Light-emitting diode treatments outperform traditional lighting methods

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This is a photo showing an intercanopy view of the LED tomato experimental setup with ripe fruit at McGill University, Macdonald Campus (Ste-Anne-de-Bellevue, QC). Credit: Mark Lefsrud

In Canada, where outdoor growing seasons are limited, sales from greenhouse fruit and vegetable production operations still surpass $1.1 billion annually. Finding more efficient methods for providing lighting

in greenhouse production is a key component to support these high levels of production and increase revenues. "Light irradiance is the limiting factor for increasing production in greenhouses, when all other factors (temperature, nutrient levels, and water availability) are adequately maintained," said the authors of a new study. McGill University researchers Paul Deram, Mark G. Lefsrud, and Valérie Orsat said that the broad-spectrum high-pressure sodium lamps currently used to provide supplemental lighting for greenhouse are "not the most efficient light source" for greenhouse plant production. The team published the findings of their study aimed at finding alternative lighting options in *HortScience*.

According to the authors, specific light frequencies in the 400- to 700-nm range have previously been shown to affect photosynthesis more directly than other wavelengths (especially in the red and blue ranges). The researchers designed experiments to determine whether light-emitting diodes (LEDs) could reduce lighting costs in greenhouses. "LEDs can be selected to target the wavelengths used by plants, enabling growers to customize the light produced, to enable maximum plant production and limit wavelengths that do not significantly impact plant growth," they explained.

The scientists subjected hydroponically grown tomato plants to three light intensities at three red-to-blue ratio levels. Secondary lighting treatments used for comparison included 100% high-pressure sodium (HPS), 100% red LED light supplied from above the plant, 100% red LED light supplied below the plant, a 50%:50% LED:HPS mixture, and a control (no supplemental lighting). Both runs of the experiment were implemented for 120 days during two (summer-fall and winter-spring) seasons.

Results showed that the five highest number of fruit-producing light treatments were 5:1 high (385 fruit), 5:1 medium (358 fruit), 5:1 low

(341 fruit), 19:1 high (315 fruit), and 100% LED (310 fruit). "Overall, the highest producing LED treatments consistently outperformed the high-pressure sodium treatment alone," the authors said. "These treatments can be considered an improvement over traditional HPS lighting for greenhouses."

Outcomes also revealed that high irradiance levels resulted in the highest vegetative biomass and fruit production for all ratios. The results showed that the highest biomass production (excluding fruit) occurred using the 19:1 ratio, while higher fruit production was obtained using the 5:1 ratio. The highest marketable fruit production resulted from the 50%:50% LED:HPS treatment. The authors said that the 5:1 high treatment performed well in every category.

"As expected from the literature, higher intensities bring forth more production with all ratios producing more under higher irradiance levels," Deram, Lefsrud, and Orsat said. They also determined that an increase in red light increased biomass production and slightly lowered the amount of fruit production. They concluded that LEDs are a "promising mechanism" to enhance greenhouse artificial lighting systems.

The complete study and abstract are available on the ASHS HortScience electronic journal web site: hortsci.ashspublications.org/c … nt/49/4/448.abstract

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