Effect of Presoaks with Sulfuric Acid and Gibberellic Acid on Seed Germination of *Ferocactus wislizeni*

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Abstract

Cactaceae includes many perennial and evergreen species which survive in areas where water is scarce due to an extensive set of unique adaptations. *Ferocactus wislizeni* (Candy Barrelcactus) is native to the Sonoran Desert, where it is protected in Arizona. Seed dormancy plays a role in controlling cactus seed germination. Studies show that presoaks in gibberellic acid (GA_3) or sulfuric acid (H_2SO_4) can play a role in breaking seed dormancy, and thus stimulate seed germination in some cactus species. The objective of this study was to determine effects of GA_3 and sulfuric acid presoaks on germination of *F. wislizeni*. Seeds of *F. wislizeni* were soaked in GA_3 (0, 500, 1000 and 2000 mg/L) for 24 hrs, and others were scarified with concentrated sulfuric acid for 0, 15, 30, and 60 minutes. Three replications of 50 seeds each were placed in Petri dishes with moistened filter paper and placed in a growth chamber at 25°C with 16 hours of light at 33 µmol/m^2/sec. Germinated seeds were counted daily. Germination of seeds presoaked in 2000 mg/L GA_3 (35%) was significantly higher than in 500 and 1000 mg/L GA_3 (18-23%), which were higher than the control (13%). Sulfuric acid presoaks did not affect germination (21-31%) significantly compared to the control. For propagation of *F. wislizeni*, GA_3 would be beneficial to increase seed germination.

Objectives

To determine effects of gibberellic acid and sulfuric acid presoaks on germination of *Ferocactus wislizeni*.

Introduction

Candy Barrelcactus, *Ferocactus wislizeni* (Engelm.) Britton & Rose, is a perennial belonging to Cactaceae. In the United States, it is found in arid climates such as Arizona, New Mexico, and Texas (USDA, NRCS 2013). Seeds of *F. wislizeni* can persist in soil for several months, indicating seeds may have dormancy characteristics to delay germination (Bowers 2000). Gibberellic acid (GA_3) is a plant growth regulator that stimulates germination in dormant seeds of some species. In some Cactaceae, different concentrations of GA_3 have increased germination (Alcorn and Kurtz 1959). Additionally, some species of Cactaceae require light to break dormancy. Another method used to break dormancy is acid scarification. Few studies have examined this method of breaking seed dormancy in Cactaceae.

Materials and Methods

Experimental setup:
- *Ferocactus wislizeni* seeds from Granite Seed (Lehi, UT)
- Tetrazolium test showed 53% seed viability
- Plastic petri dishes lined with moistened filter paper
- Seeds placed into dishes and dusted with Thiram fungicide
- Dishes placed in seed germination chamber at 25.0 C with 16 hours of light (33 µmol/m^2/sec)
- Seeds checked daily for germination for 21 days

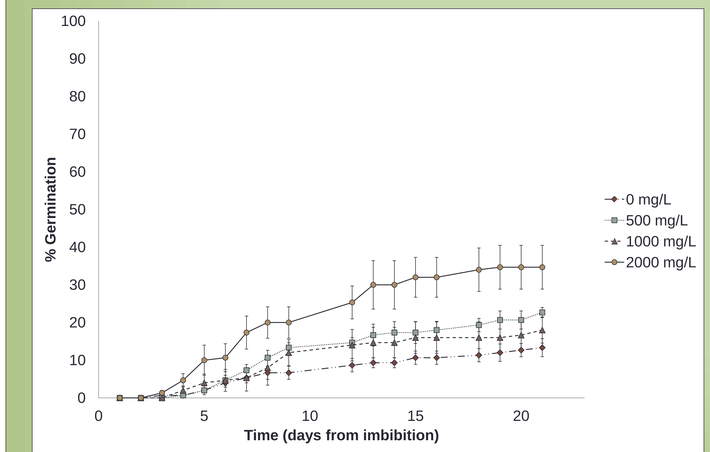
Sulfuric acid scarification:
- Seeds soaked in 95-98% H_2SO_4 for 0, 15, 30 or 60 minutes
- Scarified seeds rinsed in water for 5 minutes

Gibberellic acid soak:
- Seeds soaked in 0, 500, 1000 or 2000 mg/L GA_3 for 24 hours
- A second set of GA_3 soaks performed with dishes kept in dark

Statistics:
- Germination percentages analyzed in SPSS by ANOVA followed by Duncan's multiple range test at 95% confidence interval

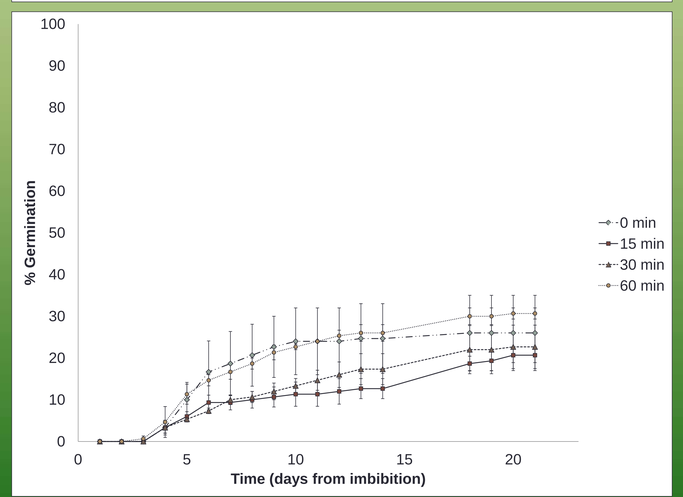
Results

Germination Rate: GA_3



Means standard errors

Germination Rate: H_2SO_4



Means standard errors

% Germination- GA_3

GA_3 Soak (mg/L)	Light	Dark
0	13.3 2.4 c	0.0 0.0 c
500	22.7 1.3 b	4.0 2.3 b
1000	18.0 3.5 b	5.3 3.3 b
2000	34.7 5.8 a	8.0 3.1 a

Means standard errors. Means followed by a different letter are significantly different at a 95% confidence interval.

% Germination- H_2SO_4

H_2SO_4 Soak (min)	Light
0	26.0 9.0 a
15	20.7 1.8 a
30	22.7 5.2 a
60	30.7 1.3 a

Means standard errors. Means followed by a different letter are significantly different at a 95% confidence interval.

Summary

- Gibberellic acid at 2000 mg/L produced significantly higher germination compared to all other GA_3 treatments.
- 66% of viable seeds germinated with a 2000 mg/L GA_3 presoak, based on a tetrazolium test showing that only 53% of seeds were viable.
- Gibberellic acid treatments in dark conditions produced significantly lower germination percentages compared to GA_3 treatments in light conditions.
- Sulfuric acid treatments were not significantly different from the control.
- These findings suggest that gibberellic acid is a useful strategy to increase germination of *Ferocactus wislizeni* for conservation methods.

References

- Alcorn, S.M. and E.B. Kurtz, Jr. 1959. Some factors affecting the germination of seed of the Saguaro cactus (*Carnegiea gigantea*). *American Journal of Botany* 46(7): 526-529.
- Bowers, J.E. 2000. Does *Ferocactus wislizeni* (Cactaceae) have a between-year seed bank? *Journal of Arid Environments* 45: 197-205.
- USDA, NRCS. 2013. The PLANTS Database (http://plants.usda.gov, 9 January 2013). National Plant Data Team, Greensboro, NC 27401-4901 USA.

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