The Effects of Commercial Mycorrhizal Inoculum on *Ratibida columnifera (Rc)* and *Helianthus annuus (Ha)*

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Introduction

•Symbiotic interactions between mycorrhizae fungi and plant roots is a growing study in the field of botany, as well as the effects of localized or foreign soil.
•Sympatric and allopatric mycorrhizae increased plant growth, but localized soil also had a measurable impact (3).
•Mycorrhizae has shown to prevent soil pollutant uptake by a plant, which increases the plant's ability to thrive (1).
•Commercial use of mycorrhizae may be an alternative to rising agricultural energy and fertilizer costs because the mycorrhizae may be able to increase crop yields while reducing fertilizer and energy inputs (2).
•In a test of native versus exotic plants and their mycorrhizal trade-offs, the results can vary between mutualistic and parasitic (4).
•Tallgrass prairie forbs have been utilized along with the addition of mycorrhizal inoculations. The perennial warm season grass and forbs benefitted the most from the mycorrhizal inoculations in the biomass results. The cool season grasses resulted in lower biomass as well as less mycorrhizal colonizations of the root systems (5).

Questions and Hypothesis

Does the mycorrhizae inocula brand, 'Plant Success,' increase the growth of the plants Rc and Ha in natural soil compared to sterile inoculated soil?
Hypothesis 1: Both mycorrhizal treatments will benefit the plants' growth, with natural soil mycorrhizae having a greater benefit over commercial inocula, specifically in height and dry biomass.

Do both commercial and natural mycorrhizae in the same treatment have added benefits compared to: non-mycorrhizal plants, natural-only mycorrhizae treatments, and commercial-only mycorrhizae treatments?
Hypothesis 2: The plants will have the most successful growth rate based on height and biomass in the non-sterilized field soil (containing natural mycorrhizae), specifically those with added commercial mycorrhizae.

Methods

- Two species of plants were used in this study, 24 were Rc-Ratibidia columnifera (Mexican Hat Plant) and 24 of the Ha-Helianthus annuus (Common sunflower).
- There were four different treatments with six plants of both species in each treatments which included:
  (LI) non-sterilized soil with Plant Success commercial mycorrhizae added
  (LN) non-sterilized soil with no commercial mycorrhizae added
  (SI) sterilized soil with the Plant Success commercial mycorrhizae added
  (SN) sterilized soil with no commercial mycorrhizae added
- The plants were transplanted to separate containers with the appropriate soil and one teaspoon of mycorrhizae in each inoculated treatment.
- The chlorophyll content was measured weekly and recorded using the spad meter.
- Plant height was measured weekly and recorded in centimeters.
- The stomata count of one leaf of each plant was taken during the first week of observations and was recorded under the microscope during the second week.
- At the end of the experiment, the above and below ground biomass was recorded in order to calculate mycorrhizal responsiveness.

Figure 1: Week 7 Final Aboveground Biomass of Ha and Rc

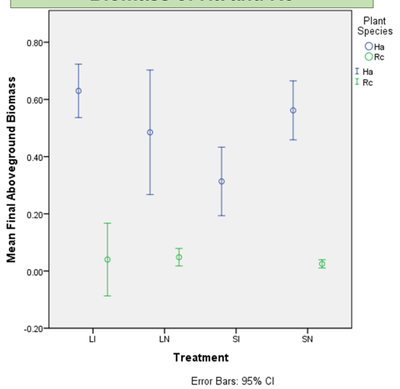


Figure 2: Week 7 Final Belowground Biomass of Ha and Rc

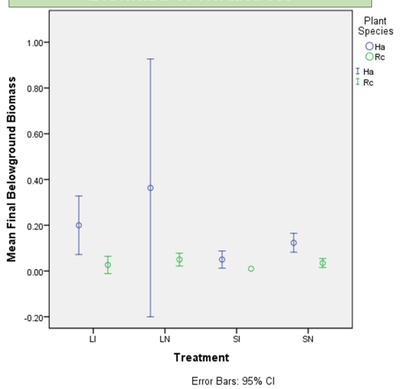


Figure 3: Final Height Measurement of Ha and Rc in centimeters

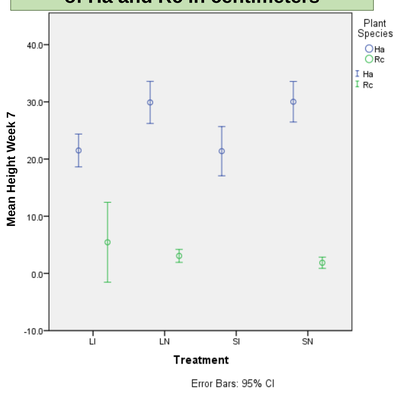


Figure 4: Final Chlorophyll Measurement of Ha

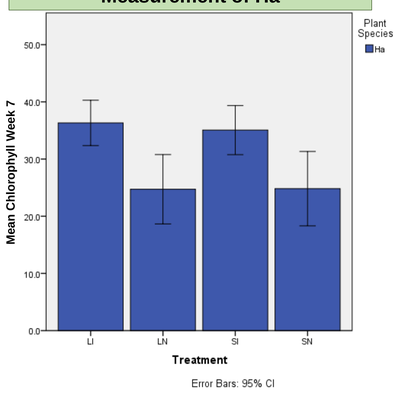


Figure 5: Final Survivorship Percentage of Ha and Rc

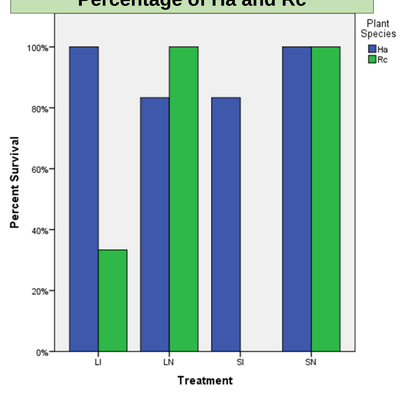
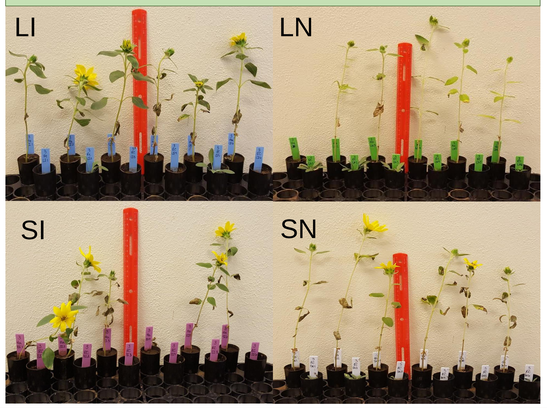


Figure 6: Week 7 Photo of Ha and Rc



Results

- Figure 1: Live soil greater aboveground biomass (P=0.018)
- Figure 2: Live soil greater belowground biomass (P=0.073)
- Figure 3: Non-inoculated treatment taller than inoculated (P=0.583)
- Figure 4: Inoculated treatment had higher photosynthesis levels (P=0.577)
  - Inoculation had varied results between treatments and species of plants. Notably, Rc plants in the sterilized inoculated treatment had no survivors by the end of the experiment.
  - In terms of biomass, for Ha plants, above- and below-ground biomass mean was highest in non-inoculated live soils, but this treatment had the greatest variability by far.
  - The highest mean biomass with relatively low variability for Ha was in inoculated live soil treatments.
  - For both plants' mean biomass, sterilized inoculated treatments had the most detrimental effect, with low mass and low variability.
  - The mean height for Ha plants experienced low variability across all treatments. However, mean heights were significantly lower in both inoculated treatments compared to non-inoculated treatments.
  - The mean height of Rc was highest for the LI treatment, but this treatment experienced significant variability. The other two surviving treatments had similar variability, but the LN treatment plants had a slightly higher mean height.
  - The chlorophyll concentration for Ha plants were inversely affected by the treatments, with inoculated soils leading to greater means than the soils that were not inoculated.

Conclusion and Discussion

The sterile inoculated *Ratibida columnifera* (Rc) had a 0% survival rate. This shows that there may be a negative affect with mycorrhizae and this species of plant. The sterile inoculated *Helianthus annuus (*Ha) had the least amount of biomass in the Ha group. This supports the hypothesis that the mycorrhizae added to natural soil will be of greater benefit than in the sterile soil, but does not support the hypothesis that added mycorrhizae in general will be of a greater benefit than non-inoculated soil. These results show that there could be a synergistic relationship with the mycorrhizae fungi and other species living in the soil. The live soil had a higher aboveground and belowground biomass compared to the sterile soil which supports the live soil hypothesis as well. The live soil also had more nutrients for the plant to uptake, which could explain the increased weight. This also adds to the thought that live soil and mycorrhizae have more benefits together than mycorrhizae in sterile soil alone. The non-inoculated Ha group had a taller final height, but a lower chlorophyll count than the inoculated. This seems to show that the Ha sacrificed height in order to expend energy for photosynthesis. The Rc plants did not grow tall enough out of the planters to get a reading with the spad meter, thus the photosynthesis to height comparison is inconclusive for this group. These results suggest that mycorrhizae can help to increase the chlorophyll build in the Ha, but that there isn't a given benefit to increasing the height of a plant. This also shows that live, and localized, soil can have greater benefits to a plants overall biomass compared to plants in sterile soil.

Literature Cited

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