GROWER 101:

Controlling Photoperiod

Since many important "cash" crops are photoperiodic, a basic knowledge of manipulating daylength is essential.

By Erik Runkle

Photoperiod, or the number of hours of light in a 24-hour period, changes dramatically during the year in temperate regions of the world. For many floriculture crops, photoperiod controls growth and flowering, and a small change in photoperiod can mean the difference between vegetative growth and rapid flowering. For example, poinsettias and chrysanthemums develop vegetative growth when the photoperiod is long and flowers when the photoperiod is shorter. Other plants, including many herbaceous perennials, flower when the photoperiod, or daylength, exceeds a set duration.

By knowing how daylength affects plant development in photoperiodic species, we can manipulate the natural photoperiod to promote vegetative growth (such as to bulk up plant size or for cutting production) or flowering, whichever is desired. Therefore, successful production of many crops requires an understanding of how plants respond to photoperiod, how photoperiod changes during the year and how to modify the photoperiod to control growth and development.

RESPONSES TO PHOTOPERIOD

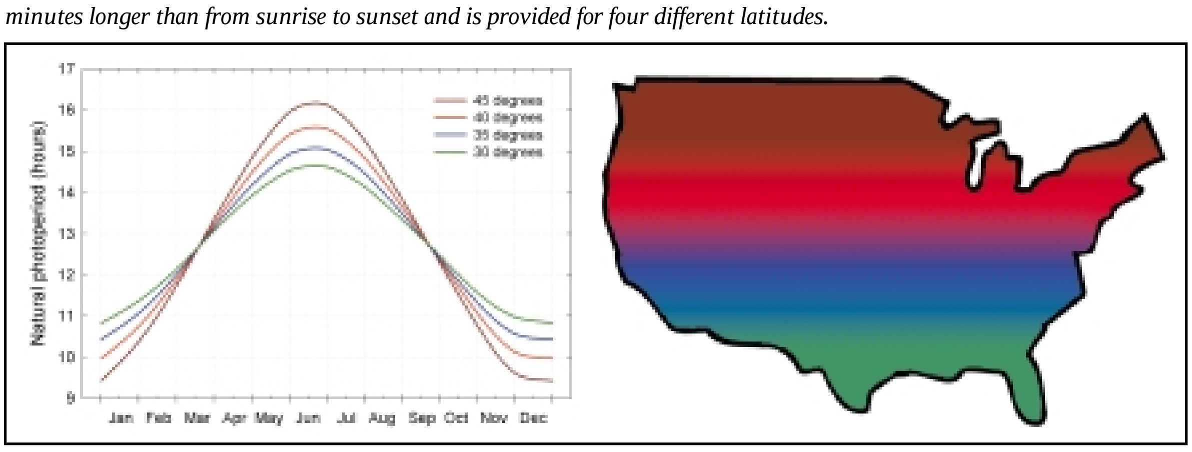
Short-day plants are those that only flower, or flower more rapidly, when the daylength is shorter than a particular duration. In contrast, long-day plants are those that only flower, or flower more rapidly, when the photoperiod is longer than a critical duration. Not all plants flower in response to photoperiod; these plants are insensitive to daylength with respect to flowering and are called day-neutral plants. Whether or not photoperiod influences flowering, it can also influence plant height, branching and other growth characteristics.

What exactly is a "short" or "long" day? It depends on the species and cultivar. For example, a long day for many herbaceous perennials is 13-14 hours or longer of light, and a short day for poinsettias is around 12 1/4 hours or less. Some plants will flower under a range of photoperiods but flower quicker under some photoperiods than others. For example, dahlia flowers under a wide range of photoperiods but flowers progressively earlier under shorter photoperiods. Other plants, such as the herbaceous perennial Lobelia, have a stricter requirement for photoperiod and do not flower unless exposed to a certain duration of light. Table 1, page 93, provides the photoperiodic responses of some commonly grown crops. Note that in some species, responses to photoperiod can vary among cultivars.

NATURAL PHOTOPERIOD

Natural photoperiod can vary dramatically during the year, depending on how far from the equator your greenhouse is located. In the northern hemisphere, the daylength is shortest on December 21 and increases until June 21; it decreases thereafter. The seasonal fluctuation of natural photoperiods becomes more dramatic the farther from the equator one travels (See Figure 1, left). For New Orleans (30° N latitude), the daylength ranges from slightly shorter than 11 hours to slightly longer than 14 1/2 hours. In Minneapolis (45° N latitude), the photoperiod fluctuates even more, with the shortest and longest daylengths being around 9 1/2 and 16 hours, respectively. One method of determining your natural photoperiod is to obtain sunrise and sunset data for your location, then assume that plants perceive light inside your greenhouse about 15-20 minutes before sunrise that ends about 15-20 minutes after sunset. Alternatively, use Figure 1 to approximate the natural photoperiod in your location.

Figure 1. The natural photoperiod varies by latitude and time of year. Here, the natural photoperiod is estimated to be 35 minutes longer than from sunrise to sunset and is provided for four different latitudes.



CREATING SHORT DAYS

Natural photoperiods can be manipulated to create artificially long days or short days. Under natural long days (from late spring to early fall), short days can be created by blocking out all light with black plastic or cloth. Many growers use blackcloth to provide short days to induce flowering of poinsettias, chrysanthemums and other short-day plants. In addition, short days may be desirable when one wants to delay or prevent flowering of long-day plants. In general, plants can perceive very low levels of light (less than one foot-candle), so gaps or holes in light-exclusion material are unacceptable. When natural daylengths are short and blackcloth is not used, growers should be aware of "light pollution." Light pollution is light coming in from nearby greenhouses, street lights or other areas bright enough for plants to perceive, which can cause undesired growth and flowering.

When using blackout, the temperature under the blackcloth can be excessive if

Dahlias flower rapidly under short photoperiods (left), and flowering is progressively delayed as the photoperiod increases. (Photo courtesy of Cathy Whitman)

The herbaceous perennial Lobelia only flowers when the photoperiod exceeds a particular daylength, greater than 10 hours. Here, flowering occurred earlier and was more uniform under photoperiods of 14 or longer, or under a 4-hour night interruption. (Photo courtesy of Erik Runkle)

closed in the afternoon or early evening. Consequently, plant quality can be reduced, and flowering can be delayed (such as in chrysanthemum). To prevent such a temperature rise, some growers don't close the blackout material until late in the evening (e.g., 8:30 p.m.), then open it later in the morning (e.g., 8:30 a.m.). Alternatively, some growers don't pull the blackcloth until one hour before sunrise (e.g., 5 a.m.) and open it when the dark period is sufficiently long.

CREATING LONG DAYS

Under natural short days, long days can be created by lighting at the end of the day, known as day-extension, or by lighting during the middle of the night, known as night-interruption. A 4-hour night interruption, such as from 10 p.m. to 2 a.m., is an effective strategy to create long days from autumn to spring. To create a long day for a range of different species, night interruption lighting should be delivered during the middle of the night for a continuous four hours.

For day-extension lighting, lamps should be turned on around sunset and remain on until the desired photoperiod is completed. For example, to create a 16-hour photoperiod, if sunrise is at 6:45 a.m., lamps should be turned on within 15 minutes of sunset and turned off at 10:30 pm.

Table 1. The photoperiodic responses of some commonly grown floriculture crops. For some genera, species and cultivars can have a different photoperiodic response.

	DAY-NEUTRAL PLANT	SHORT-DAY PLANT	LONG-DAY PLANT
Bedding plants			
Begonia	×		
Dahlia		×	
Geranium (Pelargonium)	×		
Impatiens	×		
Marigold, French (Tagetes)	×		
Pansy (Viola)			×
Petunia			×
Snapdragon (Anitirrhinum)			×
Herbaceous perennials			
Black-eyed Susan (Rudbeckia)			×
Campanula			×
Columbine (Aquilegia)	×		
Coreopsis			×
Hosta			×
Lobelia (Lobelia)			×
Shasta daisy (Leucanthemum)			×
Potted plants			
African violet (Saintpaulia)	×		
Chrysanthemum (Dendranthema)		×	
Cyclamen	×		
Poinsettia (Euphorbia)		×	
Rose (Rosa)	×		

Regardless of how you create long days, the additional light should be at least 10 foot-candles. As mentioned before, most plants will perceive lower light intensities, but flowering can be delayed and less uniform. Purchase or borrow a light meter to determine how much light is delivered at plant level, and measure in all corners of the greenhouse to ensure equal intensity.

When plants are exposed to at least 10 foot-candles, all common light sources — incandescent, high-pressure sodium, metal halide and fluorescent lamps — are equally effective. Incandescent lamps are often used since they are inexpensive and easy to install. Unfortunately, incandescent lamps emit a high proportion of far-red light, which in many plants promotes stem elongation. Incandescent lamps are also the least-efficient lamp at converting energy into visible light. An alternative strategy is to use widely spaced, high-pressure sodium or metal halide lamps, positioned high above crops (e.g., near the greenhouse peaks). Although these lamps are expensive, they are more energy-efficient and won't promote stem extension as much as incandescent lamps. GPN

Erik Runkle is assistant professor and floriculture extension specialist in the Department of Horticulture at Michigan State University. He may be reached by phone at (517) 353-3761 or E-mail at runkleer@msu.edu.

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