Presence and Abundance of Arbuscular Mycorrhizal Fungi in Florida Mangroves

Faith Yost

This project investigates the presence and role of arbuscular mycorrhizal fungi (AMF) in the migration of black mangroves (*Avicennia germinans*) in Florida. The black mangroves in this experiment inhabit Northeastern Florida in a marsh-mangrove ecotone. Using plots from the Chapman Lab's WETFEET project, soil core samples from interior and creekside zones will be analyzed for AMF colonization. The study aims to correlate AMF presence with mangrove growth metrics, hypothesizing that AMF abundance is greater in less waterlogged soils, which may aid mangroves in migration and resilience.

Mangroves are coastal wetland trees known for their ability to dampen wave energy, sequester carbon, and reduce flooding (1-3). Due to less frequent freeze events, resulting from climate change, mangrove forests are encroaching northward along Florida coasts (4). In addition to climate change, arbuscular mycorrhizal fungi (AMF) may aid in mangrove migration. AMF colonizes plant roots and assists with nutrient uptake. AMF provides plants more resilience against environmental stressors, including an increased temperature range tolerance (2-3, 5). AMF colonization of plants is widespread, but there is little evidence of AMF in wetland plants due to the lack of oxygen in soils (6). Studies from Mexico and India indicate the presence of 17 different AMF species in mangroves,noting that soil moisture and flooding negatively affects AMF colonization (7-8). Identifying the presence of AMF on black mangrove roots will expand on the possible role of AMF in mangrove migration. My project aims to quantify the presence of AMF on black mangrove roots (*Avicennia germinans*) along creekside and interior plots in Florida.

Using existing experimental plots from the Chapman Lab's WETFEET project, I will collect one soil core sample from each of the 10 mangrove plots from a depth of 0-15 cm (9). Five of the plots inhabit the creekside zone, a section of marsh adjacent to a creek, while the other five occupy the interior zone, a section of marsh less influenced by waterways (Figure 1). From each soil core, I will collect 10 *A.germinans* root samples and stain them for AMF presence. Following the methods in McGonigle et al., adjusted by Akaji et al. root samples will be washed, cut to 1.0 cm, then stored in methanol (10-11).

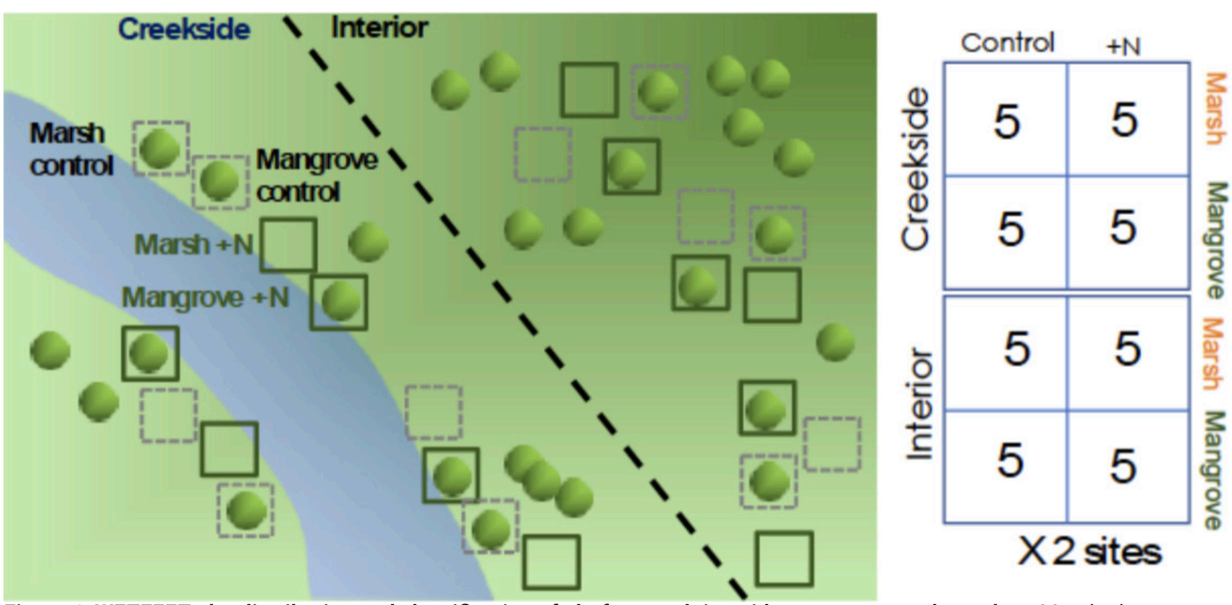
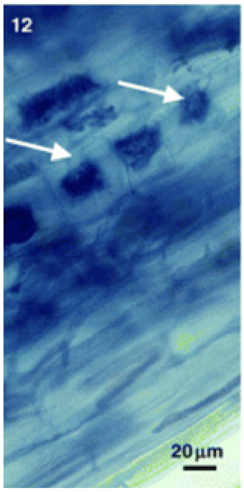


Figure 1. WETFEET plot distribution and classification of platform and riverside mangroves and marshes. Marsh plots are included but will not be used for this experiment. Diagram is from WETFEET Projects (9).



Samples will be heated to 90°C in 10% KOH to clear the cytoplasm. Cleared roots will be soaked in 3% H_2O_2, placed in 1% HCl, and left in 0.05% Trypan blue stain overnight. To destain the roots, I will place them in lacto-glycerol and mount them on microscope slides. I will use a light microscope to determine AMF colonization by quantifying arbuscules and hyphae, the branching filaments that absorb nutrients (11-12).

Figure 2. Two AMF arbuscules in the plant Tropaeolum majus stained with Trypan Blue dye as stated in Vierheilig et al. (13). Image provided by H. Vierheilig.

AMF hyphae and arbuscules will be obvious as the rest of the cell's contents have been cleared (Figures 2-3). I will analyze AMF presence in all mangrove roots and explore the correlation with mangrove growth metrics, including size and biomass.

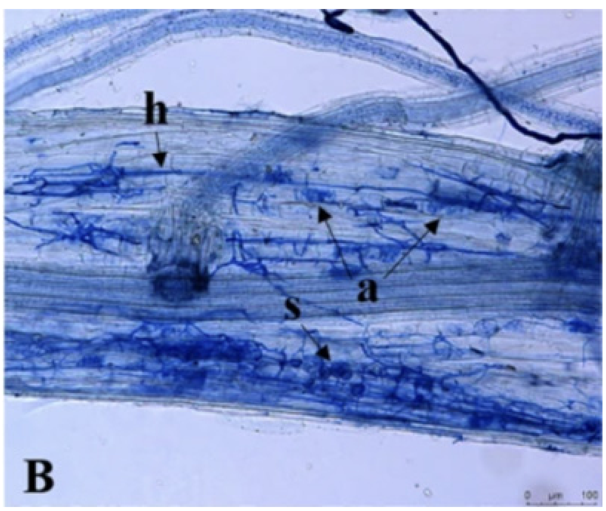


Figure 3. Hyphae (h), arbuscules (a), and spores (s) in a root fragment stained in Trypan Blue dye. Image provided by Bernaola and Stout (14).

Due to existing evidence of AMF-mangrove mutualism, I expect AMF to be present on the roots of *A.germinans* in northeastern Florida (7-8). I hypothesize that mangroves further from the river will have a greater abundance of AMF than the mangroves closer to the river due to anoxic conditions unsuitable for AMF in waterlogged soil. I expect that increased presence of AMF will correlate to increased root biomass, as AMF mutualism is beneficial for plant growth, though environmental variability and detection methods may affect accurate AMF and biomass assessment. Investigating the presence of AMF on mangroves will help illuminate plant-soil interactions in wetlands.

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Mentor

Dr. Samantha Chapman

Samantha Chapman, PhD, received her PhD from Northern Arizona University and did a postdoctoral fellowship at the Smithsonian Environmental Research Center. She is a professor and the codirector of the Villanova CLAS Center for Biodiversity and Ecosystem Stewardship (CBEST). She runs the WETFEET Project, funded by the National Science Foundation. Dr. Chapman and her team collaborate to understand how climate change and rising sea levels alter coastal ecosystems. She feels honored to be able to study how plants shape our world and hopes that her work can contribute to our ability to rediscover how to value and live with nature.

Mentor

Tess Adgie

Tess Adgie is the Laboratory Manager for the combined Chapman and Langley labs. She received her master's degree from Villanova's Biology program where she combined her background in horticulture with her excitement for ecological systems to study salt marsh plant competition in Florida wetlands. As a member of the WETFEET Project, she combines her field experience and technical skills to collaborate with scientists, land managers, and students on ecological research in the context of climate change.