



The Growers Network is the first vetted and exclusive community that connects the world's cannabis professionals to make them more productive and successful. The community facilitates communication between commercial cannabis professionals, including grow operation owners, master growers, academics, dispensary owners, equipment manufacturers and more. Below is a copy of a question and answer forum with members of the Growers Network and management of CO2 GRO Inc.

US GROWERS NETWORK

CO2 GRO INC. DISSOLVED CO2 FOLIAR SPRAY

ASK ME ANYTHING ABOUT DISSOLVED CO₂ FOLIAR SPRAY QUESTION AND ANSWER - July 25, 2018

1) This is very fascinating already and thank you for taking our questions. Using your dissolved CO₂ techniques have you noticed the best results from daily applications/ multiple times per day?

Yes multiple applications per day during the light period so plants can assemble more sugar. Optimal frequency of CO₂ spray applications will vary by species of plant and maturity of the plant. At the beginning of plant seedling stage, would be more frequent with variable CO₂ concentrations in the water based on plant maturity. The highest dissolved CO₂ concentration spray (we can go to 2,000 PPM without material loss) should be on juvenile vegetative state growth plants for best growth success.

2) With mold being a concern in the Cannabis Industry is application only recommended during Vegetation Cycles?

Re mold - apply dissolved CO₂ spray daytime only. Re cannabis plant growth, to maturity you could spray dissolved CO₂ through to bud harvesting on the leaves to maximize sugar delivery to the buds.

3) Can you tell us what corresponding changes were made in other additives, to achieve this? (More or less fertilizer, etc.?). Have you incorporated this holistically into the plant cycle or how do you recommend adjustment to the other inputs when using this? How about light and temperatures?

There is a ratio of NPK/other micronutrients to biomass weight you have to respect if you grow a plant 50% larger/heavier. Generally the nutrient ratio to maintain quality when you grow larger cannabis plants faster is 110% of increased expected plant biomass growth.

We can adjust the frequency of dissolved CO₂ spray and the degree of CO₂ saturation in the water to accommodate any temperature or light to CO₂ balance to maximize plant growth.

4) What are the comparative costs of the dissolved CO₂ and CO₂ gassing?

We use only 50% of the CO₂ gassing used today to grow larger cannabis plants faster as we target dissolved CO₂ to cannabis leaf surface areas only. We have proof of that at St. Cloud State where Dr. Matt Julius is doing a variety of grow trials using both dissolved CO₂ spray and gassing of CO₂ with lettuce and peppers.

At our 2013 lettuce trials at the University of Guelph, we achieved 33% and 100% increased lettuce biomass using dissolved CO₂ foliar spray versus CO₂ gassing at 800 PPM in side by side grow chambers.

Dissolved CO₂ and CO₂ gassing are not however, directly comparable as atmospheric CO₂ exposes both CO₂ sources and sinks. We only apply dissolved CO₂ for specific plant leaf surface areas only that are sinks.

5) pH - I remember back in the day we used to add baking soda to our sprays to prevent molds and mildews. Worked well, didn't realize it was because we were causing pH disruptions. That's part of the role that your nutrients (N, P, K) play - adjusting the pH levels. I can tell you pH absolutely works to control fungi/molds.

Plant leaves will absorb all the CO₂ they want in 90 seconds when coated with dissolved CO₂. The excess CO₂ not absorbed will evaporate back into the air. Our dissolved CO₂ water is mildly acidic (carbonic acid) when applied but quickly turns alkaline as dissolved CO₂ is rapidly absorbed with the C (acidic) entering the leaf and the O₂ (alkaline) leaving.

This creates PH volatility on the plant leaf surfaces after every misting which appears to turn away pests. We will be testing that anecdotal hypothesis scientifically at St Cloud State in August. It is possible that dissolved CO₂ spray is a natural pesticide. May also be a natural herbicide, fungicide and insecticide.

6) How about adjusting for various light and humidity conditions to avoid excessive CO₂?

Our guess is probably not for excess humidity. Our targeted dissolved CO₂ spray is independent of atmospheric water humidity.

Re excessive CO₂, climate change scientists believe that the 2,000 PPM level of dissolved CO₂ we can put on plant leaves with minimal loss was the level of CO₂ gas in the Jurassic period atmosphere. Back then it is believed temperatures at the poles were in the 90's and there was no snow or ice on earth. The giant Jurassic ferns share a common ancestors of with all C3 plants on the planet today including cannabis. So the cannabis genetic code goes back to Jurassic with 2,000 PPM in the atmosphere.

7) I have been hoping for the same thing. Perhaps a system to infuse O₂ in the water for hydroponics while misting to upper part of the plants with CO₂. Maximum Potential Growth system (MPG).

Yes we are exploring such systems with hydroponic cannabis growers.

8) Is this something that has to be applied by hand, or can sprayers be permanently set up to turn on when needed?

Yes sprayers can be permanently set up. The more automated with remote control of spray frequency like overhead spray booms the more effective with no human interaction as in backpack sprayers. Morningstar Grower Services (David Marshall) is involved in a dissolved CO₂ grow trial in Kalamazoo where he tied a dissolved CO₂ system to an existing mist system. He switches between dissolved CO₂ infused mist and fresh water mist with a simple valve switch. He has been rooting garden mums for a large grower that is very impressed with what they have seen with dissolved CO₂.

9) In regards to applying during daytime hours or with the lights on, is there any fear of burning the foliage?

There is no risk of damaging foliage as we control the dissolved CO₂ dosage and application rate.

10) What is the cost of your dissolved CO₂ system?

Cannot estimate that until we get specific information on your grow room configuration. It will be a royalty of a small fraction of the incremental plant value we create that will first be validated by a grow trial.

Outdoor, 40,000 sq ft of canopy. I also have about a 0.25 acres of veg that would get treated. DM me an estimate, or add me to your mailing list. Thanks for the great Ask Me Anything (AMA), will come back to you when budgets are laid out for next year.

Thank you, we will be in touch.

11) Other than noticeable increases in yields through foliar application of CO₂, what are the other most remarkable benefits over traditional application methods i.e. cost, consistency, efficiency, pest management etc...?

For cannabis, we have proven 33% accelerated cannabis plant vegetative growth times 60% of a full grow cycle or a net 20% and got 22% larger bud weight. Our first cannabis grow trial press release - [PR20180725 CO2 GRO Cannabis Post SGS Final.pdf 2](#) (217 KB). We believe we will achieve similar bud results outdoors with cannabis growers who have no alternative other than Nature's air CO₂.

We used SGS Labs to verify our bud THC, CBD and CBN concentrations for three trials we submitted on indica, sativa and hybrid (G-13) strains. After the next two results SGS is performing we will publish the averaged SGS analyses of their exact THC, CBD and CBN averages versus control buds.

We will get to trials with major cannabis growers using CO₂ gassing shortly. Our first results point to adding one more cannabis crop per year to cannabis growers already producing up to 5.5 crops per year indoors.

For cost, consistency and efficiency, we are convinced with proof that we will use only half the CO₂ currently used in greenhouses to grow more than they currently do, faster. We have not experienced any erratic indoor plant growth to date nor completed any outdoor cannabis grow trials yet to have comments.

For pest management we are observing that dissolved CO₂ being rapidly absorbed by plant leaves creates surface pH volatility and have noticed a distinct drop in pests on those plant leaves. More specific, the fluctuating pH appears to inhibit mold and bacteria and the locally diminished O₂ and elevated CO₂ appears to deter animal (insect) grazers.

12) I have never seen an increase in yield with CO₂ at the level of the Rhizosphere (soil). So, you think that dissolved CO₂ will increase the level of the root mass?

Yes but only if applied to leaves that use 50% of the sugars they produce to grow. Leaves send the other 50% of sugars they produce to growing stocks, stems and yes to roots also. (Apical Roots, Stem, and Buds are all carbon sinks; excess carbohydrate should benefit growth in all locations.)

In the 1950's, the first documented proof that leaves transfer half their created sugar to roots was performed at Michigan State with the use of radioactive isotopes put on leaf surfaces. With a Geiger counter, it was proven that isotopes reached the roots in 24 hours from being applied to leaves.

13) Have trials for dissolved CO₂ been conducted on CO₂ Infused Root Applications as well and do you see that in the future for the industry? To the best of my knowledge CO₂ can damage roots. It's oxygen that roots love.

You are right that dissolved CO₂ damages roots so no, do not see it getting past misting leaf canopy. The way it works is that dissolved CO₂ getting on roots blocks some dissolved oxygen reaching the roots, partially choking them. Average dissolved oxygen in water is only 8 parts per million.

Yes we have done a pepper trial at the University of Guelph where they applied 2,000 PPM of dissolved CO₂ sprayed on pepper roots. This led to a 36% decrease in pepper yields. We are now doing the exact same experiment but 100% applied on pepper plant leaves only and zero to the roots. We will press release those pepper grow trial results in September.

14) What is the #1 problem you are solving and why should growers choose your products over your competitors?

More food/plant yield for the planet's humans and proper recycling of human CO₂ emissions.

We have no human competitors outdoors. Nature outdoors has only 400 PPM of CO₂ in air. We can dissolve 2,000 PPM instantly into water without bubbles to apply directly outdoors and indoors. We compete against CO₂ gassing practices indoors only. We need only half the CO₂ they gas with to grow larger plants faster.

Delivered CO₂ indoors is not free. A 1M sq ft greenhouse spends about \$500K/y for delivered CO₂ gas and \$1-\$2M for initial capex to install CO₂ gassing infrastructure. Our capex for some irrigation retrofitting and a cabana to interconnect CO₂ and water to our mixing technology will be a small fraction of that.

Higher plant and bud values will far exceed the variable cost of delivered CO₂ dissolved into water for foliar spray in most cases. We proved that in our first completed trial with a 45% increase in commercial bud value on a cannabis crop in Canada versus a control group that was not CO₂ gassed.

15) Can this application be used with any standard misting system or is special assembly needed?

Any standard misting system

16) Is dissolving CO₂ in water more effective than simply increasing atmospheric CO₂? And if so, do you have a theory why that is?

Yes we do scientifically and is the basis for our global PCT patent pending. It works because of the osmotic pressure differential between dissolved CO₂ applied to the

surface of a plant leaf and the CO₂ level inside of that leaf. Nature wants to balance everything so is constantly dissolving CO₂ at 400 PPM available and oxygen at 190,000 PPM available into ocean water at the surface that algae and phytoplankton (CO₂) and fish (O₂) constantly consume below that water surface. Same reason why liquid nicotine and medical patches work on human skin which is almost identical to plant leaf skin - both are semi-porous.

Dissolved CO₂ foliar spray has never been thought through to accelerating plant growth. Dr. Julius at St Cloud State is doing great work for us at CO₂ GRO Inc. articulating the plant science on why it works so well.

17) How about plant respiration which happens when CO₂ levels in the environment rise. As CO₂ levels rise (think climate change / rising temps), plants release less CO₂ and hold onto it. Here's a Smithsonian article on the subject of plant respiration: [Way Plants Trap CO₂](#)

Yes plants respire less when you coat them with dissolved CO₂ foliar spray/mist as their stomata guard gate cells shrink as more soluble CO₂ is offered. Dr Julius at St Cloud State performed dissolved CO₂ conductance experiments that showed an 800% plus increase in CO₂ conductance, a combination of higher CO₂ transfer and lower respiration. Remember respiration is being conducted at the sinks (roots, shoots, buds). It should increase in accordance with increased cell division and growth. Our numbers are for gas exchange at the leaf. With that said, we will sequester much more CO₂ in the form of plant biomass than is released via increased cellular respiration.

18) Would dissolved CO₂ have a negative impact on the microbial and enzymatic processes that play a vital role at the canopy level or the rhizosomal level?

We have not witnessed any negative microbial or enzymatic impacts at the canopy level in all our scientific trials to date. Our one pepper grow trial at the rhizosomal root level proved it should not be in irrigation water that reaches the roots as dissolved CO₂ blocks some dissolved oxygen reaching the roots.

19) When you say traditional CO₂ gassing, do you mean like the www.leafly.com article for CO₂ growing marijuana?

Yes

20) The amount of CO₂ that can be dissolved in water can be described by Henry's law. Water just above freezing will hold more dissolved CO₂ as will water under pressure. If temperature is raised an/or pressure lowered that will cause effervescence with CO₂ bubbles coming out.

Yes re Henry's Law observations.

That is what soda companies do but they extract oxygen first so there is no fermentation. They pressurize up to 7,000 PPM of CO₂ in their soda cans. Our patented technology does **not** pressurize water as the amount of CO₂ we dissolve displaces the dissolved gases already in water as our technology is two way flow. This maintains constant water pressure which is crucial for algae and aquaculture fish growth.

What we do is stop dissolving CO₂ based on water temperature and pressure conditions before CO₂ effervescence occurs. We can dial up to create CO₂ effervescence (off gassing) easily if felt it is value added to plant growth at the floor level of greenhouse drip lines and misters.

21) Do you find there is a difference in the saturation rates into the plant leaves depending on the pH in the area?

No. We are finding that CO₂ saturation occurs in 90 seconds into the plant leaves exposed to a misting of dissolved CO₂. In our latest micro green trials we are using delivered 5.7pH water that when we dissolve CO₂ into that lowers pH by 0.2 to 5.5. The degree of PH drop adding dissolved CO₂ will vary with the water quality, mineralization, dissolved salts etc.

22) Ah the good ole Jurassic where the plants were huge and over-stimulated by CO₂. Crazy that you are able to achieve that with a CO₂ foliar spray.

Yes. Climate scientists estimate that the Jurassic period had temperatures in the 90's at the poles, there was no snow or ice and the atmosphere had 2,000 PPM of CO₂ gas in the air that we replicate in dissolved format.

23) Is your carbonated water drinkable?

Yes but there aren't any CO₂ bubbles so it would be like flat soda.

24) What sort of volume and frequency does this need to be sprayed to be effective?

The more frequently divided by irrigation water volume typically used the better. In greenhouses with overhead booms, we simply tap into the existing moving irrigation system and interconnect to a source of CO₂ gas with our dissolving CO₂ technology. Most have remote control over frequency already. In our St Cloud State plant science trials we followed aeroponics principles of a mist every 15 minutes but only on the leaves.

In our first completed cannabis trial we misted five times per day without variation only to flowering. We know we can continue spraying during flowering as long as leaves have not yet been stripped for bud harvest.

Outdoors we are currently looking at the 1,250 gallon per minute water wheels and windshield wiper irrigation guns that do 5-25 acres and tractors (or humans) that move with overhead misting equipment. We will see how we do with those irrigation set-ups with in line dissolving CO₂ equipment before moving to higher pressure pivots.

In all commercial cases we will be remote monitoring water and CO₂ flow rates to ensure the right level of dissolved CO₂ at the right maturity curve of the plant being misted.

**Thank you very much for presenting this to us and answering all of our questions!
Wishing you great success!**