



By Erik Runkle



Lighting Greenhouse Vegetables

I've been receiving an increasing number of inquiries from greenhouse growers about lighting guidelines for growing fruiting vegetable crops. Certainly for vine crops like tomato, pepper and cucumber, the daily light integral (DLI) is the biggest limitation for greenhouse growers during light-limiting conditions. The primary way to increase fruit yield (fruit number and/or size) is to increase the amount of photosynthetic light provided to plants. As a general rule, a 1 percent increase in DLI increases production by 1 percent. Most vegetable crops are day neutral, so there's no reason to provide photoperiod (low-intensity) lighting.

Below are answers to commonly asked questions about lighting of vegetable crops.

How much light do I need?

A recommended minimum DLI for lettuce production is 12 to 14 mol·m⁻²·d⁻¹, whereas at least 15 (and preferably more than 20) mol·m⁻²·d⁻¹ is suggested for vine crops. Therefore, the answer to this question depends primarily on your geographic location. In the northern half of the United States, achieving such a high DLI requires high-intensity lighting for at least six months of the year. In the southern half of the United States, supplemental lighting is less

Figure 1. High-pressure sodium lighting of greenhouse cucumber in Norway.



critical, although it will increase crop yield from autumn through spring.


A typical supplemental lighting intensity for high-light vegetable crops is 125 to 175 μmol·m⁻²·s⁻¹ [950 to 1,330 foot-candles from high-pressure sodium (HPS) lamps]. If a grower wants to increase the DLI by 10 mol·m⁻²·d⁻¹ and plans to operate lamps for 18 hours per day, then an intensity of 155 μmol·m⁻²·s⁻¹ (1,175 foot-candles) needs to be provided. That's at least twice the intensity that is typically provided by U.S. growers of ornamentals. An even higher intensity (for example, 200 μmol·m⁻²·s⁻¹, or 1,520 foot-candles) is commonly provided in greenhouse tomato production in northern Europe, where the natural DLI is very low. Growers also provide supplemental carbon dioxide to maximize the benefit of supplemental lighting.

How do I provide that light?

The HPS lamp is still the recommended way to provide high-intensity lighting to greenhouse vegetable crops. During the winter, heat emitted from the lamps can account for 25 percent of the total heating of a greenhouse, although the cost of that heat is likely higher than if provided by a heater or boiler. As light-emitting diode (LED) technology improves, and as their prices decrease, they may become the preferred light source, especially for growers who use lighting much of the year.

Some growers and academics are experimenting with "intra-canopy" lighting of high-wire vine crops, where lamps are positioned between plant rows to provide light to leaves towards the middle of the canopy. LEDs are particularly well suited to this technique, since they emit less heat than HPS lamps and thus, can be placed close to the leaves. It's possible that in the future, a combination of HPS lamps and LEDs will be commonplace in greenhouse production of vegetables.

When should the lamps operate?

The benefit of supplemental lighting is greatest when the ambient light intensity is low and at night. Thus, lamps are operated much more during the winter than during other parts of the year. Some crops, especially tomato, become stressed and develop chlorotic leaves if grown under continuous light. Therefore, four to six hours of darkness is suggested each night. For more information on greenhouse lighting, visit <http://flor.hrt.msu.edu/lighting>. 

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