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GROWING EDGE
International

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Vol. 20, No. 1
September/October 2008

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LEDs and hydroponics: Are we ready?

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Another Perspective: Are LEDs Ready for use in Commercial Hydroponics?

Ed Harwood is the founder of Great Veggies® LLC in Ithaca, NY and is currently involved in a collaborative research project with Cornell's Dept. of Horticulture and Rensselaer Polytechnic Institute's Lighting Research Center to explore LED applications to his aeroponic technologies to grow salads in a controlled environment.

Ed Harwood's story is a cautionary tale about the use of LEDs before the right kind of technology is available to make them effective in commercial hydroponics. He believes that some manufacturers are hyping their LED products to the detriment of growers. He recalls one claim that said LED lights save 33 times the power of an HID. A few years ago, he wanted to test out these claims and spent $1,000 on LED lights and set up shop in the basement of an old factory with the intent of growing lettuce. He set up an eight-bar LED (24 clusters) light according to one manufacturer's specifications and in the first three-week trial, it etiolated (a technical term for "reaching"). Basically, his greens weren't getting enough light. He consolidated the light bars and then moved them closer to the plants in subsequent trials and had a little more luck but yields and the look never matched the outcome of the HPS lamps. He found that use of LEDs was "more like a power savings of 3 times over a standard HID."

The good thing about LEDs, he said, is that there is no radiant heat, making the light cool to the touch, but he pointed out that LEDs produce approximately the same amount of heat to light as an HID or fluorescent whether high intensity LEDs or not. The heat with LEDs is just emitted at the back end of the light which requires a system to remove the heat. "If you do not remove the heat," explains Harwood, "the life of your LEDs will be reduced by thousands of hours per degree C°. Placed without ventilation they will have a life expectancy of around 5 years- or until the lamp emits only 80 percent of the original amount, the current industry definition of the end of life."

Removing the heat requires some kind of fan or water cooling system., Harwood says. Typically an LED light array manufacturer will add heat sinks on the back of the circuit board which pulls the heat away, but this doesn't remove the heat, merely increases the surface area for water or air to remove it. This is one reason Harwood feels that a lot of refinement is still needed for LED lights to be practical in commercial hydroponic projects. Though Harwood admits the hobbyist may be okay, especially if their crop is exposed to some ambient light as well. In his case, he was growing in a basement without any other source of light.

Harwood says that an interesting aspect of plant light spectral research, which only began in earnest about ten years ago, is that the absorption of light often has little to do with the resulting action of the plant. There are redundant pathways resulting from specific light spectra that often confuse results. Every plant variety has evolved its own sets of light stimulated pathways for each basic plant function.

"We do not know the combinations: how much, when to apply, and how long to apply using arrays of narrow band spectra. Thus we will have to experiment carefully and precisely. It is clear that all varieties and stages of growth and flowering may be different in their use of specific light spectra."

For instance, he says growers will find that they don't need green and yellow light and in fact, for most green leafy plants these colors can inhibit growth and yield. Also, Harwood says, "there is no evidence that amber is useful for anything plant related and these LEDs are very expensive."

But in general he thinks it would be wonderful to encourage "citizen science", where growers are experimenting with LEDs in order to get the kind of practical case studies that will lead to greater knowledge about what looks like will be the future of hydroponics. "Imagine the ginormous task of identifying the correct light spectral application for thousands of plant varieties across several phases of plant growth!"

Resources

The RPI Lighting Resource Center, http://www.lrc.rpi.edu.

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grow lights than are ready to start using them. Gardeners do not want their crop to wind up as the "guinea pig" in a failed garden-lighting experiment. A lot of trials and research have been conducted in labs that show LED grow lights to be effective and cost-efficient. But those trials were done in a laboratory setting. What's missing are verifiable and repeatable consumer-oriented trials that put LED grow lights up against their HID counterparts, in conditions that resemble a hobbyist indoor garden room. Until that happens, individual gardeners can experiment with LED grow lights on their own, either on a small scale or by segregating a small number of plants within their garden for trials.

Looking ahead

What is the future of LED grow lights?

Near-term, we should expect to see a wider variety of LED grow lights coming onto the market. These lights will increasingly include higher output LEDs in a variety of light colors and configurations. We expect to see combination lights hitting the market, using LED plus T5 fluorescent or HID garden lights to provide a more balanced spectrum than is available from these garden lights used alone.

We are starting to see LED grow lights designed to support different plant growth stages, such as grow and bloom, and should expect lights to be introduced for specific plants such as tomatoes, herbs, or orchids. We will see continued improvements in light output, particularly as fourth-generation LEDs continue their migration from the lab to the market. Prices will begin to come down when sales volume increases.

In the long run, LED lighting could make almost every other type of light source obsolete. Retrofit LED lamps that fit into standard fluorescent lighting fixtures are already available, and LED fixtures are in the works that will replace street lights, stadium lights and other interior and exterior lights. Already, Amsterdam and Rotterdam in the Netherlands are testing LED street lighting. Press reports indicate that other major cities are considering similar trials.

LED grow lights will be swept ahead with the tide of mostly government-funded research and development now under way. Research dollars invested by NASA and other