Advantages of Growing with LED vs Traditional Technology Lighting

AcuityBrands.

The Verjure™ Pro Series LED™ was designed using real academic-based plant research, paired with over a decade of industry-leading LED fixture design experience. The result? A smart industrial-grade and reliable LED fixture that is simple and effective to use. But the question is, how does LED stack up to traditional lighting technologies like HID and HPS when it comes to indoor horticulture?

Over the years, LED horticulture fixtures have been a much discussed (and debated) topic, constantly being compared and contrasted to traditional lighting technologies such as metal halide and HPS. Early LED horticulture fixtures were lacking in many areas, and for some this created a hangover effect when it came to perceptions and opinions around the effectiveness of LED technology. When asked “Can you get the same yield and quality with LED?”, for years many growers would answer, “I’m not sure, I didn’t get great results when I tried them.”

For example, first generation LED horticulture fixtures commonly featured the narrow band red and blue LED’s, and often appeared purple. It was assumed that most of the light absorbed by plants was in these wavelengths (< 500 nm, > 600nm), and therefore these lights in theory would be more efficient in giving the plants what they need. However, for many, these lights did not perform as well as HPS and other “full spectrum” lights. Not to mention the plants appear almost black under these lights, making it extremely difficult to identify early problems and assess overall plant health.

In addition to the spectral distribution deficiencies, early LED output and efficacy was also not where it is today. The combination resulted in an ROI and payback period of an expensive and marginally efficacious LED solution compared to HID/HPS very long and unattractive. With early LED fixtures providing less of the right types of light to the plants at a much higher price, it’s no wonder these fixtures weren’t exactly flying off the shelves.

Fast forward to present day, the industry has learned a lot, and LED technology has come a long way. More and more growers are converting to LED as the new standard for indoor horticulture lighting. LED is growing so fast that most experts and industry forecasters anticipate over 95% of indoor horticulture will be LED in the next 10 years.

So if you’ve come here to learn about LED, you’ve come to a great place at a great time. With the right LED fixture, there can be many significant advantages compared to traditional technology lighting in indoor horticulture applications.

Efficacy and Energy Usage

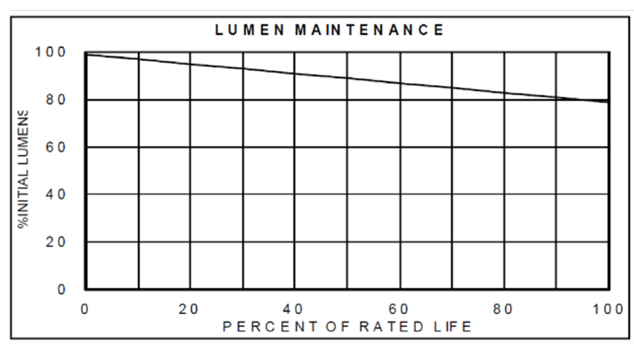
One of the most obvious benefits of LED vs traditional technology is the overall efficacy of the lighting system measured in µmol/j. While HID lights can have efficacies ranging from 1.7 to 1.9 µmol/j depending on the ballast, lamp, and reflector type, the Verjure™ Pro Series LED™ is independently tested and verified to perform up to 2.8 µmol/j while producing a full spectrum distribution. This is approaching a 40% reduction in energy usage and generated heat. Less wattage equals less heat into your environment, which will have benefits we will discuss shortly. When evaluating efficacies of LED fixtures, make sure to check the Design Lights Consortium QPL (Qualified Product List) which requires independent and impartial testing of performance. You'll notice many horticulture lighting spec sheets make claims of higher performance than what has been tested and verified here. Approach these products with caution.

One other note on LED efficacy is that the spectral distribution of the light is important. Some LED fixtures claim to be 3.0 µmol/j and above, but many of these contain primarily all red LEDs. While red LEDs have the potential to increase fixture efficacy, a lighting solution featuring only red photons is limited in its application and may not be ideal for many plant types.

So we know using LED can lower your lighting power bill, but there is also a significant effect on the HVAC load. Some research has shown that LED can lower A/C usage by as much as 30-40%, depending on geographic location. This is significant additional operating cost savings.

Lamp and Fixture Life

In addition to better efficacy, quality-built LED fixtures with proper heat-dissipating mechanical design and quality components can last 50,000 hours while maintaining 90% of their initial light output (Average rated life based on industry standard measurements). Compare this to double ended HPS lamps: Many of these report a 24,000 hr rated life, losing as much as 15% of the initial light output by 16,000 hrs of operation. While 15% may not seem like a big difference in the way humans view light, this can be a significant impact in the growth of plants. The result is growers have learned they need to frequently change lamps and fixtures every few grow cycles to keep up their light levels. LED fixtures such as the Verjure™ Pro Series LED™ allow you to spend less time and money servicing and replacing your fixtures. The Verjure™ Pro Series LED™ features an IP66 sealed design with a wipe-down protective lens to help keep the LEDs clean and the light output maximized over time.



Typical HPS Light Output Degredation

Payback/ROI

Combining fixture energy savings, HVAC impacts, and lamp replacement factors, the Verjure™ Pro Series LED™ can deliver a payback period as little as 22 months when compared to HPS. This doesn't include some of the additional financial and operational benefits and advantages we will continue discussing here.

1 for 1 Replacement example	DE HPS 1000W	Verjure Pro Series LED VPS6
# of Fixtures	10	10
Initial Fixture Cost	$2,999	$12,000
Potential Rebate/Fixture		$250
Wattage/Fixture	1040 w	690 w
Estimated Annual Energy cost*	$6,830	$4,530
Annual Relamping**	$650	-
Cooling Load Expense***	$2,270	$1,510
Yield****	No change	No change
Payback Period from HPS to LED		**22 months**

*Based on .12/kwh, Veg and Bloom combined (5000 Hrs/Year)
** Assumes relamping every year - $65/lamp
*** Estimated 1 watt of AC to eliminate 3 watts of lighting
**** Yield assumed to be the same, but LED may be superior with higher sustained light levels due to far superior lumen maintenance

PPFD and Uniformity

For some the perception is that LED just can't match the intensity of a 1000W Double-Ended HPS lamp. However, with the Verjure™ Pro Series LED™, you can in fact achieve equal or better canopy PPFD with far superior uniformity. The Verjure™ Pro Series™ VPS 6 delivers an ultra-high output of 1880 umol/s, compared to 1810 umol/s from a popular selling DE HPS lamp tested in an independent lab. On a one-for-one basis, the Verjure™ Pro Series™ exceeds the output.

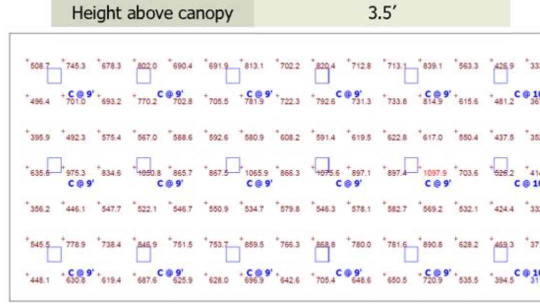
The next step is to look at the lighting distribution. Light uniformity on the canopy is one of the most important factors for many growers. The Verjure™ Pro Series™ VPS 6 features six bars spaced out in a broad 47" X 42" form factor. This allows the light to be much better distributed over the canopy compared to the much more point-source HPS. Due to the types of wavelengths of light produced by LEDs and the resulting lower correlated radiated leaf temperatures, LED fixtures can typically be placed closer to the plants than HPS, resulting in higher light levels, and far better uniformity. The comparative lighting layout example below shows the clear advantage of the Verjure™ Pro Series LED™.

Verjure™ LED VPS 6™

	Output
Wattage	690 W
Output	1880 µmol/s
Efficacy	2.7 µmol/j
Avg PPFD	705 µmol/m2/s
Max/Min	1.9:1
Height above canopy	2'

1000W DE HPS

	Output
Wattage	1034 W
Medium Output	1810 µmol/s
Efficacy	1.75 µmol/j
Avg PPFD	653 µmol/m2/s
Max/Min	3.5:1
Height above canopy	3.5'



Plant Visibility

Part of growing healthy plants is being able to sufficiently see them, and quickly discern their health and condition. One downside to HPS lamps is the extremely low color rending. HPS CRI comes in around 26, making it very difficult to detect plant disease, disorders, and pests. Verjure™ Pro Series LED™ fixtures offer a much better color rendering (80 CRI +), which allows for better plant visibility.

Spectrum

Perhaps the most debated and least understood component of LED and traditional technology lighting is the spectral distribution. The most transparent and forthright lighting companies (these are far and few between it seems) will tell you there is no "perfect" or "magic spectrum" for all plants. The fact is, different plant species, and varying cultivars of a plant within a species may respond differently to different wavelengths, and other factors like lighting duration, intensity, and synergistic effects. Be wary of any lighting manufacturer who claims to have the perfect or ideal spectrum, that will allow you to greatly increase your yields/quality/etc. This just doesn't exist.

If there is no perfect spectrum, what spectrum should you look for? When it comes to LED lighting, it is now widely accepted in both academic and cultivator circles that a full spectrum white light with supplemental red is a far more effective solution than the LED fixtures that contain only red and blue LEDs. After all, plants did evolve under "white" sunlight and not red and blue lights.

So which full-spectrum white + supplemental red LED solution is the best? Most of the available published academic research indicates there may not be an exact answer to this question due to the aforementioned factors, and that lighting is only one of the many inputs into the controlled growing environment.

HPS

LED

We looked to existing published research, and participated in our own research1 to try to answer this question (see Research tab on Acuitybrands.com/Verjure). When cannabis was grown under different full spectrum LED solutions and HPS (all other growing conditions equal), we saw very little difference in yield and quality between the different treatments. When comparing full spectrum LED solutions, efficacy, intensity, duration, and uniformity seem to have the greatest potential impact on plant yield and quality, rather than the minute differences in full ranging spectra.

We know spectral differences absolutely have the potential to impact certain plant characteristics, but it's extremely difficult to draw general conclusions on how much, and the breadth of plants species and cultivars these would apply to. That is the reason we believe for most commercial growers, a tunable spectrum with knobs and dials is not necessary. The added complexity of constantly changing and adjusting each light source without fully knowing the outcomes and impacts is not a desirable place to be for most growers on a large scale.

The advantage of LED vs lamps is the ability to combine discrete light sources to create a spectrum that is in balance, and has the versatility to be used for both Veg and Flower stages. Our research has shown that an LED spectrum can deliver yield and quality that is on par to traditional light sources, when all other factors are held constant. Refer to the Research Tab for more information and details.

Environmental Stability

Growers know that maintaining environmental control and stability is critical in indoor farming. LEDs generate much less heat than traditional lighting sources per watt of electricity, which allows for much more consistent environmental control. High heat-generating fixtures such as HPS create large temperature swings as they turn on and off during the grow cycle. This in return can cause significant changes to many of the environmental factors that need to be closely controlled, including temperature, humidity, and Vapor Pressure deficit.

Form Factor

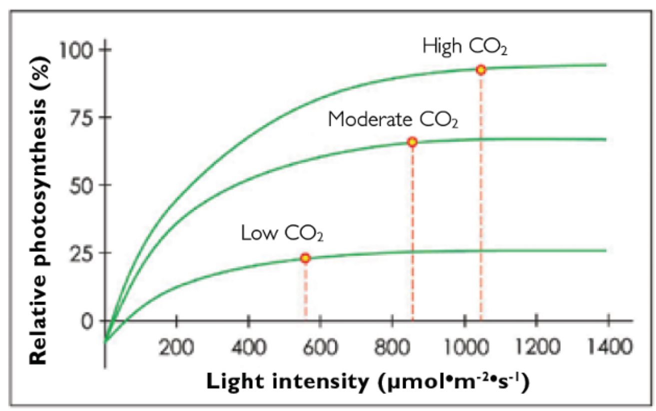
The form factor of LED lends itself to more versatility in growing applications. Being low profile, and having a lower heat profile, including a lower infrared component than traditional lighting technology, may allow you to place the lights closer to the plants. Many growers are now taking advantage of LED designs and maximizing their space by growing in multiple racks and levels.

Converting from Traditional Technology lighting to LED

With all the advantages of LED in controlled environment horticulture, many growers are making the switch now. Depending on the type of growing environment and types of plants being grown, LED adoption can be deployed with different strategies. For some it makes sense to replace the traditional technology lighting with LED on a 1-for-1 basis, maintaining (or increasing) existing light levels and taking advantage of the lower wattage LED fixtures to reduce overall energy usage and costs.

Other strategies involve using a higher quantity of LED fixtures, or higher output LED fixtures than what is currently being used to maintain current energy usage but increase overall canopy light levels. This has the potential to increase plant yields (and thus revenues) over existing if the current lighting is providing light levels that is below the light saturation point for the plants being grown, and the grower has the ability to increase the other limiting environmental factors (such as CO2). This is especially true for cannabis, which has extremely high saturation points compared to most other plants.

It is important to remember that a change to LED lighting has the potential to impact many parameters of the growing environment, including optimal room temperature, humidity, supplemental CO2 level, soil pH, watering, etc. A full-scale change from HPS to LED will require these controlled parameters to be adjusted and optimized, in order to fully realize the potential of the new LED light source. There are several general guidelines available on this topic that can be found with a quick internet search, and Verjure can help provide specific guidance for your specific growing space when converting to LED. This topic will also be addressed in a future publication, stay tuned!



Example of how plants approach light saturation points as light levels change, and how these saturation points are impacted by CO2 levels.

Source: Interactions of Light, CO2, and Temperature on Photosynthesis. June 2015, www.GPN.mag

1. Westmoreland FM, Kusuma P, Bugbee B (2021) Cannabis lighting: Decreasing blue photon fraction increases yield but efficacy is more important for cost effective production of cannabinoids. PLoS ONE 16(3):

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