



By Erik Runkle



Replacing INCs with LEDs

Incandescent (INC) lamps have been used to create long days to regulate flowering since the discovery of photoperiodism nearly a century ago. They've been effective, inexpensive, and easy to install, but have been phased out of production due to their low energy efficiency. Many growers have replaced some or all INC lamps with compact fluorescent lamps (CFLs), which consume about one-fourth the amount of electricity as INC lamps. Although CFLs are generally effective at creating a long day, flowering of some long-day plants is delayed because CFLs emit little far-red light. You can read more about replacing INCs with CFLs at www.gpnmag.com/replacing-incandescent-lamps.

Light-emitting diodes (LEDs) are considerably more energy efficient than INC and CFL bulbs. LEDs also last much longer (at least 20 times longer than an INC bulb) and the spectrum of light emitted can be adjusted to elicit desired plant responses, such as to inhibit or promote flowering. In 2009, we started working with LEDs to regulate flowering using customized fixtures for experimentation. In 2011, we also started working with the GreenPower LED flowering lamps developed by Philips (Figure 1). Our research team, composed of several graduate students and technicians, has learned several important aspects about how the light spectrum influences flowering

of ornamentals. Most of these studies were with a four-hour night interruption (NI) with low-intensity lighting that delivered usually 2 to 5 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ of light.


- To inhibit flowering of short-day plants, red (R) light is the most effective light color. We grew plants under a range of ratios of red and far-red (FR) light, and the addition of FR light had essentially no effect on regulating flowering. Generally, plants did not perceive FR light alone; flowering responses under short days (without an NI) were the same as those provided with an FR NI. In some cases, plants under an R+FR NI were slightly taller than those under an R NI.

- To promote flowering of long-day plants, R+FR is the most effective on a wide range of plants and growing conditions. Some long-day plants flowered as quickly under

an R NI as an R+FR NI, but others (petunia, calibrachoa, and dianthus to name a few) flowered earlier under an R+FR NI.

- Later, we compared flowering responses under two types of the Philips flowering lamps: one type that emitted red and white light (R+W) and another that also emitted FR light (R+W+FR). Responses under incandescent lamps were also compared. We learned something surprising. When daylight levels were low (the average daily light integral was 6 $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$, which is typical of winter conditions in the Northern U.S.), several long-day plants flowered earliest under the R+W+FR lamps. However, when daylight levels were higher (12 $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$), flowering occurred at the same time for both lamp types. In some cases, plants under the R+W+FR lamps were taller than under the R+W lamps.

What can we conclude from this research? First, the LED lamps are equally effective as INC lamps at regulating flowering, assuming light intensity is similar. The flowering lamps from Philips consume about 15 watts per bulb and can reportedly replace a 150-watt INC bulb, resulting in a 90 percent decrease in energy consumption. Second, we learned that in the North and for early spring sales, lamps that emit R+FR light are the suggested INC replacement. In the South and for late spring sales, both LED types are effective. If more compact growth is desired, then the R+W LED is suggested.

The LED replacements for INC lamps are considerably more expensive than INC or CFL bulbs, but they last much longer and consume less energy. In locations where electricity supply is limiting, electricity costs are high, and/or photoperiodic lighting is used for more than a few months of the year, the LEDs could have a favorable return on investment. Conduct your own economic analysis considering your costs and lighting needs. For more information, contact Philips or one of their LED horticulture partners. 

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Figure 1. The GreenPower LED flowering lamps from Philips are suitable replacements for incandescent bulbs. (Photo: Philips Lighting)