Response of Mojave Desert-native perennials to inoculum from invasive and native annuals

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Threats to the Mojave Desert

Anthropogenic disturbances

- Renewable energy development
- Resource extraction
- Wildfires
- Invasions



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Brassica tournefortii (Saharan mustard)

Bromus rubens (Red brome)

Restoration

- Seedling transplant efforts risk failure even with dedicated input, such as weeding, irrigation, and fencing^{1,2}
- Attempts to increase transplanting of seedlings have been made with abiotic soil variables in mind
- There is a need for approaching restoration from a ground up perspective where potential rhizosphere influences are considered



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Soil biota

- Can be important for plant growth and stress tolerance³
- Some Mojave-native perennials have been identified to form relationships with important soil biota, such as arbuscular mycorrhizal fungi (AMF)
- Commercial inoculants
 - Expensive
 - Intended for agricultural applications
 - Can potentially introduce nonnative biota into already at-risk soils

Goals & Hypotheses

Goals

- Determine which soil biota have positive associations with key Mojavenative perennials
- Identify native annual species ideal for creating cost-effective inoculants to increase desert restoration success
- Understand how invasive species disrupt soil biota

Hypotheses

- Inoculants conditioned by native annuals previously shown in literature to associate strongly with AMF, such as *Plantago ovata*, will increase perennial growth
- Inoculants conditioned by invasive annuals will not increase perennial growth



Stipa speciosa Yucca brevifolia

Study Species

Common name	Family
Devil's lettuce	Boraginaceae
Pale yellow sun cup	Onagraceae
Bigelow mimulus	Phrymaceae
Sixweeks grass	Poaceae
Coulter's lupine	Fabaceae
Desert dandelion	Asteraceae
Desert bells	Hydrophyllaceae
Desert plantain	Plantaginaceae
Chia sage	Lamiaceae
Saharan mustard	Brassicaceae
Red brome	Poaceae
Desert needle grass	Poaceae
Joshua tree	Agavaceae



Native perennial grassNative perennial tree

1. Collect disturbed soil

2. Condition with native and invasive annuals

3. Characterize soil biota

4. Test response in native perennials



Results

Response of Joshua Tree

Response of Desert Needle Grass

Key Takeaways

- Annual species vary in their associations with AMF
- Soil conditioning by annual species affects biomass allocation in Mojave perennials
- S. speciosa growth increased with Plantago and polyculture inoculants
- Y. brevifolia growth also increased with Plantago and polyculture inoculants; growth decreased with invasive inoculants
 - Potentially due to the tendencies of:
 - Brassicaceae not associating with AMF
 - *B. rubens* associating with non-AMF fungi

Conclusions

- Biota at the soil level can potentially assist the establishment of mycorrhizal native species by increasing plant growth
- Ecological restoration may be facilitated by utilizing cost-effective inoculants of indigenous soil biota
- Future restoration practices should consider:
 - Potentially negative belowground impacts of invasive species in restoration efforts, especially with threatened and endangered plant species
 - Evaluating not only above ground factors, but potential interactions in the rhizosphere

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