# Do biocrusts differentially influence non-native and native grass establishment?

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## Introduction

- Biological soil crusts (biocrusts) have positive/negative/neutral effect on plant germination[1] but little known about establishment
- Undisturbed biocrusts inhibit some non-native annual plants, such as cheatgrass[1]
- Mechanisms underlying germination and establishment outcomes are poorly understood
- Understanding these mechanisms could benefit land management and help develop restoration strategies

## Hypotheses

1. Seed morphology and biocrust characteristics (type, integrity) interact to determine seed-soil contact and therefore seed germination/seedling establishment

2. Small seeds, seeds with small or no appendages, and native grasses are more likely to establish on biocrusts

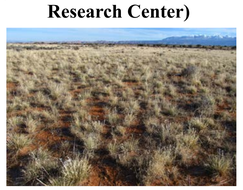
## Study Areas

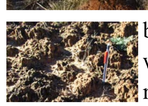
- Experiments in contrasting bioclimatic regions with differing biocrust topography to determine if outcomes are consistent across Western rangelands

**Sonoran Desert**
**(Santa Rita Experimental Range & CALS Campus Agriculture Center)**

biocrusts with < 3cm relief

**Colorado Plateau**
**(Hatch Point & Canyonlands Research Center)**



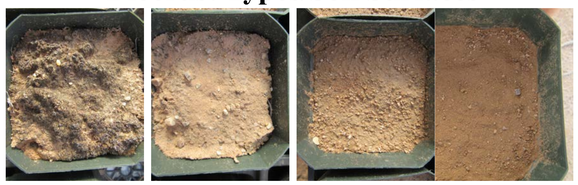


biocrusts with ~10cm relief

## Experimental Design

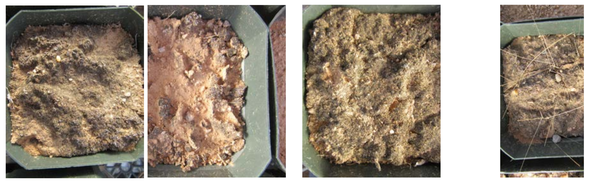
- Factorial experiments on germination and establishment of native and non-native grasses in semi-controlled environment and field environment in both study areas
- To address Hypothesis 2, grasses represent a range of seed masses and appendage sizes; appendages manipulated (awns/bristles removed vs. awns/bristles intact)

**Biocrust Types/Soil Surfaces**



lichen | cyano-bacteria | polyacryl-amide | bare soil

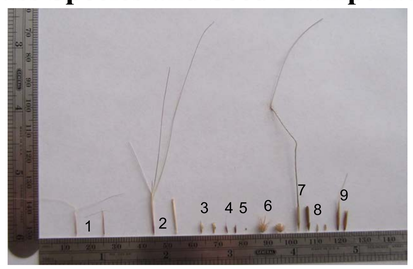
**Surface Disturbance** | **Seed Placement***



intact | trampled | surface | cracks

*semi-controlled environments only

**Grass Species and Seed Manipulation**



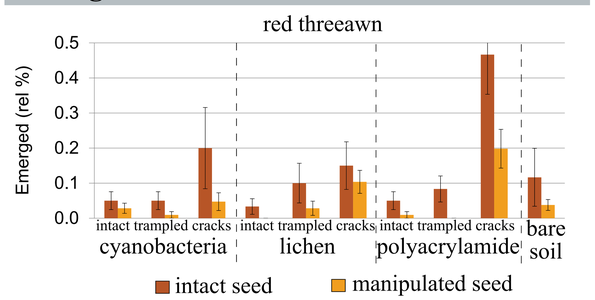

Intact and manipulated seed:
1. purple threeawn (*Aristida purpurea*)
2. red threeawn (*A. purpurea* var. *longiseta*)
3. blue grama (*Bouteloua gracilis*)
4. bush muhly (*Muhlenbergia porteri*)
5. sand dropseed (*Sporobolus cryptandrus*)
6. buffelgrass (*Pennisetum ciliare*; non-native)
7. needle-and-thread (*Hesperostipa comata*)
8. sixweeks fescue (*Vulpia octoflora*)
9. red brome (*Bromus rubens*; non-native)

Note: Cheatgrass (*B. tectorum*) is the non-native grass used on the Colorado Plateau

## Preliminary Results

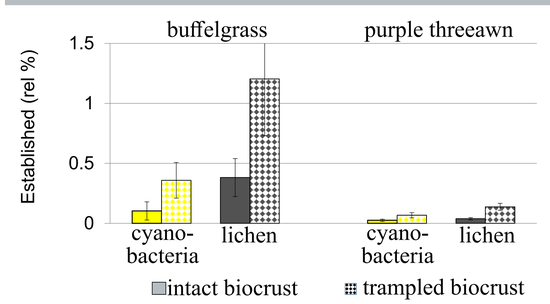
- Warm-season grasses (species #1-6 above) in Sonoran Desert evaluated to date

**Emergence in semi-controlled environment**




- Mean emergence (± SE) higher when seeds placed in cracks compared to seeds placed on the surface
- Mean emergence (± SE) was higher for intact seeds compared to manipulated seeds for native grasses in the Sonoran Desert

**Establishment in field environment**




- Mean establishment (± SE) higher on trampled biocrusts compared to intact biocrusts
- Buffelgrass established at higher rates than purple threeawn when standardized for seed viability

## Next Steps

- Test cool-season grasses in Sonoran Desert
- Test native grasses on Colorado Plateau
- Experiments on germination and establishment of native and non-native grasses on restored biocrusts in areas where non-native grasses removed

- Quantify infiltration rates at Santa Rita Experimental Range and dry-down rates in pots in semi-controlled environments to estimate duration of near-surface moisture
- Add sites on the North Rim to form latitudinal gradient and broaden applicability of findings
- Repeat experiments to understand temporal variability

## Acknowledgements

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1. Belnap, J., R. Prasse, and K. T. Harper. 2001. Influence of biological soil crusts on soil environments and vascular plants. Pages 281-300 in J. Belnap and O. L. Lange, editors. Biological soil crusts: Structure, function, and management. Ecological Studies 150. Springer, New York.

Biocrust schematic based on Rosentreter, R., M. Bowker, and J. Belnap. 2007. A Field Guide to Biological Soil Crusts of Western U.S. Drylands. Government Printing Office, Denver, CO.