Evaluation of soil fungal inoculants as biofertilizers for foliage plants

Dr. Sarah Emery, University of Louisville

National Horticulture Foundation 2021 Annual Report

Abstract:

Eighty percent of land plants form symbiotic associations with soil micro-organisms called arbuscular mycorrhizal fungi (AMF), and there are many commercial products currently on the market that use AMF as biofertilizers. However, very little is known about the potential for AMF to benefit foliage plants. In a series of lab experiments, this research evaluates the biofertilizer effects of AMF on vegetative growth and foliage coloration of several cultivars of foliage plant taxa including *Aglaonema spp*., *Sedum spp.,* and *Plectanthrus scutellarioides* (Coleus). I found that AMF can have positive biofertilizer effects on foliage plants. Sedum and Coleus plants showed increased vegetative growth, and Aglaonemas showed increased red leaf variegation when inoculated with some types of AMF. Later analyses will examine whether these benefits are correlated with increases in plant defensive chemistry, particularly leaf anthocyanins.

Objective:

My main research objective was to evaluate the biofertilizer effects of different AMF species on vegetative growth and leaf color of indoor foliage plants.

Methods

Experiment Set #1

In my first set of experiments, I tested effects of two commercial AMF biofertilizers on growth and leaf coloration of multiple cultivars of Sedum (Jelly Bean, Burrito Burro's Tail), and Aglaonema (Siam, Sparkling Sarah, Emerald Beauty). Nursery plants were transplanted into 4" nursery pots (Aglaonema) or plug trays (Sedum) filled with standard potting mix (Jolly Gardener C25). Pots were inoculated with one of three biofertilizer treatments: 10ml of a commercial product containing the single AMF species *Rhizophagus intraradices* (product name withheld), 10ml of the product Mycobloom (mycobloom.com), which contains 7 AMF species, or 20ml of sterilized (autoclaved) inoculum. Each biofertilizer treatment was replicated 4-5 times. Plants were placed under LED grow lights on 16h light/8h dark cycles in ambient room conditions (65-75°F/18-24°C) and watered frequently. Height, number of leaves, date of first flowering, and total flowers per plant were recorded biweekly for 16 weeks. The newest fully-open leaf on the two cultivars of Aglaonema that produce red variegation were photographed and image analysis (ImageJ) was used to calculate the % red color per leaf. Aglaonema and Sedum plants will be harvested in December 2021 for biomass measures. For all cultivars, leaf anthocyanin concentration will be quantified in spring 2022 using a spectrophotometric approach.

Experiment Set #2

A second set of experiments has started to test effects of individual AMF species on plant growth and leaf coloration. This experiment has been completed using 4 cultivars of Coleus (Wizard Scarlet, Wizard Jade, Watermelon, Lime Delight) and will be conducted on two sedum cultivars starting in January 2022. Due to COVID-19 supply chain issues, I have been unable to secure enough Aglaonema plants from my industry suppliers for experiment set but will keep reaching out to potential wholesalers.

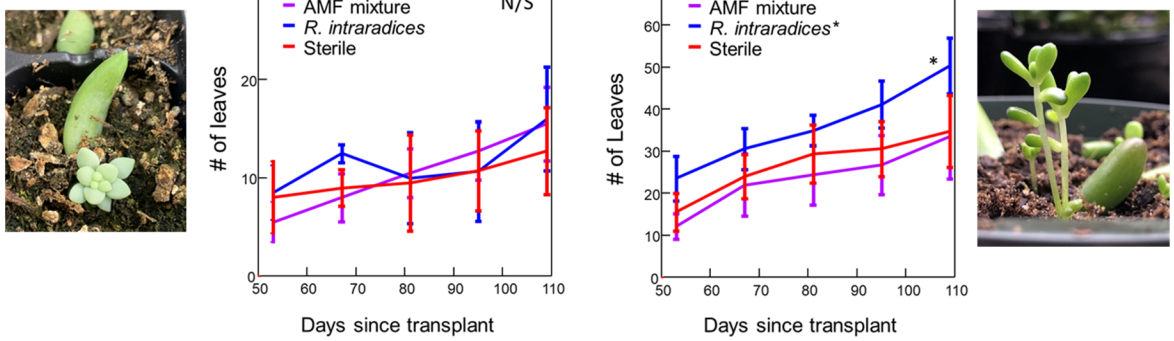
For this experiment, I used 10 soil inoculation treatments: Eight single AMF species (4 expected biofertilizers and 4 expected bioprotectors), a mix of all 8 AMF species, and a sterile treatment (autoclaved mix of 8 species). AMF species included: *Giaspora margarita, Rhizophagus intraradices, Clariodeoglomus lamellosum, Claroideoglomus claroideum, Funneliformis mosseae, Acaulospora spinosa, Cetraspora pellucida,* and *Racocetra fulgida*. All AMF cultures for experiments were provided below cost by Dr. Liz Koziol, owner of Mycobloom. Small conetainers (164ml capacity; 1.5 x 8.25") were filled with standard potting mix and inoculated with one of 10 treatments above. 15ml of single-AMF species cultures, or 2ml of each species culture for the mix treatment were added to conetainers and seeds were planted. Each treatment combination was replicated 5 times, for a total of 200 pots (4 Coleus varieties x 10 biofertilizer treatments x 5 reps). Conetainers were placed under LED grow lights in ambient room conditions and watered frequently. Time to germination, height, number of leaves, date of first flowering, and total flowers per plant were recorded biweekly for 16 weeks. At the end of the experiment, three leaves were scanned for image analysis and one leaf was frozen for later anthocyanin analyses. The remaining root and shoot biomass was dried and weighed. Image analysis and leaf chemical composition will be conducted in spring 2022.

Results

Experiment #1: Sedums

The commercial biofertilizers had no effects on growth of the Burrito Burros Tails cultivar, but the biofertilizer containing *Rhizophagus intraradices* increased growth of the Jelly Bean cultivar by 48% (Figure 1). Image analyses are difficult with succulent leaves, but I plan to analyze leaves for anthocyanin content in Spring 2022.

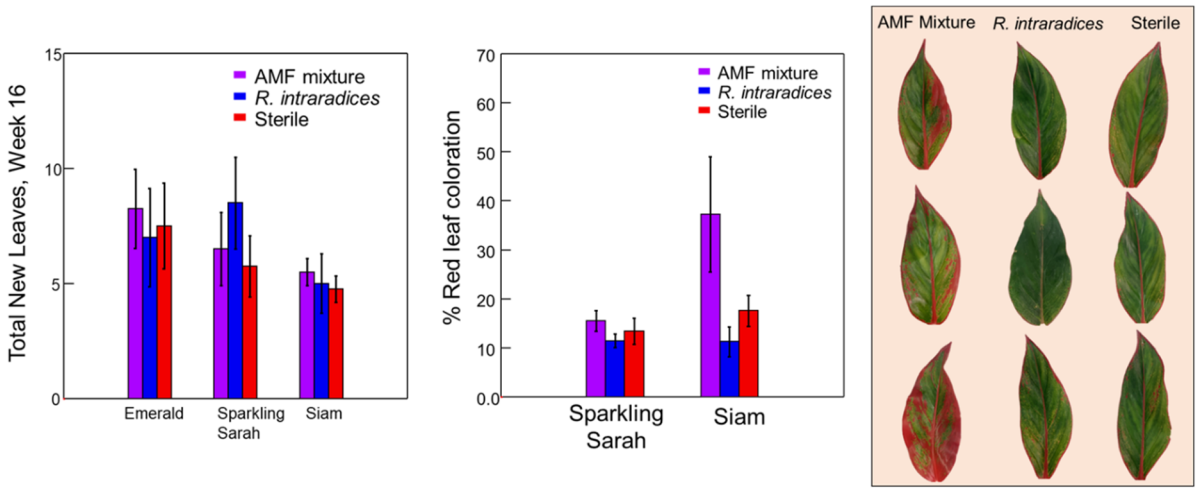
Figure 1. Effects of AMF biofertilizer products on Sedum growth.



Experiment #1: Aglaonemas

The commercial biofertilizers had no effects on growth of the three Aglaonema cultivars over time, but the AMF mixture increased red leaf coloration in the Siam cultivar by 160% (Figure 2). Plants will be harvested in December 2021 for biomass data and additional image analysis. Leaf anthocyanin content will be measured in preserved leaves in spring 2022.

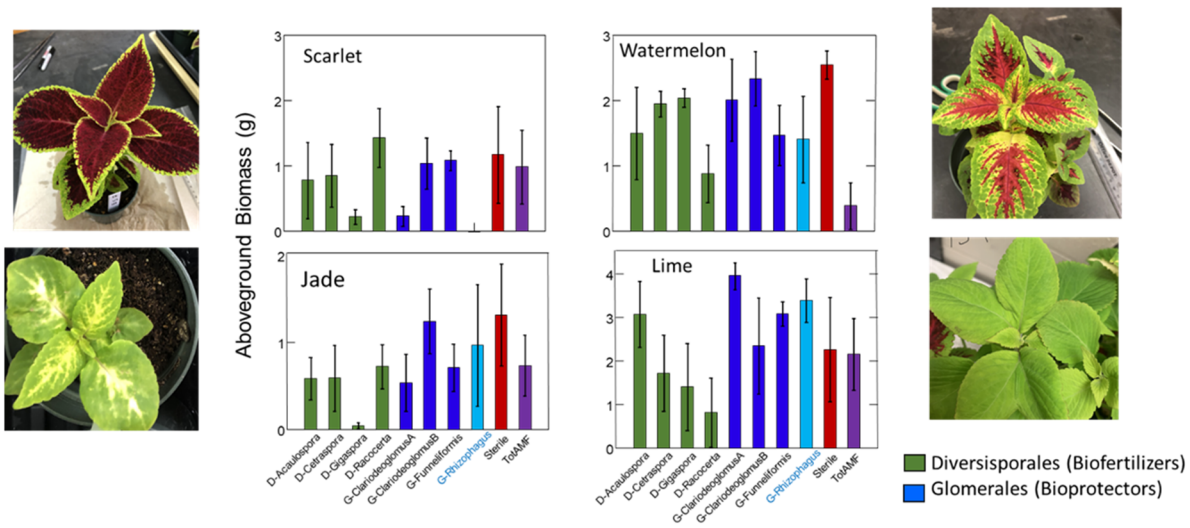
Figure 2. Effects of AMF biofertilizer products on Aglaonema growth and leaf coloration.



Experiment #2: Coleus:

Individual AMF species had variable effects on aboveground growth of the different Coleus cultivars (Figure 3). Overall, species in the order Diversisporales, which I expected to have strong biofertilizer effects, were less beneficial to plants than species in the order Glomerales, which I expected to act more as bioprotectors. *Rhizophagus intraradices* had inconsistent effects on plant growth, despite the fact that it is extremely common in commercial biofertilizer products. Root biomass, leaf image analyses, and anthocyanin analyses will be finished in spring 2022. I plan to conduct a second round of this experiment design using two cultivars of Sedums starting in January 2022.

Figure 3. Effects of AMF single-species cultures on Coleus growth.



Conclusions

Preliminary results from these experiments indicate that AMF can have positive biofertilizer effects on foliage plants. Sedum and Coleus plants showed increased vegetative growth, and Aglaonemas showed increased red leaf variegation when inoculated with some types of AMF. Later analyses will examine whether these benefits are correlated with increases in plant defensive chemistry, particularly leaf anthocyanins. Possible next steps for this project include assessing AMF as bioprotectors for foliage plants by evaluating their contributions to plant drought tolerance and pest resistance.