Perennials: best long-day treatments for your varieties

by Cheryl K. Hamaker, Royal Heins, Art Cameron and Will Carlson

New MSU research reveals precise strategies for using long-days to force perennial flowering

In the greenhouse industry, growers often use photoperiod manipulation to shorten or lengthen natural day lengths to obtain vegetative or reproductive growth. When days are naturally short, you can provide long-days by lighting in the middle of the night (night interruption lighting) or by lighting before or after the natural day (predawn or day-extension lighting). Like in poinsettia and chrysanthemum production, you can use lighting to create long-days to induce flowering in long-day herbaceous perennials. In our experiment at Michigan State University, we wanted to determine how different lighting strategies compared for inducing consistent flowering in several

A green plus (+) indicates faster or greater flowering percentage, while a red minus (-) indicates delay or smaller flowering percentage compared to that of plants in other treatments (blank cells).

		Light treatments									
		Four-hour Night Interruption	Seven-hour Night Interruption	Seven-hour Day Extension	Seven-hour Predawn Treatments	24-hour	Four-hour Night Interruption	Seven-hour Night Interruption	Seven-hour Day Extension	Seven-hour Predawn Treatments	24-hour
Species	Flowering	No cold					12 weeks at 41F				
Achillea filipendulina	Days to first flower	No flowering without cold						+		-	+
	Flowering percentage									-	+
Asclepias tuberosa	Days to first flower	No significant difference					Not tested				
	Flowering percentage		+		-	+					
Campanula carpatica	Days to first flower					-			-		
	Flowering percentage	No significant difference					No significant difference				
Coreopsis lanceolata	Days to first flower			+	-					-	+
	Flowering percentage	No significant difference					No significant difference				
Leucanthemum x superbum	Days to first flower	No significant difference					Not tested				
	Flowering percentage	No significant difference									
Salvia superba	Days to first flower	No significant difference					No significant difference				
	Flowering percentage	No significant difference					No significant difference				

60(8)

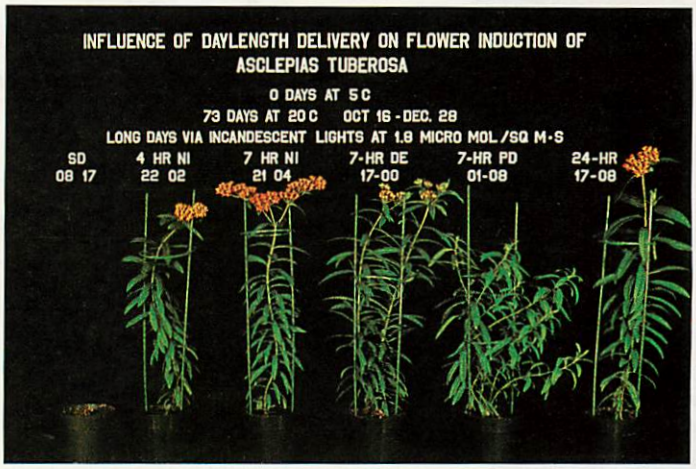

Figure 1. Flowering percentage of *Asclepias tuberosa* was affected by long-day lighting strategies. Only 40% flowering occurred for plants grown under a seven-hour predawn extension. Plants initiated buds under this treatment; however, buds were aborted before first flower.

herbaceous perennials. Keep in mind that short-day and long-day plants respond differently to photoperiodic lighting. Most short-day plants remain vegetative in response to relatively short periods of night interruption lighting. However, most long-day plants require night breaks of at least several hours for uniform and consistent flowering.

Traditionally, long-days used to prevent flowering in poinsettias and mums have been delivered as a four-hour night interruption with incandescent lamps. We've generally found that a four-hour night interruption also induces flowering in long-day herbaceous perennials. Alternatively, 14- to 16-hour day lengths provided by day extension also induce rapid uniform flowering (see "Manipulating day length to flower perennials: *Grower Talks*, June 1996).

We grew plants in the greenhouse at a constant 68F after receiving either zero or 12 weeks of 41F. Plants were forced under a nine-hour short-day or one of five long-day lighting strategies for 12 weeks. The five long-day lighting methods include a seven-hour day extension, a four-hour night interruption, a seven-hour night interruption, a seven-hour predawn extension and 24-hour continuous light. All treatments received nine-hour natural day lengths before black cloth was pulled. All long-day treatments were delivered by incandescent lamps that provided a minimum of 10 f.c.

In this experiment, each long-day lighting strategy induced flowering, but some lighting treatments were more effective than others for some species (Table 1). Factors such as flowering percentage, time to flower and bud number at first flower were influenced by the long-

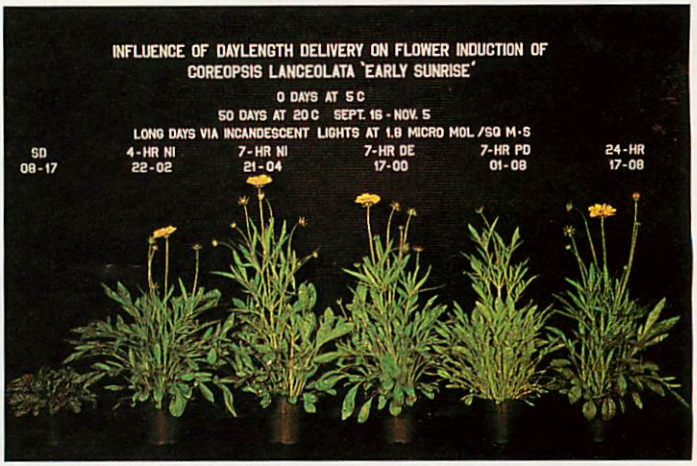

Figure 2. Early Sunrise *Coreopsis grandiflora* doesn't require cold in order to flower. However, time to flower for coreopsis was delayed 10 days in plants grown under a seven-hour predawn extension compared to other long-day treatments.

day delivery strategy. In general, a seven-hour predawn treatment was less effective than other long-day treatments for inducing flowering For example, flowering percentage for *Asclepias tuberosa* grown under the seven-hour predawn treatment was low compared to plants grown under other long-day treatments (Figure 1).

Long-day delivery method affected time to flower in both Early Sunrise *Coreopsis grandiflora* and Snow Lady *Leucanthemum* x *superbum*. Flowering was delayed approximately 14 days in coreopsis grown under seven-hour predawn treatments compared to plants grown under other long-day treatments either with or without a cold treatment (Figure 2). Time to flower for leucanthemum was also delayed approximately 10 days when plants were grown under seven-hour predawn treatments. Finally, final inflorescence number was reduced in both Blue Clips *Campanula carpatica* Early Sunrise and coreopsis when grown under the seven-hour predawn treatment compared to other long-day delivery methods.

Plant response to long-day treatments was also affected by cold treatment. Cooling often decreases the minimum photoperiod required for flowering of many long-day plants. We found that flowering was significantly delayed in uncooled Blue Clips *Campanula carpatica* grown under 24-hour continuous lighting; following a cold treatment, flowering was no longer delayed (Figures 3 and 4). As mentioned previously, flowering of coreopsis grown under seven-hour predawn treatment was delayed on cooled and uncooled plants. However, the delay in time to flower was reduced approximately seven days on cooled plants.

This experiment shows the variation in response of herbaceous perennials to different long-day delivery techniques. Overall, both night-interruption and day-extension treatments were superior to predawn treatments for most species tested. In addition, a four-hour night interruption was horticulturally similar to both a

seven-hour day extension and a seven-hour night interruption for supplying long-days to induce flowering because plants actually perceive the duration of darkness, rather than light, in each daily cycle.

For flowering to be induced in a long-day plant, the length of the dark period must be less than a critical value. For example, if a plant has a critical photoperiod of 16 hours, it actually requires a period of darkness equal to or less than eight hours. So, even though plants grown under a seven-hour day extension receive three hours more light than those grown under a four-hour night interruption, the uninterrupted period of darkness for both long-day treatments is less than the critical value required for flowering.

MSU's forcing advice

You can use a variety of methods to provide long-days in the greenhouse to force herbaceous perennials effectively. Certainly, plants will flower under the natural long-days of the summer; so what's the best way to provide long-days under naturally short-days? The results of this experiment show that both seven-hour day extensions and four-hour night interruptions can be equally effective during the middle of winter when days are shortest. However, the four-hour night interruption requires less electricity because plants are lit for three fewer hours each night. During the longer days of spring, the difference in electrical usage disappears because the duration of a day extension only needs to be long enough to provide a 16-hour photoperiod.

We suggest a four-hour night interruption to provide long-days to herbaceous perennials. If electric service to your greenhouse is inadequate to light all the plants you want to light simultaneously, we suggest that you light part of the plants as a day extension so the total day length is 16 hours. Light the remainder of the plants with a night interruption. If electrical services are still inadequate, lighting before sunrise to provide a 16-hour day will promote flower-

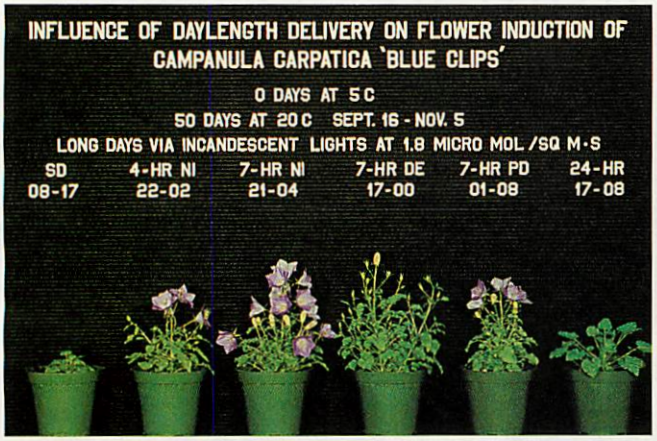

Figure 3. A cold treatment isn't necessary for flowering of Blue Clips *Campanula carpatica.* However, without a cold treatment, flowering is delayed significantly (approximately 30 days) when plants are grown under 24-hour continuous lighting.

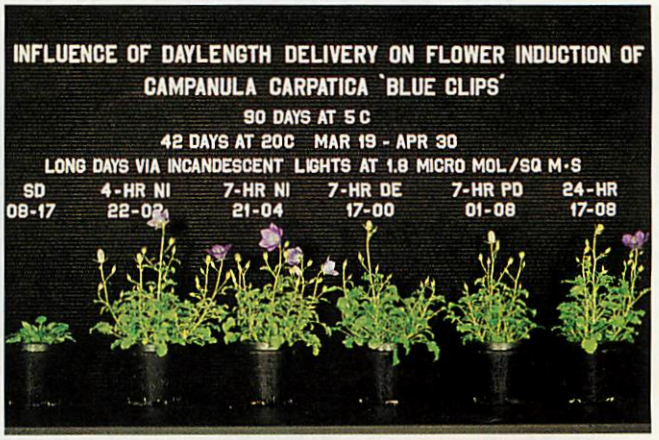

Figure 4. After a cold treatment, flowering of Blue Clips *Campanula carpatica* was no longer delayed when grown under 24-hour continuous lighting. All plants flowered quickly and uniformly, regardless of long-day lighting strategy.

ing, but plants may not flower as quickly as plants lit with day extension or night interruption. ❑

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