The Effect of Commercial & Wild Mychorrizae on C4 Grasses

Annagrace Lewis, Dylan Thayer and Colton Burns
Department of Plant Biology, Ecology, and Evolution | Oklahoma State University | Stillwater, OK

Introduction

- Arbuscular mycorrhizal fungi are terrestrial fungi that associate with plant roots, so far, fewer than 200 species have been discovered, but 80 to 90 percent of all plants associate with these fungi (4). The hyphae of the fungus enters the root and penetrates the cell walls of root cells, in order to form a mutualistic relationship.
- The mycorrhizae use glucose and carbon from the host plant as their primary energy sources, converting these products into other fungi specific sugars that are unable to be returned to the host plant (4). In return for the plant's glucose and carbon, the fungus increases the surface area of the roots in vascular plants, which aids in increased water and nutrient uptake (1).
- Arbuscular mycorrhizae provide a significant benefit to plants grown and adapted to low nutrient soils, while plants benefit much less from the fungi when grown and adapted to high nutrient soils (3).
- The commercial use of arbuscular mycorrhizae may be a viable alternative to the rising use and costs of modern fertilization processes (2).

The main questions in this study that will be addressed include:

- What the effects of commercially available mycorrhizae for plant biomass comprise, how commercial mycorrhizae compares with wild mycorrhizae in terms of plant biomass growth, and if commercial and wild mycorrhizae actually interact to influence plant biomass.

Hypothesis

We hypothesize that sterile soil that is inoculated with commercial mycorrhizal fungi (SI) will show the greatest increase in the overall plant biomass due to the fact that the soil does not already have living mychorriza that could potentially compete with the commercial mychorriza.

Treatment Groups	*Sorghastrum nutans*						*Sorghum bicolor*					
LI	1	2	3	4	5	6	1	2	3	4	5	6
SI	1	2	3	4	5	6	1	2	3	4	5	6
LN	1	2	3	4	5	6	1	2	3	4	5	6
SN	1	2	3	4	5	6	1	2	3	4	5	6

Number of Plants in each Group

Table 1 (left): Experiment Groupings

Methods

1. We used two plant species: *Sorghastrum nutans* and *Sorghum bicolor.*
2. In half the plants, we inoculated with Root Naturally Endo Mycorrhizae.
3. The two species will be subject to our treatment levels and replicated six times with a total of 24 individual plants within a species and 48 individual plants total. *(Table 1)*
4. Our treatment levels are as follows: 1. The control group, commercial mycorrhizal inoculum present with non-sterilized prairie soil (LI), 2. Commercial mycorrhizal inoculum present with sterilized prairie soil (SI), 3. Commercial mycorrhizal inoculum absent with non-sterilized prairie soil (LN), and 4. Commercial mycorrhizal inoculum absent with sterilized prairie soil (SN).
5. Record the survival and measure the stem/plant height with a ruler each week for four weeks.
6. Take final measurements, including plant biomass, and record final leaf count of each plant at the end of four weeks.
7. Perform a two-way ANOVA test and a t-test to get a p-value.

Results

- *Figure 1* shows that the Sb Plant Species' aboveground biomass was greatly affected by the sterilized soil treatment groups. The sterilized soil that was not inoculated (SN) produced the greatest aboveground biomass at about 0.30 grams.
- *Figure 2* shows that the Sb Plant Species' belowground biomass was also greatly affected by the sterilized soil treatment groups. The sterilized soil that was not inoculated (SN) produced the greatest belowground biomass at about 0.50 grams.
- *Figure 3* shows that the Sn Plant Species' aboveground biomass was affected primarily by the sterilized soil that was inoculated with the commercial mychorriza (SI), and weighed about 0.12 grams. The living soil that was inoculated with the commercial mychorriza (LI) was the next most affective treatment group, weighing about 0.08 grams.
- *Figure 4* shows that the Sn Plant Species' belowground biomass was affected primarily by the sterilized soil that was inoculated with the commercial mychorriza (SI) , and weighed about 0.15 grams.
- The height of the plants was also measured, however, there was not a significant difference in the data.

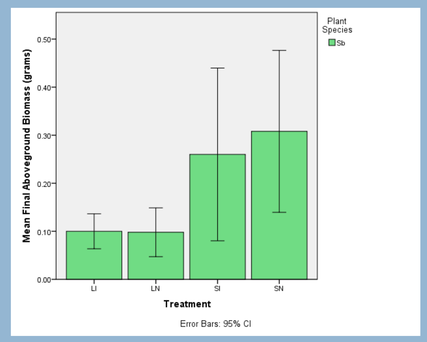

Figure 1 (above): Sorghum bicolor Plant Species Aboveground Final Biomass

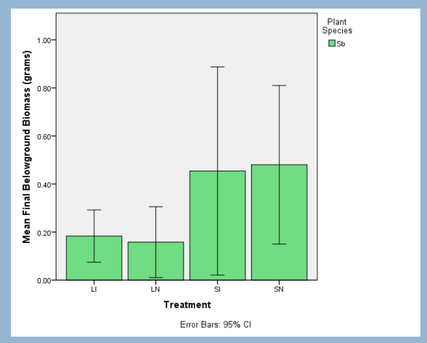

Figure 2 (above): Sorghum bicolor Plant Species Belowground Final Biomass

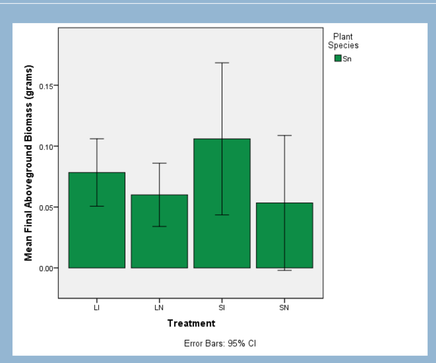

Figure 3 (above): Sorghastrum nutans Plant Species Aboveground Final Biomass

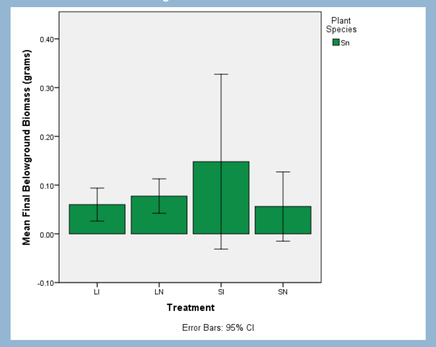

Figure 4 (above): Sorghastrum nutans Plant Species Belowground Final Biomass

Above shows *Sorghum bicolor* treatment groups

Above shows *Sorghastrum nutans* treatment groups

Discussion

Our hypothesis that stated the sterilized soil inoculated with commercial mychorriza would show the greatest increase in the overall biomass of the plant was supported. *Sorghum bicolor* seemed to favor the sterilized soil compared to the living soil, but the presence of mychorriza did not have an influence on the overall biomass. Mychorrizal fungi does not show to have an affect on the growth of *Sorghum bicolor*. *Sorghastrum nutans,* however, flourished in the presence of mychorriza. In the aboveground biomass measurements, sterilized soil with inoculated commercial mychorriza greatly increased the growth compared to the other treatment groups. The living soil with inoculated commercial mychorriza also had a positive affect on the aboveground biomass. In the belowground biomass, the sterilized soil with inoculated commercial mychorriza was the most significant treatment group. Overall, *Sorghum bicolor* seems to not require mychorriza for increased growth, but sterilized soil. *Sorghastrum nutans* is impacted by mychorriza, and does increase its' nutrient uptake with the fungi without any relevance to the need for sterilized or living soil.

In previous studies, mychorriza has been shown to increase nutrient and water uptake for the plant, but only in certain species. Based on our results, *Sorghum bicolor* is a species that is not affected by mychorriza, while *Sorghastrum nutans* is a species that thrives in the presence of mychorriza. In order to solidify these results, further research would need to be done on these two species. More research would show if mychorriza really does not have a positive effect on *Sorghum bicolor*. There does not seem to be any question if it influences *Sorghastrum nutans,* but because both of these species are C4 grasses, it would be implied that they would have the same influence in the presence of mychorriza. If this experiment was repeated, larger containers would be a better investment so that the belowground biomass is not limited to a small space and influences the results.

Literature Cited

1. John, T.V.S., and D.C. Coleman. 1983. The role of mycorrhizae in plant ecology. *Canadian Journal of Botany* 61: 1005–1014.
2. Menge, J.A. 1983. Utilization of vesicular–arbuscular mycorrhizal fungi in agriculture. Canadian Journal of Botany 61: 1015–1024.
3. Rúa, M.A., A. Antoninka, P.M. Antunes, V.B. Chaudhary, C. Gehring, L.J. Lamit, B.J. Piculell, et al. 2016. Home-field advantage? Evidence of local adaptation among plants, soil, and arbuscular mycorrhizal fungi through meta-analysis. BMC Evolutionary Biology 16.
4. Sadava, D., D.M. Hillis, H.C. Heller, and M.R. Berenbaum. 2012. Life: The Science of Biology. Tenth. The Courier Companies, Inc.

Acknowledgements

We would like to thank Howard Hughes Medical Institute for the funding for this experiment. We would also like to thank the Department of Plant Biology, Ecology, and Evolution for the opportunity to conduct this experiment. The idea for this experiment was developed by Dr. Janette Steets, so we would like to thank her for her contribution to this experiment.