Seed Propagation of *Cordia boissieri and Cordia parvifolia*

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Abstract

Cordia boissieri and Cordia parvifolia are plants commonly used in landscapes in the Southwest. Although they are available in the nursery trade, Cordia species are recalcitrant to germinate from seeds. The objective of the study was to determine a reliable propagation protocol for each species. Germination percentages for Cordia boissieri of 70 to 100% were obtained when seeds were stratified under warm conditions before germination. However, with prolonged storage seeds lose viability and age of the seed and seed storage conditions need further investigation. Seeds of Cordia parvifolia collected from local sources had low viability and did not germinate in response to several different seed treatments.

Introduction

Cordia boissieri in the Boraginaceae family, known as Texas olive, wild olive, or anacahuita, is a popular landscape plant in the Southwestern United States. It grows 3 to 7.5 m tall as a densely branched, multi-stemmed shrub or small tree. Leaves are to 5 inches long, medium green, and covered with numerous short hairs. Native to the Rio Grande Valley of Texas and south to Monterey, Mexico, *C. boissieri* is adapted to most soils with good drainage. Plants are drought tolerant, but benefit from irrigation during the hot season with improved growth and flowering. Plants are prized for their long flowering season from spring to fall. Tubular, white flowers with yellow throats appear in terminal clusters and develop into ovoid drupes, half an inch long, and bright red-brown.

Cordia parvifolia or little-leaf cordia, is a medium evergreen shrub 1.7 to 3 m tall and wide. Leaves are small, grayish to olive-green, flowers are white and appear in small terminal clusters. Flowering begins in spring and continues, when moisture is available, in intervals until fall. The plant is native to Chihuahua, Sonora, and Baja California and is very drought tolerant. Leaves may abscise during prolonged drought or when subjected to severe frost.

Seeds of both species are not available commercially. Seeds are considered recalcitrant and the preferred method for propagation is cuttings. Previous reports on seed propagation of *C. boissieri* present conflicting information regarding stratification requirements to break dormancy. One recommendation is to collect fruit as soon as it turns yellowish white or light brown and the seed inside feels hard and filled out. Seeds should then be cleaned, air-dried, and stored in a cool, dry place. Stored seeds require 30 days of warm stratification at 20°C followed immediately by 30 days of cold stratification at 5°C. Another report states that seeds that were stored in a cool, dry place for 5 to 12 months and were then exposed to temperatures of 30°C for 12 h followed by 12 h at 40°C in the dark resulted in 77% germination after 22 days – without previous stratification. No protocols for germination requirements of *C. parvifolia* are published to our knowledge.

The objectives of this study were to determine optimum conditions for germination of *C. boissieri* and *C. parvifolia* seeds.

This is a part of the University of Arizona College of Agriculture 2001 Turfgrass and Ornamental Research Report, index at: http://ag.arizona.edu/pubs/crops/az1246/

Materials and Methods

C. boisseri: Seed cleaning, stratification, and germination temperatures

Seeds were collected from the ground under a mature *C. boissieri* tree at the University of Arizona campus in Tucson in September 2000. Cleaned and non-cleaned seeds were stored in paper bags at room temperature after collection. On

September 17, 2000, seeds were assigned to 5 treatment combinations of cleaning and stratification: 1. no clean, no stratification, 2. clean, no stratification, 3. no clean, warm stratification, 4. clean, warm stratifcation, and 5. no clean, warm stratification followed by cold stratification. Cleaning seeds involved removing the fleshy pericarp. Seeds exposed to warm stratification were placed in a plastic bag with moist media (vermiculite : perlite : peat at 1:1:1), and were left for 14 days at room temperature (21°C). Cold stratification involved placing the bags with seeds and the moist media in the refrigerator at 4°C for 14 days. Seeds were soaked in distilled water for 24 h and subsequently placed in petri dishes filled with moist, sterilized vermiculite. Three dishes per treatment with 10 seeds each were then placed at 25, 30, or 35° C. Seed germination was monitored daily for 21 days and seeds with a 3 mm-long radicle were considered germinated. Media was moistened in the petri dishes as necessary.

C. boisseri: Seed stratification and germination temperatures

On October 31, 2000, *C. boisseri* seeds were assigned to four treatments similar to those in the first experiment: 1. clean, no stratification, 2. no clean, warm stratification, 3. clean, warm stratification, and 4. no clean, warm stratification followed by cold stratification. Treatment procedures were the same as described above. After seeds were imbibed for 24 h, they were placed on moist media in petri dishes. Petri dishes were exposed to temperatures from 30°C to 45°C, and individual temperature treatments in this range differed from 1 to 2.4°C increments. Seed germination was monitored daily for 14 days.

C. boisseri: Seed stratification temperatures

C. boisseri seeds collected in September 2000 were stratified in March 2001 for 14 days at 25, 30, or 35°C in moist media as described above. Seeds were then assigned to individual petri dishes and exposed to temperatures from 29 to 40.5°C at 2.5°C increments. Seed germination was monitored daily for 20 days.

C. parvifolia: Soaking treatments

C. parvifolia seeds were collected in November and December 2000 from underneath shrubs growing in Tucson and Phoenix, Arizona. On December 6, 2000, distilled water at room temperature or distilled water that was boiling was poured over the seeds, and they were left to soak for 24 h at room temperature. Following the soaking, seeds were rinsed, and placed on sterilized, moistened vermiculite in a petri dish. Twelve petri dishes per treatment were maintained at temperatures of 21°C to 43°C at 2°C increments. Seed germination was monitored daily for 18 days.

C. parvifolia: Sulfuric acid scarification

On February 5, 2001, seeds were treated for 5, 10, 20, or 40 minutes with 95% sulfuric acid. Seeds were then thoroughly rinsed with tap water, placed in petri dishes at temperatures of 23°C to 45°C at 2°C increments. Seeds were monitored for 21 days. At the end of the experiment seeds that had not germinated were tested for viability with tetrazolium. On March 6, 2001, seeds were submerged for 20 minutes in water, and only seeds that sank were treated for 5, 10, 20, or 40 minutes with 95% sulfuric acid. After rinsing, petri dishes with 6 seeds each were assigned to germination temperatures of 25, 30, 35, 38 or 41°C, and were observed daily for 21 days.

C. parvifolia: Warm and cold stratification

Seeds deemed viable after a 20 minute submersion in water were assigned to the following treatments: 1. 2 weeks warm stratification, 2. 2 weeks warm followed by 2 weeks cold stratification, 3. 4 weeks warm stratification, or 4. 4 weeks cold stratification. Seeds were mixed in moist perlite/vermiculite media and warm stratified at 30°C or cold stratified at 4°C. Treatments 2, 3, and 4 began on March 28, 2001, treatment 1 began on April 11, 2001. Seeds in petri dishes with moist vermiculite were maintained at temperatures of 25, 30, 33, 36, 39, 42, and 45°C for 28 days.

Results and Discussion

Cordia boissieri

Warm stratification or warm stratification followed by cold stratification and a germination temperature of 35°C resulted in the highest germination among all treatments (Table 1). Removing or leaving the fleshy pericarp before stratification had no effect on germination. On seeds that were warm stratified, the pericarp was easily removed before sowing. When warm stratification was followed by cold stratification, the pericarp started again to adhere to the seed, but was removed before placing the seeds on the media for germination.

A germination temperature of 25°C resulted in no germination, regardless of pericarp cleaning or stratification treatments (Table 1). Germination temperature of 30°C resulted only in 6.7% germination. Time of germination from the emergence of the first seed until maximum number of seeds germinated was shortest for the seeds that received warm/cold stratification and 35°C. The first radicle appeared after 3 days at 35°C, and the maximum number of seeds had germinated after 9 days. Warm stratified seeds at 35°C germinated after 5 days and reached maximum germination after 15 and 16 days for seeds with and without pericarp at warm stratification, respectively. Warm stratification helps to loosen the pericarp, which adheres firmly to the hard seed after imbibing fruit for 24 h, and is time consuming to remove without stratification. These results led us to investigate the effect of higher germination temperatures in the second experiment. We eliminated non-cleaned, non-stratified seeds in the second experiment, because they were completely covered with mold and showed little germination.

In the second experiment, maximum germination of 70 to 100% was attained by seeds previously cleaned, warm stratified and germinated for 14 days at temperatures of 35 to 42°C. Two seedlings emerged from some of the seeds, resulting in 7 to 12 seedlings per 10 seeds in this temperature range. Radicles emerged as early as 3 days after placing petri dishes in the germinating environment. Maximum germination occurred within 13 days in the optimum temperature range. Germination below or above this temperature range was 40% or less. Seeds that were not cleaned and were warm stratified for 2 weeks had 90% germination at 40°C, and 50 to 70% germination at 33 to 38°C. One to two seedlings emerged from these seeds, and the total number of germinated seeds ranged from 7 to 11 for 10 seeds per dish at the above temperatures. Seeds germinated as early as 3 days after starting the temperature treatments. The clean, no stratification treatment, and the no clean, warm stratification followed by cold stratification treatment yielded 30% or less germination at any temperature.

These results suggest that when seeds are used within 2 months of a fall collection, 14 days of warm stratification at 20°C followed by germination temperatures of 38 to 40°C will yield 70 to 100% seed germination, with one or two seedlings emerging per seed.

When seeds were warm stratified in March 2001, less than 3% per treatment germinated. Subsequent tetrazolium tests revealed that seeds from all treatments placed in germination temperatures of 31.5 or 38°C had only a viability of 10 to 20%. Seed age or storage conditions may have caused this decline in viability. Therefore we will continue work on *C. boissieri* to determine how the age of the seed and outdoor exposure prior to collection affect germination.

Cordia parvifolia

All treatments resulted in 0 to less than 1% germination. Tetrazolium tests of seeds collected from Tucson and Phoenix suggested viability of 10 and 30%, respectively. Experiments will continue with seeds collected earlier during the season.

Acknowledgements

We thank the Arizona Nursery Association Foundation for financial support. We thank Steve Priebe, City of Phoenix, and Terry Mikel, Maricopa County Cooperative Extension for collecting *C. parvifolia* seeds in Phoenix.

Literature

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Table 1. Germination percentage of *Cordia boissieri* seeds exposed to different cleaning, stratification, and temperature treatments.

Clean	Stratification	Temperature (°C)	Germination (%) (Standard deviation)	First germination (No. days)	Maximum germination (No. days)
Yes	No	25	0	--	--
Yes	No	30	6.7 (5.8)	8	8
Yes	No	35	16.7 (15.2)	8	21
Yes	Warm	25	0	--	--
Yes	Warm	30	0	--	--
Yes	Warm	35	40.0 (0)	5	16
No	No	25	0	--	--
No	No	30	6.7 (11.5)	5	6
No	No	35	0	--	--
No	Warm	25	0	--	--
No	Warm	30	0	--	--
No	Warm	35	33.3 (15.3)	5	15
No	Warm + Cold	25	0	--	--
No	Warm + Cold	30	0	--	--
No	Warm + Cold	35	43.3 (15.2)	3	9

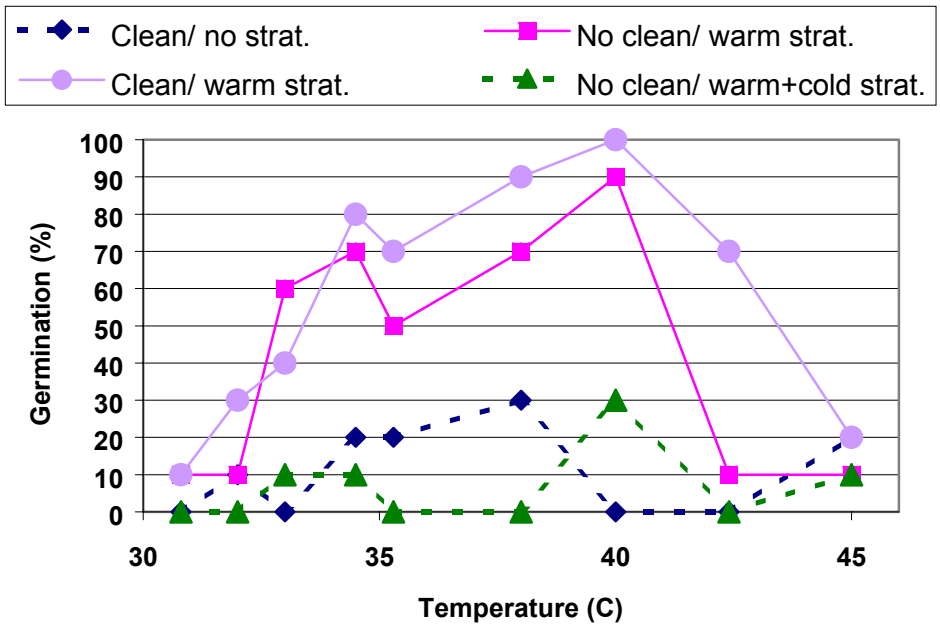

Fig. 1. Germination percentage of *Cordia boissieri* seed exposed to different cleaning and stratification pretreatments and a range of germination temperatures.