

Carbon Dioxide enrichment

By Scott Andrew – Nerang Hydroponic Centre

Carbon Dioxide enrichment is a difficult subject. While growth can be phenomenally improved, the danger of reduce growth rates through temperature and humidity makes the undertaking more complicated than it might seem on the surface.

What is Carbon Dioxide (CO2) enrichment

All plant cells are made from organic molecules, which, by that definition require carbon. Science fiction calls us all Carbon Based Life Forms. Plants obtain Carbon from the air, and cannot get it through any other method. In an indoor or controlled environment, over feeding with CARBON DIOXIDE can increase growth rates.

The stomata under the leaves are tiny holes that the plants breathe through. (Transpiration) The Stomata work very hard to obtain CARBON DIOXIDE and plants leaves often change shape just to catch fresh air.

What can be expected?

Ordinary Air contains around 300-350ppm (parts per million) of carbon dioxide.

If we said 300ppm is normal growth, by increasing CARBON DIOXIDE to 500-700ppm we would expect very little other than greener healthier growth.

From 1000ppm to 1500ppm, the growth rates accelerate. Some articles claim 30% and some up to 100% extra plant growth and development over normal growth.

From 1500ppm to 2000ppm the growth slows again, and above 2000 the plants actually choke, and the growth rates are below normal.

At 5000ppm your fingernails and skin will begin to turn blue and you will become sick. You may not be able to identify this, generally, as only people unaffected will be able to see the change. Get into fresh air and seek medical advice.

How is it done?

All Methods for CARBON DIOXIDE enrichment require high maintenance. Examples of the most common are

Yeast

Yeast is unlikely to produce enough CARBON DIOXIDE to benefit the plants. Adds around 50-200ppm or so, and must be the correct temperature, and have the right sugar levels etc. to work at all.

Other chemical reactions

A product called CO2 enricha is \$30 and has about 30 cubic meters worth of CARBON DIOXIDE crystals. Helps boost plants in small areas, but expensive to use on a large scale. Add one measurer full of crystals to water and away it goes.

LPG burners

Burners are like a BBQ, and may add up to 10 degrees to your growroom temperature. They are difficult to manage. Prices from around \$350

Some growers balance the cheap fuel, with using an Air conditioner. Very complicated as testing must be done to ensure levels are right.

Bottled Carbon Dioxide (Beer Gas or Food Grade CARBON DIOXIDE)

Using a regulator, we measure the number of litres of carbon dioxide to inject into a room atmosphere.

Method one:

Open cylinder and give the plants "a blast"

I'm not kidding, some growers actually do that. And some actually get a boost.

Method two

4 stage Injection – No Airconditioning

PHASE ONE – STOP FANS

First we have to stop the exhaust fans; and to eliminate leakage, reduce any gaps under doors etc.

PHASE TWO - INJECT

Add enough litres of CARBON DIOXIDE to raise CARBON DIOXIDE levels to 1500ppm.

PHASE THREE - WAIT

An enrichment period is set, based upon heat levels. In a normal room, we usually set this at 30 minutes as air temperature will build up from the use of lighting or sunlight if left longer, however sometimes it is set at 60 minutes if allowed by a cooler room temperature.

PHASE FOUR – EXHAUST ALL AIR

After Enrichment period has elapsed, the exhaust fans then start up again, and draw out hot air, and any unused CARBON DIOXIDE. Because we will not know how much CARBON DIOXIDE is used up during the enrichment process, we don't know how much more CARBON DIOXIDE to inject. We must reduce the CARBON DIOXIDE back down to a known level, so we can inject gas again. This level is normal atmosphere, 300ppm approx. We turn on the fans and draw out at least 10 times the air of the room, replacing it with normal fresh air. We then inject the appropriate litres of CARBON DIOXIDE and we redo the whole cycle.

We will need to use digital timers with battery backup at \$55 each, 1 for the fans, 1 for the injection. We also need a regulator, flow meter and solenoid to be powered by the timer, around \$400 for the set. You buy this at BOC gases in Australia.

The only real issue is that we have to keep the temperature below 35 degrees Celsius and we can either set the timers to give longer fan times at appropriate hot periods of the day. You can also use a CO2 system with a thermostat, so exhaust and inlet fans come on when the temperature hits the maximum temperature, and the CARBON DIOXIDE injection timer stops while the room is at that temperature. This is more expensive way to set up, and an all in one timer unit and thermostat is available for around \$700-\$800 (check with store) to override the injection and run your only set of fans continually until temperatures drop. This system is best as you cannot predict temperature changes in a growroom with accuracy.

Method three

You can also use an infra-red unit which detects CARBON DIOXIDE levels and maintains them at the set level of PPM. You then use an air-conditioner thus maintaining a perfect environment. From \$2000 plus, this is not a cheap setup but creates amazing results.

I can recommend the airconditioning with small fans in and out (say computer fan size) so air conditioning is not sucked out too fast, and hot outside air is not drawn in too fast.

GENERALLY

As the growth rate is faster, any problems will happen faster, and as such all CARBON DIOXIDE systems will require checking twice per day as a minimum including water, pH, nutrients, lamp height etc

Why do plants stop responding to Carbon Dioxide enrichment?

After 4-6 weeks, depending on the environment and plant type, plants can stop responding to CARBON DIOXIDE. This is due to the stomata on the bottom of the leaves closing slightly. The reason is that the plants sense the high CARBON DIOXIDE and realize that they no longer have to work so hard to their carbon dioxide, and stop trying so hard. Imagine you were 'breathing heavily' and caught your breath, then you would breathe more shallow.

To avoid this, it is best to only use CARBON DIOXIDE enrichment for 2 weeks, then a week off, and so on, which results in higher yields as the plant is continually seeking as much CARBON DIOXIDE as possible. This of course, varies from plant to plant and may or may not apply.

How can I combine CARBON DIOXIDE with FANS and air conditioning?

If the growroom can be sealed and air-conditioned, then the fans need not be switched on for many hours. The amount of CARBON DIOXIDE is usually enough for 2 to 4 hours.

Some testing might be of benefit, and a CARBON DIOXIDE kit that has two single tests and a measuring syringe is \$40 You can determine how long the CARBON DIOXIDE stays at high levels with the test kit.

How Can I achieve high growth without CARBON DIOXIDE?

Easy, I can tell you that it is much easier to use common sense to increase yields than to use CARBON DIOXIDE

If you have one light, and one hydroponic system, to double your yield, add another growing area and light and system and increase the ventilation accordingly.

Consider all your effort in CARBON DIOXIDE, and then if your regulator fails, and the plants get no CARBON DIOXIDE, your plants could be slowed or stopped for the lack of air. If there is a leak, you can asphyxiate your crop in a few hours. You could cook your plants if the temperature goes too high in a CARBON DIOXIDE environment. When pH or nutrient problems occur, they harm the plants at around 4 times the rate when plants are accelerated by CARBON DIOXIDE. Finally, the yield is better. But you can double your crop just by adding more growing area.

Ask yourself what your goals are before spending money on a CARBON DIOXIDE unit. It really is not the answer for most people. It suits people who are maxed out on power, or have no room left. Perhaps another location should be considered as well as the current one?

CARBON DIOXIDE can be difficult, can produce problems, and is definitely not for the beginner. It is easy to damage a system when it grows at that rate, and there are so many variables. E.g needing to fill tanks more regularly to keep nutrients from becoming too strong. The tanks need to be adjusted in the morning and afternoon. Lamp height may need to be adjusted most days.

How to calculate the litres of CARBON DIOXIDE to achieve 1500ppm of CARBON DIOXIDE in the air?

Width of room, in centimetres, divide by 10 _____

Length of room, in centimetres, divide by 10 _____

Height of room, in centimetres, divide by 10 _____

Multiply them together,
this is the number of litres in the room _____

1ppm is 1 millionth of the total litres in the room

To make 1200ppm (which is the ideal 1500ppm but take away 300ppm of CO2 in normal air), and work out how many litres of gas in the room would be

total litres in room x 0.0012 _____

And if you worked that out, well done, otherwise contact me on 07 5527 4155 or the message page on www.hydrocentre.com.au if you want me to do the calculations for you.

CO2 Gas Cylinders

You cannot "own" a cylinder in Australia. BOC Gases own them all, and supplies them all. You need to take your regulator into the BOC gases distributor (to ensure they give you a right hand or left hand thread to suit your equipment) They can provide you with a list of cylinder rental prices, and refill prices. You will need a Drivers Licence or similar to open an account with them. If you lose the cylinder expect a very big bill. They are expensive.

Happy Gardening

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