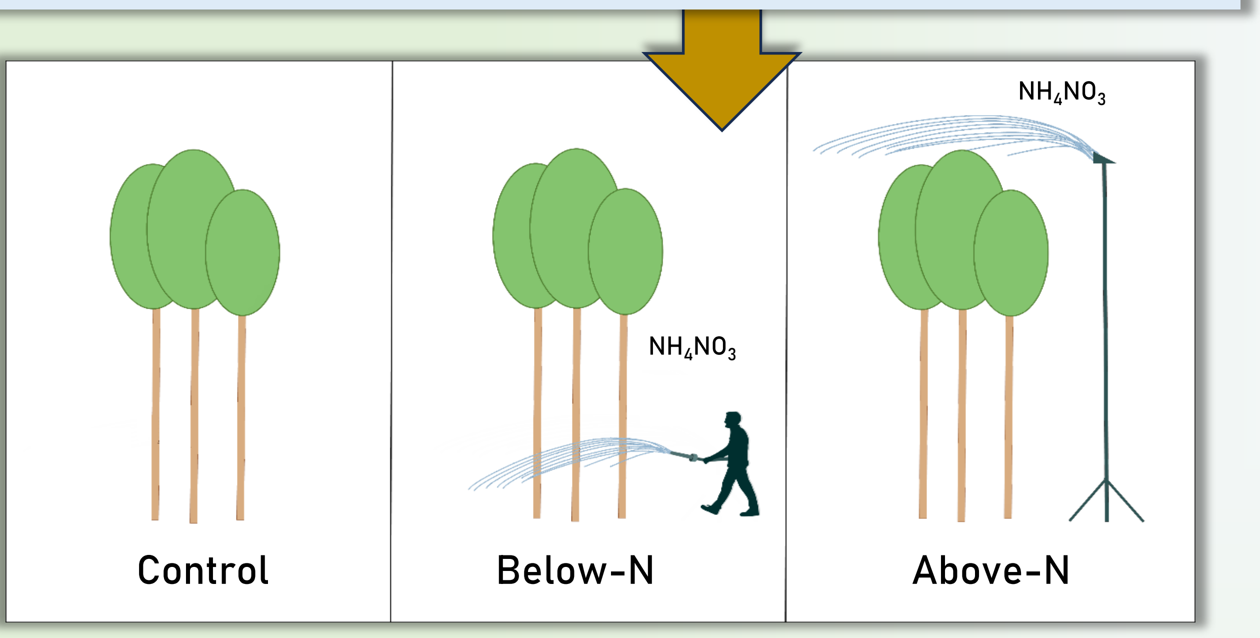

**Fig. 1.** Experimental design of Nitrogen fertilization in our Sessile oak forest. Three treatments: above canopy N application (Above-N); below canopy N application (Below-N); and unfertilized plots (Control).

## Methods

- **Improved simulation of N deposition** by applying N from above the canopy (Fig. 1; **Above-N**).
- Including the **conventional ground N application (Below-N)** for comparison between the two fertilization approaches.
- Using a **conservative amount of 20 kg N** ha$^{-1}$ yr$^{-1}$ (as opposed to the excessive average of 100 kg N commonly used).
- Fertilization applied annually since 2015.

### Side Note

The motivation for nutrient analysis was due to a lack of apparent growth response during 7 years of fertilization.

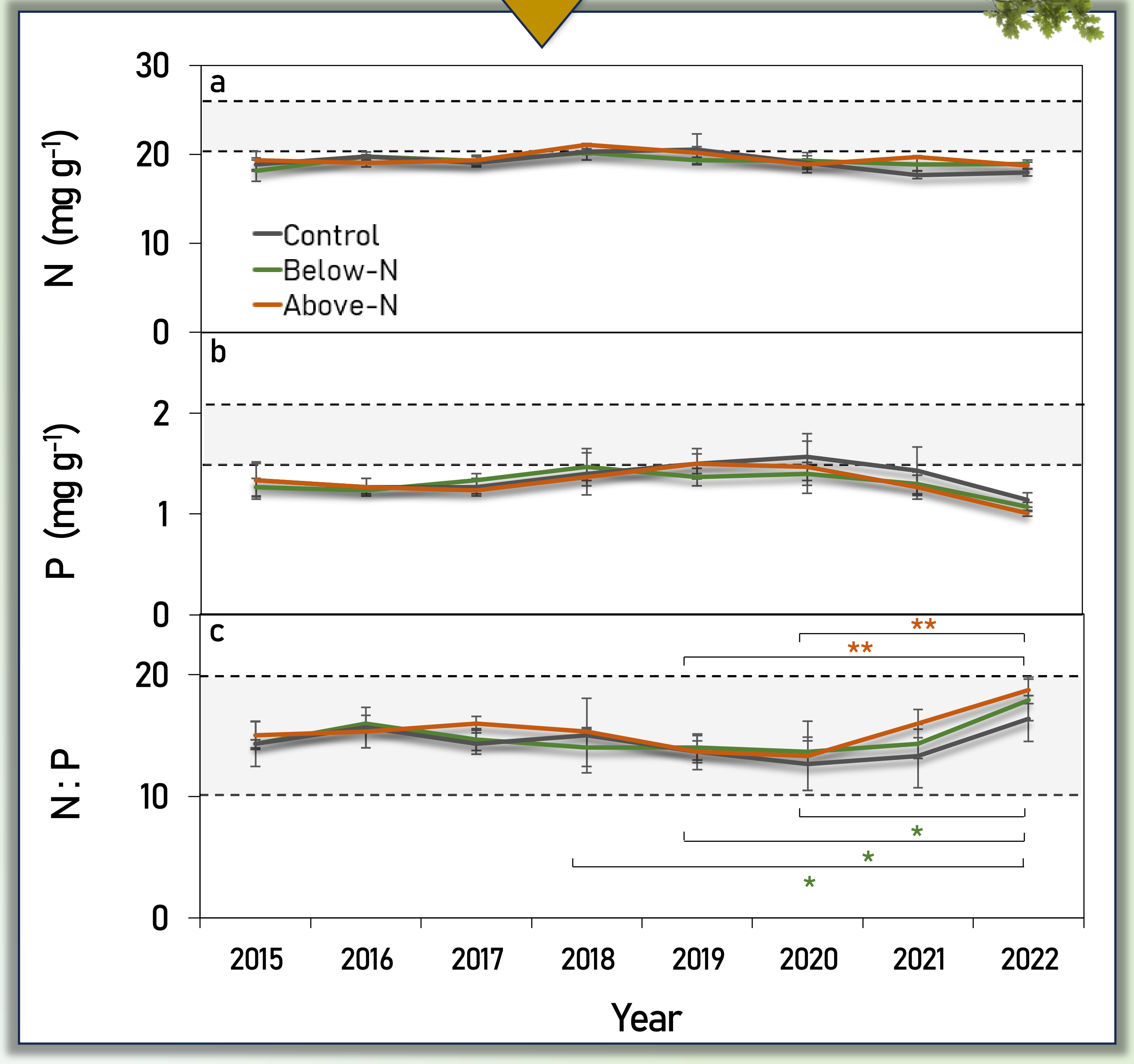

**Fig. 2.** Leaf Nitrogen (a) and Phosphorus (b) concentrations, and N:P ratios (c). Grey section represents the normal range for critical concentrations. Asterisks indicate significant differences in N:P ratios between the years, colors corresponding to the treatments (*$p < 0.05$*; **$p < 0.01$*).

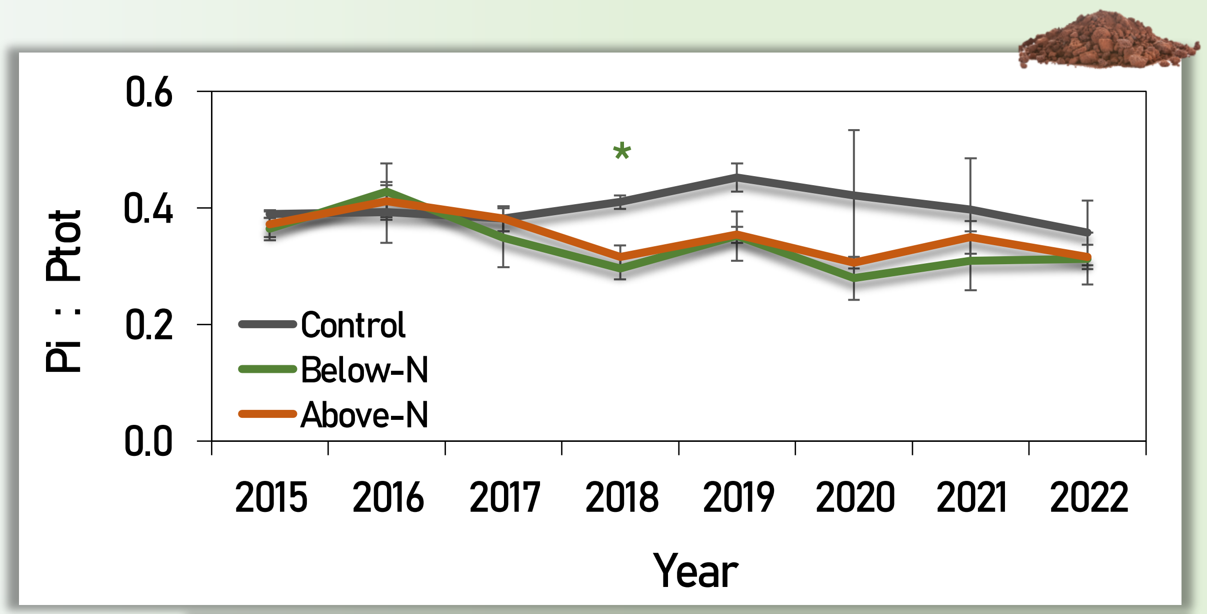

**Fig. 3.** Soil available Phosphorus (Pi) to total Phosphorus (Ptot) ratio. Asterisk indicates significant difference between Below-N and the control in 2018 (*$p < 0.05$*).

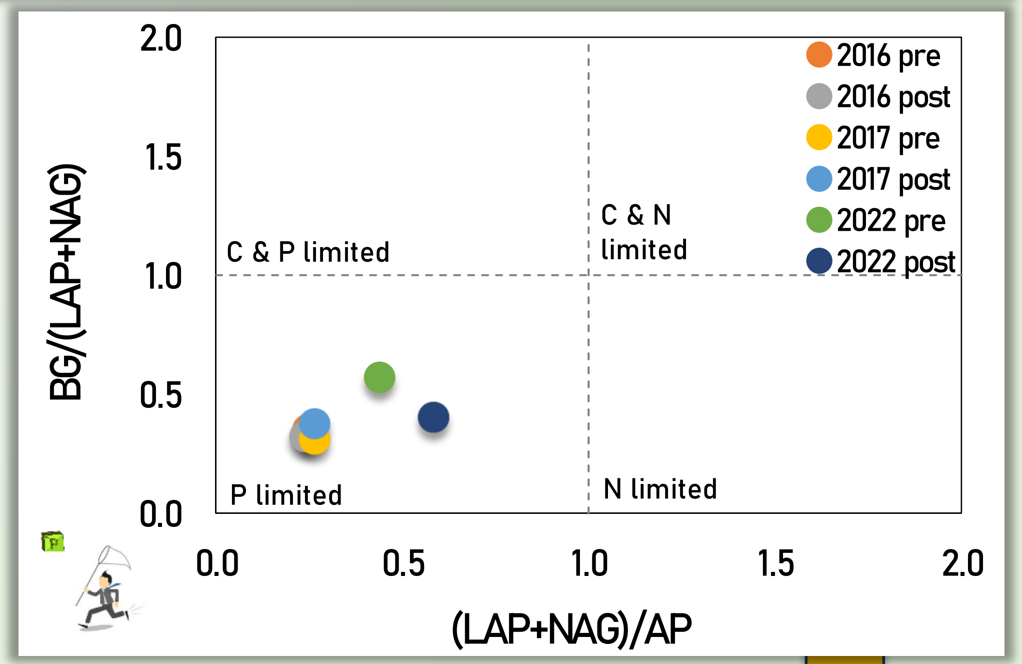

**Fig. 4.** Soil enzymatic stoichiometry (right) analyzed pre and post annual fertilization. *β-glucosidase (BG); leucine-aminopeptidase (LAP); N-Acetylglutamate synthase (NAG); acid phosphomonoesterase (AP).*

## Concluding Remarks

- Analysis of **leaf N & P** pointed to **sub-optimal concentrations** of both nutrients (Fig. 2a,b).
- **Leaf N:P ratios** exhibited an **increasing trend in recent years**. While not significant in the control plots, indeed **significant in both fertilized treatments** (Fig. 2c).
- **Soil available P** appeared to be decreased in both fertilized treatments (Fig. 3).
- Soil enzymatic stoichiometry indicated a general **ongoing P limitation** (Fig. 4).
- We observed mild, but **distinct, effects between the two N application methods**.

## Take home message

Whether it is for management or research, please consider identifying the nutrient status of your lovely forest for more proper outcomes.