Does frozen storage change the germination performance of native forb species from the Southwest U.S.?

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A Brief History of Seed Banking
Agriculture
Conservation
Restoration
Study Location

- Southwest U.S. – Arizona, Colorado, New Mexico, Utah
- Large-scale restorations
- Limited availability of regional native plant material
Species Selection

• 7 common forb species*
• Widespread throughout the Southwest
• High priority species for use in large-scale restorations
• Little information about dormancy and germination
• Physiological and combinational dormancy
• Orthodox

*Selected from a list of species created by the Colorado Plateau Native Plant Program and collaborators
Seed Banks

- Low moisture and temperature (-20°C or below)
- Preservation of seeds for hundreds of years
- *Ex situ* collections in case of extinction or population destruction
Hypotheses

1. Southwestern native forb species will be amenable to seed banking conditions (i.e., drying and storing at sub-zero temperatures)
2. Germination response (proportion and rate) will not differ between non-frozen and frozen seeds
3. Seed bank storage effects will not differ within species
Dieteria canescens  
hoary tansyaster

Heliomeris multiflora  
showy goldeneye

Packera multilobata  
lobeleaf groundsel

Cleome serrulata  
Rocky Mountain beeplant

Penstemon comarrhenus  
dusty beardtongue

Plantago patagonica  
woolly plantain

Sphaeralcea parvifolia  
small-leaf globemallow
Seed Collection

- Summer and fall 2015
- 9 populations
- Seeds of Success protocols
Methods

Collect seeds

Clean seeds

Seed dryer

Plate seeds

Stratification Incubation

Score germination

Cut tests

Seed bank

1/2
Methods

1. Collect seeds
2. Clean seeds
3. Seed bank
4. Plate seeds
5. Seed dryer
6. Score germination
7. Stratification
8. Incubation

No stratification

<table>
<thead>
<tr>
<th>Incubation</th>
<th>2 weeks</th>
<th>4 weeks</th>
<th>6 weeks</th>
<th>8 weeks</th>
<th>10 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(3, 6, 9°C)</td>
<td>(3, 6, 9°C)</td>
<td>(3, 9°C)</td>
<td>(3°C)</td>
<td>(3°C)</td>
</tr>
</tbody>
</table>

Temperatures:
- 20/10°C
- 25/15°C
Sphaeralcea parvifolia shows differences between non-frozen and frozen seeds.

All treatments shown

Cox p-value = 0.001
Rate DOES NOT differ for *Penstemon comarrhenus*

Cox p-value = 0.18
Rate DOES differ in 10- and 8-week treatments

Cox p-value = 0.05
Packera multilobata shows no difference

All treatments shown

Cox p-value = 0.58
Dieteria canescens shows difference during stratification and in rate

All treatments shown

Cox p-value = 0.03
*Dieteria canescens* Mogollon population shows no difference in rate

All treatments shown

Cox p-value = 0.49
*Dieteria canescens* San Juan population shows difference in rate

All treatments shown

Cox p-value = 0.03
<table>
<thead>
<tr>
<th>Species</th>
<th>No stratification</th>
<th>Monsoon</th>
<th>Short winter</th>
<th>Long winter</th>
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</thead>
<tbody>
<tr>
<td>Cleome serrulata</td>
<td>Pop UT</td>
<td>Cool AZ</td>
<td>Warm NM</td>
<td></td>
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<tr>
<td>Dieteria canescens</td>
<td>UT</td>
<td>UT1 AZ</td>
<td>UT2 NM</td>
<td></td>
</tr>
<tr>
<td>Heliomeris multiflora</td>
<td>CO</td>
<td>AZ</td>
<td>NM</td>
<td></td>
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<tr>
<td>Heterotheca villosa</td>
<td>UT</td>
<td>UT1 AZ</td>
<td>UT2 NM</td>
<td></td>
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<tr>
<td>Machaeranthera tanacetifolia</td>
<td>UT1</td>
<td>UT2 NM4</td>
<td>NM5</td>
<td></td>
</tr>
<tr>
<td>Packera multiflora</td>
<td>UT1</td>
<td>AZ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penstemon comarrhenas</td>
<td>UT1</td>
<td>UT2</td>
<td></td>
<td></td>
</tr>
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<td>Plantago patagonica</td>
<td>CO</td>
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<td>AZ</td>
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<td>Sphaeralcea parvifolia</td>
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<td>AZ</td>
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</table>

Germination Percentage

- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%
Summary

1. Species are amenable to seed banking

2. Germination does not differ after freezing

3. Effects do not differ within species

TRUE

FOR MOST SPECIES

DIETERIA CANESCENS SHOWS DIFFERENCE IN RATE
Seed bank for restoration!

- All species have orthodox seeds and are amenable to seed banking
- Dormancy and germination largely unchanged following seed bank storage
- Effects were most pronounced during stratification for most species
- Understanding early life stages is critical for restorations now and in the future

**Action 2.2.1** Conduct seed germination studies and develop seed testing protocols for key restoration species.

**Action 2.2.2** Develop storage guidelines for restoration species to improve maintenance of seed viability.
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Questions?

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