GROWERTALKS

Cover Story

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LEDs—What's the Pay-off?

Jennifer Zurko

As the advent of controlled environment agriculture and hydroponic growing picks up the pace, new technologies are starting to join the race to help make life in the greenhouse (or warehouse) a little easier.

One of those technologies is light-emitting diodes (LEDs). Although the concept of electroluminescence (the effect that LEDs have) was first discovered in the early 1900s, the actual products that derived from this discovery weren't commonly used until the mid-2000s, when consumers could start buying LEDs for the lighting fixtures around their homes.

Pictured: Rainbow Greenhouses in Chilliwack, British Columbia, installed LED lights in 90,000 sq. ft. of new glass greenhouse three years ago, making them the biggest single installation in North America so far.

It's no surprise that researchers within companies like Philips and GE, who have been conducting research on lighting for decades, started to tinker with LEDs to see how they could be used in other applications. We began reading about university horticulture researchers trialing LEDs in greenhouses—which makes sense since light is part of the plant requirement trifecta.

Today, there are many companies that have been knocking on greenhouse doors, armed with research data and a laundry list of benefits with growing under LEDs. We're seeing more and more of the pretty pink and purple lights above crops like cannabis, microgreens and vegetables; however, ornamental growers have been slower adopters. Cost and overall skepticism have been the primary reasons for this, but the tide may be changing.

Winning over the skeptics

Heliospectra is one of those companies that manufactures LED lighting for the ag/hort sector, but they have one advantage over other suppliers—they began as a plant research company. Based in Göteborg, Sweden, Heliospectra was founded by plant physiologists and biologists whose sole focus was to study how to best optimize growing conditions in greenhouses from top to bottom. Obviously, this included traditional greenhouse HPS lighting, which researchers felt wasted energy and weren't, in their opinion, really providing the best lighting conditions for the plants. So they turned their focus on finding which type of lighting worked the best, both in their own research lab in Sweden and together with a large local herb greenhouse operation as their trial site.

Their first product run was strictly a research prototype that featured many different wavelengths and was too high-tech and expensive for a greenhouse grower. But after a couple more years of trialing and tweaking, they introduced their LX60 series of LED lights for the greenhouse in 2014. Rebecca Nordin, Marketing Manager for Heliospectra and based in Sweden, joked that they kind of worked backwards—developing the complicated product first and then taking the steps back to fine-tune it to be the ideal lighting support that's easy to operate.

To help establish themselves in the North American market, Heliospectra hired Caroline Wells to manage sales and marketing. Caroline has a strong background and knowledge of LEDs and the industry in general, so she's familiar with their main challenge: getting growers to change their thinking about LEDs.

"As you can imagine, the serious competition is just the status quo; it's just, 'Look, I have some lights. They're working for me. Why should I make a change?'" Caroline explained. "The traction here is just getting started, but it's exciting. For the first time in years, growers are starting to talk about lighting. All of these other advances have been made in the greenhouse growing environment in recent decades, but lighting has kind of languished because we had a way of dealing with lights. We had our HPS lights and they worked okay for a lot of scenarios, but with the advent of LED lighting, we've opened up a whole lot of other possibilities for growers."

Caroline said that her philosophy isn't to walk into a greenhouse and try to sell LEDs; you need to act as more of a consultant than a salesperson. You have to first sit down and found out what it would involve if the grower switched from HPS to LEDs. Listen to their wants and needs based on the kind of crops they're growing.

"The first thing that we do is try to pretty closely match the light output that they've been receiving with HPS," said Caroline. "If they're reasonably comfortable with the yields and the crop performance, then we get a benchmark. We tell them, 'This is what you're getting with your HPS. Let's approximate that with LEDs before we do anything else.' I think that makes growers much more comfortable because right off the bat they see those energy savings—that we're not doing anything fancy—and then we can start to introduce some changes."

Are LEDs worth it?

Admittedly, some growers are more open to change and new technology than others, and Heliospectra tailors their support based on how accepting the grower is to switching over. This also helps them as they go through the process of finding out whether it's worth the effort of completely replacing the lights … because

sometimes, it isn't.

"Sometimes there isn't savings there for the grower and I'm always up front about it because nobody here is interested in specifying an installation that's not going to deliver the benefits that we tout," said Caroline, but more times than not, the grower does see the benefits that LEDs provide. And the most important reason isn't what you may expect.

Sure, you save on energy with LEDs—almost any grower paying attention knows that—but it's the increase in crop quality and yield that convinces them to make the switch. Caroline gave an example of when they showed a cannabis grower how he could reduce his crop cycle by two weeks, which could increase his yield over the course of a year—maybe by as much as a full growing cycle.

"Instead of just looking at energy savings, they're looking at those revenue gains," said Caroline. "It's a whole different way of looking at the payback scenario."

Not that the energy savings is anything to sneeze at—Caroline said that the average grower can typically see up to 50% savings on energy costs, which includes a reduction in their HVAC load. But if you really want to know what the payback with LEDs is, Caroline says that it's usually within three years after installation. If you choose to pay for your LEDs in installments, you can see the payback much sooner, almost right from the first electric bill. It just depends on how and when you want to pay for your LEDs.

Also, LEDs last longer than HID or HPS lights and that's a benefit that's appealing to any grower.

"A lot of growers grumble about the bulb replacement burden that HPS lights pose. I've seen a replacement schedule varying from every two years to every six months, so it's a big burden," said Caroline, who said that Heliospectra LED lights last up to 50,000 hours. Traditional greenhouse lights last about a fifth of that.

And you can pretty much grow anything under LEDs. Heliospectra is really pushing that with their new research where they're growing oats, barley and wheat under LEDs and getting successful results.

"LED lighting has really emerged and we got to the place where you are able to grow everything, basically," said Rebecca. "In the end, you just need to have the right spectrum and intensity for the right plant."

A few of the cons

The expense is a huge concern for many growers, as LEDs can cost as much as three times more than HID/HPS lights, so some may just be waiting for the price to come down. But the question is will it and when?

Caroline admits that's tough to predict. "There are some components that go into lights that drive the cost to the points that they're at—the LEDs themselves, some of the metals involved," she said. "So do I think there will be some price depression? Probably, but there could be some shortage of some element that drives them higher."

Caroline believes that, even if the price of LEDs doesn't decrease or does so slowly, as more growers adopt them there will be less of an emphasis on the actual product and more on the services they will expect from

their supplier. As with plant cultural information growers get from the breeders, they will demand that the lighting vendors provide all of the information they need to operate their LEDs, which includes lighting recipes or plans for specific crops, and some companies are still trying to figure that part out.

“There have been a lot of improvements [in LEDs] and I know a lot of different companies are working on setting more standards within the industry,” said Rebecca. “But one of the things that we’re pushing is to be very open with our customers, so growers shouldn’t be afraid to ask questions to get information. A good company should be able to answer those questions and they should have that information ready.”

A grower’s perspective

Rainbow Greenhouses in Chilliwack, British Columbia, installed LED lights in 90,000 sq. ft. of new glass greenhouse three years ago, making them the biggest single installation in North America so far. Owner Stan Vander Waal and Head Grower Rob O’Hara admit that two seasons isn’t enough to really know what the true payoff will be because they’re still learning how to best use the programs, but they did offer some thoughts on the system.

When asked why they would put in LEDs instead of traditional HPS lights, Stan and Rob chuckled, but the answer was simple. As of early March, electricity cost 9 cents per kw/hour, which is less than other areas of Canada, but Stan knows that probably won’t last.

“We were building a new greenhouse and we were wondering what we were going to do for lights,” said Stan. “We know the cost of electricity is just going to keep going up and that the LEDs will eventually pay for themselves.”

“We tested LEDs for one season and saw the benefits,” Rob said. “So we thought we’d stick out our necks and try it.”

The math is hard to do in the beginning because LEDs cost three times as much as traditional lighting, said Stan. And there are a number of different factors involved with having an LED system—like knowing which colors on the spectrum to use and for how long. But one main requirement that the LEDs had to have was that they had to grow just as well as HPS lights. And so far, Rob is seeing that.

“There isn’t a crop you can’t grow under them,” said Rob. “And you can grow under LEDs at any stage. Even with veggies, we’ve seen zero negative effects with regard to yield. Nothing is as good as natural light, but the bottom line is they give the plants the light they need.”

Controlling the lighting system is easy since Rob can work it directly from his iPhone, so he has more control on which areas of the range to light. The lights are grouped into smaller blocks of lights—16 per block—and he can manually turn them on and off when there isn’t a crop under that section of lights.

The downsides

You may assume that almost anybody can operate an LED system, but Rob says that you have to have a handle on your daylength and the number of light hours you need; you can’t just wing it. Although your LED supplier will provide some guidance, Rob says he’s mostly learned the intricacies of their system by trial and

error, and they're still learning as they go.

For example, he's been trying to figure out which colors work best with specific crops—something that some of the lighting vendors don't have a good handle on yet. Rob said he knows the company that provided their LEDs is working on lighting "recipes" to help growers program their system better.

Although LED bulbs last longer than HID/HPS lights, Rob said, in their experience, they still require the same amount of maintenance, such as bulb outages and climate control issues with the cooling fans. He believes the fail rate has been about the same as the traditional lights they've used over the years. Stan said so far they've had to replace about 8% of their bulbs in three years and all of them have been covered under the warranty.

You also need a good climate-control computer and software that works in conjunction with the lighting system.

"You need a fairly advanced computer system," said Rob. "The info you get from the lighting vendor is only as good as what you give them, so you need to know how many hours you're running before you know how much you're saving."

But the biggest issue Stan and Rob see with LEDs is the cost. As Stan stated above, LEDs can cost up to three times as much as traditional lights—for 90,000 sq. ft. of new greenhouse, Rainbow spent $750,000 on LEDs. So you really have to work with your supplier to determine if the switch is worth it.

Still, Stan and Rob believe that we'll be seeing more LEDs in bedding plant greenhouses as more research and information comes out about how to best utilize them.

"I would still buy LEDs in the future, but the price needs to come down or there needs to be improvements in the technology," explained Stan. "At this point, the capital cost versus benefit makes it hard to justify LEDs versus HPS."

"In the long, long, long run, LEDs will be the way to go," said Rob. "There will be other technologies that come along, but LEDs have propelled our industry to look at light in a new way."

Are the traditional HID lights still viable? If so, for how long?

By A.J. Both, Associate Extension Specialist, Rutgers University

Research shows that the most efficient high-pressure sodium (HPS) luminaires (with double-ended bulbs) are as efficient as light emitting diode (LED) luminaires specifically designed for horticultural applications. This means that for every unit of electricity consumed by the luminaires, approximately the same amount of photons is produced in the photosynthetically active radiation waveband (400 to 700 nm). The rest of the electricity is converted to heat.

In the case of HPS (and metal halide) luminaires, this heat is in the form of radiant heat and any surface with a direct line-of-sight to the light source will be receiving this heat radiation. In the

case of LED luminaires, the generated heat is typically transferred to a heat sink attached to the LEDs and then either actively (with a fan) or passively removed by convection to the surrounding air. Thus, by moving air around in the greenhouse and possibly removing hot air through ventilation, it's relatively easy to remove heat from LED luminaires without impacting the plants too much.

As a result, LED luminaires can often be placed closer to the plants, thus reducing any loss of light intensity due to a longer distance between the source and the receiving surface. On the other hand, the heat radiation from HPS luminaires will impact exposed plant surfaces. Whether this impact is positive or negative is determined by the difference between the actual and target canopy temperature. So when the greenhouse is cold, radiant heat generated by a supplemental lighting system can benefit plant growth and development. Keep in mind that this radiant heat disappears as soon as the lights are turned off.

It's difficult to predict what efficiency improvements we can expect for future LED luminaires, so it's possible they will be significantly more efficient in the future, but contrary to several claims, they don't appear to be at the moment. What is clear is that many LED luminaires designed for horticultural applications are currently significantly more expensive than equivalent HPS luminaires. Thus, predicted savings from switching to LED lighting systems are offset by the (often significantly) higher purchase price. **GT**