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Creative Germination Techniques for Difficult Seeds©

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INTRODUCTION

My comments are anchored around woody ornamental seeds of the temperate region, particularly the deciduous taxa that we have 25 years of experience with, including 140 genera and hundreds of species — primarily of Asian and North American origin.

As propagators of woody and perennial seeds, our goal is a crop that germinates:

- Predictably,
- Uniformly,
- In high percentage,
- At lower cost in labor, space, materials, and frustration than before.

The title of my talk is germination techniques, but with only 20 min available, my sense is that to get great germination, we really need to focus on seed preparation strategies. Hopefully that will interest the most people here, especially the younger propagators among us.

So, what specific techniques can we focus on that may help you germinate woody seeds more effectively? I will focus on four key items and give some examples.

SEED PREPARATION FOR BEST GERMINATION

I will discuss four areas for best germination:

- Ordering and collecting high-quality seed: what to look for; what to insist upon
- Pre-cleaning and purification: methods you may not have considered
- Scarification with acid
- Scarification by pouring boiling water over hard seed

Purchasing High-Quality Seed. Given the number of hard-seeded ornamentals, how do we handle seed, especially if we buy it, having almost no knowledge of its essence — origin, date of collection, handling, storage, and health of the mother shrubs/trees? In fact, we often have no way to determine if it is even correctly labeled, might be a hybrid, or even if it's dead or alive.

Seed propagation success is enhanced by always confronting our assumptions, recalling the basics, and imagining how to improve results. The most important of these, in my own experience, is to always confront our assumptions.

Getting the Relationship Right With Your Supplier. Insist that he clearly state the cut test and keep a sample in case quality questions come up: document its percentage of sound seed and moisture content. Seeds are sold "as is" but suppliers will normally hear business-like concerns.

Try to evaluate a supplier's source a year ahead of time (order a sample to try), and insist on consistency of source — to the extent he keeps records and will cooperate. Sometimes, dealers make mistakes and ship old seed. If it's dry, it may appear fine on a cut test, but when you moisten it or fall-plant it, the whole amount of it will rot. In a cooler or in the field, this may not be apparent until spring, when there's no

germination. At that point your claim for quality is of indeterminable cause, probably. When you buy seed, do like ol' Ronald Reagan, "Trust but verify." Consider the tetrazolium test for colorimetric verification of seed respiration a few weeks after you add water to dry, purchased seed, or old collected seed.

The reputable dealers appreciate your being a conscientious client. Return their favors by giving them generous referrals.

Seed Quality — Collecting Your Own Seed. Unlike garden seeds, we propagate woody ornamental seedlings from "wild" trees, or at most, a nursery-propagated generation once-removed from the wild. These aren't the product of years of selection and hybridization efforts. Moreover, a significant portion of woody seeds are simply genetically inferior, if not hollow — aborted altogether due to poor weather or their habit of bearing seed in alternate years. How many times have you collected seed from a tree, cleaned it up, and gotten to the cut test after considerable work, only to find that it is mostly empty of any "meat" inside? Believe me, it happens to our seed collection crews still. Adjacent trees in a seed orchard are not necessarily all alike in seed quality, either. Why collect garbage and contaminate the most essential key ingredient in your seedling propagation with inert matter? Insist on a pre-collection cut test with your crews.

Among the individually sound seeds, there's often a variable character in their seed coat permeability, especially with seeds that are collected after they're fully dry. It's often best to collect seeds before they get below 20% – 25% moisture content to avoid hard-seeded character in a collected crop. (Example: *Acer* sp. collected when the wing is dry but the "nut" is turning color from green to brown.)

Pre-cleaning and Purification: Tried and True, but Perhaps Novel to You. Why purify seeds? We want a "crop," but we're starting with "wild" seed.

- Mechanical seeders require homogenous seed lots, uniform in size and mass.
- Mechanical seeders require extremely clean seed or they plug up with junk and give poor uniformity.
- To get the inferior, less dense, and very large or very small seeds out.
- To ensure the strongest, most uniform germination possible, so that 80% of emerged seedlings are not inhibited by the strongest 20% that emerged early, and are more robust to start with.
- To verify seed viability, do more than a cut test when the seed arrives. Re-clean it, purify it, and sort it by density with air or size with screens. Know what you have to start with.

When we build a house, we start with known quality, certified components and build it to code. It gives us fewer surprises and problems that way. Why would we undertake propagation, upon which our livelihood depends, with any less determination or method?

Perhaps you have seen air density separators, many types of screens — see what you can find locally in your agricultural industry circles, or even at the local hardware store. Several types of fans, screens, hardware cloth, and so on can help to greatly purify seed. When it is essentially clean, then you can perhaps use water to take out further impurities.

Cautionary note: Using a Dybvig-type cleaner can be a dangerous endeavor since the apparently tough seeds like *Nyssa, Cornus*, and *Myrica* can be bruised, although not apparent on cleaning or purchase. Sometimes they will later perish in stratifi-

cation treatment and you won't know the cause. I always make sure we know how the seed was cleaned if I want a strong prospect of uniform germination success.

Another trick is to use a dissecting microscope to view small seeds and/or seed coats that are not immediately seen with the naked eye. It helps to have a visual image of your challenge in handling seed, especially if you have others doing the work.

Message: Be especially careful with mechanical seed cleaners, and doubly so if you are buying seed cleaned that way.

Use of Sulfuric Acid as a Germination Enhancement Tool for Impermeable ("Hard") Seeded Woody Plants. Much has been published about complex embryo dormancy challenges in woody seed propagation, so I'll focus on hard seed in this discussion and specifically the use of concentrated sulfuric acid treatment as a germination enhancement.

Hard seed examples:

- *Cotinus*: extremely hard-seeded due to glassy outer seed coat.
- Legume family: *Cercis, Gleditsia, Gymnocladus, Cladrastis.*
- Hard but not needing acid: *Cornus kousa* — size variability, hardness of "stony" seed makes it brittle.
- *Nyssa sylvatica*: apparently hard seeded, but vulnerable to damage.
- *Acer griseum*: hard seeded, but able to be run through a hammer mill
- *Corylus americana*: tough enough to tolerate running over with pickup tires — "hard" seeded, but not requiring acid treatment.

We use 93% sulfuric, available in 225 lb. poly carboys from Univar (univarusa.com).

Any batch of impermeable seed is variable in hard-seeded character of individual seeds: some *Gymnocladus* seeds will imbibe water immediately with a warm water soak (125–140 °F, 50–60 °C), whereas, others within that same lot will not imbibe water even after 1-h-long treatment with 93% sulfuric acid. The goal of acid treatment therefore, as opposed to time-consuming mechanical abrasion of the seed coat, is simply to save labor and time. But there are risks with such highly reactive material.

- Parts of your kitchen garbage disposal begin to resemble what you ran through it after you dispose of acid in the kitchen sink.
- Your clothes look like those of the freeway exit beggar.
- You feel humiliated when you look for the baking soda, only to learn that you have a teaspoon available and need a quarter-pound of it.
- You treat the seed too long, cooking the life out of it.
- You don't treat the seed long enough, requiring multiple trials and time between 10 PM and 2 AM cleaning seed in what used to be the kitchen.

There are some practical ways to diminish the risks of using concentrated acid:

- Do a trial first using a 15-min hot water soak at 150ºF. Careful: Using hotter water or longer soaks may give you the makings of a creative new soup.
- Try acid on a sample, using a white ceramic coffee cup. Stop the treatment when the bit of acid develops a strong brown color, using only enough acid to stir the seed with a plastic spoon.

For relatively small lots of seed, under 1–2 pounds at a time.

- Place the seed in a nylon bag so that you don't have to scrape it out of bowls. This works best on small lots of a pound or so, but many seeds we need to treat must be handled in small lots to keep the seed from over-heating when acid is added anyway. It's not practi-

cal to handle large lots of seed with acid treatment unless you are doing *Gymnocladus* in a poly drum, stirring it with an old shovel, and neutralizing the acid with lime.

- With the nylon bag, you can slosh it around in a toilet bowl and merely flush out the acid, not needing to add water to it in a bowl or transfer water and the seed around — this minimizes the opportunity for getting it on your clothes or in your eyes.
- Neutralize the acid with bicarbonate of soda or fine lime powder until it stops fizzing and then flush with clean water before letting it imbibe water. Change the water frequently to avoid it sitting in its "tea" that may have germination inhibitors. Remember, in nature, successive rains and snow melt flush the seed over time and we are trying to abbreviate that natural time factor outdoors. Where practical we ought to try to mimic outdoor conditions that have literally stood the test of time.

Use of Hot Water as an Alternative to Acid. A discussion on this was written by Dr. Donna Fare in Tennessee (Fare, 2006 and <http://www.sna.org/pdf/2005/08Propagation.pdf>).

FINAL POINTS TO CONSIDER

1. Use detergent on oily seeds like *Pistacia* to enhance water uptake into the dry seed. Flush promptly.
2. Use tetrazolium hydrochloride as a test of respiration activity in treated seed if there is a question about viability.
3. Fluctuating outdoor winter temperatures often give more uniform germination results than seed stored in a cooler at constant 35 °F (2 °C) for 90 days. (Ex: *Fagus, Acer, Cornus, Corylus, Nyssa, Cercis.*) For this reason, fall planting enhances germination as long as mice are controlled. Periodic freezing may even be a benefit, as in nature.

To close, I hope we can all remember that when we take "wild" plants from their native habitat, we expect them to immediately behave like agricultural crops in greenhouses and cultivated fields, we can be humbled quickly. It is almost always instructive to observe what conditions promote successful growth of such plants in the wild: factors like shade, temperature, slope, seasonal soil moisture, and mycorrhizal associations. What can we do as propagators to mimic such conditions, add natural benefits such as mycorrhizae to our propagation system, and promote healthy, uniform germination? Often, it is the simple things, keeping careful notes of seed pre-treatments, and training staff to consistently treat seed in ways that have proven successful. And more often than not, it knows exactly what you have to begin with.

These are not so much germination techniques as they are relationship development with suppliers and employees. It's the same in almost all business, and especially with the nursery business.

LITERATURE CITED

Fare, D. 2006. Redbud germination affected by seed treatment. Proc. Southern Nursery Assoc. Res. Conf. 50:401–403.