

The Impact of Long-Term Nitrogen Addition on Legume-Rhizobia Symbiosis

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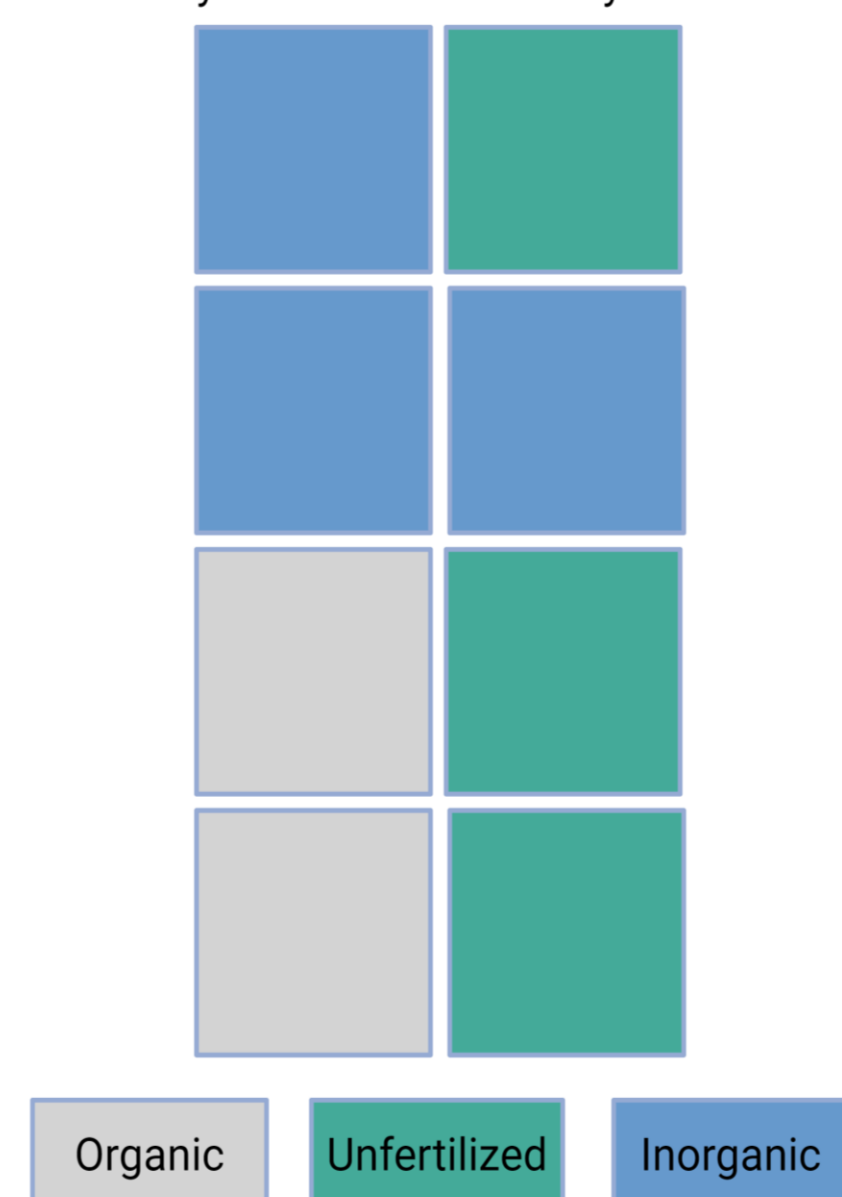
Introduction

- Soybean-*Bradyrhizobium* symbiosis enables natural nitrogen fixation in the nodules of a legume's root system.
- Long-term application of nitrogen fertilizer, commonly used in traditional agriculture, can cause microevolution in soil microbiomes that impact mutualism (Weese et al. 2015).
- Reduced mutualism often decreases plant performance and productivity.
- This study examines how soybean-*Bradyrhizobium* symbiosis is impacted by fertilization history, by examining nodule health and legume productivity.

Background

Morrow Plots Treatments

2 year rotation Corn-soybean



The microbiomes studied for this experiment were extracted from eight distinct plots. These plots included a variety of treatment histories: organic, inorganic, and unfertilized.

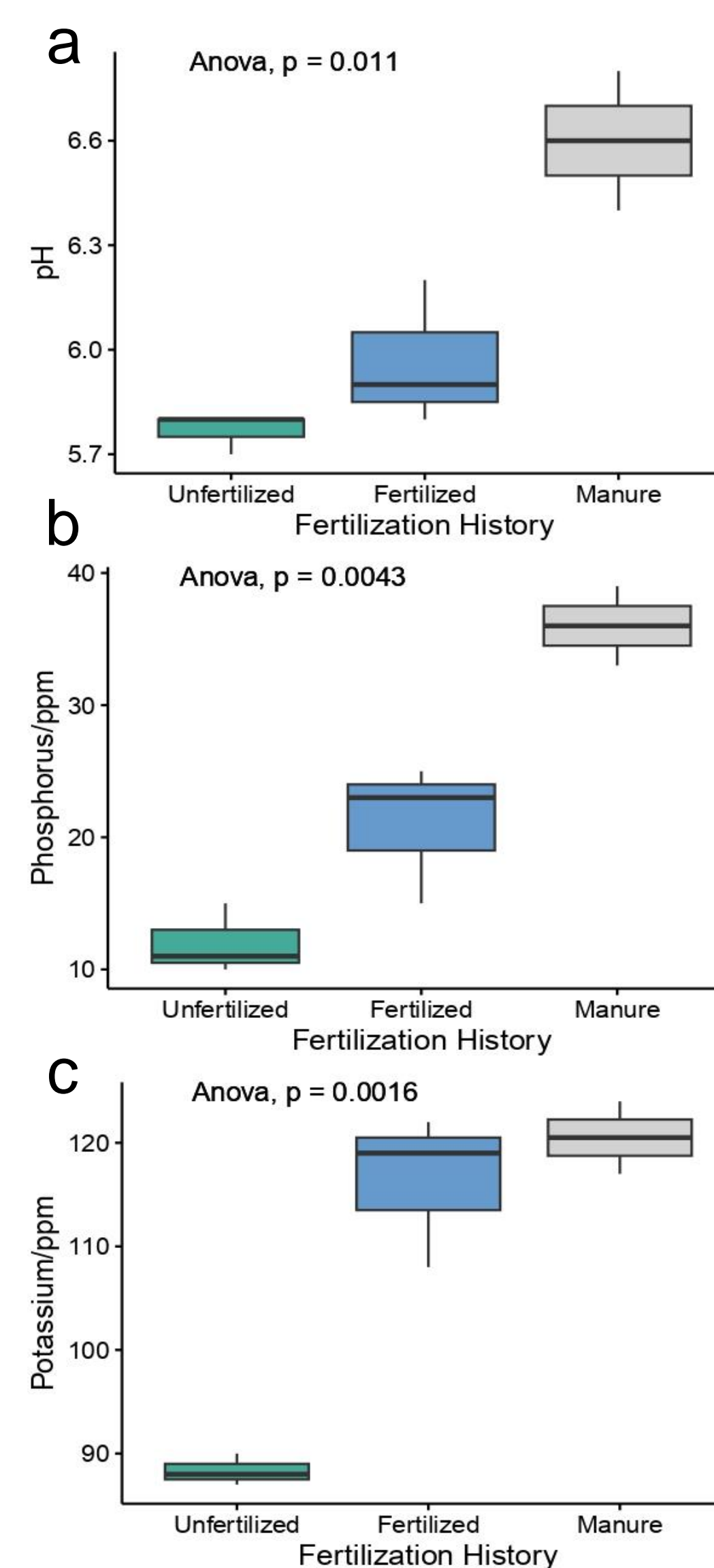
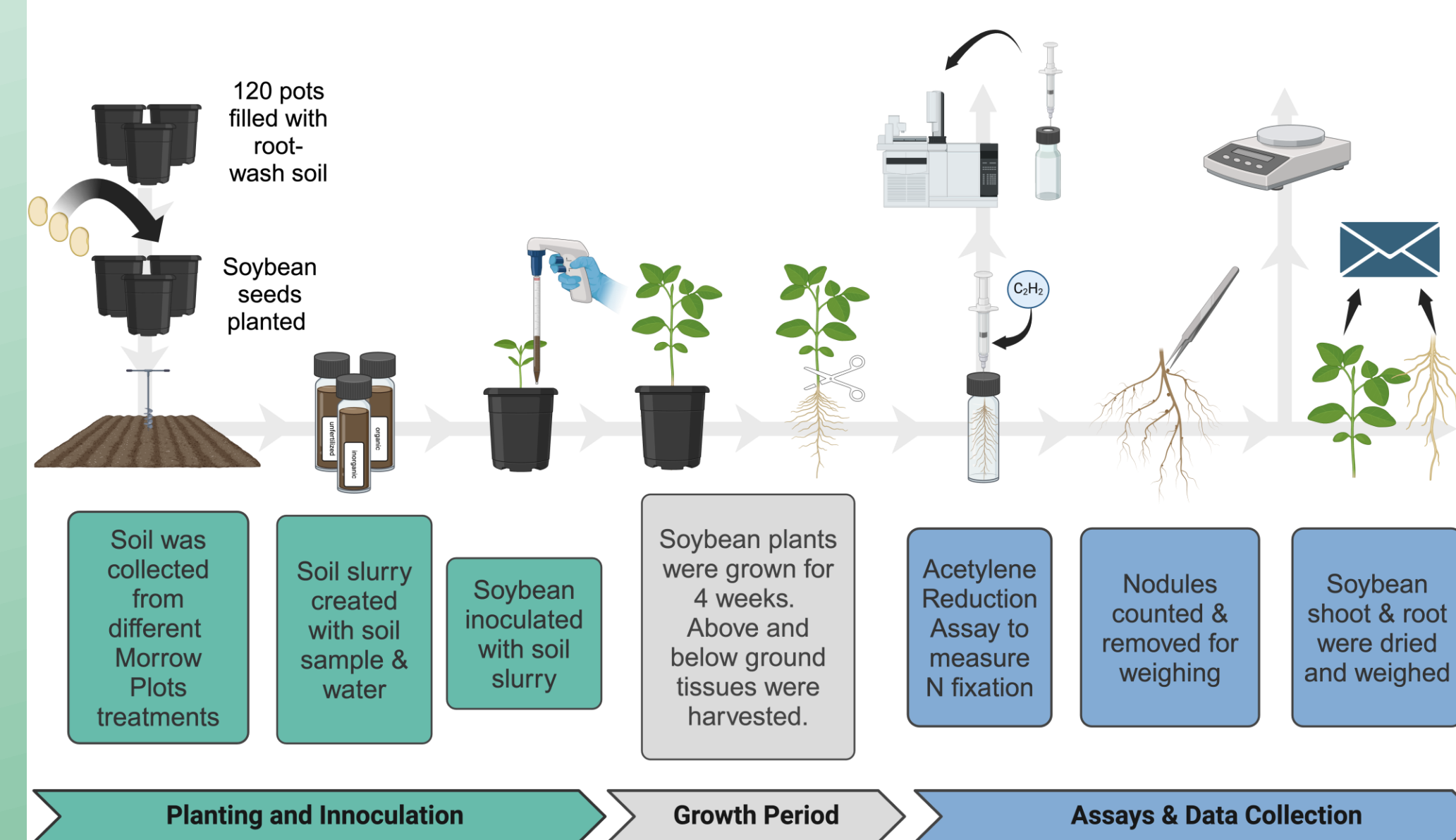


Figure 1 comparison between Morrow Plots treatments a) soil pH b) soil Phosphorus/ppm c) soil Potassium/ppm

Methods



Acetylene Reduction Assay (ARA)

ARA is used to assess the ability of nitrogenase enzyme to convert atmospheric dinitrogen (N_2) into legume available nitrogen (NH_4^+). Acetylene reduction is analogous to nitrogen fixation due to the shared triple bond structure.



Dry Biomass

Soybean dried in oven for 24 hours to eliminate water content.

This allows for standardized measurement of legume biomass.

Nodules

Harvested root system is analyzed by nodule count and mass of nodules.

Since nitrogen fixation takes place in the nodules, nodule size and count can be a measurement of the symbiosis.

Results

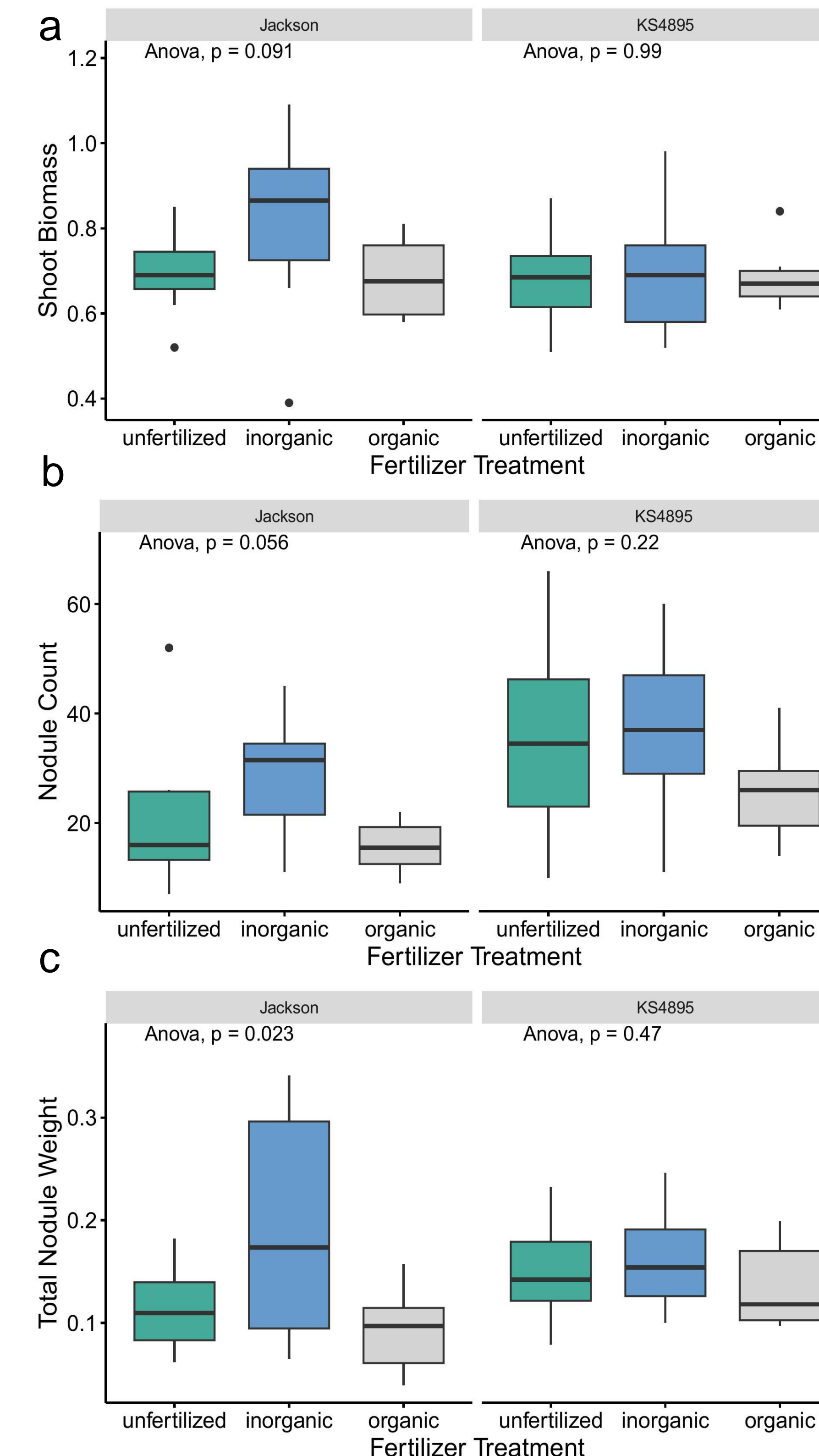


Figure 2 comparison between Jackson & KS4895 soybean cultivars a) dry shoot biomass b) nodule count c) total nodule weight

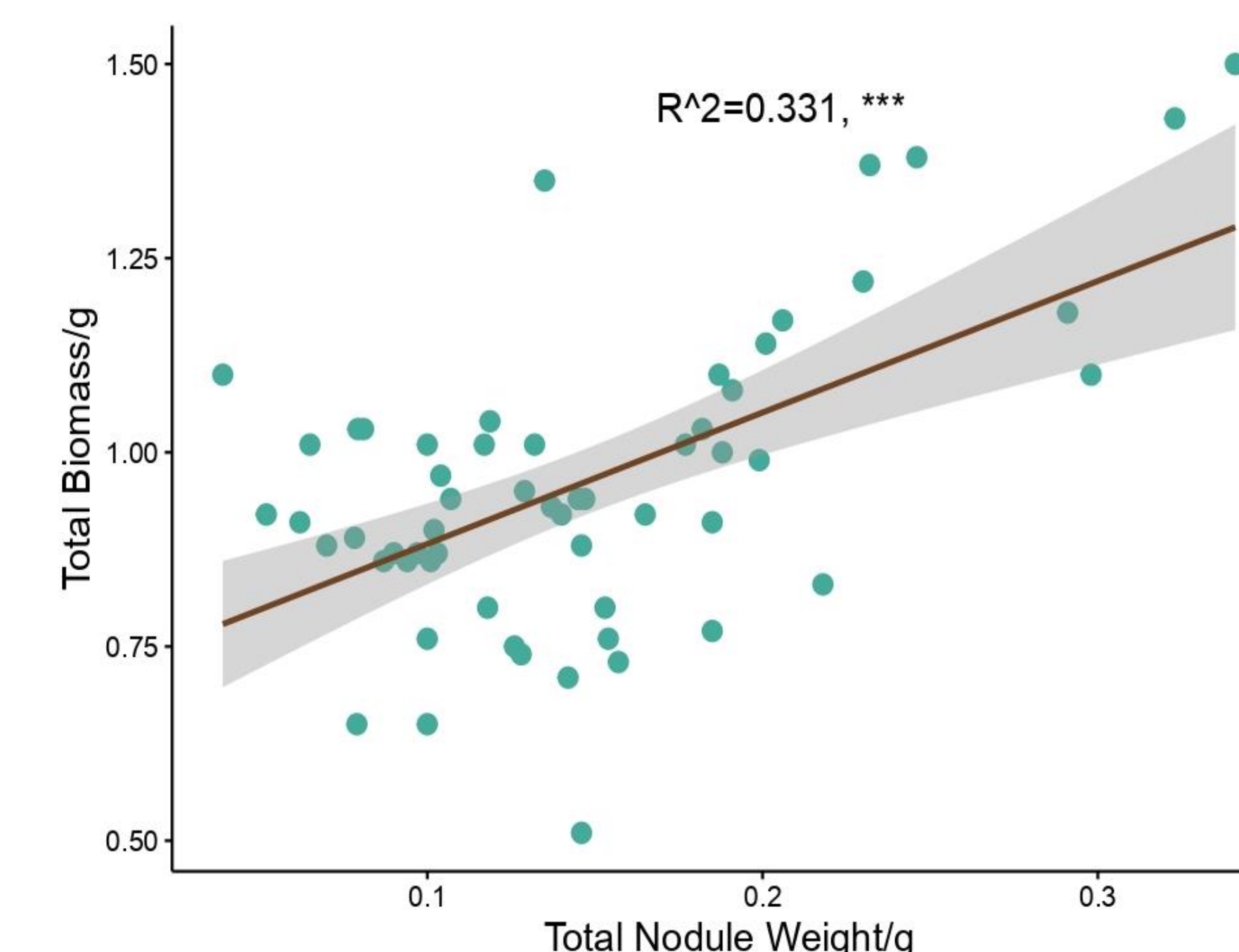


Figure 3 soybean biomass is positively correlated with total nodule weight.

Conclusions

Based on our results, we conclude that long term inorganic nitrogen application produced microbiomes with a modest impact on soybean-*Bradyrhizobium* symbiosis and plant biomass production. However, this promotion was specific to the Jackson cultivar.

Future Work

- Completing ARA by running gas sampling on gas chromatography.
- Relating the ARA results with nodule size and plant health data.

References

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