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Seed Germination and Viability of *Bursera* Species of Morelos, Mexico©

Evelyn A. Healy and Richard y. Evans
Department of Plant Sciences, University of California, Davis, California 95616
Email: ryevans@ucdavis.edu

Consuelo Bonfil
Departmento de Ecologia y Recursos Naturales, Facultad de Ciencias UNAM, Ciudad Universitaria, Mexico D.F. 04510

Tropical dry forest restoration in Mexico is hindered by poor germination of *Bursera copallifera* and other common *Bursera*. Fungal infections of the seeds are common. Preliminary work on *B. copallifera* found that the stony endocarp was water-permeable. One germination experiment on a mixed collection of *B. copallifera* seed tested treatments with (1) deionized water, (2) 4-h soak in 3% hydrogen peroxide, (3) mechanical scarification by cracking, and (4) 4-h soak in 3% hydrogen peroxide plus mechanical scarification. There was no statistical difference between the treatments, although mechanical scarification alone appeared to encourage fungal infection. A second experiment with individual seed collections of several *B. copallifera* trees tested: (1) deionized water (control), (2) moist pre-chill for 6 days at 4 °C preceded by a 48-h imbibition period at room temperature, (3) 250 µM GA_3, (4) 600 µM benzyladenine (BA), and (5) 125 µM GA_3 plus 300 µM BA. Logistic regression analysis found that the most important effects on germination were the variation between the seed collections of each tree ($p = 0.05 < 0.0001$) and the tree by-treatment interaction ($p = 0.0005$). Treatment effect was minimal ($p = 0.0432$). While the seeds of each tree responded differentially to the treatments, none of the treatments improved germination to a statistically significant extent. Pre-chilling decreased germination of the seeds of one tree. Most of the remaining seeds were dead at the end of the test period. The proportion of viable seeds varied widely among the trees. Low viability and vigor appeared to be the most important factors limiting germination in *B. copallifera*. The results suggested a possible relationship between tree density and seed viability that should be examined more closely.

BACKGROUND

Of the approximately 100 *Bursera* (Burseraceae) species, 80 occur in Mexico; 70 are endemic. Several *Bursera* are common dominant tropical dry-forest trees. Poor germination is common.

Preliminary Observations.

- Many filled seeds don't germinate.
- Stony endocarp was water-permeable.
- Endocarp was usually infected with various fungi.
- Germination was poor in most preliminary tests.
- Six-day pre-chill treatments and GA_3 looked promising.
- Between 10%–20% of nongerminated embryos stained weakly with tetrazolium chloride.
- Excised embryos germinated within 3–5 days.

Research Questions Focused on *Bursera copallifera.*

- Does some type of dormancy inhibit germination?
- What treatments, if any, promote germination?

EXPERIMENT I

Seeds, dry-stored for 8 months, were treated as below and incubated under 16 h of fluorescent light. Daily temperature fluctuation was 21–26 ºC.

Treatments include: (1) Mechanical scarification (cracked endocarp); (2) 3% H_2O_2, 4-h soak; (3) 3% H_2O_2, 4-h soak + mechanical scarification; and (4) Control: DI water.

Results. One-way ANOVA ($p = 0.089$) found no significant difference between treatments.

EXPERIMENT II

Treatment response vs. variation between seed collections from nine *B. copallifera* trees of two localities was studied.

Treatments included: (1) Control (DI water), (2) Pre-chill, 6 days, 4ºC, (3) 250 µM GA_3, (4) 600 µM BA, and (5) 125 µM GA_3 + 300 µM BA.

Treatment conditions: 16-h fluorescent light/daily temperature fluctuation 21–26 C.

Results of Regression Analysis.

- Variations between seed collections of the different trees ($p < 0.0001$) and the tree-by-treatment interaction ($p = 0.0005$) were most important.
- Treatment effect was minimal ($p = 0.0432$).
- No single treatment increased germination for all of the seed collections.

Viability and Vigor of Seeds.

- Estimated viability varied among seed collections.
- Most nongerminated seeds were dead by Day 45.
- Late germinating embryos often exhibited signs of low vigor.
- Estimated difference in the proportion of viable seeds for the two locations, Quilmula and Teocalco, was about 0.2 (Fig. 1).

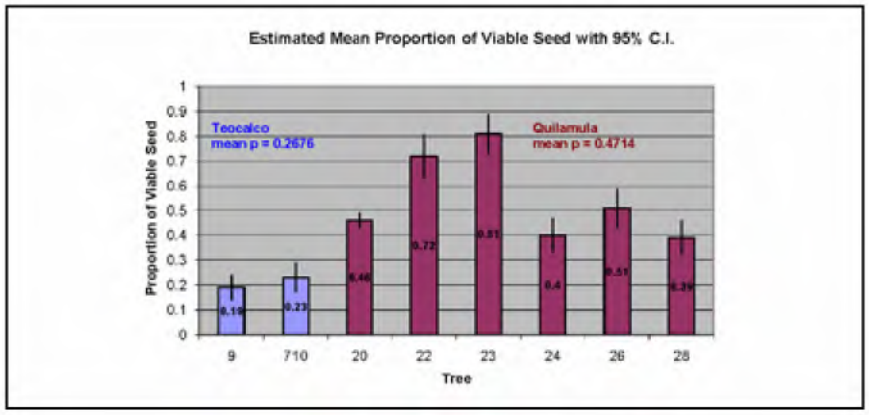

Figure 1. Estimated mean proportion of viable seed from two locations (Teocalco and Qualamula).

DISCUSSION

- No strong dormancy mechanism was detected for *B. copallifera.*
- None of the treatments tested could be recommended to improve seed propagation of this species.
- Mechanical dormancy did not inhibit germination of strong embryos; scarification promoted fungal attack; warm stratification on moist sand (results not shown) did not improve germination over the control.
- Seeds may have a mild degree of physiological dormancy, but for these collections, any after-ripening requirement was met by 6 weeks or more of dry storage between harvest and treatments.
- Seedlings of seeds treated with GA_3, BA, and especially GA_3 + BA had statistically lower rates of survival after potting compared to the control and pre-chill seedlings (results not shown).
- Low vigor and viability appeared to be the greatest inhibitors of germination in *B. copallifera.*

FOR FURTHER STUDY

- The trees sampled at Teocalco were fairly isolated, in a more disturbed habitat, and produced a lower proportion of viable seeds compared to the trees sampled at Quilamula. Is this location effect real or an artifact of limited sampling?
- How do samples from other locations compare? The *Bursera* are generally dioecious and outcrossing, and most species are conspicuously absent from secondary forests.
- Is inbreeding depression a problem in disturbed, fragmented forests?

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