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Flower Induction of Long-day Annuals for Early Spring Sales

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We all know that color sells annual bedding plants. However, growers often struggle inducing certain long-day bedding plants into flower by target sales dates in early spring (Fig. 1). Many annuals flower in response to photoperiod and, to a lesser extent temperature and light quantity.

Fig. 1. A flowering ageratum crop that was provided with artificial long-days.

Long-day (LD) bedding plants typically flower faster when provided with a night length of less than 10 hours or when the day length is at least 14 hours long. Therefore, if you want to induce flowering, you need to provide an artificial LD photoperiod from approximately September 1 to April 15. If you are growing LD bedding plants under non-inductive short-day (SD) photoperiods, you are unintentionally increasing your production time, costs, and ultimately shrink! For example, this grower we visited on April 30th did not provide LD to their lobelia crop and consequently it will not be in flower for Mother's Day weekend sales (Fig. 2).

Let's say you want to have your seed petunia crop in flower for Mother's Day weekend sales, week 20. Most petunia cultivars are obligate or facultative LD plants. Depending on the cultivar, finishing temperature, and daily light integral (DLI) they can flower about four to six weeks after the start of LDs. To have flowering plants by this target sales date, you would want to start LDs during week 14 to 16 depending on the cultivar.

Fig. 2. A non-flowering lobelia crop grown under non-inductive short-days.

There is a long list of spring garden crops that only flower (obligate) or flower faster

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(facultative) when provided with LDs. Common annual bedding plants that require LDs include: ageratum, blue lobelia, blue salvia, dianthus, gazania, pansy, petunia, snapdragon, tuberous begonia, and verbena. Common perennials that require LDs include: campanula, coreopsis, leucanthemum, phlox, and rudbeckia. For more information on flower induction of annuals, please visit: Purdue Extension Bulletin HO-249-W.

Creating Long Days

Low-intensity photoperiodic lights and high-intensity discharge (HID) lamps can be used to provide artificial long-day photoperiods in greenhouses or outdoors. Growers typically use day-extension (DE) or night interruption (NI) lighting to provide LDs; each method has advantages and disadvantages.

Lamp types/light sources

To create DE or NI conditions, there are several choices available to growers, including low-intensity incandescent (INC), compact fluorescent lamps (CFL), and light-emitting diodes (LEDs) (Fig. 3), or HID lamps such as high-pressure sodium (HPS), mercury, and metal halide (MH).

Incandescent lights are the most commonly used photoperiodic

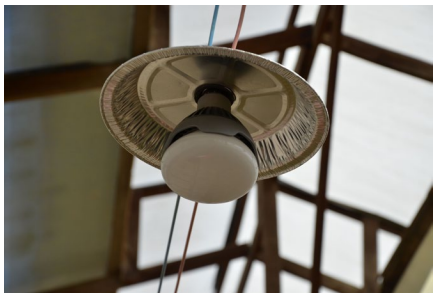

Fig. 3. A screw-in LED photoperiod lamp (currently available in Europe) with a pie plate reflector.

lamps in greenhouses to provide DE and/or NI lighting (Fig. 4). INC lights may be used for cyclic lighting, as the frequent on-and-off will not have an appreciable impact on bulb and fixture longevity.

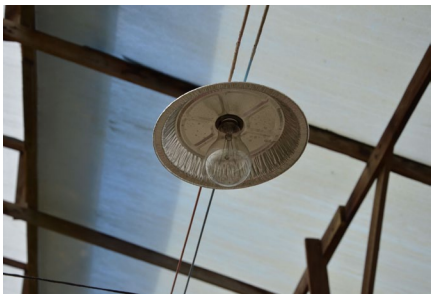

Fig. 4. An incandescent bulb with a reflector pie plate used in greenhouses to provide LDs.

There are several ways to use HPS lamps to provide DE and NI lighting. Most commonly, HPS lamps are suspended above the canopy. Another method is to mount HPS lamps on booms that move over the canopy. Light-emitting diodes are an emerging light source with promise (Fig. 3).

The development of screw-in CFLs

has posed an attractive alternative to traditional INC lamps for DE and NI lighting (Fig. 5). While CFLs are effective for use in photoperiod management for many crops, they are not ideal for all crops. The light quality of CFLs is low in far-red (FR) light and may not provide the required wavelengths for LD crops such including pansy and petunia. It is possible to "mix" CFL with INC bulbs to provide the required light quality for effective photoperiodic lighting.

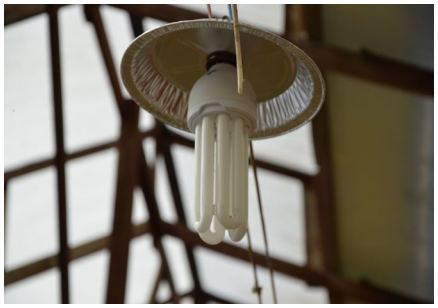

Fig. 5. A screw-in compact fluorescent lamp (CFL) with a reflector pie plate used in greenhouses to provide LDs.

Day extension lighting

Day-extension (DE) lighting is the use of photoperiodic lighting to extend the length of the day. The duration of DE lighting will depend upon: 1) period of darkness required; and 2) the natural day length. DE lighting begins at sunset and ends once the total desired photoperiod is achieved. For example, if sunrise in your area is at 7:30 a.m. and sunset is at 7:30 p.m., the natural day length is 12 hours. If you want to provide your LD crop with a 16-hour photoperiod, you would provide DE lighting from dusk for ~4 hours (an extra ½ hour for "insurance" against sunset/dusk).

Using a low-intensity light source such as INC or a combination of INC and CFL, the contribution of DE lighting to the overall photosynthetic daily light integral (DLI) is minimal. However, when HID lamps such as HPS lamps are used for DE, the DLI may increase, depending on the duration and intensity of light used. While the benefits of supplemental or photosynthetic light, they will not be discussed here. For more information, please visit: Purdue Extension Bulletin HO-238-W.

Night interruption

Night interruption (NI), is the practice of providing low-intensity light from one of the above mentioned light sources (~10 foot candles, 100 lux, or ~2 $\mu mol \cdot m^{-2} \cdot s^{-1}$) to plants during the middle of the night. By interrupting the dark period the plant will not perceive a "long" night ("short" day), but rather a "short" night (or "long" day).

When do you need to provide NI lighting and for how long? While responses may vary between different species and cultivars, common practice is to provide NI lighting from 10:00 p.m. to 2:00 a.m. Research has shown that a 4 hour NI is sufficient for plants that demonstrate a LD response.

Providing continuous light during NI is the safest way to ensure LD responses and most growers do provide continuous NI lighting. However, continuous light during the NI is not absolutely necessary for plants to perceive a LD and cyclic lighting is an alternative that can reduce costs for equipment (ballasts and lamps) and energy.

Cyclical lighting

Cyclical lighting is the use of periodic or intermittent lighting in the middle of the night. Generally speaking, plants need to receive the same low-intensity light (~10 foot candles, 100 lux, or ~2 $\mu mol \cdot m^{-2} \cdot s^{-1}$) for a minimum of 6 to 10 minutes every 30 minutes. This may reduce the overall amount of energy required to elicit a LD response by up to 83%.

Cyclic lighting may be provided several ways. First, timers may be used to turn incandescent lamps on and off, however this technique is not recommended for HPS lamps as it can decrease bulb life. Second, high-intensity HPS lamps may be mounted on a boom that moves back and forth over the canopy for at least four hours. Lastly, a new type of HPS lamp with an oscillating reflector/luminaire (ie. Beamflicker, Parsource) provides cyclic-type from a stationary light source (Fig. 6).

Fig. 6. A High-pressure sodium lamp with an oscillating reflector/luminaire.

How long should long-days be provided?

In most instances, once a plant is induced to flower under artificial LDs, flowers will develop even if subsequently exposed to non-inductive photoperiod (ie. short-days). Therefore, photoperiodic lighting can be discontinued once flower buds are visible to the naked eye (3 to 4 weeks after the start of LD), and LD plants will proceed to flower. This is not recommended for obligate LD bedding plants such petunia as plants will not flower as vigorously.