Back To The Roots: an Analysis of Mycorrhizal Fungi Interaction on Leaf Area and Chlorophyll Content

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Introduction

Introduction

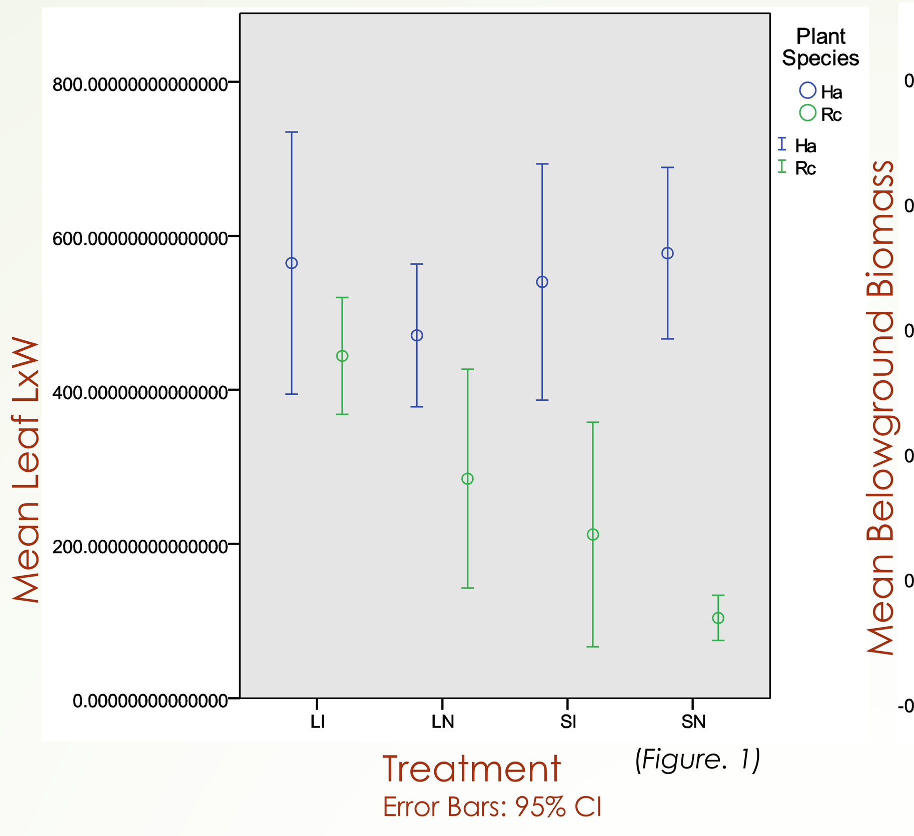
- Mycorrhizal Fungi are widely known to benefit many species of plants, and are essential for plants grown in nutrient poor prairie environments (Dostalek 2016).
- Mycorrhizae attach to plant roots and facilitate nutrient uptake from the surrounding soil.
- Increase plant nutrients can evoke increased photosynthetic production potential, and thus increased chlorophyll content
- AM plants can adjust more easily to salinity stress than non-AM plants, suggesting that these plants will grow larger and more robust in nutrient poor soil (Qiang-Sheng Wu 2006)
- Mycorrhizal can affect plants negatively, especially in contaminated soils with harmful pathogens or bacteria. Mycorrhizae can stunt plant growth by absorbing needed organic carbon from the plant.(Aghababaei 2015)
- Native mycorrhizae from the same area has an evolutionary relationship with plant species, while artificial "Earth Juice Rooters" Mycorrhizae has no evolutionary relationship with the plant species
- "Earth Juice Rooters" mycorrhizae contains 4+ species of AM fungi, and added non-mycorrhizal fungi (Pisolithus tinctorius) which is advertised to promote root growth

Hypothesis: We tested the effects on chlorophyll content and plant biomass of wild and commercial mycorrhizae on a perennial, *Ratibida columnifera* and annual forb *Helianthus annuus*. We predict that any form of mycorrhizae will be beneficial to the plant, and that native mycorrhizae will outperform commercial mycorrhizae.

Methods and Materials

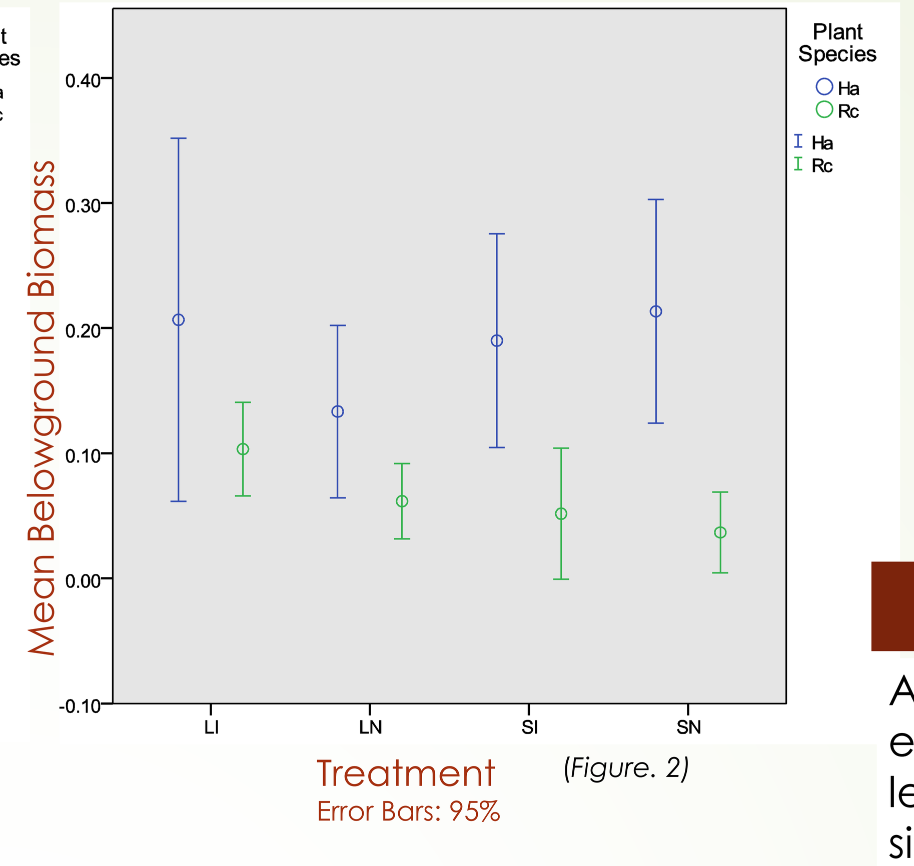
We created four mycorrhizal treatment groups for both *Ratibida columnifera* and *Helianthus Annuus* (8 groups and 48 plants total) utilizing commercial mycorrhizal inoculum and the manipulation of arbuscular mycorrhizal fungi that naturally occur in soils. To test the effect of wild and commercial mycorrhizae on leaf area, biomass, and chlorophyll content. Groups were separated as: 1. Commercial mycorrhizal inoculum present in non-sterilized prairie soil (wild mycorrhizae present), 2. commercial mycorrhizal inoculum present in sterilized prairie soil (wild mycorrhizae absent), 3. commercial mycorrhizal inoculum absent in non-sterilized prairie soil (wild mycorrhizae present), and 4. commercial mycorrhizal inoculum absent in sterilized prairie soil (wild mycorrhizae absent). Plants were placed under constant light and watered as needed throughout experimentation. Each week we collected data on chlorophyll content, using a SPAD meter, and leaf length X width with digital calipers. Dry aboveground and belowground biomass measurements taken one week post-harvest. An ANOVA test was conducted using SPSS to determine treatment significance for each variable.

Treatment Compared to Leaf LxW



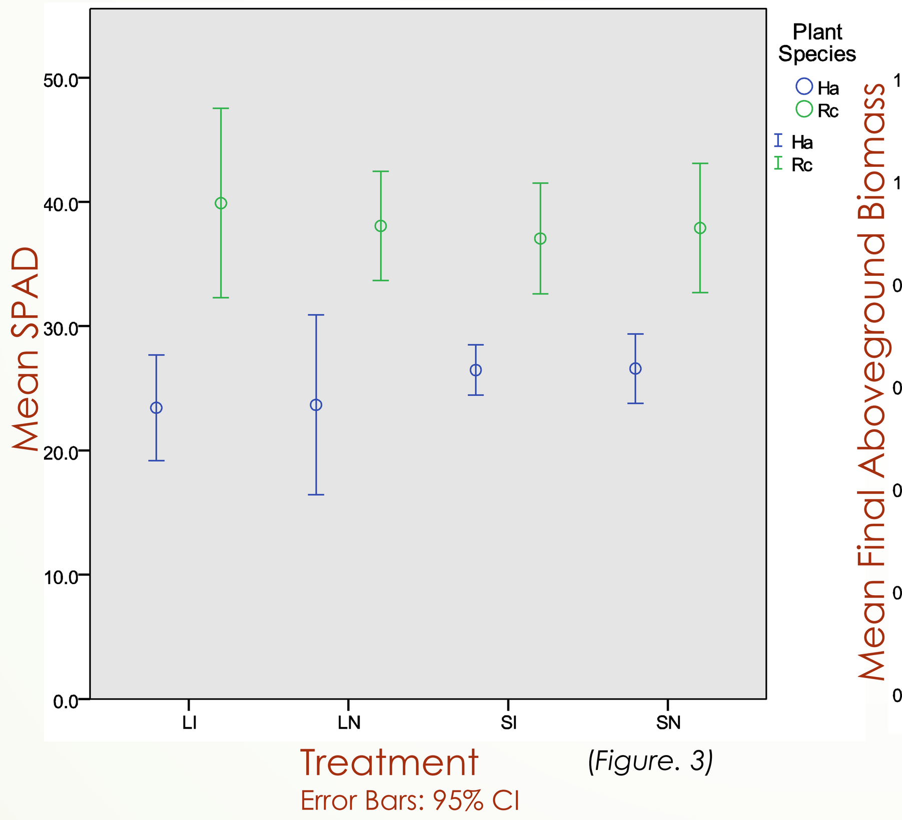
(Figure. 1)

Treatment Compared to Belowground Biomass



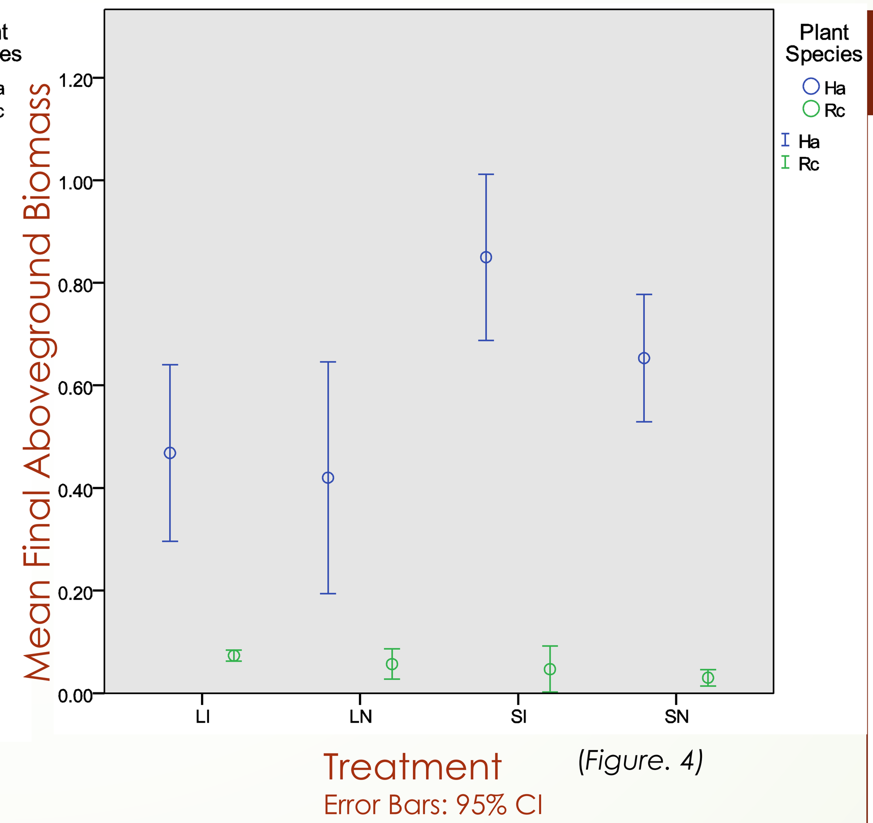
(Figure. 2)

Treatment compared to mean SPAD



(Figure. 3)

Treatment Compared to Mean Aboveground Biomass



(Figure. 4)


(Figure. 5)
(Adult *Ratibida columnifera* flower)


(Figure. 6)
(Adult *Helianthus annuus* flower)

Variable	F Statistic	Significance	Live vs Sterilized	Inoculum
AG Biomass	42.876	0.288	<.001	0.05
BG Biomass	5.83	0.412	0.875	0.214
SPAD	13.196	0.619	0.603	0.91
Leaf Length	12.458	0.688	<.001	0.01
Leaf LxW	13.781	0.557	0.019	0.022

Results

A two-way ANOVA did not reveal statistically-significant treatment effects for any measured plant traits. Inoculum treatments on leaf length and width (.022) and aboveground biomass (.050) were significant. ANOVA also showed that aboveground biomass (<.001) and leaf length and width (.019) was significant, growing in live versus sterilized soils.

Discussion

Significant effects on leaf area could be seen in *Ratibida columnifera*, as there was a noticeable difference from the LI, LN, SI, to SN treatments (Fig. 1). This showed that plants growing in complete absence of mycorrhizae (SN), were significantly harmed by this lack of interaction, and that supported our hypothesis. *Ratibida columnifera* grown in LI soil on the other hand, in the presence of wild and commercial mycorrhizae, outperformed other plant groups. Our treatments had little to no effect on SPAD and leaf area in *Helianthus annuus*; however, the final aboveground biomass of the species was significantly larger in the SI soil treatment (Fig. 1,3,4). This suggests two things, an evolutionary relationship with mycorrhizae may not be as important for helianthus annuus, and, *Helianthus annuus* may be more prone to pathogens or harmful microorganisms present in the live soil and not in the sterile soil.

Ratibida columnifera, a P demanding perennial forb (Karanika 2008), has evolved utilizing mycorrhizae to obtain the phosphorus it needed to reproduce. The dependence upon a specific local strain of mycorrhizae is likely a derived trait from a historical dependence on mycorrhizae in general. *Helianthus annuus*, while commonly found in nutrient poor grassland much like the *Ratibida columnifera*, does not have the same evolutionary dependence on mycorrhizae as the perennial forb. In this case, the added stimulation of non-AM fungi in the commercial innocula could benefit the plant more, especially in sterile soil, absent from pathogens.

References

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