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Enhanced Germination of *Sophora secundiflora* Seeds

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Abstract. **Percentage germination of *Sophora secundiflora* (Ort.) Lag. ex DC. red, dry seeds was 50% and 8% for fresh and one-year old seeds, respectively, 70 days after sowing. Chemical scarification with undiluted sulfuric acid (93%) for 10 min with fresh seeds or for 60 min with one-year old seeds (reduced germination time to within 14 days) enhanced percentage germination to 80% and 70% respectively. Mechanical scarification by drilling a small hole through the hard seed coat resulted in relatively quick and the highest rate of germination (over 83% in 14 days), regardless of seed age. In a second experiment, soft seeds with light yellow seed coats harvested on 18 May 1991 had 44% dry weight and reached maximum germination (93%) in 14 days. Firm seeds with red seed coats harvested on 28 May 1991 had 82% dry weight, primarily the result of water loss, and reached 99% germination within 24 days of sowing.**

Abstracto. **El porcentaje de germinación de semilla *Sophora secundiflora* (Ort) Lag. ex DC. roja y seca fue 50% y 8% en la semilla fresca y de un año, respectivamente, 70 días después de sembrar. Penetración de la cubierta da la semilla por medio químico utilizando ácido sulfúrico no diluido (93%) por 10 minutos en semillas frescas o or 60 minutos en semillas de un año (el tiempo de germinación se redujo dentro de 14 días) aumentó el porcentaje de germinación a 80% y 70% respectivamente. Penetración de la cubierta de la semilla mecánicamente taladrando un hoyo pequeño a través de la cubierta de la semilla, resultó en una germinación relativamente rápida y en el porcentaje más alto (más de 83% en 14 días), indiferente de la edad de la semilla. En un segundo experimento, semillas suaves con cubiertas amarillas claras cosechadas el 18 de Mayo, 1991 tuvieron 44% peso seco y alcanzaron germinación máxima (93%) en 14 días. Semillas firmes con cubiertas rojas cosechadas en Mayo 28, 1991 tuvieron 82% peso seco, primordialmente el resultado de perdida de agua, y alcanzaron 99% germinación dentro de un período de 24 días después de sembrar.**

Sophora secundiflora (Ort.) Lag. ex DC. (Texas mountain laurel or mescal-bean) is a small evergreen shrub native to Texas, New Mexico, and northern Mexico (Vines, 1984). Cultivated for its dense, dark-green foliage and abundant showy, fragrant flowers which bloom in early spring. The demand for this species has increased with its resistance to the 1983 and 1989 freezes which occurred in the southern United States and killed many tender plant species. This species also tolerates moderate drought, although supplemental irrigation increases growth rate.

The increased demand for Texas mountain laurel plants has prompted the need for increased and improved plant propagation practices. Shoot tip cuttings generally do not form roots in this species (Wang, unpublished data). Germination of *S. secundiflora* seeds collected after pods have become dry is often slow and incomplete. Therefore, experiments were initiated to study the effect of several scarification techniques for accelerating and improving germination of freshly collected and one-year old seeds. A second experiment was designed to examine the effect of harvest time on seed germination.

Materials and Methods

Seed treatment on germination. Seeds were collected from dry pods in mid-July 1985 and 1986. The 1985 seeds were stored in a clear polyethylene bag at room temperatures ranging between 15C and 33C. Scarification treatments included acid soak, mechanical abrasion, and drilling a hole in the seed coat. Seeds were soaked in concentrated sulfuric acid (93%) for 5, 10, or 60 minutes followed by a 5 min rinse under running tap water. Mechanical abraded seeds were placed in a rotating scarifier (Forsbergs Inc., Thief River Falls, Minn.) with 100 medium sand paper (3M Corp., Minneapolis, Minn.) for 1 min. Drilled seeds had a small hole made just deep enough to penetrate the seed coat using a vise and a small hand-held drill (Radio Shack Cat. No. 64-2095 and 64-209, respectively). Control seeds received no treatment. Seeds were planted one per 7.5-cm pot filled with a peat-lite medium, then watered immediately and placed in a shadehouse with 400 $\mu mol \cdot m^{-2} \cdot s^{-1}$ maximum photosynthetic photon flux. Air temperatures ranged between 25C and 38C. Seed germination was evaluated 2, 4, and 10 weeks after sowing. The experimental design was randomized complete block (RCB) with 12 replications of four seeds per treatment.

Effect of harvest date on germination. Soft seed pods were collected on 18 May 1990 from trees which had begun to flower during the first week of February. At this time, all seeds were soft and seed coats were light yellowish. Forty seeds were weighed, dried at 97C for three days, and weighed again. Of the remaining seeds, half received a cut on the dorsal side to break the soft seed coat. Five seeds from each of the treatments were sown in a 10-cm pots filled with 0.5 liter peat-lite medium representing an experimental unit. Treatments were replicated four times in a RCB design. Seeds were dug up after six days for radical length determination then reburied. The percentage of seed germination was determined 10 and 13 days following sowing.

Fresh seed pods were harvested again on 28 May 1990 and separated into two groups. The first group consisted of partially dried, light brown but still soft pods. Seeds in these pods had already developed the deep orange-red coloration but had not dried completely and remained the size similar to that of the wet seeds. The remaining group had soft pods and the ivory-colored seeds had just started to show orange color. Forty orange-red seeds were used for fresh and dry weight determinations as described above. Half of the ivory-colored seeds were placed in a glass beaker and covered with plastic film to prevent water loss. The other half received a cut on the dorsal side and were allowed to dry alongside the fully-

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colored seeds on a laboratory bench at room temperature for three days. All seeds in this experiment were sown 10 to a 10-cm pot (0.5 liter in volume) each representing an experimental unit. Treatments were replicated four times in a RCB design. Radical lengths were determined after one week. Percentage germination was determined 10, 14 and 24 days after sowing. All seeds in this experiment were germinated at room temperature in a laboratory.

Results and Discussion

Untreated fresh seeds required 10 weeks to achieve 50% germination, whereas untreatd one-year old seeds had only 8% germination at the termination of this experiment (Table 1). Mechanical scarification did not enhance the germination of fresh seeds (42%), but did improve germination of the old seed (27%) compared to the control (8%). Chemical scarification of fresh seeds in undiluted sulfuric acid greatly enhanced the percentage and speed of germination, with no significant difference among soaking times. Although a 5 min soak enhanced the germination (42%) of the one-year old seeds when compared to the untreated seeds, a 60 min soaking time was required to obtain an acceptable rate of germination (70%). Ruter and Ingram (1991) reported that some or all of the cuticular layer was removed when seeds were treated with sulfuric acid, which resulted in rapid germination. The manually scarified (drilled) seeds had a high rate of germination (Table 1). The seed coat around the hole became swollen and softened within a few days following sowing. All viable seeds germinated by the end of the second week, with most germination occurring within 10 days. The final percentage germination for the drilled old seeds was the same as that of the fresh seeds. Additional water loss during storage may have made the seed coat more impermeable to water and seed germination more difficult. The viability of the old seeds did not appear to have changed during storage for one year.

Table 1. Effect of scarification treatments on germination of fresh and year old *Sophora secundiflora* seed.[z]

	Seed germination (%)					
	Weeks after sowing					
Method of	Fresh seed			Year old seed		
Scarification	2	4	10	2	4	10
None (control)	6 b	27 b	50 b	0 d	0 d	8 c
Mechanical	19 b	38 b	42 b	6 d	23 c	27 b
Chemical						
H_2SO_4 5 min	79 a	83 a	83 a	37 c	42 b	42 b
10 min	81 a	81 a	81 a	35 c	35 bc	35 b
60 min	83 a	83 a	83 a	69 b	69 a	69 a
Manual drilling	88 a	88 a	88 a	83 a	83 a	83 a

[z]Means in columns are separated by Duncan's new multiple range test at the $P = 0.05$ level.

Table 2. Effect of harvest time on weight and germination of *Sophora secundiflora* seeds.[z]

Harvest Date	Condition of seed	Fresh wt. (g)	Dry wt. (g)	% dry wt.	Percentage germination days after sowing				Radical length (cm)
					10	13	14	24	
18 May	Soft, intact	2.45	1.08	44	43 a	93 a	--	--	4.5 a
	Soft, cut	--	--	--	43 a	85 a	--	--	4.6 a
28 May	Intact (red)	1.42	1.16	82	5 a	--	65 a	98 a	4.4 a
	Soft, cut	--	--	--	13 a	--	65 a	78 b	3.5 a
	Soft, intact	--	--	--	0 a	--	35 b	75 b	2.0 b

[z]Means in columns within harvest date are separated by Duncan's new multiple range test at $P = 0.05$.

Seed dry weight did not change significantly between 18 May and 28 May 1991. (Table 2). Colored seeds harvested on 28 May had low fresh weight due to water loss, increasing percentage dry weight from 44% on 18 May to 82% on 28 May. Rate of seed germination and radical growth on seeds harvested on 18 May were similar regardless of the treatments. When seeds were harvested 10 days later, the fully colored and ivory-colored seeds with a cut germinated equally well at the end of 14 days (Table 2). Percentage of germination after 24 days was higher with the intact, colored seeds (98%) than that with the soft, cut seed (78%) or intact, uncut seeds (75%). Some of the soft seeds from this later harvest may have come from the extremely late blooms and did not develop fully, thereby resulting in lower overall germination. The above may have accounted for the lower overall rate of germination (83% to 88%) of seeds collected from dry pods in the first experiment.

McWilliams (1986) suggested the collection of "immature" seeds at about 85% dry weight for quick germination which was similar to the stage of the colored seeds harvested on 28 May in this study. A simple technique for determining the most appropriate harvesting stage to enhance seed germination would be to collect the seed when the color of seed pods has just started to change from silver green to light brown or the seed coat is changing from ivory to red while pods and seed coat are still soft. These seeds will germinate soon following planting.

The results of this study suggest that one of the major obstacles preventing untreated, dry *S. secundiflora* seed from rapidly germinating is the physical barrier presented by the water impermeable seed coat. Seeds of this species do not appear to undergo any physiological dormancy or have immature embryo as that found in fresh *Cycas revoluta* seeds (Dehgan and Schutzman, 1989). Waiting until the majority of the pods have begun to dry before harvesting necessitates that caution should be exercised to avoid over-drying seeds before planting or slow germination may result.

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