Natural and Synthetic Mycorrhizae Symbiosis with *Bromus inermis* and *Elymus canadensis*

Madi Franklin, Bailey Olvera, Chelsea Cornett, Josh Randolph
Department of Plant Biology, Ecology, and Evolution, Oklahoma State University

Introduction:

Mycorrhizae are a type of fungus that reside in the roots of many plants across the globe. Proven as a necessary symbiont due to nutrients becoming more easily available to plant roots, mycorrhizae has a positive effect on plant growth and soil quality (Hamel 1996). In an effort to enhance the success of crops and therefore increase crop yield, mycorrhizae inoculation solutions have been created and are being sold for commercial use. The addition of synthetic mycorrhizae to desert, depleted, or synthetic soils that may not have a strong population of natural mycorrhizae can be extremely beneficial to plant success. For the overall experiment, we tested how different commercial mycorrhizae inoculate effects the plant biomass, chlorophyll count, and leaf width of two different grass species: *Bromus inermis* and the *Elymus canadensis*. We also examined the relationship between sterilized and unsterilized soil to see if natural mycorrhizae thrived better by themselves or with natural mycorrhizae, and then tested how the soil affected the growth of mycorrhizae and the growth of the plant. We expect that both species will grow best in the mycorrhizae inoculated, non-sterilized soil because this would create and environment with both natural and synthetic mycorrhizae. Therefore, these plants will also have the highest chlorophyll content, grass width, and biomass due to increased nutrient uptake from the mycorrhizae symbiosis. We also expect that plants without inoculant will grow better in a non-sterilized soil environment than the sterile soil due to the presence of natural mycorrhizae.

Methods:

We tested the effect of wild mycorrhizae versus commercial mycorrhizae on the chlorophyll content and blade width of the grasses *Bromus inermis* and *Elymus canadensis.* Our four treatment groups were divided into commercial mycorrhizae in a non-sterilized prairie soil, commercial mycorrhizae in sterilized prairie soil, no commercial mycorrhizae in non-sterilized prairie soil, and no commercial mycorrhizae in a sterilized prairie soil. Each treatment group had six replicates to make twenty-four total plants, and then we repeated the experiment for two grass species making forty-eight total plants . We separated the four treatment groups of each species into two groups based on whether or not they were going to receive commercial mycorrhizae or not receive commercial mycorrhizae. Every week we measured the blade width of each grass blade in centimeters for both species using a ruler, and we measured the chlorophyll content of each plant using a SPAD meter. At the end of the experimental period, we harvested the plants and obtained measurements for the above ground and below ground biomass in order to calculate the responsiveness of the mycorrhizae.

Bromus inermis

Elymus canadensis

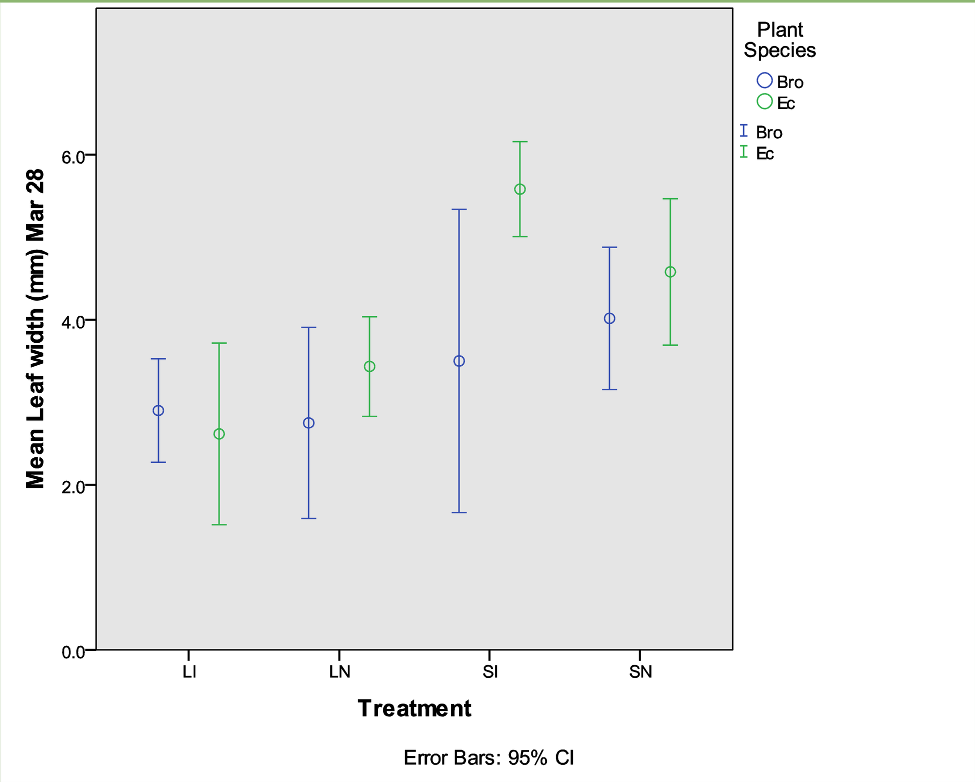

Figure 1. The mean leaf width of each treatment level for *Bromus inermis* and *Elymus canadensis*

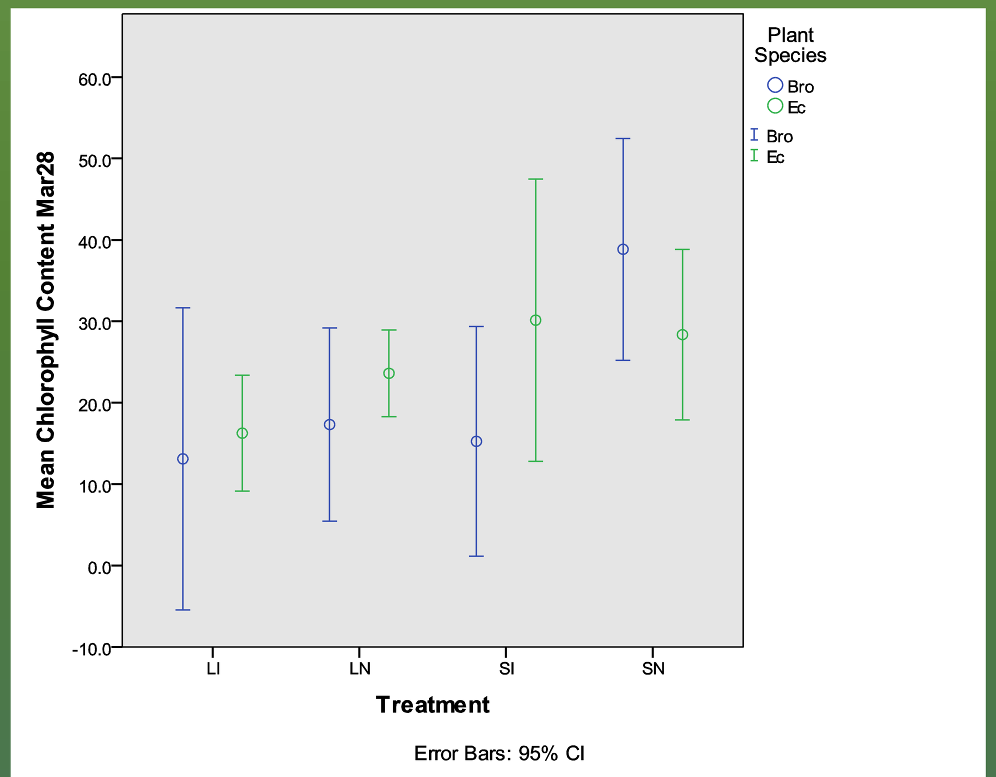

Figure 2. The mean chlorophyll content of each treatment level for *Bromus inermis* and *Elymus canadensis.*

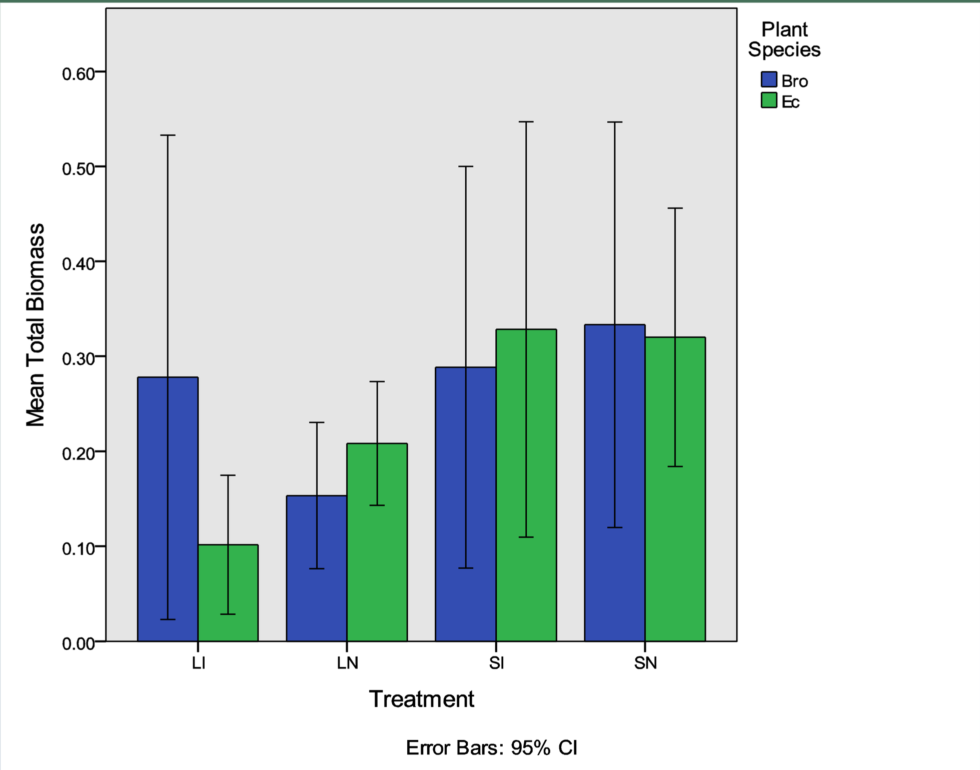

Figure 3. The mean total biomass of each treatment level for *Bromus inermis* and *Elymus Canadensis.*

Results:

Three different two-way ANOVAs were conducted to examine the effects of soil treatment, inoculum treatment, and plant species on the leaf width, the chlorophyll content, and the total biomass of *Bromus inermis* and *Elymus canadensis.*

- The two –way ANOVA conducted on the leaf width showed a significant difference with the soil treatment (p=<0.001) and plant species (p=0.012). It also showed a statistically significant interaction between inoculum treatment and plant species (p= 0.039).
- The two-way ANOVA conducted on the chlorophyll content showed a significant difference with the soil treatment(p=0.004) and the inoculum treatment (p=0.022). It also showed a statistically significant interaction between inoculum treatment and plant species (p=0.048).
- The two-way ANOVA conducted on the total biomass showed a significant difference in only the soil treatment (p=0.006).

Using SPSS statistical software, graphs of each of the independent variables were created:

- Figure 1 shows the mean leaf widths of both species. According to the graph, there is a significant difference between the species in the sterilized, inoculated treatment level where Elymus canadensis appears to have grown better than Bromus inermis.
- Figure 2 shows the mean chlorophyll content of both species. According to the graph, there is no statistically significant differences in means, although there is a slight difference in means between the species in the sterilized, inoculated treatment and the sterilized, non-inoculated treatment level.
- Figure 3 shows the total biomass and the error bars of both species. It shows a slight difference in means of the two species in the living, inoculated treatment group.

Discussion:

From our results we believe that the sterilized, inoculated (SI) soil benefitted the leaf width more than the other treatments. Although, we do believe that this could have been random due to the fact that the experiment was very short and so the plants had not had time to fully develop their leaf width. In the results for chlorophyll content, it is shown that there was a slight difference in the sterilized, inoculated (SI) and sterilized, non-inoculated (SN) in the species. The *Elymus canadensis* appeared to benefit more in the SI while the *Bromus inermis* appeared to benefit more in the SN. The biomass of both species seemed to benefit more in the sterilized soil, but there was not much difference between the SI and the SN. The best we can explain this is that while the sterilized subjects did better, there was not enough time to see the full results of the biomass differences in the SI and the SN soil. The results that we obtained were not what we had hoped. While there were some differences, our thought is that because the experiment was short, the plants did not have enough time to fully develop. Therefore, we could not fully test the effects that the different types of soil and mycorrhizae had on the subjects.

Citations:

HAMEL, C. 1996. Prospects and problems pertaining to the management of arbuscular Mycorrhizae in agriculture. Agriculture, Ecosystems and Environment 60: 197 210.

MAHENDRAN, G., V. MUNIAPPAN, M. ASHWINI, T. MUTHUKUMAR, AND V. NARMATHA BAI. 2013. A symbiotic seed germination of Cymbidium bicolor Lindl. (Orchidaceae) and the influence of mycorrhizal fungus on seedling development. Act Physiologia Plantarum 35: 829-840.

MIRANSARI, M., H.A. BAHRAMI, F. REJALI, AND M.J. MALAKOUTI. 2009. Effects of arbuscular mycorrhiza, soil sterilization, and soil compaction on wheat (Triticum aestivum L.) nutrients uptake. Soil and Tillage Research 104: 48-55.

WILSON, G.W.T., D.C. HARTNETT, M.D. SMITH, K. KOBBERMAN. 2001. Effects of mycorrhizae on growth and demography of tallgrass prairie forbs. American Journal of Botany 88: 1452-1457.

ZHU, X.C., F.B. SONG, S.Q. LIU, T.D. LIU, AND X. ZHOU. 2012. Arbuscular mycorrhizae improves photosynthesis and water status of Zea mays L. under drought stress. Plant Soil and Environment 58: 186-191.