Key to Success for Germinating Perennial Seed

by Allen R. Pyle

Perennials can be much more challenging to produce from seed than annuals. Even small mistakes in production can cause large problems when growing seedlings, particularly perennials. Attention to detail (ATD) throughout production is critical for consistent success growing perennials from seed.

Characteristics of perennial seed

Though the perennial market as a whole is growing steadily, sales of any single perennial species or cultivar are limited compared to annuals. For this reason, perennial seed production is generally both smaller scale and much less refined than annual seed production. Problems with low vigor, poor germination, and weedy or trashy seed are not uncommon in perennials. In addition, there can be surprisingly large differences in performance among seed lots of a given perennial, even from the same supplier.

Although some perennials are easy to grow from seed, others are notoriously difficult to germinate. Seed dormancy is a common problem and has multiple mechanisms, which are not fully understood. In addition, seed of some perennial species (the "fresh germinators") is short lived, and cannot be stored long, if at all (see Table 1.)

Seed storage

Don't neglect ATD when storing perennial seed. Even under the best storage conditions, seed vigor declines over time. Germination and vigor of improperly stored seed can decline quickly, particularly with poor quality seed lots. Ideal seed storage conditions are 40-45º F and 40-50% relative humidity, in sealed containers. Minimizing the length of time seed is out of cool storage when not being sown prevents excessive moisture uptake by the seeds and helps preserve storage life. Though seed of many perennials stores well, it is difficult to predict how a seed lot will perform after being stored for 6 months or more.

Growing medium

There are a number of good commercial plug media available, but there is no one perfect medium for all growers. Choosing the right media depends on your production system, growing style, and water quality. The most critical factor in a good plug medium is consistency from batch to batch. Test your medium to make sure it is consistent in composition, pH, EC, and nutrient charge. Unless the medium you use is consistent, it is impossible to know how its properties (pH, EC, etc.) will react over time, and production problems will be likely.

Whether or not your medium has a nutrient starter charge affects how early you need to begin a liquid feeding program. A small starter charge can help seedlings get off to a good start and satisfy early nutrient needs. However, when using a medium with a starter charge, growers must take extra care to prevent leaching. Overwatering plug trays can easily leach out the nutrients in a starter charge before plants have a chance to take them up.

For most perennial plugs, pH should generally range from 5.5-6.0 throughout production. The lime in most peat-based media will generally bring the pH to 5.3-5.8 within a week of sowing.

Tray filling

An often overlooked key to success in germinating perennials is tray filling. Although it seems easy, achieving consistency in tray filling – both within a given tray and across a batch of trays – is challenging. One result of poorly filled trays is overcompaction, which can lead to reduced germination and increased losses from disease. Unevenly filled trays also hold water non-uniformly, which can cause irregular or erratic germination.

Proper tray filling is a combination of using media at the proper moisture level (moist but not saturated) and evenly packing the correct amount into the trays. Filling equipment must be set up properly for the size of plug tray being filled. Plug trays with a smaller cell volume (200+ cells per tray) are more difficult to fill consistently than larger volume trays.

Do not allow filled trays to overly dry out before sowing. If filled trays will be stored more than a day before sowing, put them in a cooler or a cool place, to slow down water loss.

Water

Although quality water is important in successful perennial plug production, as with media there is no single ideal water for all growers, and no single strategy that can produce the "perfect" water. Because every grower has different water quality, they key factor is understanding how your water reacts in your system over time, and making the necessary adjustments to keep parameters in an acceptable range. Raker's well water has moderate to high pH and alkalinity, and we use both sulfuric and phosphoric acid to bring the pH to 6.0 and alkalinity to 60-70 ppm.

Remember that acid injection to control pH and alkalinity adds nutrients to the irrigation water (typically sulfur or phosphorous, depending on the type of acid used). These nutrients must be considered when designing a fertility program for perennial plugs.

Regular water testing allows growers to plan for and understand seasonal changes in their water. Test water at least twice a year (summer and winter) to monitor changes in water quality. If injecting acid into the irrigation water, test at least once a week to ensure that the injector is working properly.

Sowing

Accuracy in sowing is critical for good germination and good useable seedling stands. Trays are usually dibbled before sowing, to create a depression in the media and help guide the seed to the center of the plug cells. Placing seed into the centers of cells is important, because roots do not develop well when seeds germinate at the edges of plug cells.

Proper seed placement depends on close monitoring and ATD by the seeder operator. Because of the wide range of sizes and shapes in perennial seeds, adjusting a seeder to properly pick up and place the right number of seeds in a cell takes quite a bit of work. Proper staffing of a sowing line and training of a sowing crew pays off with improved sowing accuracy.

Because perennial seed is gerneally inexpensive, sowing multiple seeds per cell (typically 2-5, depending on tray size and perennial species) can help improve tray fill and overcome germination and vigor problems.

Keeping records of which seed lot is sown in a given tray and which supplier provided that lot can be helpful in diagnosing production problems. Raker's production software tracks seed lot information for each tray, linking it to the unique barcode of every tray. If a germination problem occurs, other trays sown with the same seed lot can be checked, to help determine whether the problem is cultural or seed lot related. When you identify a seed lot which has low vigor or germination, it may be less frustrating and cheaper to simply discard the lot and purchase a new one, rather than try to overcome the problems with a poor seed lot.

Covering

Covering seed after sowing can be helpful in perennial germination. Seed is covered to exclude light, help prevent seed from drying out too quickly, and improve uniformity of water uptake. It also can help to direct emerging roots to grow into the medium and help minimize initial stretch after germination (hypocotyl stretch).

Raker's generally covers large seeded perennials, using a 50:50 blend of our plug media and fine vermiculite. Compared to using coarse vermiculite, our growers find moisture management during germination easier with this blend.

Germination

Germinating perennials can be frustrating and difficult, especially in year-round production. There is a mystique surrounding some of the more difficult perennials, and the best ways to germinate them. Consistency in germination moisture and temperature are two important key factors.

Moisture management is the primary factor involved in seed germination. The goal is to provide sufficient water for seeds to germinate without oversaturating the media. Either too much or too little water can reduce germination, and overwatering is a more common problem than underwatering. Applying too much water to germinating seeds reduces the oxygen levels in the media, which slows root growth, stresses plants, and promotes disease. Applying less water more frequently is a better strategy than keeping the media saturated.

Temperature management is a second key factor in perennial germination. Because media temperature regulates germination, bottom heat is the most efficient way to heat germinating perennials. When germinated under non-optimal temperatures, perennials may germinate poorly, irregularly, and/or slowly. However, the result can be seed lot dependent. High vigor seed lots may germinate acceptably at non-optimal temperatures, but less-vigorous lots may not germinate well out of the optimal range.

Rakers' uses three basic strategies for germinating perennials: bench germination in the greenhouse at 70-75° F, cool germination in a dark environmental chamber at 60-65° F, and warm germination in a lighted environmental chamber at 80-85° F. See Table 2 for specific temperature recommendations for germinating specific perennials.

Difficult to germinate perennials

Certain perennials are notoriously difficult to germinate, and seed dormancy is a common problem. Remember that dormancy is a survival mechanism which evolved to help plant populations survive in the wild, so dormancy is beneficial to a perennial species.

The first step to germinating a "problem perennial" is to do some library research to determine the plant's place of origin, native climate and habitat, and season of bloom. These factors can provide good clues about the plant's germination needs. Review the available literature to see if anyone else has worked with the plant or a similar species, and note what temperatures and seed treatments they used. If you trial your own seed treatments, always test them on multiple seed lots, and don't forget to include control (untreated) seed in your trial, so you have something to compare the treatments too.

Cold stratification and scarification are two common seed treatments used to break dormancy in troublesome perennials. Perennials which need cold stratification are typically referred to as "frost germinators." Cold stratification is the process of using a cool, moist period to overcome dormancy. The traditional method for cold stratifying perennial seed is to sow in the fall and overwinter flats outdoors or in cold frames.

For off-season stratification, sown trays can be grown warm (65 to 70º F) for 2 to 4 weeks and then moved into a cold chamber 4 to 6 weeks (or more) of cold temperatures (38 to 41° F or less). Sometimes a second warm/cold period is needed to overcome dormancy, and some species (notably those in the Buttercup family, Ranunculaceae) require temperatures closer to freezing during the chilling period.

Scarification is using a chemical or mechanical process to break down hard seed coats, so germination can begin. For small lots of seed, nicking or filing off a portion of the seed coat is effective, but slow. Larger amounts of seed are usually scarified with sulfuric acid or with mechanical abrasion – for instance in a rock tumbler.

Seed of some perennials dies very quickly in storage, and shelf life may be 6 months or less. These "fresh germinator" perennials should be sown as soon as possible after harvest. Harvesting your own seed from mother plants and sowing immediately may be the easiest way to grow these perennials from seed. For some species, cold stratification may be helpful in germinating seed which has been stored, but this is not always effective.

Table 1: Perennial "Fresh Germinators"

Plant	Common name
*Aconitum**	Monkshood
*Adonis vernalis**	Spring Adonis
Anemone spp.	Windflower
Anemonella	Rue-Anemone
*Anemonopsis**	False Anemone
Asarum canadense	Canadian Ginger
*Astrantia**	Masterwort
Baptisia	False Indigo
Caltha palustris	Marsh Marigold
Campanula alliarifolia	Spurred Bellflower
Cardiocrinum giganteum	Giant Lily
Caryopteris incana	Common Bluebeard
Claytonia virginica	Spring Beauty
Clematis spp.	Clematis
Corydalis spp.	Corydalis
Dicentra spectabilis	Bleeding Heart
Eryngium alpinum	Alpine Sea Holly
Helictotrichon sempervirens	Oat Grass
*Helleborus**	Hellebore
Paeonia	Peony
Primula rosea	Primrose
Thalictrum	Meadow Rue
Tiarella	Foamflower
Viola odorata	Sweet Violet

* = Perennial which does not tolerate storage, and is best sown immediately after harvest.

Table 2: Perennial Germination Requirements

Genus	Common name	WTF#	Cover	Germ Temp (°F)
Achillea	Yarrow	8	No	70-75
Alcea (Althea) *	Hollyhock	4	Yes	70-75
Alchemilla	Lady's Mantle	10	No	70-75
Aquilegia	Columbine	9	Yes	70-75
Arabis	Rock Cress	8	Yes	70-75
Armeria	Thrift	10	Yes †	60-65
Asclepias	Milkweed	9	No	70-75
Aster	Aster	8	No	70-75
Astilbe	Spirea	10-11	Yes	70-75
Aubrieta	False Rockcress	8	Yes	70-75
Aurinia (Alyssum)	Perennial Madwort	8	No	70-75
Baptisia *	False Indigo	9	Yes †	60-65
Bellis	English Daisy	7	No	70-75
Bergenia	Heartleaf	10	No	70-75
Buddleia	Butterfly Bush	10	No	70-75
Campanula *	Bellflower	9-11	No	70-75
Catananche	Cupid's Dart	9	No	70-75
Centaurea *	Cornflower	8	Yes	70-75
Centranthus	Valerian	8	No	60-65
Cerastium	Snow-in-Summer	8	No	70-75
Coreopsis *	Tickseed	9	No	80-85
Coronilla *	Crown Vetch	7	Yes †	60-65
Delphinium *	Delphinium	8	Yes	60-65
Dianthus	Pinks	8	No	70-75
Digitalis *	Foxglove	8	No	70-75
Doronicum	Leopard's Bane	8	Yes	80-85
Echinacea	Coneflower	8	Yes	70-75
Echinops	Globe Thistle	8	Yes	70-75
Euphorbia *	Spurge	8	Yes	70-75
Gaillardia	Blanket Flower	8	Yes	70-75
Geum	Avens	10	No	70-75
Gypsophila	Baby's Breath	8	No	70-75
Helenium	Helen's Flower	8-11	No	70-75
Helianthemum	Rock Rose	9	No	70-75
Heliopsis	Sunflower Heliopsis	9	No	70-75
Heuchera	Coral Bells	11	Yes	70-75
Hibiscus	Rose Mallow	5	Yes †	70-75
Iberis	Candytuft	8	Yes †	60-65
Kniphofia	Torch Lily	10	Yes	70-75
Lathyrus	Sweet Pea	8	Yes †	70-75
Lavandula	Lavender	11	Yes †	60-65
Leontopodium	Edelweiss	10	No	70-75
Leucanthemum	Shasta Daisy	8	No	70-75

Genus	Common name	WTF#	Cover	Germ Temp (°F)
Liatris *	Blazing Star	10	No	70-75
Limonium	Statice	10	No	70-75
Lupinus	Lupine	5	Yes	70-75
Lychnis	Campion	8	No	70-75
Monarda	Bee Balm	8	No	70-75
Myosotis	Forget-me-not	7	No	70-75
Nepeta	Catmint	7	No	70-75
Oenothera	Primrose	9	Yes †	60-65
Papaver alpinum	Alpine Poppy	10	Yes †	60-65
Papaver nudicaule	Icelandinc Poppy	10	Yes †	60-65
Papaver orientale	Oriental Poppy	10	Yes †	70-75
Penstemon barbatus	Beard Tongue	7	No	70-75
Physostegia	Obedient Plant	9	No	70-75
Platycodon	Balloon Flower	8	No	70-75
Polemonium	Jacob's Ladder	9	No	70-75
Potentilla	Cinquefoil	8	No	70-75
Primula *	Primrose	10-12	Yes †	60-65
Pulsatilla *	Windflower	12	Yes †	60-65
Rudbeckia fulgida	Orange Coneflower	9	No	80-85
Sagina	Pearlwort	7	No	70-75
Salvia x superba	Sage	9	No	70-75
Santolina	Lavender Cotton	10	No	70-75
Saxifraga x arendsii	Saxifrage	11	Yes	80-85
Scabiosa *	Pincushion Flower	6	Yes	70-75
Sedum	Stonecrop	9	No	70-75
Sidalcea	Prairie Mallow	8	Yes †	60-65
Silene	Campion	8	No	70-75
Stachys	Lamb's Ears	6	No	70-75
Stokesia	Stokes Aster	8	Yes †	70-75
Tanacetum	Painted Daisy	8-9	No	70-75
Teucrium	Germander	11	No	70-75
Thalictrum	Meadow Rue	10	Yes †	70-75
Veronica	Speedwell	7	No	70-75
Viola	Violet	7	Yes	60-65

† = a light media cover added after germination
* = some species or cultivars commonly have poor germination and/or seedling vigor
# = weeks to finish (WTF) for 128 cell plug

Allen R. Pyle (*pyleman@perennialguru.com*) is Research Team Leader for C. Raker & Sons, Inc. (*www.raker.com)*. He holds a bachelor's degree in Horticulture and a master's degree in Entomology, both from Michigan State University. He is also certified in Permaculture Design