What to Know About Lighting Cannabis

FROM A FORMER GREENHOUSE CULTIVATOR

Read on for insights from traditional horticulture that can be used to optimize cannabis production.

By Travis Higginbotham

Changing perceptions around cannabis has many commercial growers seriously examining the plant for the first time, and many are underestimating the long "maligned weed." I say maligned because cannabis is by no means an unwanted wild plant, as many strains — better known as "varieties" and "cultivars" in greenhouse parlance — are heavily traded and coveted by a growing body of researchers, medical professionals, and consumers excited by the differing medicinal and recreational effects each strain uniquely produces. However, technical terminology around the budding field can be confusing for veteran greenhouse cultivators entering this industry, which has been long dominated by an enthusiastic, but mostly well-meaning, hobbyist market.

The cannabis industry has surprised me by how rapidly it has changed over the last few years. The industry has matured quickly, and many growers have adapted to insights brought over by (too few in my opinion) veteran horticultural professionals and embraced optimizations brought on by traditional floriculture photoperiod scheduling.

As such, I've put together a few key notes and observations around scheduling and the general light cycles my team and I have observed while assisting growers to optimize yields via effective light and environment management.

A SHORT DAY, HIGH DLI PLANT

Since cannabis is a highly versatile crop valued for its flowers, maximizing floral biomass and understanding the photoperiod thresholds (see Figure 1) for cannabis has been my primary focus over the last few months. This is because cannabis takes on more light than any other flowering plant I have worked with in the past. And the cultivation of the plant is just the beginning of the crop's productization as dried flower, extract or oil which requires a thorough understanding of plant maturation and the necessary treatments just prior to harvest.

The most noteworthy aspect of how cannabis differs from typical greenhouse plants is how the plant thrives under high-intensity light. Cannabis is one of the few plants which flourish under more than 950 to 1,200 photosynthetic photon flux density (PPFD) in full bloom, i.e., 41 to 51 daily light integral (DLI). However, several factors in a controlled, sole-source lighting environment

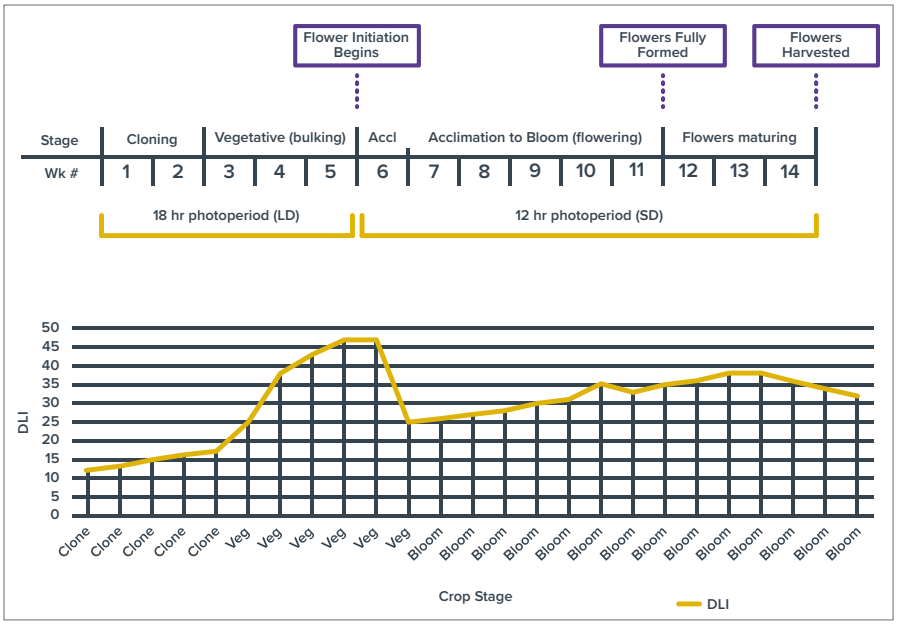

Figure 1. Recommended light schedule for cannabis across propagation, vegetative and flower stages of growth.

need to be optimized to transition a cannabis plant to this level of high-intensity lighting — we call this transition process "photoacclimation." During the early stages of growth — propagation and vegetative growth — cannabis plants can require some of the DLI levels the plant will experience during its life cycle, but with the long, 18-hour photoperiod, the DLI is relatively easy to achieve at low light levels.

After this vegetative bulking period, the reduction to 12-hour photoperiods during the reproductive growth stage can confuse the need to still maintain relatively high DLI levels during this stage of growth. While DLI requirements dip to a degree, the loss of the six additional hours of light should not be dismissed; growers who do not account for this change will see poor yields in terms of flowering productivity. This is why high-intensity PPFD lighting is especially important during the bloom stage. Some growers assume the same supplemental or primary lighting can be used for every stage of growth. This has led to bad experiences with some LED systems, which were not designed to provide enough photons to promote efficient photosynthesis during a short photoperiod.

Cannabis can be photoacclimated at such a pace that you can reach extremely high levels of PPFD near

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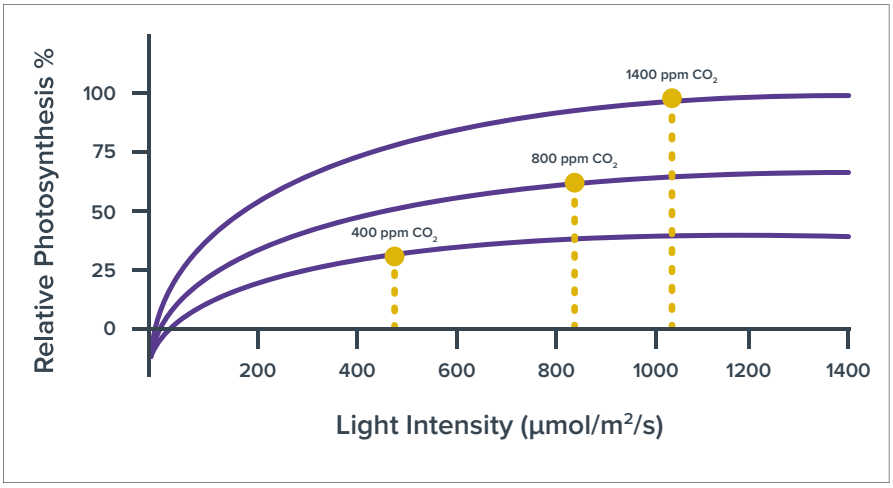

Figure 2. Influence of CO_2 concentration on the rate of photosynthesis.

the tail-end of the bloom growth stage (see Figure 1). Even then, it is critical to administer this level of high-intensity light in short, 12-hour cycles to ensure the plant receives full and uninterrupted cycles of darkness to properly develop its reproductive organs, e.g., flowers for cannabis. These light intensity levels will ensure the plant hits the proper DLI, so it will produce yields to its fullest potential, which is one of the most important factors many new growers underestimate when first taking on a new cannabis strain.

KNOW YOUR LIMITING FACTOR

In addition to its ability to take on copious amounts of light, cannabis is also a particularly hardy plant, able to withstand vigorous handling and pruning. This hardiness does belie its need for a strict regimen of carbon dioxide enrichment to ensure it can efficiently drive photosynthesis.

All cannabis plants do have a point where light saturation becomes the limiting factor which impedes efficient photosynthesis, but often, inadequate CO_2 supplementation is the primary limiting factor.

At ambient carbon dioxide levels of 300 to 400 ppm — normal CO_2 levels in a non-enriched environment — carbon dioxide (Figure 2) quickly restricts photosynthetic activity in the typical greenhouse. Growing under high PPFD light, my team typically recommends supplementing CO_2 to at least 800 ppm in the typical vegetative room, and anywhere from 700 to 1,200 ppm in a reproductive room (Figure 3). These recommendations, however, are based on appropriate ratios of all environmental factors, in addition to light intensity.

The most common problem we

see when a grower begins using high-intensity lighting is not factoring in other environmental concerns, like CO_2 supplementation. This is not the only limiting factor — HVAC, nutrition and strain selection are all variables that can drastically impact yield, plant quality and consistency — that is why the first environmental variable that I often recommend new cannabis growers test for is CO_2.

MEDICINAL OR RECREATIONAL?

The final thing I'll touch on when discussing light scheduling for cannabis involves knowing what the end use of your crop will be.

The two primary markets for cannabis today revolve around either recreational or medicinal uses. While it's fairly well-known THC is the primary metabolite responsible for the psychoactive effects that many recreational consumers look for, the recent discovery of cannabidiol (CBD) is not as well known. Preliminary medical research is attributing the composition of all cannabinoids, particularly CBD, as being the main ingredients in cannabis that are most beneficial from a medical standpoint. While some believe strains can be categorized as being primarily either THC or CBD producers, data suggests every strain of cannabis produces both metabolites to varying degrees.

The more important factor to account for is how THC and CBD concentrations develop at different times during a cannabis strains' bloom schedule. Exact timing varies between strains, but metabolite measurements should be taken in between weeks six to nine of flower to track where in your bloom cycle you are hitting your target quality. This will greatly influence exactly when you will want to harvest the plant, as well as how your lighting should be adjusted just prior to harvest to ensure optimal metabolite production.❖

RECOMMENDED CO_2 CONCENTRATION (PPM)			
Species	**Establishment**	**Vegetative**	**Reproductive**
Cannabis	400	400-800	800-1400
Tomatoes	400	400-800	700-1200
Cucumbers	400-600	400-600	800-1000
Peppers	400-600	400-800	800-1000

Figure 3. Recommended CO_2 concentration (in parts per million) of cannabis with other common vegetables for reference.

Travis Higginbotham is director of cultivation support with Fluence Bioengineering. For additional information, go to www.fluencebioengineering.com.