The Effects of Mycorrhizal Fungi Inoculum and Soil Type on *Sorghum bicolor* and *Sorghastrum nutans* Based on Chlorophyll Content and Stem Diameter

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INTRODUCTION

Background

Mycorrhizal fungi is able to create a relationship with plant roots and act as biofertilizers, bioprotactants, and biodegraders. (Mishra et.al 2016) When the fungi was introduced to different *Sorghum* genotypes is was found that there was greater plant production. (Cobb 2016) Chlorophyll content also increases when mycorrhizae are present. (Arun 2013). In turn, photosynthesis is increased and overall plant growth may be increased.

In the presence of mycorrhizae water uptake is increased. (Piao 2016) With an increase in water uptake there is an increase in vascular tissue. Vascular tissue runs through the stem of a plant. With this overall increase, it is likely there is an increase in the stem diameter in the presence of mycorrhizae.

Recent studies say microbial community benefits can greatly increase plant performance creating a tradition of abundance, diversity, and coexistence. (Herzberger 2015) As we look to the future, mycorrhizae could play an important role in environmental health as well as increasing crop production.

Hypotheses

1. Mycorrhizae will increase the chlorophyll content in *Sorghum bicolor* and *Sorghastrum nutans* planted in native (non-sterile) soil.
2. Mycorrhizae will have a positive effect on the stem diameter in *Sorghum bicolor* and *Sorghastrum nutans* planted in native (non-sterile) soil.

METHODS

Sorghastrum nutans and *Sorghum bicolor* were planted evenly in sterilized and non-sterilized soil into 48 cone-tainers. After that the plants were evenly divided by species and soil-type. Half of each group was given "Extreme Gardening Mykosk" commercial mycorrhizae. The treatment groups were as follows:

6 - *Sorghastrum nutans*(Sn) – sterilized prairie soil(S) – (+) Mycorrhizae inoculum(I)
6 - *Sorghastrum nutans*(Sn) – sterilized prairie soil(S) – (-) Mycorrhizae inoculum(N)
6 - *Sorghastrum nutans*(Sn) – non-sterilized prairie soil(L) – (+) Mycorrhizae inoculum(I)
6 - *Sorghastrum nutans*(Sn) – non-sterilized prairie soil(L) – (-) Mycorrhizae inoculum(N)
6 - *Sorghum bicolor*(Sb) – sterilized prairie soil(S) – (+) Mycorrhizae inoculum(I)
6 - *Sorghum bicolor*(Sb) – sterilized prairie soil(S) – (-) Mycorrhizae inoculum(N)
6 - *Sorghum bicolor*(Sb) – non-sterilized prairie soil(L) – (+) Mycorrhizae inoculum(I)
6 - *Sorghum bicolor*(Sb) – non-sterilized prairie soil(L) – (-) Mycorrhizae inoculum(N)

Chlorophyll content and stem diameter were measured weekly for three weeks. Chlorophyll content was measured using a soil plant analysis development (SPAD) meter. Stem diameter was measured using digital calipers. The teaching assistants (TAs) took care of the day-to-day care of the plants. Plants were harvested after eight weeks and the root and shoot biomass was weighed.

All statistical comparisons were made between groups and not individual plants. All the gathered data was analyzed using ANOVA test in the program SPSS. An alpha (α) of 0.05 was used to test significance. Graphics and illustrations were also generated using SPSS.

RESULTS

Stem diameter *Sorghum bicolor*:
Figure 2 demonstrates stem diameter in week three had a significant effect from soil treatment (F=6.266, p-value=0.021). Also there was no significant effect on stem diameters in week three from inoculum treatment (F=2.017, p-value=0.171).

Chlorophyll content *Sorghum bicolor*:
There is no significant effect on chlorophyll content in week three from soil treatment (F=1.111, p-value=0.305). There is also no significant effect on chlorophyll content in week three from inoculum treatment (F=0.017, p-value=0.897)

Stem diameter *Sorghastrum nutans*:
Stem diameter in week three had no significant effect from soil treatment (F=0.015, p-value=0.0.903). Also there was no significant effect on stem diameters in week three from inoculum treatment (F=0.061, p-value=0.808).

Chlorophyll content *Sorghastrum nutans*:
There is a significant effect on chlorophyll content in week three from soil treatment (F=6.406, p-value=0.020), which is shown in figure 4. There is also no significant effect on chlorophyll content in week three from inoculum treatment (F=2.168, p-value=0.157).

Above-ground biomass:
There significant species effect on above-ground biomass (F=17.455, p-value=0.000). There is also a significant effect on above-ground biomass from soil treatment (F=26.766, p-value=0.000). There is no significant effect on above-ground biomass from inoculum treatment (F=0.091, p-value=0.764). The effects on above-ground biomass can be seen in figure 1.

Below-ground biomass:
There significant species effect on below-ground biomass (F=14.167, p-value=0.001). There is also a significant effect on below-ground biomass from soil treatment (F=20.427, p-value=0.000). There is no significant effect on below-ground biomass from inoculum treatment (F=1.188, p-value=0.282). The effects on below-ground biomass can be seen in figure 3.

RESULTS

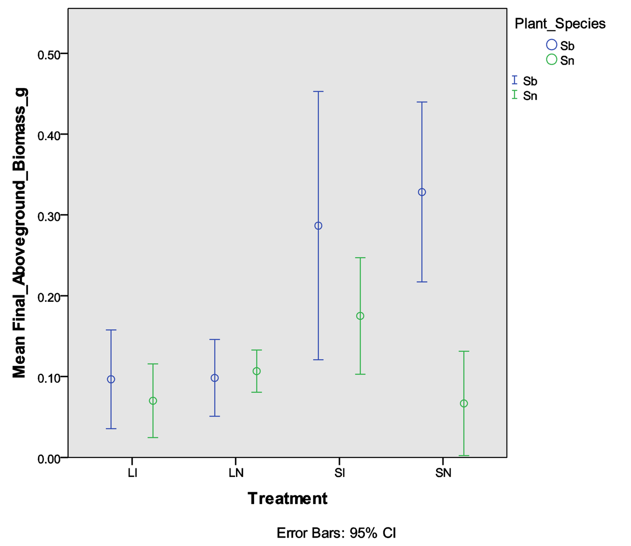

Figure 1. Mean final above-ground biomass (g) by plant species as a function of treatment type

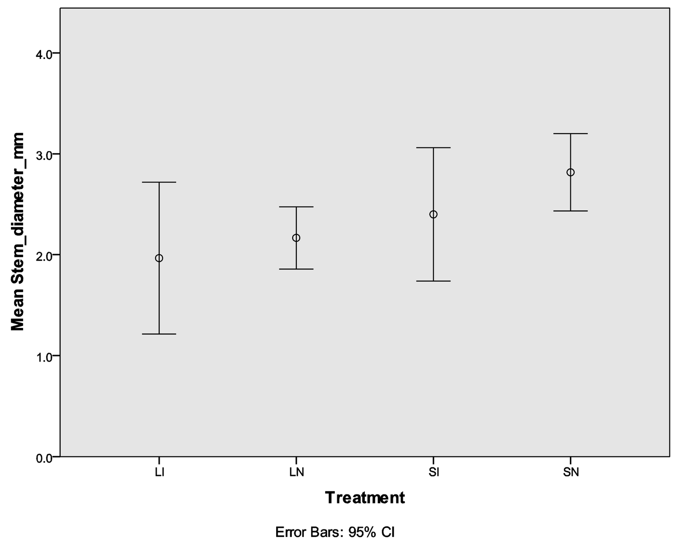

Figure 2. *Sorghum bicolor* mean stem diameter (mm) in week 3 as a function of treatment type

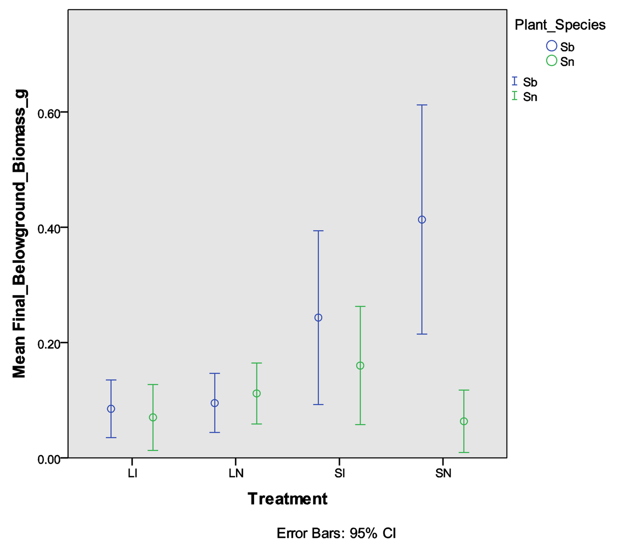

Figure 3. Mean final below-ground biomass (g) by plant species as a function of treatment type

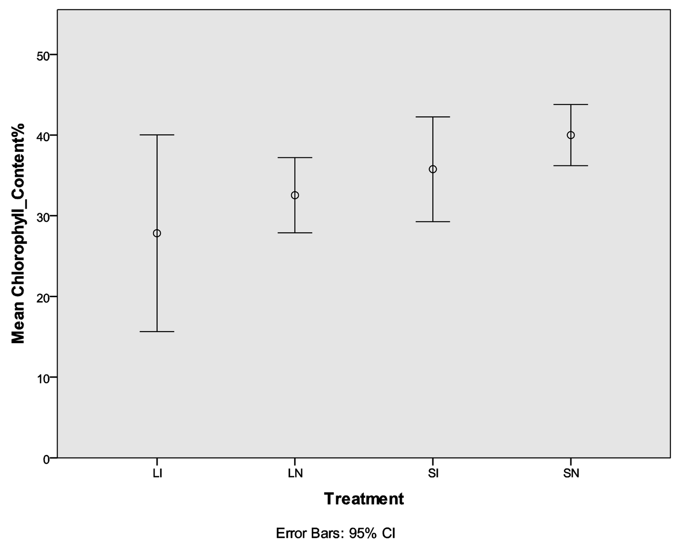

Figure 4. *Sorghastrum nutans* mean chlorophyll content (%) in week 3 as a function of treatment type

CONCLUSION

Biologically we are able to conclude there was and effect from non-sterile (native) soil versus sterile soil in *Sorghum bicolor*. Figure 2 shows the mean stem diameter for the sterile soil plants is slightly higher than those with native soil. For this particular species sterile soil is more effective in increasing stem diameter. For *Sorghastrum nutans* there was no effect from the type of soil on the stem diameter. Whether there was mycorrhizae inoculum present or not had no effect on either species. In regards to stem diameter, based on the results of this experiment, our hypotheses was proven to be incorrect.

The chlorophyll content was effected by the soil type in *Sorghastrum nutans.* Figure 4 shows a slightly higher mean of chlorophyll content in the plants with sterile soil. In the *Sorghum bicolor* soil type had no effect on chlorophyll content. The presence or absence of mycorrhizae inoculum had no effect on chlorophyll content for either species. Based on the results from this experiment, our hypothesis regarding chlorophyll content was incorrect.

Above-ground and below-ground biomass was effected by species type and soil type. Figures 1 and 3 show a larger biomass from *Sorghum bicolor*. Also shown in both figures is that both species grown in sterile soil had overall increased biomass.

Overall it appears the plants in the sterile soil saw a positive growth increase (Figure 5 & 6). We also learned the commercial inoculum used did not seem to have an effect on the growth of the plant.

As we look to the future it is important to find out if different brands of inoculum affects the plant differently. With the results of this experiment showing no effect from inoculum, the type of inoculum may play a large role. It is important to discover the commercial inoculums on the market and test them to determine if they are fulfilling the promises made to crop producers.

Figure 5. Image taken of *Sorghum bicolor* at week 8 of growth. Treatment levels left to right: LI, LN, SN, SI

Figure 6. Image taken of *Sorghastrum nutans* at week 8 of growth. Treatment levels left to right: LI, LN, SN, SI

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