Sexual Propagation: Scarification to Overcome Hard Seed Coat Dormancy

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1 Introduction to Treatments Used

Five treatments are used in this lab:

1. Control (Non-treated; Seed coat not broken)
2. Mechanical scarification - Hammer
3. Mechanical scarification - File
4. Hot water treatment
5. Acid scarification

2 Plant material

Two plants are used in this lab:

- *Gleditsia triacanthos*
  (Common Honey Locust; Fabaceae, Bean Family)
- *Gymnocladus dioica*
  (Kentucky Coffee Tree; Fabaceae, Bean Family)

3 Results

Here are the results and observations for this experiment, sorted by week:

- **February 2, 2006** - At this point in the experiment, none of the coffee tree seeds have germinated above the soil, and only three honey locust seeds are visible. This means that 0% of the coffee tree seeds and 30% of the honey locust seeds have germinated. The three germinated locust seeds were from the filed, hot water, and acid scarification treatment groups. The means of identification of the individual plants is by the location of the cotyledons. Since the coffee tree seed is very large, it must stay in the ground as a hypogeal germinating plant. The honey locust is epigeal, meaning that you can see the cotyledons rise above the soil. This not only enables us to observe how many plants have sprouted, we can also identify which type they are.

- **February 9, 2006** - By the second week, the first shoots started to appear in the coffee tree. They were from the control and hot water treatment groups. For the coffee tree, the total germination is now 2/10, or 20%. No additional plants sprouted from the honey locust group, leaving the totals for this plant at 3/10, or 30%. The existing seedlings have grown much larger, with their cotyledons starting to shrivel up as their food supplies are used.

- **February 16, 2006** - Since last week's observations, four more plants have sprouted, bringing the total numbers to 9/20, or 45%. For the coffee tree, both of the acid-treated plants have sprouted, as well as one of the hammer treated plants. The total for the coffee tree is now 5/10, or 50%. For the honey locusts, in the past week, only the other acid-treated seed sprouted, leaving the honey locust's numbers at 4/10, or 40%.

- **February 23, 2006** - No additional seeds have germinated since last week. The existing seedlings continue to grow, and there is no discernible difference in the seedlings between the different treatments. The total germination count for the Kentucky Coffee Tree is 5/10, or 50%. The total germination count for the Common Honey Locust is 4/10, or 40%. The grand total for the entire experiment is 9/20, or 45%.

4 Tables

Germination statistics for February 2, 2006				
	Kentucky Coffee Tree		Common Honey Locust	
Treatment	# Germinated	% Germinated	# Germinated	% Germinated
Control	0	0%	0	0%
Hammer	0	0%	0	0%
File	0	0%	1	50%
Hot Water	0	0%	1	50%
Acid	0	0%	1	50%

Germination statistics for February 9, 2006				
	Kentucky Coffee Tree		Common Honey Locust	
Treatment	# Germinated	% Germinated	# Germinated	% Germinated
Control	1	50%	0	0%
Hammer	0	0%	0	0%
File	0	0%	1	50%
Hot Water	1	50%	1	50%
Acid	0	0%	1	50%

Germination statistics for February 16, 2006				
	Kentucky Coffee Tree		Common Honey Locust	
Treatment	# Germinated	% Germinated	# Germinated	% Germinated
Control	1	50%	0	0%
Hammer	1	50%	0	0%
File	0	0%	1	50%
Hot Water	1	50%	1	50%
Acid	2	100%	2	100%

Germination statistics for February 23, 2006				
	Kentucky Coffee Tree		Common Honey Locust	
Treatment	# Germinated	% Germinated	# Germinated	% Germinated
Control	1	50%	0	0%
Hammer	1	50%	0	0%
File	0	0%	1	50%
Hot Water	1	50%	1	50%
Acid	2	100%	2	100%

The germination criteria used in this lab was simply the presence of a visible shoot. The species of the shoot was not always immediately apparent, but as soon as the identity of the shoot was determined, the data was updated to reflect the proper species. All data included in this report is correct. Percentages were calculated based on the planting of two seeds per treatment, per species. All four seeds of each treatment were planted in the same pot.

5 Discussion

Overall, the two species in question appear to have a hard seed coat dormancy that needs to be overcome before germination can begin. The acid treatment was the most effective for both species, where all four of the acid-treated plants sprouted. The hot water treatment was also effective, helping half of the treated plants germinate. The results for the control, hammer, and file scarification were somewhat inconclusive, as only one plant out of four sprouted for each of these treatments. One important aspect of seed scarification that needs to be considered is the large-scale practicality of the chosen method. For the hobbyist gardener or propagator sowing seeds in limited numbers, all of these methods would be reasonable. For a seed company or commercial farmer trying to propagate these species, some of the methods tested would be either very difficult or prohibitively expensive to implement on a large scale. Hot water treatment and acid-scarification methods would be very easy and effective to implement on a large scale, as you can simply use a very large vat of hot water or acid. Applying a hammer, or equivalent force, to a large number of seeds could be problematic, unless specialized machinery is available that can crack the seed coats reliably, and with few broken seeds. The filing of the seed coat could be accomplished with large numbers with a sandpaper-coated machine, or perhaps a simple plastic drum filled with sand and the seeds, which could be either rolled or shaken until the sand removed a sufficient amount of seed coat. The control treatment would be trivial to implement When considering accuracy and lost seeds, the hot water and acid treatment is also very safe, as they can be used for very specific durations with specific concentrations of the acid. Very few seeds would be killed with those methods. With hammering or filing, the danger of damaging the seed's embryo has a greater possibility. The control treatment is quite safe compared to the other methods. Scarification of seeds causes physical damage to the hard seed coat, which allows water, heat, and air to enter into the seed and start the germination process. Stratification is a temperature-based treatment which causes chemical changes inside the embryo, enabling it to sprout. Treating seeds with gibberellic acid (GA3)

can also help break some seed dormancies caused by chemical means.

6 Recommendation

For germinating Kentucky Coffee Tree or Common Honey Locust seeds, the most effective treatment is soaking in an acid bath, but a hot water bath can also be effective.