



"Seed the Day" by: Matthew Holm (*Research/Penn State*, Vol. 17, no. 1 (March, 1996))

On his porch, surrounded by plants and blooms from around the world, Norm Deno tells me how, when he retired from his chemistry professorship about 15 years ago, he went down to the library to see what had been written about his lifelong hobby, seed germination. He felt -- as he says, like Darwin at the Galapagos -- that everyone in the field had somehow gotten it completely and utterly wrong. "My only choice," he says, "was to do the whole field over.

"The problem all plants have, that most botanists have overlooked," he says -- and he's tested more than 6000 species of plants -- "is keeping the seeds *from* germinating." My first reaction is that this energetic, eccentric, 70-something man has his statement backwards.

But then I look at his yard and see the ease with which the wildflowers have devoured the land, staring lawn-care in the face and laughing. Deno's yard is a testament to many things -- the beauty of nature, the haziness between the terms *weed* and *flower* -- but especially to the need for a plant to disperse its seeds. "You don't want the seeds to start growing in the follicle," Norm says, and I can see his point -- it would be rather embarrassing (if not fatal) for seeds to germinate before they're off the branch. Plus, he adds, they need to wait for the right growing conditions once they hit the ground.

Deno's approach to seed germination -- the one that turns the field on its head -- is that seeds have chemical inhibitors to prevent germination. No seed can grow until these blocks have been destroyed by things like temperature changes, moisture, and sunlight. These conditions combine in nearly infinite ways, making each plant's germination needs different. Of course, when you know what the proper conditions are, you can break down the barriers relatively quickly and easily -- this is why you can plant Burpee seeds straight from the envelope (where they have waited in dry storage for several months) and have sprouts in a few weeks, and why you can "force" a crocus to bloom in February by keeping the bulb in your cool, dark garage and then moving it to a sunlit windowsill.

To test his inhibitor theory and catalogue the germination patterns of thousands of seeds, Deno employed some of the most powerful tools of modern science: a small, brown, dormitory-style refrigerator, moist paper towels, and polyethylene sandwich bags. His mighty home lab sports a 6-foot long workbench, a row of unfinished plywood shelves, some fluorescent lamps, and miscellaneous fly-fishing tackle -- a far cry from the gas chromatographs, mass spectrometers, ultraviolet and infrared lights of his chemistry days at Penn State, but it's all he needed to redefine thought about seed germination.

In less than two years, his self-published, 242-page book (printed by Kinko's Copy Center, no less), *Seed Germination Theory and Practice*, has sold more than 8,000 copies without any advertising whatsoever -- Simon and Schuster, eat your heart out. Norm gets boxloads of mail every day, from people asking him to try out some interesting seeds, solve a tricky germination problem in South Africa, or send them his book. "For \$20, I'll get it to you anywhere in the world, postage-paid," he grins.

Deno unashamedly acknowledges his success in the field, accrediting it to good science. "One of the biggest mistakes experimenters made in the past," says Deno, "was not controlling for the fungi in the soil," -- hence the moist paper towels and plastic bags, which make for a sterile, controlled environment. The fungi are significant because they, too, can break down the chemical inhibitors. Deno tells of a cactus that will only germinate in the presence of a fungal chemical called a gibberellin (gibberellins, of which only 3 of 70 known types appear to affect plants, are not well understood). "Here you have this tiny seed, with a tiny speck of a root, in the middle of this huge, dry desert," he says -- if the seeds germinate just anywhere, they'll surely die and the parent cactus will be left with no offspring. "What it needs, then, is a pocket of moist leaf mold," says Deno. "It drifts around and will only germinate when exposed to that gibberellin, produced in that pocket of mold, where it can get a start."

This ingenious twist of natural selection demonstrates just one of the six main ways that inhibitors are destroyed. Along with the gibberellins go exposure to sunlight, dry storage (this works for most seeds, including all of our grains), moist storage at 70 degrees F, moist storage at 40 degrees F, and the puncturing of the seed coat.

This last method -- removing a physical rather than chemical block -- is the least common, used by only 5% of all species. But Deno, of course, has some of these seeds as well -- he picks a Kentucky Coffee Tree seed pod off the ground (his yard is littered with vegetation in various states of growth and death, including a spectacular 150 different species in bloom -- just today) and tears it open, exposing the smooth, dark, walnut-sized seeds that lie in a sticky, sickly yellow paste.

"Raccoons carry these pods away, then eat the sweet stuff inside," Norm says, offering me a taste. I dab my fingertip in the goo, then touch it to my tongue, where the initially sweet flavor soon fades into a persistent sourness. As Norm warns, "Not too much -- I think it's got toxins," I'm reminded of underripe banana.

As the raccoons take their treat home, they also disperse the seeds. The seeds themselves, which look like they would require a few good hours with a hammer and a tungsten-carbide drill to open, won't germinate until heat expansion and contraction finally crack the shell in another 5 to 10 years. "They can be viable for over 150 years," says Deno.

Dropping the seed and leaving it to its decades-long journey, he ambles along the winding, rocky path through his sloping backyard. Common and endangered plants vie for soil and sunlight in a manner that would make a conservationist cringe. "I went to a Sierra Club meeting," Deno says, shaking his head. "Once." At the meeting, he recalls, the club members spoke for five minutes about the disappearance of the lady slipper orchid, then spoke for 45 minutes about the need to plant trees.

"Reforestation is the single worst thing for a lady slipper like the Queen's lady slipper or the small white lady slipper," says Deno. "Encroaching trees rob the orchids of the sunlight they require." Under a large power line junction in Ohio, where every spring the earth is intentionally burned free of brush and weeds, the white lady slipper still covers acres. The snow orchis grows in the Bennett bogs in New Jersey, Deno notes, because farmers mow the marsh in June, allowing sun to reach the plant's ground-hugging rosettes. A rare gentian in Centre County is found only along the roadside where the road crews mow. "Many rare species of flowers exist only because of man's interference," Deno says. "Without this, some of them would probably be on their way out."

Deno's approach to conservation is realistic -- not everyone can be responsible for saving all species simultaneously. He waves at a patch of dry brown foliage where he has killed some flowers with Roundup, saying, "My wife and I encourage a species to grow some years, then cut it back other years." In his garden, everything gets its fair turn. "If you want to preserve a species, then I think you need to set aside an area and just concentrate on that one alone," he says. I am reminded of the hundreds of thousands of seeds he has worked on and the hundred or so more that await preparation later today as he tells me, "You just have to take things one at a time."

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