

SEEDY PERSPECTIVES

Production, Collecting, Cleaning and Storage of Seed

On the wall of my seed office is a framed reminder:

If there is no seed in the receptacle, don't collect it...
If there is only chaff in the bag, don't clean it...
If the seed does not contain an embryo, don't save it...

And next to this is another:

Strive to know the plants by their seed...

SEED PRODUCTION

In House

I live on the same property where I run my business- 8 acres in farm country in the Ottawa valley of Ontario, Canada. Approximately 6 acres of land are devoted to seed production.

Plants were historically field-grown in rows in seed production areas. However, this practice was abandoned over time, due to the risks involved having all seed stock growing in one area together. The potential dangers from weather, insects, disease or wild animals are too great if your entire inventory is grown in too-close quarters. This was experienced first hand during the ice storm of 1998, which wiped out the seed-production areas.

The plants from which seed is collected are now found within the landscaped structure of the garden, grown en masse. Depending on how much seed is required, one or 100 plants of any particular species is grown. This method also provides a healthier environment for pollinators, and, as a result, better quality seed.

The original stock plants are grown from wild collected seed whenever possible and new genetic stock is introduced regularly. Care is taken to separate the notorious crossers but otherwise plants are open pollinated, as is the standard practice in the seed business.

In The Wild

Whenever possible, seed is collected from wild sources. While I sometimes travel great distances for seed collection, most years my energies are spent within a 100 km radius of home. On average, I spend 3-5 days per week in the wild; the remaining 2 days I harvest from the garden. Collecting begins in early June, accelerates as the season progresses, and normally does not stop until sometime in December for the very-late-ripening (usually woody) species.

I also custom collect for other seed-houses and have standing orders from nurseries propagating native plants. One large batch of *Asarum canadense* seed might take 2-3 days of solid picking in the woods (at ground level at the beginning peak time for mosquitoes and black flies) and a solid week to clean the seed.

I collect herbaceous and woody species as well as fern spores in very diverse habitats from bog to alvar, meadow and woodland. It is not the romantic stereotype often put forward- but to those of us who love this life, there is nothing better than heading out again and again with our backpacks ready to be filled.

The threshold difficulty with wild collecting in a developed world is in finding the actual wild spaces. In our area, this is often private land. Luckily many landowners here still own large acreages (100 acres being common), often with relatively undisturbed eco-systems. Over the past 17 years, I have built up a strong resource of seed collecting spots, but each year I lose at least one favorite site as the bulldozers move in to create yet more civilization.

Second in challenge is the perpetual search for the "seed mother lode." This is finding spots where particular species are abundant- both a practical and a moral necessity. It is an important

consideration for me not to seriously impact any particular site in terms of how much seed is collected there. Also, I would prefer to collect all the seed I require in one area, rather than spending the day driving from one spot to another accumulating seed of the same species.

Once the perfect collection spot is found, I need to get there at the right time. The timing of seed ripening and collection is relatively easy in the garden- one simply walks around and sees what is ready. But this is a bit more complex in the wild, especially if you have to drive some distance. Over the years charts of wild collecting spots and harvesting times have been created so that it can be seen at a glance what is coming up for collection, and where. Notwithstanding changes in weather conditions, the relative consistency of seed ripening has been very amazingly consistent; within one week each year. Luckily few species are so unforgiving that they must be collected within a very narrow, limited time frame. A species needs to ensure its survival, so its seed is rarely dispersed all at once.

No matter where the seed is collected, a preliminary evaluation should be made of whether there is in fact any seed worthy of collection. How does one know? Some of this is obvious: is the seed receptacle empty, is it insect infested, deformed or damaged? Is the seed plump so as to indicate the presence of an embryo? If the seed is large enough, one can make some of these threshold judgments in the field with the naked eye. If I am certain the seed is no good, I do not bother to collect. If I cannot make a good determination, the only ultimate way to know is to bring it home and test it. And ultimately, I do not trust my eye with any seed. As I have learned too often, the only way to know whether a seed is good in the end is to test it by subjecting to moisture.

SEED COLLECTION

Harvesting seed is low tech. All seed is hand collected in bags; paper for species that shed dry from the plant, plastic for species producing berries or fruit.

The dry seed is further dried either inside their paper bags or on trays. These are simply left in the greenhouse on the benches until they are ready to be cleaned.

The seed in fruit or berries is kept in their zip-lock bags until cleaned.

Ferns spores are collected by harvesting the fronds of the plants (the entire leaves) in oversized paper bags.

Equipment that always comes with me on wild excursions in addition to the obvious bags are gloves, moist towelettes (handling poisonous seed and cleaning sticky hands), a hammer, Swiss army knife, and a "tree-seed picker" (a painters extension pole with the metal portion of a paint roller bent into a hook shape screwed into the end, affectionately named "Le Hook"). This is used to bend down the limbs of very high tree branches in order to access the seed. Sometimes I take knee pads if I expect to be down on all fours for the entire day.

Dry seed is ripe when it naturally "wants to hit the ground," when the wind starts taking it away or the wildlife claims it. Seed receptacles will often change color or open to release the seed. Learning when the seed is ripe is an intuitive, learned, experiential skill. Everyone can understand ripe poppy seeds spilling from the holes in their seed capsules. But some species are not so straightforward. Although I have collected seed for over 20 years, it took 2 seasons to understand when to collect *Erythronium grandiflorum* seed. This I now know is harvested when the underdeveloped-looking soft, beige pods lie on the ground, their stalks often still attached to the remains of the plant. If the seed is collected then, before it is reclaimed by wildlife, it will finish ripening left thus in its pod in the humid environment of open plastic bags, just as it would lying on the moist ground in the woods. One can observe the seed harden and change color to brown. It is then that it is cleaned of the remaining slimy debris, and moist packed immediately to preserve viability. *Galanthus* species can be handled in a similar manner- even while the pods are still slightly green, and ripened inside a plastic bag.

Dirca palustris was another species that took a number of seasons to learn to collect. This is one of the very few species we must watch carefully each year, as the seed can be lost to the forest

floor within a 48 hour period. Once it is ready to expel from the seed capsule, it does not wait for me to arrive. And even when the seed is caught at the right moment, a high percentage of the seed will be empty, so one must hand-sort. It is a laborious and time-consuming process.

While a “ripe” color of the seed is often a good clue (the norm being brown to black, or brightly colored, soft berries in the case of fruits), some seed is shed “green” or unripe-looking in the natural course of events, such as the seed of Sweet Fern (*Comptonia peregrina*). The herbaceous *Knautia macedonica* is also collected at the greenish or light-beige phase. Natural dropping of the seed, not color is the deciding factor here.

Fern spores follow this same rule (shedding rather than color being the deciding factor). The spores form in the back of the leaf (or on a separate fertile spore-bearing frond in the center of the plant). The spores are gathered together in clusters called sori and covered with a membrane called an indusium, which lifts up when the spores are ripe. Spores can be yellow, green, brown or black. As a very general rule, ferns producing green spores are often ephemeral.

The best rule of thumb for timing spore collection is an intuitive one. You touch the spore sack. If your hand gets covered with what feels like a smooth dusting of talcum powder, your timing is likely correct, even if the color or the general appearance of the sori looks wrong. Until I taught myself the “talcum-powder” lesson, I was often wrong relying too much on the visual appearance of the spores. Often when the spore sack is quite brown and lifted up, the spores had already been released. The spore-bearing fronds are gathered in large envelopes, stood up on end in a warm place to dry and allowed to release the spores, which will “waft” off like dust. I have been in the woods on occasion on a peak spore-release day for a particular species and, in the right light; one can literally see clouds of spore releasing into the wind.

While I collect seed in many environments, collecting tree seed ranks high on my list of pleasurable activities, as this is often done in the forest, where I feel particularly happy and comfortable. Trees produce seed in a more interesting variety of receptacles than herbaceous plants and this too fascinates me. Among them are cones, pods, berries, fruits, nuts, wings, and acorns.

For genetic diversity, I try to collect tree species from various sites (more northerly spots for hardiness), and from different individual trees. I choose the healthiest, most productive specimens.

Before I begin, I ensure that I am collecting good seed. First, look for tell-tale holes or spots that could indicate insect damage. Also, avoid taking “suspect” seed- any that are obviously distorted or undeveloped.

Many tree seeds are bulky; *Quercus* (Oak), *Juglans* (Black Walnut, Butternut), *Fagus* (Beech), *Gymnocladus dioica* (Kentucky Coffee Tree) or *Carya* (Hickory) and usually contain one seed per receptacle. Before gathering these heavy seeds- crack the shell or cut through a few of the fruits, if possible, to ensure they actually have seed inside and that the seed is not infected by insects. Live, healthy seeds will be white or green and noticeably plump. I always carry a small hammer to crack open these seeds and to inspect them before collection.

Oaks, Tilia, and Acers are often empty or infected. Again- if checked before the seed becomes dry and hardens, this task is easy and can be done with fingernail, penknife or your shoe in situ.

Collecting woody seed at the right time is again very important, as under-ripe seed will mean an immature embryo and over-ripe seed may be rotten or damaged by insects. While keen observation of individual species is the best gauge for seed readiness, one can use the following rough guidelines for woody species:

Color As seeds ripen their receptacles normally change color, starting out green and turning tan, brown, grey or yellow. Ripe conifer cones may still appear green, but their scales will be edged brown. They are ideally picked when tan, but before they open and release their seeds. Open cones found on the ground will be largely empty. Fruits will take on their ripe colors of red,

orange, blue or black and may become juicy and soft. Winged fruits, pods and cones will also lighten and become less dense as they ripen and dry.

Opening or Dropping With ripeness, the seed receptacles may split open, fall off the plant or be carried away by the wind. This is a sure sign that the seed is ready. It seems trite to say, but wildlife also waits for seed to ripen - and will begin to harvest seeds as soon as they are ready, so if you are unsure, watch the creatures, because they know.

While there is always a very small risk of missing a harvest, there is total waste in collecting unripe or underdeveloped seed. Without a fully developed embryo the seed is simply compost. My long experience with seed exchanges has taught me that most inexperienced seed collectors make the mistake of harvesting too early and “empty” or improperly developed seeds are regularly submitted to exchanges.

SEED CLEANING

It needs to be said that seed cleaning has nothing to do with viability. While seed houses are held to a certain standard, and some seed debris may contain insects, home growers or nursery persons collecting seed for their own propagation need not (with one exception) clean it. Any debris remaining in a seed lot will be attacked by fungi as it breaks down in moisture. However, the fungi will not attack live, healthy seed, which will germinate notwithstanding any fungus attack to the chaff. This is very different from fungi attacking the actual seed (which is normally a symptom of weak, dead seed, or seed lacking an embryo (making it in effect, chaff).

Seed that should always be cleaned is seed contained in fruit. This is because the fruit is believed to contain germination inhibitors preventing the seed from germinating while still contained in the fruit. In nature the cleaning function is normally performed by animals or by the elements washing the seed.

Most dry seed can be safely left in its collection bags until there is time to clean it, even if that is months down the line. This after-drying is often required in any event for many dry-stored species- and some will not germinate if sown too soon after harvest. The after-drying requirement can be as little as a few days or months or as long as a year (many *Opuntia* species). Seed such as this will also alter its germination pattern after dry storage, so older seed is often rotated here with fresh seed, which is kept for the following season.

Whenever there is uncertainty about whether a batch of seed is good, the cleaning is left until after testing. A small pinch of the un-cleaned seed is placed into a petri dish on moistened filter paper and is placed in warmth. Notwithstanding the germination pattern of the seed (whether it is a warm or cold germinator or requires some other treatment), the seed will show you its health when exposed to moisture. If it rots or gets attacked by fungi (which will not harm a healthy seed), it is composted. If the seed stays sound (healthy looking and firm) it is fine, whether it germinates in this preliminary test or not.

Seeds that tolerate dry storage are normally cleaned by sifting, blowing, tossing or rubbing, or a combination of all these. The tools of my trade are sieves and bowls of every size and shape. I do not recommend plastic sieves.

My favorite bowl is a particular antique wooden one - just the right size and outward angle for seeds, and no static, which is a real problem with plastic, metal and glass. This bowl gets used for tossing the seed - and once you master the art, the chaff will land on one side, the clean seed on the other. Seed without embryos will also end up on the chaff side, because of the weight factor. Chaff and empty seed can be blown or wiped out of the bowl. I have a theory- you must be East European to master the bowl- it has to do with hip movement while tossing- but that is another story.

There are other implements- face masks become essential for irritating seeds (*Malvaceae*), gloves a must for fresh *Hellebores* and rubber gloves with a ribbed palm are perfect for de-fluffing seed or removing tails from *Pulsatilla*, *Clematis* or fluffy daisies. There are rolling pins and large trays

for breaking the hard *Penstemon* seed receptacles. Tarps are placed on the floor with piles of un-husked legumes on top; *Baptisia* or *Cassia* pods are then danced on wearing heavy work boots to break the shells and release the seed. There is even a blender for cleaning some seed that will not be damaged by this process. Lastly, and of particular interest to rock gardeners are a series of seed-cleaning-troughs which were purposely made low and wide. The rough texture of the hypertufa is used to rub debris off seed. One learns from trial and error which seed has a hard-enough seed coat to tolerate being rubbed in the trough.

Fern spores which have been dried in large paper bags are cleaned by lightly hitting the dried fronds against the inside of the seed collecting bag. The open end of the bag is kept open just far enough for hand insertion, and even then your entire body will be covered with spore. What remains in the bag is then sifted through the smallest mesh sieve (usually sold for powdered sugar) which removes the bulk of the chaff that falls from the spore sac. After having cleaning a few batches of spore, one begins to be able to identify what is the spore and what is chaff. The spore is the smooth, dust-like entity, while the chaff from the spore sac tends to be larger, and distinctly textured. This can be seen with the naked eye.

And then there are the berries. When the fruity seed starts piling up, awaiting cleaning, the red, blue, black, white and orange fruits are a feast for the eye and my seed office begins smelling of strange wine. The fruited seed piles up more often because of the extra effort required to clean it (3 stages being the norm).

Seed in fruit is always collected in Zip Lock bags. I keep the seed in the original collection bags to soften. The fruits are then squished through the bag using the pressure of my hand until a juicy mess results. This extracts the seed from the fruit. The contents of the bag are then put in a sieve and washed under running water. I normally add dishwashing detergent at the final stage to help remove germination inhibitors. It is rarely possible to have the seed clean at this stage. The seed and the pulp that remains after the washing is then spread out in trays to dry and the final clean is done by rubbing the dry pulp off the seed with ribbed gloves or in the seed-cleaning trough. Lastly is either a clean with the sieve or with tossing in the bowl.

Some seed does not respond to this technique because it has a glutinous, almost glue-like undercoat that does not remove by washing. Examples of this are *Opuntia* (moist-fruited species) and *Chaemaepericlymenum canadensis*. The seed of these species is hard enough that one can risk putting them in an old blender to clean. To avoid damaging the seed, it is done on low setting, in small batches with the addition of water. Other very-hard coated (primarily woody) species can also be cleaned in the blender without harm.

Hard-fruited species such as *Malus* are soaked in buckets to soften the pomes before cleaning can begin.

For some berries (such as *Asarum*), there is no escape from the tedious and labor-intensive pushing the seed out, pod by pod. When these seeds are allowed to sit on trays, exposed to air they will either turn mushy or hard as a rock, making the final seed cleaning even tougher.

Other berries, such as *Gaultheria* or *Vaccinium macrocarpon* which have tiny seeds encased in a mealy berry or *Epigaea repens* with equally tiny seeds formed on the outside of a juicy berry can be dried on trays, or in brown paper bags, then broken up and rubbed. *Arisaema*, which we used to squeeze out of their fruit, seed by seed, can be left to dry and the seed coat will rub off easily.

Finally, there is seed that needs to be dealt with soon after collection and not simply left to be cleaned later- and this is the “ephemeral” or short-lived seed. These are the seeds that must be either sown immediately or stored in a manner that will preserve their viability.

SEED STORAGE

Once you have collected good seed, its proper storage is crucial to its viability. Knowing how to store optimally requires knowledge of germination patterns and longevity of individual species.

While there are many variables, the most common categories for my business are:

- (1) Dry stored in a cool, dry place. This is the majority of seed. Shelf life can vary from a few months to some years, with the average being 1-2 years. All seed that tolerates dry storage is an ideal candidate for storage in the freezer, both short and long term. Seed must be completely dry, ideally packed in paper and placed in freezer containers with tight-fitting lids.
- (2) Dry stored and immediately frozen. These are seeds that tolerate dry storage, but have a short life span. I routinely freeze immediately after harvest the seed of Pulsatilla, Anemone, (woolly seeded types), Clematis, Primula, Allium, Glaucidium, Angelica, Tiarella and others to maintain maximum viability.
- (3) Cleaned and moist-packed, kept either at warm, or at cold, depending on the germination pattern of the seed. These can be moist-packed and kept in a state “suspension” until they receive the treatment they require to germinate. The bags are regularly opened and shaken to check moisture levels, and to ensure air is adequate inside the plastic. Anemone (non-woolly types), Anemonopsis, Erythronium americanum, Dicentra, Corydalis and Aconitum (ephemeral species only), Fritillaria meleagris, Astrantia, Cardiocrinum, Cornus alternifolia, Dirca palustris, Daphne sp., Hacquetia, Hydrophyllum, Leucojum, Panax, Ranunculus (many species), Streptopus, Stylophorum diphyllum, Trollius laxus, Triosteum sp., Viola (some species) Trilliums that have a dual-cold requirement, such as T. erectum or undulatum, Uvularia, Helleborus, Saruma, Sanguinaria canadensis, Claytonia, Magnolia and others.
- (4) Dealt with as a fresh-harvest seed and sent to customers immediately after collection and cleaning, moist-packed (Trillium grandiflorum, Paris quadrifolia, Asarum, Hepatica, Daphne mezereum and others). This is because these particular species often germinate late the first season after collection if kept moist-packed and warm.
- (5) Bulbils are kept in dryish sand in the fridge (Begonia grandis, Arisarum proboscideum etc).

Ephemeral Seed

Willows are perhaps the most notoriously short-lived seeds, as they can be dead within days if not kept moist after collection. The year I collected dwarf Salix species in the Yukon I simply placed the seed inside plastic baggies mixed with moist sphagnum I found in situ. These bags were on the road with me for almost 2 months and were perfectly viable and germinated immediately when I returned home.

Gardens North was the first seed business to use innovative methods such as sending out ephemeral seed fresh on the day of harvest, and moist-packing short-lived species to preserve viability. This has significantly increased the availability of species in the marketplace heretofore impossible to obtain commercially. We moist-pack most seed requiring it in vermiculite. This is done for a number of practical reasons:

- (1) Shipping to parts of the world where soil-based substances are not allowed. Even soil-less mixes look too much like soil to take a chance. Vermiculite is not questioned, even in Australia.
- (2) The light color of the vermiculite makes it easy to see the (usually darker) seed for ease of packaging.
- (3) I find it easy to maintain a proper moisture level inside the zip-lock bags than with other media.

The moist-packing of seed continues to fascinate me as an on-going research project, particularly how the element of time affects the seed “suspended” at non-germinating temperatures. What I have learned thus far is that some species that require cold as a normal treatment will germinate eventually at warm, if kept moist-packed long enough. I am currently testing how long seed can be kept moist-packed and what happens when given optimal germination conditions after various periods of time of one year or longer.

Kristl Walek is the owner of Gardens North, a Canadian seedhouse devoted to out-of-the-ordinary perennial and woody species. She describes herself as single-mindedly absorbed by seed and germination. Her seed catalogue serves her two-pronged desire to both educate and sell. She is currently working on a book about the propagation of eastern Canadian native plants from seed.