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Let Them Eat Photons

Among the many advantages of SSL is its potential to offer benefits that go well beyond energy savings — and, in so doing, to expand the definition of what lighting can be and do. One aspect of this involves horticultural lighting, a field that lately has been attracting a growing amount of interest (puns intended) from multiple quarters.

Although horticulture lighting has been around for decades, there's no question that LED technology has sparked the present upsurge of interest. That's because, in a horticultural setting, LEDs have the potential to outperform the incumbent lighting technologies on a number of parameters — not just in terms of energy efficiency, but also in terms of directing the light better, producing less heat, lending themselves to form factors suited to indoor farming, and tuning the spectrum to meet the specific needs of plants.

Recently, at the 14th annual DOE SSL R&D Workshop, Bruce Bugbee of Utah State University and Tessa Pocock of Rensselaer Polytechnic Institute's Center for Lighting Enabled Systems & Applications held the audience spellbound as they discussed these and other related points. For example, Bruce observed that selectively tuning the spectrum can not only increase crop yield, but can also affect such plant characteristics as nutritional content, flavor, appearance, and disease resistance. That's not surprising when you consider that, as Tessa explained, plants have a dozen different types of photoreceptor cells, which are activated by the entire light spectrum and drive the process of photosynthesis that converts light into food.

But although LED lighting has the potential to outperform conventional lights in horticultural applications, it's far from a slam-dunk at this stage of the game. That's because conventional lighting technologies used in greenhouses and indoor farms are not only relatively efficient, but also relatively inexpensive — which means that LEDs have to be at their best in order to compete. Just recently, LED products have been able to surpass high-pressure sodium (HPS) lights in terms of horticultural efficacy, characterized by photosynthetic photon flux (PPF) in units of μ-moles/second. And while conventional lighting technologies matured long ago, LED lighting is continuing to improve at a rapid pace, getting cheaper as it gets better and more efficient. So the tipping point is fast approaching.

However, as Bruce pointed out at the workshop, the economics of growing plants with the

help of electric light are such that, no matter how cheap and efficient LEDs become, indoor farming will never make economic sense for staple crops such as wheat and corn, because their market value per unit of weight is too low to justify the expense of electric lighting. But high-value crops with considerable water content — such as tomatoes and lettuce — are already being grown effectively and profitably in greenhouses and “vertical farms” — multistory buildings that have been converted to agricultural use.

The horticultural use of LEDs would not be possible without the many advances that have resulted from their use for general illumination, because the underlying technology is the same. Many of the lessons learned from developing LEDs for general illumination, and the standards that have been developed, can be applied to their use in growing plants indoors. In the same vein, as Bruce noted at the workshop, because of their controllability, spectral tunability, and other advantages, LEDs are helping scientists tremendously in gaining a better understanding of the role of light in the growth of plants.

The proliferation of horticultural lighting will, no doubt, increase energy use, but the use of LEDs in greenhouses and vertical farms can also increase productivity, reduce water usage, enable more-diverse produce, and promote fresher, more local food supplies. That's why it’s crucial that LED lighting continue to improve for the specific needs of this application, improving productivity and quality while simultaneously minimizing the cost and energy required.

Best regards,
Jim Brodrick

As always, if you have questions or comments, you can reach us at postings@akoyaonline.com.