

# ARE PLANTS THAT FORM MUTUALISTIC MYCORRHIZAL RELATIONSHIPS MORE RESILIENT TO DROUGHT AND FLOODS?

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## Background

- Mycorrhiza is the association of the mycelium of a fungus with the roots of a seed plant and around 90% of plants form this association (Garden, 2003). The fungi colonize the root system of the host plant, as seen in figure 3, and hyphae from the fungus increase the surface area of roots allowing the plant to uptake more water and nutrients while the plant provides the fungus with soluble carbohydrates formed from photosynthesis. Mycorrhizae also offers the host plant increased protection against certain pathogens, disease, and drought. The mycorrhizal network connects to other plant networks and has the ability for plants to “talk” to one another and warn others of insects, disease, or danger and can send sugars to each other (Libretexts, 2021).
  - We propose to evaluate the relationship between mycorrhizal fungi and their host plants against plants with no associations under different controlled environmental conditions. We wanted to see how the resilience to environmental stresses changes in plants due to the added benefit of having a mutualistic relationship with the mycorrhizal fungi.
- ## Predictions
- We predict that plants with mycorrhizal associations will have more plant productivity measured by chlorophyll concentration taken from leaf tissue samples than plants with no mycorrhizal associations (Figure 1).
  - We also predict that plants with no mycorrhizal associations will do the worst under drought conditions and plants with mycorrhizal associations will have the most productivity in the overwatered environment. (Figure 1).

## Hypothesis

- If plants have a mutualistic relationship with mycorrhizal fungi, then they will have more nutrients and be more resilient to environmental stresses than plants without this connection.



Figure 2. Mycorrhizal network of a plant. These networks allow plants to live in difficult conditions as it provides help in accessing nutrients.

## Study Design

- We will conduct a case-control study to observe how the resilience to environmental stresses like drought and flood change when a plant forms a mutualistic relationship with mycorrhizal fungi. It will be measured by chlorophyll content taken by an instrument that uses dual wavelength absorbance measurements between 640 nm to 940 nm
- There will be four treatment groups and two control groups:
  - Group 1: Mycorrhizae + Drought
  - Group 2: Mycorrhizae + Normal Conditions
  - Group 3: Mycorrhizae + Flood
  - Group 4: No Mycorrhizae + Drought
  - Group 5: No Mycorrhizae + Normal Conditions
  - Group 6: No Mycorrhizae + Flood

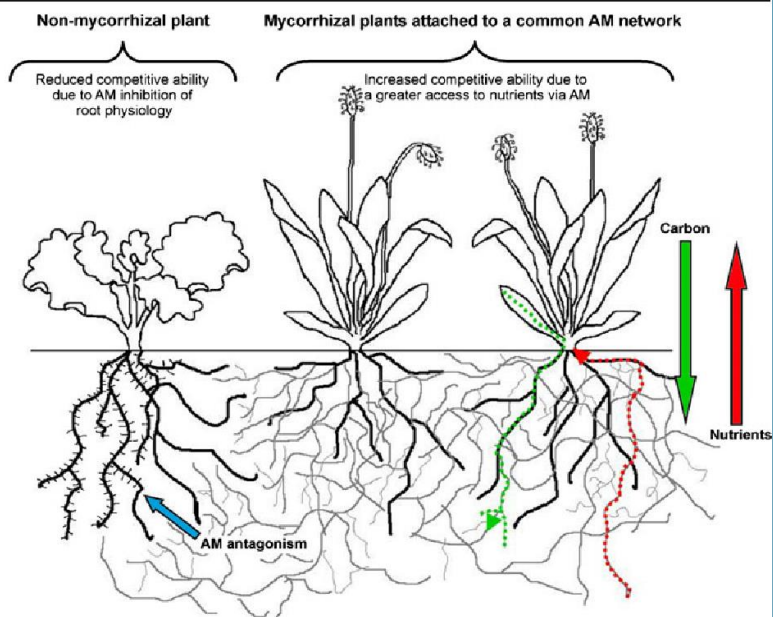


Figure 3. A diagram of the root system with and without a mycorrhizal association. Plants that do form the relationship are able to compete better for resources than plants that do not form the relationship.

## Intended analysis

- Since our predictor variable (drought/flood) is categorical and our response variable (nutrient levels) are continuous, and we are testing two categories, we will use a T-test to analyze the data collected from the experiment.
- The results from the t-test will tell us whether our two groups are more different than we would expect by chance alone.
- Scope of Inference: Plants exposed to drought with the mycorrhizal association are able to keep more nutrients in their leaves than those without. We can see an example of this in Figure 4. Similarly, plants exposed to overwatering with the mycorrhizal fungi association were able to keep more nutrients in their leaves than those without.

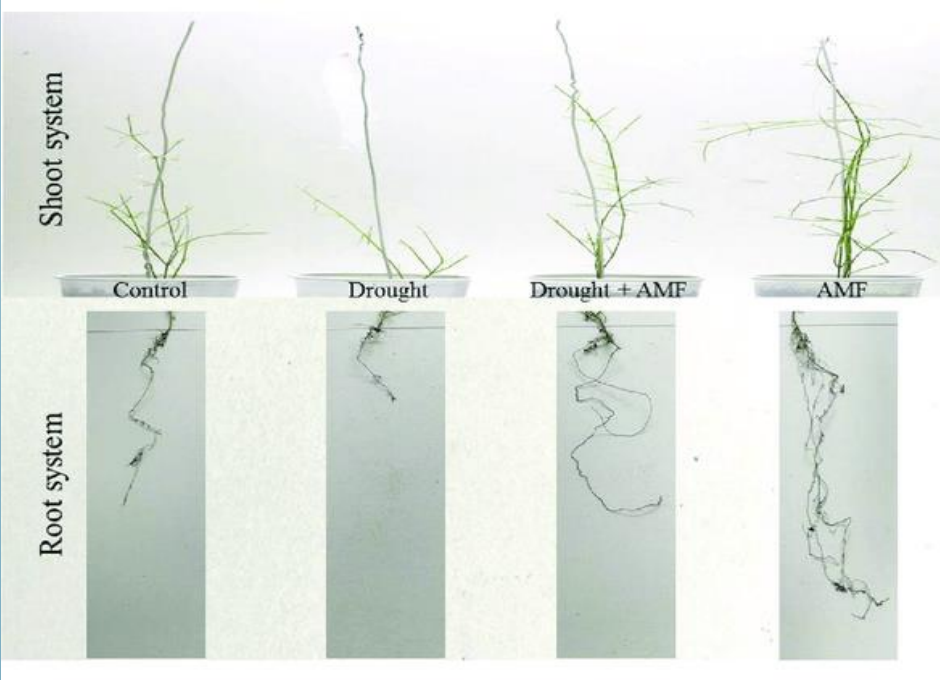


Figure 4. Visual depiction of root and shoot systems with and without mycorrhizae. Plants with mycorrhizal associations have healthier shoots and roots when exposed to drought compared to no relationship.

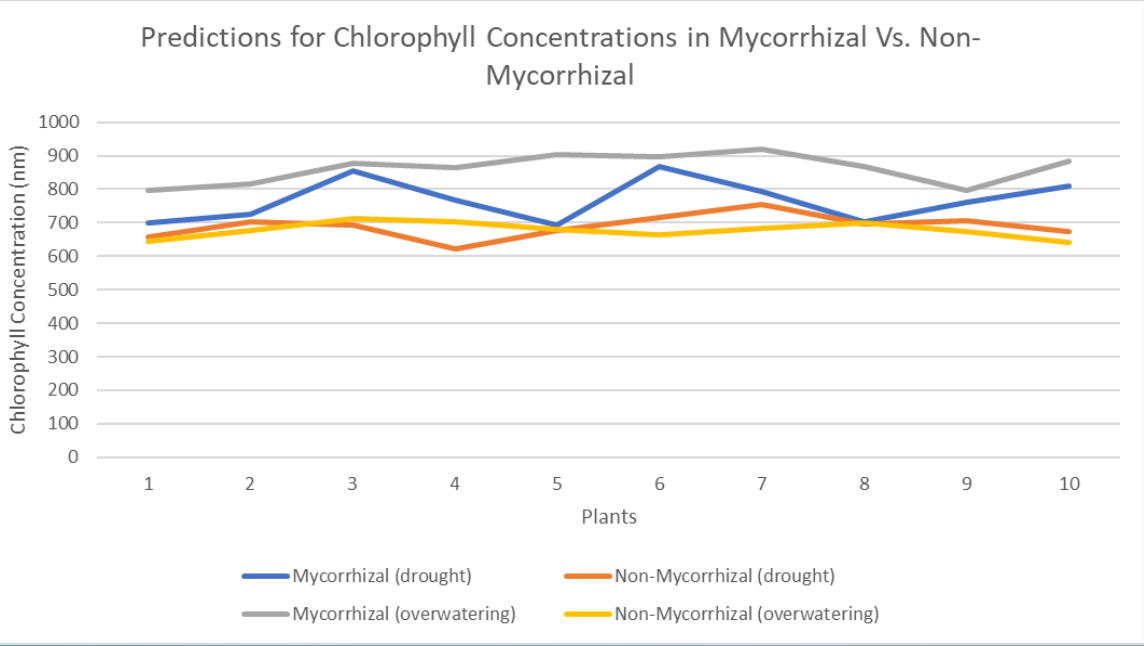


Figure 1. Our predictions about how overwatering and underwatering will affect plants with or without mycorrhizal networks. Plant productivity is measured by chlorophyll concentration in leaf tissue.

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