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Redbud Seedpods Hold Surprises

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Redbud seedpods hold surprises

As fall advances across the Old Dominion, canopies of redbud, the 2013 VNPS Wildflower of the Year, transform themselves from green to gold, revealing seed pods also changing color from pale green to dark chocolaty brown. These seedpods, which may be retained on the tree into winter, are typical legume fruits, the product of the flower's simple pistil, each containing several seeds. Unlike most legumes, however, redbud seed pods seem disinclined to open and release individual seeds for dispersal. Redbud fruits tend to disperse intact. Once on the ground, the inevitable action of weather and microbes gradually degrades the pod, whereupon the process of seed germination can proceed.

Fresh seeds of redbud, however, are dormant and will not germinate until two different factors, each responsible for different aspects of seed dormancy, are overcome. This double dormancy derives from the presence of an extremely hard, impermeable, seed coat and physiological dormancy of the embryo contained within. For temperate-zone trees, seed dormancy makes good ecological sense. Rapid germination would leave redbud seedlings vulnerable to the harsh rigors of winter; better to remain dormant through the coldest months and germinate during the more favorable weather of spring.

Most legumes have very hard seeds, and redbud is no exception. Anatomically, the stereotypical legume seed coat consists of two (or more) layers of tough sclereid cells: elongate macrosclereids at the surface underlain by one (or more) layers of boxlike brachysclereids directly below. Both of these sclereids are very nearly solid masses of cell-wall material. Together, they tile the surface of the seed, except for a small patch known as the hilum, which marks the

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Redbud seedpods. (Courtesy John Hayden)

• Redbud

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spot where the seed attaches to the seed pod. These tightly packed sclereids constitute an impermeable barrier to water, and, as long as water is excluded, the seed will remain dormant.

Besides dormancy, the tough seed coats of legumes also provide a measure of protection from seed predators. For plants, rich stores of food, usually starch, or protein, or oil, assist in establishment of the new seedling. But the world is full of hungry animals, and many (including us humans) have learned how to exploit the nutrients contained in seeds. Very few people, however, eat wild-collected legume seeds; toxins and tough seed coats render wild legume seeds essentially inedible. But we can eat seeds of various crop legumes (e.g., beans, peas, chickpeas, and soybeans) because during the process of domestication, our ancestors selected less toxic and softer seeds from the natural variability of the wild legume ancestors of these crops.

But one group of animals is especially adapted to eating wild legume seeds, a group of beetles known as bean weevils (family Chrysomelidae, subfamily Bruchinae). Adults of these insects live in flowers, consuming pollen and nectar. After mating, females lay their eggs inside the ovary of the flower. As larvae emerge from their eggs, they enter the plant's ovules, which at this early stage are soft and unprotected. An infected seed develops more or less normally; but as it reaches maturity, the hungry weevil larva (already inside) consumes all the internal tissues. Just before pupation, the weevil larva cuts an exit hole through the seed coat, again, working from the inside. There are well over 1,000 different species of bean weevils, including specialists that attack just a single host plant, and generalists with more catholic tastes. Most hosts are legumes, but some weevils also attack plants in the mallow (Malvaceae) and morning glory (Convolvulaceae) families. The weevil *Gibbobruchus mimus* is commonly encountered in eastern redbud seeds.

Redbud seeds that escape being eaten by weevils eventually find themselves in the soil. Time passes, rain and snow come and go, temperatures climb and fall, and ubiquitous microbes secrete their digestive enzymes, all of which gradually break down the seed coat and water gains access to the interior of the previously very dry seed. In this way, nature breaches the physical dormancy of redbud seeds.

Impatient gardeners can speed up seed hydration in a number of ways. Sandpaper, files, or sharp knives can be used to nick into the seed coat, providing pathways for the quick entry of water. For the chemically inclined, brief treatment in a strong acid can also soften the seed coat and promote permeability. These techniques, either mechanical or chemical, are known as scarification. And to hasten water entry, redbud seeds can be soaked in warm water prior to planting.

Mere hydration of redbud seeds, however, is not sufficient to prompt germination of the embryo because there is also a physiological dormancy factor that must be overcome. Hydrated redbud embryos must endure several weeks of cool temperature followed by a return to warmth before they germinate. In a horticultural practice called cold stratification, scarified redbud seeds can be induced to germinate relatively quickly by sowing in moist soil and keeping the pot refrigerated for one or two months before returning to warm conditions. In nature, the physical (seed coat) and physiological (embryo) dormancy may be overcome in the course of a single winter. But based on personal experience, passage through a second winter season yielded many more redbud seedlings than the first—perhaps it took that long for both dormancy factors to be overcome.

It has been said that wishes are like seeds—few ever develop into something. Indeed, we should expect, on average, each redbud tree to succeed in making just one redbud seedling that will survive to maturity—any less and the species would eventually go extinct, any more and we would be overrun with redbuds. It is a sobering proposition to think that the despite the elaborate biology of redbud seeds, despite their double dormancy adaptations for proper germination, their structural and chemical defenses notwithstanding, and despite the undeniable fact that each has the genetic potential to become a handsome redbud, only a tiny percentage of the seeds produced can be expected to become trees themselves.

Redbud seeds may seem like such simple little things, but close examination reveals unexpected intricacies. One is reminded of a saying by the Chinese philosopher, Lao Tzu (Laozi), "To see things in the seed, that is genius."

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