PERENNIALS

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Perennials have become increasingly popular with gardeners over the past few years.

Perennials have become increasingly popular with gardeners over the past few years. Perennials have the image of being carefree plants. That is, plant them now and they'll take care of themselves. While this isn't exactly the case, many gardeners find perennials useful in their gardens to add diversity in shape and foliage, as well as for their adaptability to conditions. Perennials, as their name implies, last for several years when planted. Some species, such as Delphinium, Columbine and Lupine, will last a few years, while others, such as Daylily, Peony and Bleeding Heart, can last for decades (Beattie and German).

Perennials can also add to a garden with a wide range of blooming times from Primrose in the early spring to mums and Asters in the late fall. In a similar way, perennials can provide for a long sales period for the grower/retailer. With some effort on the growers part to provide plants in the early spring and to maintain them throughout the summer and fall, consumers are asking for plants throughout the growing season to help spread out their work load and expense. In order for the grower/retailer to keep this later season market alive, they need only maintain healthy plants. This may require repotting the plants, providing insect and disease control, watering and fertilizing. While the effort may seem like a lot at first, remember that this may well be a somewhat slower time of year for growers, and by maintaining healthy, vigorous and often larger plants, growers may very likely be able to get a bigger price for these same plants.

Many growers who have been producing perennials have seen some changes over the years.

Many growers who have been producing perennials have seen some changes over the years. Production has moved largely from the field to containers, or large producers are shipping bare root stock to smaller growers who then pot up the plant material for sale. The production practices seem to be moving to a faster crop in order to keep up with the increasing demand. Many of the annual flowering perennials, those that don't require a cooling treatment to flower, are started in plug trays and then grown on with other bedding plants. In many cases the cultural requirements are similar.

Cold temperatures have an effect on two important processes in the life of a perennial plant, germination and flowering.

One of the biggest hold ups in further expansion of perennial production is the lack of information available for growers. There are different requirements for many of the plant species in respect to propagation, flower initiation and growing conditions. This can be further complicated by the fact that plants can vary in these requirements from species to species, cultivar to cultivar and even by seed lot. The effects of light and temperature on different growth phases of these plants are of particular interest.

Cold Temperature Effects

Cold temperatures have an effect on two important processes in the life of a perennial plant, germination and flowering. In terms of germination, cold temperatures generally come into play in the process known as stratification. Stratification involves exposing seed to a cold treatment in a moist environment. This is usually done by imbibing the seed and layering the seed in moist paper towel or moist, sterile sand and then providing a cooling treatment. This cooling is generally around 38°F and can last from several days to several months. Seeds from different species react differently to stratification (Table 1) and some species may not react at all.

Table 1. *Hardy herbaceous perennials where stratification improves seed germination. Reprinted from "Bedding Plants III".*

Species	Stratification Time
Aconitum casmichaelii	undetermined
Aquilegia species	3 weeks
Clematis species	3 weeks - 3 months
Dicentra spectabilis	6 weeks
Dictamnus albus	4-6 weeks
Dodecatheon meadia	undetermined
Gentiana acaulis	undetermined
Helleboris niger	3-6 weeks
Hemerocallis species	6 weeks
Iris kaempferi	6 weeks
Phlox paniculata	3-4 weeks

Stratification allows for imbalances of growth promoters and inhibitors to be overcome so that seed will be able to germinate over a wider range of temperatures. As mentioned, the most effective temperature for stratification is about 38°F. Temperatures below 32°F or above 50°F are ineffective for this process. Also, in order for the seed to perceive the stratification, it must be imbibed. This means that the seed must have been soaked to take up water. Stratification is not effective if the seeds are just left in the water because oxygen must also be present.

There is a point of diminishing returns with stratification, a point beyond which additional cooling time is of no more benefit. This time period is species dependent.

Vernalization is the response of a plant to cold temperatures that will induce the plant to flower. This will generally occur when a plant reaches a certain stage of development. This may be a particular age or size for a given plant. Vernalization generally occurs at temperatures of about 35-40°F.

Following vernalization many plants then need to receive a particular photoperiod in order for them to flower. If the inductive photoperiod is not given soon after the cold treatment the plant may be devernalized and will not perceive the photoperiod and therefore will not bloom. If this is the case, then the plant will have to be vernalized again in order for it to bloom.

Table 2. *Selected photoperiodic responses for flowering herbaceous perennials and biennials grown as ornamentals. (Information based on material from Vince-Prue (1975) and Salisbury (1978).) Reprinted from "Bedding Plants III".*

Short-Day Plants

1. Plants must have short days
   Chrysanthemum x *morifolium* (Chrysanthemum)
2. Plant flowers faster in short days
   Chrysanthemum x *morifolium* (Chrysanthemum)
3. Short-day response accelerated after low temperature vernalization
   Chrysanthemum x *morifolium* (Most garden chrysanthemums)

Long-Day Plants

4. Plants must have long days
   Chrysanthemum maximum (Shasta Daisy)
   Phlox paniculata (Summer Phlox)
   Rudbeckia hirta (Black-eyed Susan)
   Sedum telephium (Stone crop)
   Sedum spectabile (Stone crop)
5. Long-day response accelerated after low temperature vernalization
   Dianthus caesius (Cheddar Pink)
   Oenothera spp. (Evening Primrose)
   Aquilegia x *hybrida* (Columbine)
   Aurinia saxitilis (Basket-of-Gold)
6. Long-day at low temperature, day neutral at high temperature
   Delphinium x *cultorum* (Larkspur)
   Rudbeckia bicolor (Coneflower)
7. Flowering speeded up by long-days
   Dianthus barbatus (Sweetwilliam)
   Dianthus caryophyllus (Carnation)
8. Flowering speeded up by exposure to long days following low temperature vernalization
   Campanula persicifolia (Peach-leaf bellflower)
   Dianthus caryophyllus (Carnation)
   Dianthus barbatus (Sweetwilliam)
   Digitallis purpurea (Foxglove)
   Lupinus x 'Russell Hybrid' (Lupine)
   Lychnis coronaria (Rose campion)
9. Flowering speeded up at high temperature, no effect at low temperature
   Centaurea cyanus (Cornflower)
10. Short-long-day plant; low temperature substitutes for the SD effect and responds as long-day plant after low temperature exposure
   Campanula medium (Canterbury bells)

Stratification allows for imbalances of growth promoters and inhibitors to be overcome so that seed will be able to germinate over a wider range of temperatures.

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Flower initiation can also occur before the cold treatment in which case it is considered a direct effect initiation. In this case the floral meristem is released from dormancy and allowed to develop as a direct result of the cold temperatures. This type of initiation is common in very early flowering plants.

The other type of initiation can be during the cold treatment. While this is not common, it does occur. The plants need to be returned to warmer temperatures for flower development to occur. Again temperatures of about 35-40°F are required by these plants.

The time that plants are receptive to their cold treatment, whether before, during or after flower initiation, is species dependent.

The time that plants are receptive to their cold treatment, whether before, during or after flower initiation, is species dependent. *Campanula medium* plants need to be about 4 months old (Wallensiek 1960), Columbine needs to have 12-15 fully expanded leaves (Shedron 1980), Shasta daisy should be about 3 months old and Lupines need to be 6 months old (Shedron 1980) for the treatment to be perceived. By knowing the age or size at which a plant perceives the cold treatment, growers can control plant size and flower initiation.

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Photoperiod

Photoperiod can have a great effect on perennial plant growth. As mentioned, many plants need to be vernalized, but that vernalization is negated if the plants don't receive the proper photoperiod following the cold treatment.

Photoperiod is truly a measure of the dark period that a plant needs to initiate flower. So while we talk about day-length, we are really meaning dark period.

Some plants require as little as a single cycle through the appropriate photoperiod, while other plants will require weeks or months of long- or short-days. Another "complication" of photoperiod is that some plants require one photoperiod for flower initiation and another for flower development. These plants are called dual daylength plants. The there are those plants that are not affected by day length, these plants are day neutral. They will flower no matter what day length they are exposed to.

To further confuse the issue of photoperiod, there are plants that respond to the photoperiod on a qualitative level or a quantitative level. In some cases photoperiod response can also be modified by temperature. Some photoperiod responses are shown in Table 2.

Photoperiod is one place where seed populations of the same plant can vary greatly. Differences have been reported in several species ranging from no need for vernalization and varying photoperiods to 3 months of chilling and a short day treatment. There is also variation in the age if the seedlings with some showing very little flowering with vernalization and photoperiod control at a young age, and greater flowering with less treatment with older seedlings.

There can also be differences in morphological characteristics depending on the chilling and photoperiod treatments that are given to the plant.

Perennial Production

The demand for new and different perennials is increasing all the time, this is demanding that growers devise new information for growing these plants and also for growing the plants in containers.

As previously mentioned, the production of perennials seems to be moving from field grown plants to container production. This runs from producing plugs and distributing these to smaller growers, all the way to producing large nursery containers sold as flowering plants. Some growers have taken to producing perennials as flowering plants for Mother's Day sales. While this is not a wide spread practice, it is an area that seems to have a lot of potential. The demand for new and different perennials is increasing all the time, this is demanding that growers devise new information for growing these plants and also for growing the plants in containers.

Growing any plant needs to start with the propagation of the material, perennials are no different.

Propagation

Perennials are generally propagated in one of four ways, by seed, by cuttings, either stem or root, by division or by tissue culture.

Perennials are generally propagated in one of four ways, by seed, by cuttings, either stem or root, by division or by tissue culture. While there are advantages to each type, the method used is often dependent on what works for the plant, what works for the grower and how much time there is to produce the plant. Different methods for propagating some perennials are shown in Table 3.

In general, seed propagation is still considered the most economical and often the

Table 3. *Propagation methods for herbaceous perennials. Reprinted from "Bedding Plants III".*

Name	Seed	Stem Cuttings	Root Cuttings	Division	Tissue Culture
Achillea spp. (Yarrow)		x		x	
Aconitum spp. (Monkshood)			x		
Aegopodium podagraria (Goutweed)				x	
Ajuga spp. (Bugleweed)		x		x	
Alcea rosea (Hollyhock)	x				
Anemone pulsatilla (Windflower)	x				
Anemone x *hybrida* (Japanese Anemone)			x	x	
Anthemis tinctoria (Golden Marguerite)	x	x		x	
Aquilegia spp. (Columbine)	x				
Arabis spp. (Rock-Cress)	x	x			
Armeria spp. (Sea Pink)	x	x		x	
Artemisia spp. (Artemisia)		x		x	
Asarum Europeum (Ginger)				x	
Asclepias tuberosa (Butterfly Weed)	x		x		
Asperula odorata (Woodruft)		x		x	
Aster spp. (Hardy Aster)	x			x	
Astilbe x *arendsii* (Astilbe)	x			x	
Aubrietia deltoides (False Rock-Cress)	x				
Aurinia spp. (Alyssum)	x	x			
Bellis perennis (English Daisy)	x				
Bergenia cordifolia (Bergenia)	x		x	x	x
Brunnera macrophylla (Dwarf Anchusa)		x	x		
Campanula medium (Canterbury Bells)	x				
Campanula carpatica (Harebells)	x				
Catanache caerulea (Cupid's Dart)	x		x		
Centaurea spp. (Cornflower)	x		x		
Cerastium tomentosum (Snow-In-Summer)	x	x		x	
Ceratostigma plumbaginoides (Plumbago)		x		x	
Cheiranthus spp. (Wallflower)	x				
Chrysanthemum coccineum (Painted Daisy)	x			x	
Chrysanthemum x *morifolium* (Hardy Chrysanthemum)				x	
Chrysanthemum x *superbum* (Shasta Daisy)	x			x	
Convallaria majalis (Lily-of-the-Valley)				x	
Coreopsis spp. (Coreopsis)	x			x	
Delphinium spp. (Larkspur)	x	x			
Dianthus spp. (Pinks)	x	x		x	
Dianthus barbatus (Sweet William)	x				
Dicentra spp. (Bleeding Heart)		x		x	x
Dictamnus albus (Gas Plant)	x				
Digitalis purpurea (Foxglove)	x				
Dodecatheon spp. (Shooting Star)	x				
Doronicum spp. (Doronicum)	x			x	
Echinacea purpurea (Purple Coneflower)	x			x	
Echinops exaltatus (Globe Thistle)	x		x	x	
Erigeron spp. (Fleabane)	x	x		x	
Eryngium spp. (Sea Holly)			x		
Euphorbia spp. (Spurge)	x	x			x
Filipendula spp. (Filipendula)	x		x	x	
Gaillardia x *grandiflora* (Blanket Flower)	x		x		
Gentiana spp. (Gentian)	x				
Geranium spp. (Crane's bill)		x	x	x	
Geum spp. (Geum)	x			x	
Gypsophila spp. (Baby's Breath)	x	x			x
Helenium spp. (Helen's Flower)				x	
Helianthemum spp. (Sun Rose)		x			
Heliopsis spp. (Heliopsis)				x	
Helleborus spp. (Hellebore)	x			x	

Table 3 continued.

Hemerocallis (Daylily)	x			x	x
Heuchera spp. (Coral Bells)	x	x		x	
Hibiscus moscheutos (Hardy Hibiscus)	x			x	
Hosta spp. (Plantain-Lily)	x			x	x
Iberis spp. (Candytuft)	x	x			
Incarvillea (Hardy Gloxinia)	x				
Inula spp. (Elecampane)	x			x	
Iris spp. (Iris)				x	
Kniphofia uvaria (Red-Hot-Poker)	x			x	
Lamium maculatum (Dead Nettle)		x		x	
Lavandula angustifolia (Lavender)	x	x		x	
Liatris spp. (Blazing Star)	x			x	
Limonium spp. (Hardy Statice)	x				
Linum perenne (Flax)	x	x			
Lobelia spp. (Cardinal Flower)	x			x	
Lunaria annua (Moneyplant)	x				
Lupinus spp. (Lupine)	x	x			
Lychnis spp. (Maltese Cross)	x			x	
Lysimachia spp. (Circle Flower)	x	x			
Lythrum salicaria (Purple Loosestrife)		x			x
Matricaria spp. (Feverfew)	x	x		x	
Mentha spp. (Mint)		x		x	
Mertensia virginica (Bluebells)	x		x	x	
Monarda didyma (Beebalm)	x	x		x	
Myosotis spp. (Forget-Me-Not)		x		x	
Nepeta cataria (Catmint)		x		x	
Nepeta mussini (Catnip)		x			
Oenothera spp. (Evening Primrose)	x				
Pachysandra terminalis (Pachysandra)		x			
Paeonia (Peony)				x	
Papaver orientale (Oriental Poppy)			x		
Penstemon spp. (Beardtongue)		x		x	
Phlox paniculata (Summer Phlox)		x	x	x	
Phlox subulata (Creeping Phlox)		x		x	x
Physostegia virginiana (False Dragonhead)		x		x	
Platycodon grandiflorus (Balloon Flower)	x	x			
Polemonium coeruleum (Jacob's Ladder)	x			x	
Polygonum cuspidatum (Mexican Bamboo)			x		
Potentilla spp. (Cinquefoil)	x			x	
Rudbeckia spp. (Coneflower)	x		x	x	
Salvia spp. (Sage)	x			x	
Santolina spp. (Santolina)		x			
Saponaria ocymoides (Soapwart)	x	x		x	
Saxifraga spp. (Saxifrage)				x	
Scabiosa caucasica (Pincushion Flower)	x			x	
Sedum spp. (Stonecrop)	x	x		x	
Sempervivum spp. (Hens and Chicks)				x	
Solidago spp. (Goldenrod)		x			
Stachys lanata (Lamb's Ear)				x	
Stokesia laevis (Stokes Aster)	x		x		
Teucrium chamaedrys (Germander)		x		x	
Thalictrum aquilegifolium (Meadowrue)	x	x		x	
Thymus spp. (Thyme)		x		x	
Tradescantia x *andersoniana* (Spiderwort)				x	
Trollius spp. (Globe Flower)	x				
Verbascum spp. (Mullein)			x		
Veronica spp. (Speedwell)	x	x		x	
Viola spp. (Violet)	x			x	

simplest method of getting new perennial plant material. Consideration needs to be given to what the seed will require in order to germinate. Stratification has been discussed as one treatment that may be necessary for seed to germinate. Other treatments may include scarification, or nicking the seed coat to allow water and/or oxygen to the embryo for germination. This can be done mechanically with a file or by using concentrated acid to eat away the seed coat. Care needs to be taken with each method that the embryo or seed food source is not injured. If injury occurs germination can be greatly affected (Nau).

Chilling of the seed may also be necessary (Nau). While similar to stratification, chilling just means allowing the seed to have a cold treatment while still in the seed packet. The moisture is not necessary at this stage in order for the treatment to be perceived.

Another form of treatment for germination is called frost or freeze germination. Some seeds require the freezing and thawing of nature in order for the germination to occur. In this case it is best for the seeds to be planted in some germination media in a wooden flat and covered with plastic. The seed is allowed to imbibed water on a greenhouse bench for several days at 50-60°F and then placed outdoors in a cold frame, or other protected location, out of the sun in mid- to late-December. If possible, insulate the flats with snow for protection. Following a few months of typical freeze and thaw temperature, the flats are brought into the greenhouse in March and allowed to warm gradually to avoid damage to the seed (Nau).

Seed of annual flowering perennials, or those that don't require a chilling treatment to flower, are generally sown in late winter and are sold in the spring and summer, with them flowering that summer. These plants are generally sold in 3 to 4 inch pots. For plants that require a chilling treatment to flower, seed is generally sown in late spring through mid summer. The plants are grown out and then overwintered in a protected structure. This way the plants will be ready to flower the following spring and early summer.

In all cases of seed germination, good conditions are needed to get the best possible germination percentage. For larger growers, germinating a lot of seed, germination chambers or rooms may be the best way to go. For smaller growers, trying to fit seed germination into the right environment may be a problem. If this is the case, it may be more economical to buy in perennial plugs and grow them on from there. In any event, try to provide germination conditions for the seed that is as near as possible to the native germination conditions of the plant. This includes both temperature and light conditions. Be sure to use sterile media for germination and consider a fungi-

Table 4. *Improved perennial seed germination is often obtained if these conditions are provided. Reprinted from "Bedding Plants III".*

Germinate in Light

Achillea spp.
Aquilegia spp.
Arabis spp.
Campanula spp.
Coreopsis grandiflora
Doronicum cordatum

Germinate at higher temperatures (75°F +)

Anenome spp.
Asclepias tuberosa
Aster alpinus
Coreopsis spp.
Doronicum spp.
Ranunculus spp.
Statice spp.

Germinate in Dark

Centaurea cyanus
Delphinium spp.
Phlox spp.
Saponaria ocymoides

Germinate at Cool Temperatures (55-60°F)

Adonis spp.
Asperula odorata
Aurinia montana
Aubrietia deltoidea
Dictamnus albus
Delphinium spp.
Erigeron spp.
Iberis sempervireus
Linium spp.
Lupinus spp.
Leontopodium spp.
Papaver spp.

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cide application to the seed before sowing. This may be beneficial since often times perennial seeds are in the germination chamber for a long period. Recommendations for light and temperature requirements for some perennials are found in Table 4.

Tissue culture has become a popular propagation method for plants that are difficult to propagate.

Tissue culture has become a popular propagation method for plants that are difficult to propagate. It can be very effective in helping to eliminate disease problems from plant materials that can spread disease from seed or cuttings or divisions. The biggest concern with tissue culture propagation at the present time is that of cost of facilities and training of propagators. Currently only large operations are able to afford this means of propagation.

In the case of perennials, cuttings are often used when the plants don't come true from seeds, where the seed set is poor or inconsistent or where other propagation methods aren't economical.

Cutting propagation is not uncommon to many growers today. Poinsettias, New Guinea impatiens, mums and many geraniums are all grown from cuttings. In the case of perennials, cuttings are often used when the plants don't come true from seeds, where the seed set is poor or inconsistent or where other propagation methods aren't economical (Beattie and German). Both stem and root cuttings are used, depending upon the species being propagated. Rooting hormones are often used on stem cuttings, especially if the cuttings are from older plant tissue. Generally hormones are not necessary on root cuttings.

The final method of propagation is division. Plant division is much more common among home gardeners and is not widely used commercially. Division is used commercially when other methods of propagation are not effective. One case of this is Astilbe. Astilbe sets seed well, but the seed does not come true in planting. Cuttings are not economically practical, and tissue culture techniques have apparently not been developed. This makes crown divisions of the plant the practical method of propagation. This also makes Astilbe one of the more expensive perennials on the market.

Production Factors

Media

When evaluating factors for production of perennials one of the first considerations is media.

When evaluating factors for production of perennials one of the first considerations is media. Many growers like to maintain a mix with some soil in it. This adds weight to the mix and also may reduce the amount of irrigation and fertilization that needs to be done. Many growers are having success using a soilless mix and with attention to irrigation and fertilization the results can be very successful. The main thing to consider when selecting or mixing a media is drainage for the plants. Most perennials don't like to have wet roots, and in fact root and crown rot can be a big problem for these plants.

Table 5. *pH preferences of selected herbaceous perennials (Adapted from Spurway, 1941). Reprinted from "Bedding Plants III".*

Botanical Name	Common Name	Optimum pH Range
Aconitum napellus	Aconite	5.0-6.0
Adonis vernalis	Adonis	6.0-8.0
Aethionema coridifolium	Persian Candytuft	5.5-7.0
Alyssum saxitile	Goldentuft	5.5-6.5
Anemone japonica	Japanese Anemone	6.0-8.0
Anemone pulsatilla	Anemone	5.0-6.5
Anthemis tinctoria	Yellow Camomile	6.0-8.0
Aquilegia caerulea	Colorado Columbine	6.0-7.0
Aquilegia canadensis	Eastern Columbine	5.5-7.0
Aquilegia chrysantha	Golden Columbine	6.0-7.0
Aquilegia flabellata	Japanese Columbine	5.5-6.5
Asclepias tuberosa	Butterfly Weed	5.0-6.5
Asperula odorata	Sweet Woodruff	4.0-8.0
Aster alpinus	Alpine Aster	5.5-7.0
Aster novae-angliae	New England Aster	6.0-8.0

Table 5 continued.

Aster novi-belgii	New York Aster	5.0-7.5
Astilbe x *arendsi*	False Spirea	6.0-7.5
Aubrietia deltoidea	Aubrietia	6.0-7.5
Brunnera myosolidiflora	Anchusa	6.0-7.5
Campanula medium	Canterbury Bells	6.0-7.5
Centaurea cyanus	Cornflower	6.0-6.5
Centaurea montana	Mountain Bluet	6.0-7.5
Cheiranthus Cherii	Wallfower	6.0-8.0
Chelone glabra	Turtlehead	5.0-6.0
Clematis crispa	Curly Clematis	5.5-6.5
Clematis Jackmani	Clematis	5.5-7.0
Clematis paniculata	Virgin's Bower Clematis	6.0-7.0
Coreopsis verticillata	Threadleaf Tickseed	5.0-6.0
Delphinium grandiflorum	Delphinium	6.0-7.5
Dianthus caryophyllus	Carnation	6.0-7.5
Dianthus deltoides	Maiden Pink	6.5-7.5
Dicentra eximia	Fringed Bleeding Heart	5.0-6.0
Dicentra spectabilis	Old Fashioned Bleeding Heart	6.0-7.5
Echinacea purpurea	Purple Cone Flower	5.0-7.5
Festuca ovina	Sheep's Fescue	4.5-6.0
Gentiana mackinoi	Royal Blue Gentian	3.4-3.7
Geum chiloense	Avens	6.0-7.5
Gypsophila paniculata	Baby's Breath	6.0-7.5
Gypsophila repens	Gypsophila	6.0-8.0
Helleborus niger	Hellebore	6.0-8.0
Hemerocallis fulva	Tawny Daylily	6.0-8.0
Hosta plantaginea	Plantain Lily	6.0-7.5
Iberis sempervirens	Perennial Candy tuft	5.5-7.0
Iris germanica	German Iris	6.5-7.5
Iris Kaempferi	Japanese Iris	5.5-6.5
Iris pumila	Dwarf Iris	5.5-6.5
Leontopodium alpinum	Edelweiss	6.5-7.5
Liatris scariosa	Blazing Star	5.0-6.0
Lobelia cardinalis	Cardinal Flower	5.0-6.0
Lobelia syphilitica	Great Blue Lobelia	6.0-8.0
Lupinus polyphyllus	Lupine	6.5-7.5
Lychnis chalcedonica	Maltese Cross	6.0-7.5
Miscanthis sinensis	Maiden Grass	6.0-7.0
Monarda didyma	Bee Balm	6.0-7.5
Papaver orientale	Oriental Poppy	6.0-7.5
Phlox divaricata	Wild Sweet William	5.0-6.5
Phlox paniculata	Summer Perennial Phlox	6.0-8.0
Phlox subulata	Moss Pink	6.0-8.0
Platycodon grandiflorum	Balloon Flower	5.0-6.0
Primula auricula	Primrose	6.0-8.0
Primula polyantha	Primrose	5.5-7.0
Primula vulgaris	English Primrose	5.5-6.5
Rudbeckia hirta	Black-eyed Susan	5.5-7.0
Sanguinaria canadensis	Bloodroot	5.0-6.5
Sempervivum tectrum	Hen-and-Chicks	6.0-8.0
Veronica rupestris	Speedwell	5.5-7.5
Veronica spicata	Speedwell	5.0-6.0
Viola cornuta	Horned Violet	5.5-7.5
Viola odorata	Sweet Violet	6.0-7.5

As perennials become established in their containers, it is important to maintain good growing temperatures, especially going into the fall and winter seasons.

When selecting a media also consider pH. While growers try to maintain a general "standard" pH in their growing area, perennials can required quite a varied pH range (Table 5). If necessary, modify media pH with lime or sulfur, or by acidifying your water source. By maintaining the appropriate pH levels you can greatly increase the quality of the plants you produce.

Temperatures

As perennials become established in their containers, it is important to maintain good growing temperatures, especially going into the fall and winter seasons. Keep the night temperatures as close to 50°F as possible to help develop a good root system. As the time gets closer to be overwintering the plants, gradually lower the temperatures into the low 30's to help harden the plants (Beattie and German). Maintain these temperatures until the plants go into their winter storage, and watch for winter heat up on sunny days.

Watering

As with any growing practice, common sense is the key to watering perennials. Be sure that the plants are kept well watered, but not waterlogged. As the plants are moving closer to the winter season be sure to cut back on the amount of water that they get. Perennials should be slightly moist, not wet when going into their dormant season. As the weather starts to warm up and the plants begin to grow, increase the amount of water that is applied, and consider starting to fertilize to promote good spring growth.

The major insect problems that are seen on perennials are aphids, whitefly and spider mites.

Insects and Diseases

The major insect problems that are seen on perennials are aphids, whitefly and spider mites. This is not surprising since these are also the major problems see on many of their crops. Be sure to maintain good insect control throughout the growing season to produce healthy plants. But be especially sure that the plants are clean going into overwintering. This is also true with disease problems. Crown rot and root rot seem to be the biggest disease problem. Be sure to treat plants before overwintering to make sure that the problems aren't increased while the plants are dormant. Healthy plants going into the winter is the biggest key in their survival rate.

Healthy plants are a key to successful overwintering of perennials.

Overwintering

Many growers choose to overwinter perennials, whether it is stock that they are bringing into bloom for the following spring, or if it is extra stock from the current growing season. Overwintering perennials is a task that requires some extra time and effort to make sure you will be successful. Many growers use a greenhouse for overwintering. They may turn off the heat and use the structure as a large cold frame, or retain a minimal amount of heat for insulation. Generally if the plants are in good condition, they will survive with no supplemental heating. Many types of perennials will have a better survival rate if they are mulched over winter. There are mulching blankets available for this, or you can use other plant material such as evergreens or straw. With the mulch material, make sure it is clean so that disease or weed problems aren't introduced in the spring.

Healthy plants are a key to successful overwintering of perennials. Plants need to have a vigorous root system and be free of insects and diseases going into winter. More success is achieved if growers don't try to overwinter plants that are less hardy. Table 6 gives a list of some perennials that are difficult to overwinter.

Be sure to consider pest control over the winter months. This doesn't mean insect problems, but rather rodent and deer problems. Many growers have success using rodent bait to keep the small pests out. With

Table 6. *Herbaceous perennial taxa considered difficult to overwinter in containers. Reprinted from "Bedding Plants III".*

Anethionema
Anenome
Asclepias
Artemisia
Brunnera
Delphinium
Digitalis
Epimedium
Erigeron
Erysimum (Chieranthus)
Gaillardia
Geum chiloense
Helianthemum
Heliopsis
Lavandula
Lobelia
Lupinus
Papaver
Phlox subulata
Tritoma

deer, try to have the area enclosed. The main point here is try to see what will work in a particular growing area.

Perennials can be a challenging and rewarding growing experience. While the information on growing these plants is sometimes limited, success can be achieved by using good growing practices and communicating with other growers.

Perennials can be a challenging and rewarding growing experience.

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