MYCORRHIZAL SYMBIOSIS AND ITS EFFECT ON ACER SACCHARUM DROUGHT STRESS RESPONSE

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Background

- *Fungi and plants often work together through symbiotic relationships referred to as mycorrhiza in order to achieve homeostasis.*
- *Fungi provide the host plant with water and nutrients after passing through epidermal cells and forming arbuscules and vesicles within the root system of the host (Gorzelak 2015). The fungi are provided with carbohydrates from the plant's photosynthesis.*
- *Drought conditions often negatively dictate plant distribution, growth and productivity; by applying arbuscular mycorrhizal fungi to plants they will inherently have improved drought resistance (Desal 2013).*
- *Drought stress is a common reaction to drought conditions and causes physiological, morphological and biochemical change in the plants effected.*

Figure. 1: Mycorrhizal relationships impact the physical productivity of plants.

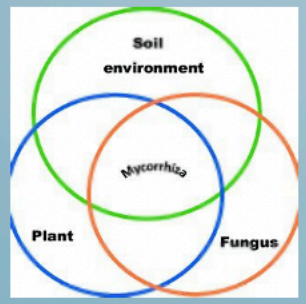

Figure 2: Mycorrhiza relationships are dependent on three core factors.

Objectives

Hypothesis:

- *Mycorrhizal fungi reduce drought stress in plants by improving their regulatory mechanisms in order to prevent the effects of water deficit condition and allow growth to be uninhibited.*

Prediction:

- *Plant population Impacts will be positive as a result of decreased drought stress and improved drought resistance.*

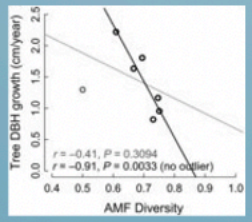

Figure 3: This graph highlights that as trees reach max height, AMF diversity is not as necessary and decreases overall.

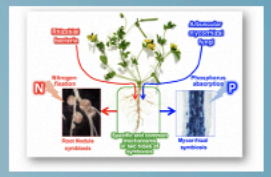

Figure 4: Mycorrhizal symbiosis is directly responsible for the absorption of phosphorous and other nutrients.

Methods/Approach

- *Experimental design will include citing other research papers to draw conclusions about natural world phenomenon regarding relationships between fungi and plants (meta-analysis).*
- *Sampling protocol will entail sampling research papers regarding plant stress as it relates to fungi availability.*
- *Major variables include fungi availability, drought conditions present, hormone levels and photosynthetic rate.*
- *For the study we will use mesocosms planted with Acer saccharum saplings. We will use mesh to create chambers separating roots, mycorrhizal fungi, and other plants in the area. We will then impose a drought rewetting simulation on the area and compare photosynthetic rate and rate of nutrient sharing and uptake. We will also examine the plants hormonal behavior and find what hormonal changes there are in the plant during drought conditions. The experiment will consist of a control group which will receive the normal amount of water (15% soil/ water content), and another group which will have simulated drought conditions (2% soil/water content) Both groups will have a sample with no mycorrhizal fungi, and a sample with mycorrhizal fungi. We will focus primarily on the stomata and how well the plant thrives depending on the varying amounts of water.*

Intended Analysis

- *Given that our response variable (rate of nutrient uptake) is continuous, and our independent variable (presence or absence of drought conditions) is categorical, we can analyze the data using a T-test.*
- *The other response variable we are going to look at are the changes in plants the plants hormones as a result of the mycorrhiza influence. This is a continuous variable.*
- *Our first prediction being that plants with little to no neighboring fungi will work harder to survive and therefore not have as much of a survival rate, because more resources would be used at a faster rate. (Huang 2020)*
- *Expected Benefits: Mycorrhiza are crucial to forest and plant ecosystems. The results of this study will allow us to understand the worth of Mycorrhiza and learn how much they affect plant ecosystems. It could also be applied to farming and agriculture in that planting fungi species on agricultural fields could increase the yields and protect against that. I bet California wished they had more mushrooms.*

Babikova, J. (2013). *Underground signals carried through common mycelial networks warn neighboring plants of aphid attack* [Research paper]. In *Ecology Letters*. Retrieved November 22, 2020, Batool, A., Pan, J., Zhang, Q., Liu, Y., Mingsen, Q., Bahadur, A., & Nasir, F. (2019, June 7). Mechanistic Insights into Arbuscular Mycorrhizal Fungi-Mediated Drought Stress Tolerance in Plants. Retrieved November 29, 2020, Desal, S. (2013, December). *The influence of phosphorous availability and Laccaria bicolor symbiosis on phosphate acquisition, antioxidant enzyme activity, and rhizospheric carbon flux in Populus tremuloides* [Research paper], Ficken, C. D. (2018, December 18). *The carbon economy of drought: Comparing respiration responses of roots, mycorrhizal fungi, and free-living microbes to an extreme dry-rewet cycle* [Scholarly project]. Retrieved November 22, 2020, Gorzelak, M. A. (2015, May 15). *Inter-plant communication through mycorrhizal networks mediates complex adaptive behavior in plant communities* [Research paper]. In *AOB Plants*. Retrieved November 22, 2020, Huang, D. (2020). *Arbuscular mycorrhizal fungi enhanced drought resistance in apple by regulating genes in the MAPK pathway* [Research paper]. In *Plant Physiology and Biochemistry*. Retrieved November 22, 2020.