# Manipulating day length to flower perennials

by Erik S. Runkle, Royal D. Heins, Arthur C. Cameron and William H. Carlson

## Do the perennials you grow need long days? Find out here

Perennials in flower sell. The challenge, of course, is to make them flower. Some herbaceous perennials present no problem—just turn up the temperature in the greenhouse in the winter or early spring. However, many species remain vegetative until April or May, even if heated. We're finding that most of these slow starters are actually long-day plants, which are signaled to flower when day lengths reach or exceed a certain point known as their critical photoperiod. These plants flower in response to changes in natural day lengths. By understanding the critical photoperiod for flower induction, growers can manipulate photoperiods to make plants either vegetative or reproductive.

### Photoperiods

Natural photoperiods vary during the year and by latitude. Day length is the shortest on December 21 and increases until June 21; thereafter, it decreases. The transition from spring to summer—from short days to long days—initiates flowering in some plants.

The seasonal fluctuation of natural photoperiods becomes more dramatic traveling farther north. For New Orleans, (30° N latitude) perceived day length ranges from slightly fewer than 11 hours to slightly more than 14½ hours. In East Lansing, Michigan, (43° N latitude) day lengths range from fewer than 10 hours to longer than 16 hours. These day lengths are approximately 35 to 40 minutes longer than the time from sunrise to sundown because plants perceive light before sunrise and after sunset.

Photoperiods can be created in the greenhouse, an already common practice with poinsettias and chrysanthemums. Short days are created by pulling black cloth or plastic over plants to limit the day length. For poinsettias, which are short-day plants, black cloth is used in northern areas to induce flowering. Long days can be cre-

**The effect of photoperiod on flowering of selected perennials**

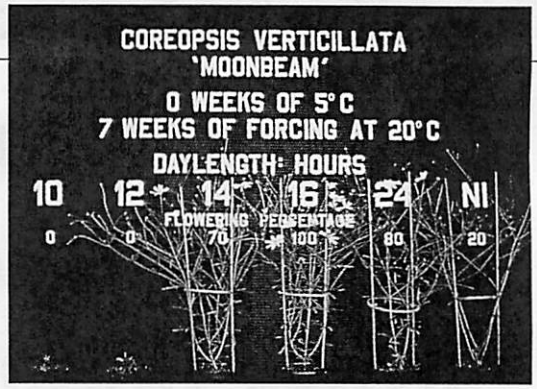
| Species | Recommendation | | Flowering percentage | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Photoperiod | | | | | |
| | Night interruption* | Cold treatment** | 10 | 12 | 14 | 16 | 24 | NI |
| **Long days required** | | | | | | | | |
| *Asclepias tuberosa* | Yes | Yes | | | | | | |
| *Campanula carpatica* Blue Clips | Yes | N/Y | | | | | | |
| *Gaillardia* x *grandiflora* Goblin | Yes | Yes | | | | | | |
| *Coreopsis verticillata* Moonbeam | Yes | N/Y | | | | | | |
| *Hibiscus* x *hybrida* Disco Belle Mixed | Yes | No | | | | | | |
| *Gypsophila paniculata* Double Snowflake | Yes | Yes | | | | | | |
| *Oenothera missouriensis* | Yes | Yes | | | | | | |
| *Echinacea purpurea* Bravado | Yes | Yes | | | | | | |
| **Long days beneficial** | | | | | | | | |
| *Physostegia virginiana* Alba | Yes | Yes | | | | | | |
| *Lobelia* x *speciosa* Compliment Scarlet | Yes | Yes | | | | | | |
| *Salvia* x *superba* Blue Queen | Yes | Yes | | | | | | |
| **No repsonse to long days** | | | | | | | | |
| *Armeria* x *hybrida* Dwarf Ornament Mix | No | No | | | | | | |
| *Armeria latifolia* | No | Yes | | | | | | |
| *Lavendula angustifolia* Munstead Dwarf | No | Yes | | | | | | |
| *Scabiosa columbaria* Butterfly Blue | No | N/Y | | | | | | |
| *Veronica longifolia* Sunny Border Blue | No | Yes | | | | | | |
| *Veronica spicata* Blue | No | Yes | | | | | | |

*Yes=4-hour night interruption is recommended, No=no benefit from night interruption.
**Yes=10 to 15 weeks of cold treatment is recommended, N/Y=plants respond the same way to photoperiod with or without cold, No=cold treatment not recommended.

| |
|---|
| 0% flowered |
| 1 to 33% flowered |
| 34 to 66% flowered |
| 67 to 99% flowered |
| 100% flowered |

ated by lighting (greater than 10 f.c.) either at the end of the day (known as day-extension lighting) or for several hours during the middle of the night (known as night-interruption lighting). Night-interruption lighting commonly is used to keep mums vegetative.

These same techniques can be applied to herbaceous perennials. A long-day plant will remain vegetative under short days. The same plant will be induced to flower when given photoperiods equal to or longer than its critical photoperiod. Within a given species, like mums, for example, there may be different critical photoperiods. Be careful not to assume that cultivars of the same species will respond identically to the same photoperiod.



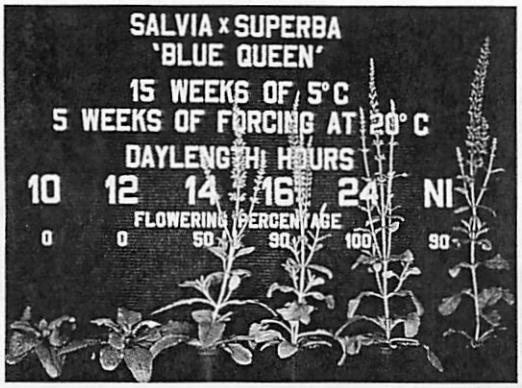

***Coreopsis verticillata* Moonbeam did not flower under 12-hour or shorter photoperiods.**

## Photoperiod experiments

At Michigan State University we are studing photoperiod and how it influences flowering of many herbaceous perennials. Plants were grown in a greenhouse at a constant 68F from either uncooled plugs or plugs that received 15 weeks of 41F. The photoperiods were 10, 12, 14, 16 or 24 hours or a nine-hour day with a four-hour night interruption. Plants were discarded if there was no visible bud after 100 days in the greenhouse.

A summary of some of the results of this experiment is given in the table. The recommendations are based on the percentage of plants that flowered and the time it took them to flower. A "Yes" in the cold treatment column indicates plants either benefit from or require a period of cold before forcing. An "N/Y" means plants responded to photoperiod the same way with or without a cold treatment.

Based on this experiment, herbaceous perennials that grow in most northern climates can be grouped into three categories based on photoperiodic effects on flowering: obligate long-day, facultative long-day and day-neutral plants. An obligate long-day plant will not flower without long days and then only when the day length exceeds its critical photoperiod. For example, *Coreopsis verticillata* Moonbeam did not flower under 12-hour or shorter photoperiods. All Moonbeam



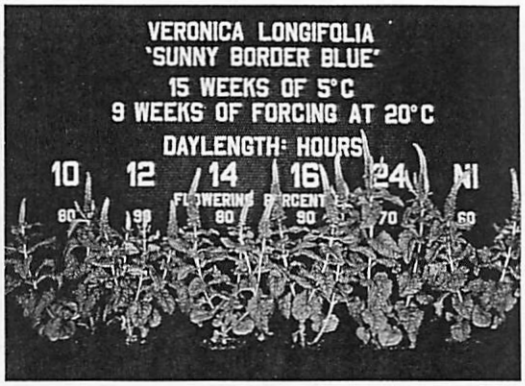

***Salvia* x *superba* Blue Queen is a facultative long-day plant: After cold treatment, plants flower under all photoperiods but long days accelerate flowering.**

plants grown under photoperiods of at least 14 hours or night interruption flowered uniformly.

Facultative long-day plants flower under short days but more rapidly under long days. Long days thus are beneficial, but not required, for flowering. An example of a facultative long-day plant is *Salvia* x *superba* Blue Queen. After a period of cold treatment, plants flower upon exposure to warm temperatures. However, plants flower faster as the duration of the photoperiod increases. Plants averaged 58 days to flower under 10-hour photoperiods but only 30 days under photoperiods of at least 16 hours or night interruption.

Day-neutral plants flower regardless of photoperiod at the same time; long days are not beneficial. An example of a day-neutral plant is *Veronica longifolia* Sunny Border Blue. *Veronica longifolia* relies on other environmental signals to initiate flowering, such as warm temperatures following exposure to a period of cold treatment.

Although there is no clear-cut division between short and long days, the long-day plants in this




***Veronica longifolia* Sunny Border Blue flowers when temperatures are warm following a cold period without being influenced by day length.**

study normally remained vegetative when there were fewer than 12 hours of light per day. They all flowered quickly when there were more than 14 or 15 hours of light per day. Few long-day plants flowered with 12 hours of light per day and those that did took longer.

A long-day plant actually perceives the duration of darkness, not light, in each 24-hour cycle. An obligate long-day plant flowers only when the uninterrupted duration of darkness is *less* than a critical value. Short day with night-interruption lighting is equally effective as a long-day extension because the critical night length is not reached. To keep an obligate long-day plant vegetative, the uninterrupted duration of *darkness* must exceed some value, usually 12 to 14 hours for many perennials.

**Although there is no clear-cut division between short and long days, the long-day plants in this study normally remained vegetative when there were fewer than 12 hours of light per day.**

Photoperiod is just one environmental signal that initiates flowering of herbaceous perennials. Some perennials require only inductive photoperiods and warm temperatures to flower. Others have one or more requirements that must be met. For example, some species have a juvenile stage during which plants will not respond to flower-inductive conditions until they grow a certain number of leaves (or nodes). Furthermore, many plants require or benefit from a period of cold before forcing under warm temperatures.

As these flowering components are discovered, they can be integrated to form a schedule for bringing a given species into flower. As schedules are developed, perennial growers will be able to bring a wide range of perennials to flower on any desired date. In the meantime, the table provides pertinent photoperiod information for bringing selected herbaceous perennials into flower. ❑

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