

HOW TO COMPARE GROW LIGHTS

Let's face it: comparing various horticulture lighting systems can be a very difficult task.

This is especially true due to the amount of exaggerated marketing claims, misleading information and blatantly wrong metrics that are common in the horticulture lighting industry. Hence, we decided to publish a quick guide to help you compare the various lighting solutions on the market. By following these guidelines and asking manufacturers these questions, we believe you be in a much better position to find a horticulture lighting solution that meets your needs.

OK, in order to explain the correct method for evaluating a horticulture lighting system, let's start by highlighting the metrics you should never use when comparing horticulture lighting systems.

DON'T Do The Following:

RULE NUMBER 1
Don't use electrical watts to compare grow lights

RULE NUMBER 2
Don't use Lumens to compare grow lights

RULE NUMBER 3
Don't be fooled by a company that claims to have a magical growth spectrum

RULE NUMBER 4
Don't just look at a single PAR (PPFD) measurement directly under the fixture

RULE NUMBER 5
Don't focus on the wattage of the LED used in the fixture (1W, 3W, 5W, etc.)

In general, if you see a company using any of the above items to promote their horticulture lights, run away and don't look back. Neither of these metrics, nor their derivatives, tell you anything about the performance of a horticulture lighting system.

RULE NUMBER 1: Many people use total electrical watts, \$/watt or watt/square foot to compare horticulture lighting systems, but these metrics are 100% useless and will most likely lead a consumer to make a poor purchase decision. Why? Simple. Electricity doesn't grow plants.

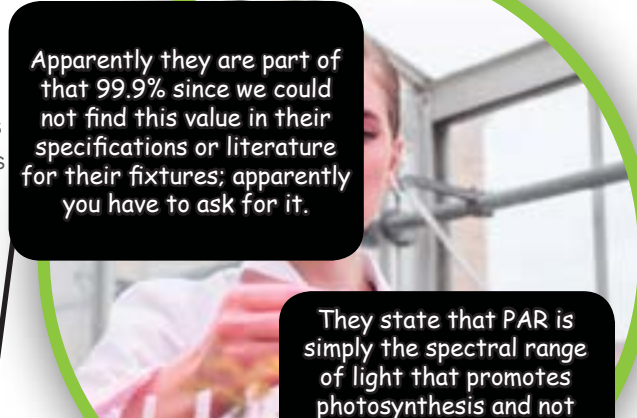
Furthermore, radiometric efficiency (how much light a fixture emits per watt of electricity) can vary by up to 200% amongst the popular LED fixtures on the market today. Hence, since light (not electricity) grows plants, you need to ask how much light a fixture emits. It sounds simple, but 99.9% of horticulture lighting companies do not advertise this metric. Instead, they focus on electrical watts.

Why? Because it is very hard to design an efficient lighting system that delivers high light levels (measured in $\mu\text{mol}/\text{joule}$), and it is very easy to build an inefficient lighting system that consumes a lot of electricity. High efficiency LEDs, power supplies and optics cost more than less efficient components, and many manufacturers use lower quality components to increase profit margins. To reinforce Rule #1, let's compare two lighting systems using a real-world example.

Let's assume Fixture A consumes 333 watts and Fixture B consumes 430 watts. Fixture A costs \$1000 and Fixture B costs \$1300. By only looking at the electrical watts of each fixture, many consumers would assume Fixture B is a better fixture. After all, the \$/Watt is \$3 for both fixtures, and many people assume higher wattage lights are better for growing plants. (See Figure 1)

NOTE: If you are not familiar with the differences in PAR, PPF and PPFD – please read our article first to get the most out of the rest of the information provided on our website.

As a refresher, PAR (Photosynthetically Active Radiation) simply means the light a fixture emits will promote photosynthesis in a plant. Important - PAR is not a metric; it is simply a type of light. PPF (Photosynthetic Photon Flux) is a critical metric that tells us how much light a fixture emits. It doesn't measure the intensity at any location, but it tells us how many photons are coming out of the light every second. PPFD (Photosynthetic Photon Flux Density) tells us how much light is falling on a very specific location (i.e. a specific leaf on your plant) every second. If you have a PAR meter, it is reporting PPFD ($\mu\text{mol}/\text{m}^2/\text{s}$) measurements. You must understand the differences in these metrics before you can compare various horticulture lighting systems. Many manufacturers realize this can be a confusion topic, so it is very easy for companies to mislead consumers by showing a limited set of metrics. However, once you understand the differences in these metrics, you will be able to cut through all of the 'marketing' and 'hype' and ask manufacturers to provide all of the metrics you need to successfully compare lighting fixtures.



Apparently they are part of that 99.9% since we could not find this value in their specifications or literature for their fixtures; apparently you have to ask for it.

They state that PAR is simply the spectral range of light that promotes photosynthesis and not a metric yet there are multiply locations in this document that reference PAR as if it were a metric (PAR per Dollar, PAR per Watt, PAR map)

All good information if they were going to provide PPF values for their products. They don't.

INCORRECT WAY TO COMPARE HORTICULTURE LIGHTS			
	FIXTURE A	FIXTURE B	DIFFERENCE
ELECTRICAL WATTS	333	430	29%
FIXTURE PRICE	1000	1300	30%
\$/ELECTRICAL WATT	3.00	3.02	1%

FIGURE 1

CORRECT WAY TO COMPARE HORTICULTURE LIGHTS			
METRIC	FIXTURE A	FIXTURE B	DIFFERENCE
PPF (total amount of light)	566	367	54% ¹
$\mu\text{mol}/\text{J}$ (electrical efficiency)	1.70	0.85	100% ²
\$/PPF (cost per unit of light)	\$1.77	\$3.54	101% ³

Findings:

- ¹ Fixture A emits 54% more light than Fixture B
- ² Fixture A emits 100% more light per watt than Fixture B
- ³ Fixture B costs 100% more per unit of PAR than Fixture A

FIGURE 2

RULE NUMBER 2: Rule Number 2 is easy to explain. A Lumen is a rating of how bright a light appears to the human eye. However, since human vision is not correlated to photosynthetic grow rates, total lumens is a dead metric. As a rule, if someone is trying to promote lumens for a horticulture lighting system, they should not be selling horticulture lighting systems.

Lights for GREENHOUSES

INTRODUCING THE

spydr 600

Easy to claim but all of these metrics rely on knowing the lights PPF, yet they do not provide that information.

NUMBER ONE IN: • PAR per Dollar • PAR per Watt
• Optical Control • Coverage

It is curious that despite the use of their PPF maps and previous statements where you should not rely on a single PPF value they still felt compelled to publish a maximum value with all the light bars being centered at only 12" below the fixture.

BML states elsewhere, correctly, that PAR is a region, not a measurement metric. In the same paragraph they claim their 333 watt light produces the same light levels as a 600 watt HPS but then go on to say they provide the same PPF as a thousand watt HPS. Which is it? By the way, the only possible way they could be equaling a 1000 watt HPS at 1300 $\mu\text{mol}/\text{s}$ is if they measured a single hot spot under each light. Also when discussing these values the term 'many greenhouse applications' makes no sense. It would either be all or none.

LEDs **READ** to achieve
coverage over wide area

Light bars **CENTERED** to achieve
maximum PAR values under fixture

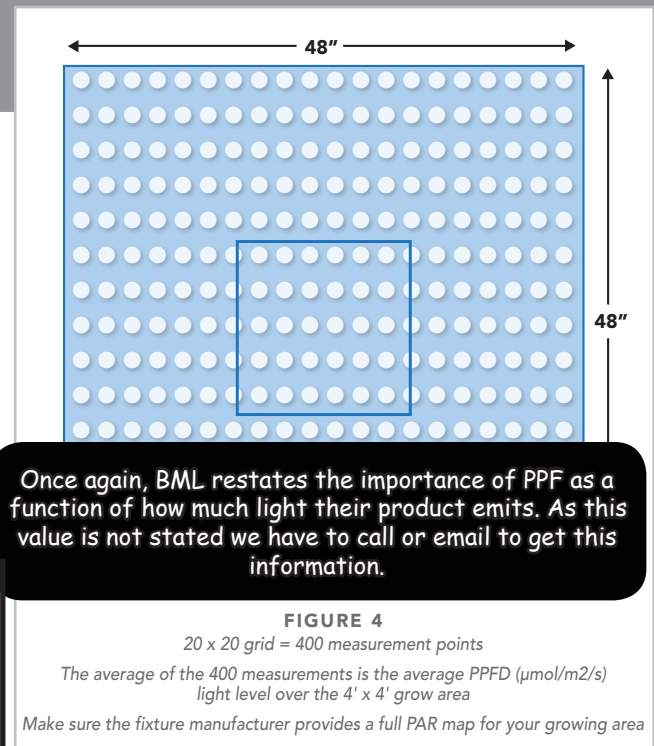
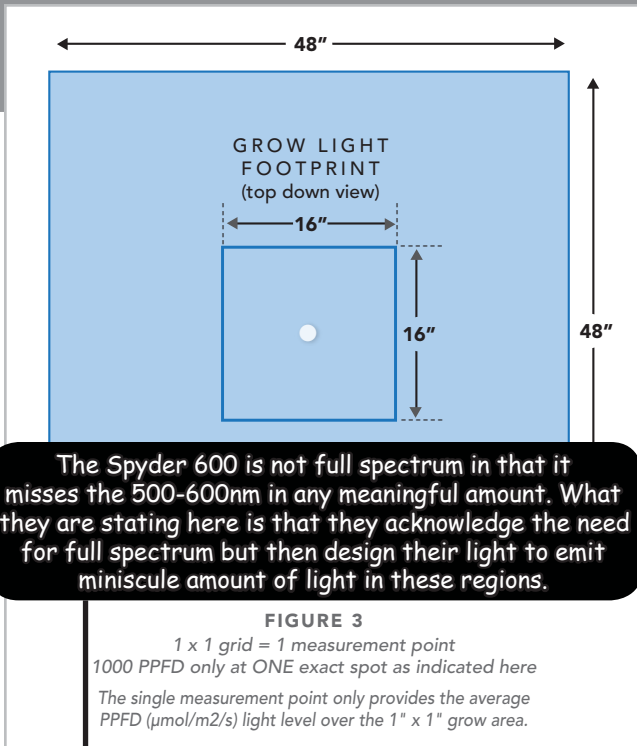
The world's first true LED replacement for High Pressure Sodium (HPS) 600W lights

The **SPYDR 600** LED lighting system uses an amazing 50% less electricity to deliver the same light level as 600W High Pressure Sodium lights (HPS). Due to an innovative optical system, the **SPYDR 600** can provide the same PPF (PAR) levels as 1000W HPS and Metal Halide (MH) fixtures in many greenhouse applications. The **SPYDR 600** uses a breakthrough optical engineering design that allows you to focus the light directly towards your plants.

Six industrial grade, 3-foot long, high power LED light bars are arrayed on a rugged rack that allows tool-free adjustment of each fixture for light concentration and maximum radiation capture on your plants. Since we spread the LEDs evenly over the 36" x 36" fixture design, the **SPYDR 600** delivers light in a more

uniform coverage pattern compared to any other LED fixture on the market. When the bars are centered in the fixture to achieve max PAR levels, you can expect PPF readings of up to 2100 $\mu\text{mol}/\text{m}^2/\text{s}$ at a 12" mounting height!

A major drawback to HPS lamps is the light spillage associated with their poor optical beam control. But each of the SPYDR's six LED fixtures are adjustable on two axes, so you can easily maximize radiation-capture by keeping individual fixtures focused on the plants as they grow. High quality, tool-less hardware firmly hold the fixtures and make immediate adjustment to your light distribution pattern a snap. Since we do not use fans to keep the LEDs operating at their target temperature, you do not need to worry about premature fixture failure caused by clogged fans.



The Spyder 600 is not full spectrum in that it misses the 500-600nm in any meaningful amount. What they are stating here is that they acknowledge the need for full spectrum but then design their light to emit miniscule amount of light in these regions.

Once again, BML restates the importance of PPF as a function of how much light their product emits. As this value is not stated we have to call or email to get this information.

RULE NUMBER 3: Many scientific papers have confirmed that all wavelengths from 400nm to 700nm (the typical PAR range) will grow plants. However, there is a myth that is widely propagated on the Internet that claims plants do not use green light. Many companies promote their magical grow spectrum by publishing the commonly-referenced Chlorophyll A and B absorption spectrum chart. Armed with this chart, they mention that plants are green, so plants reflect green light from the full-spectrum light source. Have you heard this one before? Without going any deeper into this topic, it is important to note that there is no magical spectrum that is going allow a 50W fixture to replace a 1000W fixture because it only uses the "wavelengths that plants need." While plants certainly have multiple pigments and photoreceptors across the PAR range, nothing will trump the need for delivering the required light levels of light to your plants. Spectrum has a very real effect on plant morphology, but be cautious of a company that spends too much time talking about their special spectrum (especially if they do not spend equal effort in publishing their delivered PAR measurements.) There is a short list of companies who manufacturer commercial-grade LED fixtures for the professional horticulture industry, and none of them market the number of LED 'bands' in their fixture.

RULE NUMBER 4: Let's take a quick look at Rule 4. Unless you are growing a really small plant directly under your light, a single PPFD measurement doesn't tell you much. By clustering the LEDs closely together and using narrow beam optics, it is very easy for a manufacturer to show an extremely high PAR measurement directly under the fixture. However, unless you are only growing one plant in this exact location, you need to know how much PAR is being distributed across the entire grow area. Since most LED lighting systems centralize the LEDs into a small fixture footprint, these systems naturally produce very high PPFD levels directly under the fixture. However, these light levels will drop significantly as you move the PAR sensor just a small distance from the main fixture housing. Let's take a look at this example. If you are growing over a 4' x 4' area, you need to review the PPFD levels over the expanded footprint to calculate the average light level the lighting system is providing. If you only had the measurement point from figure 3, you may assume this fixture is extremely powerful. However, you would need multiple measurements across the 4x4 grow area to calculate the average amount of PAR that is provided by the fixture. (See Figure 4) Some companies rely on extremely narrow optics to provide sky-high PPFD numbers, but if your plants are bigger than a few square millimeters (the average sensor size on a PAR meter), than this number does not tell you much about the complete coverage area. Light uniformity across the grow area varies greatly from fixture to fixture, and unfortunately, most manufacturers do not publish complete PAR maps. It is easy to produce high PPFD numbers

directly under the fixture, but it takes a very powerful light to deliver high PPFD values to the outer edges of a 4x4 grow area. Compared to fixtures costing less than \$2,000, the SYPDR 600 was developed to provide the industry's best uniformity over a 4' x 4' grow area. (See Figures 3 and 4) This is where a properly calibrated PAR meter is extremely useful. Coupled with a watt meter, these tools are invaluable when comparing the true performance of various lighting systems. If you would average the 400 measurement points in Figure B, you would have the true average light level in your grow area.

RULE NUMBER 5: Do you use 1W, 3W, 5W or 10W LEDs? We are asked this question on a frequent basis, but the wattage of the LED does not tell you anything meaningful about the lighting system's performance. Since LED and fixture efficiency varies widely, the wattage of the LED is not a meaningful metric.

As a simple analogy, the LED inside a lighting system is equivalent to the engine in a car. By itself, the horsepower rating of the engine doesn't tell you how fast the car will go. Pair a high-horsepower engine with a poorly designed transmission, and the car will not go very fast. Hence, as far as the driver is concerned, the relevant metrics for a car are related to the performance the car actually delivers (i.e. 0-60 mph time, top speed, miles per gallon, etc.). Any reference to a component inside the car is irrelevant to the driver. It is the same situation with lighting systems. The amount of light delivered to your grow area, the fixture's electrical watt consumption and the light distribution pattern are the important metrics, so ask for more information if a manufacturer wants to focus on the type of LED they use.

Note: Since LED quality varies by a very wide margin, it is important to know the brand of LEDs used in the lighting system. There are a handful of world-class LED manufacturers, so make sure you find out what type of LEDs are used in the lighting system. Assuming the fixture manufacturer has developed a reliable fixture design, higher quality LEDs should last longer if they are not being over-driven to achieve higher light levels.

Again, you are buying light to grow your plants. In our opinion, you want to buy a lighting system that delivers the required amount of light to your plants for the lowest initial cost while consuming the fewest electrical watts possible. Ask the fixture manufacturer to provide the following pieces of information: PPF, Input watts and PPFD Maps for your intended coverage area. With this information, you can calculate the most important metrics these metrics: PPF/\$, $\mu\text{mol}/\text{J}$, light distribution patterns and uniformity levels.

If you have any questions about this process, feel free to email or call us.

Nick Klase, Co-Founder