FREQUENTLY ASKED QUESTIONS: LED PLANT GROWTH

What is "LED"?

LED stands for "Light Emitting Diode". Basically, LED's are built like a microchip, passing electricity between very thin light emitting layers. All this happens on a micro-level scale, with each LED "emitter" measuring between one and three millimeters in width.

Low output LED's were first commercialized in the 1960's on early handheld calculators and other consumer electronics. Over the last 50 years, this technology has continually improved in output, longevity, and color range. High output LED lights now produce more light and last longer than any competing lighting technology, in a package with highly specific and selectable color options. This combination of cost-saving efficiency, ultra-long life, and flexible output and form-factor is unrivaled among commercially available lighting technologies.

Today, solid-state LED lighting is becoming the technology of choice for commercial, industrial, medical, and residential applications. Diverse applications, including streetlights, surgical lights, automotive headlights, stadium highbay lights, and office overhead lights are all rapidly converting to LED technology. The US Department of Energy's Solid-State Lighting Program has estimated that over 99% of installed US lighting will be LED by 2030.

Why would I convert over from fluorescent to LED in my plant chambers?

LED offers many advantages over the existing fluorescent lighting technology. High output LED is far more efficient, producing as much as 180 lumens of light for every watt of input power, versus only 50-60 for most fluorescent tubes. More energy efficient means reduced electricity usage and diminished cost of operation. LED efficiency also results in less heat production, and since LED's conduct most of the heat that they produce into their fixture or heat-sink, instead of radiating it to the chamber walls and product, surface temperature rise over setpoint is kept to a minimum. Simply put, your plants are much less likely to overheat and desiccate than when using fluorescent.

Solid-state LED elements also last much longer then fluorescent bulbs. While most T5 fluorescents have a total life of 20,000 to 30,000 hours, their output (referred to as "lumen maintenance") is too low through most of this range to allow units to reach specified setpoints. Useful life of most fluorescents in a plant growth chamber application is typically around 5,000 hours. Assuming a standard 12/12 hour diurnal cycle, this shortened lifespan necessitates yearly bulb replacement, a process that involves both bulb removal and disposal as well as replacement bulb purchase and installation. High output LED's, by comparison, have a useful life of as much as 70,000 hours, producing potential service life of over 15 years. Effectively, LED lighting used in plant chambers can provide lifetime lighting.

LED lighting also provides more experimental options than fluorescent. LED emitters can be selected in specific colors, and can be individually tuned, while in use, to vary the color balance between colors to meet user specifications.

Finally, LED technology is better suited to low-temperature growth studies than fluorescent, which loses intensity as temperature drops below ambient. At a 10C unit setpoint, fluorescent tubes may produce as little as half of their rated output. Even at slightly lower temperatures, fluorescent lights may flicker or not illuminate at all. LED emitters maintain full intensity, regardless of temperature, at or below operating temperatures in the 10C range.

Which LED light type should I pick, white or multi-color?

Your choice will depend on your application and research goals. White LED lighting offers high efficiency, reducing your plants' exposure to radiated heat. It also provides full-spectrum lighting that is very similar to current fluorescent options, only longer-life, and generating less heat.   This is the ideal choice for applications where standard full-spectrum lighting is required, but reductions in plant thermal stress and overall unit maintenance are desired.

Multi-color LED setups incorporate the advantages of full-spectrum white LED and add the flexibility to create unique spectral profiles. These light profiles may permit you to mimic specific seasonal lighting effects, replicate large-scale growth environments, or configure custom lighting conditions never seen in nature.   Popular applications include exploring the blue to red ratio as a tool for increasing antioxidant production or altering foliage density and varying red to far-red ratios to alter stem height or promote flowering.

If exploring multi-color LED it's important, however, to make a choice that provides maximum future flexibility. Some "color" LED packages only provide red, or red and blue, or red & blue with far-red lighting. Since LED emitters cannot be easily "swapped", you probably won't be able to easily or inexpensively add light spectra to a chamber post-purchase.

Do you have a far-red lighting option?

Yes. Far-red emitters are built into Caron's optional 4-color lighting. Caron's available variable-intensity system permits you to alter the ratio of red to far-red lighting for photoperiodic studies.

My far-red module looks really dim; is something wrong with it?

No; most far-red light (between 710 and 850 nanometers) is beyond what the human eye can see. There is some overlap, however, between the human visual range, which ends around 750nm, and far-red, which begins at 710nm. Far-red LED emitters appear very dim because almost all their output curve is generated outside of that overlap range.

Will Caron continue to offer fluorescent lighting?

Yes. Fluorescent lighting fills a legacy role in the research plant growth market, for existing protocols and to interface with existing greenhouse and walk-in room configurations. Caron will continue to offer fluorescent lighting within our plant growth chamber lineup for as long as there's a demonstrated market need.

Are there any issues to watch out for when purchasing an LED-lighted plant growth chamber?

While LED's are cooler than fluorescent lights, they are very sensitive to the waste heat that they do generate. Allowing heat to build up in LED emitters can damage their connectors and materials, degrading their performance, and causing them to prematurely dim below their minimum useful life. This risk is intensified since LED lighting systems also tend to block vertical airflow through a chamber, since they disperse light generation among many points (vs. just to a few bulbs) and take up more space under each shelf. Good heat management, including high surface area heat-sinks with horizontal directed air ventilation, is essential to keep LED's running cool even if your chamber is run full. Look for chambers that force air past the LED arrays using full-height plenums/ventilation ducts that bypass loaded upper shelves, versus units without an air path that try to push air from the top of the chamber though each unit shelf.

I want to perform more than one plant lighting experiment per chamber. Can your units do that?

Absolutely. Caron's optional variable-intensity lighting allows you to control not only overall intensity, but also specific spectral distribution by shelf on single door units (multi-door units are controllable by door section). Setting up one chamber with multiple test protocols creates unmatched experimental flexibility, without needing to invest in (and find the space for) multiple growth chambers.

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