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FEATURES

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The Best of Both Worlds

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Many cultivators today, especially produce growers, are caught between the past and the future. They're constantly looking for ways to improve their operations—to be more consistent and efficient, to improve margins, to optimize production, and to enhance quality and profitability. At the same time, they're often limited by factors like facility constraints, available capital or even their own comfort level in adopting new technology and innovations with which they're not as familiar. As with any change to an environmental input, this is very much true for supplemental lighting options.

So what happens when a cultivator can't afford to or isn't yet comfortable replacing their legacy high-pressure sodium (HPS) lighting systems, but still wants the benefits associated with an LED retrofit? For these cultivators, a hybrid lighting solution is an important in-between step to help them transition to 100% LED lighting solutions while staying competitive in the market. Many growers have embraced models that combine the affordability of retaining some existing HPS lighting while introducing new LEDs to enhance performance.

The benefits and challenges

In a field with increasingly tight margins, top-line metrics like year-round crop consistency and yield will only become more important. As the market evolves toward continuous, consistent production models, the benefits LEDs provide—even when they're only a subsection of the total lighting—simply can't be ignored.

For many growers, the most critical of these benefits is affordability. A full retrofit often requires not only the capital expense of the lights themselves, but also a re-examination of an entire facility: electrical systems, HVACD utilization (for cannabis growers), environmental stability and heat dispersion. Cultivators must account for all of these and more, raising the barrier to entry and shifting the cost-benefit analysis of a facility-wide retrofit.

This is exactly the type of situation where hybrid lighting solutions can help growers bridge the gap without having to make system-wide changes. One of the most frequently cited hurdles, for instance, is how to replace the "free" heat HPS provides while maintaining environmental set points with LEDs.

Cannabis grow room facilities using full LEDs will have a lesser HVACD load. However, growers should take notice of their facility's relative humidity and map a clear plan for the transition from HPS to LEDs. The heat from HPS systems helps reduce relative humidity, subsequently reducing the dehumidification load.

Under a hybrid deployment, cultivators don't have to buy into one strategy or the other. They can test how an

environment and their crops change when shifting from full HPS to half HPS/half LED. If they can easily maintain or improve environmental control, optimize their HVACD loads (for cannabis growers) and improve plant performance, they can easily make the case for a full facility retrofit when it makes the most sense for them based on budget, production timeline or market demand.

Finding the right spectrum

We at Fluence are constantly working with growers to optimize their lighting strategies using LEDs—finding that combination of spectrum and intensity that improves plant performance and helps cultivators achieve their production goals. It's often the area cultivators exploring a retrofit are least comfortable with and want to know more about before committing to a full LED strategy. It's also the area that, when done well, holds the key to creating new economies of scale.

Pictured: Although a full LED retrofit is ideal for optimizing spectrum control, a hybrid system introduces enough LEDs to induce the desired spectrum to enhance plant growth while retaining HPS fixtures.

Although a full LED retrofit is ideal for optimizing spectrum control, a hybrid system introduces enough LEDs to induce the desired spectrum to enhance plant growth while retaining HPS fixtures. The process of identifying the right spectrum is governed by many factors, one of which is the efficacy of the LED fixture. Efficacy increases as the percentage of red light increases when compared to spectra with higher blue or green content. It's not always true, however, that the most efficacious spectrum is the best choice for the crop's growth and quality.

That's why it's vital that cultivators use the latest research, conduct their own trials and consult with experts like Fluence's horticulture services team to determine the right spectrum—and the optimal intensity—for their unique growing conditions. When helping growers conduct a full or partial LED retrofit, Fluence's Horticulture Services team will work with the grower to understand their intended objectives, geographic location and other infrastructure characteristics to recommend the ideal spectrum and intensity for their growing conditions.

How will my crops benefit?

In recent years, the number and diversity of controlled environment crops supported by hybrid LED-HPS lighting systems have grown rapidly. The following studies were conducted under full LED strategies, broadly illustrating the benefits of LED technology and how a transition to a hybrid strategy could create new opportunities for plant yield and quality.

Strawberries

Fluence studies with leading Dutch researchers, greenhouse facilities and strawberry cultivars have shown the potential for this type of spectrum-specific growth potential. Fluence's triple-replicate study of June-bearing strawberries, for instance, analyzed conditions under white light, white light with a fraction of far-red, pink light and pink light with a fraction of far-red, all at a photosynthetic photon flux density (PPFD) of 200 µmols/m2/s, with winter and spring flushes.

The study's findings showed that strawberries grown in broad-spectrum lighting conditions with a fraction of far-red outperformed their counterparts across metrics, including plant height, canopy width, yield and Brix value.

Vine crops

Fluence, in partnership with Wageningen University & Research (WUR), also studied the effect of light distribution within cucumber and tomato canopies, this time with a particular focus on light intensity on plant growth using intercanopy LED lighting. The studied intensities (top light only at 250 µmol/m-2/s-1, top light and intercanopy lighting at 250 µmol/m-2/s-1, top light only at 375 µmol/m-2/s-1, and top light and intercanopy lighting at 375 µmol/m-2/s-1) displayed the variety of settings and configurations available to cultivators when they adopt and finetune LED systems.

Using Fluence's VYPR luminaire and VYNE intercanopy lighting solution, Fluence and WUR demonstrated that adding intercanopy lighting at the highest studied intensities increased cucumber yield by up to 110% and increased the number of cucumber fruits by up to 53% when compared to lower-intensity top lighting solutions.

Tomatoes showed a similar response to the varying light intensities, with total tomato yield increasing 62%, while the total number of tomatoes increased 57% using intercanopy lighting at higher intensities.

The impact on other environmental factors

Along with light spectra and intensity, hybrid LED lighting allows growers to understand the importance and process of adjusting their current cultivation processes, including practices relating to HVACD systems (for cannabis growers), ventilation and vapor-pressure deficit.

Ambient temperature is a critical factor in plant growth and has a major impact on a plant's physiological functions and its morphological responses. Since there's a learning curve on temperature management when working with full LEDs for the first time, a hybrid system assists the grower by maintaining partial excess heat from the existing HPS system—an element they're accustomed to—while simultaneously improving the grower's ability to adapt to future full-LED lighting scenarios.

Growers utilizing HPS systems are also limited in increasing PPFD due to higher radiant heat levels from HPS fixtures. It can be a challenge to manage excess heat at higher light intensities while maintaining consistent temperature and humidity levels critical to crops during their developmental stages. Even replacing 50% of a legacy HPS system with LEDs is a big step toward ensuring better control over environmental conditions. It also affords new opportunities to increase PPFD levels and optimize overall crop productivity.

Another byproduct of high HPS temperatures is that temperature changes when HPS lights are turned off, leaving crops vulnerable to condensation and pathogens as they cool more rapidly than the rest of their environment. These risks are avoidable with the inclusion of LED lights, making the environment less affected by the heat produced by changes in HPS temperatures. The stability provided by LEDs helps create less condensation and lower overall water use. **IG**

Abhay Thosar has a Ph.D. in plant physiology from Gujarat Agricultural University, more than a decade at leading greenhouses and nurseries, seven years at Philips Lighting and a role at Fluence that allows him to work directly with the world's cultivators. As director of horticulture services at Fluence, he manages a team of horticulture specialists that enhances how cultivators grow their crops, optimize their lighting strategies and increase profitability. For more, visit www.fluence.science.
