Multi-year Funding Status Report 2022

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Title: Testing the effect of native arbuscular mycorrhizal fungi on prairie restoration success at Nachusa Grasslands

Summary

In 2022, we continued our study on the effects of arbuscular mycorrhizal (AM) fungi inoculation with soil cultured from four remnant prairies and one post-agricultural site at Nachusa Grasslands. We consider these cultures sources of native and non-native AM fungi, respectively. In early summer, we implemented the proposed field study at two restoration sites and monitored plant survival, growth, and community composition throughout the summer. We also performed a greenhouse experiment over a larger set of plant species to assess the effects of inoculation on both weedy and conservative (i.e. early and late successional) plant species. Additionally, we are sequencing the DNA in the soil used to inoculate the plants to determine the soil microbial community. This research should help us better understand how AM fungi from post-agricultural sites and remnant prairies impact the growth of individual plants and plant communities in prairie restorations.

Field experiment

In early June, we established experimental plots in both the Senger planting and MRCP Hill site, established in 2015 and 2021, respectively. Both sites contain 12 plots of each treatment (sterile, post-agricultural, and remnant soil inoculation) for a total of 36 plots at each site. Inocula containing AM fungi was introduced via plugs grown with the cultured soil in a greenhouse at the University of Kansas.

While we had initially planned to include a variety of conservative species, most of the seeds we received failed to germinate in the spring despite our best efforts. Therefore, at the Senger site, we planted *Asclepias tuberosa* (butterfly milkweed) and *Coreopsis lanceolata* (lanceleaf coreopsis); at the MRCP Hill site, we planted *A. tuberosa*, *C. lanceolata*, *Echinacea pallida* (pale purple coneflower), and *Dalea candida* (white prairie clover).

At both sites, we monitored the survival and change in height and leaf number through the last week in July. There was higher mortality overall in the established Senger planting than in the MRCP Hill site likely due to increased competition from established plants. In terms of height, we saw species-specific responses to inoculation ($P < 0.001$) at both sites, where some species responded more to inoculation with post-agricultural or remnant-cultured soil than others.

We also monitored the plant communities at both sites at the end of July. At the Senger site, we observed the species composition in 12 plots. While we did not expect or find differences between treatments this year, there was an astounding amount of native plant diversity and conservative species already established. At the MRCP Hill site, we collected the percent cover of all the plant species in all 36 plots. In the first growing season, we already detected a difference in plant diversity due to inoculation, with lower diversity seen in plots with post-agricultural inoculum ($P < 0.05$).

Greenhouse experiment

Using the soil cultures created over the past year, we inoculated 12 plant species (*Asclepias syriaca*, *A. tuberosa*, *Baptisia alba*, *Chamaecrista fasciculata*, *Coreopsis lanceolata*, *Coreopsis tripteris*, *Dalea candida*, *Desmanthus illinoensis*, *Echinacea pallida*, *Eupatorium altissimum*, *Liatris pycnostachya*, and *Rudbeckia hirta*) with either sterile soil or soil cultured from the post-agricultural site or one of the four prairie remnants (six total treatments). Half of these plant species were weedy/early successional, and half were conservative/late successional.

We collected aboveground and belowground plant biomass as well as percent root colonization by AM fungi. While we are still analyzing this experiment, it preliminarily appears that conservative plant species respond more to inoculation in general than more weedy species.

Future Work

In 2023, we plan to continue to monitor the survival and growth of the plants in our field experiment as well as their impact on the plant community. We will also continue to analyze our greenhouse data for patterns in plant response to inoculation with different sources of AM fungi. Finally, we will process the DNA sequencing results of our soil inocula and continue our efforts to create single-species AM fungi cultures.

We thank the Friends of Nachusa Grasslands for allowing us to take part in this research and provide valuable research experience for undergraduate students who assist in this work. We look forward to working with the community at Nachusa Grasslands in 2023.