

**Differential seed dormancy and  
germination requirements of two  
upland prairie sedges**

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

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*Carex inops* ssp. *inops*



*Carex tumulicola*





# **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





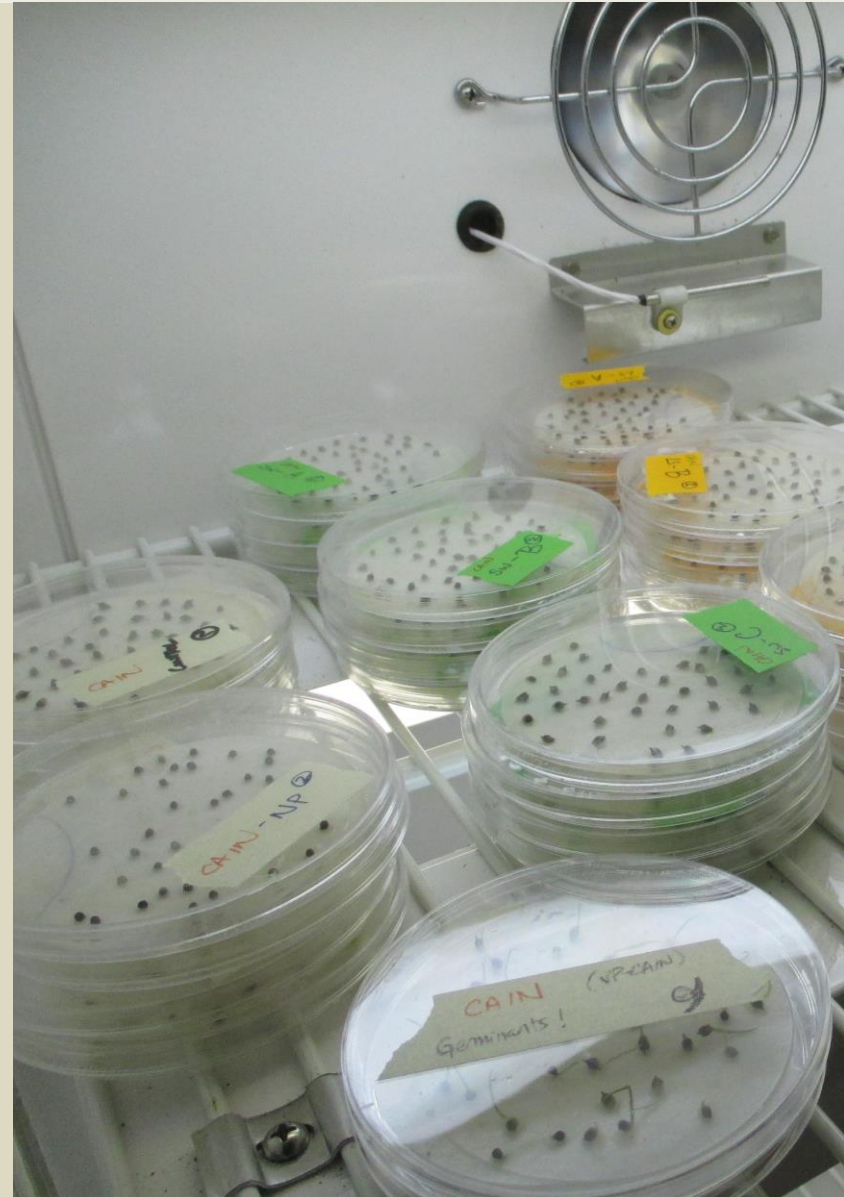
# Exp #1: Seed Dormancy & Germination Temperature





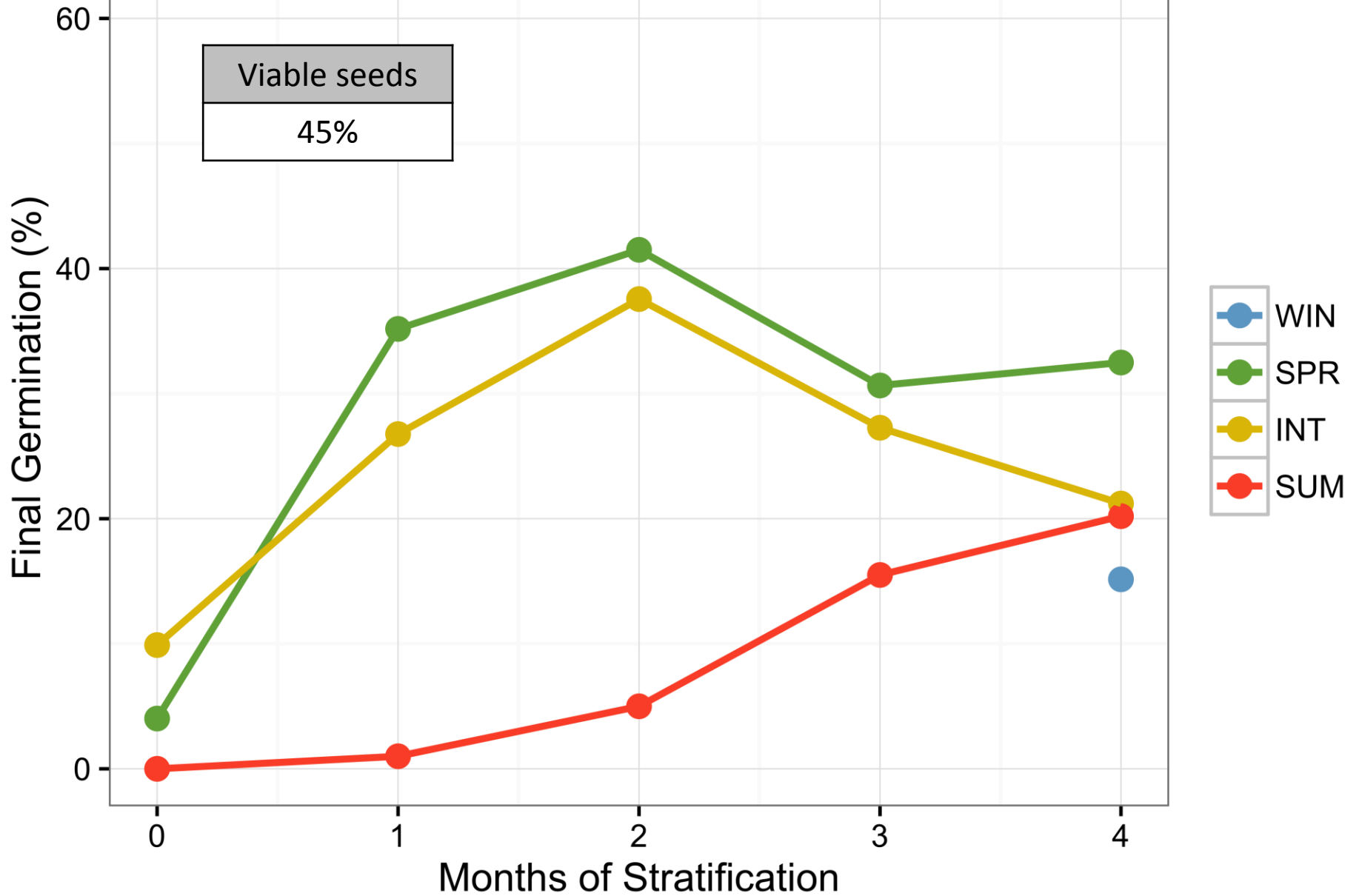
# Experiment #1

- 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



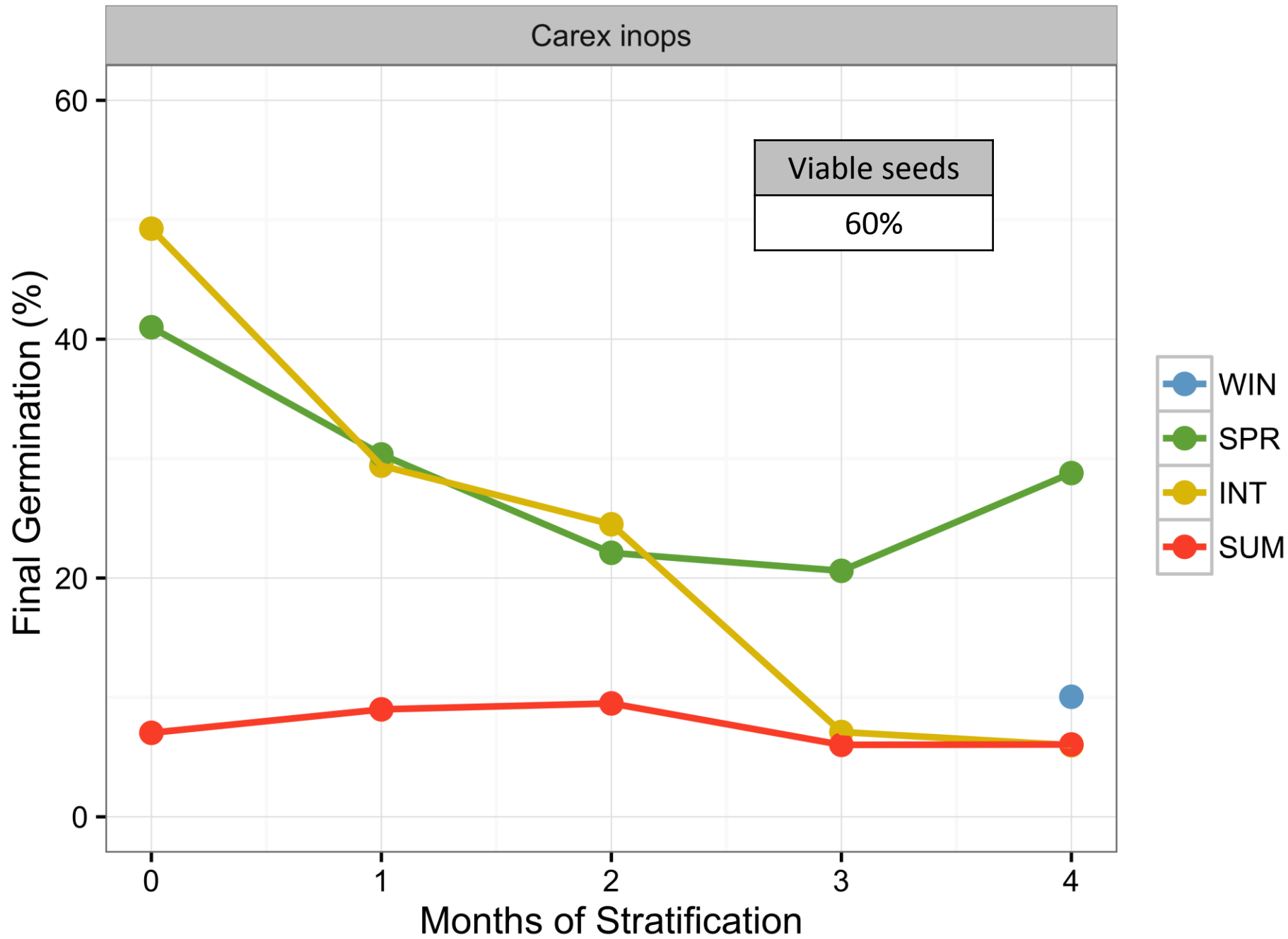


Carex tumulicola





Carex inops





# How these sedges compare to other *Carex* spp.

	Most <i>Carex</i> spp.	<i>Carex</i> <i>tumulicola</i>	<i>Carex inops</i> <i>ssp. inops</i>
Cold Stratification	Increases Germination	Increases Germination	Decreases Germination
Ideal Germination Temperature	Warm	Cool	Cool
Germination timing	Summer	Spring	Fall

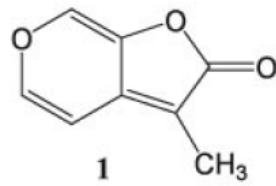




## Exp #2: Germination Cues



# 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





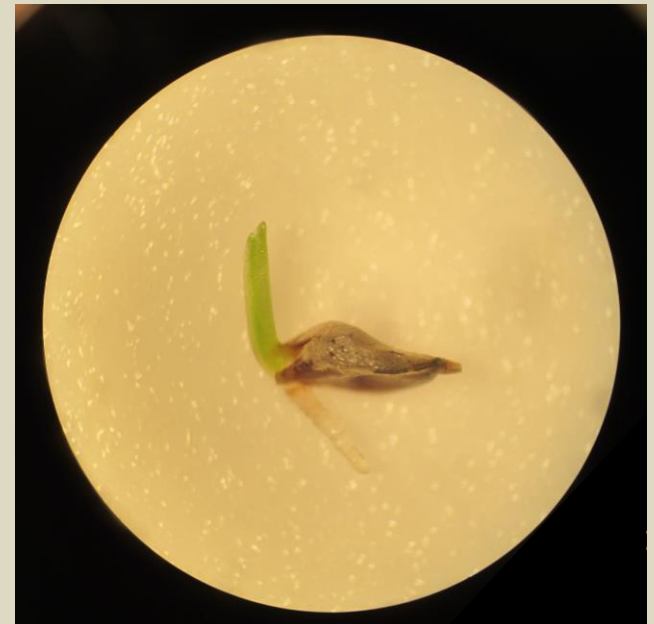
# Results

## 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%

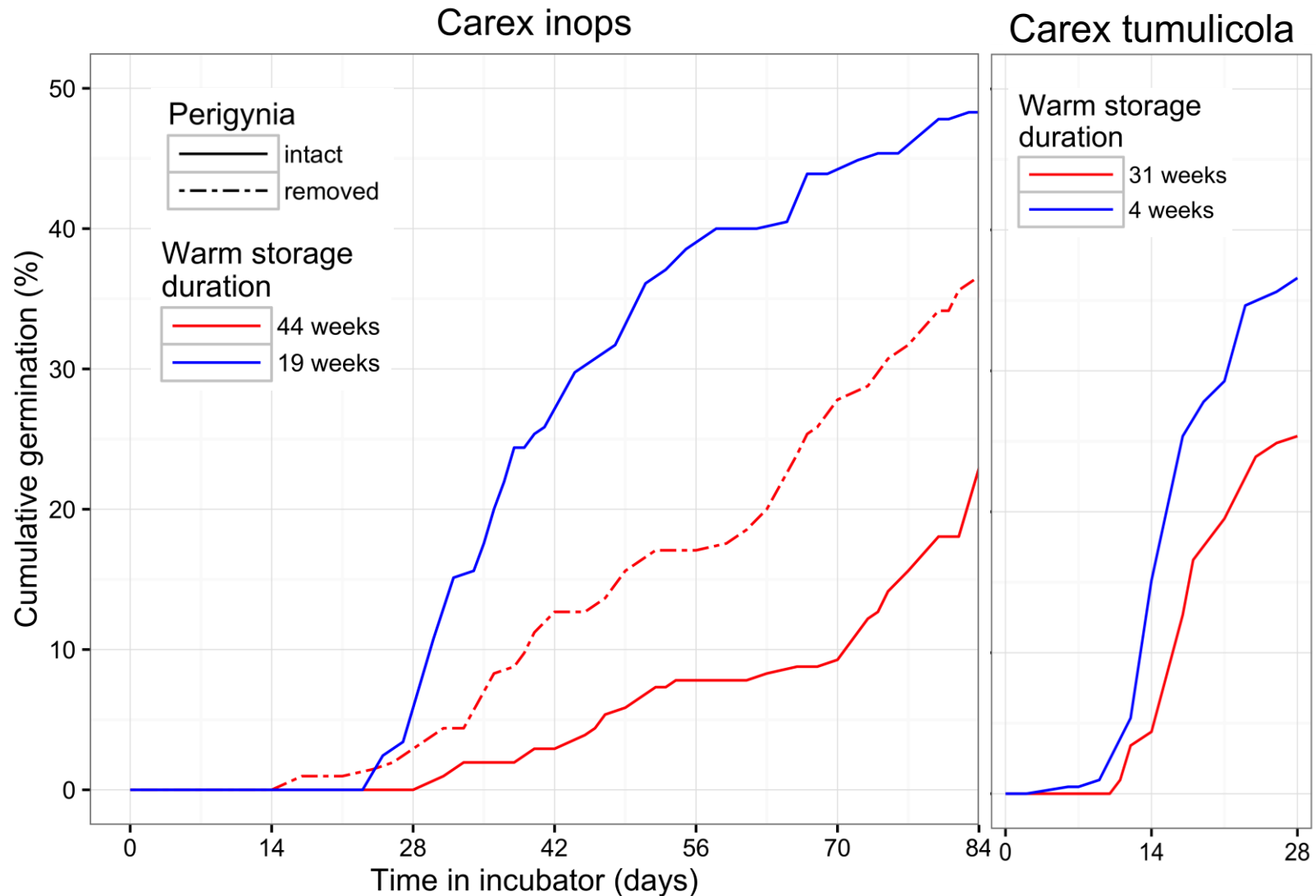








# Warm Dry Storage/After-ripening





# TZ testing



	Viable seed from initial TZ test	Viable seed at end of experiment (germinants + viable seed)
<i>Carex inops</i>	38%	41 – 56%
<i>Carex tumulicola</i>	8%	28 – 41%

- 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
  - Testing Native Species with Deep Dormancy, Vivrette & Meyer (2002) *Seed Technology*

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*This work was supported by:*



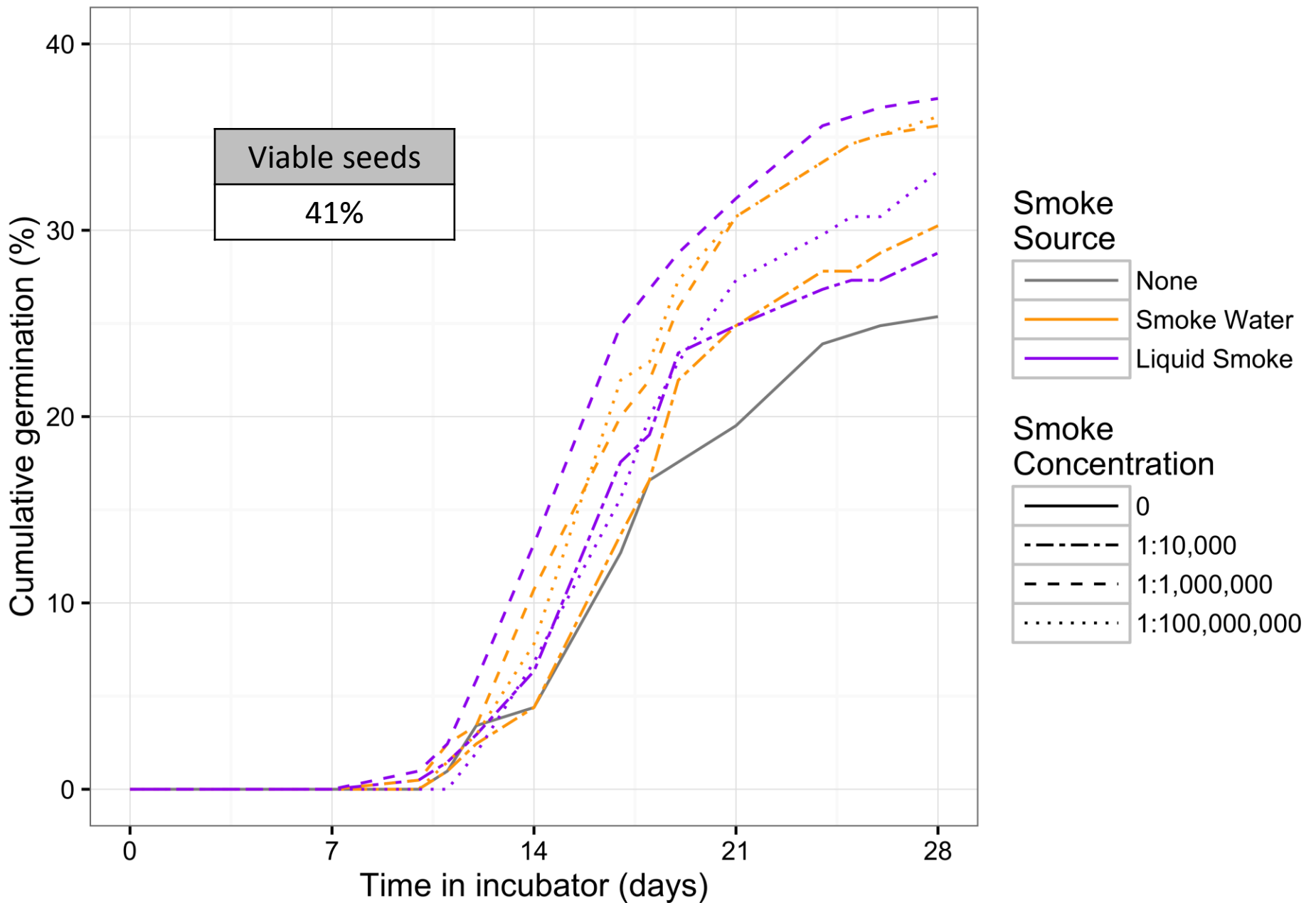
**NORTHWEST  
HORTICULTURAL  
SOCIETY**

**Questions?**

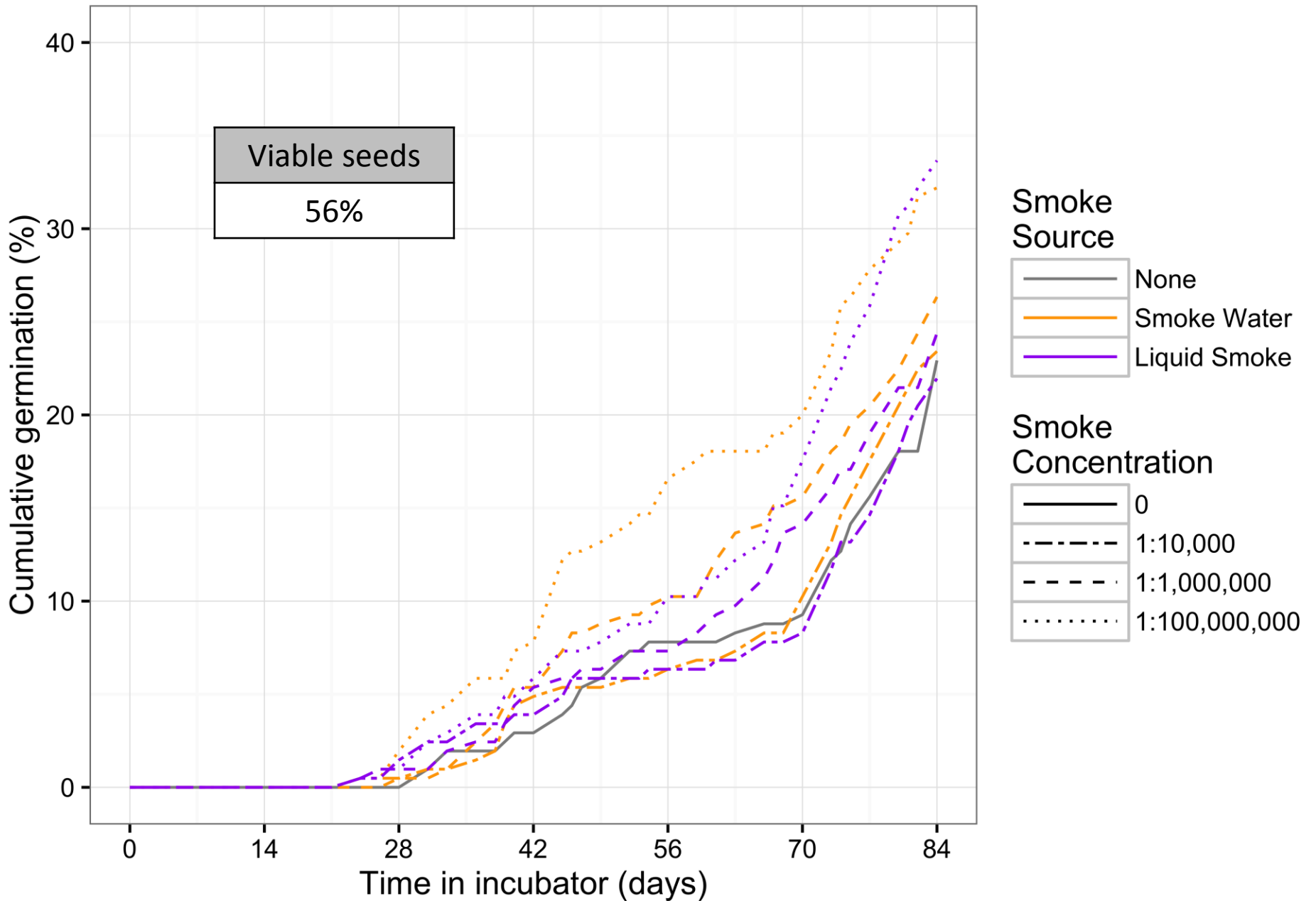
[kelly.broadlick@gmail.com](mailto:kelly.broadlick@gmail.com)



# Carex tumulicola

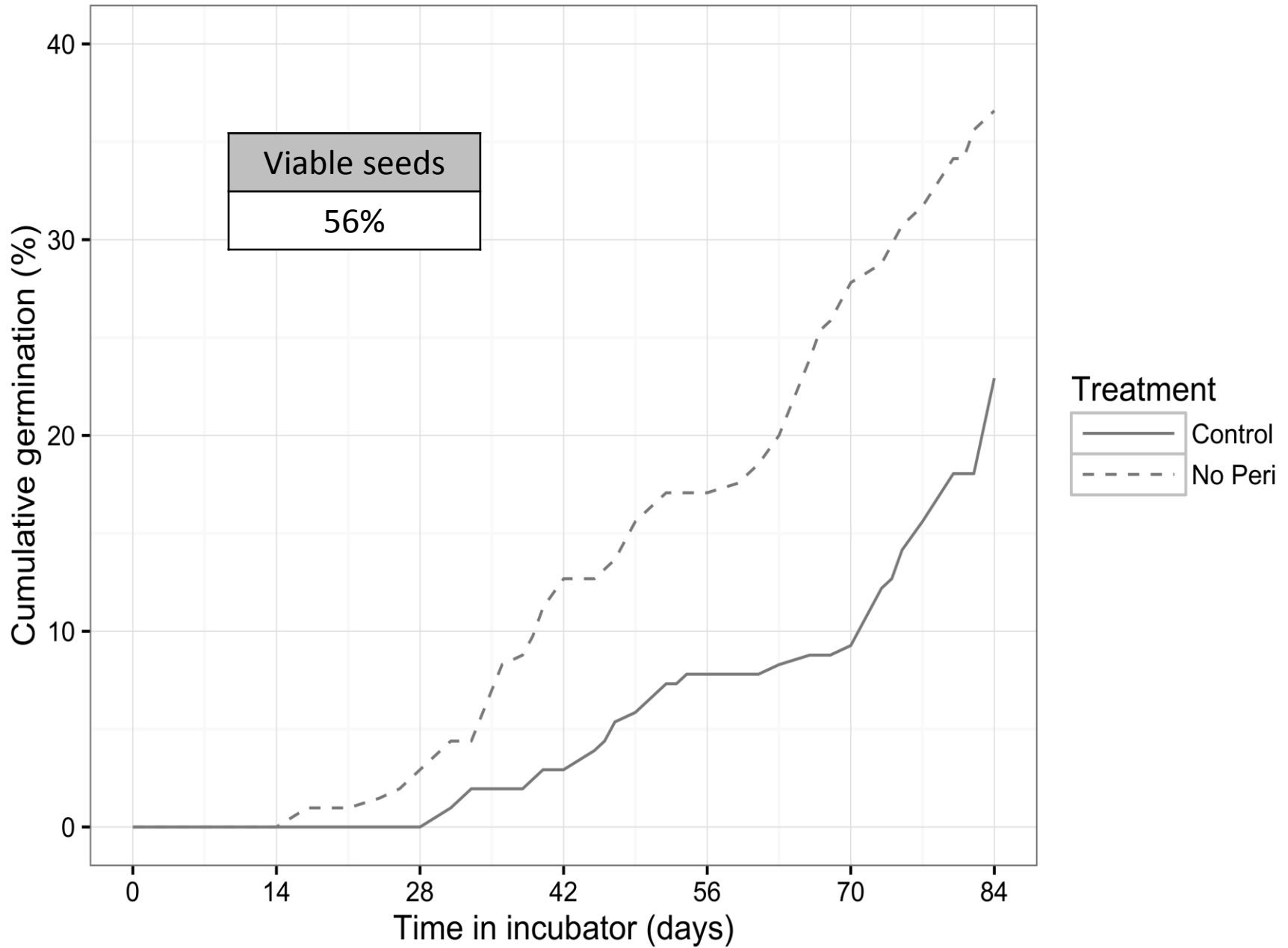


# Carex inops





# Carex inops



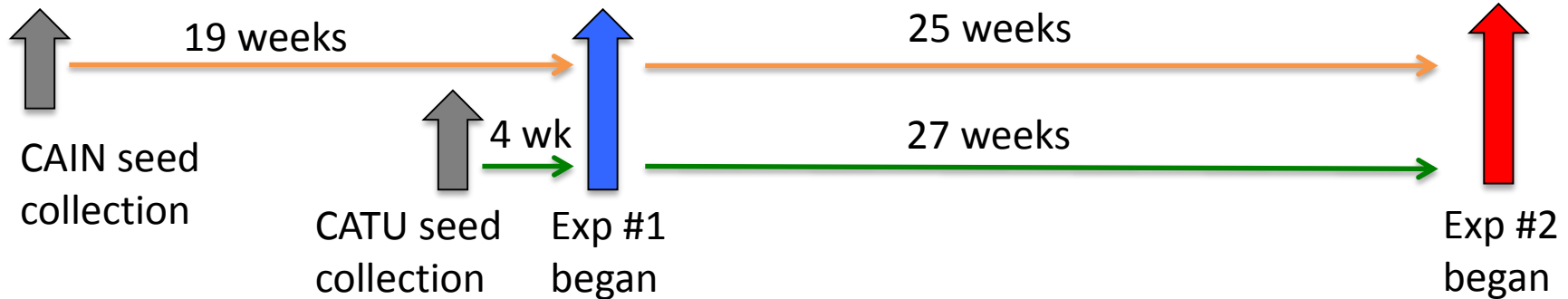
# Warm Dry Storage/After-ripening

Project timeline:

**2015**

**2016**

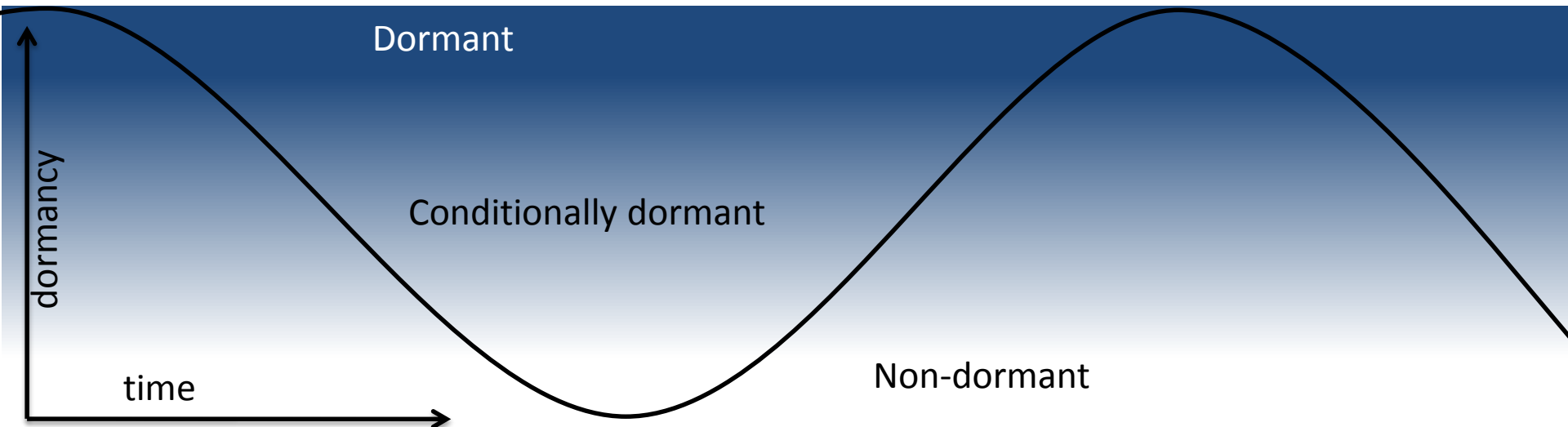
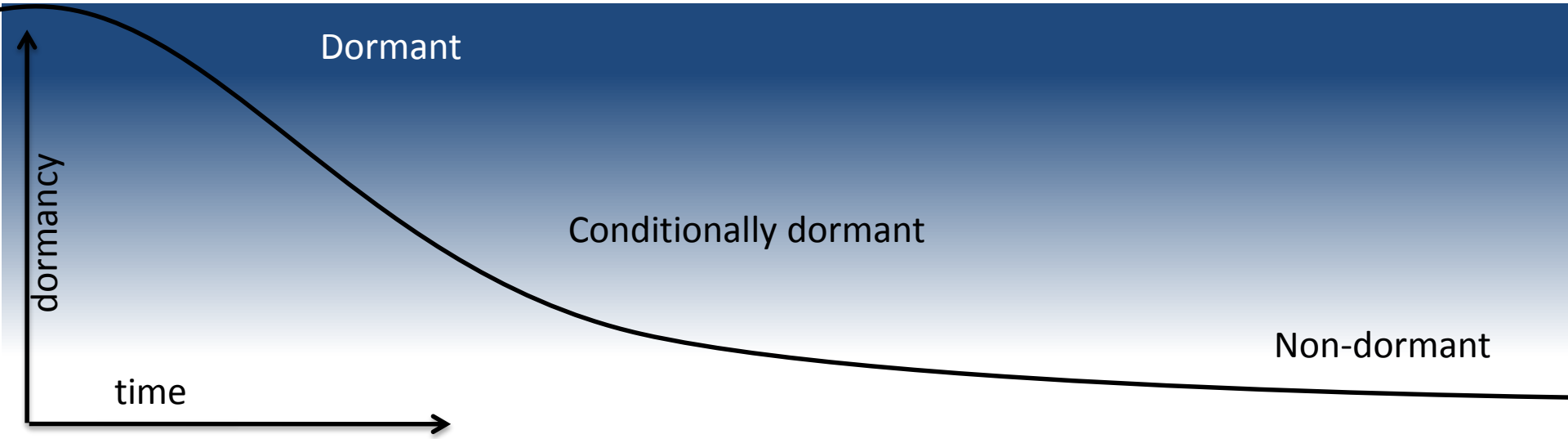
Jun – Jul – Aug – Sept – Oct – Nov – Dec – Jan – Feb – Mar – Apr – May



Seeds stored dry, at room temperature (70F)



# Dormancy Patterns

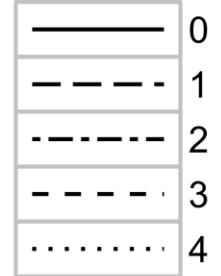


Carex tumulicola

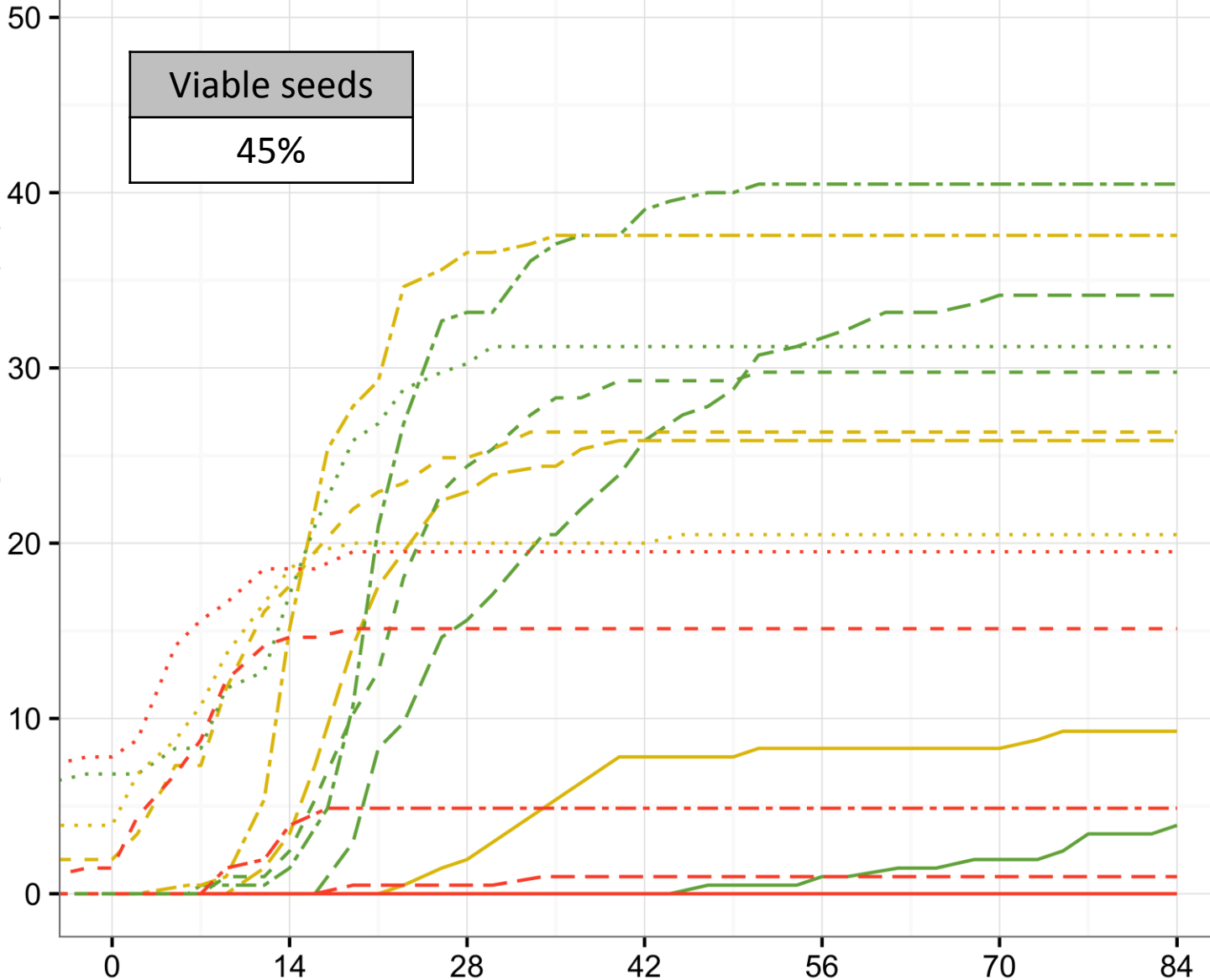
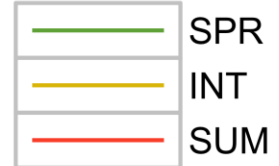
Viable seeds  
45%

Cumulative germination (%)

Months of Stratification

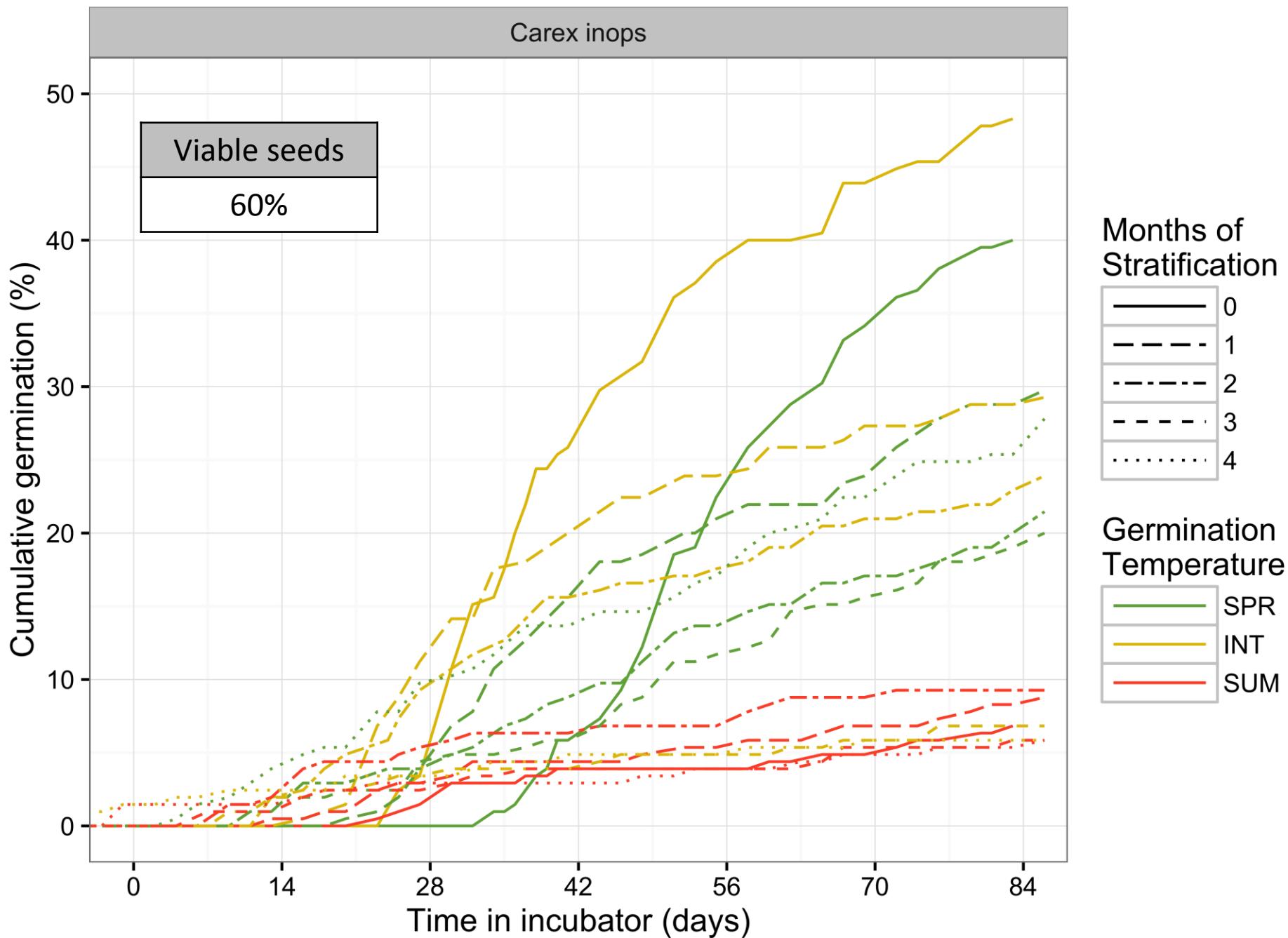


Germination Temperature



Time in incubator (days)





# *Carex tumulicola*

## Dormancy

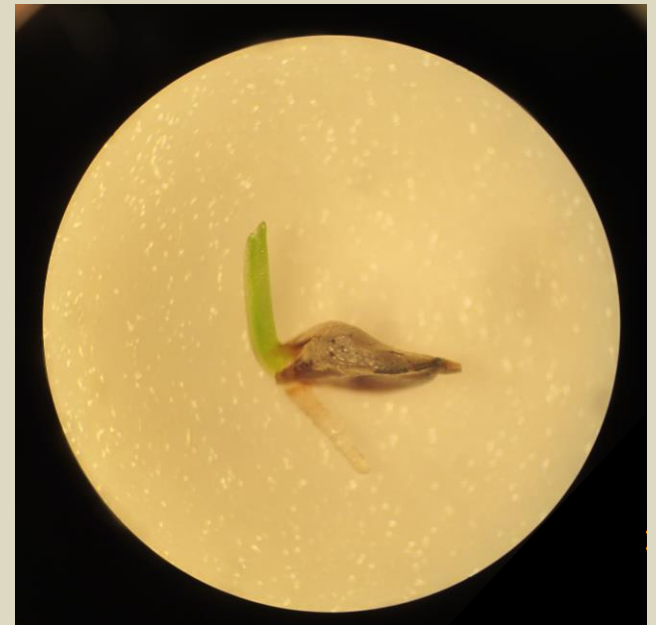
- Released by 2 months of winter stratification

## 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

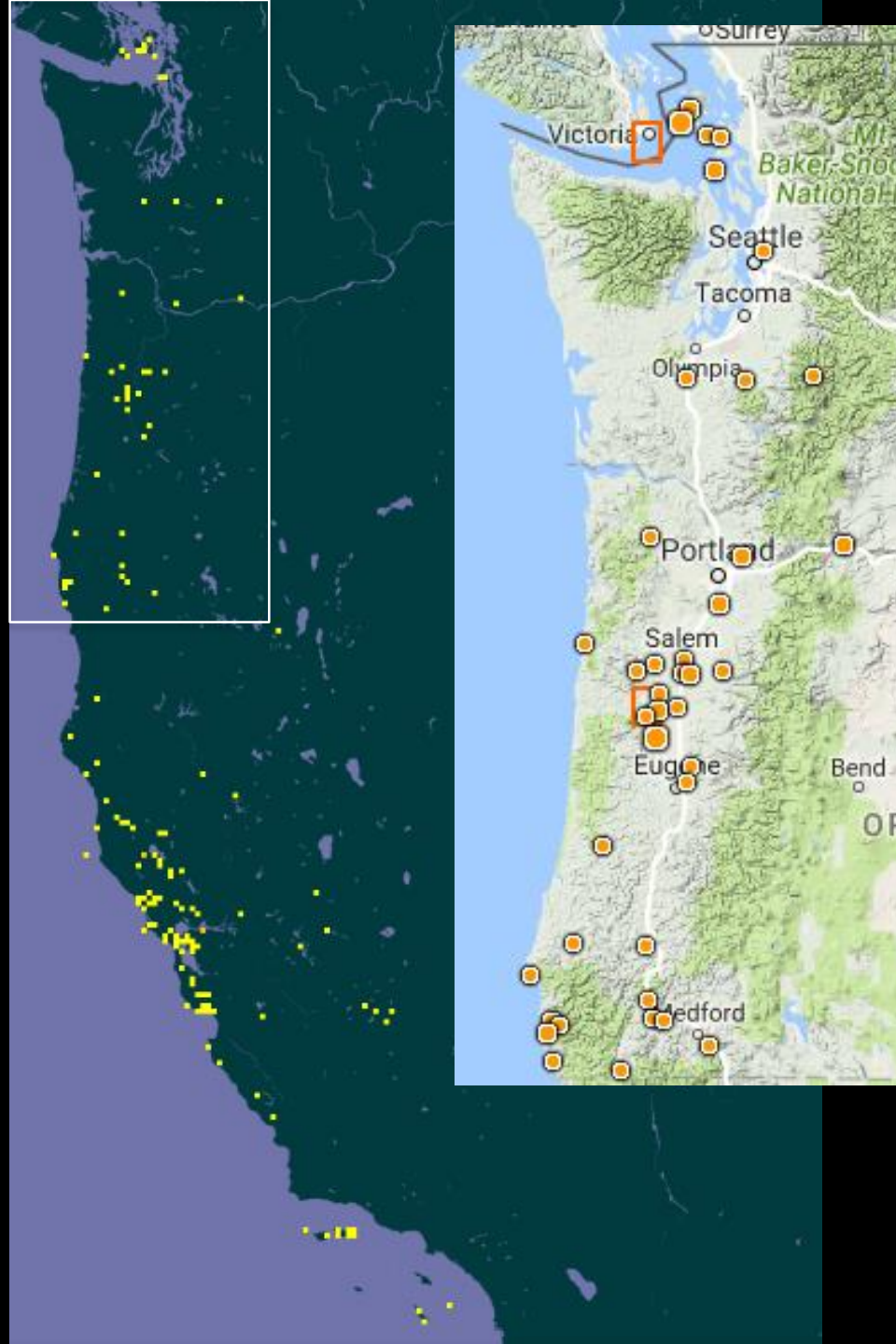


*Carex inops* ssp. *inops*

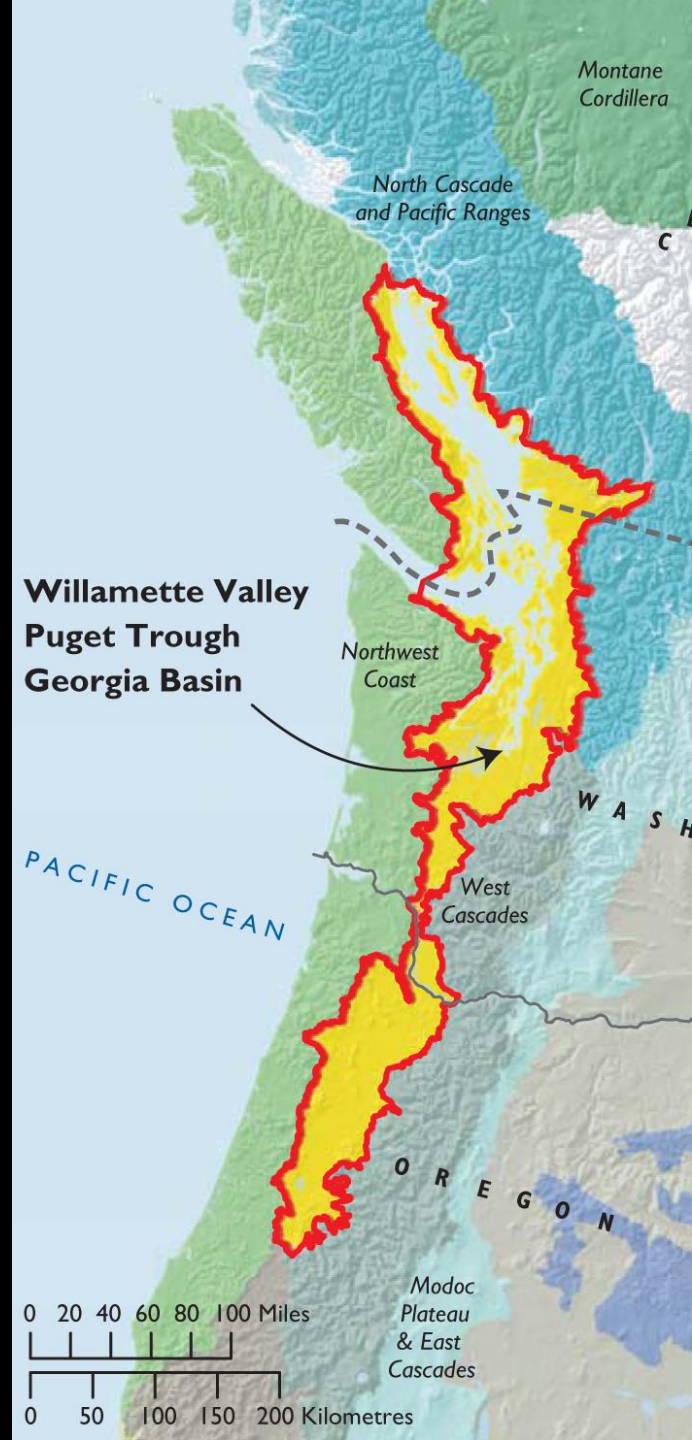




*Carex tumulicola*









# Recommendations for propagators

## *Carex tumulicola*

- After-ripen for up to 4 weeks
- Place in cold (dry) storage
- Imbibe in smoke water  
(1:1000000 – 1:1000000000 dilution)  
or liquid smoke  
(1:1000000 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



# Lots

Accession Codes	0-4 weeks	5-8 weeks	9-12 weeks	13-16 weeks	17-20 weeks	21-24 weeks	25-28 weeks	
WIN	winter							
W0-SPR	spring							
W0-INT	intermediate							
W0-SUM	summer							
W1-SPR	winter	spring						
W1-INT	winter	intermediate						
W1-SUM	winter	summer						
W2-SPR	winter		spring					
W2-INT	winter		intermediate					
W2-SUM	winter		summer					
W3-SPR	winter			spring				
W3-INT	winter			intermediate				
W3-SUM	winter			summer				
W4-SPR	winter				spring			
W4-INT	winter				intermediate			
W4-SUM	winter				summer			



The preceding presentation was delivered at the

## **2017 National Native Seed Conference**

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

