2018

Black Cohosh Seed Germination and Conservation

W. John Hayden
University of Richmond, jhayden@richmond.edu

Recommended Citation
Hayden, W. John. "Black Cohosh Seed Germination and Conservation." *Sempervirens* Winter 2017/2018: 6-7.

BLACK COHOSH

Seed Germination and Conservation

Article and illustrations by W. John Hayden, Botany Chair

Like many plant enthusiasts, I have spent a considerable amount of time planting seeds. Every year I grow many vegetables—my garden always includes some annual bedding plants—and I sow seeds of cover crops (winter wheat, winter rye, and buckwheat) by the tens of thousands. While I have committed vast numbers of propagules to moist soil, I cannot say that I have watched every single one sprout. Nevertheless, I certainly have observed the germination process many, many times for lots of different seeds. For these seeds of garden plants, germination is quite rapid, just a few days to maybe as much as two weeks, tops—provided that temperature and moisture are appropriate. Further, in the usual case, the embryonic root (radicle) emerges first, followed in short order by embryonic leaves (cotyledons) and the first bits of the seedling shoot (epicotyl). Sometimes, as in Garden Peas, the cotyledons stay below ground, but the pattern of radicle shortly before epicotyl is still the typical situation.

In contrast, anyone who has grown temperate zone trees, shrubs, or wildflowers from seed knows that our wild native plants do not always follow the quick and straightforward pattern described above for domesticated plants. Often, germination of native plant seeds can be a protracted process requiring months of patient waiting. Further, our native species may require a particular sequence of moisture and temperature exposure before dormancy breaks and germination begins. Usually, native species time the germination processes to match the natural progression of seasons. Seeds that mature and disperse in late summer or fall will be exposed, first to warmth and moisture, and then to the cold temperatures of winter, before germinating in the warmth of spring. The savvy native plant gardener employs a process called stratification to mimic this natural cycle; seeds sown in moist soil, or merely wrapped in moist paper towels, are given a winter-like cold treatment in order to prompt germination when brought back to warmth.

Actaea racemosa (Black Cohosh), our 2017 VNPS Wildflower of the Year, exhibits an interesting twist on the usual cold stratification requirement: within each seed, the radicle and epicotyl have different requirements for breaking dormancy. In nature, Black Cohosh seeds (Figure 1) mature and disperse while temperatures are still reasonably warm. Sooner or later the seeds will be moistened by autumnal rains, and the germination process commences with emergence of the radicle. The epicotyl, however, at this time, remains dormant. Time passes, fall becomes winter, and winter brings cold temperatures that provide the necessary "stratification" effect required by the epicotyl.

When warm spring temperatures return, the epicotyl becomes active and emerges, establishing the shoot system of a Black Cohosh seedling. Baskin and Baskin (1985) studied seed germination in Black Cohosh. For seeds sown in late September and exposed to ambient temperature conditions of Lexington, Kentucky, radicles emerged in early November, but epicotyls remained inactive until mid-March. Seeds of Hepatica (*Anemone acutiloba*), also studied by Baskin and Baskin (1985), show a similar pattern.

Baskin and Baskin (1985) offered several hypotheses for the adaptive value of epicotyl dormancy observed in Black Cohosh and Hepatica. For example, cotyledons that remain inside the seed may suffer less predation than would be the case if these young and tender tissues were exposed all winter long. Further, retention in the seed may ameliorate extreme fluctuations in winter temperatures experienced by the epicotyl meristem. Finally, the Baskins noted that precocious development of a root system could help provide water and mineral nutrients for the epicotyl in spring better than if both root and shoot were developing simultaneously.

It occurs to me that there may be another perspective on precocious radicle and delayed epicotyl germination in *Actaea* and *Anemone*. Both of these plants are members of Ranunculaceae, a family in which seeds characteristically have "underdeveloped" embryos. "Underdeveloped," of course, is in comparison with seeds of other plants. Figure 2 shows a Black Cohosh seed that has been sectioned longitudinally with a razor blade. Most of the seed consists of endosperm cells full of stored food for use by the embryo. The embryo of this fully mature seed is the remarkably small heart-shaped blob near the narrow end of the seed, the size and shape of which is much like a

Figure 1. Dormant seeds of *Actaea racemosa*.

Figure 2. Dormant seed of *Actaea racemosa*, longitudinal section. Embryo is the small heart-shaped structure (bottom), everything else contained by the seed coat is food-storing endosperm.

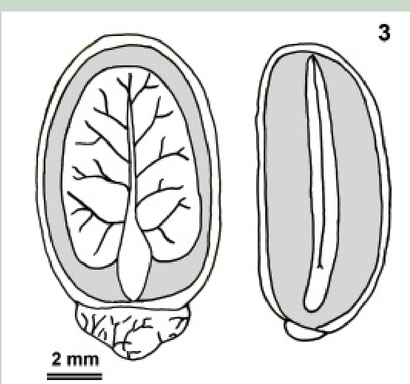

Figure 3. Dormant seed of *Ricinus communis*, longitudinal sections. Endosperm is the gray shaded area between the seed coat and the well-developed embryo. Redrawn from J. Sachs (1887) *Die Vorlesungen über Pflanzenphysiologie*, Wilhelm Engelmann, Leipzig.

textbook example of an early embryo shortly after fertilization of the egg. In other plant families, seeds generally have much larger embryos at maturity. Castor Bean (*Ricinus communis*) (Figure 3) provides a convenient example; though endosperm volume is still greater than that of the embryo, cotyledons of Castor Bean embryos are well-developed, and the whole embryo extends for nearly the full length of the seed. Perhaps epicotyls of *Actaea racemosa* have delayed emergence from the seed because they are anatomically and physiologically too immature to germinate when the seeds disperse in autumn. I wonder if the cotyledons and epicotyls of Black Cohosh are truly dormant and inactive during winter. Might they continue to develop through the winter, whenever temperatures are warm enough to permit growth? There certainly is ample food stored in the endosperm, and the precociously developed root would be able to supply water and minerals. Perhaps it is not until spring that the cotyledons and epicotyl are developmentally competent to emerge. It should be a simple matter to monitor Black Cohosh seed structure over the full course of germination to determine whether epicotyls are truly winter dormant or whether they are opportunistically active, following a cryptic post dispersal developmental process and getting ready for eventual germination in spring.

Why do the details of Black Cohosh seed germination matter? As pointed out by Kaur et al. (2013), the growing popularity of Black Cohosh in herbal medicine threatens unsustainable overharvesting of wild populations for its roots and rhizomes. Cultivation of Black Cohosh could alleviate pressure on wild populations; thus, efficient propagation by seed could be an important step to make that conservation-worthy goal a reality. ❖

WORKS CITED

Baskin, J.M., and C. C. Baskin. 1985. Epicotyl dormancy in seeds of *Cimicifuga racemosa* and *Hepatica acutiloba*. Bull. Torrey Botanical Club 112: 253-257.

Kaur, B., J. McCoy, and E. Eisenstein. 2013. Efficient, season-independent seed germination in Black Cohosh (*Actaea racemosa* L.). Amer. J. Plant Sciences 4: 77-83.

Travelers on the Society's upcoming trip to the Great Smoky Mountains are in for vistas such as this one from Clingman's Dome. (Photo by Sally Anderson)

FIELD TRIPS: SAVE THE DATES!

The Society is sponsoring two upcoming field trips, the botanical explorations of which you won't want to miss. The Great Smoky Mountains trip is **April 8-14** and the journey to Southwest Virginia and the Grayson Highlands is **June 10-16**.

For details, email vnps.org@gmail.com or call 540-837-1600.