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Propagation of Herbaceous Native Perennials

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INTRODUCTION

Herbaceous native perennials include wildflowers, grasses, sedges, and rushes. Most can be readily propagated from seed. Some exhibit complex seed dormancies and are more easily propagated vegetatively by root division or stem cuttings. This article will focus on propagation of wildflowers and grasses using seed, as this is a commonly used, but often misunderstood method of producing native herbaceous perennials. The methods described herein are based upon our forty-five years of experience at Prairie Nursery in propagating a wide range of native plants from seed.

SEED TREATMENTS WE USE TO OVERCOME SEED DORMANCY

Most native perennials require that their seed be pretreated to break dormancy prior to seeding. There are four basic types of seed treatments or planting methods that we use to overcome seed dormancy:

1. Dry stratification: Seed is exposed to freezing temperatures for 30 or more days.
2. Moist stratification: Seed is mixed with a damp inert substrate and stored in a refrigerated environment at 34–36°F (1–2°C). The seed should not be frozen, as this may damage the cell walls and destroy the seed.
3. Scarification: Seed with hard seed coats are scratched with sandpaper to allow moisture to penetrate the seed and initiate the germination process.
4. Hot water: Seeds that are stimulated to germinate by wildfires are treated with near-boiling water.

Dry stratification

Many native seeds require exposure to cold temperatures as a protective mechanism, so they do not germinate in fall and have their tiny seedlings killed over winter. The term “seed stratification” originated many years ago when wildflowers seeds were originally pretreated by planting them in layers of damp, clean sand, and refrigerating them to mimic the effects of winter. Many native seeds require exposure only to cold

temperatures without the addition of moisture to break dormancy. The process of treating seeds with cold temperatures to break dormancy is referred to as "dry stratification."

Most of the prairie grasses and many native prairie wildflowers require simple dry stratification. Seed can be dry stratified by placing it in a refrigerator or freezer for 30 to 90 days prior to seeding. Large quantities of seed can be stored in an unheated building over winter in rodent-proof metal containers.

Commonly grown native prairie wildflowers and grasses that require only dry stratification to break seed dormancy are found in Table 1.

Table 1. Commonly grown native prairie wildflowers and grasses that require only dry stratification to break seed dormancy.

Latin name	Common name	Time (days)
Wildflowers:		
Asclepias tuberosa	butterflyweed	30
Coreopsis lanceolata	lanceleaf coreopsis	30
Desmodium spp.	prairie tick trefoils	30
Echinacea purpurea	purple coneflower	30
Heliopsis spp.	ox eye sunflowers	30
Monarda spp.	bergamot, beebalm, etc.	30
Ratibida spp.	coneflowers	30
Rudbeckia spp.	black eyed susans	30
Solidago rigida	stiff goldenrod	30
Grasses:		
Andropogon spp.	bluestems	30
Bouteloua spp.	grama grasses	30
Elymus spp.	wild ryes	30
Koeleria macrantha	junegrass	30
Panicum virgatum	switchgrass	30
Sorghastrum nutans	indiangrass	30
Sporobolus heterolepis[1]	prairie dropseed	30

[1]**Note:** Prairie dropseed only germinates under cool temperatures in the field. It is best sown directly in early spring as soon as the soil can be worked, or in fall as a dormant seeding.

Moist stratification

Species that benefit from moist stratification

Many prairie flowers and most woodland wildflowers require moist stratification to break dormancy and yield high rates of germination. For example, shootingstar (*Dodecatheon meadia*) has a zero rate of germination when dry stratified, but after 30 days of moist stratification it will germinate at close to a 100% rate.

Different species require varying lengths of moist stratification to break dormancy. Lupine (*Lupinus perennis*) requires only 7 days. After 1 week of treatment, it often begins to germinate while still in the refrigerator. Members of the genus *Iris* require 90 days or more of moist stratification to yield good germination. Dormancy in most prairie wildflowers can be broken with 30 days with this treatment. Some prairie species that benefit from moist stratification of their seeds are shown in Table 2 (Figure 1 shows a few images of these plants).

Figure 1. Examples of plants requiring moist stratification for germination, top row: *Callirhoe involucrata*, *Camassia scilloides;* bottom row: *Eryngium yuccifolium, Ruellia humilis.*

Table 2. Species that benefit moist stratification[1,2].

Latin name	common name	Time (days)
Wildflowers		
Allium spp.	wild onions	30
Amorpha canescens (low shrub)	leadplant	30
Asclepias spp.	most milkweeds	30
Aster (*Symphyotrichum*) spp.	asters	30
Baptisia spp.	false indigos	90
Callirhoe spp.	poppy mallows	30
Camassia scilloides	wild hyacinth	30
Cassia hebecarpa	wild senna	30
Dodecatheon meadia	shootingstar	30
Echinacea pallida	pale purple coneflower	30
Eryngium yuccifolium	rattlesnake master	30
Eupatorium spp.	joe pye weeds, boneset	30
Helenium spp.	sneezeweeds	30
Helianthus spp.	sunflowers	30
Iris species	wild iris, blue flag	90 to 1 year
Lespedeza spp.	bushclovers	30
Liatris spp.	blazingstars	30
Lobelia spp.	cardinal flower, lobelias	30
Lupinus perennis	wild lupine	7
Parthenium integrifolium	wild quinine	30
Penstemon spp.	penstemons, beardtongues	30
Ruellia humilis	wild petunia	30
Silphium spp.	compassplant, prairie dock	30
Solidago spp.	most goldenrods	30
Tradescantia spp.	spiderworts	30
Verbena spp.	vervains	30
Vernonia spp.	ironweeds	30
Veronicastrum virginicum	culver's root	30
Zizia spp.	golden alexander species	30
Grasses, sedges, and rushes:		
Carex spp.	sedges	30
Calamagrostis canadensis	Canada bluejoint grass	30
Spartina pectinata	prairie cordgrass	90–150
Scirpus spp.	rushes, bulrushes	30

[1]**Note:** Many of the species listed above requiring moist stratification can be direct sown into flats and will germinate well in a greenhouse with regular mist or watering to maintain consistent soil moisture. Although nontreated seed will typically germinate at significantly lower rates, the seeding rate can be increased to ten seeds per plug to compensate for the lack of pretreatment. This increases seed costs, but saves significant labor and infrastructure required to carry out the moist stratification process.

[2]**Beware:** Some species and genera, such as shootingstar, spiderworts, false indigos, *Eryngiums*, and irises will not germinate without the requisite period of moist stratification pretreatment.

Seed can be moist stratified by mixing it with an equal or greater volume of slightly damp inert material. Oak and pine sawdust work admirably for this purpose. It is easy to work with, absorbs moisture and transfers it to the seed well. The relatively high acidity of the sawdust limits the growth of bacteria during the stratification process. Vermiculite, perlite, and peat most can also be used as the inert material.

The inert matter should be only lightly dampened prior to mixing with the seed. If water can be wrung out of the sawdust or peat moss by squeezing it, then it is too wet. Vermiculite and perlite should be moistened in a bowl or colander, so that excess water will drain off. Mix the seed and inert matter together thoroughly, place in a zip top plastic bag labeled with the species and date and place it in the refrigerator for the specified amount of time for the species being treated.

Another method of moist stratifying seed is to plant the seed directly into flats, cover them with plastic wrap to retain moisture in the soil, and store them in a refrigerator or walk-in cooler. If such facilities are not available, the flats can be seeded in fall and stored over winter in an unheated building or greenhouse. Make sure that the flats are protected from damage by mice and other animals during winter storage.

Timing of moist stratification pretreatment

The initiation of moist stratification should be timed so that the seed will be removed from the refrigerator at the appropriate time of year for optimal germination. Cool season plants can be started in a cool greenhouse in late winter or early spring. Warm season plants can be started once the air temperature reaches the high 70s or low 80s ^{o}F.

Scarification

Seeds with hard seed coats often require scarification, or scratching of the outer seed surface, to allow penetration of water into the seed itself to initiate the germination process. This can be accomplished by placing a single layer of seed in the bottom of a wooden box and rubbing it with sandpaper wrapped around a wooden block or sandpaper holder. Rub the seed with the sandpaper just hard enough to scratch the outer surface, being careful not to grind the seed into flour! Light pressure is usually sufficient to scarify all but the most resistant seeds.

Some genera, such as *Baptisia*, *Ceanothus*, and *Iris*, require scarification followed by moist stratification or a hot water treatment (Figure 2). Following scarification, the seed should be moist stratified as described in the directions above or treated with hot water (below).

Figure 2. *Baptisia australis* (left) and *Ceanothus americanus* (right) that require scarification.

Hot Water

A few species are known to benefit from treatment with hot water, which mimics the effect of a wildfire. Some seeds have dormancy mechanisms that require exposure to high temperatures, signaling that a fire has recently occurred and there will be open soil available for germination and growth of new seedlings. The prairie shrub, New Jersey tea (*Ceanothus americanus*) exhibits higher germination following exposure to hot water, followed by 30 days of moist stratification.

Place the scarified seed to be treated in a bowl. Heat water in a teakettle to boiling, then turn off the heat and allow the water to cool for a minute or two. Pour the hot water over the seed and allow it to cool to room temperature. Pour off the water, and the seed can be seeded directly, or in the case of New Jersey Tea, mixed with a damp inert material and moist stratified for 30 days prior to seeding.

Other growers have reportedly had good results using the hot water treatment with the genus *Baptisia*, followed by placing the seed in the freezer for a short period, until ice crystals begin to form on the wet seed (about 1 hr or less). One grower uses this treatment three times in succession (hot water followed by near freezing) to obtain higher rates of germination on this notoriously recalcitrant genus.

OTHER CONSIDERATIONS IN NATIVE SEED PROPAGATION

Fleshy fruited seeds

Many woodland wildflowers have fleshy pulp on the outside of their seeds. The pulp often possesses compounds that can prevent seed germination, and therefore must be removed prior to sowing. Collected when ripe, the flesh surrounding the seed is usually soft and can be easily removed. Wash the seed with water while rubbing the seed carefully across a screen with openings smaller than the seed (a ¼ in. screen works for most species). The flesh will go through the screen and the seeds will remain on top where they can be collected. If the flesh is hard, allow it to soften for a week or longer in a bucket, storing the seed in a cool, damp place until it softens. Woodland wildflowers with fleshy fruits are found in Table 3.

Table 3. Woodland wildflowers with fleshy fruit.

Latin name	Common name
Actaea spp.	red baneberry, white doll's eyes
Aralia spp.	spikenard, wild sarsaparilla
Arisaema spp.	jack in the pulpit, green dragon
Caulophyllum thalictroides	blue cohosh
Cornus canadensis	bunchberry
Hydrastis canadensis	goldenseal
Panax quinquefolium	ginseng
Polygonatum spp.	Solomon's seals
Smilacina spp.	Solomon's plume, starry Solomon's seal, Canada mayflower

Double-dormant seeds

Some species, especially members of the rose and lily families, exhibit a phenomenon known as "double dormancy." These seeds require exposure to two consecutive winters in the soil before they will germinate. Some species will "germinate" in the first year, but all of their development occurs underground, and no visible leaves are produced. The seedlings emerge in the spring after the second winter, almost 2 years after seeding.

The seeds of these species are typically sown fresh, directly in beds in the ground, or allowed to overwinter in flats, either in a cooler or in a greenhouse at ambient temperature. During the growing season, the flats are kept in a cool greenhouse or shade house. They are then allowed to experience a second winter in the flat, stored in a cooler over the winter or in an unheated greenhouse. The seed will then germinate the following spring.

Because this is such a lengthy process, many growers accelerate the process by seeding plug trays or flats and placing them in a cooler for 2–3 months, starting in early fall. The trays are then removed from the cooler in spring and placed in a warm location for 2–3 months, mimicking summer. Following this period, the flats are again stored in the cooler for 2–3 months, and then set out in the greenhouse to germinate. This process saves a full year.

Some of our best-known wildflowers produce seeds that are double-dormant (Table 4) (Figure 3).

Table 4. Species with double-dormant seeds.

Latin name	Common name
Allium tricoccum	wild leek
Caulophyllum thalictroides	blue cohosh
Polygonatum spp.	Solomon's seal
Rosa spp.	rose species
Smilacina species	Solomon's plume, starry Solomon's seal
Trillium grandiflorum	large flowered trillium
Uvularia grandiflora	bellwort

Figure 3. Double-dormant seed plants: *Polygonatum biflorum* (left) and *Trillium grandiflorum* (right).

Timing of seed sowing and pretreatment

Different species germinate in nature at different times of the year. Most summer-blooming prairie flowers and grasses are "warm season" plants and germinate best at temperatures near or above 80 °F (27 °C). The warm season prairie grasses are best seeded in mid to late spring or early summer, and not in fall. The exceptions include the cool season native grasses, which do best when seed in fall or early spring. Spring-blooming prairie and woodland flowers are "cool season" plants, and typically germinate in early spring at cool temperatures in the 60 and 70s °F (15 to 21 °C).

The following prairie grass genera germinate well at warm temperatures (Table 5).

Table 5. Prairie grasses that germinate well at warm temperatures.

Latin name	Common name
Andropogon spp.	bluestems
Bouteloua spp.	grama grasses
Elymus spp.	wild ryes
Panicum spp.	switchgrass, panic grasses
Schizachyrium scoparium	little bluestem
Sorghastrum nutans	indiangrass
Spartina spp.	cordgrass, saltgrass (after extended moist stratification)

Cool season grasses and sedges typically germinate best when sown in early to mid- spring when temperatures are cool. They can also be seeded in fall as a "dormant" seeding and will germinate the following spring when conditions are optimal. Prairie cordgrass, although a warm season grass, germinates best when sown in fall because it requires an extended period of moist stratification to break dormancy. The following prairie grasses germinate best at cool temperatures (Table 6).

Table 6. Prairie grasses and grass-like plants germinate best at cool temperatures.

Latin name	Common name
Calamagrostis canadensis	bluejoint grass
Carex spp.	sedge species (following 30 moist stratification)
Koeleria macrantha	junegrass
Hierochloe odorata	vanilla sweet grass
Sporobolus heterolepis	prairie dropseed

Planting freshly collected seed

Certain wildflowers of both prairies and woodlands germinate well when their seeds are sown fresh, immediately after collecting in summer. This is particularly true of woodland wildflowers that possess *elaiosomes*, a fleshy, strap-like appendage that is attached to the exterior of the seed. Rich in lipids and proteins, elaiosomes attract ants, which harvest the seeds and take them back to their nests. After the ants have consumed the elaiosomes, they take the seed to their waste disposal sites and "plant" them in this nutrient rich environment. This symbiotic relationship benefits both parties and has been observed in several different species of ants and plants.

In some cases, the seeds may enter a state of "deep dormancy" if allowed to dry out, in which it becomes resistant to germination. Once a seed has entered deep dormancy, it typically requires exposure to cool, moist conditions for an extended period to induce germination. Planting the seed fresh, immediately after harvest, is recommended

for the following species and genera of woodland wildflowers (Table 7).

Table 7. Planting the seed fresh, immediately after harvest, is recommended for the following species and genera of woodland wildflowers.

Latin name	Common name
Asarum canadense	wild ginger
Caulophyllum thalictroides	blue cohosh
Hydrastis canadensis	goldenseal
Jeffersonia diphylla	twinleaf
Sanguinaria canadensis	bloodroot
Trillium spp.	trilliums

Some other species that do not possess elaiosomes but generally benefit from seeding immediately after collection include the following (Table 8).

Table 8. Other species that generally benefit from seeding immediately after collection.

Latin name	Common name
Actaea spp.	red baneberry, white doll's eyes
Claytonia virginiana	spring beauty
Hepatica spp.	hepaticas
Mertensia virginiana	Virginia bluebells
Tiarella cordifolia	foamflower
Uvularia grandiflora	bellwort (double dormant)

When planted fresh in summer when they ripen, these seeds generally will not germinate until the following spring, or the second spring if they are double dormant. Planting the seed immediately after collection prevents it from drying out and allows the process of internal "after-ripening" to proceed under conditions similar to those in nature. The seeds can be sown directly into the ground or into flats. Keep the seeded flats in a cool shade house and avoid exposure to high temperatures and dry conditions during the summer. In fall, move the flats to a secure, unheated building or cooler that is protected from rodents that might damage the flats. Bring them out into the greenhouse in late winter or early spring to initiate the germination process.

General rule of thumb for seeding woodland wildflowers: When in doubt, plant the seed fresh and allow it to experience the natural seasonal cycles.

Spring blooming prairie flowers

Certain spring-blooming prairie flowers will often germinate in late summer or early fall when their seed is planted immediately after being collected in summer. The seedlings will develop in fall, in preparation for their most active growth period early the following spring. Species and genera whose seed will often germinate shortly after sowing in summer include the following (Table 9) (Figure 4 shows some examples).

Table 9. Spring-blooming prairie flowers that germinate in late summer or early fall when their seed is planted immediately.

Latin name	Common name
Anemone patens	pasque flower
Delphinium spp.	larkspurs
Geum triflorum	prairie smoke
Lupinus perennis	lupine
Ranunculus spp.	buttercups
Tradescantia spp.	spiderworts
Viola spp.	birdsfoot violet, prairie violet, etc.

Figure 4. Spring-blooming prairie flowers that germinate in late summer or early fall, from left to right: *Geum triflorum, Tradescantia ohiensis, Viola pedata.*

PROPAGATION BY CUTTINGS AND ROOT DIVISIONS

Some native species are extremely slow growing from seed, or seed is rarely available. For instance, producing plants of the genus *Dodecatheon* (shootingstars) requires up to 5 years, as members of this genus are only active for a few months in spring. Their growth rates are painfully slow, making propagation by seed both expensive and time-consuming. However, members of this genus are easily propagated by root divisions, which can be dug and divided either in early fall (they go dormant in mid-summer) or in very early spring before these spring ephemerals initiate new growth. Once they begin to emerge, they should not be disturbed, since they are very sensitive to root damage when actively growing.

Members of the genus *Phlox* and *Viola* have exploding seed pods that make seed collection challenging, to say the least. To make matters worse, most members of these two genera are indeterminate, and bloom over a period of time so only a few seeds come ripe at any given time. Seed collection is laborious and costly.

Seeds of some native species are not reliably available in the marketplace, making propagation by cuttings the only method. Others, especially members of the Lily Family with double dormant seeds, can be readily propagated by dividing their rhizomes or corms, rather than performing multiple cold and warm seed pre-treatments. Most of our native *Liliaceae* are also slow growing from seed, making divisions a faster and more economical method of production. The following species are commonly propagated by taking cuttings (Table 10).

Table 10. Cutting propagated species.

Latin name	Common name	Notes
Coreopsis rosea	rose coreopsis	
Fragaria virginiana	wild strawberry	Runners root readily
Phlox spp.	phloxes	
Salvia azurea	blue sage	
Sedum ternatum	wild stonecrop	
Solidago caesia	blue stemmed goldenrod	
Solidago odora	anise scented goldenrod	

Some species are easily and most economically propagated by division of roots, rhizomes, bulbs, or scales (Table 11) (Figure 5.).

Table 11. Species economically propagated by division of roots, rhizomes, bulbs, or scales.

Latin name	**Common name**
Arctostaphylos uva-ursi	bearberry
Asarum canadense	wild ginger
Carex pensylvanica	Pennsylvania sedge
Dicentra cucullaria	dutchman's breeches
Dodecatheon spp.	shootingstars
Erythronium americanum	trout lily
Ferns (although some growers propagate ferns using spores)	
Hepatica spp.	hepaticas
Iris spp. dormancy results in poor germination	irises: difficult from seed
Polygonatum spp.	Solomon's seal
Podophyllum peltatum	mayapple
Smilacina spp.	Solomon's plumes, Canada mayflower
Trilliums spp.	trilliums (some divide better than others)
Uvularia grandiflora	bellwort
Viola spp.	violets

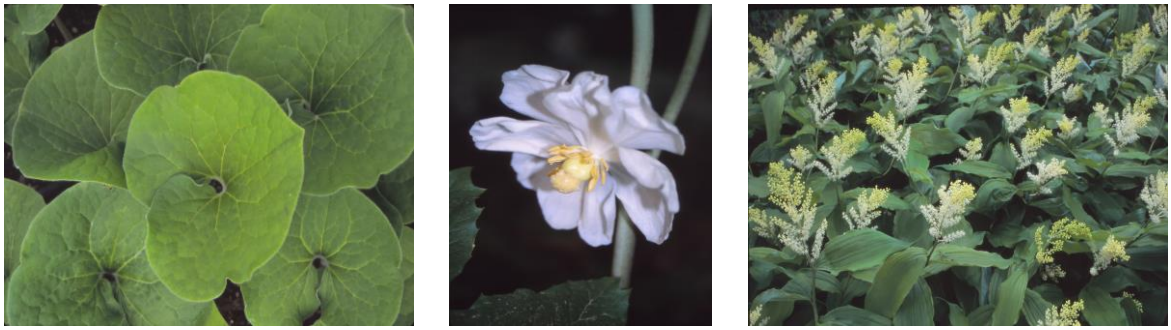

Figure 5. Examples of species propagated by division from left to right: *Asarum canadense, Podophyllum peltatum, Smilacina racemosa.*

SUMMARY

By following these procedures and using quality seed from a reliable supplier, the mysteries of propagation of native species from seed can be unraveled. With a little experience, reliable results can be achieved in growing our beautiful native wildflowers and grasses for fun and profit!