It is often the combination of previous knowledge of a given plant, with our experience in germinating its seed, and perhaps most importantly with what we know of the plant's natural habitat that results in the discovery of an efficient germinating procedure. For it is when we succeed in our attempts to mimic those natural conditions that we can overcome dormancy in the seed, and are rewarded with germination.

LITERATURE CITED

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Propagation and Production of Wildflowers.

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INTRODUCTION

The topic of this paper is propagation and production of wildflowers. It is based on the work I did from 1990 to 1995 as propagator at Garden in the Woods, the botanic garden of the New England Wild Flower Society in Framingham, Massachusetts. The nursery at Garden in the Woods was established to propagate plants for the garden's collection, to conduct research on propagation and cultivation techniques for native species, and to produce plants for sale to the general public. Every year approximately 16,000 pots of nursery-propagated native plants (mostly herbaceous wildflowers) are sold from this facility to support the Society's various education and conservation programs.

When I became propagator, I wanted my nursery practices to reflect the Society's mission of native plant conservation. In my mind, this means plant propagation that preserves the genetic diversity inherent in wild native plants and cultivation practices that are conserving of natural resources. I see traditional nursery practices which emphasize vegetative propagation of "superior clones" and a reliance on sterile peat-based soil mixes nourished with petroleum fertilizers as counter to this mission. Instead, I focused most of my propagation on seed germination out of doors in flats or raised beds, and I developed an inexpensive compost-based potting mix that eliminated the need to use peat moss and fertilizers made from fossil fuels.

SEED PROPAGATION

Because much of our native flora has been overlooked by the nursery trade, many species have not been altered by plant domestication and breeding. Hence these plants can be propagated the way they do in nature—from seed. Seed propagation of wild flowers has several advantages:

- Plants grown from seed exhibit a wide range of genetic diversity, unlike plants which are vegetatively propagated and are genetically identical to the parent plant. Genetic diversity in wild plant populations enhances a species' ability to adapt to changing conditions. This is particularly desirable for plants that are used by

ecologists and designers for habitat restoration, where the hope is that once established, the plants will grow and reproduce with minimal human interference. Much of the interest and demand for wildflowers today is for this kind of use. To fill this niche as propagators, we need to think in terms of maintaining biological diversity in plants produced by the nursery trade so they have the best chance of adapting to changing environmental conditions. Vegetative propagation of "superior clones" may have a role for plants destined for ornamental gardens, but not for natural landscapes.

- Seed is generally inexpensive. Often a large number of seeds can be collected from one or several stock plants yielding many plants for sale. Cuttings or divisions from the same stock plant often yield much fewer plants. Also, if the seed is being collected from wild plants, the impact of removing a small percentage of the seed from a healthy wild population is minimal.
- Seed propagation does not require expensive or sophisticated facilities. Seeds can be germinated outdoors in beds or flats. Seed that needs cold stratification are taken care of by the freeze and thaw of our northeastern winters, and seed which must be sown fresh will not be thrown off their natural cycle by the artificial climate of a greenhouse.

There are several procedures that I follow based on the germination requirements for various species:

No Pretreatment Required. Seeds that need no pretreatment can be stored dry in the refrigerator and sown outdoors in early spring. Examples include: *Aquilegia canadensis*, *Arisaema triphyllum*, *Asclepias tuberosa*, and *Solidago* spp.

Cold Stratification. Seeds that need cold stratification to germinate can be sown outdoors in late fall. Examples include: *Anemonella thalictroides*, *Cornus canadensis*, *Dodecatheon meadia*, and *Sarracenia purpurea*.

Fresh Seed. Seeds which need to be sown immediately upon ripening. If the seeds are allowed to dry out, they usually will not germinate. Most of these species seeds ripen from late spring through late summer and germinate the following spring. Examples include: *Actaea* spp., *Caltha palustris*, *Clintonia* spp., and *Hepatica* spp.

In some instances, species which disperse their seeds quickly or are carried off by ants are easiest to handle by letting seed drop into a growing bed and then later transplanting the seedlings into pots. Examples include: *Mertensia pulmonarioides* (syn. *M. virginica*) and *Sanguinaria canadensis*.

Some species take 2 years to germinate. Examples include: *Polygonatum* spp., *Smilacena racemosa*, *Trillium* spp., and *Uvularia grandiflora*.

Alternating Warm and Cold. Some species need a warm moist period of approximately 3 months before cold stratification to germinate. They are sown outdoors in spring and germinate the following year. Examples include: *Cimicifuga racemosa* and *Lilium canadense*.

After sowing, all seed flats are covered with a thin layer of coarse sand. This helps prevent the seeds from splashing out in the rain. Responding to the local environ-

ment, seeds sown outdoors will germinate when soil temperatures are optimum for each species, which can vary from the cool and frosty temperatures of early spring to the heat of early summer. The generally good air circulation out of doors (as opposed to in a greenhouse) reduces or eliminates the incidence of damping off and other problems such as fungal gnats. Because some species can take a year or more to germinate, I am careful to keep the flats weeded. If rodents are a problem the flats can be covered with wire screen. Seedlings are potted, often several to a pot, when they start to crowd the seed flats. If there is an oversupply of a species, they can be successfully held in the flats until needed. While some of the species which are slow to germinate and grow, such as *Trillium*, may be artificially accelerated with hormones or tissue culture, this outdoor method is simple and free of pest and disease problems. For a busy propagator, this method has many advantages.

COMPOST-BASED POTTING SOIL

Many modern horticultural practices are polluting to the environment and wasteful of limited natural resources. This has a negative impact on biological diversity in wild ecosystems. Therefore, I sought alternatives to the nursery practices that I saw as unsustainable, i.e. the widespread use of peat moss which is an extremely slow-forming old-growth product and fossil-fuel bases fertilizers which are not renewable and can be polluting to manufacture.

As an experienced organic gardener, I know that most plants flourish when grown in compost and that healthy plants are often resistant to pests and diseases. As a primary ingredient in a potting soil, compost can replace both the peat moss as a source of organic matter and chemical fertilizer because it slowly releases nutrients to the plants. Compost also contains beneficial microorganisms which aid plant growth and help defend against harmful plant pathogens.

A commercially produced compost made from chicken manure, fruit refuse, and wood pulp that is hot composted to kill weed seeds and screened to make a uniform product is used. It has a pH of 6.5 which is ideal for many plants. To this mixture a small amount of vermiculite and perlite—to lighten the mixture—and varying amounts of sand—depending on the moisture and drainage needs of each species—is added. Coarse sand is very beneficial to many natives grown in pot culture, even when using a commercial potting mix. A typical mix is compost, vermiculite-perlite, and sand (1 : 1 : 1, by volume). When a more acidic mixture is needed rotted pine bark is added. When I am growing bog plants such as sundews and pitcher plants, I still use sphagnum peat moss, which has the correct pH and nutrient levels for these plants.

This composed-based mixture has worked well. Plants are healthy and strong from seedling to maturity, and pests and disease in the seed flats and potted plants have been negligible. It also is less expensive than the peat and fertilizer mixture we had previously been using.

CONCLUSION

I have been very satisfied with this low-tech system of wildflower production. Along with cheaply producing thousands of healthy plants and a clean environment, the nursery is a rich and diverse place for a variety of beneficial creatures, such as birds, insects, and earthworms. This makes nursery work an enjoyable outdoor experience. I think these practices could be successfully used by larger commercial nurseries.