nextlight

FULL SPECTRUM LED

Helping Navigate the Ever Changing Grow Light Market.

Highest Efficiency.
Higher Yields.

Contents

Executive Summary

What to Expect

This document is intended to help navigate the ever changing grow light market. As technology advances and the gap between poor and quality manufactured grow lighting increases, it is important for consumers to be able to detect the red flags of the industry. In order to understand what really matters when comparing grow lights, one must first understand the fundamentals of light. We begin with the basic concept of light and finish with robust industry concepts such as; PAR, PPFD, DLI and PPF.

Introduction

Understanding your Grow Light

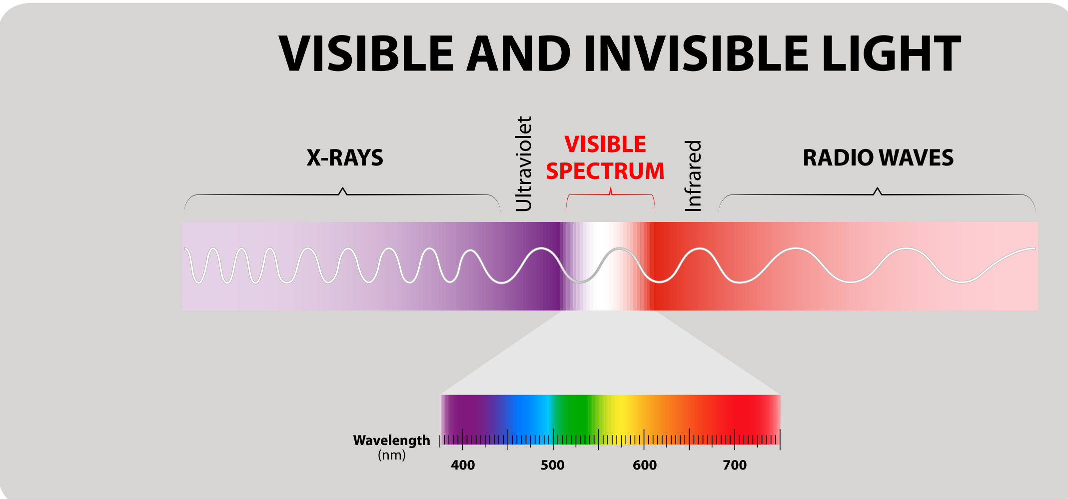
If you're not sure what to look for, figuring out what makes one grow light better than another can be an overwhelming task. There are plenty of factors that come into play when choosing a grow light. The first step is understanding grow lights are NOT compared by wattage alone. The challenge is learning what really matters when comparing and being able to detect the red flags of the industry. Let's start with the basics.

What is Light?

We all want the best for our plants. This pursuit starts with a quality light source. Light is a form of energy. It is part of the **electromagnetic spectrum. Electromagnetic radiation** is all around us and takes many forms, ranging from radio waves to gamma rays. Sunlight is a form of EM energy.

Visible light falls in the range of the EM spectrum between infrared (IR) and ultraviolet (UV). **Visible light** is light which is visible to the human eye. Subsequently, visible light is also what plants primarily use to promote photosynthesis. Visible light is generally defined as wavelengths ranging between 380 and 740 nanometers (nm). Plants fundamentally utilize light ranging within the visible light spectrum, between 400 and

700 nm. The big difference between plants and humans is the way we interpret visible light.



Humans See Lumens, Plants See PAR

Most people are trained to understand light in terms of lumens. The **lumen** is a measure of the total quantity of visible light emitted by a source. This measurement was created in respect to how humans perceive light. In normal lighting conditions, humans are most sensitive to the yellowish-green color around 555 nm. If lumens are a measure of how people interpret light, should we be talking about lumens in regards to our plants?

As previously noted, plants utilize a much broader bandwidth of light between 400 and 700 nm. This is the amount of light available for photosynthesis which encompasses all of the colors from violet to far red. This is known as **Photosynthetically Active Radiation (PAR)**. When talking about light and plants, we should be talking PAR. PAR is defined by the kind of light photosynthetic organisms can use to convert into chemical energy used for plant growth.

How is PAR Measured?

PAR is a commonly misunderstood concept. PAR itself is not a measurement. So, if you need to know how much PAR is available for your plants to grow, then how do you measure PAR?

Growers use quantum light meters to measure how much PAR is present over their desired growing area. These specific light meters calculate what is called

Photosynthetic Photon Flux Density (PPFD). PPFD is a field measurement of the number of photons (light) in the PAR region emitted each second over a one meter square area. This is known as "micromoles per square meter per second" and the unit of measure is expressed as "μmol/m2/s".

It is important to note PPFD readings of your entire growing area. The point is, no grow light puts out perfectly uniform coverage of usable light. Some do a better job than others. Some grow lights have extremely intense light output directly under the fixture but lack significantly everywhere else.

Keynote: Manufacturers frequently publish skewed PPFD readings to mask the downfalls of their light fixtures. Here is what to look out for:

1. Only publishing a ***single*** PPFD reading from directly under the fixture.

2. Publishing an ***average*** of the best PPFD readings in one or more regions of the suggested footprint.

3. NOT publishing the ***height*** from canopy or environment from which the PPFD readings were taken.

Every grow light should have a suggested footprint where usable light is present. It is important to know PPFD readings over the entire suggested footprint. Do NOT be fooled by a single reading from directly under the center of the light fixture. BEWARE of manufacturers who do not supply PPFD mapping over their entire suggested footprint. If this information is not readily published, they most likely have something to hide.

It is important to note the hanging height from light fixture to floor or plant canopy when studying PPFD readings. Some manufacturers will take a single reading only, one inch from the most intense area of their fixture. This will show a very high PPFD value but does not accurately represent how much PPFD your plants will receive in a real world application. This skewed reading is only published to impress the uninformed consumer. PPFD mapping should be done at the manufacturer's suggested height from canopy. You should also note the environment in which the readings were taken. i.e. reflective material, etc.

Lastly, a quality light meter is essential for accurate representation of PPFD. If readings are taken with a cheap light meter, they most likely are inaccurate.

Quality PAR Mapping Example

NextLight Veg8
2 ft x 4 ft footprint at 12 in, lamp to floor.

This mapping was done using a matte black environment with no help from reflective material. Note: The light meter used is noted.

12″ LAMP TO FLOOR

	24″	18″	12″	6″	0″	6″	12″	18″	24″
12″	96		194		202		196		95
6″				333	320	334			
0″	168	288	369	379	365	379	368	290	166
6″				347	334	339			
12″	97		208		212		205		96

*All Readings Taken Using LI-COR LI-250A Light Meter

How Much PPFD Do My Plants Need?

Now that you understand PAR and PPFD. You may be wondering how much PPFD your plants actually need. Supplying your plant canopy with an even and adequate amount of usable light is vital, but supplying your plants with more than they need can be a waste of energy and money. This can also lead to negative impacts on your plants.

All plants are different but can be placed into categories based on light needs per day. This is known as **Daily Light Integral (DLI)**. DLI is the amount of PAR received each day as a function of light intensity and duration. This is known as "moles per square meter per day" and the unit of measure is expressed as "mol/m2/d".

There is a direct correlation between how much PAR your plants are exposed to and for how long each day. Generally speaking, with indoor gardening, plants in the vegetative stage are exposed to 16 - 24 hours of light per day, while plants in the flowering stage are exposed to 12 hours of light per day. Below is a general breakdown of how much PPFD is needed for plants to thrive during the different stages of growth.

Sustainable Veg	Production Veg	Flowering Plant
50 - 200 PPFD	150 - 400 PPFD	400 - 1000 PPFD

These numbers vary based on type of plant and environmental variables like introduction of carbon dioxide into the environment.

How Efficient is your Grow Light?

As previously noted, you do NOT want to compare grow lights based on wattage alone. This is because some grow lights use energy from the outlet more efficiently than others. Some grow lights comparatively convert more energy into usable light, while others convert more energy into heat, which is essentially waste. The key is knowing the **Photosynthetic Photon Flux (PPF)** of the fixture. PPF is a value published by manufacturers as the fixture's total emitted number of photons per second in the PAR region. This is known as "micromoles per second" and the unit of measure is expressed as "μmol/s". It is important to note, a true PPF rating should only be obtained using an integrating sphere, a device for measuring optical radiation.

The PPF value of a light fixture can be taken and divided by the wattage consumed by the fixture to obtain the true efficiency. For instance, the NextLight Mega has a PPF rating of 1400 and consumes 650 watts. This equals 2.15 PPF/Watt. (You may also see this expressed as "μmol/J")

Keynote: Some manufacturers publish PPF values obtained from theoretical mathematical calculations. This is NOT the same as values obtained directly from an integrating sphere. The integrating sphere is representative to real world application.

PAR Spectrum

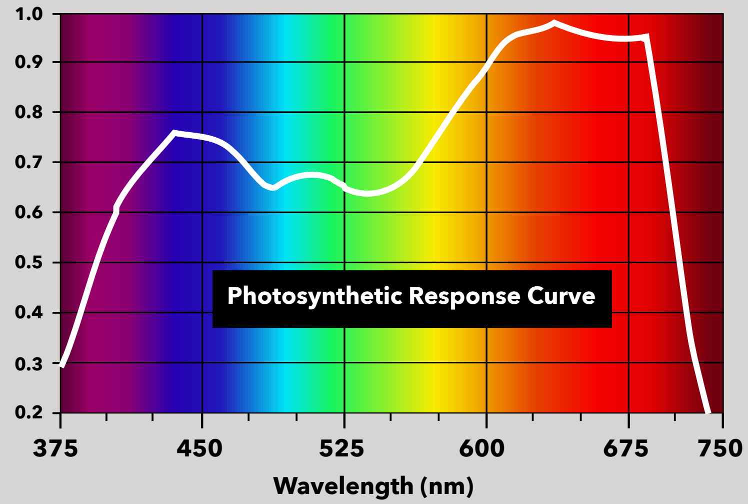
As previously noted, the PAR spectrum falls within the bandwidth of light between 400 and 700 nm. Many grow light manufacturers assume they can target certain colors within this range to power the photosynthetic response curve. As many growers know, the quest for the “perfect spectrum” is more of a gimmick than a scientific pursuit.

McCree-curve - The Green Light Myth

The McCree-curve is a commonly discussed and often misunderstood concept regarding photosynthetic efficiency. The McCree-curve shows that certain wavelengths of light within the PAR spectrum lead to different amounts of photosynthetic response. As you can see from the chart below, there is a dip in the curve between the blue and red peaks. Many people use this as evidence to conclude green light is insignificant with little benefit to the growth of your plants.

The truth behind this myth can be easily exposed. Although there certainly is a trough between the 450 and 560 nm marks of the McCree-curve, the dip is far from zero. Also, data used in this chart was taken from individual leaf segments. When taking the entire crop into account, studies have shown the trough is barely noticeable.

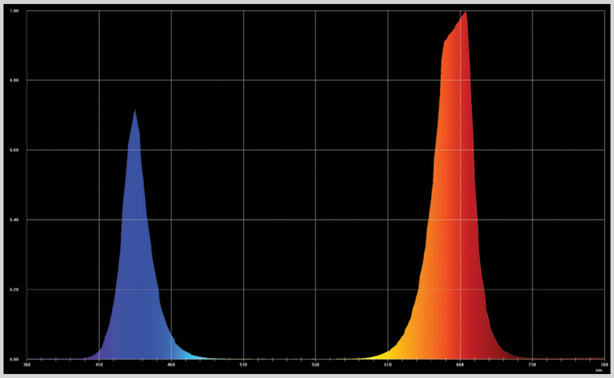
Although McCree’s research from the late 60s and early 70s laid a foundation for studies of photosynthetic response, more recent research from The University of Tokyo and The Australian National University in 2009 has concluded green light drives leaf photosynthesis more efficiently than red light in strong white light.



Mind you, bright white light is comprised of blue, green and red, and closer matches the spectrum of the sun than even your traditional high pressure sodium light fixture.

"Perfect Purple, Proprietary Spectrum"

This Green Light Myth has been further perpetuated by companies marketing the "purple" grow lights of the past. When these LEDs were first introduced to the market, it wasn't feasible to use monochromatic diodes that put off green light. This was due to electrical inefficiencies of the technology at the time. The choice to omit green from their "perfect spectrum" was supported by the desire to oppose the high electric usage of traditional lighting and patent a spectrum of their own. For these reasons, manufacturers chose to patent their

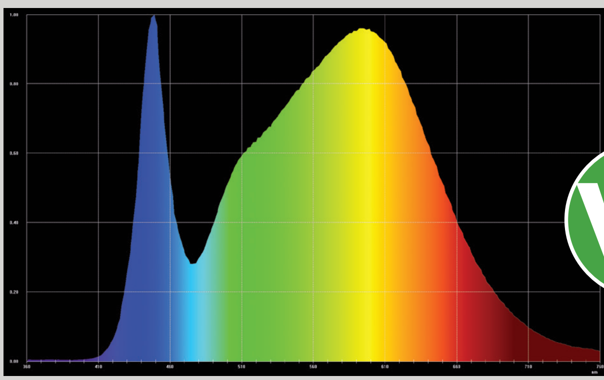


LED competitors assume they can target certain colors to power the photosynthetic response curve. As any grower knows, the quest for the "perfect spectrum" is more of a gimmick than a scientific pursuit.

"perfect, purple, proprietary spectrum" and continue to market the Green Light Myth today.

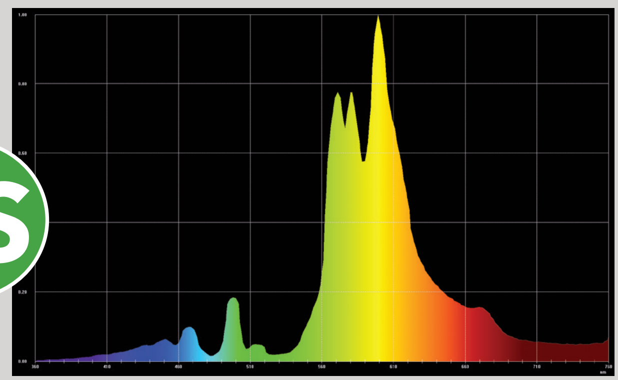
NextLight Commercial Series Spectrum vs HPS

Many manufacturers use the term "full spectrum" loosely. The NextLight Commercial Series Spectrum truly creates a full spectrum, bright white light that closer matches the sun than even your traditional HPS. The NextLight Spectrum was designed to encompass and outperform the trusted HPS 1000 spectrum that has been the choice of commercial and home growers alike.



NextLight's Full Spectrum has been specifically designed to outperform the HPS spectrum, providing the same sun-like qualities plants love without the negatives of high energy requirements and high heat.

VS



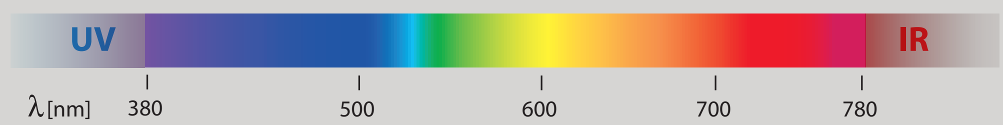
The HPS1000 has been the choice of the commercial greenhouse industry and hobby growers alike for 30+ years – its powerful white light simply delivers results.

Many growers are unaware HPS lighting was originally designed for supplemental greenhouse lighting with the expectation that the sun would supply the lack of blue and spectrum above the 560 nm mark. Many growers bring their HPS lighting indoors without the thought of needing supplemental lighting to counteract spectrum loss. By switching to NextLight, you will receive the same spectrum growers have always trusted without the need to supplement with additional lighting.

Ultraviolet and Infrared Light

Plants primarily utilize light within the visible light spectrum for plant growth. Some grow lights supply EM energy outside of the visible light spectrum such as ultraviolet and infrared light. The reason base models of NextLight products do not incorporate ultraviolet or infrared light is due to risk and reward.

In regards to ultraviolet (UV) light, plants do not make much use of UV for photosynthesis. In fact, most greenhouses are enclosed using UV protective polycarbonate to inhibit UV light from breaking down the transparent material as well as negative effects it may cause to the plants. We do understand certain plants react differently when UV is incorporated into the environment. We feel if UV is desired, it should be added as supplemental lighting by the knowledgeable choice of the grower.



In regards to infrared light (IR), NextLight products do give off what is considered far-red or near-infrared light. Near-infrared light is IR light close to the visible light spectrum, which has been proven to accelerate certain plant growth. NextLight has chosen to exclude IR light because most IR is essentially converted into waste heat which does no good for your plants and additional HVAC is needed to combat the higher temperatures.

Safety, Manufacturing and Warranty

It is easy to fall into the trap of a cheap grow light for the added benefit of initial savings. As we have learned, it is almost certain that the initial savings will result in inferior plant growth and loss of money due to lack of PPFD output, footprint and efficiency. The other risk is purchasing an unsafe, poorly manufactured product backed by a limited warranty.

If you are comparing grow lights, safety, manufacturing and warranty should never be overlooked.

When looking for a safe product to use at home or commercially, look for products backed by independent safety science companies like UL and ETL. UL certifies products, validates, tests, verifies, inspects, audits and advises. When a product is listed with a safety consulting and certification company like UL, you can be certain of your safety.

A quality manufactured product is not only backed by safety but also warranty. When comparing, be sure to look out for the life expectancy of the fixture and type of warranty the fixture holds. For instance, all NextLight Commercial Series fixtures hold 100,000 hour life ratings and 5 year FULL manufacturer warranties.

Overview for Comparing Grow Lights

With the poorly manufactured and outdated horticulture fixtures of yesterday and the continuous influx being manufactured today, it is easy to get excited by misleading marketing claims. When purchasing a grow light, look for a manufacturer who readily provides the accurate information that matters.

Important Information for Comparing Grow Lights

1. Do NOT compare grow lights on wattage alone.
2. Use PAR, NOT lumens to compare grow lights.
3. Watch out for misleading PPFD readings.
4. Compare PPFD mapping and footprint size.
5. How efficient is the fixture? What is the PPF/W output?
6. Is the fixture listed with an independent safety science company?
7. Where was the light fixture manufactured?
8. How long is the fixture under warranty?

Red Flags

1. A single PPFD reading
2. No PAR mapping
3. No PPF rating
4. The claim of a “Perfect Proprietary Spectrum”
5. No UL or comparable listing
6. Poor warranty
7. Inexpensive