Differential seed dormancy and germination requirements of two upland prairie sedges

*Carex inops* ssp. *inops* and *Carex tumulicola*

Kelly Broadlick & Jonathan D. Bakker

National Native Seed Conference
Washington, D.C.
February 14<sup>th</sup>, 2017
Challenge:
Poor (< 5%) germination was inhibiting production efforts

Goals:
Identify ways to improve germination
Develop reliable propagation protocols
Overview

• Results from two experiments
• Additional findings
• Resources
• Questions
Exp #1: Seed Dormancy & Germination Temperature
Experiment #1

• Cold Moist Stratification
  – Mechanism of dormancy release
  – 0-4 months (0, 1, 2, 3, or 4)

• Germination temperature
  – Spring (Fall)
  – Intermediate (late Spring/early Fall)
  – Summer

• Tested 16 combinations (lots) for each species
  – 200 seeds per lot
Carex tumulicola

Viable seeds

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Viable seeds</td>
<td>45%</td>
</tr>
</tbody>
</table>
Viable seeds: 60%
How these sedges compare to other *Carex* spp.

<table>
<thead>
<tr>
<th></th>
<th>Most <em>Carex</em> spp.</th>
<th><em>Carex tumulicola</em></th>
<th><em>Carex inops</em> ssp. <em>inops</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cold Stratification</strong></td>
<td>Increases Germination</td>
<td>Increases Germination</td>
<td>Decreases Germination</td>
</tr>
<tr>
<td><strong>Ideal Germination Temperature</strong></td>
<td>Warm</td>
<td>Cool</td>
<td>Cool</td>
</tr>
<tr>
<td><strong>Germination timing</strong></td>
<td>Summer</td>
<td>Spring</td>
<td>Fall</td>
</tr>
</tbody>
</table>
Exp #2: Germination Cues
Experiment #2

- Smoke Treatment
  - Karrikin
  - Smoke water & liquid smoke
  - 3 different dilutions

- Perigynia Removal
  - Tissue surrounds seed
  - Just Carex inops

- Tested 7-8 lots per species
  - 200 seeds per lot

- All received optimum strat/temp from Exp #1
Results

Smoke
• Increased germination by ~ 10% in both Carex
• Lower concentrations generally had a stronger effect (1:10,000, 1:1,000,000, 1:100,000,000)
• Both smoke sources were effective

Perigynia Removal
• Increased germination for Carex inops by ~10%
Warm Dry Storage/After-ripening

**Carex inops**

- Perigynia
  - Intact
  - Removed

- Warm storage duration
  - 44 weeks
  - 19 weeks

**Carex tumulicola**

- Warm storage duration
  - 31 weeks
  - 4 weeks

Cumulative germination (%) vs. Time in incubator (days)
TZ testing

<table>
<thead>
<tr>
<th>Species</th>
<th>Viable seed from initial TZ test</th>
<th>Viable seed at end of experiment (germinants + viable seed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carex inops</td>
<td>38%</td>
<td>41 – 56%</td>
</tr>
<tr>
<td>Carex tumulicola</td>
<td>8%</td>
<td>28 – 41%</td>
</tr>
</tbody>
</table>

- If TZ testing will be used to assess viability, guidelines for TZ testing may need to be developed for each species
Carex inops ssp. inops

Carex tumulicola
Carex inops ssp. inops

Carex tumulicola

These sedges have different...

• Responses to winter stratification
• Germination timing (fall vs. spring)
• Germination temperature (compared to other Carex spp.)
• Responses to TZ testing
Resources

• Carex germination
  – Ecology of Seed Dormancy and Germination in sedges (Carex), Wolfgang Schutz (2000) Perspectives in Plant Ecology and Systematics

• Propagation resources for other species
  – npn.rngr.net
  – When Breaking Seed Dormancy is a Problem, try a Move-along Experiment, Baskin & Baskin (2003) Native Plants Journal

• TZ testing seeds with dormancy
Thanks to Dr. Kern Ewing, Sierra Smith, Carl Elliott, Mark Sheehan, Cáelan Sky, the Center for Natural Lands Management, and Whidbey Camano Land Trust

This work was supported by:

Questions?

kelly.broadlick@gmail.com
Viable seeds 56%
Viable seeds

56%
Warm Dry Storage/After-ripening

Project timeline:

2015


19 weeks

CAIN seed collection

2016

CATU seed collection

4 wk

Exp #1 began

25 weeks

Exp #2 began

27 weeks

Seeds stored dry, at room temperature (70F)
Dormancy Patterns

- Dormant
- Conditionally dormant
- Non-dormant
Viable seeds

45%
*Carex tumulicola*

Dormancy
- Released by 2 months of winter stratification

Germination Temperature
- Spring and intermediate temperatures are best
- Can germinate in summer with 3-4 months of strat

Implications
- Seeds naturally germinate in spring
**Carex inops**

Dormancy
- Not reduced by stratification
- Zero months of stratification is best

Germination Temperature
- Intermediate and spring temperatures are best
- No germination in summer

Implications
- Seeds naturally germinate in fall
Carex inops ssp. inops
Carex tumulicola
Recommendations for propagators *Carex tumulicola*

- After-ripen for up to 4 weeks
- Place in cold (dry) storage
- Imbibe in smoke water
  - (1:1000000 – 1:100000000 dilution)
  - or liquid smoke
    - (1:10000000 dilution)
- Cold stratify for 8 weeks
- Sow seeds in spring
Recommendations for propagators

*Carex inops ssp. inops*

- Allow seeds to after-ripen for up to 19 weeks
  - no cold (dry) storage
- Imbibe with smoke water
  - 1:100000000 dilution
- Remove perigynia
- Sow seeds in early fall
  - no cold (moist) stratification
Takeaways

• Extended warm dry storage was not beneficial

• Initial warm dry storage may have reduced dormancy, especially for Carex inops

• Initial warm dry storage simulated natural conditions
Guidance for Germination Studies

• Do your seeds have dormancy? What kind?
• What relieves that dormancy?
• What temperature is ideal for germination?
• What other treatments can stimulate germination?
  – Start with ecologically significant cues that might signal a disturbance
• Track germination % and timing
• Measure seed viability before and after treatments
<table>
<thead>
<tr>
<th>Accession Codes</th>
<th>0-4 weeks</th>
<th>5-8 weeks</th>
<th>9-12 weeks</th>
<th>13-16 weeks</th>
<th>17-20 weeks</th>
<th>21-24 weeks</th>
<th>25-28 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIN</td>
<td></td>
<td></td>
<td></td>
<td>winter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W0-SPR</td>
<td></td>
<td></td>
<td></td>
<td>spring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W0-INT</td>
<td></td>
<td></td>
<td></td>
<td>intermediate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W0-SUM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>summer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1-SPR</td>
<td>winter</td>
<td></td>
<td>spring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1-INT</td>
<td>winter</td>
<td>intermediate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W1-SUM</td>
<td>winter</td>
<td>summer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2-SPR</td>
<td>winter</td>
<td>summer</td>
<td>spring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2-INT</td>
<td>winter</td>
<td>intermediate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W2-SUM</td>
<td>winter</td>
<td>summer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3-SPR</td>
<td>winter</td>
<td>spring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3-INT</td>
<td>winter</td>
<td>intermediate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W3-SUM</td>
<td>winter</td>
<td>summer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W4-SPR</td>
<td>winter</td>
<td>spring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W4-INT</td>
<td>winter</td>
<td>intermediate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W4-SUM</td>
<td>winter</td>
<td>summer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The preceding presentation was delivered at the

2017 National Native Seed Conference
Washington, D.C. February 13-16, 2017

This and additional presentations available at http://nativeseed.info