



Mastering Plant Care With Your Cultivation Tools

A Guide to Cultivation Tools for the
Optimal Growth and Performance of your Facility.

eBook Series



Introduction

While integrated systems in cultivation facilities provide overarching data on processes like fertigation and set point accuracy, it's the granular data from hand tools that often makes the difference.

Understanding how to use these tools to validate sensors, placements, and data ensures that the actions you take are based on reliable information.

By mastering these tools, cultivators can confidently pave the path toward consistent and repeatable cultivation success.

On the following pages, we'll cover some of the instruments that every cultivator should have in their toolkit.

1. Digital Hygrometer

Description:

A digital hygrometer is a compact, electronic device designed to measure and display ambient temperature and relative humidity in real-time. Equipped with sensors, it provides instantaneous readings which are shown on a digital display. The presence of a magnet or a mountable design often allows for easy placement in various spots within the cultivation area.

Usage:

Position the digital hygrometer in various areas within the grow space, especially near critical regions such as the canopy, to monitor temperature and humidity levels and collect acute and granular data.

Importance in Cannabis CEA:

Understanding humidity management in the cultivation space influences room design, planting density, [racking layout](#), and retrofit opportunities. The relative humidity and temperature are fundamental parameters in cultivation. They directly influence plant transpiration, growth rate, and susceptibility to diseases.

By ensuring that both parameters are within the ideal range, cultivators can prevent issues like mold growth, heat stress, and poor nutrient uptake, leading to healthier plants and improved yields.

The information collected with this tool can help guide environmental itineraries and crop steering plans.

Recommended Value Ranges:

Temperature: This is not an easy one to answer. The ambient temperature is important but the leaf temperature is paramount. Lighting and airflow choices impact what room temperatures are best to maintain healthy plants.

The warmer you run your rooms the more efficient your HVACD, but it has limits. All things considered if you try for a 75-80F leaf temperature you may be able to run an 85F room temp and achieve your goals.

Understanding the leaf temp and ambient temp allows you to optimize the performance of your lighting, fertigation and HVACD systems

Relative Humidity (RH): This target will depend on your leaf temperatures and VPD goals. Popular ranges are 60-75% during the vegetative phase and 45-60% during the flowering phase, but cultivar dependent outliers exist.



2. Emissivity Adjusted IR Gun

Description:

An emissivity adjusted IR gun, or infrared thermometer, is a non-contact device that measures temperature by sensing the infrared energy emitted by an object. It allows the user to quickly gauge the temperature of an object, like a plant leaf, without touching it. The “emissivity adjusted” feature ensures that the tool provides accurate readings regardless of the material or surface being measured, which is vital when comparing leaf temperatures to ambient conditions. While mildly debated, the most popular emissivity for cannabis is 0.97. This adjustment allows for accurate data collection. For example, reading of cannabis leaves can vary more than 10F between 0.95 and 0.97 adjusted emissivity.

Usage:

Regularly measure the temperatures of plant leaves at various growth stages and canopy depths then compares them to ambient conditions. This can help identify if any adjustments in the environment or equipment are needed.

Importance in Cannabis CEA:

Leaf temperature can provide insights into plant health. If leaves are too warm, they might suffer from reduced photosynthesis and increased transpiration, which can lead to dehydration. On the other hand, cold leaves might slow down metabolic processes and

growth. Identifying and correcting these imbalances ensures the plant’s physiological processes run optimally. Moreover, Crop Steering for bag appeal, color and forced senescence are often achieved through manipulation of plant temperature which can be guided with accurate data and built into SOPs for consistency.

This also measures the effectiveness of your [airflow solution](#) to provide convective cooling and homogenize leaf temp and can trigger action plans to change environmental itineraries and adjust airflow as needed.

Recommended Value Ranges:

Leaf Surface Temperature: Ideally within a few degrees of the ambient temperature, between 68°F to 85F

Why such a big range? Cannabis is an annual plant and very reactive to its environment. The more you dial in your leaf temps, the more you dial in your cultivar and give consumers a consistent best in class experience.



3. FLIR Gun (Forward Looking Infrared)

Description:

A FLIR gun is an advanced thermal imaging camera designed to visualize heat. This tool allows users to see temperature differences in various objects, making it useful for spotting “hotspots” or areas of heat concentration. In a cultivation context, this can help identify areas or equipment emitting excessive heat that could potentially harm plants or suggest the need for airflow solutions. The imagery provided often ranges from grayscale to multicolored, with different colors indicating different temperatures.

Usage:

Regularly scan all equipment and sections of the grow room, especially areas where heat production is expected. The impacts of dehumidifiers, humidifiers, lighting, fans, HVAC supply/return can be visualized with FLIR.

Importance in Cannabis CEA:

By identifying sources of excess heat or excess cold with the FLIR gun, cultivators can make necessary adjustments to maintain a uniform and conducive temperature throughout the grow space. Popular solutions are airflow adjustment and augmentation, damper adjustments, and repositioning of equipment to prevent a negative impact on plant health.

This data can also support informed decisions regarding fan placement and [airflow management](#), as well as inform facility design regarding appropriate front aisle, working aisles, and spacing from the back wall to facilitate effective plant management, air mixing and the elimination of microclimates.

Recommended Value Ranges:

Equipment such as lights, dehumidifiers and fans all have recommended operating ranges that help you extend the useful life and should be considered. If your room is too hot your equipment may be less efficient and more likely fail.



4. ePAR Meter

Description:

The ePAR meter is a specialized tool for measuring Photosynthetically Active Radiation (PAR) – the range of light wavelengths used by plants for photosynthesis. ePAR stands for 'Effective PAR', which considers both the intensity and quality of light from 400nm-750nm. This meter assesses how much usable light plants are receiving at various levels and locations within the cultivation area, aiding in optimizing light conditions for maximal growth and yield.

Usage:

Measure light intensity at various heights and regions within the grow space. This includes the top middle and bottom of the canopy to determine which parts of the plant are receiving optimal or suboptimal light levels.

Importance in Cannabis CEA:

Light is a crucial factor for plant photosynthesis. Poor light intensity management leads to issues like leggy growth, leaf burn, photobleaching or reduced yields. It's critical to choose the appropriate light intensity to optimize your tier spacing in [multitier](#) and total canopy lighting overlap for single tier.

The ePAR meter helps ensure that you can match all the other plants demands as distance from the light and PPF change as the plant grows. This tool can also help inform defoliation techniques top down to achieve higher light intensity goals deeper in the canopy.

Recommended Value Ranges:

Ranges depend on stage of growth and desired outcome. It is importance to establish a low light limit threshold that can be measured to trigger action plans. Many cultivator remove leaves that receive less than 600PPFD allowing the plant to focus on more energized growth. In Flower, many cultivators target 1000+PPFD in peak flower whereas Vegetative plants can receive less intensity but achieve similar DLI's due to their longer photoperiod.



5. Hot Wire Anemometer

Description:

Unlike a vane anemometer, a hot wire anemometer measures wind speed based on the cooling effect of air on a heated wire. As air passes over this wire, it cools down, and the anemometer calculates the airflow speed based on the rate of cooling. This tool is exceptionally sensitive and can detect minute airflow changes. It's especially useful in tight spaces or areas where a vane anemometer might not be as effective.

Usage:

Use the hot wire anemometer to measure airflow in areas that might be challenging for the vane anemometer, like tight spaces or directly within thick canopies. Its precision can provide more accurate readings in these conditions.

Importance in Cannabis CEA:

Consistent airflow not only benefits the above-ground parts of plants but is also crucial for the root zone, where it can prevent issues like root rot. By ensuring every part of the plant—from the canopy to the root zone—receives adequate airflow, cultivators can promote overall plant health, nutrient uptake, and growth.

Measuring the airflow at the plant level allows you to make targeted

investments in airflow management solutions that will increase plant performance.

Recommended Value Ranges:

Airflow: Depends on so many factors from light intensity, to stage of growth, to specific goals. This also depends on where we are measuring. In the duct? At the supply? At the end of In-Rack Airflow? At the top of the canopy? At the bottom of the canopy?

One popular baseline is to achieve around 200 feet per minute or 1 meter per second of airflow in the cultivation space.

Additionally we know that if we apply 0.4-0.7m/s airflow at the plant level we can break the boundary layer and increase gas exchange to keep up with high PPF D cultivation environments.

As the other cardinal parameters are controllably increased we can continue to increase airflow. Choosing the appropriate [airflow system](#) will allow you to control air movement in the room and at the plant level, supporting consistent plant vitality.

How much airflow you need will depend on plant height, plant density, leaf area index, tier spacing for multitier, tray style, stage of growth, cubic volume in the room and your goals.



6. PH/EC/Water temp meter

Description:

pH Meters are indispensable tools for cannabis cultivators, particularly those using hydroponic or soilless growing systems. They ensure that the pH levels of the growing medium or nutrient solution remain within the optimal range for nutrient uptake. This is crucial for the plant's ability to absorb essential minerals, which directly impacts overall health, vigor, and yield.

Usage:

A cannabis pH meter functions by utilizing a pH electrode or probe designed to work in soil or hydroponic solutions. The electrode is inserted into the growing medium or nutrient solution, where it detects the concentration of hydrogen ions. It then generates an electrical potential, which is translated into a pH value and displayed on the device's screen.

Importance in Cannabis CEA:

This tool can validate inputs and outputs at various points in the water cycle to trigger action plans regarding root zone health and fertigation throughput. Swings in pH can trigger nutrient lockout, or be signs of root zone fungal pathogens.

Make sure that [racking](#), walls, floors and other fundamentals are of high quality and easy to clean so they do not harbor pathogens. When you see outliers in the data try to trace them back to a cause. Was it a clogged drain that was too small, or a moldy bulkhead fitting? Knowing your inputs and output expectations allows you to use the pH/EC meter as a detective tool as much as a crop steering tool.

Recommended Value Ranges:

pH ranges: From 5.4 to 5.9 depending on media and fertigation.

Ideal root zone temp: Likely in the 70F range, however crop steering may dictate warmer or cooler temperatures for targeted phenotypic expression.

Measure and control temperature of input water controlling root zone temperature, a cardinal parameter. Verify and validate your fertigation system by making sure your settings are what is going to the plant. Test runoff after passing thorough the root zone and media to determine changes from inputs and trigger action plans to maintain root and plant health.



7. Substrate Sensor

Description:

A substrate sensor tests the media for water content which allows you to adjust and maintain appropriate drybacks and fertigation strategy. This includes variables like moisture content, temperature, and potentially other factors critical for maintaining an optimal growing environment.

Usage:

A substrate sensor typically uses metal probes with sensors which are inserted into the root zone of crops to measure temperature, WC (water content) and EC (electrical conductivity) in real-time. Employing multiple substrate sensors at your crops' root zone allows you to precisely understand what nutrients your crops need to thrive.

Importance in Cannabis CEA:

The importance of a substrate sensor lies in its ability to provide growers with accurate, real-time data about the conditions within the growing medium. This data is vital for making adjustments to the watering schedule, nutrient application, and other aspects of cultivation. By ensuring that the substrate maintains appropriate levels of moisture, temperature, and potentially other factors, growers can optimize nutrient uptake and overall plant health.

Assuming proper transpiration and excellent drainage, this tool allows you to adapt to new cultivars and fine-tune phenotypic expression to meet your goals. With poor drainage, anaerobic water conditions develop and spread to the roots of the plants and impact yield and quality.

Recommended Value Ranges:

Drybacks, total saturation rates, and fertigation crop steering is both nutrient and substrate dependent. This tool allows you to execute large scale fertigation events and maintain precision strategies. Whether you are fine tuning P1,P2,P3 strategies with your rockwool, looking to maintain the perfect air to water balance in coco or timing a microbe activation event with soil; this meter allows you to establish consistent and scalable SOPs for media management and nutrient availability.



8. Water Activity / Moisture Content Meter

Description:

Water activity meter/moisture meter is a specialized instrument designed to measure the moisture content content, water activity and cannabis that is being dried or cured. This tool allows for testing throughout the curing process to predict rates of sublimation and access biological safety. The findings can trigger adjustments in curing itineraries and lead to standardized curing setpoints on a day-by-day basis.

Usage:

They provide critical information about the moisture levels in the harvested cannabis material, which is vital for preventing mold growth and ensuring product quality and safety. Additionally, Moisture Meters can be used during the growing phase to assess soil or growing medium moisture levels, aiding in proper irrigation management.

Importance in Cannabis CEA:

Water activity is another metric that is becoming more regulated for consumer safety. Water activity at a high rate 0.8 will grow mold but properly sealed cannabis flowers with a water activity below 0.65 will remain safe after packaging and maintain better shelf life.

Moisture content impacts potency results. Higher water content = less potency, lower water content = higher test results. Controlling moisture content for consumer experience is a powerful brand decision but most agree that around 12% moisture content is the chewy, bounce back styrofoam texture we have come to associate with the best flower in the world. In most places moisture content must be below 15% in order to be considered safe to sell.

Building or retrofitting a curing space with [racking](#) that focuses on plant spacing and augmented [airflow](#) empowers a brand to produce consistent flower, on consistent timelines while also reducing risk and reducing labor.

Recommended Value Ranges:

Harvested Cannabis: For dried and cured cannabis flower, the moisture content should ideally be around 10-15%. This range helps prevent mold growth and ensures a quality, smokable product.





ELEVATING CULTIVATION *to new heights*

We are always happy to help fellow cultivators achieve their goals and maximize their yields.

If you have any questions or require further assistance, please feel free to reach out to us.



(951) 462-4111



info@growglide.com

www.growglide.com

Check out our other informational resources:

[Ask the GrowBot Podcast](#)

[White Paper Wednesdays](#)

[The Cultivator Series with Darin Siples](#)

**Come see us at
MJBizCon[®]**

Booth number - 31019