HERBACEOUS PERENNIAL PRODUCTION IN ALABAMA GREENHOUSES

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Growing consumer demand for herbaceous garden perennials has encouraged more greenhouse growers to consider these crops as part of their production program. However, for growers accustomed to producing annuals, perennials present a whole new set of production challenges. Unlike annuals, herbaceous perennials growing outdoors die to the ground and go dormant in the fall (except a few evergreen species) and then over-winter as fleshy roots or rhizomes. The shoot portion of the plant then grows again each spring producing vegetative structures followed by flowers and seed. Because of this lifestyle, many perennial species have developed strategies for determining what time of year to grow, when to flower, when to go dormant and when seed should germinate. Unlike annuals that flower over a long period, most perennials also have a limited season of bloom ranging from two to six weeks. Perennials may be classified as spring, summer or fall bloomers.

A further complication for growers is that there are thousands of species and cultivars of perennials native to widely different environments from all over the world. As a consequence, cultural requirements and time of flower varies tremendously. This diversity makes perennials appealing to customers, but makes managing production difficult. Growers desiring to force perennials in containers for the spring market must therefore understand and manipulate factors controlling growth and flowering to meet market timing.

Life Cycle

Like most higher plants, herbaceous perennials germinate from seed, experience a juvenile period, become reproductive, produce seed and eventually die (Figure 1, page 30). However, several points in the live cycle are of interest to growers because they may be obstacles to production or they can be manipulated to control crop scheduling. For example, seed of many species exhibit some type of seed dormancy that may require scarification to overcome hard seediness or stratification to satisfy a low-temperature requirement before rapid, uniform germination can occur. Young plants of many perennial species must also reach a certain minimum stage or size (based on number of leaves) before they attain the ability to initiate flower buds (Table 1, page 30). This period of vegetative growth is referred to as juvenility. Once juvenility is completed, many perennials do not automatically flower but require a period of cold (vernalization) and/or a specific day length to initiate flower buds. Many named perennial cultivars that are vegetatively propagated also exhibit a kind of juvenility because rooted cuttings must also reach a minimum stage or size before they attain the ability to flowers.

In the fall, most perennials enter a vegetative dormancy to protect the plant from harsh winter conditions. In many species, this is triggered by the onset of short day lengths. A cold period is often then required to satisfy dormancy. Most species require a minimum of six to eight weeks at 40 degrees F in a cooler or eight to 12 weeks in a minimum heated greenhouse (>35 degrees F, <45 degrees F), enough heat to keep temperatures just above freezing. Perennials may also be overwintered in containers outdoors as long as they are protected from freezing by covering with some type of thermoblanket such as microfoam. Watering during cold treatment, especially in a cooler, is fairly critical, do not allow plants to dry out or to remain too wet for long periods. Cold treatment is beneficial to most species, even those that do not, strictly speaking, require cold to flower. Cold treatment often reduces time to emergence, increased plant uniformity, reduces time to flower and allow plants time to develop a larger crown to fill large containers.

In some species, typically late spring and summer blooming species, the cold period must be followed by long day lengths for flower buds to initiate. These plants can be flowered earlier by providing night-break lighting using incandescent lights designed to provide 10 to 20 footcandles. Apply the lighting as a four hour night break from 10:00 PM to 2:00 AM. Perennials that do not require long days are not adversely affected by night-break lights, although stem length may be longer. Night-break lighting can be discontinued once natural day lengths exceed 13 hours. The exact requirements for flowering all herbaceous perennials are not known but many are listed in Table 2 (page 32).

Propagation

The main methods for propagation of perennials are by seeds, divisions or stem cuttings. Seed is widely used for true species and a few cultivars that come true from seed. However, most of the improved cultivars must be propagated by asexual methods. Many perennial seeds can be germinated easily, but careful attention must be given to the importance of obtaining fresh seed, the conditions necessary to satisfy dormancy (if any) and providing the correct germination environment. Seeds of many perennial species germinate readily if the seed is collected fresh and sown immediately. If seed storage is necessary, store seed at 40 to 45 degrees F and 40 to 50% relative humidity in sealed containers.

Seeds of many perennial species do not require pre-germination treatment, but some germinate more rapidly and uniformly when provided stratification or scarification. Stratification is accomplished by sowing seed in moist sand or seedling mix and placing them in a refrigerator at 35° to 40° F for four to six weeks. Scarification is a process of cutting or abrasion of the seed coat or soaking seed in hot water (170 degrees to 210 degrees F) to allow rapid absorption of water during germination. Seed are frequently sown in plug trays similar to annuals. Germination of perennial seed occurs most rapidly and uniformly under warm (60 degrees to 75 degrees F), humid conditions. High humidity can be provided using intermittent fine mist or covering with a pane of glass

Figure 1:

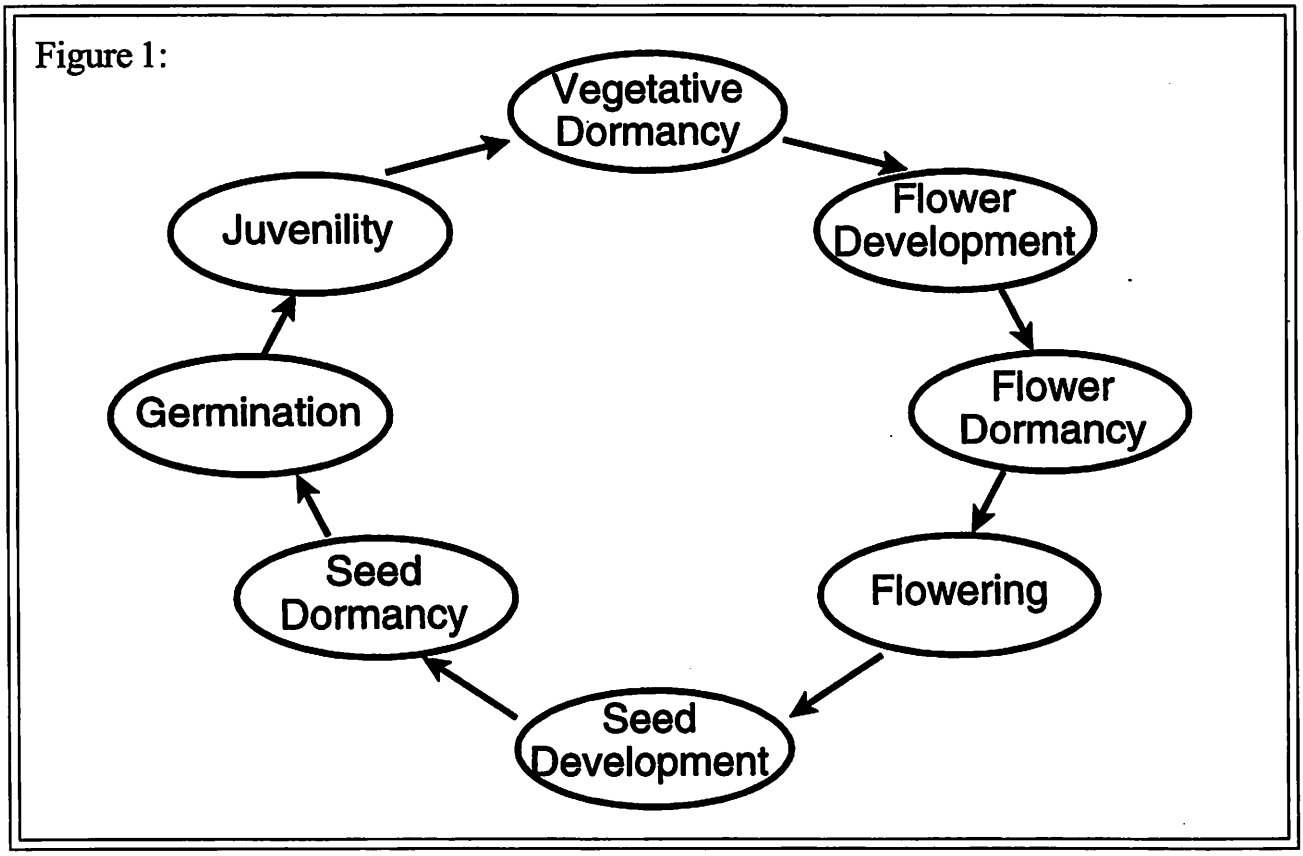

Table 1. Juvenility requirement for response to flower initiation treatments of herbaceous perennials.

Species / cultivar	Common name	Number of leaves
Achillea filipendulina 'Cloth of Gold'	Fern-leaf Yarrow	13 or more
Aquilegia (most species)	Columbine	12 to 15 or more
Aster alpinus	Alpine Aster	at least 15
Astilbe arendsii	Astilbe	at least 6
Chrysanthemum coccineum	Painted daisy	at least 15
Coreopsis grandiflora 'Sunray'	Tickseed	16 or more
Delphinium ∞ *elataum*	Delphinium	4 to 5
Echinacea purpurea	Purple Coneflower	at least 4
Euphorbia epithymoides	Cushion Spurge	more than 8
Goniolimon tatarica	German Statice	more than 14
Heuchera sanguinea	Coral Bells	at least 16
Lavandula angustifolia	Lavender	40 to 50
Lobelia ∞ *speciosa* 'Compliment Scarlet'	Lobelia	6 to 7
Papaver orientale 'Brilliant'	Oriental Poppy	more than 14
Physostegia virginiana	Obedient Plant	at least 10
Rudbeckia fulgida 'Goldsturm'	Gloriosa Daisy	at least 10
Veronica spicata 'Blue'	Speedwell	6 to 8

* D.A. Bailey and H. Scoggins. 1996. Perennials: Basics of profitable production (part II). North Carolina Flower Growers' Bulletin. 41(6): 1-11.

or plastic bag. Generally, perennial seed germinate best when sown on a well-drained medium that is low in soluble salts with a 5.5-6.0 pH. Seed of perennial species vary in the optimum temperature range for germination. Three germination temperatures are often used: cool (60-65 degrees F), moderate (70-75 degrees F) or warm (80-85 degrees F). The humidity and temperature should be reduced and light intensity increased once the first true leaf is visible. Perennials that can be started from seed are in Table 3(page 33).

Division of field-grown stock plants into individual offsets is a technically simple way of propagating perennials, but is often inefficient in terms of labor cost and maintaining large stock blocks. The number of offsets that can be obtained varies widely with the plant species, some yield thousands while others only a half dozen. Offsets are generally established in trays or large plugs before transplanting to the final container.

Stem cuttings are a rapid and increasingly popular method of propagating perennials. Cuttings can be harvested from field-grown stock plants in the spring, or from greenhouse-grown stock and stuck in flats or plug trays under intermittent mist. A rooting hormone is often unnecessary and plants are ready to transplant in three to six weeks.

Facilities

Growers who want to start perennials from seed and/or vegetative cutting will need propagation facilities appropriate for these methods. This will also include a refrigerator if the seed of those species requiring stratification will be handled. A minimum heat greenhouse or large walk-in cooler will be required if the grower wants to provide cold treatment. The greenhouse can be a simple Quonset-style house to protect dormant plants from freezing. Forcing greenhouse should have the ability to provide water, fertilization, insect and disease prevention and temperature and photoperiod control. Many growers establish separate houses or sections for two temperature zones, a cool night temperature area and a warm night temperature area.

Forcing Temperature

Early and mid-spring blooming perennials are more compact if they are grown at low night temperatures (45 degrees to 55 degrees F), but more time will be needed for forcing to a marketable plant. Warmer night temperatures (60 to 68 degrees F) can be used for most perennials which reduces the time needed for forcing a marketable plant, but may cause stretching, especially under low light intensity.

Container Medium

No single type of container medium has proven to be the best for growing perennials. However, the medium should be exceptionally well-drained, hold sufficient water and fertilizer and be free of pathogens and weed seed. The choice of media and media components frequently depends on the production system. Peatlite media composed of sphagnum peat moss, vermiculite and perlite is often used where perennials are forced in a greenhouse. When perennials are finished in a nursery setting, various combinations of pine bark, peat and sand are often used. Regardless, the pH of the medium should be adjusted to a 5.5-6.0 pH using dolomitic limestone. Micro-nutrients and slow-release may also be mixed with the media according to manufacturers' directions.

Fertilization

To date, little work has been done on fertilization requirements for perennials. Generally, fertilizer rates should be adjusted for the growing temperature. When growing plants at cooler temperatures, 50 to 100 ppm nitrogen two to three times a week should be sufficient for most species. At warmer temperatures, increase the rate to 100 to 150 ppm nitrogen at every watering. A calcium nitrate and potassium nitrate mix or 15-0-15 gives better results than high ammonium fertilizers such as 20-20-20, especially at cooler temperatures. If micro-nutrients were not incorporated in the mix, use a fertilizer formulation that includes micro-nutrients. Once flowering begins, reduce the rate to about 100 ppm nitrogen. Slow-release fertilizer is often used on container-grown perennials in a nursery setting either as a top-dressing or incorporating in the mix. As a starting point, follow manufacturers' directions for rates.

Plant Growth Retardants

Most early spring blooming perennials require little height control unless temperatures are too high and/or light intensity is too low. However, many late spring and summer blooming perennial species grow too tall for market acceptance in small containers and pose problems in shipping. B-Nine is the most commonly used plant growth retardant on perennials and is applied as a spray at 3000 to 5000 ppm. Cycocel at 750 to 1,500 ppm can be used on balloon flower, dianthus and English daisy. A-Rest, Bonzi and Sumagic are useful on some crops. Check the label for a list of perennials registered for a product.

Production Systems

Unlike many greenhouse crops, there is a wide range of production systems that can be used to produce perennials. The choice of which system to use depends on the market. Define who is the customer, when will plants be marketed and how much time is available to grow the plants? The answers to these questions will help define the market container size, the range of plants to grow and the type of operation required for production. To generalize, perennial production can follow one of three regimes:

Small plugs - Plug flats in the 288 to 375 size range are used primarily for seed propagated perennials. Seeds are sown in July to August for transplanting into 6-inch pots or quarts in September to October. Seed of slow-growing species or those planted in gallon pots may be sown in June. In either case, plants must complete the juvenile stage before vernalization in November, December and January. Once vernalization is complete, plants are placed under forcing conditions until flower.

Medium-size plugs - Plug flats in the 50 to 125 size range may be used for seeds, cuttings or offsets for planting in 4-inch, quarts or gallon pots in the fall. Many growers who do not wish to propagate perennials purchase perennial plugs from specialists propagators. Purchased plugs may be received in the fall for potting in the final container and vernalization by the grower. Or plugs (50-72 count trays) may be received from January to March as already vernalized plugs (vernalized by propagator) that are potted

Table 2. Forcing requirements of several herbaceous perennials.

Plant	Vernalization	Daylength during forcing[1]	Weeks forcing at 60° F NT
Achillea filipendula 'Cloth of Gold'	Required	LD	4-6
Achillea millefolium 'Red Beauty'	Required	LD	4-6
Aquilegia ∞ hybrida	Required	none	6-9
Anemone sylvestris	Beneficial	(LD)	-
Armeria	Required	none	8
Asclepias tuberosa	Required	LD	-
Aster alpinus 'Goliath'	Required	none	-
Aster novae-angliae	none	SD	-
Astilbe arendsii	Required	(LD)	4
Campanula carpatica 'Blue Chips'	none	LD	10-11
Campanula glomerata 'Joan Elliott'	Required	none	4
Convallaria sp.	Required	none	3
Coreopsis grandiflora 'Sunray'	Required	LD	10-11
Coreopsis grandiflora 'Early Sunrise'	none	LD	6-8
Coreopsis verticillata 'Moonbeam'	none	LD	8-10
Delphinium elatum 'Blue Mirror'	Beneficial	none	-
Dianthus plumaris 'Cottage Pink'	Required	none	-
Dianthus deltoides 'Zing Rose'	Beneficial	none	-
Dicentra spectabilis	Required	none	4-5
Echinacea purpurea	Beneficial	LD	-
Echinops bannaticus 'Taplow Blue'	Required	LD	11-13
Euphorbia polychroma	Required	none	4
Gaillardia grandiflora 'Goblin'	Beneficial	LD	-
Gaura lindheimeri 'Siskyou Pink'	none	none	-
Geranium ∞ hybrida 'Johnson's Blue'	Required	none	-
Gypsophila paniculata 'Double Snowflake'	Required	LD	-
Heuchera sanguinea 'Blessingham Hybrids'	Required	none	8-10
Hibiscus ∞ hybrida 'Disco Belle'	none	LD	-
Iberis sempervirens 'Snowflake'	Required	none	-
Iris sp.	Required	none	4
Lavendula angustifolia 'Hidcote'	Required	LD	-
Leucanthemum ∞ superbum	Beneficial	LD	4-7
Liatris spicata "Kobold'	Required	LD	4
Linium perenne 'Sapphire'	Required	none	-
Lobelia ∞ speciosa 'Compliment Scarlet'	Required	(LD)	-
Monarda didyma 'Croftway Pink'	none	LD	-
Oenothera macrocaropa	Beneficial	LD	-
Phlox paniculata 'Eva Cullum'	Required	LD	-
Phlox subulata	Beneficial	(LD)	-
Physostegia virginiana 'Alba'	Required	LD	10-13
Platycodon grandiflorus 'Sentimental Blue'	Beneficial	(LD)	11-13
Rudbeckia fulgida 'Goldstrum'	Beneficial	LD	12-14
Salvia superba 'Blue Queen'	Beneficial	(LD)	-
Sanguinaria canadensis	Required	none	4-7
Saponaria	Required	none	4
Scabiosa caucasica 'Buttery Blue'	Beneficial	(LD)	-
Sedum spectabilis 'Autumn Joy'	Beneficial	SD	14-18
Tradescantia ∞ andersoniana 'Innocence'	Required	none	4
Verbena ∞ 'Homestead Purple'	none	none	-
Veronica longifolia 'Sunny Border Blue'	Required	none	9-12
Veronica spicata	Required	none	-
Viola	Required	none	3-4

[1] Parentheses indicate condition beneficial but not required.

Table 3. Herbaceous perennials propagated from seed.

Genus	Temperature	Seed cover	WTF[1]	Genus	Temperature	Seed cover	WTF[1]
Achillea	70-75	None	8	Lavandula	60-65	Light	11
Alcea	70-75	Heavy	4	Leotopodium	70-75	Heavy	10
Alchemilla	70-75	None	10	Leucanthemum	70-75	None	8
Anaphalis	70-75	None	9	Liatris	70-75	None	10
Anchusa	70-75	Heavy	7	Limonium	70-75	None	10
Anemone	60-65	Heavy	12	Linaria	70-75	None	9
Anthemis	70-75	None	9	Linum	70-75	None	8
Aquilegia	70-75	Heavy	9	Lobelia	70-75	Heavy	10
Arabis	70-75	Heavy	8	Lunaria	70-75	Heavy	9
Arenaria	60-65	Heavy	8	Lupinus	70-75	Heavy	5
Armeria	60-65	Light	10	Lychnis	70-75	None	8
Asclepias	70-75	None	9	Monarda	70-75	None	8
Aster	70-75	None	8	Miscanthus	70-75	None	8
Astilbe	70-75	Heavy	10	Myosotis	70-75	None	7
Aubrieta	70-75	Heavy	8	Nepeta	70-75	None	7
Aurinia	70-75	None	8	Oenothera	70-75	Light	9
Baptisia	60-65	Light	9	Papaver alpinum	60-65	Light	10
Bellis	70-75	None	7	Papaver orientale	70-75	Light	10
Bergenia	70-75	None	10	Penstemon	70-75	None	8
Campanula	70-75	None	10	Physalis	70-75	None	7
Catananche	70-75	None	9	Physostegia	70-75	None	9
Centaurea	70-75	Heavy	8	Platycodon	70-75	None	8
Centranthus	60-65	None	8	Polemonium	70-75	None	9
Cerastium	70-75	None	8	Potentilla	70-75	None	8
Cheiranthus	70-75	None	7	Primula	60-65	Light	10
Coreopsis	70-75	None	9	Pulsatilla	60-65	Light	12
Coronilla	60-65	Light	7	Rodgersia	70-75	None	10
Cortaderia	70-75	None	8	Rudbeckia fulgida	80-85	None	9
Cymbalaria	70-75	None	8	Rudbeckia hirta	70-75	None	8
Delphinium	60-65	Heavy	8	Rudbeckia triloba	70-75	None	9
Dianthus	70-75	None	8	Sagina	70-75	None	7
Digitalis	70-75	None	8	Salvia	70-75	None	9
Doronicum	80-85	Heavy	8	Santolina	70-75	None	10
Echinacea	70-75	Heavy	8	Saponaria	60-65	Heavy	8
Echinops	70-75	Heavy	8	Scabiosa	70-75	Heavy	6
Euphorbia	70-75	Heavy	8	Sedum	70-75	None	9
Festuca	70-75	None	8	Sempervivum	70-75	Heavy	13
Gaillardia	70-75	Heavy	8	Sidalcea	60-65	Light	8
Geum	70-75	None	10	Silene	70-75	None	8
Gypsophila	70-75	None	8	Stachys	70-75	None	6
Helenium	70-75	None	11	Stokesia	70-75	Light	8
Helianthemum	70-75	None	9	Tanacetum	70-75	None	9
Heliopsis	70-75	None	9	Teucrium	70-75	Light	11
Heuchera	70-75	Heavy	11	Thalictrum	70-75	Light	10
Hibiscus	70-75	Light	5	Thymus	70-75	None	9
Iberis	60-65	Light	8	Trachelium	70-75	None	9
Kniphofia	70-75	Heavy	10	Veronica	70-75	None	7
Lathyrus	70-75	Light	8	Viola	60-65	Heavy	7

[1] Weeks to finish in 128 celled plug tray.

P. Karlovich. 1995. Perennial plugs from seed. PPGA News.

in the final container and placed under forcing conditions.

Large plants - Perennials are received from specialist propagators as bare-root plants or large field-grown plugs. These may be planted in the fall for vernalization or in early spring already vernalized and ready to plant and force. Large size plants are mostly planted into one- to three-gallon pots.

One critical decision is whether to grow plugs or purchase them from a specialist propagator. Growing perennial plugs in one season and then vernalizing them for spring sales requires more skill and careful planning than purchasing already vernalized plugs. Propagation and potting to final containers occurs in late summer and fall, which may not be a busy time for some growers. Propagation has inherent risks and requires special facilities. Plants must then grow sufficiently to overcome juvenility and have sufficient root growth for vernalization. However, the cost per plug can by less with growing your own plugs.

Perennials may also be treated as spring bedding plants. The starting point may be vegetative propagation, sown seed or small to medium-size plugs that are then planted into 4-inch pots or large-cell market flats in early spring. Those species that grow rapidly and do not require special conditions will grow and flower for the spring bedding plant market. Those that grow slowly or have special requirements for flowering are sold green. Because customers are often reluctant to purchase plants that are not in flower, "green packs" should have color labels or point-of-purchase material.

Insect Problems

With the wide range of plant species frequently included in perennial production, it is important to practice early detection and learn to identify insect pests and their distinguishing symptoms. Chewing insects such as caterpillars, beetles, grasshoppers and slugs and snails can cause extensive damage to the foliage of perennials in a short period of time, especially in outdoor production. Boring insects cause damage when larvae bore into the plant and feed on internal tissues. European corn borer and stalk borer attack the stems while leafminers cause white serpentine trails in the leaves. Insects that feed on the sap of plants include aphids, mites, thrips and whitefly. These insects leave symptoms such as small yellow or brown specks, chlorotic spots or streaking and often twisted, stunted or curled growth. Good sanitation practices in the production area and inspection and quarantine of incoming plants will help reduce the introduction of insect pests. Before applying pesticide controls, identify the pest and apply the appropriate pesticide at the most vulnerable stage in the life cycle.

Disease Problems

Like insects, early detection and learning to identify disease pests and their distinguishing symptoms is a key to disease control. Botrytis blight, root and stem rots, powdery mildew, leaf spots and viral diseases have been problems on perennials. Often learning the species and cultivars that are susceptible to a particular disease problem is part of the early detection process. Learning the environmental conditions and cultural practices that favor disease development can also help avoid serious problems. Sanitation, inspecting incoming plant material, isolation or destruction of infected plants are all part of a prevention program. It is important to get a definitive identification of the pathogen before applying a fungicidal control program.

Marketing

Perennial consumers may be placed into three categories: 1) Spring consumers - those who traditionally purchase bedding plants in the spring and wish to expand into perennials to try something new. These consumers frequently required information which starts at the very beginning about perennial selection, culture in the garden and what can be expected from the plants. 2) Plant collectors or specialists - these are often gardeners with more experience that are looking for something unusual or different from what they have. These consumers require a wide selection of plants or they may specialize in a particular genus such as hosta, daylily or Iris. 3) Landscaping consumers - commercial or amateur landscapers who may purchase a large number of one-of-a-kind plant, often in larger containers.

Each perennial grower must define the kind of market and the type of consumer their business will serve. However, providing information to help customers succeed with perennials and then providing an adequate selection of plants and containers sizes at a reasonable price are keys to success in any market. Perennials offer the grower a way to expand sales beyond the traditional spring market. Because of the wide selection of species and cultivars that bloom in different seasons, groups of flowering perennials can be featured in the sales area each week from early spring through fall, compelling the customer to make repeated visits to see what is in bloom next.✿