

# CARBON DIOXIDE ENRICHMENT (CO<sub>2</sub>)



## Benefits of CO<sub>2</sub>

The process of photosynthesis relies on a trinity of elements - water, light and carbon dioxide. Plant metabolism is regulated primarily by the availability of these three essential requirements. If any of these elements are at levels below what the plant needs, the plant will only be able to perform at that level and no greater.

Enriching a grow room with CO<sub>2</sub> allows your plant to use excess water and energy stored in their leaves, resulting in dramatically increased growth. Think about this: the average outdoor CO<sub>2</sub> level is 300 to 600 parts per million (ppm). But plants can use much more than that. Here's the wonder of growing indoors - a grow room can be enriched to a level of 1000-2000 ppm. That's 3 to 6 times the amount of CO<sub>2</sub> encountered outdoors. The result? Plants grow faster, fuller and have more zest for life. When using elevated levels of CO<sub>2</sub>, plant growth rates can increase by as much as 100 to 200%. Even to an already "dialed in" room a 30% increase is to be expected!

It is difficult to maintain optimum CO<sub>2</sub> levels in a grow area employing an air intake and/or exhaust. For this reason, it is important that the room be a 'closed' system. Oxygen tends to push additional CO<sub>2</sub> out of a room, and since oxygen is created by plants, it is only necessary to vent in order to lower temperature and humidity levels within the space. On the back of this page, we include more information about air flow and venting with CO<sub>2</sub>.

## Using Bottled CO<sub>2</sub>

The most common way of enriching a grow area with CO<sub>2</sub> is by using an Injection System like the Co<sub>2</sub> Regulator from Titan. This system runs off of CO<sub>2</sub> gas (from a tank, much like a soda dispenser) & is a good choice for a small room. The drawbacks to this kind of enrichment system is the need to consistently change CO<sub>2</sub> tanks and the fact that it can often take a long time to enrich a room. The largest room this should be used with is 10' x 15' (and that's pushing it).

A CO<sub>2</sub> Injection Valve consists of a pressure gauge (monitors how much gas is in the tank), a flow meter (monitors the amount of gas being released) and a solenoid valve (turns flow of gas on and off). Some method of controlling the valve is employed, a timer or a CO<sub>2</sub> controller, and an oscillating fan to disperse the CO<sub>2</sub>. CO<sub>2</sub>, being heavier than air, fills the garden from the floor up like water in a swimming pool.

## CO<sub>2</sub> Generators

Most CO<sub>2</sub> generators create CO<sub>2</sub> as a byproduct of burning propane or natural gas. They are built to run off of liquid propane tanks or a natural gas line. The natural gas option is preferable to most growers as it eliminates the need to constantly refill tanks. Most buildings have a natural gas line, although you may need to have it extended to reach your grow area. We do not suggest you do this on your own. Get help from a professional!

We sell Titan CO<sub>2</sub> Generators in which a pilot (controlled by an electronic ignition) is used to ignite the gas when the generator is turned on. A thermocouple is used to monitor the pilot flame. If the pilot flame is lost, a safety valve will close so that unburned fuel will not be released into the enclosure. Generators come in different sizes and you want one which is optimum for your room size - one capable of enriching your room in 5 - 10 minutes. Titan Generators come with 2, 4, 8 or 10 burners.

CO<sub>2</sub> generators do create heat, and depending on the size of generator you choose, you may be adding a considerable amount of heat to your grow room. This combined with grow lights can create a very warm room indeed. The good news is that heat is a necessary catalyst for plants to use the added CO<sub>2</sub> and that they prefer warmer temps than they do without CO<sub>2</sub> enrichment. Most plants prefer temps of 86 degrees F with CO<sub>2</sub> enrichment. If your room doesn't heat up this warm you may need to bring in a heater (this can be the case for greenhouses). More often the room will get too hot and the use of an air conditioner will be employed.

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## CO<sub>2</sub> Optimization

When enriching a room with CO<sub>2</sub>, the idea is to produce just enough to be effective, but not so much that precious CO<sub>2</sub> is wasted. The simplest way to handle this is to use a timer. If you go this route, we suggest using a timer that is capable of running very precise, timed intervals such as an irrigation timer. Even better is to use a timer that is made for CO<sub>2</sub> enrichment such as the **Apollo 2** from Titan (Affordable Day / Night Cycle Timing down to 10 seconds), or the **DRT-1A** Digital Timer from Sentinel - (Allows digital timing down to the second). Both employ a photocell allowing for Day / Night Use or for Both. CO<sub>2</sub> is not needed for Night use. **Apollo 15** day/night cycle timer is 2x the price. On time is 5 seconds to 20 minutes.

Professional growers will want to take advantage of automated CO<sub>2</sub> control equipment that controls venting actions as well as CO<sub>2</sub>, and quickly pays for itself by providing a method of accurately controlling CO<sub>2</sub> producing equipment. (For more information, read below under CO<sub>2</sub>, temperature and humidity.)

## CO<sub>2</sub>, Temperature and Humidity

CO<sub>2</sub> enriched rooms can get extremely wet. This increase in relative humidity is due to the fact that the plants' metabolic processes are occurring at a more extreme rate and water is flowing up through the roots and out of the leaves quickly. Most plants do not thrive in an overly humid environment, and when the level of humidity gets too high it needs to be removed with a vent fan or a dehumidifier. The most common problem for growers is finding the balance between exhausting moist air, enriching a room and keeping the temperature at the right level. If this is done incorrectly, CO<sub>2</sub> will be exhausted with the air and plants will not get the benefit of the CO<sub>2</sub> enrichment. There are many solutions to this conundrum and here are two of them:

If you are using a CO<sub>2</sub> emitter system, and are on a budget we suggest using two timers. It is very affordable, and easy to use. Timers will turn CO<sub>2</sub> enrichment on and off at predetermined intervals, based on basic information you provide to our CO<sub>2</sub> calculator (Room dimensions, desired ppm, size of emitter in CFH) It does all the calculations for you and creates a CO<sub>2</sub> on/off schedule. Once you couple this with a 5-10 minute per hour Vent-Fan Exhaust schedule you will be up and running. Remember to not turn your CO<sub>2</sub> on at night time because Plants cannot utilize any CO<sub>2</sub>.

For larger situations when a CO<sub>2</sub> generator is employed, heat and humidity are even more of an issue. In this growing situation, we highly recommend the grower invest in the CO<sub>2</sub> Monitor & Controller Package from Titan. Titan Controls is both affordable and does the job well. Titan Controls makes a few different CO<sub>2</sub> Monitors and Controllers. Our favorites are the **Saturn 6**, **Atlas 8**, and the **Atlas 2**. The Saturn 6 Monitors and controls CO<sub>2</sub> level accurately within the Grow environment and allows for a vent fan to be hooked up for High Temperature override control. (If temps get to HIGH then CO<sub>2</sub> is turned OFF and room is exhausted.) The **Atlas 8** (employs FUZZY LOGIC for more accurate CO<sub>2</sub> control) and **Atlas 2** (has preset CO<sub>2</sub> control at 1500 and is the cheapest digital CO<sub>2</sub> Controller on the market today.) Titan also make Environmental Controllers (working in conjunction with their Monitor and Control units) which keeps the Environment (Temp / Humidity) within the accepted levels. The **Saturn 4** is a CO<sub>2</sub> Monitor that samples the atmosphere and transmits the values to the Controller which then operates its CO<sub>2</sub> outlet (and correspondingly the CO<sub>2</sub> generator) according to setpoints. If the sampled level of CO<sub>2</sub> is lower than the setpoint, the CO<sub>2</sub> generator will turn on. The generator will stay on until the controller is informed by the monitor that the CO<sub>2</sub> level has reached the appropriate point. The **Saturn 4** interrupts the CO<sub>2</sub> loop if either the temperature or humidity rise above their designated points on the **Saturn 4**. For example, if the humidity is set at 60% RH and the humidity in the room rises to 63% RH, the Saturn 4 will turn the CO<sub>2</sub> off and turn the vent fan on. The vent fan will stay on until the room reaches the desired humidity level. At that point the vent fan turns off and the CO<sub>2</sub> turns back on. If the temperature or humidity go up during dark periods, the vent fans will still function, although CO<sub>2</sub> will not.

In rooms with more than two lights, it is difficult to use CO<sub>2</sub> without an air conditioner. HID lights are mighty heat generators, so having more than two will invariably cause problems. A CO<sub>2</sub> generator (not a tank) will also add excess heat. We recommend using an air conditioner in these situations. Yes, it is possible to avoid using an air conditioner, but it's tricky. You must use a carefully designed system using a CO<sub>2</sub> controller and air cooled lights to avoid wasting precious CO<sub>2</sub>. We think it's easier to whip out your trusty Window mount or "Split Unit" Air Conditioner. (Please note: Portable "In Room" AC units do NOT work for CO<sub>2</sub> - They blow ALL CO<sub>2</sub> out of the back end exhaust port.)