CONSIDERING LEDS FOR CANNABIS?

Choose carefully as they are not all the same

Traditional light technologies like high-pressure sodium, metal halide or fluorescent lights produce distinct light spectrum and wavelengths that are effective, but not necessarily optimized for cannabis growth. LEDs, on the other hand, have the flexibility to deliver specific wavelength combinations and lighting strategies that may yield faster and more favorable results for growers depending on the spectrum type of LED used and the particular plant response they are seeking. The options for LEDs, however, are numerous and cannabis growers need to understand their own objectives in order to choose the right manufacturer, fixture, and spectrum.

The use of artificial light to improve plant growth by providing longer photoperiods and higher daily light sums (DLI) has been in use for decades. Lights are designed to stimulate plant growth by emitting an electromagnetic spectrum that drives photosynthesis, which is the process plants use to convert light radiation into biomass.

What's interesting to see is the advancement in lighting technologies used for horticulture in the past 15 years, including the transition from T12 fluorescents to T8 and T5 lamps, and the introduction of metal halide and high-pressure sodium light sources, which have given indoor growers new opportunities to improve cannabis growth significantly in controlled environments.

High Pressure Sodium (HPS) HID lights have been the traditional lighting technology in cannabis production for decades. HPS lights have good electrical efficiency properties compared to other traditional lighting technologies, and they are relatively inexpensive. The light spectrum of HPS, however, is not optimized for plants. Thus some light is used inefficiently, and HPS lighting generates significant heat, which can adversely affect plant growth.

The advent of LED technology now allows growers to isolate and mix wavelengths that are most effective in promoting consistent and healthy plant growth. LEDs can alter a cannabis plant's strategy for energy use during photosynthesis by transmitting different information from the spectrum. From the perspective of a commercial cannabis grow operation, LEDs typically offer longer lifespan, lower power consumption, significantly less radiant heat directed at the plants. In addition, LEDs produce consistent light across a wide range of temperatures, unlike fluorescent lamps that are very sensitive to the surrounding temperature and airflow. And lastly, compared

to fluorescent lighting which contains mercury,the disposal of LEDs is friendlier to the environment.

MEASURING LIGHT PERFORMANCE

There are at least four main factors to consider when assessing LED manufacturers and their products., By evaluating light performance in terms of electrical efficiency, photosynthetic activity, desired plant response, and human tolerance, the grower can determine their optimum LED solution.

ELECTRICAL EFFICIENCY

Traditionally, artificial light performance has been measured by how much light intensity (µmol) the light source provides in the photosynthetically active radiation (PAR) area. In this way, efficiency is determined by how many µmol can be produced by each watt of energy input. Unfortunately, µmol/W does not reveal anything about the plant's response to the light.

Many LEDs provide a pure red (660nm) spectrum (where all light is within the PAR region) and produce high electrical efficiency measured by µmol/W. In terms of cannabis growth, however, there are very few applications where a pure red light spectrum yields good plant growth results for cannabis. Cannabis typically requires a color spectrum from 400 to 700 nm (nanometers) to achieve photosynthesis effectively. An uneven spectrum may kill the plant or impede growth by causing bleaching, spots, and brittle leaves.

PHOTOSYNTHETIC ACTIVITY

An alternative to measuring the radiation in the PAR area is to measure the Relative Quantum Efficiency (RQE) - which quantifies the relative photosynthetic reaction at each wavelength - to differentiate a LED's photosynthetic efficiency. Unlike traditional light sources, an LED's energy is directed towards specific wavelengths that produce a better utilized spectrum, ultimately making it a much more efficient light source. Photosynthesis, however, is not the only aspect to consider for successful plant growth. Shape, flowering, root development, color are all important factors in growing a quality plant.

PLANT RESPONSE

Some LED lights are customizable to suit the objectives of the grower, and the choice of LED is strongly determined by the type of cannabis plant, which can vary in response to the photoperiod and spectrum. In the case of cannabis, blue spectrum light – from HID fixtures for example - during the vegetative phase will often produce a thick and short plant with large leaves while the red spectrum light has been found to trigger budding in the flowering phase of growth. Certain full or "wide-spectrum" LEDs have been specifically developed for plant growth and can provide a light source that covers the entire light spectrum that is required to produce healthy cannabis plants from seed or clone to flowering plant.

HUMAN TOLERANCE

Wide-spectrum LEDs provide white, deep pink or light pink light. Like the sun, wide-spectrum LEDs, deliver a more balanced spectrum including red, blue and yellow light that not only nourishes cannabis plants, but provides an environment in which people can work with little or no eye protection for extended periods of time.

TRIAL FIRST

With the plethora of LED options available, it is vital to assess the light spectrum from a manufacturer's LED and understand its effect on the cannabis plant relative to the grower's objectives. Setting up a small-scale trial with several fixtures and plants is one way to assess the effectiveness of a particular LED prior to outfitting a complete room or several rooms.

OTHER IMPORTANT FACTORS

FORM FACTOR

Size, shape, and uniformity of light are all factors to consider when devising a lighting strategy. Designing lit areas with standard lengths in mind will avoid custom configurations that could be costly to implement. As LED technology advances, so will their adaptability and availability in more standard sizes. Detailed lighting simulations are useful in determining how many light fixtures to use and where to place them in a cannabis grow room.

MANAGING HEAT

LEDs produce less radiant heat than HID lamps, which allows LEDs to be positioned closer to the cannabis plants with less risk of burning. This closer proximity concentrates light towards the plants and minimizes spillage into the alleyways, reducing waste.

Even though LEDs run cooler than traditional lighting strategies, their fixtures still produce heat that needs to be managed. A high-quality LED fixture converts 30-40% of energy to light and 60-70% of heat. An LED fixture with insufficient cooling will convert more than 70% of its energy to heat that tends to overheat the circuitry and cause them to "burnout" quicker if not properly cooled. LEDs can be cooled actively using fans or circulating water, or passively using heat sinks. Both strategies reduce energy consumption without compromising the lifespan of the LED diodes.

CERTIFICATION & SAFETY

Safety certification is an important factor to consider when selecting a LED. CE markings, UL or cETLus certifications, warranty and decay test results are all important when determining quality and security.

Color rendering index (CRI) can be used to estimate how comfortable the light is to human eyes. Values under 50 are considered difficult to work under for a long period. CRI values for HPS are 20-40 (depending on lamp type), while traditional red-blue LEDs are zero.

Test standards like LM79 (Test environment), LM80 (decay measurement step), and TM21 (projection of decay) are useful when comparing performance of LEDs. These standards, however, only pertain to the LED components, not the fixtures that provide the cooling and working conditions of the LED. Currently, there are no standards that address LED fixture testing and how they behave over time. However, this is a topic currently being addressed and committees are being formed to develop standards for horticulture LEDs.

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THE VALOYA DIFFERENCE

Proven Effectiveness for Cannabis

Valoya LEDs are specifically made for professional plant growing purposes.

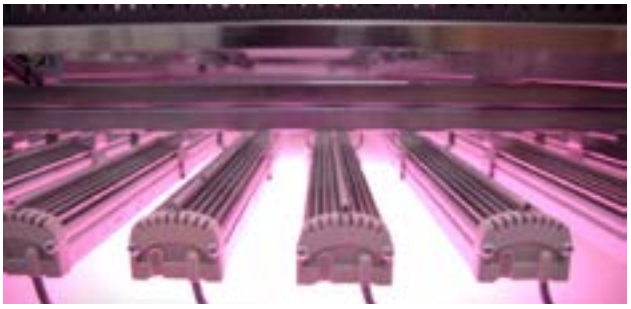
Valoya spectra have been developed based on extensive academic, in-house/on-site research and verified by hundreds of professional growers, breeders, and research customers.

PROVEN PERFORMANCE

Valoya has conducted over 80 trials with plants during the past five years, testing unique light spectra based on our patented* wide spectrum LEDs.

Valoya's wide spectrum effectively drives photosynthesis resulting in faster growth and better yield. In addition, our spectra gives valuable information to plants about their environment that ensures the desired plant growth.

We have concluded that our wide spectra offers superior yields in most applications when compared to competing narrow bandwidth red-blue LEDs. In some basic configurations, narrow red and blue LEDs have been effective in keeping plants compact and delaying plant growth. Valoya has specialized spectra for these instances as well.



spectrum LEDs rather than monochromatic red/blue LEDs, light uniformity is excellent and allows installation close to plants.

SEEDLING PRODUCTION IN MULTILAYER GROWING ENVIRONMENTS

Thanks to different underlying technology, LED lights emit less heat and the heat emitted is of a much lower temperature (50-60°C / 1XX°F compared 400°C / XXX°F with HPS). The heat from the LED is also transferred backwards, away from the plants, thus enabling the light source to be closer to the plants. This lower thermal load enables vertical cultivation techniques

30% more cannabinoids at an equal light intensity

In research Valoya demonstrated about 30% more cannabinoids at an equal light intensity. Valoya lights produced less leaves and equal amount of flower compared to HPS. The relative chemical content was significantly higher, resulting in an overall higher cannabinoid content per plant. Valoya lights drove the plants to spend less energy to leaf production and more into flowering and chemical content production. This trial was conducted with a single light spectra, both in short day and long day phase.

LIGHT

Optimal light spectrum provides increased yields as well as energy savings. Valoya's spectra enable superior growth at lower light intensities compared with traditional light or un-optimized generic LEDs.

HEAT

Valoya light fixtures use passive cooling producing minimal heat radiation towards the plants. The optimized passive cooling ensures durability and noise free usage. Due to the usage of full

(i.e., growing in shelf systems in several layers). Vertical growing can be suitable for the cannabis production process in the clones and in breeding in general.

TOTAL COST OF OWNERSHIP

Valoya's products are designed to have a long working life. Typically rated at more than 90% of initial output remaining at 35,000 hours, which in most cases leads to a productive life of 7-8 years and beyond. The long time is the result of excellent thermal properties of the LED fixture, high quality of the LEDs and the high-quality power units used by Valoya.