

I have two active grants. Both can be used to support FFIRE scholars and are projected to end in 2026. In addition, I still have startup/foundation monies that can also go towards supporting more independent FFIRE scholar research.

1. NSF DEB-2105482 “Collaborative Research: Understanding spatiotemporal dynamics of plant-soil feedbacks: Consequences for shrub-grass interactions in a dryland ecotone”

The balance between two alternative stable states, grassland and shrubland, in drylands has important economic and environmental implications such as grazing and carbon sequestration. In addition, range-edge dynamics are an ideal case to study the spatial dynamics of plant-microbe interactions. Being sessile, there are spatial limits to the interactions between a host plant and the microbial milieu. While there exist a few spatially-explicit theoretical models of PSFs, empirical parameter estimates are lacking. The proposed work targets specific mechanisms by which plants interact with soil microbes, such as soil exudates and litter decomposition, quantify their spatial extent and response to elevated CO₂, and incorporate these empirical estimates into a spatially-explicit model to understand the implications for long-term plant species range dynamics. By uncovering the invisible microbial dimension of this ecosystem transition, this work will inform ecological theory, management practices, and improve predictions of feedbacks between ecosystem productivity and the changing climate.

Postdoctoral scholar involvement: There is a fully funded postdoctoral position to conduct the modeling component of this project. This would involve 1) Developing working, theoretical, models that explicitly incorporate spatial dynamics of plant spread as well as their competitive and microbial interaction neighborhoods. 2) Parameterizing an empirical version of this model based on the experiments we have conducted in the field and in the growth chamber to project future dynamics under elevated CO₂ scenarios.

With FFIRE support, there may also be opportunities to write manuscripts related to desert plant microbiomes and their mechanisms of assembly based on existing, collected data from recent experiments.

2. DOE DE-SC0021386 “Systems analysis of the beneficial associations of sorghum with arbuscular mycorrhizal fungi studied with genetics, genomics, imaging, and microbiomics”

This is a large collaborative grant to understand the systems biology of interactions between biofuel sorghum and arbuscular mycorrhizal fungi. Within this collaboration, my lab will use select sorghum genetic lines to investigate the temporal dynamics of microbial community assembly, community stability, and invasibility in greenhouse and field experiments under different resource contexts. If host selection is strong, it should result in deterministic, genotype-specific, assemblages whose interaction outcomes can be predicted based on resource context regardless of small fluctuations in starting species pool and other stochastic influences.

Postdoctoral scholar involvement: I currently fully fund a postdoctoral scholar on this grant to investigate the effects of sorghum host genotype on soil and rhizosphere microbiome assembly and their legacy effects. With FFIRE support, there are opportunities to explore additional questions under the umbrella of microbiome community assembly mechanisms, interactions among fungal mutualists (e.g. AMF and DSE), hyphosphere microbiomes, and soil C sequestration.