Wild vs. Commercial Arbuscular Mycorrhiza in Prairie Plants

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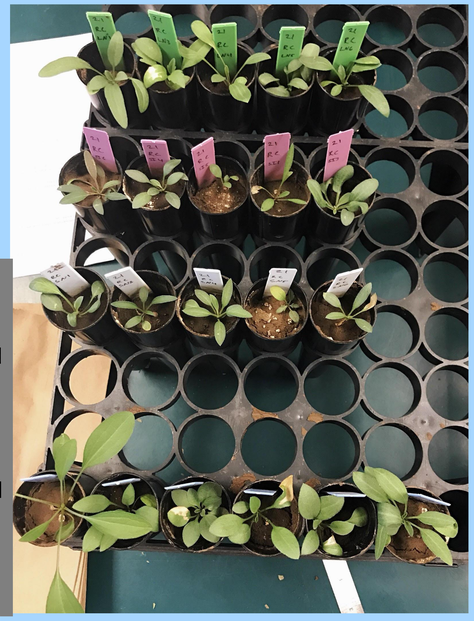
1 Introduction

Over 90% of species of plants have a symbiosis with Arbuscular Mycorrhizae fungi. Their symbiosis is mutualistic because the plant receives increased uptake in water and nutrients, while the fungi receive carbon from the plant produced during photosynthesis. Many plants see increases in growth rates and survival, and higher rate of photosynthesis due to extended root surface area caused by mycorrhizae, which increases water, nutrient, and mineral uptake of the plant. This increased uptake may also increase the plants leaf and thus sunlight harvesting area (Adolphsonn 2015), which one may predict would lead to a higher rate of photosynthesis. Given the many benefits of mycorrhizae fungi, many companies have begun to develop and sell commercial mycorrhizae inoculum (Corkidi 2004). We set up an experiment to answer the question of whether commercial mycorrhizae would cause a greater increase in plant biomass and photosynthetic rate than wild mycorrhizae found in natural soils of Oklahoma. We used a commercial mycorrhizae produced by Sustainable Agricultural Technologies. Since the commercial mycorrhizae is composed of 3 different species of Arbuscular mycorrhizae and is specifically engineered to be beneficial, we hypothesized that the commercial strains would have more of a symbiotic benefit than the wild mycorrhizae. The two plant species that we compared were the slow-growing perennial, *Ratibida columnifera,* and a semi-weedy annual with a taproot, *Helianthus annuus.* We expected that the faster growing annual *Helianthus annuus* would develop a symbiosis faster and thus would benefit more from its fungal partner than the *Ratibida columnifera,* leading to increased biomass.

2 Methods

- To test whether commercial mycorrhizae was more beneficial than wild mycorrhizae, we compared the commercial mycorrhizae brand Sustainable Agricultural Technologies Endomycorrhizae with native Oklahoman mycorrhizae comparing production of two native prairie species, *Helianthus annuus* and *Ratibida columnifera*.
- Both species had a replication of 6 plants per treatment:
  1. Non-Sterilized prairie soil with inoculum(LI)
  2. Sterilized prairie soil without inoculum (SN)
  3. Non-Sterilized prairie soil without inoculum (LN)
  4. Sterilized prairie soil with inoculum (SI)
- Each week we measured length times width of two leaves and took the average.
- We used a LiCor6400 instrument to measure photosynthetic carbon assimilation to calculate Maximum rate of photosynthesis
- We removed plants from pots, washed off their roots, and dried them for a dry weight root and shoot biomass measurement.
- Lastly we took our final data and conducted a two-way ANOVA to test for effects of the above treatments on our measured plant traits



Blue Tag: Live soil with Commercial Inoculum
White Tag: Sterilized soil with out commercial inoculum
Purple Tag: Sterile Soil with commercial inoculum
Green Tag: Live soil without commercial inoculum.

Photo 1. *Ratibida* at the conclusion of the experiment.

Photo 2. Measuring sunflower photosynthesis with the Licor instrument!

Trait	F statistic	overall treatment effect	live vs sterilized soil	Inoculate vs No Inoculate	sterilized inoculate interaction
Biomass	28.835	<0.001	0.016	0.853	0.571
leaf area	12.626	<.001	0.001	0.295	0.044
Photosythetic rate	2.433	0.115	0.179	0.134	0.128

Table 1. Here is a table showing our ANOVA test results.

Picture 1. Heilianthus annuus

Picture 2. Ratibida Columnifera

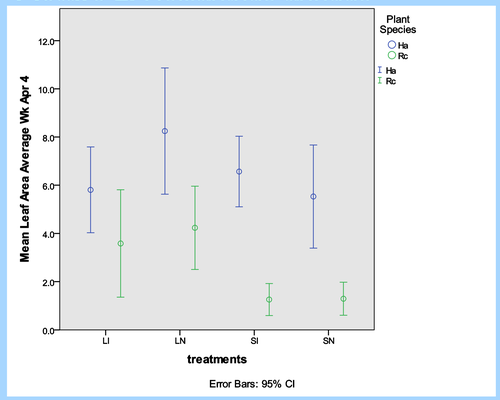


Figure 1. Total Biomass of Ratibida (green) and Heilianthus (blue) in four treatments.

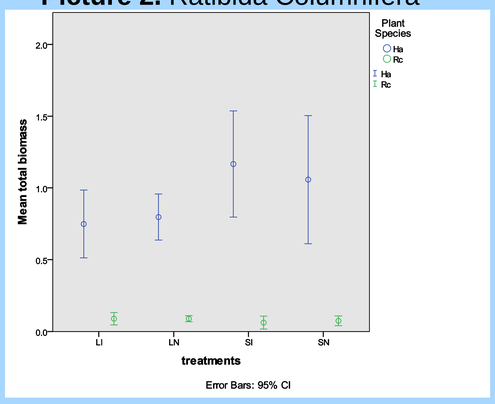


Figure 2 Leaf lenth x width of Ratibida (green) and Heilianthus (blue) in four treatments.

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3 Results

- A two way ANOVA test showed Soil treatment significantly affected biomass(*P*= .016) and leaf area (*P*= .001). Across the two species we see plants grown in sterile soil are larger than plants grown in live soil (figure 1). Although we see plants grown in sterile soil have smaller leaves that plants grown in live soil (figure 2)
- For biomass and leaf area we did not see any statistically significance from the inoculum treatment groups.
- There was a statistically significant interaction between soil treatments and inoculate treatments on leaf area(*P*= .044) but not on biomass(*P*=.571).
- For our photosynthetic rate variables we pooled from a small sample size of *Helianthus* only but our results showed no statistically significant figures.

4 Conclusion

Our hypothesis that commercial mycorrhizal fungi from Sustainable Agricultural Technologies would provide a stronger symbiotic benefit than wild mycorrhizae was not supported. On the contrary, when both species were grown in live soil with wild mycorrhizae they had larger leaf LxW. There was also a better outcome for the biomass of each species when grown in the live soil as compared to the sterilized soil. Although both species had larger leaf LxW, Helianthus seemed to benefit more, lending support to our prediction that *Ratibida columnifera* would not form a symbiosis as fast. This leads us to believe the *Ratibida* did not form a symbiosis with the commercial mycorrhizae but since it is a native plant growing in native soil, we believe this helped it grow larger leaves. For both the inoculum and soil treatments, our hypothesis was further not supported; whether the soil was live or sterile the groups with commercial mycorrhizae cumulatively showed lower results in all plant traits. When measuring photosynthetic rater, we predicted that the plants grown in the commercial mycorrhizae would have a higher value, but the results showed no significant difference across treatments. Without the time restraint and possible stress that could have resulted from small pots we could have seen different results. If we were to conduct this experiment again we would take a longer period to grow the plants, so that mycorrhizae would likely form a stronger symbiosis. We also think the experiment would produce different results if we had access to larger planting space for more trials and to create less stress on plant root systems. Farmers in Oklahoma might consider utilizing local wild mycorrhizae over the commercial mycorrhizae in order to yield better results.

5 Acknowledgments

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Literature Cited

ADOLFSSON L., SOLYMOSI K., ANDERSSON MX., KERESZETS A, UDDLING J, SCHOEFS B., et al. 2015. Mycorrhizae symbiosis increases the surface for sunlight capture in Medicago truncatula for better photosynthetic production. *PLos ONE* 10:8

LEA C, EDITH B., DONALD M, MICHAEL F., JAMES D., JEFF B., et al. 2004. Assessing the infectivity of commercial mycorrhizal *Journal of Environmental Horticulture* 22:149-154

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