Boom Lighting

By Erik Runkle and Royal Heins

Many large-scale commercial growers utilize automated booms to deliver water, nutrient solutions, pesticides and/or plant growth regulators to crops. Some growers have also installed lights on their booms to deliver photoperiodic lighting to promote or inhibit flowering. Providing exact recommendations for boom lighting is difficult because the research needed to generate such information is very limited. However, we have developed some general guidelines based on limited research with simulated boom lighting, studies with cyclic lighting and grower experiences.

The most common way of delivering long days to plants is to provide four hours of night-interruption (NI) or day-extension lighting. While lamps usually operate continuously during the lighting period, in many cases, turning the lights on and off can also be effective. This on-and-off strategy is termed "cyclic" or "intermittent" lighting and has been successfully used for decades, especially to inhibit flowering of short-day plants.

The most common way of delivering boom lighting is to install high-pressure sodium (HPS), metal halide or mercury lamps on the boom although some growers have installed several fluorescent, incandescent or LED lamps. Depending on the length of the boom and the fixture intensity, one to four high-intensity lamps are installed per boom to ensure both a sufficient intensity and reasonably good light uniformity.

Several years ago, Matthew Blanchard performed a simulated boom-lighting experiment using HPS lamps delivering lighting every 15, 30, or 45 minutes during a four-hour night interruption. Plants also received different durations and intensities of continuous NI lighting, from as little as 2.4 minutes at high intensity to four hours at low intensity. Lighting treatments were designed so they delivered two different light integrals during the night: 3,600 or 14,400 µmol·m^{-2}.

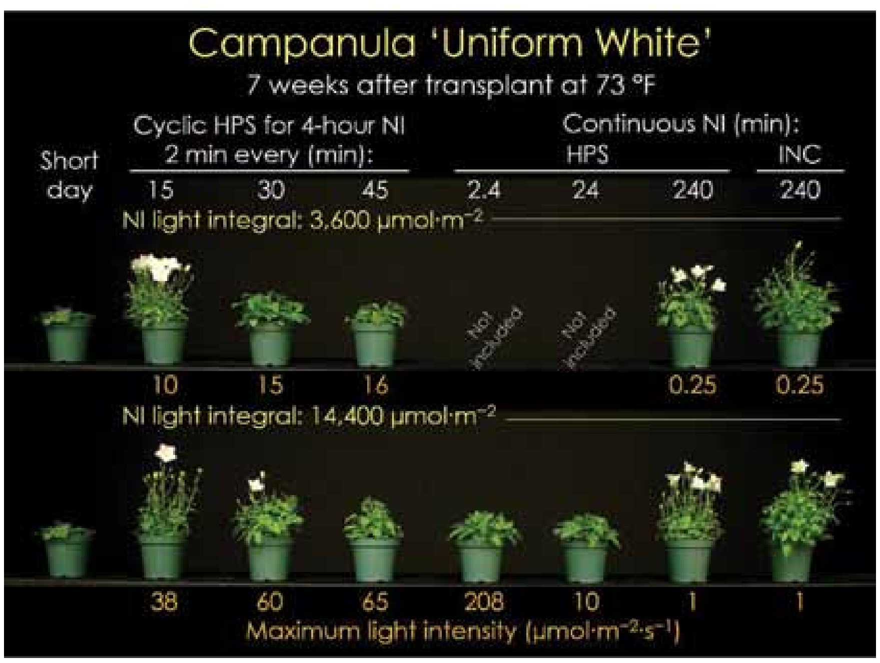

Figure 1. Campanula grown under different night-interruption (NI) lighting treatments from high-pressure sodium (HPS) or incandescent (INC) lamps that operated cyclically during a four-hour period or continuously for 2.4 to 240 minutes. Light intensity from the HPS lamps increased from the start of each lighting period until the end, and the maximum intensity (at the end of each lighting cycle) is reported.

As shown with the obligate long-day plant campanula, plants grown under the traditional four-hour NI lighting at 1 µmol·m^{-2}·s^{-1} readily flowered (lower right corner of Figure 1). Just as effective was simulated boom lighting for two minutes every 15 minutes at a low intensity (maximum 10 µmol·m^{-2}·s^{-1}). However when the interval between lighting was longer (30 or 45 minutes), the treatments promoted flowering to a lesser degree or not at all. When the light intensity increased about four-fold, then lighting intervals of 15, 30, or 45 minutes were similarly effective.

Single short periods of lighting at a high intensity (2.4 minutes at 208 µmol·m^{-2}·s^{-1} or 24 minutes at 10 µmol·m^{-2}·s^{-1}) were not effective as NI lighting on campanula or other long-day plants studied although research has shown short duration, high intensity lighting to be effective on the short-day plant chrysanthemum. Thus, the NI light integral is important in photoperiodic lighting but it is not the only factor that determines the efficacy of a long-day lighting treatment.

There is some reciprocity, or trade-off, with light intensity and interval meaning that to some extent the lighting interval (time between boom passes) can increase if the light intensity is increased. Conversely, the time between boom passes must decrease when the light intensity is lower. Here are some general guidelines for boom lighting:

- Operate boom lighting at the end of day or middle of the night for at least four hours
- Ensure that plants are lighted at least every 15-20 minutes during the lighting period
- The total amount of light provided to plants should be at least 3,600 µmol·m^{-2} during the long-day lighting period (1 µmol·m^{-2}·s^{-1} for one minute equals 60 µmol·m^{-2}).

An example that meets these goals is to have booms pass over plants every 20 minutes during a four-hour period with an average light intensity of 10 µmol·m^{-2}·s^{-1} (about 80 foot-candles of HPS light) for 40 seconds during each boom pass. Light intensity from moving booms is not constant; it increases as the boom approaches then decreases as it moves away, so calculating an average from the time plants initially are exposed to light until it is dark again is essential. In this case, the total light sum delivered would be 10 µmol·m^{-2}·s^{-1} × 40 sec × 12 boom passes, which equals 4,800 µmol·m^{-2}. Based on practical experience, this should be sufficient to promote flowering. Some growers have observed promotion of flowering with less than 3,600 µmol·m^{-2} but most rapid flowering may not have occurred. This is because many plants show a quantitative flowering response with light intensity delivered during photoperiodic lighting. Higher intensity, a longer lighting period and/or more frequent boom passes could further accelerate flowering in that case. g

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