Effect of Plant-Mycorrhizal Fungi on Plant water uptake and chlorophyll content

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Introduction

Arbuscular mycorrhizal (AM) fungal interactions with plants can affect certain plants' physiology by influencing how they absorb nutrients from the soil as well as the subsequent effects on plant growth and health. However, not all plant mycorrhizal interactions are equal, or have exactly the same effect on plant growth. For example, plant species as well as the geographic locations, allopatric or sympatric, of the soil and AM fungi, relative to the plant can create varied results among these interactions (Rúa et al. 2016).

Research suggests that mycorrhizal fungi can improve plant host water relationships through increased stomatal conductance and transpiration rates, acceleration of recovery from stress, and increased water absorption from the soil (Allen et al. 2003). Further research suggested that AM fungi more positively benefited the plant by increasing biomass as well as an increased chlorophyll content (Wu and Xia).

Hypothesis: If *Bromus inermis* and *Elymus canadensis* are cultivated in soil containing both wild and commercial mycorrhizal inocula, then they will contain significantly more water and chlorophyll than those grown in sterile soil or soil consisting of only one variety of mycorrhizae. In addition, plants inoculated with mycorrhizal fungi will have a higher biomass than plants that were not inoculated with mycorrhizal fungi or that were grown in sterile soil.

Methods

We tested plants from two species, Bromus inermis and Elymus canadensis, and separated each species into four treatment groups based on the type of soil and presence of mycorrhizal inocula.

We tested 48 plants total, 24 of each species.

The four treatment groups consisted of SI, SN LI, and LN. The first two group contained commercial mycorrhizal inoculum, but one contained sterile prairie soil and the other had non-sterile soil. The last two treatment groups had no mycorrhizal inoculum present, and one group has sterilized prairie soil and the other non-sterilized prairie soil.

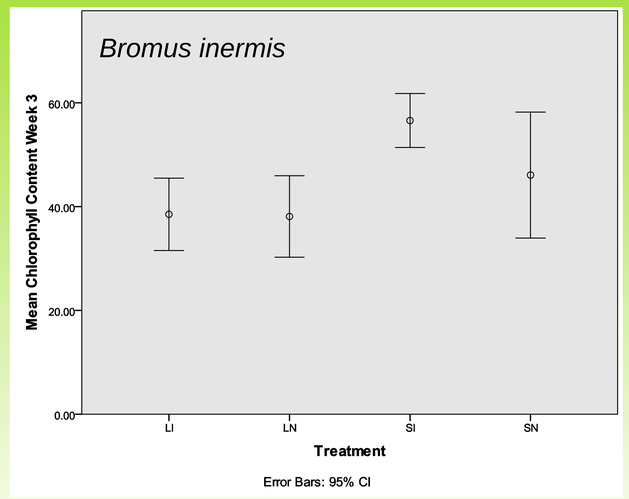
Each treatment group contained a total of six plants and there were eight groups total because the four treatment levels were repeated for both plant species.There were 6 replicates per treatment group.

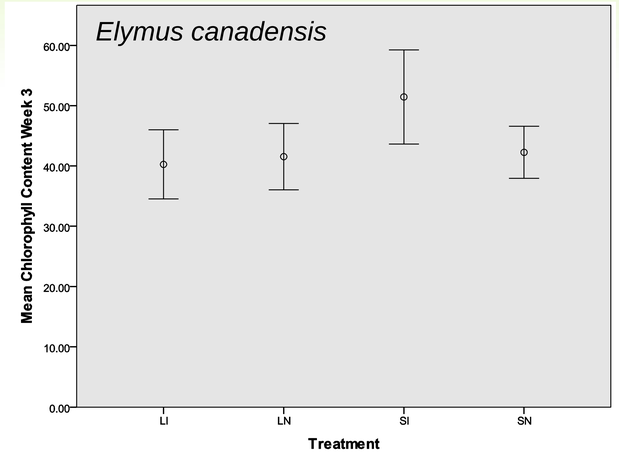
We transferred individual plants from a starting container in a vermiculite medium to a cone-tainer with either sterilized or unsterilized soil. We placed ¼ teaspoon of commercial mycorrhizal inocula in the cone-tainers designated for the presence mycorrhizal inocula.

We measured and recorded the chlorophyll content of each plant, using a SPAD meter, every Thursday for three weeks. After the four weeks of gathering data, the plants were carefully removed from their cone-tainers with above and below-soil systems intact. Once the plants were isolated from the soil medium, the shoot system was severed from the roots and weighed on a balance. The fresh weight measurements were documented only this once and then the plants' root and shoot systems, along with their identification tag, were each placed in individual, labeled bags. The paper bags were then left for a week to dehydrate the plants' biomass. After 8 weeks we harvested the plants, and the mass of the shoot system was weighed and recorded as well as the biomass for the root and shoot systems.

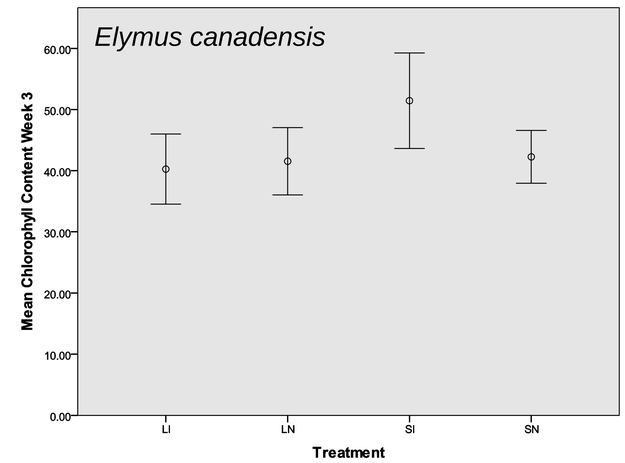
ANOVA was used to compare the means of our data and the significance was determined by the SPSS program.

Chlorophyll Content





Water Content



Results

Chlorophyll Content

Bromus inermis shows a significance in Soil Treatment (F=15.730, P=0.001) with Sterilized Inoculated plants showing the highest chlorophyll percentage

Elymus canadensis shows a significance in Soil Treatment (F=6.551, P=0.019) and Soil Treatment/Inoculum Treatment (F=5.062, P=0.036) with Sterilized Inoculated plants showing the highest chlorophyll percentage

Chlorophyll content for both species of plants show a corrolation between chlorophyll percentage and soil treatment with the sterilized soils showing a higher percentage of chlorophyll then the non sterilized soil treatment.

Water Content

Elymus canadensis shows a significance in Soil Treatment (F=10.545, P=0.004) and in Inoculum Treatment (F=4.633, P=0.044)

Only the species *Elymus canadensis* showed any significance between soil treatment/inoculum treatment with sterilized, inoculated soil increasing the water content of the plants the most.

Conclusion

Our results showed no significance between mycorrizal inoculum and mean chlorophyll content for either species of grass. There was; however, a significance between soil treatment and chlorophyll content for both species. This disproves our hypothesis that natural soil would result in greater chlorophyll content and water uptake than sterilized soil. It does however, support our hypothesis that inoculated plants will have a more positive response than those not inoculated with any mycorrhizal fungi.

For the water content, *Elymus canadensis* showed a significant differecence between Soil Treatment and Inoculum Treatment. This data suggest that mycorrhizal fungi play a role in increasing the amount of water *Elymus canadensis* can take up at a time. This was likely further aided by the sterilized soil as it helped eliminate the possibility of disease causing bateria and other microbials from competing with the plant or the mycorrhizal fungi. Our colleagues found in similar experiments that when fungi are allopatric to the soil there is a less positive resonse by the host plant, suggesting that fungi adapt to the soil type in a less mutualistic way (Rúa, M. A., et al.). This could have been offset by the sterilization of the soil, which helped to prevent the mycorrhizae from adapting to the soil in a way that hindered the mutualistic relationship between the fungi and the plant species.

Certain species of grasses seem to respond differently to the treatments. Further research could be done on water content and mycorrhizal relationships to improve inoculum treatments and soil treatments on commercially produced plants, such as crops.

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