WHITEPAPER

THE BARE ESSENTIALS OF GROWING WITH THE NEW DIMLUX LED AND THINGS YOU SHOULD KNOW

DIMLUX

THE FUTURE OF GROWING
JUST GOT BRIGHTER.

PHYTOVEGSPEC© & B:R RATIO = OPTIMUM SPECTRUM CONTROL

The PhytoVegSpec© is an adjustable spectrum that can be optimized for both the growth and flowering stage. Where most suppliers opt for a single fixed spectrum and therefore have to make a compromise between the ideal growth and flowering spectra, the PhytoVegSpec© adjustable spectrum is constructed in such a way that ideal spectra can be constructed for specific stages in the plant growth.

A fixed spectrum will always be a trade-off. There is no ideal single spectrum for the every growth phase of the plant and for every type of plant. Each phase of the cultivation requires a different spectrum. For example, different colors are important for the production of roots and for the production of flowers.

TESTS CARRIED OUT BY UNIVERSITIES AND RESEARCH INSTITUTES TO DETERMINE THE IDEAL SPECTRUM, HAVE SO FAR ALWAYS BEEN DONE OVER THE ENTIRE GROWTH STAGE.

The fixed spectra determined by many suppliers are therefore determined on the basis of limited information and will not make the most of the possibilities that are possible with separate spectra in different growth phases.

VARIABLE SPECTRUM VS. "VARIABLE SPECTRUM"

Systems are often offered as "variable spectrum". In these systems, they allow the user to add just a little bit of blue and red. Despite the fact that this spectrum is technically variable, the effect of this on the plant is minimal. The PhytoVegSpec© spectrum is constructed in such a way that it has a major effect on the growth of the plant.

The blue part is important for the production of the roots and stems of the plant. The red part is the most efficiently absorbed part of the electromagnetic spectrum and is ideal for the production of flowers. Blue and red are opposites when it comes to plant elongation, where blue shortens internodes and red lengthens them.

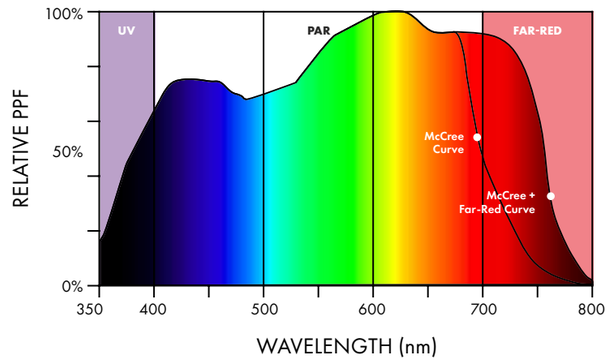
By controlling the B:R ratio, the emphasis can be placed on certain aspects of the plant's growth stage. For the growth stage, it is desirable to have a relatively high proportion of blue in the spectrum in order to stimulate root production. With a high proportion of blue compared to red, the plant will grow more compactly, and vice versa.

The B:R Ratio (Blue to Red Ratio) is the ratio between the blue part (400-500nm) and the red part (600-700nm) of the spectrum. The ratio values are limited to the range 1:1 to 1:6. The maximum PPF is reached at B:R 1:4.5. All LEDs are then at 100%. If maximum PPF is desired and the B:R ratio is set to 1:3, less red will be output. Conversely, if the ratio is set to 1:5, less blue will be output. In both cases this results in a lower PPF than at a ratio of 1:4.5.

PPF, PPE, PPF TOTAL, AND PPE TOTAL

The PPF (Photosynthetic Photon Flux) is the amount of photons that fall within the PAR range which are received by the crop within a certain time period, expressed in µmol/s. The PPE (Photosynthetic Photon Efficacy) is expressed in µmol/s/W, or how efficiently the amount of photons within the PAR range are delivered per Watt consumed. Until recently, the idea was that all light that contributed to photosynthesis in the electromagnetic spectrum ranged from 400 to 700nm along the McCree curve. The 400-700nm region is also known as the PAR (Plant Active Radiation) region. Now we know the wavelengths that fall outside this range do have an effect on the morphology and steering mechanisms of the plant, but to a lesser extent on photosynthesis (see image). In fact, it spans the range from 300nm to 800nm, but due to the decreasing response

PAR RANGE



in the 300-400nm and 700-800nm regions, and the fact that it was not possible at the time to produce sensors that followed this decreasing curve, they simplified the PAR region to be rectangular.

The latest insights show that the McCree Curve is not complete. McCree determined the curve with the limited resources available at the time. He did this by shining pure colors on different plants using a light bulb and a prism. At the time, he calculated the influence of individual colors on photosynthesis by means of a photosynthesis measurement.

According to new insights, the wavelengths of NIR (Near Infrared) 700-800nm, when combined with the wavelengths in the red PAR region 600-700nm contribute to photosynthesis to an equal or even greater extent than when applied individually. It has also been found that if the individual wavelengths are presented as a whole to the whole plant instead of to a single leaf and for longer periods with higher intensity, it appears that the McCree curve will look very different. The curve should therefore be redefined taking into account recent insights.

With this new knowledge, it is better to look no longer at the limited and outdated PPF or PPE 400-700nm for the power of a light source for growing, but at the PPF Total and PPE Total (350-800nm), as these also contain the photons of UV and NIR. PPF Total, is also called Photo-biologic Photon Flux (PBF).

THE MOST POWERFUL AND SMART LED GROW LIGHT ON THE MARKET!

With this innovative LED fixture, Dimlux sets a benchmark for horticultural lighting. With patented technology, advances in LED technology, and optimal thermal design

COLOR IPS DISPLAY AND USER INTERFACE

The integration of a color IPS screen and the PhytoVegSpec© makes the Xtreme Series unique and special. What's special about it is that the spectra and the B:R ratio are displayed very accurately on the display. Using this information, light recipes can be exchanged between growers and companies using data that is quantifiable and therefore universally exchangeable. Data that can be made transparent are the separate Blue, Green, and Red percentages, B:R ratio, PPF, PPFD, DLI, Wattage, percentage of emitted light, plant temperature, and air temperature.

BUILT IN OR EXTERNAL CONTROL

The fixture can work completely independently and even serve as a master in a group of fixtures. They can also be controlled by external devices such as the Maxi Controller or 3rd party controllers. Because the fixture can be updated via Wi-Fi, it's possible to work according to the latest insights with regard to light strategy and to supplement the spectrum by adding Add-on fixtures.

DRIVERLESS DESIGN

The drivers that control the LEDs are invisibly integrated into the frame of the fixture. Because high voltage drivers have been used, the efficiency is particularly high and therefore there is less heat loss. This lower heat loss makes it possible to integrate the drivers invisibly into the frame.

TILTED DEEP PENETRATION ULTRA HIGH TRANSMITTANCE LENSES

The tilted bars are designed to provide the ideal balance between light penetration and uniformity. At the recommended height relative to the crop, a uniformity higher than 95% can be achieved when using multiple fixtures. Because the light from the lenses is focused, less scattered light is lost to walls and paths.

The patented Ultra high transmittance lens is internally shaped in such a way that light rays which normally reflect back to the LED (converted back into heat) now end up just next to the LED and get reflected.

AUXILIARY LIGHT PIPE WITH FULL-COLOR LEDS

Our fixtures have unique auxiliary lighting that is channeled through the integrated light-pipe lens design. The auxiliary lights consist of full-color LEDs, and serve as additional lighting, alarm indication, plant temperature indicator, or night lighting, depending on the situation.

SMART PORTS 3X

The Xtreme series has 3 Smart Ports available. These are universal communication ports that have a variety of connection options, from a wide range of sensors such as Plant Temperature, Air Temperature, CO_2, and Humidity, to devices to control the climate. Communication can be both analog and digital via the Smart Protocol. It is possible to control up to 160 fixtures via analog communication and > 1000 pieces via the Smart Protocol.

PROXIMITY DOPPLER RADAR SENSOR

The built-in Doppler radar sensor can detect movements up to 3 meters away. This sensor is used, for example, to activate the screen and to automatically activate the (green) auxiliary lighting at night. The intensity and color of the auxiliary lighting can be adjusted such that the room can be entered at night without disturbing the night rhythm of the crop. Because the night lighting is only switched on then there is movement, it will not unnecessarily illuminate parts where it is not needed. The night lighting can be set to different intensities and colors, such as blue, which appears to have less effect on the sleep rhythm than green light, but which human vision is less sensitive to. The sensor will also be used to automatically switch off the UV when using the Add-on fixtures, in order to prevent damage to the eyes and skin.

DIMLUX XTREME ADD ON
SUPPLEMENTAL HIGH POWER GROW LIGHT

Accelerates flower setting and possibly shortens the night and lengthens the day for more photosynthesis (higher DLI). Increases potency and resin production which brings out flavonoids and terpenes, like UV-A, but much more powerful.

SUPPLEMENTAL HIGH POWER ADJUSTABLE NIR AND UV-A GROW LIGHT DIMLUX XTREME NIR+UV-A ADD ON 140W OR 70W

FAR-RED (NIR)

Can be used as photosynthesis booster in combination with red light. When used after sunset, accelerates the nighttime metabolism and the sleep rhythm. Accelerates flower setting and possibly shortens the night and lengthens the day for more photosynthesis (higher DLI). In the growing and early blooming phase, plants can be grown taller. Conversely, plants can be kept very compact initially (far-red off) and when switching to the flowering phase (turning far-red on), the synergetic effect of the extra far-red can be exploited.

UV-A

Increases resistance to fungi, and other pathogens. Increases resin production which brings out flavonoids and terpenes. Makes the plant stronger, healthier, shorter and increases root production. The leaves will become darker green caused by more pigmantation. Adds extra photons used in photosynthesis, resulting in more yield. When combined with a UV-B add-on, the UV-A helps protect against damage to DNA, proteins and nucleic acids in plant cells caused by UV-B. When UV-A and UV-B are combined in the right amounts and for the right duration, they have a synergistic stress response effect that makes them even more potent while also being less harmful than UV-B alone.

SUPPLEMENTAL HIGH POWER UV-B GROW LIGHT DIMLUX XTREME UV-B ADD ON 25W OR 17W HE T5

UV-B BROADBAND

Increases potency and resin production which brings out flavonoids and terpenes, like UV-A, but much more powerful. Suppresses pathogens, fungi and spider mites. Ideal when combined with a UV-A Add-on, which increases UV-B resistance of DNA, proteins, and nucleic acids in plant cells. When UV-A and UV-B are combined in the right amounts and for the right duration, they have a synergistic stress response effect that makes them even more potent while also being less harmful than UV-B alone.

(Left) Dimlux Xtreme NIR+ UV-A (right) Dimlux Xtreme UV-B

DIMLUX PLANT TEMPERATURE CAMERA
A LOOK IN THE RIGHT DIRECTION

Dimlux introduced the first indoor plant temperature camera in 2011. At a time when concepts such as VPD (Vapor Pressure Deficit) and plant temperature were still unknown, this was an absolute novelty. Now that these concepts are slowly penetrating the market, it is time to delve deeper into the matter.

VPD has now become a bit of a buzzword, but the most essential information is often still missing, making the customer think that everything is in order, when is in fact working with completely wrong information. That 'essential information' is the plant temperature!

VPD AND PLANT TEMPERATURE

Using an online calculator to calculate the VPD without factoring in the plant temperature is incorrect. So incorrect in fact that those values will probably do more harm than good to the plants. With LED, due to the larger temperature difference between the air and the plant temperature, calculating the VPD without including the plant temperature is an absolute no-go! The VPD value from a calculation without the plant temperature is totally unreliable and may cause huge problems.

GROWING PLANT TEMPERATURE AND LED

When growing with LED, the plant temperature is more important than ever, because the grower often thinks in terms of the cultivation method and schedules of HPS, and applies them to LED. This often results in poor growth due to the sub-optimal plant temperature. Growing at air temperature is a no-go when growing with LED. This was in fact already the case when growing with HPS, but with LED the importance has only increased.

The reason that the plant temperature is so important when growing with LED is because the LED fixtures do not emit infrared radiation like the vast majority of HPS fixtures. The infrared radiation in HPS cultivation ensures a considerable increase in plant temperature, and an 'ideal' air temperature has been attached to this over the years. This is actually wrong. The plant temperature should always be leading and the air temperature indirectly controls the plant temperature.

If cultivation with LED is done at the same air temperature as with HPS, the plant temperature will usually be too low and therefore the RuBisCo enzyme cannot work properly. The RuBisCo enzyme is less active and limits CO2 assimilation.

The plant temperature also depends on the spectrum of the LED lighting, the intensity, and the VPD. For example, green light will heat up the plant more than other colors. It is therefore not possible to indicate an ideal air temperature. A base value can be used and then adjusted based on the plant temperature until the ideal plant temperature is attained.

HOW SHOULD THE PLANT TEMPERATURE BE MEASURED?

The plant temperature should be measured over an as large a leaf surface as possible so that a good average temperature is measured.

The parts of the plant that need to be measured are the parts that receive the most light from the assimilation lighting. Mounting the plant temperature camera at the same angle as the assimilation lighting results in the most accurate measurements. After all, photosynthesis takes place where the most light is absorbed.

With the Dimlux Xtreme LED with high penetration lens, the camera should be aimed such that it 'sees' the most foliage and the least amount of other stuff like soil. The sensor of the camera has a viewing angle of 50° which equates to, for example, a captured area of 1m in diameter at a distance of 1m.

WHAT IS THE DIFFERENCE BETWEEN A PLANT TEMPERATURE CAMERA AND AN INFRARED TEMPERATURE METER.

As opposed to an infrared temperature meter, the plant temperature camera is made to measure the temperature with a wide field of view, and with an emissivity matched to that of plants. This ensures the most accurate measurement possible.

An infrared temperature meter is made to measure the temperature of the smallest possible spot diameter. This way, only the temperature of a single leaf can be measured, and not of a complete plant, or several plants. When measuring from a distance, measurements can also accidentally be taken from the lower leaf layers where less or no light reaches. The emissivity parameter of this type of meter is adjusted to building materials, and not to that of plants. For an accurate measurement, the result must be converted.

The plant temperature camera also monitors continuously and does not just provide a snapshot.

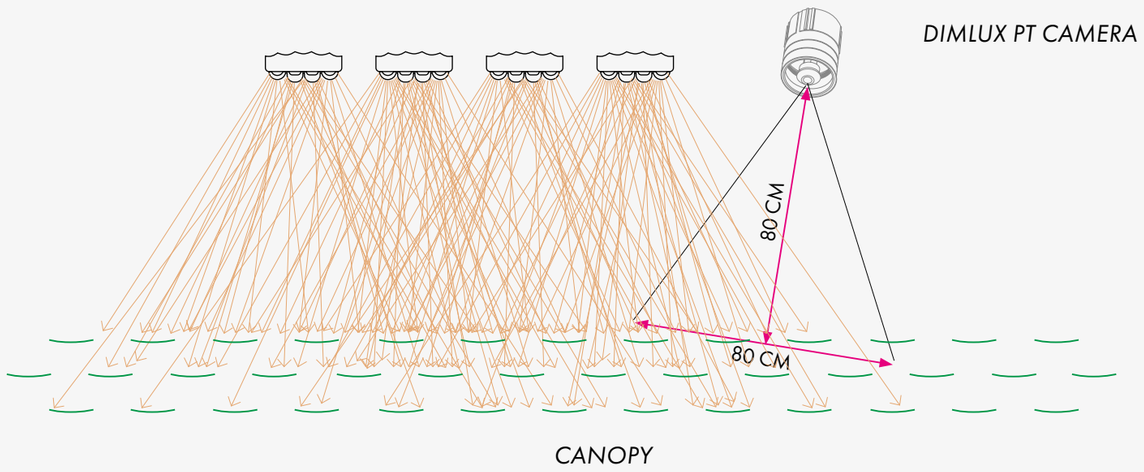
HOW DOES THE PLANT TEMPERATURE CAMERA WORK WITH DIMLUX EQUIPMENT?

The plant temperature camera is available in 2 versions, analog and digital. The digital model is for use in combination with the LED Xtreme series and the analog model for use with the Maxi Controller.

When used with the LED Xtreme series, the ideal plant temperature will be shown in the display. In addition, if the plant temperature is too low, the auxiliary lighting will flash blue, and if it's too high, it will flash red. The grower will then be able to adjust the air temperature or VPD to achieve the ideal plant temperature.

The plant temperature does not only measure whether the plant is in its optimal range for photosynthesis, it's also an indicator of whether the CO_2 level is too high because of closed stomata. When the CO_2 value is too high or the VPD is too high, the stomata may close, and the plant temperature will rise as a result. With the optical message of the plant temperature camera, the grower is informed of the situation. In the event of a water shortage, the plant temperature will also rise.

When the plant temperature camera is used in combination with the Maxi Controller, it works fully automatically as a preventive measure. If the plant temperature is too high, CO_2 supply will be stopped and the output of the fixtures will be gradually dimmed. This dimming continues until the plant temperature is back within its ideal range. If the plant temperature continues to rise, the Maxi Controller will switch off the lighting, because evaporation no longer occurs and the plant will only wilt. The lights will now stay off until the error is corrected.



VAPOR PRESSURE DEFICIT (VPD)
THE IDEAL ENVIRONMENT FOR YOUR PLANTS.

You probably already have an idea of what VPD is, but this idea is likely outdated or misinterpreted. In horticulture, Leaf VPD (LVPD) is almost always referred to as just VPD, so we will too.

At some point, most indoor growers run into some mysterious plant growth problems ranging from symptoms resembling a nutrient deficiency while the nutrients are actually perfectly balanced and fresh, or slow growth, or powdery mildew, or a whole host of other problems. These can often be traced back to the VPD. If you correctly steer the VPD, it will create a better environment for your plants. This is a somewhat advanced concept that we will now explain in great detail. Once you understand VPD, you will see that your crop improves enormously.

The VPD measures the amount of 'drying power' of the air around the plant. Basically, it's how much moisture the plant can lose to the atmosphere. You probably already know that the plant uses transpiration through it's stomata to cool down. The plant will grow much more slowly or wilt if it cannot release moisture through its stomata.

If the VPD in is too low, moisture will collect on the leaves. If this is left for too long, the plants can become susceptible to fungi and pathogens, such as mildew or mold. The transpiration process in plants is similar to how we sweat.

If the VPD is too high, the plants may not be able to meet the evaporation demands puton them. The air dries them out too quickly. This will cause symptoms that resemble a nutrient deficiency. However, if this condition only occurs a few hours a day, this might not be apparent from the plant's growth itself.

If you look up VPD, you will see all kinds of Vapor Pressure measurements. There is Air Vapor Pressure (AVP), Leaf Vapor Pressure (LVP), Air Vapor Pressure Deficit (AVPD), Leaf Vapor Pressure Deficit (LVPD), among several others not worth mentioning.

VPD is the difference between the Saturated Vapor Pressure (SVP) and the Air Vapor Pressure. AVP is based on the absolute humidity in air, which is dependent on the temperature. The Air Vapor Pressure is based on the relative humidity, the amount moisture currently in the air relative to the maximum it can hold at the current temperature.

To calculate the VPD, you need three values: air temperature, plant temperature, and relative humidity.

Many growers think that the air temperature and plant temperature are virtually the same.

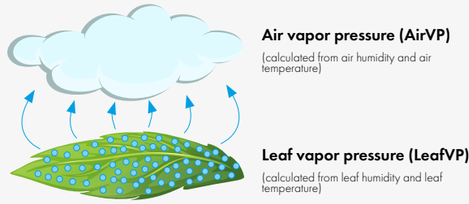
The plant will often be cooler than the room, and even more so when growing with LED. If the plant temperature is exactly equal to the room temperature, then the plant and room vapor pressures are equal. This is rarely the case. Most often, the leaves are between 0.5 and 4°C cooler than the room because they transpire. The evaporation causes the leaf to cool down. With a high VPD a lot of evaporation takes place and with a low VPD little. This is directly related to the plant temperature.

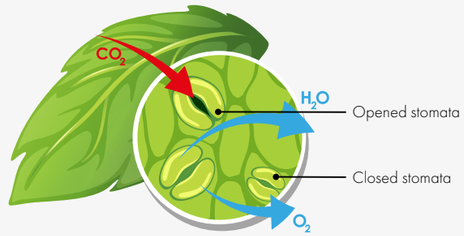
While the Air VPD is important, we really want to focus on what happens to the plant. That means we want to know the Leaf VPD. For this reason, the use of a plant temperature camera is a essential to obtain a good VPD value.

To get the Leaf VPD reading, we developed a plant temperature camera that covers a large surface area. An infrared thermometer is not suitable for accurate plant temperature measurements because it measures only a very small area and is not tuned to the emissivity of the leaves, but is instead tuned to building materials.

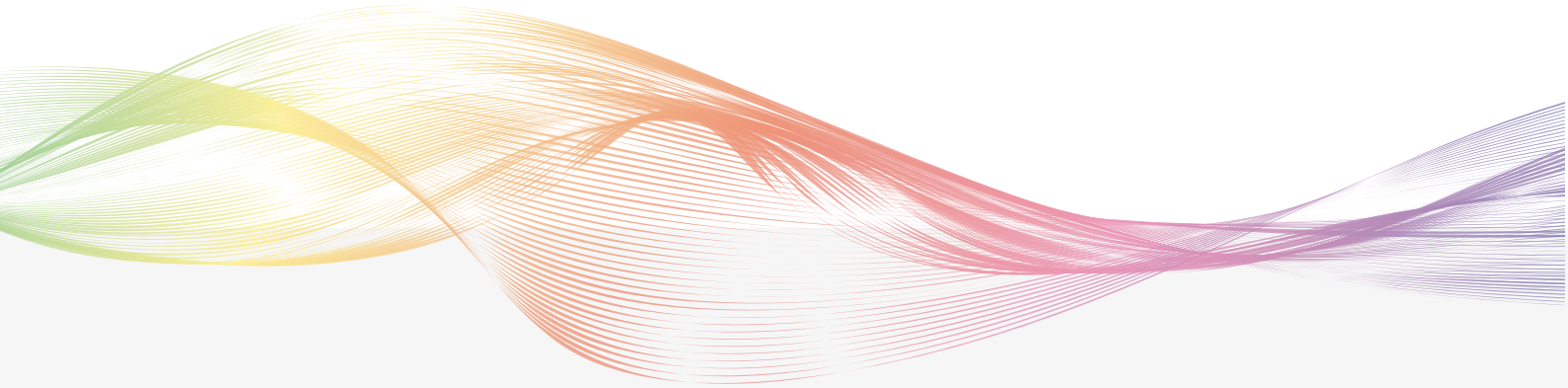
When working with a Maxi Controller, air temperature sensor, RH sensor, and plant temperature camera, it can calculate the current VPD. To determine the ideal VPD, then refer to this table:

Propagation / Early Veg stage	0.5 - 1.0 kPa
Late Veg / Early Flower stage	0.8 - 1.2 kPa
Mid / Late Flower	1.0 - 1.5 kPa





Gas exchange occurs at the stomata. Small pores on the underside of the plant leaves transport water and oxygen out, and CO_2 in



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For more information regarding our products please contact us at **support@airsupplies.nl**

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