Mycorrhizae Effects Measured by Plant Growth and Plant Stress in Sorghum Bicolor and Sorghastrum Nutans
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Introduction

- Plants and arbuscular mycorrhizal have a symbiotic relationship in which both plants and fungus benefit. Plants fix the mycorrhizal and the mycorrhizal help increase nutrients and water absorption in the plant.
- Plant stress plays a role in both the production of chlorophyll and the overall amount of biomass a plant produces. In this study, chlorophyll content was used to indicate how much stress a plant was under based on the assumption that, the more stress a plant is under, the more chlorophyll a plant will produce. Meaning that more stress on a plant will yield greater chlorophyll and less biomass.
- Synthetically produced mycorrhizal or “commercial mycorrhizae” is more effective than mycorrhizae that has developed in the wild. The effectiveness of synthetic mycorrhizae has been improved through years of experiments that have allowed higher yields in plant growth and nutrient uptake putting the plant under less stress.
- The growth rate in the stems of the plants will be highest in the presence of both commercial and wild mycorrhizae because the mycorrhizae will provide assistance in growth of the plants; when separated, growth rate will be higher when in the presence of only the commercial rather than only the wild.
- The presence of mycorrhizae will lower the chlorophyll content in the plants due to the expectation that the stress levels being exerted on the plants will be lowered.

Methods

- 48 pots total of Sorghastrum Nutans (Sn) and Sorghum bicolor (Sb) were separated under the four different categories shown below.
- Live = Live Mycorrhizae
- Sterile = No Live Mycorrhizae
- Inoculated = Commercial Mycorrhizae
- Non Inoculated = No Commercial Mycorrhizae
- Measurements of stem height (cm) and chlorophyll content were recorded weekly for three weeks using a ruler and SPAD meter.
- On the last week, we also retracted the plants from the pots and bagged them to further measure biomass.
- We performed ANOVA tests to compare groups using the software SPSS.
- We calculated growth rate using the following formula and dividing the outcome by N (number of total weeks):

\[
PR = \frac{V_{end} - V_{start}}{V_{start}}
\]

- Live vs. Sterile
- Live vs. Inoculated
- Live vs. Non-Inoculated
- Sterile vs. Inoculated
- Sterile vs. Non-Inoculated
- Inoculated vs. Non-Inoculated

Results

- Growth rate (Figure 1 and Table 1)
  - Similar growth rates were found between treatments (LI=8.21%, LN=14.26%, Sb=5.73%, Sn=0.93%)
  - LN had highest percent growth at 14.26%

- Stem Height (Figure 2 and Table 2)
  - A two-way ANOVA found significant difference overall (0.007) and between plant treatments (p<0.001) but not for soil treatment (0.428) nor interaction between soil and inoculum treatments (0.048).
  - Soil containing wild mycorrhizae produced smaller (on average) plants than the sterilized soil

- SPAD (Figure 3 and Table 2)
  - A two-way ANOVA found significant difference overall (0.002) and between plant species (0.007) but not for soil treatment (0.001) for the interaction between soil and inoculum treatments (0.221).
  - Species Sn expressed higher chlorophyll content (on average) regardless of soil treatment.

- Biomass (Figure 4 and Table 2)
  - A two-way ANOVA found significant difference overall (0.002) between plant species (0.007) and between soil treatment (0.001) but not for the interaction between soil and inoculum treatments (0.221).

- Write and between group variance (Table 2)
  - F-values for each trait measured were all less than five; smallest was SPAD measurements (1.605) and largest was total biomass (4.026).
  - High degree of within group variance clearly visible in species Sb compared to Sn (Figures 2, 3, and 4).

Discussion

- Our hypotheses concerned the relationship between increased growth and decreased stress when in the presence of both wild and commercial mycorrhizae; however the interactions between the soil and inoculum treatment produced insignificant results for each plant trait measured.
- Across the board, our data collected did not support either of our hypotheses. For stem height, it actually resulted in being the opposite as we predicted; the SN treatment produced the tallest plants and LI produced the smallest; possibly due to the time constraint the experiment was under.
- For stress level, there was no clear interpretation of the effect of mycorrhizae on SPAD measurements for the treatment; however we can slightly take away from Figure 3 that Sn had a higher amount of chlorophyll production than Sb. As a comparison for species, the prairie grass (Sn) seemed to be undergoing more stress (15) to grow at a similar rate to the agricultural species (Sb).
- The biggest effect recorded stemmed from the type of soil used: sterile vs. live. There was a significant difference in two of the three traits measured, stem height and biomass, when focusing only on the p-value of soil treatment. For both traits, the sterile soil had the greatest positive effect maybe due to the possibility that harmful elements contaminated the sterilized soil.
- Further investigation can be to experiment with a variety of agricultural and prairie species to determine if there is a clear difference of effect from mycorrhizae on the species types specifically; this can be done by manipulating mycorrhizae presence in multiple species of each agricultural and prairie type.

Literature Cited

- [6] Janette Weir, T. 2006. Species Sb; treatments from left to right are: LN, SI, SI, SN

<table>
<thead>
<tr>
<th>Trait</th>
<th>F Value (P)</th>
<th>P-Value (Overall)</th>
<th>P-Value (Species)</th>
<th>P-Value (Soil)</th>
<th>P-Value (Soil × Species)</th>
<th>P-Value (Total Biomass)</th>
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<tr>
<td>Stem Height</td>
<td>6.42</td>
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<td>SPAD Measurements</td>
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<td>0.023</td>
<td>0.023</td>
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<td>Total Biomass</td>
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<td>0.003</td>
<td>0.003</td>
<td>0.812</td>
<td>0.121</td>
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Table 2: Calculated F-values and P-values for the overall measurements and specific interactions of each variable (stem height, SPAD measurements, above/below ground biomass). P-value of 0.05 or less constitutes a significant difference.