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Germination of Western Soapberry as Affected by Scarification and Stratification

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Abstract. **Western soapberry (Sapindus drummondii Hook & Arn.) seeds were collected in Sept. 1982 and scarified with acid or hot water, or treated by freezing. The seeds were sown immediately or after cold-moist stratification for 90 days. Best germination was achieved with acid scarified and stratified seeds followed by hot water treatment plus stratification and freezing plus stratification. Stratification significantly increased the germination of all treatments by a combined average of 25%. Acid scarification for 60 or 90 min provided better germination than scarification periods of 30 or 120 min. Seeds collected in Nov. 1982 and Mar. 1983 germinated as well as seeds collected in Sept. 1982. For maximum germination, fall or winter collection of seeds followed by 60 min acid scarification and 90 days cold moist stratification is recommended.**

Western Soapberry is a deciduous tree that grows to 15 m high and performs well in dry, highly calcareous or clayey soils. The bright yellow fall color and low water requirement make it an excellent, though little used, landscape specimen (4, 5).

The germination of soapberry seeds is difficult to achieve due to a combination of embryo dormancy (4) and an impermeable seed coat (5). Recommended pretreatments include concentrated sulfuric acid scarification for 120–150 min followed by direct sowing, or acid scarification followed by 60–90 days cold-moist stratification. Other recommendations, however, state that germination of freshly collected clean seeds without pretreatment is superior (4). Hot water scarification has been shown to be an effective pretreatment for overcoming seed coat dormancy in the Leguminosae (3) as well as for ridding seeds of destructive insects (2). This study evaluates the effectiveness of acid scarification, cold-moist stratification, hot water scarification, and freezing as means of optimizing seed germination.

Seeds were collected in Sept. 1982 from several trees growing under cultivation in Lubbock, Texas. The rind-like outer covering of the seed was removed manually before experimentation. Seeds were thoroughly mixed to assure complete randomization of seed lots. Each treatment consisted of 4 replications of 100 seeds each. Treatments were divided into 2 main groups: those followed by direct sowing and those followed by 90 days cold-moist stratification. Individual treatments are described in Table 1. All 100 seeds in each replication were sown in 1 peat: 1 perlite mix (v/v) in an individual greenhouse flat. Each treatment consisted of 4 flats. Flats from all treatments were completely ramdomized and placed in a greenhouse with an 18° to 29°C night-day temperature regime. The percentage of germination was determined 120 days after sowing. All percentage data were analyzed following arcsine transformation.

In addition to the main test, replicated lots of soapberry seeds were acid scarified for 30, 60, 90, and 120 min to determine if the optimum time period for scarification varied from published recommendations. Seeds were also collected from the same sources in Nov. 1982 and Mar. 1983 to ascertain if germination would be reduced because of increased seed coat thickness or deepened embryo dormancy as suggested for other wood species (1).

The results of the main test indicated that stratification increased germination significantly when averaged across all scarification treatments (Table 2). In addition, the results also indicated that acid scarification, alone or in combination with stratification, significantly increased germination when compared with hot-water scarification, freezing, or the control. Although results from hot-water scarification and the freezing treatment were not significantly different from each other, both increased germination over that of the control. An analysis of variance of the arcsine transformed data indicates that scarification x stratification interactions were not significant.

Table 1. Seed treatments.

No.	Treatment
1	Acid scarified[z], nonstratified[y]
2	Acid scarified, stratified[x]
3	Hot water scarified[w], nonstratified
4	Hot water scarified, stratified
5	Freezing[v], nonstratified
6	Freezing, stratified
7	Nonscarified, nonstratified control
8	Nonscarified, stratified control

[z] Scarified in concentrated sulfuric acid for 120 min based on published recommendations (4).
[y] All nonstratified treatments were sown immediately after scarification or other preparation.
[x] Stratified 90 days at 5°C in 1 peat: 1 perlite (v/v) mix in poly bags.
[w] Hot water scarification accomplished by bringing water to rapid boil, removing from heat, immersing seeds in the hot water, and allowing water and seed to cool for 24 hr before sowing.
[v] Freezing treatment accomplished by placing seeds in water and freezing for 48 hr, followed by thawing and subsequent sowing or stratification.

Results of the acid scarification test were different from published recommendations (4). Results of this study show the appropriate length of time for optimum germination to be 60 min (Fig. 1). Time periods greater than 60 min resulted in somewaht reduced germination, while acid scarification for 30 min resulted in the lowest percentage of germination of acid scarified treatments.

There were no significant differences in germination of seeds collected in Sept. and Nov. 1982, and Mar. 1983. Germination percentages were 86, 86, and 85, respectively, when acid-scarified for 120 min and sown immediately. This response coincides with the suggestion that soapberry seeds can be stored dry effectively at low termperatures (4).

Based on the results of this study, commercial production of western soapberry can be accomplished effectively by collecting seeds in late autumn or early winter, acid-scarifying the seeds for 60 min in concentrated sulfuric acid followed by 90 days cold-moist stratification and sowing in outdoor seedbeds in the spring. Seeds collected in late winter or early spring may be handled in the same manner with the exception that

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Table 2. Effect of scarification and stratification treatments on the percentage of germination of western soapberry.

Stratification treatment	Scarification treatment: Acid	Hot water	Freezing	Control	Mean[z]
Nonstratified	86.0[x]	54.0	48.5	38.0	56.6 a
Stratified	89.0	73.5	68.5	50.5	70.8 b
Mean[y]	87.5 a	64.7 b	58.5 b	44.3 c	

[z] Mean separation within columns by Duncan's multiple range test, 5% level.
[y] Separation of means by Duncan's multiple range test, 5% level.
[x] Percentage of germination. Means of 4 replications of 100 seeds each.

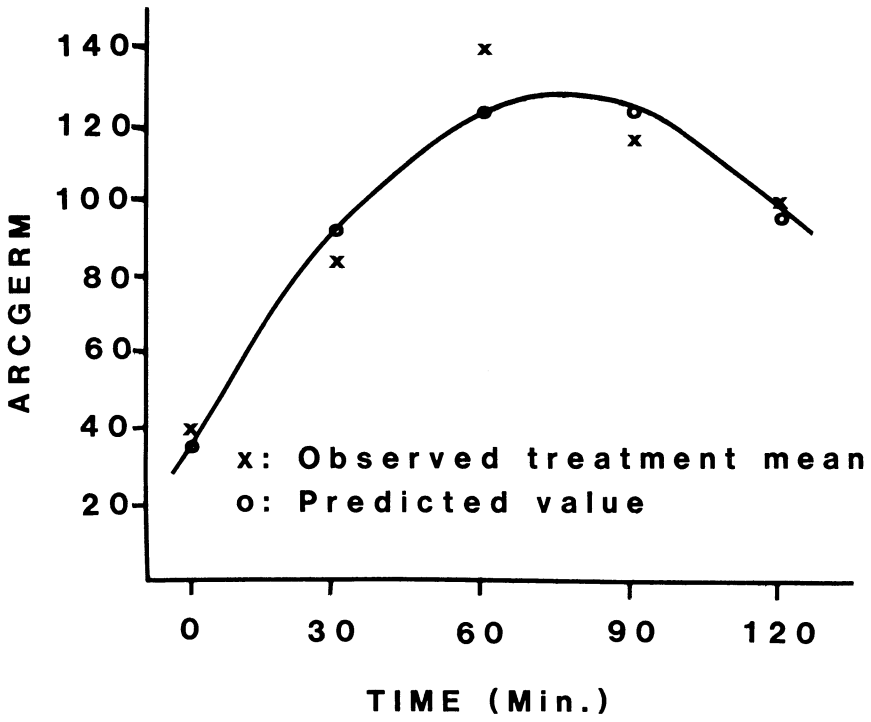

Fig. 1. Germination of acid scarified soapberry seeds. Treatments consisted of 4 replications of 50 seeds each. Regression equation: ARCGERM $= 0.378 + 0.023X - 0.00015X^2$, $R^2 = 0.94$. (ARCGERM = Arcsine transformation of percentage of germination.)

cold-moist stratification may be omitted with little reduction of total germination.

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Guayule Seedling Root Regeneration Potential Increases with Age

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Abstract. **Root generation of guayule (*Parthenium argentatum* Gray) seedlings was determined by suspending 8, 10, and 12 week old plants in a bottom mist chamber. The number and length of new roots were significantly greater after 3, 6, 9, and 12 days for 12 week old as compared to 8 week old plants. The major difference between 10 and 12 week old plants was an increased root length of 0.44 and 1.03 cm, respectively, after 3 days.**

Root regeneration potential measures root initiation and elongation in plants, and has been shown to be important in establishment and subsequent growth of evergreen and deciduous tree seedlings (2, 3, 4, 8). Root regeneration of tree species usually is measured in plants over 1-year-old and can be influenced by shoot and root dormancy, level of carbohydrate reserves, and other factors (2, 3, 4, 8).

Guayule is an evergreen desert shrub currently under investigation as a domestic source of natural rubber (6, 7). Field establishment by direct seeding has not been successful due to small seed size and seedling sensitivity to drought, salinity, and disease. In the present production system, seedlings are greenhouse-grown in small plug-type containers (medium volume of 24 cm^3 or less) and transplanted into the field at 8 to 12 weeks of age. After an initial one week lag in shoot growth at the cotyledonary stage, both shoots and roots grow continuously under these conditions. Transplanting often is conducted under conditions of high evaporative water demand. Under these conditions, seedling survival depends upon maintenance of root-available water, a difficult task because of the confined root volume. Rapid root proliferation into the surrounding soil could enhance water uptake and seedling survival. Observations indicated 12-week-old seedlings survived transplanting better than 8-week-old seedlings. Thus, this research was initiated to investigate seedling age effects on root regeneration potential.

Seeds of a bulk Mexico collection (Langely L78001) were treated with 0.5% NaOCl (5) and sown on Cornell peat-lite mix B (1) in plug-type containers. Eight, 10, and 12 weeks after germination, seedlings of similar size were removed from the containers, the roots washed and pruned to 5 major roots, each 10 cm long. The seedlings were placed in a bottom mist chamber (3) in a greenhouse. The test was conducted during April and May, 1980. Minimum greenhouse temperatures ranged from 14.4° to 17.8°C with a mean of 16.1° Maximum greenhouse temperatures ranged from 26.7° to 43.9° with a mean of 32.8°. The plants were not shaded. Misting frequency was 5 sec per 5 min, 24 hr a day with tap water. New roots were counted and their length measured to the nearest cm after 3, 6, 9, and 12 days. Increases in root lengths were totaled for each plant.

The experimental design was a randomized complete block with 7 blocks and 10 replications per block, 70 plants per treatment. Treatment effects on both new root counts and added length were evaluated via orthogonal polynomial regression. The significant independent variables for both dependent variables were age linear, time linear, age quadratic, time quadratic, age linear by time linear, age linear by time quadratic, and

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