This article was listed in Forest Nursery Notes, Winter 2008

**29. Large-scale propagation and production of native woodland perennials.** Cullina, W. International Plant Propagators' Society, combined proceedings 2006, 56:313-317. 2007.

# Large-Scale Propagation and Production of Native Woodland Perennials©

**William Cullina**
New England Wild Flower Society, 180 Hemenway Rd, Framingham, Massachusetts, 01701 U.S.A.
Email: bcullina@newfs.org

**Native woodland perennials are a source of frustration for propagators, because issues concerning seed viability, extended germination times, and slow and seasonal growth of seedlings discourage large-scale propagation and production. However, with proper seed handling and pretreatments as well as a "liner" approach to production, I believe that large-scale production is possible and profitable.**

## INTRODUCTION

The demand for native plants grows greater every year. Access to improved cultivars, increasing sophistication on the part of the gardening public, and increased interest from government and the commercial sector have all contributed to this phenomenon. Many species can be easily and quickly produced from cuttings or seed (i.e., Asteraceae, Scrophulariaceae, etc.), but others — especially the woodland wildflowers commonly known as spring ephemerals — have proved especially difficult to accommodate in large-scale perennial production. Genera such as *Trillium*, *Cypripedium*, *Polygonatum*, and *Hepatica*, while outstanding garden subjects that command premium prices, have developed a reputation for recalcitrance that is only partly deserved. Woodland wildflowers and bulbs are still supplied primarily as bare root, wild-collected stock. Thankfully, this questionable practice is now looked down upon by most of the perennial industry and consumers alike. Although collected plants are extremely cheap, we have found through experience that consumers will pay premium prices for genuinely nursery-raised material if it is available as an alternative. Besides being environmentally and ethically sound, nursery propagation also helps ensure a more consistently labeled and sized, well-established product.

## WILDFLOWER PROPAGATION

**Overview.** Because they cannot be rooted from stem cuttings, many woodland species have traditionally been multiplied by division of rhizome, tubers, corms, or bulbs. This is a very labor- and space-intensive method, often prohibitively so. Furthermore, as in all types of nonsterile, asexual production, systemic diseases, especially debilitating viruses and bacterial infections, can be passed on from plant to plant. Other pests, such as nematodes, can also be a problem. I believe that seed propagation is a viable and cost-effective alternative for many of these woodland species. Seedlings are usually free of systemic diseases and pests, and allow us to take advantage of genetic variability to select individuals for vigor, color, disease resistance, etc. But to be successful, it is important to have some understanding of their physiology and development.

**Hydrophilic and Hypogeal Seed.** Many of the spring ephemerals have a reputation for being difficult to grow from seed. Much of this reputation stems from a lack of understanding that usually leads to germination failures or poor growth. The biggest problem is that the seed dies quickly under conventional dry storage. The list of plants with what has been termed ephemeral seeds (meaning short-lived or transitory) includes most of the stars of our spring wildflower displays. Included are: *Asarum* sp., *Hepatica*, *Sanguinaria*, *Trillium* sp., *Phlox divaricata*, *Iris cristata*, *Chrysogonum virginianum*, *Stylophorum diphyllum*, *Jeffersonia*, *Claytonia* sp., *Podophyllum peltatum*, *Shortia*, *Uvularia*, and *Dicentra* sp. (see Table 1 for a more complete list).

The term ephemeral is not entirely accurate, however, and I think leads to misconceptions about handling the seeds correctly. Many of these species have seeds that are very long-lived if stored under moist conditions (trilliums for example can remain viable in the soil for at least 3–4 years). I think a more accurate term is "hydrophilic," meaning needing or requiring the presence of water. In general, hydrophilic seeds are associated with stable temperate forest communities, and especially with species whose seeds ripen in the spring and early summer.

**Immature Embryos and Hepatica.** Many of the woodland wildflowers produce seed with embryos that are immature at the time of senescence. These are indicated in Table 1 as Type D and some Type C. If seed is sown immediately when ripe, many will germinate the following year. *Hepatica* species (also classified as *Anemone*) are Type D germinators. Seed ripens 4–6 weeks after pollination, and the clusters of seeds are green when ripe. They typically fall from the plant and are taken away by ants. We collect the seeds in mid spring when they fall from the peduncle with slight pressure. The seed is sown immediately and kept outdoors in the shade (Remay cover) through the summer (average temperature range 55–85 $^{0}$F) and overwintered in an unheated greenhouse under winter blankets (temperature 25–35 $^{0}$F). Seedlings emerge early the following spring. In the wild, only the cotyledons or sometimes these plus one small true leaf will be produced the first year. However, if we germinate them in the greenhouse in March, by June they have produced 2 or 3 true leaves and can be transplanted into individual 2 $^{1}$/2-inch pots (Landmark Plastics). They are kept in the covered greenhouse under ambient temperatures and fertilized weekly with Peters Pear Lite Special (150 ppm N). By fall, the seedlings have filled the liner pots. These are stepped up into 1 qt pots (Kordloc) using a variation of Fafard #52 growing mix [pine bark, perlite, and peat moss (12 : 5 : 3, by volume)] with incorporated Nutricoat 100-day fertilizer. The plants are ready for sale the following spring with a 2-year production time once seed has emerged. The main disease of *Hepatica* and many Ranunculaceae is ascochyta leaf blight (*Ascochyta actaeae* or related species). It produces lesions on the petioles and leaf, causing premature leaf drop and weakening or killing the plants. The disease is most prevalent in cool, wet weather, but can be a serious problem under irrigation in the nursery. Good sanitation, protection from rain, and good watering control plus a weekly application of Millstop fungicide has controlled the disease.

**Trillium.** *Trillium* species are one of the most cherished and most challenging woodland wildflowers to produce commercially. In the wild, it is estimated that seedlings take 7–10 years to reach maturity, and 5–6 years is the standard in

**Table 1.** Representative species with hydrophyllic seed (intolerant of dry storage).

Dry storage will kill seed or greatly delay germination. Ideally, cleaned seed should be sown as soon as ripe in an outdoors cold frame. Alternatively, seed can be stored in a self-sealing plastic bag for 6–12 months at 40 °F, but this will not always substitute for outdoor stratification. I recommend including some damp (not wet) vermiculite in the bag for those species followed by an asterisk(*).

Germination patterns:

A — seed germinates upon sowing at 70 °F.

B — seed germinates after 90-day moist stratification at 40 °F.

C — seed has a double dormancy (immature embryo, impermeable seed coat, or a combination) or is hypogeal, showing above ground the second spring.

D — immature embryo – seed requires 90 days moist stratification at 70 °F followed by 90 days at 40 °F.

H — seed requires light to germinate.

*Achlys triphylla* (vanilla leaf) B*

*Aconitum* sp. (wild monkshood) B

*Actaea* sp. (doll's eyes, baneberry) B or C*

*Anemone quinquefolia* (windflower) B

*Anemonella thalictroides* (rue anemone) D

*Asarum* sp. (wild ginger) D**

*Athyrium* (syn. *Diplazium*) *pycnocarpon* (glade fern) A, H

*Caltha palustris* (marsh marigold) B*

*Cardamine* (syn. *Dentaria*) sp. (toothwort) D

*Carex plantaginea* (plaintain sedge) B

*Carex platyphylla* (silver sedge) B

*Caulophyllum thalictroides* (blue cohosh) C*

*Claytonia virginica, C. caroliniana* (spring beauty) D*

*Clintonia* sp. (wood lily) C*

*Clematis* sp. (clematis) C* (or long A*)

*Coptis* sp. (goldthread) B or C

*Corydalis* sp. (corydalis) D

*Dicentra canadensis* (squirrel corn) B*

*Dicentra cucullaria* (Dutchman's breeches) B*

*Dicentra eximia* (wild bleeding heart) B*

*Dicentra formosa* subsp. *oregana* (western bleeding heart) B*

*Diphylleia cymosa* (umbrella leaf) B

*Disporum* sp. (fairy bells, Mandarin) C*

*Erythronium americanum* (trout lily) C*

*Galax urceolata* (galax) A, H,

*Hepatica* sp. (hepatica) D*

*Hydrastis canadensis* (goldenseal) B*

*Hydrophyllum* sp. (waterleaf) B*

*Iris cristata* (dwarf crested iris) B or C*

*Iris verna* (dwarf iris) B*

*Jeffersonia diphylla* (twinleaf) D*

*Lysichiton americanus* (western skunk cabbage) A*

*Maianthemum* (syn. *Smilacina*) sp. (false Solomon's seal) C*

*Maianthemum canadense* (Canada mayflower C*

*Medeola virginiana* (Indian cucumber) C*

*Mertensia virginica* (Virginia bluebells) B*

*Orontium aquaticum* (golden club) A*

*Osmunda* sp. (osmunda ferns) A, H

*Pachysandra procumbens* (Allegheny spurge) B

*Panax quinquefolius* (American ginseng) B or C*

*Podophyllum peltatum* (mayapple) B*

*Polygonatum* sp. (Solomon's seal) C*

*Pyxidanthera barbulata* (pixie moss) A, H

*Sanguinaria canadensis* (bloodroot) D*

*Scirpus* sp. (rush) B, H

*Shortia galacifolia* (Oconee bells) A, H

*Stylophorum diphyllum* (celandine poppy) B*

*Symplocarpus foetidus* (skunk cabbage) B*

*Trillium* sp. (trillium) C*

*Trollius laxus* (spreading globeflower) B

*Uvularia* sp. (large-flowered bellwort) C*

*Viola* sp. (violet) B

*Xerophyllum asphodeloides* (turkeybeard) B

cultivation. We grow *Trillium grandiflorum, erectum, sulcatum, simile, flexipes, cuneatum,* and *luteum* from seed and have been working to speed up the process as much as possible. The seed ripens in mid summer, 10–12 weeks after pollination. Each capsule contains 15–30 seeds. The embryo within a mature seed is somewhat immature and dormant as a result of desiccation at the time of seed-coat maturation. If fresh seed is sown immediately, it will germinate after the first winter, producing a root and rhizome the first summer and a cotyledon the second summer. However if seed is collected before the seed coat matures ("green"), which is typically 2–3 weeks early, and kept in controlled, moist, warm conditions for 4–8 weeks, many seeds will produce the root and rhizome that season, which cuts a year off the production time (Solt, 2002). I call this a "long summer" treatment, and it has worked to overcome embryo dormancy on other species such as *Clematis, Actaea,* and *Caulophyllum*.

Trilliums are very temperature sensitive and possibly also daylength sensitive. Air temperatures above 85ºF will trigger dormancy. We have had promising results when we give trillium seedlings "long springs," placing the seed flats in a cool greenhouse that is run 5–15 oF above outdoor temperature in spring. The seedlings emerge a month earlier than they would outdoors, and so have extra growing time during the cool, short-day months. *Trillium* seedlings are very succeptable to lily grey mold, *Botrytis elliptica.* Affected seedlings develop watery then necrotic blotches and spots and usually the whole leaf is quickly affected. Fungicides labeled for *B. elliptica* are effective controls. We use a weekly application of Millstop from April through June as a prophylactic. Trillium seedlings grown with a combination of long summers and long springs with good botrytis control can reach saleable size (1 year from flowering) in 4 years, which is still a long production time, but I think it does make specialist production more feasible.

**LITERATURE CITED**

Solt, S. 2002. Propagation protocol for *Trillium* L. (Liliaceae). *Native Plant J.* 3 (1):18–20.