HORTICULTURE

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

HORTICULTURE LED LIGHTING

HortiCoolture. LED it grow!

New Horticulture LEDs from the High Power Ceramic series. The wavelengths (450 nm, 660 nm, 730 nm) specially selected for plant cultivation promote photosynthesis and optimize plant development. The superior PPF values, small size and low power dissipation make the WL-SMDC series perfect as a future selection for Horticulture lighting. Item available from stock. Samples available free of charge.

Advantages:

- High luminosity
- Color spectrum individually adaptable to plants
- Complete color spectrum available including white, UV and IR LEDs
- Low thermal resistance
- Electrically neutral heat path
- One solder pad for the complete color spectrum

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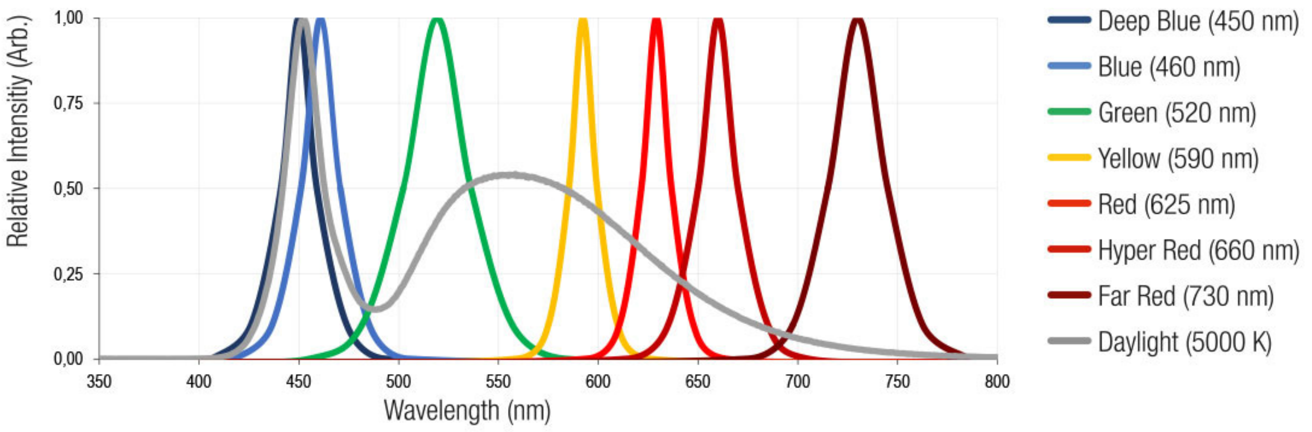
What Plants Need

Emission spectrum of the Horticulture LEDs



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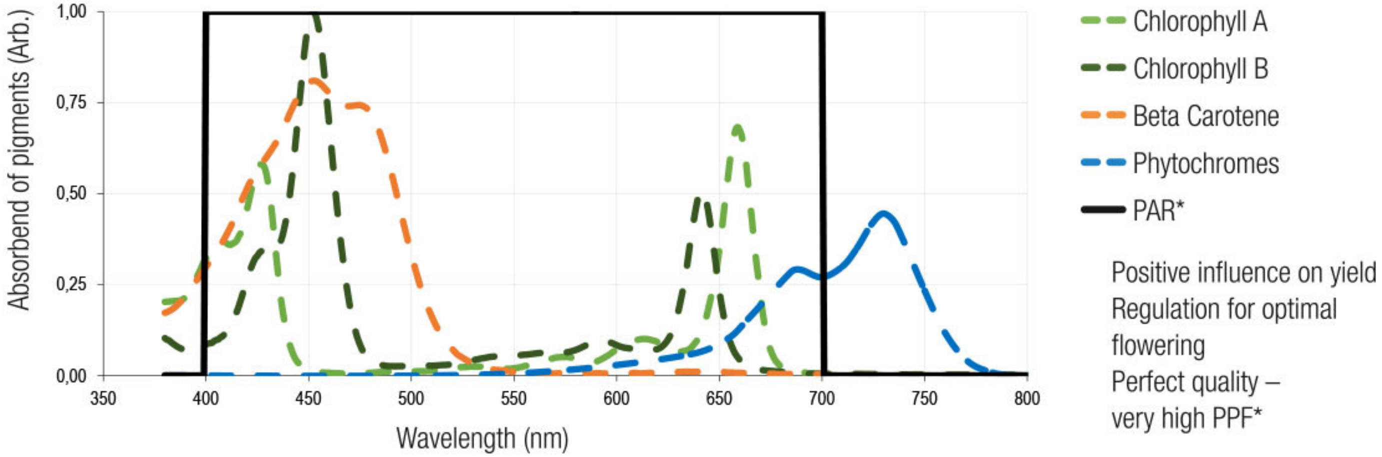

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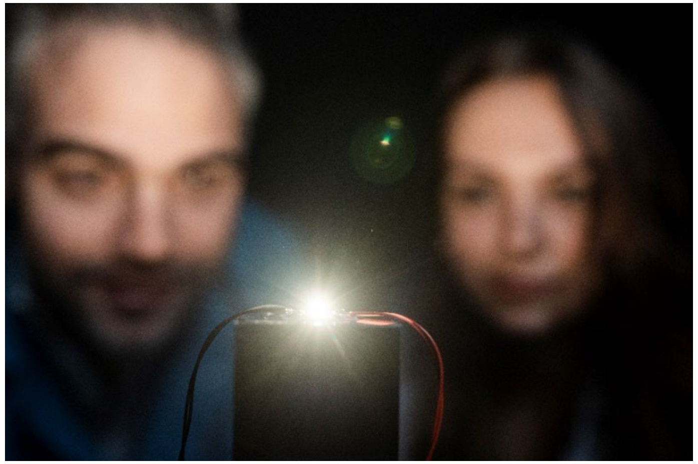
Why LED Lighting Will Surpass HID Lighting in the Horticultural Industry

In the past, high intensity discharge (HID) lamps have been used in artificial greenhouses because of their economic viability and their ability to provide a consistent, adequate spectrum for plant growth. Light emitting diodes (LED) lamps were not implemented as often due to early difficulties, such as cost and intensity.

Lately, that has all changed. Rapid advances in LED design and manufacturing have closed the gap to traditional discharge-based lighting technologies and are now becoming an economically viable alternative to HID sources, especially for high-value crops. In fact, some are calling this "a monumental shift."

There are five key properties that contribute to the advantages of LEDs compared with traditional HID light sources. Although we the properties are addressed in different sections, note that they are highly interrelated and that gains in one performance characteristic will compromise others.



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Output Intensity of LED vs. HID Lighting

Initially, the intensity of LEDs was too low to be of practical use in horticulture, being more suited to indicator lights and control panel backlighting. The intensity of light that can now be generated by LEDs means photosynthetic photon flux (PPF) output is comparable to that of HID sources when used in clusters.

It is difficult to compare the output intensity of LED and HID sources in a useful way due to a number of factors, including:

- The number of LEDs
- The inherent radiation pattern of the devices (LEDs are unidirectional while HID lamps have an omnidirectional broad emission pattern)
- The use of reflectors and lenses

The aim is to maximize the transfer of the emitted light from the light source to the plant leaves. Therefore, it may be more interesting to consider how light is delivered to the plants.

There is no perfect emission distribution pattern, but there are some that are more suitable for certain greenhouse configurations. Precision overhead luminaires and lenses can be used to control the emission pattern of HID devices and focus light to the plant growth areas. This is necessary in small greenhouses with widely separated cultivation areas.

Canopy photon capture efficiency of above 90% can be achieved in this manner, regardless of the light source. But capture rates near to 100% can be achieved using LED intracanopy lighting. The heat generated by HID fixtures makes intracanopy lighting infeasible.

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Efficiency of LED vs. HID Lighting

The potential efficiency of LEDs over traditional lighting sources has long been recognized. This is because of their low losses, generated as heat, meaning a greater proportion of the electricity goes toward generating light. Additionally, this means the light source can be placed extremely close or even within the plant canopy.

The varying cost per photon flux means that LED efficiency is highly sensitive to electricity prices. As the price of electricity increases, the savings of implementing an LED lighting system become far more significant.

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Light Quality of LED vs. HID Lighting

The key advantage of LEDs in relation to light quality is their ability to adjust and optimize the total light spectrum. This can be used to not only enhance and improve photosynthetic efficiency and control developmental phases, but also to reduce the amount of wasted light and therefore energy.

Because of their monochromatic output, a number of LEDs with different wavelengths can be used to configure light "recipes" specific to species, cultivars, and growth phases. This is opposed to HID sources that have a fixed output spectrum, which supply sufficient quantities of light in some wavelengths while providing excessive or deficient quantities at others.

Additionally, the light recipe cannot be modified to suit a plant's development. There are currently a number of projects that use feedback control to optimize the light recipe (and other parameters) to the growth stage of plant. These systems use cameras, usually in the visible or infrared spectrum.

The ultraviolet region (UVA and UVB, 280 to 400 nm) is currently a very interesting topic in horticulture. Sunlight consists of 9 % UV (percent of PPF), while HID sources emit a fixed level of 0.3 to 8 % UV radiation (percent of PPF). With LEDs, it is very easy to control the level of exposure. Deficient levels of UV can interrupt development in some plant species. HID sources have minimal far-red radiation (710 to 740 nm), which LEDs are capable of efficiently generating. You can learn more about the importance of far-red radiation here.

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Lifespan of LED vs. HID Lighting

When operated at appropriate temperatures (i.e. well below the maximum operating temperature),
LEDs: 60,000 hours = 20.5 years when operated for 8 hours a day
Metal halide (MH) lamps: between 6,000 and 20,000 hours or (at most) 6.8 years when operated for 8 hours a day

The lower the operating temperature, the longer the lifespan of LEDs. In their lifespan, LEDs can drop to around 70 % of their luminous output. However, this is highly dependent upon operating temperature.

Because of the relatively high investment needed to replace LED fixtures, some believe LEDs will be operated to the limit of their lifespan despite the lower PPF in the end-of-life period (like HID lamps). Replacing individual LEDs is prohibitively expensive and impractical in the field.

However, the LED is often not the limiting factor. Power supplies, fans, and other components (such as sealings, fixtures, or enclosures) in LED fixtures can fail well before the LEDs themselves. It is therefore important for any LED fixture fabricator to ensure the supporting electronics for the LEDs are designed with reliability in mind, operating well within operating limits to maximize the lifespan of the fixture to match the lifespan of the LEDs.

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Physical Properties & Environmental Impact of LED vs. HID Lighting

There are countless benefits of LED lighting when it comes to physical and environmental impact.

The small size of LEDs and their fixtures, in combination with their low operating temperatures, allows them to be positioned in places where HID sources cannot (such as intracanopy lighting); it also means there is no risk of burn injuries to operators.

Their low operating temperature also allows LED fixtures to be fully or partially encased, so they can be water and/or dust resistant. Because of their fabrication, LEDs are also significantly more resistant to shock, meaning less risk when handling or transporting lamps and fixtures. Additionally, the fabrication of LEDs does not use glass, which can be easily damaged and cause injury.

Unlike HID light sources, LEDs are RoHS compliant, which means they do not contain mercury that necessitates specialized disposal. In addition, they do not generate UV wavelengths (unless specifically added), as HID lamps can do if damaged. Because LEDs can be operated close to the canopy with a smaller emission pattern, and because they only emit the specific wavelengths used by plants, they produce much less wasted light and therefore reduce energy electricity use.

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Horticulture and Würth Elektronik

As you can see, the performance of LEDs has increased enormously in recent years. When operated at an optimal temperature, with a well-designed power supply and an optimized spectral output, not only can LED light sources compete with HID light sources, they will actually surpass them in the near future.

So where can you find products to support LED lighting in horticultural applications? Right here, of course!

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Würth Elektronik Components

Würth Electronics offers the WL-SMDC SMD Mono-color Ceramic LED Waterclear range of LEDs. The WL-SMDC range has been expanded to include wavelengths of 450 nm (Deep Blue), 660 nm (Hyper Red), and 730 nm (Far Red), which have been optimized to match the absorption spectra of photosynthetic pigments.

In addition to the existing products in the WL-SMDC, WL-SUTW, WL-SUMW, WL-SMTW, WL-SWTP and WL-SIMW, a diverse range of combinations is possible that can be catered to the target cultivar.

All-in-one Lighting Development Kit provides an easy solution to mix RGBW color for different lighting situations, amplify the growth of plants with the horticulture panel or even for indoor illumination based on Human Centric Lighting (HCL).

To develop all this products the team is doing is own research, has a biologist and works together with different Universities.

Please contact us if you would like to learn more!

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Further Information

- Further material: Links to app notes, videos, or such.
- ANO002: LEDs – The Future of Horticultural Lighting
- Horticulture LED Lighting Campaign
- Webinar:
  - Sustainable food production with Horticulture LEDs
  - Supplemental lighting in greenhouses with Horticulture LEDs
  - Horticulture LEDs – high and low power application examples
- #askLorandt explains:
  - The benefits of using LEDs in horticultural applications
- Video from CEO Alex Gerfer about the theme:
  - The future of food production! Würth Elektronik as enabler in the field of vertical farming.