



Ultimate Guide to

Horticultural LED Lighting

Shining a light on the use of LED technology to nurture and grow urban farming & horticulture.



CULTIVATE

FLOURISH

GROW

SPROUT

PROPAGATE

NURTURE



Change is coming...

There is a revolution happening in horticulture. It's a change that will fundamentally alter how we grow plants – and it's all down to lighting. Thanks to the unique properties of LED lighting and major advances in our understanding of plants, we now have exciting possibilities to tune light to improve yield, customize the plant characteristics and maintain plant health.

Being able to control the entire spectrum of light brings innumerable benefits to the growing industry. The ability to precisely control light enables growers to create conditions that are most conducive to growing plants ranging from acacia to zinnia, including legal cannabis for the now-flourishing medicinal and recreational market.

Indoor farming involves a wide variety of growing systems and facility types, including everything from purpose-built indoor vertical farms to recycled shipping containers, as well as growing systems ranging from hydroponics to cultivating plants traditionally in soil in standardized containers.

LED lighting for horticulture takes a variety of form factors, depending on the type of plants grown and the structure of the growing environment. These form factors include LED strings, LED arrays, flowering lamps, or linear LED lamps (also known as TLEDs).

Costs of electricity is the number one expense facing producers and often matches or exceeds total lease costs per month during production. Artificial lighting, dehumidification, ventilation, air conditioning, and irrigation control systems all require immense amounts of electricity, leading some growers to investigate energy-efficiency options such as using LEDs instead of traditional fluorescent or high-pressure sodium (HPS) luminaires.

LED lighting systems operate using direct current (DC) but nearly all greenhouse electrical systems operate from alternating current (AC) driven power systems. Within the luminaire, the electronics will therefore include an AC to DC converter.

Luminaire

The luminaire is the 'light fitting' that holds the components that make an electrical light operate. It also holds the reflector or lens that directs the light generated by the 'light bulb' towards the area that needs it.





Benefits of LED lighting

Light Wavelengths

Plants grow best when they receive light from specific parts of the visible electromagnetic spectrum. In particular, photosynthesis works best when plants get light from the red and blue ends of the spectrum.

Some lighting technologies produce light that falls mainly outside of this range; high-pressure sodium lights, for example, produce mostly yellow light. While innovations in the design of fluorescent, high-pressure sodium and other light sources are resulting in lamps that produce a more effective spectrum of wavelengths, those produced by LEDs are more easily targeted, making it theoretically easier to tune LED arrays to produce the best light for plant growth.

Researchers have also found that different spectra of light affects the plant's qualities, including the level of antioxidants, plant height, timing of flowering, or nutritional value, such as the amount of vitamin C in a tomato.

Heat

Compared with other light sources, LEDs radiate very little heat along with the light they produce. This can be an advantage in a situation where heat-producing lights could raise the temperature in the growing room beyond a level that's healthy for the plants.

However, in a situation where the heat produced by lighting is a bonus - such as in an unheated greenhouse during cold weather - LEDs don't have much to offer.

Energy Usage

LEDs are very efficient as they convert electricity to light, much more so than other grow light technologies. This efficiency translates to much lower operating costs for LED arrays compared with other light sources. Factors other than the efficiency of the LEDs can cut into those savings, however.

For example, even though LEDs radiate very little heat, the diodes themselves heat up when they operate, and they must be cooled in order to prevent their failure; active cooling systems in some arrays consume energy, resulting in a substantial increase in their operating cost.

Longevity

LED lights are extremely long-lived; they can last 50,000 hours or more before they fail, and some LEDs may last as long as 100,000 hours. Most other types of grow lights, including fluorescents, metal halide lamps, and high-pressure sodium lights, have a life span of between 10,000 and 20,000 hours. Incandescent lamps are much shorter-lived than other lighting technologies; some incandescent lamps fail in as little as 750 hours.

The longevity of LEDs makes their relatively high initial cost less of a disadvantage.



Effects of light color on plants

Plants absorb light via pigments called chlorophyll a and chlorophyll b, which reflect green light but are effective at absorbing 'deep blue' light (450nm) and 'hyper red' light (660nm) as well as 'deep red' (730nm). Exposure to different amounts of these wavelengths can affect how the plant grows. Blue light provides plants with a lot of energy and is used to regulate the opening of stomata - tiny openings on the surface of leaves that control water loss and uptake of carbon dioxide. Providing more blue light results in plants with smaller, thicker and darker green leaves. Hyper red light is especially effective at triggering photosynthesis, and makes plants grow tall and fast. And deep red light impacts on when a plant begins to flower. By combining different colour light in different quantities, you can change the final plant's qualities. For instance, a plant mainly exposed to red light will grow tall and thin. But add around 10 per cent of blue light into the 'recipe' and it will grow shorter and more densely. Exposing the plant to more of one type of light or another at different stages of its growth can also affect its development.



Challenges of using LED lighting

For all the benefits outlined above, LEDs bring a different set of challenges to the horticultural market. LEDs aren't as robust in terms of withstanding electrical disturbances as HPS lamps. Hazardous conditions that affect horticultural lighting can be the result of environmental factors such as heat and humidity, in addition to the typical disturbances that can negatively impact any electrical system, namely power faults and switching load surges. Unlike many general lighting applications, LED lighting systems designed for plant growth are usually intended to operate continuously to maximize annual crop yields. In addition, the operating environment is often very humid, and electronics may be subject to chemical, biological, or other types of corrosion.

Criteria for selecting a horticultural lighting power supply

Sensitivity to Supply Voltage

Electricity supply regulations vary around the world with a typical tolerance from nominal voltage of -6%/+10%.

In addition to this variation in voltage at the point of supply, the length and size of the cables running from the electricity company's supply point to the lighting installation can also affect the voltage. Conventional electrical wiring design allows for a voltage drop between the site main switch and the farthest electrical connection point. This means that, when taken in combination with the statutory electrical supply tolerance, a nominal 400V supply may be as low as 361V at the farthest point on a lighting system (i.e. a 10% reduction on the nominal supply voltage). This reduced voltage has implications on system output and efficiency.

The ability of an LED power supply to accommodate and compensate for variations in supply voltage can affect light output and therefore efficiency of the light fitting.

Power Factor

Power factor is important when considering the electrical wiring requirements of a lighting installation.

Power factor is the ratio of working power (W) to apparent power (Va) and it ranges from 0 to 1. The energy actually used and consumed by a lamp is the working power; the apparent power is the sum of the

working power plus any reactive power, typically generated by inductive loads.

Inductive loads require electrical current to generate a magnetic field, enabling some types of lamp such as HPS to operate. However, the only energy consumed is the working power.

One of the advantages of LED light fittings is that many have high power factors. Values of around 0.95 are common for LED luminaires. This eliminates the problems that occur with designing cabling requirements for an installation of HPS lights.

Useful Life and Light Output Depreciation

Manufacturers of LEDs claim that an advantage of their equipment is it has a longer life than traditional solutions such as HPS.

Depending on usage, the normal recommendation is to replace HPS lamps after 10,000 hours. After this time the light output of the lamp has usually reduced to 90% of its rated output. LED luminaires have a longer life than this, and it is normal to expect the luminaire to last 25,000 to 30,000 hours after which the light output has only degraded to 95% of the rated 'as new' output.

However, care must be taken to ensure that the internal components (particularly the capacitor) do not suffer catastrophic failure.



Criteria for selecting a horticultural lighting power supply

Relevant Standards

Various regulatory organizations around the world have established a number of test standards that provide clear guidelines for manufacturers to follow when designing, manufacturing, and testing indoor LED bulbs, fixtures, and luminaires. Here are a few notes on some of the most important ones.

UL 8750 (Standard for Safety of LED Equipment for use in Lighting Products) requires the design to use a protective device that will interrupt or limit the flow of current in the event of an overload, in order to minimize the risk of fire and shock.

In the United States, bulb manufacturers must comply with Energy Star transient voltage surge specifications for LED replacement bulb assemblies used in residential and certain commercial applications. For example, Version 1.4 of the Energy Star program requirements defines a 0.5- μ s, 100-kHz ring wave transient test for integral LED lamps. Other test requirements include a test level of 2.5 kV/83 A, line-to-line (ANSI/IEEE C62.41-1991, Class A [i.e., indoors] operation) and the ability to withstand seven strikes in common mode and seven in differential mode, with one minute between each strike.

In countries other than the United States, the IEC/EN 61347 LED driver (power supply) specification and IEC/EN 62031 for LED arrays/modules contain safety requirements for these power supplies.

IEC 61000-4-5 is used throughout many countries. It is a surge standard often used for LED lighting assemblies. In addition, part of IEC 61547, "Equipment for General Lighting Purposes" requires EMC immunity testing.





Featured SL Power Products for Horticultural LED Lighting



LU225



LE500

This product family was specifically designed for large-scale horticulture applications.

To support a structure with thousands of LED Lighting fixtures, a power supply must ensure continuous operation without interruption. Ordinary power supplies with high inrush currents require dedicated circuit breakers, increasing costs in high power applications.

With the LU225's lower inrush current, a single circuit-breaker can support up to 6 power supplies, thereby reducing installation costs and saving space.

Ordinary power supplies with high inrush currents require dedicated circuit-breakers, increasing costs in high-power applications.

With the LE500's lower inrush current, a single circuit-breaker can support up to 4 power supplies, thereby reducing installation costs and saving space.

With droop current sharing, the LE500 enables easy scalability to high-power applications with different wattage configurations – in a single SKU – thereby reducing your total cost of ownership.

Features of LU225

- 225W - Fan cooled, 200LFM
- 2.2" (55.88 mm) body width x 4.16" (105.66 mm) body length without mounting flange x 1.5" (38.1 mm) height
- Universal Input 90 to 305VAC
- Active Inrush Current Max. 15A
- Approved to UL8750 & EN55015
- 88% - 90% Efficiency @ 115V Input, 90% - 92% @ 277V Input
- Single Output

Features of LE500

- 500W - No derating for temperature or input voltage range
- 4.0" (101.6 mm) body width x 9.8" (248.8 mm) body length without mounting flange x 1.93" (49 mm) height
- Universal Input 90 to 350VAC
- Active Inrush Current Max. 20A
- Approved to EN60950 2nd Edition and UL8750 & EN61347
- 93% Efficiency @ 230V Input, 92% @ 115V Input
- Droop Current Sharing
- IP67 rating



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