



Germination of Perennial Seed

Key Factors in Perennial Germination

Moisture Management

Moisture management is the single most important factor in germination and plug production. The goal for moisture management during germination is to provide enough water to allow germination without over saturating media.

Proper moisture will vary with the crop and the stage of the crop

Grow dry in stage 1: <i>Alcea</i> <i>Asclepias tuberosa</i> <i>Centaurea</i> <i>Echinacea</i> <i>Echinops</i> <i>Gaillardia</i> <i>Hibiscus</i> <i>Lunaria</i> <i>Lupinus</i>	Grow wet in stage 1: <i>Alchemilla</i> <i>Asclepias incarnata</i> <i>Astilbe</i> <i>Hypericum</i> <i>Lobelia</i> <i>Saxifraga</i> <i>Sempervivum</i>
Grow dry in stage 2+: <i>Achillea</i> (except <i>A. ptarmica</i>) <i>Anchusa</i> <i>Arenaria</i> <i>Catananche</i> <i>Coreopsis</i> <i>Euphorbia</i> <i>Iberis</i> <i>Scabiosa</i>	Grow wet in stage 2+: <i>Aquilegia</i> <i>Bergenia</i> <i>Campanula</i> <i>Cymbalaria</i> <i>Heuchera</i> <i>Limonium</i> <i>Myosotis</i> <i>Physalis</i> <i>Polemonium</i> <i>Primula</i> <i>Sagina</i>

Water quality

Water quality is important, but there is no single “perfect” set of conditions.

- Test over time to monitor changes
- Know how *your water* reacts with *your media* over time

We acidify with phosphoric and sulphuric acid, to control pH and alkalinity

- pH ~ 6.0
- alkalinity ~ 60-70 ppm
- Phosphorous ~ 5-10 ppm (keep P < 10-15 ppm to prevent stretch)
- Test before and after injection, to make sure injector works consistently

Temperature

General temperature requirements

- “Cool” (60-65° F): Delphiniums, violas, etc. – cool chamber germination
- “Bench” (70-75° F): bulk of crops – bench germination in greenhouse
- “Warm” (75-80° F): a few warm loving crops – warm chamber germination

Bottom heat is best, as media temperature is what matters for germination. Remember the temperature effect on evapotranspiration and on the relative humidity

- The less we have to water, the less likely it is that we will be tempted to over- or under-water
- Shading and/or fog are valuable tools to help control temperature and moisture loss

Light

Some perennials need light to germinate, others need dark, and some are not affected. In general, for items requiring light, do not cover seed. A heavy cover or dark germination chamber is sufficient to block light for items which require darkness to germinate.

Light beneficial or required for germination

Aconitum heterophyllum
Astilbe chinensis
*Campanula punctata, ramosissima, rapunculoides**
Campanula takesimana
Chelone glabra
*Clematis connata, grata**
Clematis verticillata
Clematis virginiana
Gaultheria trichophylla
Gentiana saponaria
Geum coccineum
*Hypericum perforatum**
Iris milesii, pseudoacorus, sibirica, spuria, tectorum
Lamium maculatum
Lobelia cardinalis, siphilitica
Macleaya cordata
Meconopsis aculeate
Monarda fistulosa
Nepeta cataria
Oenothera biennis
Penstemon digitalis, frutescens, hirsutus, smallii
Physalis alkekengi, virginiana
*Primula pamirica, warshenewskiana**
Ranunculus repen
*Sedum pulchellum**
Tiarella cordifolia, wherryi
Tricyrtis affinis, dilitata

* = Light beneficial, but not required, for germination.

Dark required or beneficial for germination

Convallaria majalalis
Cyclamen
Myosotis
Primula sinensis

Increasing Plant Stands

Tray patching

Raker sells trays with a guaranteed plant count. To meet these counts, trays are patched from “oversow” trays – extras sown for use in patching. We use a 10 to 100% oversow for perennials (average 25%). Hand patching is done 2-3 weeks before shipping, robotic patching is done 1-2 weeks after sowing.

Oversow vs. seeds per cell

For crops which don’t germinate well, there are two options: increase oversow and do more patching, or increase the number of seeds per cell. In deciding which tactic to use, consider:

- Cost of the seed
- How easy it is to patch the item
- Typical germination percentage of the item
- Whether having multiple seedlings per plug is desirable

Enhanced Perennial Seed

A number of companies now offer enhanced perennial seed. Products range from mechanically cleaned seed, to pelleting and film coating, to proprietary (and secret) treatments.

Defuzzing / detailing

Removing wings and other structures from seed, to make it easier to sow.

Example: *Gaillardia x grandiflora*

Film coating

A thin, colored layer is applied to seed to make it easier to sow mechanically, and easier to see in the tray, which helps ensure good sowing accuracy. Chemicals like fungicides can be incorporated into the film coat.

Example: *Dianthus deltoids*, *Scabiosa caucasica*

Pelleting

Coating small seed with clay and other material to increase the size for easier handling and mechanical sowing. Sometimes multiple seeds (2-5 or more) are put into each pellet, for items that are typically multiple sown. Chemicals like fungicides can be incorporated into the pellet.

Example: *Heuchera*, *Campanula carpatica*

“Secret Sauces”

Proprietary treatments, which may involve priming, scarification, etc. May be multi-step processes. Examples: Benary’s ApeX seed, Jelitto’s Gold Nugget seed.

Seed Treatments

Disinfection

Some diseases can be transferred via seed. In most cases, this is from the seed coat being contaminated with pathogens. Surface disinfection can help reduce disease pressure, but may not eliminate the need for fungicide applications.

A 10% bleach solution (10-30 minute soak) or ZeroTol treatment can be effective in surface sterilization.

Crops which may benefit from disinfection include:

- *Leucanthemum*
- *Lupine*
- *Iberis*

Note that S&G offers *Safecoat* Lupine seed in Europe, a fungicide-containing film coat. The fungicide used in the treatment is not approved for this use in the USA currently, however, so it is not available in the US.

Scarification

Some perennials have very hard seed coats, which prevent water uptake and thereby delay germination. Physically or chemically breaking down a hard seed coat allows seed to take up moisture. Nicking, sanding, or filing the seed coat works for small amounts of seed.

Acid scarification (5-30 minutes with Sulfuric acid) can be used to treat larger amounts of seed. Always be very careful when using acid, and dispose of used acid properly and safely.

Crops which may benefit from scarification include:

- *Baptisia*
- *Hibiscus*
- *Lathyrus*
- *Lupine*
- *Malva*
- *Sidalcea*
- *Thermopsis*

Priming, hormone treatment, etc.

A wide range of priming and hormone treatments can be used. Priming is a process of allowing seed to take up moisture to a certain point, by using an osmotic solution (a solution with salts or other chemical additives which affects seeds' ability to take up water). Plant hormones such as GA are sometimes included in the priming treatment.

A disadvantage to treatments like priming that moisten the seed is seed must be dried before it can be sown mechanically.

Summer Production

Crops that do best in shaded areas (30-50% shade) during summer production (high temperatures, high light)

<i>Alchemilla</i>	<i>Hypericum</i>
<i>Anemone sylvestris</i>	<i>Lobelia</i>
<i>Aquilegia</i>	<i>Papaver</i>
<i>Astilbe</i>	<i>Primula</i>
<i>Bergenia</i>	<i>Pulsatilla</i>
<i>Bellis</i>	<i>Sagina</i>
<i>Campanula</i>	<i>Saxifraga</i>
<i>Doronicum</i>	<i>Sidalcea</i>
<i>Heuchera</i>	<i>Thalictrum</i>

The Basics of Growing Perennials from Seed

Attention to Detail (ATD) is key

Pay attention to all the little things – they add up to big problems if you don't

Seed storage

General environment: 40-45° F, 40-50% RH

- Some species store well, but it can be variable
- All seed lots will decline in vigor over time
- Hard to predict performance after storage 6 + months

Media & tray filling

Poor filling and watering practices can lead to compaction and poor oxygen supply, especially in small plug cells, regardless of the media used!

Critical media characteristics:

- Consistency from batch to batch
- pH 5.5-6.0 throughout crop (most perennials)
- At proper moisture when trays are filled (moist enough to hold together loosely when squeezed, but not saturated)
- Trays are filled consistently, every time

Consistency in media and tray filling is essential

- Especially challenging for trays with small cell volume (288, 338, etc.)
- Need uniform media from batch to batch, tray to tray, and within a tray
- Use “softer” tray fill (lighter compaction) for items which are covered

Media should be moist enough to just hold a dibble at sowing

- Don’t fill trays > 1 day ahead of time (store them in a cool place if you need to fill trays early)

Sowing

No matter how high-tech your seeder, it is no better than the operator. Seed placement is important for good stands and high useable seedling counts. Growers can use multiple seeds per cell (2 to 5) to improve tray fill and useable seedling counts

Covering

We use 50:50 media with fine vermiculite – easier for our growers to read moisture vs. straight vermiculite. Most crops are not covered, and primarily large seeded items are covered. Some crops get a light cover, or are covered after radicle emergence

Watering in

Best to use a watering tunnel for consistency and control

Moisten media, but don’t saturate or leach (especially if you have a starter charge in the medium)

Tips for difficult to germinate items

Research the plant’s native habitat for clues, and review the literature for suggestions. Remember that seed dormancy evolved to benefit a species. Consider trying in-house treatments, but *always* test in-house treatments on multiple seed lots, and don’t forget to have a control!

“Frost germinators”: plants which require cold temperature period to germinate

- General strategy: 2-3+ weeks at warm temperatures, then then 4-6+ weeks at cold temperatures (38-41° F). May need to repeat the process for perennials with double dormancy
- Fresh seed may germinate better

“Fresh germinators”: species with short storage life, generally < 6 months (see list below)

- For some species, using “frost germinator” strategy will help germinate older seed
- Best bet is to use fresh seed – may want to collect it yourself from mother plants grown for seed production

Stages of plug production

In each Stage, cultural requirements change – with increasing stage, there are higher need for light and feed and plugs are better able to tolerate fluctuations in water (can allow to dry down)

- **Stage 0:** Everything that leads up to germination, including tray filling and seed storage. ATD starts here
- **Stage 1:** Classic Definition - From sowing until radicle emergence. Production Definition - Is broader than the classic definition because we are evaluating a group of seeds
- **Stage 2:** Radicle emergence until the first true leaf develops. The primary goal in this stage is getting the radicle into the medium, to develop a good root system
- **Stage 3:** From the first true leaf until product is shippable size
- **Stage 4:** A toning stage prior to shipping or holding plugs to toughen the plant. Stage 4 is usually 7 days, but can be longer for perennials

Growth regulators

Used as a last resort – primary height control through cultural methods

- DIF, water management, “lean” fertilizer program, etc.
- B-Nine (2,500-5,000 ppm) and Sumagic (10-15 ppm) are effective over a wide range of species of perennials
- Not all perennials respond to growth regulators

Fertilizer

Our media has a small starter charge. Most perennials are not heavy feeders, use 100-200 ppm N as needed. Consider total levels of nutrients being applied, including what is in irrigation water. Limiting phosphorous in irrigation water (10-15 ppm maximum) helps control stretch.

Crops which benefit from extra feed for best quality

<i>Anchusa</i>	<i>Linum</i>
<i>Aquilegia alpina, flabellate</i>	<i>Lobelia</i>
<i>Arabis</i>	<i>Myosotis</i>
<i>Astilbe</i>	<i>Nierembergia</i>
<i>Aurinia</i>	<i>Papaver</i>
<i>Campanula carpatica</i>	<i>Primula</i> (seasonal)
<i>Cerastium</i>	<i>Rosmarinus</i>
<i>Doronicum</i>	<i>Salvia x sylvestris</i>
<i>Ornamental grasses</i>	<i>Saxifraga</i>
<i>Heuchera</i>	<i>Sempervivum</i>
<i>Hypericum</i>	<i>Veronica subsessilis</i>
<i>Iberis</i>	
<i>Lavandula</i> (seasonal)	
<i>Leucanthemum</i> (seasonal)	

Temperature

Crops preferring warm growing on temperatures (70-75 F)

Astilbe
Bergenia
Campanula
Coreeopsis
Doronicum
Heuchera
Lobelia
Rudbeckia
Saxifraga
Thalictrum

Crops preferring cool growing on temperatures (60-65 F)

<i>Anemone sylvestris</i>	<i>Oenothera</i>
<i>Arenaria</i>	<i>Papaver</i>
<i>Armeria</i>	<i>Primula</i>
<i>Alstroemeria</i>	<i>Pulsatilla</i>
<i>Coronilla</i>	<i>Sidalcea</i>
<i>Centranthus</i>	<i>Saponaria</i>
<i>Delphinium</i>	<i>Sempervivum</i>
<i>Iberis</i>	<i>Viola</i>
<i>Lavandula</i>	

Pest control

Remember: IPM is not “count the bugs on the card, then spray”

Thrips

- Number 1 pest for us
- Primary problem is vectoring viral diseases like TSWV/INSV – many perennials are hosts
- Strongly consider screening as a preventative measure
- Weed control is critical

Disease problem crops

The following perennials commonly exhibit disease problems in plug production, particularly if temperature, light, and/or fertility levels are not optimal. Preventative fungicide drenches may be helpful in preventing problems

Achillea

Anchusa

Arabis

Arenaria montana

Aubrieta

Aurinia saxatile

Campanula glomerata

Campanula medium

Centaurea

Cerastium

Delphinium

Echinacea

Erysimum

Gypsophila

Iberis sempervirens

Linum

Lupinus

Myosotis

Papaver

Platycodon

Rudbeckia triloba

Salvia x sylvestris

Saponaria

Verbascum



Perennial "Fresh Germinators"

The following perennials germinate best when fresh seed (stored less than 6 months) is used. Some, noted with a *, do not tolerate storage, and are best sown *immediately* after harvest. For some species, cold stratification may be helpful in germinating seed which has been stored.

*Aconitum**

*Adonis vernalis**

Anemone biflora, blanda, caucasica, nemorosa, obtusiloba, polyanthes, ranunculoides, tetonensis

Anemonella

*Anemonopsis**

Asarum canadensis

*Astrantia**

Aureolaria virginica

Bulbocodium vernum

Callianthemum

Caltha palustris

Campanula alliarifolia, altaica

Cardiocrinum giganteum

Caryopteris incana

Chelidonium majus

Chionodoxa lucilia

Claytonia virginica

Clematis

Corydalis lutea

Corydalis nobilis

Dicentra spectabilis

Eryngium alpinum

*Helleborus**

Isopyrum thalictroides

Paeonia

Primula rosea

Thalictrum

Tiarella

Viola odorata

Grasses

Helictotrichon sempervirens