Selection and Use of Grow Lights

By Mike Nuckols, *Local Foods and Horticulture Program Manager*

For many, indoor growing and seed-starting offer a reprieve for the dreary days of winter, when days are at their shortest and our skies are often cloudy. Increasingly, home gardeners and growers alike are turning to artificial lighting as a way to hold plants through the winter, grow salad greens and herbs, and start seeds for spring. Selecting the right lighting is important not only for the health of you and your plants but also as a way to save energy.

As prices continue to drop, light emitting diodes (LED) are quickly replacing both incandescent and fluorescent lighting. LEDs offer exceptional light quality for a fraction of the energy required by other types. Per the U.S. Department of Energy, a 12-watt LED light bulb provides as much light as a 60-watt incandescent bulb or a 15-watt compact fluorescent bulb. This represents an 80% energy savings over incandescent bulbs. Furthermore, high-quality LED bulbs have a significantly longer lifespan. A single incandescent bulb will need to be changed between 1000 and 3000 hours. Comparatively, a compact fluorescent will last 10,000 hours and an LED bulb will last a whopping 25,000 hours. In only a few years, LEDs have gone from expensive oddity to a cost-effective lighting solution.

The exceptional energy savings offered by this new generation of LED lighting open up a realm of possibilities for cost-effective indoor growing. Increasingly, growers are investing in year-round indoor production of food crops such as lettuce. In 2019, Gotham Greens raised $39 million for indoor greenhouses in cities such as New York and Boston. After a successful demonstration in Germany, Kroger is installing small grow-chambers for herbs and greens in their Washington State stores.

When selecting LED bulbs, you need to ensure that the lighting will meet your plant's needs, both in terms of intensity and wavelength. Traditionally, recommendations for plant lighting were given in watts; however, this rule-of-thumb does not translate to LEDs. Different LED bulbs may have significant variation in the amount and type of light produced at a given wattage. The layout of circuit-boards, the presence and size of internal fans, the presence and type of lens, and the color of individual diodes vary considerably and can affect a bulb's performance.

Though measurements reported in lumens, lux, and even foot-candles are useful, they only tell part of the story. These units report the amount of light that people can see – not the amount of light that plants can use. When selecting growlights, buyers should evaluate the bulb's PAR-rating. PAR stands for *Photosynthetically Active Radiation*. In simple terms, a PAR measurement is the amount of light that is actually useable by plants – which falls between 400 and 700 nanometers. PAR is reported as a percentage; the higher the percentage the better.

Plants use only about half of natural sunlight during photosynthesis. In general, chlorophyll uses more red and blue light than green during photosynthesis. Unused light is reflected, causing the leaves to appear green. By selecting LED bulbs that are strongest in the PAR spectrum, growers can enhance plant growth while saving energy. Interestingly, when using a bulb with a high PAR rating, virtually all of the light will be absorbed by the leaves, causing the plants to appear almost black!

If you decide to use broad-spectrum (white) lighting, you generally want to use 'cool' bulbs (more blue light) to promote active plant growth. If you want flowering or fruiting, choose 'warm' bulbs that emphasize the red portion of the spectrum. Color temperature can have other effects. Lighting heavy in the red and blue spectrum has been shown to increase the concentrations of carbohydrates and proteins in lettuce. Providing more green light to plants with anthocyanin pigments (such as red lettuce or coleus) results in leaves that are a deeper red in color.

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LED growlights should include diodes that emit light in the ultraviolet spectrum. Though invisible to people, UV light has been shown to result in larger and healthier leaves, shorter stems with more branching, and increased photosynthesis. UV light can also help to control fungal infections and prevent damping off of seedlings.

The amount of light striking the surface of a leaf is a function of both the intensity of the source and the distance the plant is from the source. If you move the light further away from the plant, you need a more intense light source. Lighting intensity may be weaker around the edges of some bulbs, causing uneven growth. Some manufacturers attempt to increase a bulbs output by focusing light through lenses, resulting in uneven patterns – and uneven plant growth. Look for bulbs that have an even dispersion of light.

Unlike incandescent bulbs which can bake seedlings, LEDs and fluorescent bulbs produce little heat. When seeds first emerge, hang growlights three to six inches from seedlings and raise the lights as the plants grow. Providing seedlings with a strong light-source immediately upon germination is critical to preventing 'legginess' – where the seedlings stretch towards the light. Leggy seedlings can fall over, are more prone to disease (to include damping off), and may be more difficult to transplant.

A question that people frequently have when using growlights is how long to leave them on every day. Seedlings should generally receive between 12 and 16 hours of light. For other plants, it depends on what you are growing and what you are trying to achieve. If you are simply looking to hold plants over the winter, as little as 10-hours of lighting may be sufficient. If you are looking to promote active growth, longer periods will likely be needed. This will vary with the type of plant and the amount of sunlight that it requires as well as the intensity of the lighting. A potted lemon tree might require 16 hours of bright lighting while a snake plant (Sansevieria species) might benefit from only a few hours from a nearby lamp. In general, lights should be turned off for no less than six total hours of darkness every night.

To promote flowering and fruiting, it's important to know if you are growing a long or short-day plant. Short-day plants (like poinsettia) will flower only after experiencing long uninterrupted periods of darkness. Long-day plants (like hibiscus) will flower only when periods of darkness are short. To trick a long-day plant into thinking it is summer and get it to flower, you only need to interrupt the night-time period. This can be done using a timer to turn on the lighting for an hour or so during the night. Conversely, lighting periods for short-day plants should be shortened to create a sufficient period of darkness every day. Care must be taken not to expose short-day plants to light from other sources during the night as this can be enough to delay flowering.

If you need even brighter lighting, such as a single floodlight mounted high in a greenhouse during the winter, High Intensity Discharge (HID) bulbs remain a viable option. HID bulbs come in two types: metal halide (a 'cooler' bulb better for plants in their vegetative cycle) and high-pressure sodium (a 'warmer' bulb that is better for flowering). While these bulbs can provide more intense lighting, they consume more electricity than LEDs and generate lots of heat. They also waste energy producing lights in parts of the spectrum that plants do not use or that plants use less efficiently. One advantage of HID bulbs in a greenhouse is that, during the day, they do not shade natural sunlight as much as larger fixtures. HID bulbs typically last about 20,000 to 30,000 hours. Purchasing one or two HID bulbs may be initially cheaper and easier than trying to light a large area with many LED bulbs; however, their long-term operating costs may outweigh LEDs in the long run, particularly as the costs of LED bulbs drop.

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