

# 10 LIGHTING TIPS

## TO HELP YOUR BOTTOM LINE

Considering lighting your spring crops?  
Here are some suggestions to make  
the most of the light your plants receive.

By Paul Fisher and Erik Runkle

**L**ight is key to producing quality crops and early flowering of long-day plants. But specifically how can you turn greenhouse lighting of spring crops into profit? Here are 10 tips that can help.

light is transmitted. Two common ways that light is excessively reduced are:

• The polyethylene film covering is dirty or old. It is false economy to keep poly or other glazing materials beyond the recommended product life. Ten percent less light equals about 10 percent less plant growth. Consider anti-condensation materials for inside the greenhouse and remove dirt on the outside.

• Too many hanging baskets above can hurt the growth of your bench crop. Research by James Faust at Clemson University found that two hanging baskets per square yard above a crop can reduce light transmission to the bench below by 40 percent. When producing hanging baskets, grow crops that are less light-sensitive on the bench below, such as impatiens or dracaena spikes rather than geraniums or petunias.

### 2. KNOW HOW MUCH LIGHT REACHES YOUR CROPS.

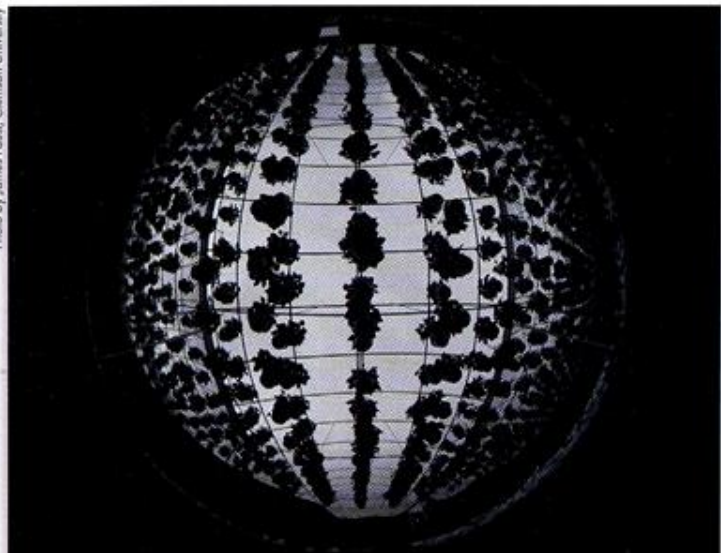
In general, at least 10 moles per square meter per day at plant level will produce bedding and potted crops of acceptable quality. Moles per day is a measure of the accumulated photosynthetic light over a 24-hour period, and is referred to as the daily light integral (DLI). In contrast, footcandles and lux are instantaneous light level units.

In December and January, most locations in the Northern half of the United States receive 10-15 moles per day of sunlight outdoors, and only 5-8 moles per day inside the greenhouse. Faust has developed "light maps" that estimate daily light integral during each month across the United States. (<http://virtual.clemson.edu/groups/hort/faculty/faust/maps.htm>).

There are affordable (\$150-\$350) light

This fish-eye image shows an upward view into a canopy of hanging baskets. One basket spaced 32 by 32 inches intercepts 27 percent of light.

**1. MAXIMIZE AVAILABLE LIGHT.** Before investing in supplemental lighting equipment, maximize the amount of light already available. You should aim for at least 50-percent light transmission in winter (i.e., half the light level outside reaches the plants inside the greenhouse). Determine your greenhouse light transmission by using a light meter outside and then inside the greenhouse to calculate what percentage of





meters that measure instantaneous light levels.

Make sure the light meter sensor is calibrated to sunlight and reads up to 10,000 footcandles, 108 kLux, or 2,000 micromoles per square meter per second. Instantaneous light meters are helpful for fine-tuning light management such as checking transmission through glazing or uniformity of light distribution from lamps.

**3. WHEN BUILDING A NEW GREENHOUSE, CONSIDER ITS ORIENTATION AND STRUCTURE CAREFULLY.** A north-south orientation provides less light transmission but is often recommended for ornamental crops because light is more uniform (shadows move during the day, resulting in even drying and flowering). An east-west greenhouse transmits more light, but transmission is less uniform within the greenhouse.

Build greenhouses with high sidewalls to allow for the installation of retractable shade and lamp fixtures. Fewer, more powerful and efficient lamps can be installed in greenhouses with high sidewalls compared with low quonset-style houses.

Consider installing polycarbonate (82-percent light transmission for twin-wall), acrylic (85-percent light transmission for twin-wall) or glass (90-percent light transmission) coverings rather than double-poly (80-percent light transmission). These light transmission levels do not account for reflection, aging and shadows from the structures. Open-roof and wide glazing panels obviously help.

**4. INSTALL RETRACTABLE SHADING TO MAXIMIZE LIGHT.** Retractable shade curtains enable growers to maximize light and growth on cloudy days and during the morning and afternoon. The curtains can be deployed for temperature control at midday on sunny days. During cold weather, curtains can be closed at night to reduce heat loss. In winter, don't shade most finished crops during the day unless less light is needed for humidity or temperature control.

**5. PROVIDE ARTIFICIAL LONG DAYS DURING EARLY SPRING WHEN PRODUCING PLUGS OF LONG-DAY PLANTS.** Long-day plants flower when the day is long and the night is short.

Starting with lighted plugs can reduce finish crop time. Research at the University of New Hampshire, Rutgers University and Kube-Pak showed that 'Ultra White' petunia seedlings that received supplemental lighting in the plug tray and were finished under natural daylengths flowered 10 days earlier in March than plugs that did not receive supplemental lighting.

The seedlings of some varieties have a juvenile period, where the plants are unresponsive to daylength until they reach a certain size or maturity. John Erwin at the University of Minnesota found that flowering of Purple Wave

## A CLOSER LOOK AT LIGHTING COSTS

A University of New Hampshire cost analysis found that typical lighting costs for supplemental lighting (375-575 footcandles) are about \$3-\$6 per square foot including installation, and 3-6 cents per square foot per week for electrical operating costs. A 1020 tray takes up 1.4 square feet, and plugs are typically lit for two to four weeks.

An example of the cost to light a plug tray:

4 weeks x 1.4 square feet x 6 cents electrical cost per square feet per week = 34 cents per plug tray. Dividing this cost into a 105- or 512-count plug tray is minimal on a per-plant basis.

In contrast, the cost (48 cents) of lighting a poinsettia at 1-square-foot spacing for eight weeks would be hard to recoup with increased crop price.

Supplemental lighting can be cost-effective if there is increased yield (more cut flowers), better quality and price (early-season perennials) or reduced crop timing. In addition, supplemental lighting is especially beneficial during dark periods. Typical supplemental light programs for ornamental crops can add 1.5-4.5 moles per day, which is roughly 50 percent more light than sunlight alone in Northern climates during winter.

### FURTHER READING

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**No HPS before transplant      HPS before transplant**

Both groups of petunias were grown under natural days after transplanting from plugs in March. The plants on the left came from plugs grown under natural days. The plants on the right came from plugs that received long days with supplemental lighting from high-pressure sodium lamps.



The long-day perennial *Campanula punctata* 'Cherry Bells' was grown under nine-hour short days (left) or 16-hour long days provided with either incandescent (center) or high-pressure sodium lamps (right).

petunia is not responsive to long-day lighting until two to three weeks after sowing. Cuttings and liners generally do not have a juvenile

phase so that lighting can be beneficial once cuttings are rooted.

#### **6. INCREASING THE DAILY LIGHT INTEGRAL CAN ACCELERATE FLOWERING OF MANY SPRING CROPS.**

Researchers at the University of Minnesota have categorized many bedding plants based on how plants respond to the average daily light integral. Some high-light plants such as petunia and geranium flower earlier and produce more flowers when the daily light integral is increased, which is independent of the photoperiod response. In other words, adding supplemental light (400-600 footcandles) in winter can reduce finish crop timing for many high-light plants.

You can use published information from the University of Minnesota and other sources or run your own trials to identify which varieties are more responsive to light levels and photoperiod to control flowering. For example, long-day, high-light plants such as petunia have a strong flowering response to both photoperiodic and supplemental lighting.

#### **7. PERENNIALS RESPOND TO LIGHT.**

Research at Michigan State University has categorized the flowering responses to light for a wide range of perennials to assist growers in programming flowering. Similar to bedding plants, perennials



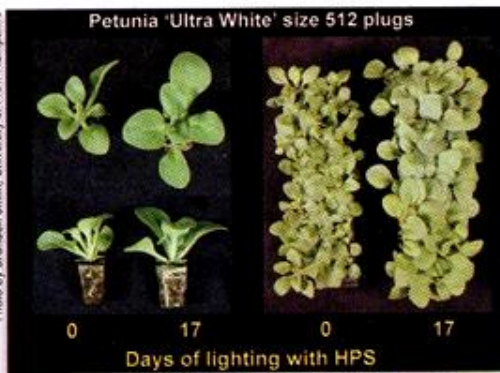
flower in response to photoperiod and daily light integral. For example, *Aquilegia flabellata* Cameo series is day neutral and requires a cold treatment for flowering. *Coreopsis grandiflora* 'Sunray' requires both a cold period and long days. *Campanula carpatica* 'Blue Clips' requires long days only. Asters and *Helianthus* 'Low Down' are short-day plants.

**8. SUPPLEMENTAL LIGHTING WITH HIGH-PRESSURE SODIUM LAMPS CAN BE MORE COST-EFFECTIVE.** Supplemental lighting with high-pressure sodium

lamps is usually more cost effective for plugs and liners than finished plants because young plants take up less space and time.

**9. PHOTOPERIODIC LIGHTING IS RELATIVELY INEXPENSIVE.** Photoperiodic lighting (10-20 footcandles) is usually less than 50 cents per square foot

Photo by Bradon Smith, University of New Hampshire



These petunia plugs received either sunlight only or sunlight and six hours of high-pressure sodium lighting at 450 footcandles.

Photo by Paul Friese, University of New Hampshire



High-pressure sodium lamps are mounted on a boom for photoperiod control of perennials.

for installation, and less than 0.5 cents per square foot per week to operate. Photoperiodic lighting is used to control flowering of daylength-sensitive crops but does little to influence the daily light integral.

A four-hour night break (from 10 p.m. to 2 a.m.) keeps short-day plants vegetative and induces flowering in long-day plants. For photoperiod control, night-break

## FOR FURTHER READING

For detailed information on this and other research, the authors recommend the book "Lighting Up Profits" from the "Online Store" at [www.meisterpro.com](http://www.meisterpro.com) or the Ball Bookshelf ([www.ballpublishing.com](http://www.ballpublishing.com)).

lighting does not usually need to be continuous. There are several ways to provide intermittent light, for example cyclical incandescent lighting, mounting high-intensity discharge lamps on a traveling boom or high-pressure sodium lamps with a rotating reflector.

**10. CONSIDER CARBON DIOXIDE AND HEAT.** As light level increases, carbon dioxide can become limiting for photosynthesis. In winter, dense crops in tight greenhouses can reduce carbon dioxide to about 200 ppm, nearly half the ambient level of 350 ppm.

Carbon dioxide supplementation is a low-cost investment that increases growth. Calculations by A.J. Both at Rutgers University found that cost is typically below 1 cent per square foot per week to maintain 1,000 ppm carbon dioxide during daylight hours in winter. In addition, heat emitted from supplemental lamps can raise plant temperature, which can hasten plant development and reduce crop timing.

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