

SEEDS, DR. DENO AND ME

Seed Starting for the Space and \$\$\$ Deprived

Donna Maroni

The Trillium

newsletter of

the **Piedmont Chapter** of the
North American Rock Garden Society

"....to water long rows of pots twice a week for months on end, to expect only a small percentage to germinate, and to resort to growing the easy ones dismissing the rest as difficult and recalcitrant."--Dr. Norman C. Deno, Prof. Emeritus of Chemistry, Pennsylvania State University.

Amen, Dr. Deno!

I've paid my seed-sprouting dues. I poked seeds into open ground, rejoiced when the bright green cotyledons emerged and then lamented when critters (slugs, grasshoppers?) mowed down my seedling patch. I resorted to sowing seeds in jillions of little pots. Despite my seemingly constant attention to the pots, many seeds simply failed to germinate; others succumbed to murder, either by me (yikes! I forgot to water them!) or by fungi most foul (damping off). Eventually I'd dump lots of expensive potting mix that had nurtured nothing but a film of slimy green algae.

In fact, after a few years of that, I wasn't tempted simply "to resort to growing the easy ones"--I was tempted to dismiss growing plants from seeds altogether. Seed starting was just too fraught with failure. But, blessed/cursed with a greedy, frugal and stubborn nature, I persisted. With the help of the method described by Dr. Deno and a few modifications of my own, I could quit entering all those million-dollar sweepstakes and ****still**** aspire to drifts of arisaemas, cyclamen and primulas.

The Deno Method

Gardeners who use the seed germination procedures described by Deno often refer to "The Deno Method." It is worth noting that Deno's method is simply a yet lower-tech version of the low- tech albeit scientific procedure long used in seed-testing laboratories (see Chapter 7 in the book by Hartmann and Kester listed under the heading Useful Information Sources). In laboratory tests for seed viability and germination rates, seeds are sown on specially made paper blotters or specially made paper toweling, and then incubated in germinator chambers that control light, moisture and temperature. Deno's approach is the same, but his paper germinating medium is not specially made; it is just high-grade paper toweling. His germinator chambers are plastic sandwich bags. Both are readily available in supermarkets. Deno has given a detailed description of this method in his self-published book (see below, Useful Information Sources).

It turns out that I had been using "The Deno Method" for years without knowing it. During one of my few trips on the local bus system, I overheard a woman say that she always pre-germinated her peas on paper towels before putting them into the ground. "Great way to give my snow peas a head start," I thought; and I immediately started pre-germinating my peas. After a while, it occurred to me that this approach could be used for all my seed-starting efforts, and I started sowing seeds on dampened absorbent paper. At about the same time, I purchased Deno's book in order to have access to his data on temperature and light requirements for successful germination of various species and lo! I discovered that great minds....blah, blah, blah.

In the following paragraphs, I describe my version of The Deno Method. I also describe my procedure for gradually transferring germinated seedlings from paper to soil. The whole process may sound like a real rigmarole, but it has advantages that are especially important to me. Some are outlined in the next paragraph

and others will be mentioned latter.

Advantages of the Maroni-Modified Deno Method

By combining the Deno method with a few modifications of my own devising, I can attempt to germinate many, many varieties of seed with little expenditure of space and money; I can provide and control the diverse conditions that are required for optimal germination of seed of different species without devoting a lot of attention to the sown seeds; and I need invest in expensive potting materials (soil and pots) only when I know that I've achieved successful germination. The latter is especially gratifying when germination rates are particularly poor--even if only one out of hundreds or thousands of seeds is viable and germinates, I can rescue it and grow it on.

Here's How I Do It

The Deno Part

As the germination medium, I use Bounty (tm) paper toweling. By folding each 11" x 11" sheet of toweling twice, I make four-layered 5.5" x 5.5" squares each of which I cut into four 2.75" x 2.75" four-layered "germination pads." I wet each pad with tap water, then press out any excess water by rolling a small, straight-sided drinking glass across the pad; this ensures that seeds sown on the pad will not drown in a standing film of water.

My germinator chambers differ depending on the germination conditions indicated for various species of seed (see next few paragraphs and section headed Useful Information Sources).

Seeds that germinate without stratification

When working with seed that can be expected to germinate at or near room temperature without prior cold treatment (stratification), I place each germination pad in a small, clear plastic container along with a paper or plastic penciled label (enclosing the label rather than writing on the container makes for easier recycling of containers--no need to scrub off old labels). Petri culture dishes, 3" round, covered plastic dishes commonly used in microbiological laboratories, are ideal (available from Carolina Biological Supply, 800-334-5551; catalog no. P7-74-1348). Disposable translucent plastic deli containers are an acceptable alternative, but they are considerably deeper than Petri dishes and so do not stack as compactly as do Petri dishes.

Prior to sowing seeds onto the germination pads in each plastic container, I subject them to any special pre-treatment that might be recommended (e.g. soaking in hot water or scarification; see Useful Information Sources). If the germination period is expected to be several weeks or months, I sometimes disinfect seeds by soaking them for two minutes in a 10% Chlorox solution and then rinsing well in tap water; a tea strainer with a very fine screen is an excellent tool for such soaking and rinsing. However, I've recently been less diligent about such treatment because I've come to trust Deno's assertion that mold plagues only inviable seeds. In a given batch of seeds, mold will form on some seeds and not on others. If I find that a mold infestation is extensive, I'm now quite confident that the whole batch of seeds was doomed from the start and can be discarded. If only a few seeds develop mold, I pick them out and leave the remainder to proceed to germination.

After I've sown seeds onto the germination pads in each plastic container, I incubate each variety of seed under conditions that have been reported to promote optimal germination (see Useful Information Sources).

If light is required for germination, I avoid stacking the Petri dishes; and I keep them close to an excellent light source. For example, I place four or five Petri dishes side-by-side on a sheet of thin cardboard and slip the cardboard and plates into a zip-lock bag (to retard drying of the germination pads). I place set these packages directly under fluorescent fixtures, about two inches from the tubes.

If darkness is required, I stack the Petri dishes in a plastic bag, close the bag with a twist tie and put the entire

package into a dark, seldom-opened cupboard or drawer.

If special temperatures are optimal (slightly above or below ordinary room temperature), I also try to provide that, for example by incubating seeds in an unheated room or near a heat source (e.g. the top of the refrigerator).

Once the seeds are sown, I need devote little attention to them; all that is required is that they be observed from time to time so that I catch them just after they begin to germinate. If the pads, appear to be drying despite being kept in closed plastic bags, I dampen them a very little using a spray bottle. Once germinated, I sometimes transfer seedlings directly to soil. However, I much prefer to move them onto another medium for a short period (see below, The Maroni Part)

Seeds that germinate only after stratification

When attempting to germinate seed that require stratification, (moist-chilling) in order to break embryo dormancy, I prefer to use germinator chambers even more compact than Petri dishes-- after all, I do need to leave for some vegetables in the crisper of my refrigerator! The more- compact chambers that I use are in fact nothing more than a wrapping of Saran Wrap (tm). I cut 12" squares of this plastic, place a dampened germination pad in the middle of each square, sow seeds on the pads, and cover each batch of freshly sown seed with another moistened pad. I then fold the plastic wrap to enclose the germination pad and a label (if using paper labels, I place these between layers of plastic rather than directly on the damp pads). I stack the resulting approximately 3" x 3" seed packets in a plastic food storage bag, close the bag with a twist tie and tuck the bag of seeds in the corner of one of my refrigerator's crisper drawers where they remain for the required period of chilling.

After the stratification period, I remove germination pads from their plastic wrappings, separate the two germination pads that were contained in each packet (usually seeds will adhere to both of these) and place the pads in Petri dishes (or other containers) that are then handled according to the foregoing section.

The Maroni Part

For the most precious varieties of seed, I transfer newly germinated seedlings to an intermediary growth medium, a jelly of agar-agar (aka Japanese Jello (tm)). Agar-agar, available in specialty food stores, is used as a jelling agent for foodstuff and for microbiological culture media. I prepare the jelly by adding three slightly rounded teaspoons of agar flakes to 2 cups of water and heating at medium-low setting in the microwave. When the agar is completely dissolved (no more undissolved agar flakes visible in the liquid), I cool the solution slightly and dispense it to fill the cylindrical wells in special 3" x 5" plastic 96- or 48-well plates (these are recycled items that I rescued years ago from laboratory trash). Such plates are available from Corning Costar (800- xxxx), but they are costly. Similar plates could be made, a few at a time, by drilling 0.25" or 0.5" holes in a 3" x 5" x 0.5" plate of plexiglas. I use a syringe or medicine dropper as a dispenser to deliver the cooled agar the small wells (plastic syringes and medicine droppers are available in pharmacies where these are sold for administration of medicines to children). For a simpler alternative, a 0.5" layer of agar could be poured into a small plastic container (again, Petri dishes or deli containers would be good alternatives).

I transfer seedlings into agar soon after the radicle has emerged, i.e., once a substantial tuft of root hairs has developed but before the radicle has elongated to any great degree. At this stage, the radicle is reasonably stiff and can easily be poked into the agar or into a slit cut in the agar with the tip of fine tweezers.

Of course, I'm careful to record the species of seedlings thus planted in agar. When I use well plates which are clearly marked with well identifiers (rows carry letter designations and each well in a row is numbered), I can simply note, for example, that seedlings of one species of primula are in wells A1 - A6 while those of another species are in wells A7 - A12. It would be a simple matter to draw such a grid matrix on the bottom of an undivided plastic container as an aid to identifying seedlings growing in a single slab of transparent agar jelly.

Once seedlings have been transplanted to the agar, I enclose the well plates in transparent plastic boxes. As a means of maintaining the high humidity required to prevent drying of the agar jelly, I place a dampened

paper towel in each box; and, to prevent the development of leggy seedlings, I place the boxes within a couple of inches of a fluorescent light source.

My practice of transferring paper-germinated seedlings to agar before putting them into soil has a number of advantages. (a) Agar is an especially safe haven for new-born seedlings: the seedlings are being provided with just the right amount of moisture (i.e., I'm neither overwatering or underwatering) and, in the absence of soil, they are not prey to soil-borne damping-off fungi. Admittedly, plain agar is not a nutrient medium, but seedlings can subsist on the food stores carried in their cotyledons until true leaves form. Therefore, I delay moving seedlings to soil as long as possible, preferably until I notice the first sign that true leaves are emerging. I move seedlings to soil earlier than this only if the roots appear to be overgrowing the agar plug, or if the agar plug begins to shrink because the seedlings are drawing off appreciable moisture. (b) While moving seedlings from paper to agar and then again to soil might sound overly painstaking, it is in fact no more tedious than pricking out seeds that have been closely sown directly in soil. Moreover, since the transplanting into soil is done with the tender roots safely encased in agar, there is never a sign of transplant shock. (c) A large number of robust seedlings can be nurtured through the critical earliest stages of development in an incredibly small space. A 3" x 5" 96-well plate contains as many seedlings as two flats of 6 packs.

Transplanting seedlings from well plates to pots or cell-packs is a simple matter. I use a stainless steel spatula and pop the agar plug out of the well. I use the spatula itself or coarse tweezers to carry plugs to appropriately sized holes in well-moistened potting soil. If seedlings were planted in a single slab of agar, it would be a simple matter to cut around each seedling to form pieces that could be picked up with a spatula or tweezers. I bury the agar plugs as far down in the planting hole as is necessary to position the cotyledons at the surface of the soil thus instantaneously curing any legginess in the seedlings. I gently draw the soil around the agar plugs and around the below-soil-level portion of the seedling stems and water-in with a gentle stream of water. Finally, as a preventative for damping off, I sprinkle a fine layer of milled sphagnum moss on the soil surface close to the seedlings and then dampen the sphagnum with a misting from a spray bottle of tap water.

It is possible to transfer newly germinated seedlings directly from the paper germination pads to potting soil. When I choose to do this (e.g., when I'm dealing with robust seedlings such as arugula and basil), I wait at least until root hairs are well-developed on the radicle and preferably until the cotyledons have emerged. Using fine tweezers, I transfer seedlings into a hole poked into well-moistened potting soil. I am always careful to grasp the seedlings very gently only by a sturdy part (seed coat or cotyledon; never the stem). Whenever possible, I use the open tips of the tweezers as a fork, scooping up a seedling and never pinching the tweezers tips closed on it. I plant the seedlings so that their seed coats or cotyledons are just at or below the surface of the soil, then I water-in and add sphagnum moss as described above. If I've been neglectful and allowed the young roots to grow into the paper toweling, I simply cut the toweling around one or a few seedlings and plant paper and all

Even If You Think the Maroni/Deno Method is Too Much Rigmarole...

... even if you insist on sowing seeds the conventional way, here are some things that you shouldn't neglect:

Use a good potting medium and one that suits your watering routines. I've found that some potting media hold a lot of water; if I use these, I end up overwatering. Others are so coarse that it is difficult to transplant the smaller seedlings into it. I favor Hoffman's Fertil-Mix (tm) which has a fine texture and still provides good drainage, but I can't always find it, especially in the big bales that I used to buy. I am now resorting to potting directly into MetroMix 360 (tm).

Be sure to provide lots of light. I once heard it said that even the brightest unshaded window is no brighter than the shade under a tree.

If you're using artificial lights, it is not necessary to invest lots of money in expensive full-spectrum plant lights. Broad spectrum light is required, but this can be had at very reasonable cost by combining equal numbers of cool white and warm white fluorescent fixtures purchased from a wholesale electrical supplier.

Place seedlings as close to the light source as possible, but avoid overheating them. Fluorescent fixtures provide cooler light than incandescent bulbs and allow for seedlings to be placed within inches of the light source.

Replace fluorescent tubes about once a year; even if they haven't burned out, the quality and intensity of their light deteriorates over time.

Take pains to prevent damping off. Use clean pots and tools and new potting medium, don't overwater, maintain good air circulation and, as insurance, add a fine layer of milled sphagnum moss to the surface of the potting medium. If damping off is noted, drenching with a fungicide might help.

If algae and mosses appear on the surface of pots, water only when the soil surface begins to appear dry and/or cover the soil surface with a layer of fine granite particles (Grani-Grit can be purchased from farm supply stores such as Southern States).

Useful Information Sources

General principles and techniques for seed propagation

Plant Propagation, Principles and Practices, Hudson T. Hartmann and Dale E. Kester. Third Edition, 1975. Prentice-Hall, Inc. Englewood Cliffs, N.J.

Recommended pre-treatments, temperature and light conditions for optimal germination

Seed Germination Theory and Practice, Norman C. Deno. Second Edition, 1993, First Supplement, 1996, Second Supplement 1998. (Available from the author at 139 Lenor Drive, State College PA 16801 at \$20 and \$15 respectively) Together these volumes specify the conditions for optimum germination seed from over 5,000 species.

Jelitto Wholesale Seed Price List. I believe Jelitto does not sell retail. However, it should be possible to get a copy of the catalog from the U.S. representative Jelitto Perennial Seeds, 125 Chenoweth Lane, Louisville, KY 40207.

Internet Web Sites

<<http://www.eskimo.com/~mcalpin/tm.html>> This is an electronic version of the no-longer in-print Thompson and the conditions for germination of about 800 genera.

<<http://www.anet-chi.com/~manytimes/page43.htm>> or <<http://home.sol.no/asles/sowing.html>> The database included in these mirrored sites is based on the personal experience of two growers, one of whom maintains a nursery in Norway.

<<http://www3.sympatico.ca/vivaces/Germin.html>>
