Mycorrhizae or Mycorrcrazy?

Testing the Effects of Wild and Commercial Mycorrhizae on Native Prairie Plants

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INTRODUCTION

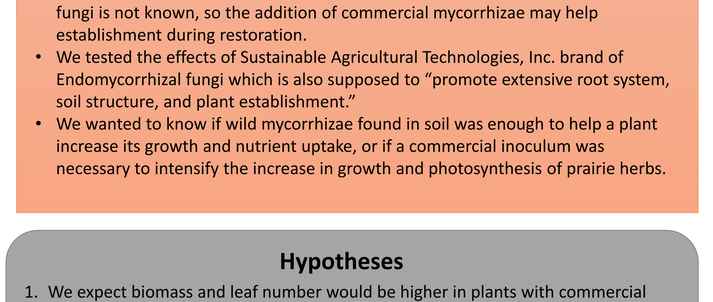
- Mycorrhizae is found in soil and acts as an extension of the roots, increasing water and nutrient uptake. The fungi also benefit from the symbiotic relationship by receiving carbohydrates formed from photosynthesis (NYBG).
- Mycorrhizae has several positive influences on plants, including increasing root growth nearly 90-fold and promoting photosynthesis, thus resulting in overall productive growth (Anon 1995). This is likely to affect vegetative growth specifically the production of leaves, or leaflets.
- Mycorrhizae is present in the wild soil around Oklahoma, it is beneficial to the plants such as *Desmodium canadense and Salvia azurea*.
- Many companies are now creating a mycorrhizal inoculum that they claim to reduce "drought stress, water and fertilizer needs," along with increasing "flowering and fruiting, water and nutrient storage and uptake, and root growth."
- Although there is wild mycorrhizae in many native soils, the concentration of the fungi is not known, so the addition of commercial mycorrhizae may help establishment during restoration.
- We tested the effects of Sustainable Agricultural Technologies, Inc. brand of Endomycorrhizal fungi which is also supposed to "promote extensive root system, soil structure, and plant establishment."
- We wanted to know if wild mycorrhizae found in soil was enough to help a plant increase its growth and nutrient uptake, or if a commercial inoculum was necessary to intensify the increase in growth and photosynthesis of prairie herbs.

Hypotheses

1. We expect biomass and leaf number would be higher in plants with commercial inoculum in live soil (presence of wild mycorrhizae) than in treatments with sterilized soil and no inoculate.
2. The plants with the commercial mycorrhizae, due to increased nutrient uptake, will have higher chlorophyll production than plants with wild mycorrhizae alone or no mycorrhizae present.

Methods

- We tested the Sustainable Agricultural Technologies (SAT) Endomycorrhizae, a commercially bought inoculum, and wild mycorrhizae naturally occurring in the soil, with two types of plants, *Salvia azurea* and *Desmodium canadense*.
- There were 24 individual plants of each species to our experiment that we transplanted into their own separate tube, each containing either sterilized soil or non-sterilized field soil and either mycorrhizae inoculum or no mycorrhizae inoculum. Pic 1.
- The treatments tested were: live soil with the inoculum present, live soil without the inoculum present, sterilized soil with inoculum present, and sterilized soil without the inoculum present.
- Twelve plants were in each of the treatment groups, six *Desmodium canadense* and six *Salvia azurea*.
- We recorded trait data weekly, counting the number of leaves produced by each plant and measuring the chlorophyll content with a SPAD chlorophyll meter.
- Finally, we then harvested the plants and measured the above and belowground biomass on a digital spring scale.
- We did a two-way ANOVA and built tables and graphs comparing the data we had collected to see if there were significant differences between the treatments across all traits measured.



Picture 1. The 24 individual plants of each species.

Desmodium canadense

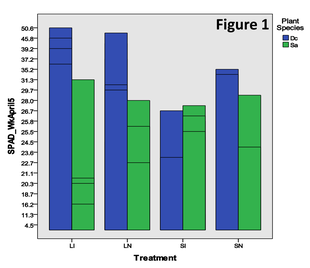
Our Plants

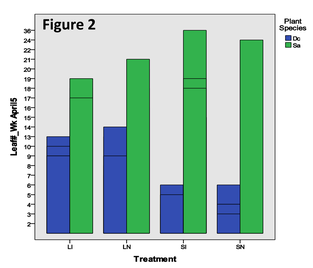
•*Desmodium canadense* and Salvia azurea are native prairie herbs, important to pollinators and capable of growing in various habitats and soil types. When cultivated they require minimal maintenance.
•Pollinator plants, such as these, are important in prairie restoration. Mycorrhizae may be important for establishment during restoration, however the effect of wild mycorrhizae versus commercial mycorrhizae on these species has not been widely tested

Salvia azurea

Results

- A two-way ANOVA resulted in a statistically non-significant effect in the final biomass in all four experimental groups with a .001 significance.
- As we predicted, *Desmodium canadense* produced more chlorophyll in the live soil rather than the sterilized soil. The average SPAD reading in live soil was a 40.7 and in the sterile soil was a 32.9. However, *Salvia azurea* did not present a difference in chlorophyll production in any treatment tested. Fig 2, Pic 4.
- *Desmodium canadense* formed more leaves when grown in live soil with the Endomycorrhizae inoculum than the sterilized soil with an average number of leaves in sterilized soil of 7 and in live soil of 14. *Salvia azurea* produced more leaves in the sterilized non-inoculated, rather than the live soil with an average number of leaves in the sterilized soil of 17 and in the live soil of 22. Fig 3.
- There was low variation in belowground biomass in the treatment groups between sterilized and live soil containing mycorrhizae. The final combined biomass mean in the live non-inoculated plants was .2852, in the live-inoculated was .4583, the sterilized inoculated was .3266, and the sterilized non- inoculated was .2299. Fig. 1,Pic 2, Pic 3
- In *Desmodium canadense,* there was an overall different physical appearance between the live soil and the sterilized soil. The leaves of the plants grown in the sterilized soil had a larger leaf area and had a darker green hue. Pic 5.





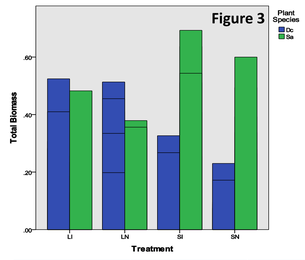
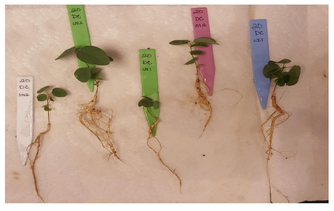


Figure 1. Graph comparing the four experimental group's chlorophyll production. Live soil with the inoculum (LI) and without the inoculum present (LN). Sterilized soil with the inoculum (SI) and without the inoculum present (SN).
Figure 2. Graph comparing the four experimental group's number of leaves produced
Figure 3. Graph comparing the four experimental group's belowground biomass in each plant.

Trait	F static	Overall Treatment Effect	Live vs. Sterilized	Inoculate vs. No Inoculate	Sterilization-inoculate Interaction
Biomass	4.458	0.001	0.792	0.222	0.703
SPAD	8.955	<0.001	0.11	0.348	0.918
Leaf #	17.13	<0.001	0.032	0.872	0.988

Table 1. A table of results from a Two-way ANOVA showing p values for our various treatments and their interactions.



Picture 2. The harvested plant of Desmodium Canadense.

Picture 3. The harvested plant of Salvia Azurea.

Picture 5. A picture showing the difference in the physical appearance between the wild mycorrhizae and the commercial inoculum.

Discussion

- The experiment resulted differently than we expected, by not supporting our hypothesis that having more mycorrhizae present will always produce a dramatic change in plant growth. While we were right in thinking that the chlorophyll content produced would increase in plants with inoculum present, only *Desmodium canadense* presented an obvious difference. Perhaps it is for this reason that it is recommended that Desmodium canadense be planted with an inoculum.
- Although we did not find a significant effect of treatments on our measured plant traits (Table 1), our data and graphs indicate a trend was formed.
- Each graph shows that *Desmodium canadense* had higher measures of each trait in wild soil than sterilized soil, more specifically in wild, non-sterilized soil, with inoculum present. Although not statistically significant, this trend does support our hypothesis. Difference in color and size of the leaves among the plants was evident (Pic 5). Plants grown in live soil had a noticeably larger leaf area and were a dark, rich hue of green, while the others did not grow to be as large and had a yellow tint.
- *Salvia azurea* reacted oppositely and grew nearly twice the size in total biomass in the sterilized soil than in live soil, yet *Salvia azurea* appeared to remain constant whether there was inoculum present or not.
- Commercialized Mycorrhizae is great for nurseries, gardens, and large production of plants in general because it has already tested and has produced positive results. The mycorrhizal species found naturally in soil may not be detrimental to plants, we simply could not measure it or control its concentration, as we could with the inoculum in this lab. Thus there was no way to tell the amount in live soil.
- Perhaps if the experiment had gone on longer, the traits measured would have had a more dramatic difference between treatments.
- Despite this, we have come to find that not all plants receive the same effect from mycorrhizae, and while inoculates are marketed to enhance many traits, it depends on the species which traits will actually be affected the most.

Picture 4. The difference between the live soil (LN) and the sterilized soil (SN)