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Turning On/Off Supplemental Lighting

An increasing number of growers are using high-intensity lighting during low-light periods to increase crop growth, especially during young plant production. The benefits of increasing the daily light integral (DLI) are well documented and include faster rooting of cuttings and greater root mass of seedlings. However, the costs to operate high-intensity lighting are quite high, so operation of lights should be managed as efficiently as possible. One question I'm commonly asked is when to turn lights on and when to turn them off.

In the January 2010 issue of *GPN*, I created a map illustrating when supplemental lighting of young plants has the greatest benefit (You can find the article at flor.hrt.msu.edu/lighting). This map also would apply to finish floriculture crops, as well as many other crops. Some very high-light crops, such as rose and tomato, would benefit from lighting for longer periods of the year. However, as a general guideline, the greatest utility of supplemental lighting in the United States and Canada is from November through February. Except for very high-light crops, the benefit of supplemental lighting is small from April through September, so in most locations the lamps should be turned off during those six months.

Figure 1. An example of input settings for a greenhouse environmental control computer to operate high-intensity lighting. Values used should be based on grower experience, the crops grown, light transmission through the greenhouse, and seasonal weather patterns.

Lamps on if:
Greenhouse in use (manual setting)
And date = October 15 to March 15
And time = 22:00 to 17:00
And outdoor light intensity < 200 µmol·m^{-2}·s^{-1} for 10 min
And outdoor 3-day average DLI < 12 mol·m^{-2}·d^{-1}
Lamps off if:
Outdoor light intensity > 400 µmol·m^{-2}·s^{-1} for 10 min
Or a condition for on is not met

Supplemental lighting is of greatest use during the night, of moderate use during cloudy weather and of practically no use during sunny weather. The operation of lighting can be controlled by a timer (less desirable) or a greenhouse climate control system (more desirable). If controlled by a timer, there are two basic options: lighting from one hour before sunset until some time during the night, such as midnight or 2 a.m., or lighting from four to five hours after sunset until one hour after sunrise. Note that in both scenarios, a period of darkness is provided, because a small number of crops do not tolerate continuous light well. A major downside of using timers is that the lights are not automatically turned on during overcast days. Regardless of strategy, the operation of lights should consider electricity costs to avoid peak rates that exist in some locations.

A better way to control lighting requires an environmental control computer with a light sensor connected to it. The light sensor should be placed outdoors and positioned so it does not get obstructed, such as on a weather station. The lamps can be programmed to turn on when the outside intensity is less than some value for a particular period of time and then turned off when the irradiance exceeds some value for a period of time. When using high-pressure sodium or metal halide lamps, the setpoints should ensure that the lamps do not frequently turn off and on, because that negatively influences bulb life (that is not a concern for LEDs, because on/off cycles shouldn't influence their longevity).

The settings used to automatically turn on and off the lights are subjective and somewhat situational. As a starting point, consider setting lights to turn on when the outside light intensity is less than 200 µmol·m^{-2}·d^{-1} (40 W·m^{-2}) for a period of time (for example, five to 10 minutes; Figure 1). The lamps could be set to turn off when the outdoor intensity exceeds a higher value, such as 400 µmol·m^{-2}·d^{-1} (80 W·m^{-2}), for five to 10 minutes. These values can be adjusted based on experience, the crops grown, transmission of light in the greenhouse and seasonal weather patterns.

A more sophisticated lighting control strategy would consider the amount of light received in the last several days. For example, if the past three-day outdoor average DLI was above some desired value (such as 12 mol·m^{-2}·d^{-1} or 6 MJ·d^{-1}), the lamps could be programmed to not operate the following day to reduce electricity costs. Because plant growth responses are based on light conditions over a period of time (weeks), in many situations, one day of low light can be compensated by other days of high light.

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