Breaking Physical Dormancy in Great Basin Fabaceae Species Using Five Seed Scarification Techniques

Remy Amarteifio[1], Olga Kildisheva[2], Andrea Kramer[3]

[1]Oakton Community College, [2]University of Western Australia, [3]Chicago Botanic Garden

Introduction

The Great Basin covers a vast portion of Nevada, Utah, Oregon, Idaho and California[1]. It is an area facing substantial ecosystem degradation due to climate change, invasive species, and catastrophic wildfires[2]. Restoration of these systems is key in maintaining the ecological integrity of this region[4]. These efforts rely on the use of large quantities of native plant seeds, but often have low establishment success, in part as a result of seed dormancy.

Astragalus filipes, *Dalea ornata*, and *Lupinus arbustus* (Fabaceae) are important members of the Great Basin plant community and are of high priority for restoration. As members of the Fabaceae genus, these plants have seeds that are physically dormant, due to a layer of palisade cells in the seed coat that prevents water uptake, and require abrasion for germination to occur[3]. Sulfuric acid and manual scarification with sandpaper are standard treatments for physical dormancy alleviation. However, these techniques are time consuming and potentially harmfull[6]. Given the large quantities (e.g. 100s of kg) of seeds that require treatment in a typical restoration project, more efficient and scalable techniques are needed.

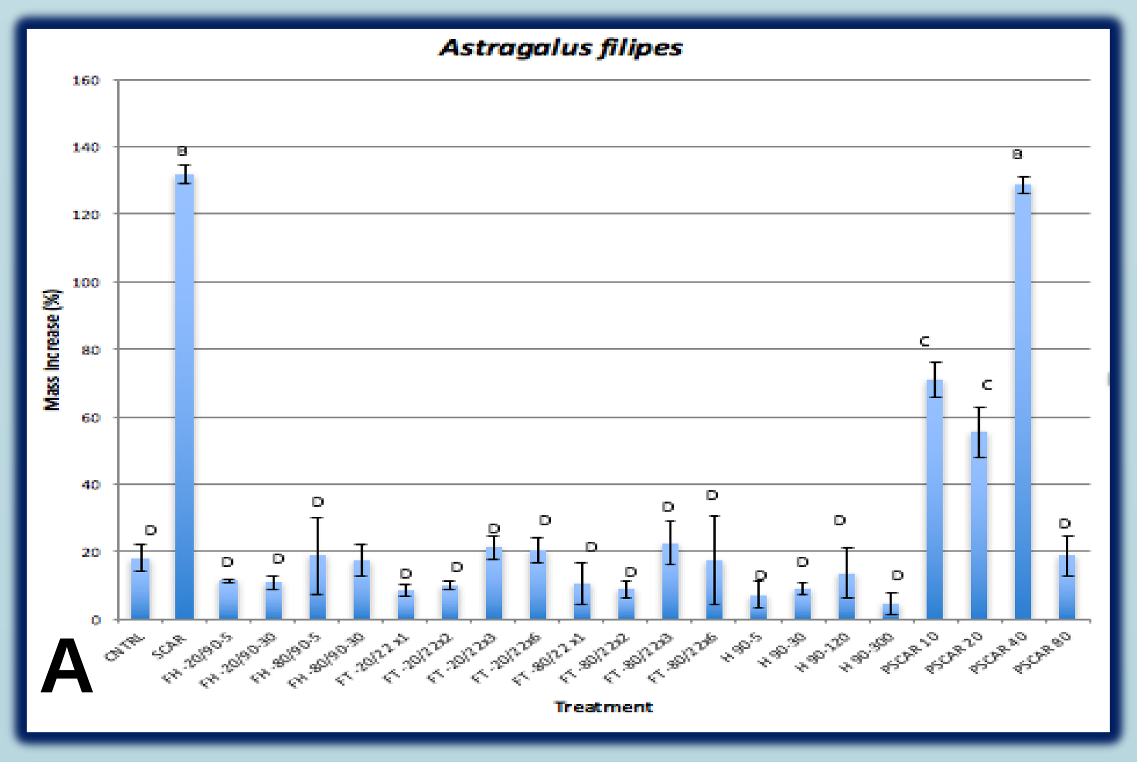
Objectives

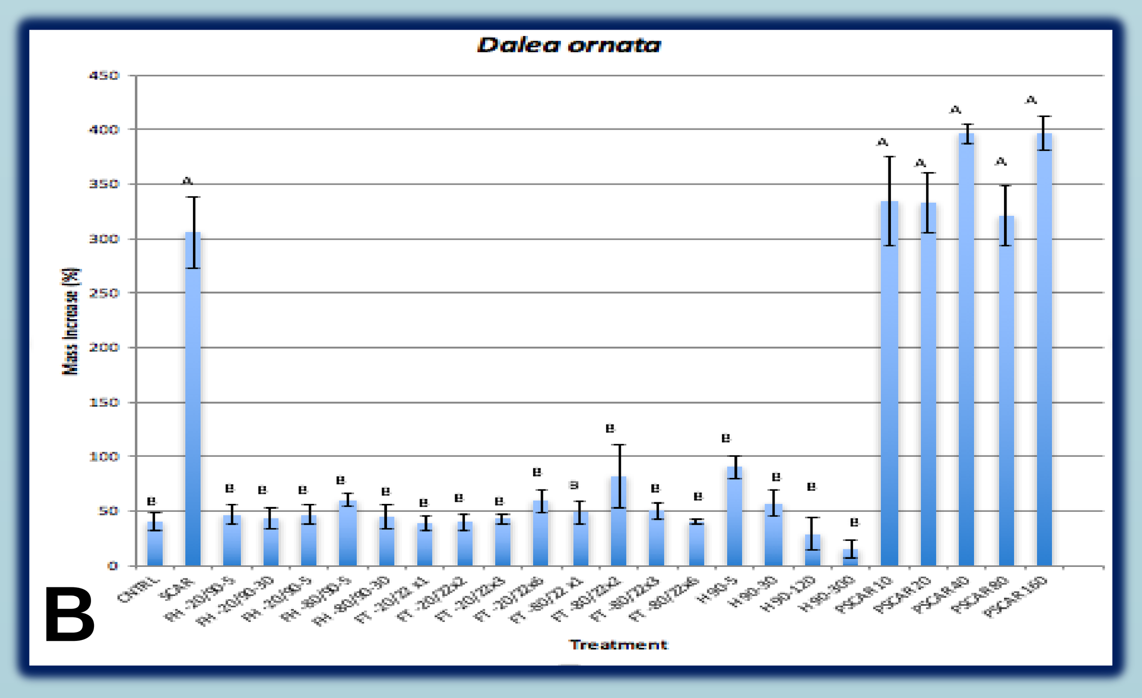
- **Determine the most optimal scarification technique for seeds of *Astragalus filipes*, *Dalea ornata*, and *Lupinus arbustus.***
- **Quantify seed water uptake and treatment uniformity of each technique**

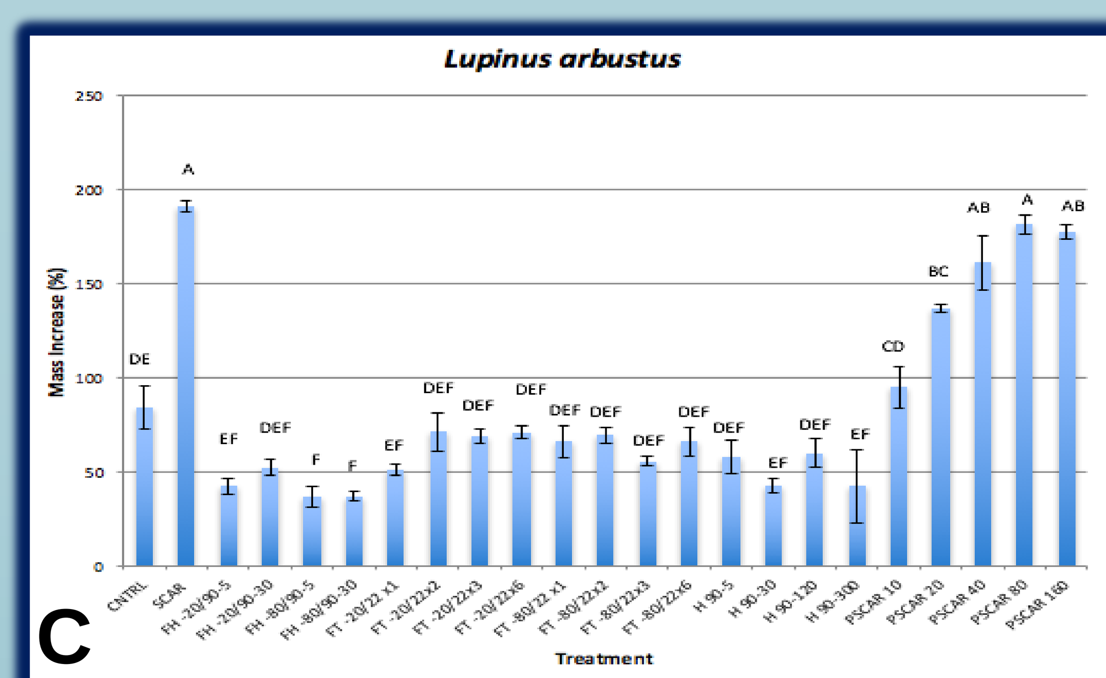
Materials and Methods

Technique	Treatment Specifications	Treatment Code
Pneumatic Scarification	10, 20, 40, 80, 160 sec	PSCAR 10 PSCAR 20 PSCAR 40 PSCAR 80 PSCAR 160
Deep Freezing+ Wet Heat	-80℃ for 2hrs and -90℃ for 5 sec -80℃ for 2 hrs and -90℃ for 30 sec -20℃ for 2hrs and -90℃ for 5 sec -20℃ for 2hrs and -90℃ for 30 sec	FH -80/90-5 FH -80/90-30 FH -20/90-5 FH -20/90-30
Wet Heat	90℃ for 5, 30, 120, 300 sec	H 90-5 H 90-30 H 90-120 H 90-300
Freeze Thaw Cycles	-80℃ for 2hrs x 1, 2, 3 cycles -20℃ for 2hrs x 1, 2, 3 cycles	FT-80/22 x 1 FT-80/22 x 2 FT-80/22 x 3 FT-20/22 x 1 FT-20/22 x 2 FT-20/22 x 3
Sandpaper Scarification	180 grade sandpaper	SCAR
Control	No treatment	CNTRL

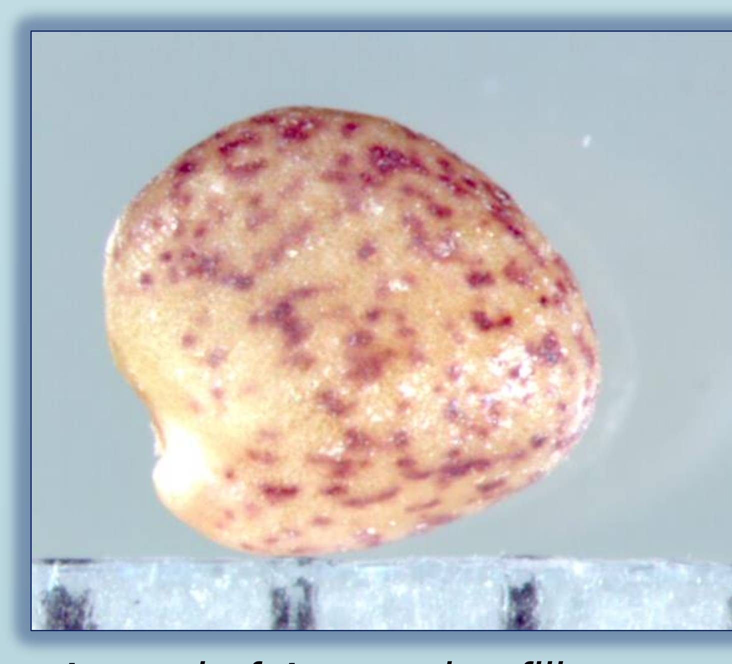
Results







Mean percent mass increase of (A) *Astragalus filipes,* (B) *Dalea ornata,* and (C) *Lupinus arbustus* seeds following five scarification techniques. Different treatment durations and intensities were examined, resulting in 21 treatments. Values were calculated based on 48 hours of imbibition on wet substrate. Each bar represents a mean of three 30-seed replicates



A seed of Astragalus filipes following pneumatic scarification for 10 seconds.

A seed of *Dalea ornata* following manual scarification with sandpaper.

A seed of *Lupinus arbustus* following pneumatic scarification for 160 seconds.

Conclusions & Discussion

Pneumatic & Sandpaper scarification

- These treatments were most effective and showed a high degree of water uptake due to the level of seed coat scarification
- Pneumatic scarification (at higher treatment durations) was as effective as manual scarification with sandpaper.

Deep Freezing, Wet Heat & Freeze Thaw Cycles

- These treatments did not result in improved imbibition

Future Research

- Examine the effectiveness of the pneumatic scarification technique across a range of species
- Evaluate the scalability of pneumatic scarification on larger quantities of seeds

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Oakton Community College

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The University of Western Australia

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