FORCING PERENNIALS

Greg Nordwig and John Erwin
Department of Horticultural Science
University of Minnesota

INTRODUCTION

The popularity of perennial plants has grown. In 1993, sales of perennials in North America were estimated at $1.37 US billion; a 43% increase from 1992 (Rhodas, 1994). Consumer attraction to diversity in flowering, foliage textures, adaptability to growing conditions, and the perennial nature of plants are reasons for the demand (Beattie, 1994). Despite the current popularity, greater potential still exists to expand the market by selling blooming perennial plants.

Consumers are inclined to buy flowering plants. Unfortunately, perennials often do not have an extended blooming period as annuals. The lack of an extended blooming season may be the reason sales of perennials have lagged behind those of annuals (Aylsworth, 1995). Until recently, consistently providing blooming perennials over time in the retail center has not always been possible. As a result, garden centers and greenhouses rely on picture tags to show customers plant appearance in bloom. A blooming plant will sell faster than a plant without flowers regardless of the picture tag. Since, picture tags are more expensive than traditional ID tags, the overall cost of individual plants increase. Fortunately, blooming perennials can be marketed at a higher price thus increasing profit compared to non-blooming perennials. Therefore, it would be of great advantage to sellers, growers, and consumers if consistently blooming perennials were available (Schroeder, 1996).

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Forcing some perennials to bloom is now possible. ‘Forcing’ is a process that induces a plant to bloom outside the normal blooming period time of year. To bring a plant into bloom, a grower must imitate environmental conditions required for natural flowering. Stimulation of flowering is typically accomplished by manipulating photoperiod/ temperatures (Iversen and Weiler, 1994). For example, *Coreopsis grandiflora* will flower if subjected to 10 weeks of cold (41°F) and then 14 hours or more of daylength (Yuan, M. et al., 1996). Flowering will not occur if plants are grown without cold or with a short photoperiod.

Forcing perennials over time can extend the marketing season. Forcing techniques allow timed marketing of flowering perennials from spring through fall, complementing fall garden mum sales, as well as spring annuals. Also, spring, early, mid, and late summer blooming perennials can be timed to bloom after sales of annuals ‘drop off’, utilizing space once occupied for annual sales.

Blooming perennials work well for impulse purchases. Another marketing strategy for flowering perennials is to use them as flowering pot plants. Forced perennials could be timed to bloom at Valentine's Day, Easter, Mother's Day and other holidays (Aylsworth, 1995). Forced perennials can also be marketed for birthdays and other occasions.

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Perennials need to be marketed differently than annuals. Labeling, container size, advertising, and price should reflect a higher value product than annuals (Schroeder, 1996). Also, producers and marketers of forced perennials must be cautious not to mislead consumers as to the normal bloom time. Lastly, sellers of forced perennials should only market plants hardy in their area (Armitage, 1996 a). Information about normal bloom time should be included with cultural information to insure customer satisfaction the following year.

Production of forced perennial plants allows greenhouse operators to increase utilization of greenhouse space. For example, forced perennials can be sown or propagated from mid spring to late summer, depending on the species, when many greenhouses have available space.

To fully understand the basics of perennial flowering, one needs to be acquainted with terms related to flower induction. These include flower initiation, induction, juvenility, vernalization, and photoperiodism.

There are three stages in flower development: 1) induction, 2) initiation, and 3) development. Flower induction is the process when a meristem changes from vegetative to reproductive development. Initiation is the process of making flower parts and flower development is the process of enlargement of those floral parts (Hartman et al., 1988).

Plants must be allowed to mature before they can perceive environmental changes that may cause blooming. 'Juvenility' is the stage in plant development when a plant is too young to be able to produce flowers regardless of inductive conditions. Degree of plant 'maturity' is best identified by leaf or node number in herbaceous perennials. Researchers showed *Coreopsis grandiflora* is 'mature' when it develops about 8 nodes or 16 leaves (it has opposite leaf orientation (Cameron et al., 1996)). Juvenility time and minimum leaf/node number varies with species.

Vernalization is defined as the action lower temperatures have in allowing plants to respond to inductive conditions for flowering or to accelerate flowering (Thomas and Vince - Prue, 1984). Plants can be placed into one of three vernalization categories: 1) Cooling required for flowering (obligate), 2) cooling improves or hastens flowering (facultative), and 3) no cooling required. Plants that require cooling must be developmentally mature to perceive the vernalization treatment in order for flower induction to occur. Plants not requiring a vernalization treatment can be forced directly to flower from seedlings or cuttings under appropriate daylength conditions (Cameron et al., 1996a).

The optimum temperature for vernalization is between 32°F and 45°F (Thomas and Vince - Prue, 1984). Plants may be cooled in greenhouses held at 32°- 45°F during the darkest and coldest months of winter. Length of vernalization treatment can vary from 4-12 weeks depending on the plant species (Armitage, 1996 b). Ten weeks at 41°F is an effective vernalization treatment for many perennials (Cameron et al., 1996b). Exposure to temperatures above or below the temperature range for vernalization may not vernalize plants or lengthen the time required to vernalize plants. Exposure to high temperatures (>86°F) can result in devernalization, which is the loss of the response to vernalization. If a plant is devernalized, the vernalization treatment must be repeated to induce flowering (Thomas and Vince - Prue, 1984).

Photoperiodism refers to the induction of flowering via response to daylength. There are three photoperiod response groups in plants: long-day, short-day, and day-neutral. Plants that flower when the light period is longer than some critical daylength are referred to as long-day plants. Plants that flower when the light period is shorter than some critical daylength are short-day plants. When the length of photoperiod has no effect on flowering, a plant is considered a day-neutral plant (Thomas and Vince -Prue, 1984).

There are obligate and facultative plants within each photoperiodic group. If a plant is an obligate short-day or long-day, the reported photoperiodic requirement is essential for flowering. In contrast, facultative long-day plants will flower under short-days, but flowering is enhanced or occurs earlier by long-days (Runkle et al., 1996).

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In referring to photoperiod, we talk about day-length when, in actuality, it is the length of night that has an effect on flowering. With short-day plants, it is the long nights that induce flowering (Beattie and German, 1984). This is why night interruption lighting

inhibits flowering of short-day plants in the winter. In contrast, long-day plants induce flowers when grown with short nights. Night interruption lighting during the long nights of winter stimulates flowering of long-day plants by shortening night length (Thomas and Vince - Prue, 1984). Unfortunately, plant responses to photoperiod can be more complicated. Some plants may only require a single cycle inductive day/night while others require weeks or months of long-days or short-days to cause a response. There are also some "dual length" plants that require a specific photoperiod for flower initiation and a different photoperiod for the following flower development (Beattie, 1994). In general most short-day plants require a shorter photoperiod for development vs. initiation.

Most perennials can be classified into categories for forcing.
1 - Obligate long day - 4 hours of night interruption lighting with 10 f.c. 10 p.m. - 2 a.m. required for flowering.
2 - Facultative long day - long days increase or hasten flowering.
This group is further subdivided into 2 categories:

Table 1

Known Vernalization and Photoperiod Requirements for Forcing Perennials

Herbaceous Perennial	Vernalization Response	Photoperiod Response
Achillea filipendulina ' Cloth of Gold'	Required for flowering	Obligate long-day plant
Aquilegia x *hybrida* (most cultivars)	Required for flowering	Day neutral plant
Aquilegia x *hybrida* 'Songbird' series only	Not needed	Day neutral plant
Armeria x hybrida 'Dwarf Ornament Mix'	Improved flowering	Day neutral plant
Armeria latifolia	Improved flowering	Day neutral plant
Asclepias tuberosa	Improved flowering *	Obligate long-day plant
Aster alpinus 'Goliath'	Required for flowering	Day neutral plant
Astilbe arendsii	Required for flowering	Obligate long-day plant
Campanula carpatica 'Blue Clips'	Not needed	Obligate long-day plant
Chrysanthemum coccineum ' James Kelway'	Required for flowering	Obligate long-day plant
Coreopsis grandiflora ' Early Sunrise'	Not needed	Obligate long-day plant
Coreopsis grandiflora 'Sunray'	Required for flowering	Obligate long-day plant
Coreopsis verticillata ' Moonbeam'	Improved flowering	Obligate long-day plant
Delphinium elatum 'Blue Mirror'	Improved flowering	Day neutral plant
Dianthus deltoides 'Zing Rose'	Improved flowering	Day neutral plant
Echinacea purpurea 'Bravado'	Improved flowering	Obligate long-day plant
Euphorbia epithymoides	Required for flowering	Day neutral plant
Gaillardia grandiflora 'Goblin'	Required for flowering	Obligate long-day plant
Gypsophila paniculata ' Double Snowflake'	Improved flowering	Obligate long-day plant
Heuchera sanguinea ' Bressingham Hybrids'	Required for flowering	Day neutral plant
Hibiscus x hybrida ' Disco Belle Mixed'	Not needed	Obligate long-day plant
Iberis sempervirens ' Snowflake'	Required for flowering	Day neutral plant
Lavandula angustifolia ' Hidcot Blue'	Required for flowering	Obligate long-day plant
'Munstead Dwarf'	Required for flowering	Day neutral plant **
Leucanthemum x superbum 'Snowcap'	Improved flowering	Day neutral plant
'Snowlady'	Improved flowering	Facultative long-day plant
Lewisia cotyledon	Required for flowering	Day neutral plant
Linum perenne ' Sapphire'	Required for flowering	Day neutral plant
Lobelia x speciosa 'Compliment Scarlet'	Improved flowering	Facultative long-day plant
Oenothera missouriensis	Improved flowering	Obligate long-day plant
Perovskia atriplicifolia	Not needed	Day neutral plant
Physostegia virginiana ' Alba'	Improved flowering	Obligate long-day plant
Platycodon grandiflorus ' Sentimental Blue'	Improved flowering	Facultative long-day plant
Primula veris ' Pacific Giants'	Not needed	Day neutral plant
Rudbeckia fulgida ' Goldstrum'	Improved flowering	Obligate long-day plant
Salvia superba ' Blue Queen'	Required for flowering	Obligate long-day plant
Scabiosa caucasica ' Butterfly Blue' (vegetatively propagated)	Improved flowering	Day neutral plant
Veronica longifolia ' Sunny Border Blue'	Required for flowering	Day neutral plant
Veronica spicata ' Blue'	Improved flowering	Day neutral plant

* - (if not first exposed to short days)
** - (after cold, shorter plants under short days)
(Cameron, et al., April 1996 and March 1996).

i. Long day horticulturally required- These plants will bloom under short days, but the flowering rate maybe so slow or the number of flowers so few that it would not be profitable to produce under short day conditions.

ii. Long day beneficial horticulturally - Benefits of long days are marginal even though it is real.

3 - Day neutral plants - These plants bloom under long day or short day conditions.
Supplemental night interruption lighting to manipulate photoperiod can be provided with incandescent lights. Metal halide HID lighting can also be used (Armitage, 1996a). New fluorescent bulbs are also available that fit a standard incandescent lamp socket, which may provide better light quality and are cost efficient.

PRODUCTION STEPS

Step 1: Vernalization

"...the amount of time needed for cooling must be extended if temperatures are outside the critical range."

Not all perennials require or benefit from a cold treatment. For those perennials which do, a grower has two options in production scheduling of forced perennials: 1) purchase vernalized seedlings, 2) vernalize their own seedlings. If a grower chooses to produce his/her own vernalized seedlings, then he/she must have the ability to maintain a cool greenhouse of 32°F - 45°F for up to 12 weeks. It will not harm the process if the temperature goes above these critical temperatures on occasion. However, the amount of time needed for cooling must be extended if temperatures are outside the critical range.

A cooler may be used to vernalize perennials. Lights are useful in the coolers if available, but may not be necessary. The closer to 32°F the less need for light. Conversely, the higher the temperature above 32°F, the more light is needed (up to 12 hours). Ten to fifteen footcandles of light is often sufficient. Use of lights reduce stress on seedlings and reduces time on the bench by 2 or more weeks compared to unlit seedlings. Plants will need occasional watering and good ventilation in a cooler as well (Armitage, 1996b).

Step 2: Photoperiod

Plants can either be grown cool or warm while receiving the proper photoperiod (if needed) once cooling has been provided. Growing plants on at temperatures of 40°-50°F will result in higher quality plants by increasing branching, providing a more compact size, and more uniform flowering. However, growing at 40°-50°F will require more time on the bench compared to plants grown at warmer temperatures. If plants are grown at warmer temperatures of 60°-70°F, time on the bench will be reduced but so will quality (Armitage, 1996 b).

This information is the beginning of an effort at the University of Minnesota to learn about and develop schedules for forcing perennials into bloom rapidly without compromising quality. We will be developing criteria for both the plug grower and finisher. Production of blooming perennials will not be as simple as producing annuals or traditional flowering pot plants. Each species, variety, and cultivar may have its own unique requirements. In the next article on forcing perennials, specific cultural information on forcing two perennials to bloom will be presented.

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INTRODUCING...

Hi! My name is Greg Nordwig, and I am one of Dr. John Erwin's new graduate students at the University of Minnesota. Recently, I arrived at the university to study and work in the area of floriculture. I am especially looking forward to meeting and working with those in the floriculture industry. I see many great opportunities in this field.

My background is a little different from traditional students. Before attending college, I operated our family dairy farm, of 5 generations, for 12 years and currently rent out the land and barns. In August, 1992, I began my education in horticulture at the University of Wisconsin - River Falls, where I graduated in December, 1995. It was a big change for me to go from dairy farming back to school, but it has been a decision that I have never regretted. I've always had an interest in horticulture.

In 1993, I worked as an intern at a landscape center in my home town of Shawano, WI. The next year I had the opportunity to work as an intern for the Ball Seed Co., in West Chicago. This spring, I started working at Ambergate Gardens in Waconia, MN.

I have a strong interest in horticulture, specifically the production of perennials, which is why I chose to come to the University of Minnesota for my Masters Degree. At the University, I will be able to work on such projects as studying the potential use of Asclepias as a flowering potted plant and garden plant in addition to fast cropping of perennials.

My goals after having completed my degree are to work in the industry and to operate a wholesale and mail order perennial nursery from my home farm. Until that time, I am looking forward to working here, learning more about floriculture, and meeting all those involved in the industry.