CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

ISSUE 17 2012

CO_2

The role of CO_2 in growing

HIPHOP

Is hip hop dead?

BONSAI

Banzai! Let's grow a bonsai

And more:

- CO_2 applications
- Pests and Diseases
- Grower's talk
- Questions & Answers
- Grower's Tip
- Factographic
- Puzzle & Win

HQ Talk:

Foreword

It's summer time again and who knows what kind of summer we'll have this year... Will we be able to enjoy a BBQ in the sunshine? Or will we have to sit inside while it pours down with rain? Well, sitting inside this summer won't be all that bad as it promises to be a great summer for sport events. There's the European Football Championship, the Tour de France and the London Olympics! Of course, all those athletes and spectators in London will breathing in oxygen and returning CO2 into the atmosphere. Most people know that CO2 is one of the causes of the greenhouse effect, but have you ever thought of using CO2 to help with your growing?

Well if this is something new to you then this issue of the CANNAtalk is going to teach you a lot! In this issue we explain the role of CO2 in plants and how to apply CO2 if you are growing indoors. Of course, there are other articles in the magazine too. There is our grow-it-yourself column, our regular growers talk spot, a pest and diseases article about spring tails and a what's happening feature on hip hop, past and present.

And I almost forgot to tell you, you can now collect CANNA points when purchasing CANNA nutrients. You can collect and redeem the CANNA points on our website and receive some great prizes!

Have fun,

Karin Brinkman

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CARBON DIOXIDE'S ROLE

and Management in the Growing Environment

Source: ABC Science

IT IS IMPOSSIBLE TO OVERSTATE THE IMPACT AND INFLUENCE OF CARBON DIOXIDE ON ALL ASPECTS OF PLANT GROWTH. CARBON ALONE ACCOUNTS FOR 45% OF THE DRY WEIGHT OF ANY PLANT. ONLY OXYGEN HAS AN EQUAL STANDING AT 45%, WITH HYDROGEN AT 6% COMPLETING THE TOP THREE ELEMENTS REQUIRED FOR A PLANT TO SURVIVE. CARBON IS A NUTRIENT, JUST AS SURELY AS NITROGEN IS A NUTRIENT, BUT SINCE IT IS DERIVED FROM THE AIR, IT IS OFTEN OVERLOOKED.

Geary Coogler, B.S. Horticulture.

Figure 1: Tropical mangrove trees are better at storing CO_2 than any other types of tree. They store two to four times the carbon that tropical rainforests do. For this reason, cutting down a coastal mangrove forest is much worse for the environment than cutting down any other forest of the same size.

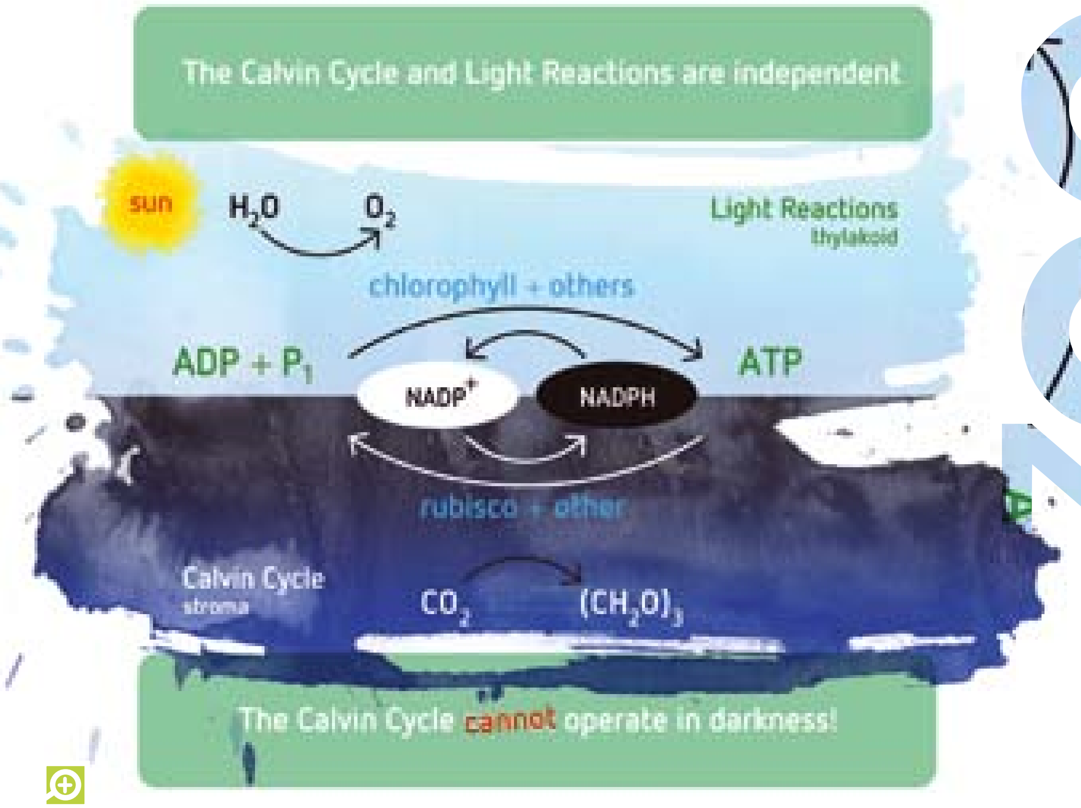


Figure 2: The Calvin Cycle occurs in two stages, the Light and Dark reactions and makes all life possible, but both require the energy of the sun (light).

Carbon comes in a convenient plant-available form, carbon dioxide (CO_2), a gas. Plants have become excellent assimilators of carbon, and employ similar – but not identical – systems to ensure they capture enough CO_2 to grow and mature. All of this to acquire the simple building blocks that they need to grow and reproduce. Any discussion surrounding carbon dioxide should begin with an understanding of carbohydrates: what they are, and how they are made.

The Product

Carbohydrates are the basic building blocks of all things classified as life. Some life forms produce carbohydrates, some life forms consume carbohydrates. Carbohydrates are a group of organic compounds that contain only carbon, hydrogen and oxygen usually in a 1:2:1 ratio. They include sugars, starches, cellulose, and many others. They are the major energy source for animals and are produced by photosynthesis in plants. Animals obtain their carbon by consuming carbon as carbohydrates and proteins, while plants get their carbon by assimilating a gas, CO_2.

There are two basic processes that occur to produce basic carbohydrates in a plant: the first is what is known as the light reaction and the second the dark reaction. Both occur in the chloroplast. The light reaction is, as the name implies, the reaction that occurs in the presence of light photons and converts light energy into chemical energy, ATP (Adenosine-5'-triphosphate) and NADPH (Nicotinamide adenine dinucleotide phosphate). These energy molecules are then used in the dark reaction (more appropriately called the carbon reaction) to produce triose phosphate, the basic carbohydrate. In reality, the dark reaction still requires light to function, not only to produce energy, but for many other light-influenced controls. This dark reaction is known as the Calvin Cycle.

In this cycle, a base carbohydrate is used as a seed molecule (known as a substrate molecule) with 5 carbons to capture CO_2 with the help of a light-activated enzyme known as Rubisco that also adds water molecules and is ultimately split into 3 carbon molecules that undergo more changes to become a carbohydrate, triose phosphate. The problem is:

1. 85% of the base carbohydrates produced return to the system; and
2. Oxygen (O_2) is more attractive than CO_2 and destroys the seed molecules stopping the process; this is known as photorespiration.

The Process

Air from around the leaves enters the leaf tissue through specialized pores known as stomata. Once inside, the molecules in the air will dissolve into the fluid around the inner plant cells, mesophyll cells, and then on through the cell membranes, across the cytosol, and to the chloroplast in this liquid phase. From the moment the CO_2 approaches the stomata, it has to go through several areas of resistance including the boundary at the opening of the stomata, the interior air boundaries including the stomatal cavity, and the intercellular air space. This resistance is caused by the lack of movement in the air, meaning that molecules like CO2 have to diffuse slowly across the opening of their own accord.

Gas molecules will disperse quickly when there are currents of air, but in the calm stillness of a boundary, they have to move under their own vibration or the action of another molecule – a very slow process. Once in a liquid state, the CO_2 molecules then have to diffuse across and through the cells until they can be integrated into the Calvin Cycle. The problem remains that there is much more oxygen than carbon dioxide in the air, so the O_2 is moving right along with the CO_2 but at a higher concentration.

Once they become part of the Calvin Cycle, there will be more O_2 available than CO_2, unless the concentration is increased or the Calvin Cycle is isolated into areas from which oxygen can be excluded or limited. The process we have described so far is both the basic idea in the conversion of light energy into carbohydrates, and the exact description of one of the three types of metabolism plants employ to do this. This one is known as the C3 cycle (also known as C-3 metabolism); it is the preferred cycle of most dicots but some monocots as well. The next cycle is the C4 cycle, so named because it captures the CO_2 in a 4-carbon sugar in the mesophyll cells, and transports it to the chloroplasts in bundle sheath cells to be processed in the Calvin Cycle, thus limiting the amount of oxygen in the process. C4 plants include all angiosperm plants and most monocots such as grass, maize, and sugar cane. C4 plants do better in hot dry locations because the process that causes the photorespiration mentioned earlier increases with temperature. Both C3 and C4 cycles require light to function. There is one more C4 variant which performs part of the cycle in daylight followed by another part

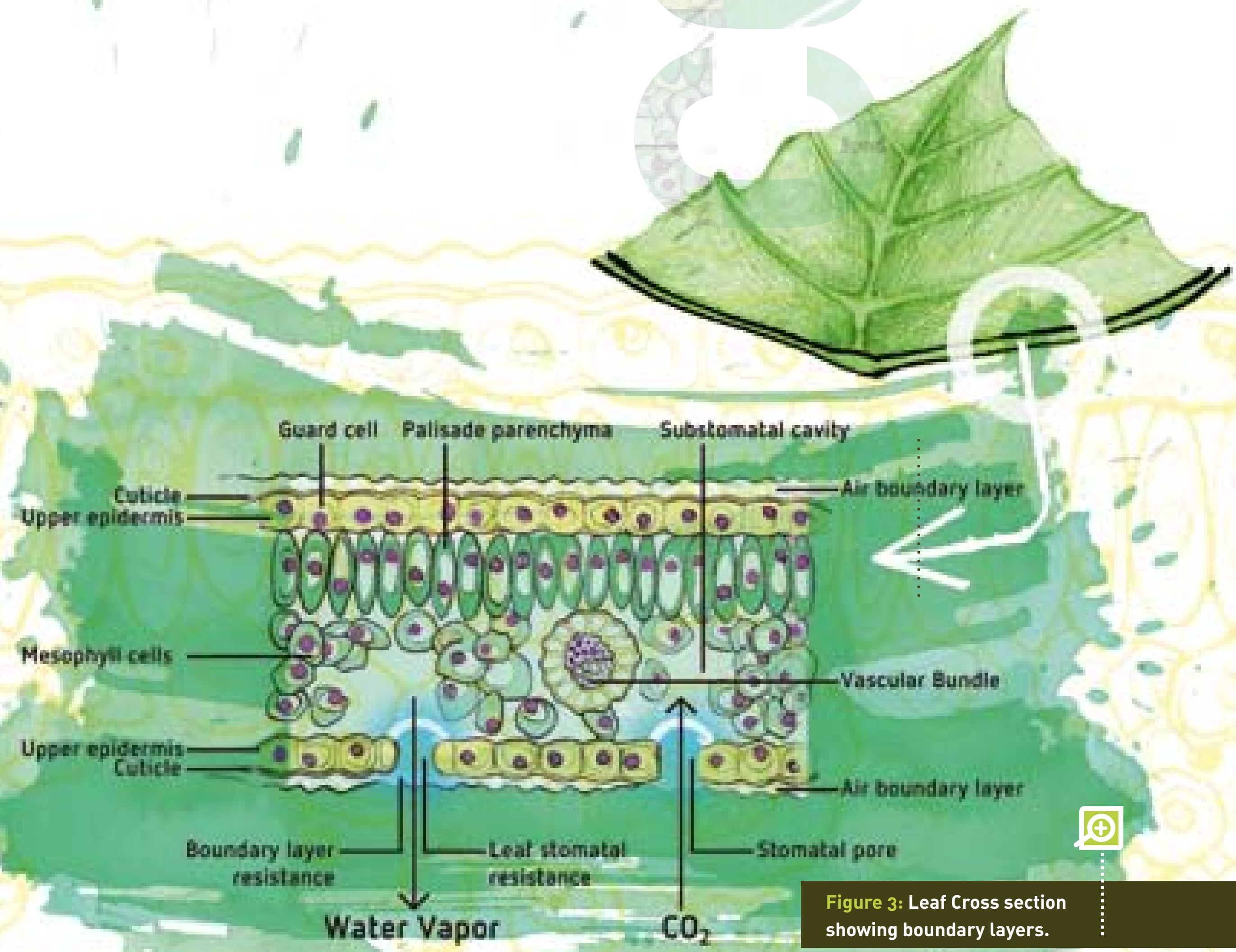


Figure 3: Leaf Cross section showing boundary layers.

during the night. These are known as CAM (crassulacean acid metabolism) **(see figure 3).** Carbon dioxide needs to be allowed in, to make carbohydrates and to do this the stomata have to open. Once they are open, not only can CO_2 enter, but water can escape, and so limiting the opening time of the stomata to the hours of darkness is a clear evolutionary advantage.

There is one other important note here, C3 plants work better at higher concentrations of CO_2 whereas C4 plants do better at lower concentrations of the gas because they actively pump the gas into the cycle.

The Environment

In plants where the CO_2 moves into the Calvin Cycle of its own accord (C3), the concentration of CO_2 in the cell will pretty much equal the atmospheric concentration. A growth increase of 30 – 60% has been documented when CO_2 is supplied at 0.86-1 EC (600 – 700ppm) in C3 plants. C4 plants, on the other hand, had no such advantage because in these plants the CO_2 is actively captured, transported, and concentrated at the same rate, no matter what the atmospheric concentration is. The ideal CO_2 level for C4 plants is the naturally occurring ambient level. So some plants do respond to higher levels of CO_2 but photosynthesis reaches a maximum rate (saturation) at a given point, and going higher than this is pointless. At really high levels above 3% or 4.3 EC (3000ppm), the rate falls off. The ideal level for C3 plants seems to be 0.86-1 EC (600 – 700ppm); any more than this will not produce any additional benefit so it will be a waste of money. Keep in mind that this level is what should be available around the stomata.

The boundary resistance we mentioned earlier applies to the area immediately adjacent to the stomata opening. When the air is still, the air under or next to leaves and inside the physical structure of the plant will have lower levels of CO_2 and O_2 than the air because the plant is removing these elements. This air will also be more humid because the plant is transpiring to cool itself and transport nutrients from the root system. In short there is a micro-climate right next to the plant's leaves.

The lower levels of CO_2 will mean that less is available in the cells and photosynthesis will slow down. The higher humidity in the air means that less water can evaporate out of the plant and so there will be less movement of water through the plant. By creating a movement of air, we can make sure that more of the necessary components come close to the stomata, while unnecessary components like water are dispersed.

Putting this into Practice

Clearly, the CO2 cycle in the plant is part of other systems and affected by many factors including temperature, light, and many more. The movement of CO_2 is only a small part of what is actually going on. We have sought to simplify a very complex process, but along the way, we have uncovered some very important information.

There are differences in the ways that plants capture carbon dioxide. When CO_2 is limited, so is the production of substrates. CO_2 is only used during the light cycle, even though some plants can capture it at night to use during the day. Temperature has been shown to be an issue especially at upper ranges. Certain plants (C3) benefit from higher ambient levels of CO_2 while for others (C4 and CAM) adding CO_2 is a waste of resources. There are many barriers that the CO_2 molecule has to cross to become part of the Calvin Cycle. Air movement at all levels is critical to eliminate the micro-climate associated with leaf surfaces.

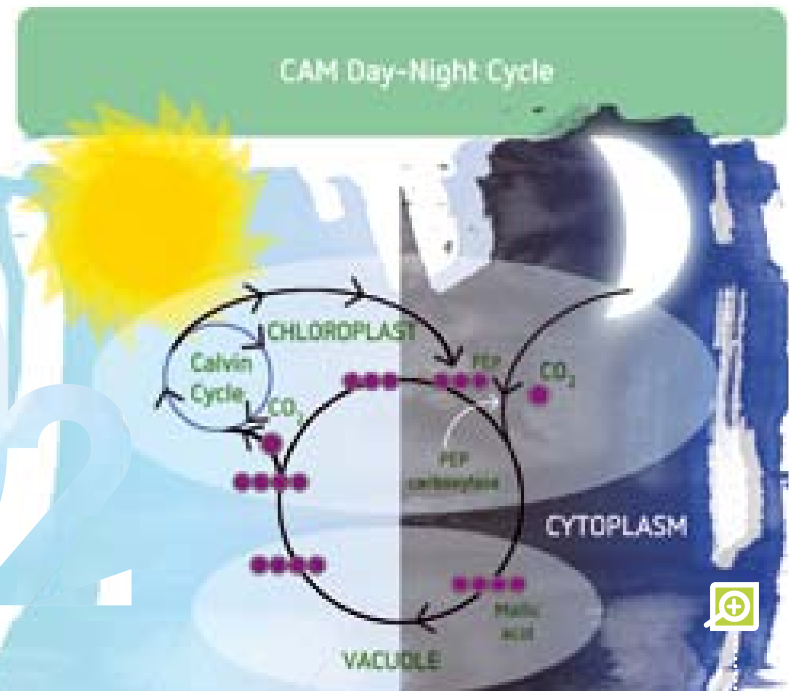


Figure 4: The CAM plant has an evolutionary advantage of doing part of its cycle at night by storing the precursor Malic acid made during the day, in the vacuole of the cell to be converted at night when the stomata has to open, in order to conserve water loss.

Figure 5: CO_2 is a term often used negatively when talking about the excesses of our consumer society. It's an invisible gas that can cause great harm to the environment. 'However, in small doses and at the right time, CO_2 isn't that bad.

Now, how can we make this information work for us?

Outdoor crops and indoor crops have different capabilities. Outdoors, little can be controlled and crops are basically at the mercy of nature. Indoors, the restrictions of technology and resources apply. The benefits of air movement apply to all plants, so this is the first thing to look at. For indoor plants, fans are essential to move the air inside the growing area, as well as to exchange the old air for CO_2 refreshed air. For outdoor plants, increasing the spacing between plants will help control some micro-climate formation, or at least its severity. Enriching the air with CO_2 in covered crops (indoor or tented) is an option, but is almost useless for C4 plants.

If a grower has C3 plants and can control the atmosphere, then he or she can add extra CO_2. There are two basic ways to apply CO_2. The first is to use bottled CO_2 gas released through a regulation system and the second is a burner system, whereby gas is burned in the room to produce CO_2 as a by-product. Both methods have drawbacks. Bottled systems require many bottles and frequent trips to have them refilled. Gas burners are less expensive and require less effort; however burners can malfunction causing a range of issues including safety.

Temperature affects photosynthesis. In indoor crops, the plants need light to function but lighting increases temperature. Throw a CO_2 burner into the mix and overheating can rapidly become an issue. Venting to the outside and drawing in fresh air will take away all the CO_2 that has been applied. It is pointless to apply CO_2 during the dark when things are cooler because it will not work. So what can be done? Well, it really depends on the money. If the money is there, first arrange for good air movement in the growth zone of the plants in the room, use air conditioning in the room or water chiller units and leave the room closed, switch lights to sealed air-cooled lights, use bottled CO_2 or vent when needed and replace the CO_2 Any of these measures will work but some are better for hotter environments.

During periods of high heat stress, the crop can be saved by shading or switching off lights. CO_2 use will also fall off so stop supplying it. Watch the humidity because plants can go a long way in cooling themselves when moisture conditions are right for good water movement. However, there needs to be enough water available at all times for this, otherwise leaf wilting and tissue damage can result. Too much water, however, will slow down transpiration enough to reduce the cooling effect. Above all, balance the system by using workable set-points and automated controls when working out the enrichment times and ventilation. Always calibrate the monitoring equipment.

Carbon-skinned balloon

In the end, plants need carbon dioxide. The gas becomes the plant in every way, like a carbon-skinned water balloon. Plants obtain the carbon they need in different ways, or rather the same way with an extra step or two thrown in. Because of the differences, some plants do well with higher concentrations of ambient CO_2 while others will be indifferent. Growth can be affected positively by managing the CO_2 as a 'nutrient'. It is possible to benefit from the introduction of additional CO_2 but all other factors for growth – such as temperature and humidity – also have to be taken into account. Basically a plant is a kind of carbon-accumulating machine. As such, carbon dioxide's role in plant growth cannot be overstated. •

Questions & Answers

We get a lot of questions on growing through the website www.canna-uk.com. as always, CANNA research is more than willing to advise you!

Question

My question is about the CANNA AQUA line. I want to know how to initially set the pH during both stages of growth. I read the info papers and all I get from that is that the pH needs to be set between 5.2 and 6.2. Also it states you can set the pH and do not have to adjust it. Could you explain this?

Answer

CANNA AQUA uses a pH buffer that can be set and, once set, the plant regulates itself. You will initially adjust the first batch to any pH between 5.2 and 6.2, then allow about 3-5 days before the buffer to become fixed. After that you should not have to adjust the pH again for the crop. That is provided you do not 1) bubble air into the tank, or 2) run fresh water through the system. You could initially set your pH during veg at about 5.8, and then allow the system to work and watch the pH for a few days. Then you'll see the pH rise slowly to a maximum of maybe 6.2, then after a few days you will see it drop and start fluctuating. The buffer is functioning. If it climbs above 6.2, you could gently nudge it down to about 6.0 and keep going. When you change tanks, only change the tanks and never run plain water through the system. When you switch from CANNA Aqua Vega to Flores, just change the tank. Do not flush the system and the pH should remain fixed. If you ever have to run plain water through the system, you'll need to start over.

Question

I'm using CANNA AQUA to grow lettuce in a floating system and getting brown edging on new tiny leaf growth in centre of head. Using 20ml/10liters. EC around 0.8. The pH is between 5.2 and 6.2. I have used sodium bicarbonate to bring pH up and nitric acid to bring it down when needed. I have read that lettuce can grow with a lower EC. Is this correct and do you have recommended nutrient strength for growing lettuce?.

Answer

You are correct in assuming that lettuce gets by on a lower nutrient concentration in the water source. I would say your levels are fine. The question here, I think, is the balance of calcium (Ca) in the system. Ca is one of those elements we are very cautious with because it loves to combine with everything. Ca can also react strangely with other elements – these are known as antagonistic reactions. When certain elements are present in solution at higher levels, this leads to other elements being less available. In this case, elevating the pH by adding a source of sodium would make the issue worse I believe. This is especially true if your source water is soft, as it should be for a hydroponic system. Now, knowing a very little bit about all the details of your system (no cultural info, system info, other symptomatology), my best guess would be that you are seeing a severe shortage of available calcium. Add about 0.1 EC Ca to the system and boost the pH using a calcium-based product if possible. Be advised, a potassium base like potassium hydroxide may well result in the same issues as sodium.

Question

I have a question about CANNA COCO and CANNA COGr. I currently have multiple seedlings in CANNA COCO that are in keg cups and these are doing well. My first question is: when should I start showing these seedlings some love in terms of nutrients and additives. Also, I bought some CANNA Start. When should I start using that? I'm currently into the 3-4 day range with the cotyledons of the seedlings protruding through the top of the soil. I have just begun to see the next set of leaves establishing themselves on a few seedlings. Normally I deal with cuttings, so I am not accustomed to working with CANNA products during the seedling stage. Also, after transferring them to a bigger pot - which will be filled with CANNA COCO - is it a good idea to eventually transfer the established plant into a mix of CANNA COCO/COGr (I am thinking 60/40 or 50/50, respectively)? I have an abundance of both CANNA COCO and COGr on hand that I could use for this. I have a decent amount of COGr nutrients that were left over from previous grows which I could also use. So to save money and maximize efficiency, is it a good idea to mix CANNA COCO together as the medium and use COGr nutrients to feed the plants? Or should I use Coco nutes? Or is the use of nutrients based on the ratio of the medium? Or should I simply avoid mixing all together?

Answer

There is some mixing you can do but let's start at the beginning. Use CANNA Start when you see the first set of true leaves expanding. Start at the low end, then at the next application you can increase the amount slightly. In CANNA COCO, you will have to change to regular nutrients about two weeks after the plants germinate. This will keep the coco in line. It is okay to mix the two, but CANNA COGr is untreated and will delay production unless treated with CANNA COGr Buffer Agent. However, do not re-treat the buffered coco. Then you can use either nutrient, but if there is too much COGr granulate, you will not get really good results with CANNA Coco A&B. Best to use COGr nutrients on the whole lot at least after switching to flower. You can use COGr nutrients on the buffered coco with no issues and actually get better results.

Question

Can I use the BIOCANNA line in a DWC (deep water culture) system? I love the results that my DWC hydroponic system produces but I don't like the flavour from my finished product using chemical nutrients. I still want to use my DWC but with organic liquid nutes. Is the BIOCANNA line okay to run in a DWC system with an airstone in the reservoir?

Answer

No, unfortunately BIOCANNA does not work accurately or consistently in any medium other than mineral soils or peat-based potting mixes. This has to do with how and why organic products break down and what they break down into. By the way, this applies to all organic products in spite of what you might hear. For more information on BIOCANNA products please visit www.biocanna.com

Question

I'm interested in using CANNAZYM. My plants are pot-grown using compost. Would using CANNAZYM destroy friendly bacteria and fungi in the compost?

Answer

CANNAZYM will not kill any bacteria or fungi in your root zone. The enzymes will break down the dead hairy roots, so there will be no food for negative micro-organisms. This also brings in oxygen again. As a matter of fact, it will encourage the friendly micro-organisms that you wanted. Some of them produce these enzymes, but not in very large amounts.

GrowIT YOURSELF

BANZAI

let's grow a bonsai!

AS YOU MAY BE AWARE, THE WORD 'BANZAI' IS A JAPANESE BATTLE CRY MEANING TEN THOUSAND YEARS. NOWADAYS, IT'S MAINLY USED AS AN EXPRESSION OF ENTHUSIASM. BONSAI – ON THE OTHER HAND – IS ABOUT AS PEACEFUL AND MELLOW AS YOU COULD HOPE FOR. NOT AGGRESSIVE AT ALL. QUITE THE OPPOSITE IN FACT! SO CHILL OUT, PULL UP A CHAIR AND LET'S EXPLORE THE ANCIENT ORIENTAL ART OF BONSAI.

Text: Marco Barneveld, www.bqurious.nl

So basically what we are talking about is a miniature tree in a pot. They are deliberately kept small and cultivated to look like a dwarf of a fully grown tree. Sounds easy. But like most things that sound easy, there is a whole world of knowledge behind this horticultural art form.
Let's take a look at a couple of facts about bonsai shall we? The word bonsai is made up of 2 Japanese characters, bon and sai. The bon is the pot, tray or container. The sai is the tree. The word Bonsai is used for both indoor and outdoor plants. The original word bonsai comes from the Chinese word P'en Tsai, which sounds similar to bonsai and has nearly the same meaning. Although many think that the art of Bonsai originated in Japan, it is actually a Chinese 'invention'.

We all love souvenirs

The earliest depiction of a bonsai can be found in a mural of the Qianling Mausoleum at the tomb built for Crown Prince Zhanghuai during the Tang Dynasty, dating from 706. In those days, even without modern aeroplanes, people were already travelling the world. And even then, tourists would take home souvenirs. Imperial embassy personnel and Buddhist students from Japan had been returning from the mainland of China with souvenirs, including the odd potted plant, since the 6th century.

Human ideal

In about the year 970 the first lengthy work of fiction in Japanese was written, entitled The Tale of the Hollow Tree, which includes this passage: "A tree that is left growing in its natural state is a crude thing. It is only when it is kept close to human beings who fashion it with loving care that its shape and style acquire the ability to move one." The idea that was already established by this time, then, was that natural beauty only becomes true beauty when modified in accordance with a human ideal. It seems a bit old-fashioned now, but hey, at that time in Europe, we were still living in straw huts, while our Oriental friends were writing books on cultivating miniature trees and refining this into an art.
But bonsai is not only creating beauty. In fact, to restrict our interpretation in this way could not be further from the true spirit of bonsai. The ultimate challenge for the bonsai grower is to bring out the essence of the tree. The art of bonsai is telling a story through a living illusion. When you see a great bonsai, you just wish you were ten times smaller so you could lie against the perfect trunk on a sunny summer day.

Messing with stress

All bonsai growers share the same concern: the ability to alter the growing process and still maintain a healthy plant. The key to this is in controlling the level of stress that a plant will take and still remain healthy. Of course, 'stress' here is not the psychological stress as we know as humans, but refers to the horticultural practice of being able to know how much is too much, and how little is too little. This principle applies to all aspects of bonsai growing including air, water, soil, sunlight, nutrients, temperature, altitude, pruning and so on. The challenge is to stay willing to learn, experiment and accept the results of your efforts.

Have a little patience

Another aspect of the art of bonsai is time. You need lots and lots of it. The growth process takes time, and there are no shortcuts. A growing year is the usual yardstick by which success is measured. There is no substitute for time; it is always constant and always moving forward. I could add a few Oriental proverbs here, but I'll limit myself to just one: it is said that through the study of bonsai, one will learn more than bonsai.
But once you have mastered the art and your tree is a living miniature of a full-size one. There is a chance that it will outlive you. Bonsai trees dating from the 17th century are still around today. One of the oldest-known living bonsai trees, considered one of the National Treasures of Japan, is a five-needle pine known as Sandai-Shogun-No Matsu. The tree is thought to be at least 500 years old and was first grown as a bonsai by the year 1610 at the latest. The earliest known report by a Westerner of a Japanese dwarf potted tree was made in 1692 by George Meister.
So bonsai is all about trees, trees grown in miniature, miniature trees that look like fully grown real-life trees, but better. It is also about time and space and about life and attitudes. Historically, bonsai was a part of the Japanese culture and an important part of family heritage. Equally, bonsai can simply be a horticultural pass-time requiring no more than a basic level of common garden sense, some artistic ability and plenty of patience. Think you're up to it?

Five golden rules

Many books have been written on the art of bonsai. It's not possible to give you a complete how-to guide here, but we can give you five golden rules. Stick to these and you might one day create your own wonderful dwarf tree.

1 Water conscientiously!

Don't over-water or under-water your bonsai. The soil should feel moist to the touch at all times; never let it dry out completely, but allow it to start to dry out before watering again. Make sure you see water running out of the bottom of the pot, so the whole root system gets water.

2 Locate wisely!

Place your bonsai tree in the right spot. Just like real estate, location is everything! Make sure you choose the right amount of light, warmth and humidity for your bonsai species. This will vary from species to species, but most bonsai trees need plenty of light!

3 Feed regularly!

Feed your bonsai tree. You will need to replenish the nutrients that gradually get washed out of the soil in the pot due to watering. There are many species of bonsai trees, and so there are also many kinds of fertilisers. You should fertilise when the soil is wet. Many fertilisers are best added during the tree's growing months, typically spring and summer.

4 Prune assiduously!

Don't neglect your pruning. Especially during the summer and spring, you'll need to trim back extra leaves, sprouts, and other new growth so that the tree doesn't grow too big. The main purpose of pruning is to remove dead branches as well as roots that have outgrown the pot. Pruning is usually done in the winter when many bonsai species have a dormant period. Be careful when trimming and pruning not to dig into the trunk.

5 Re-pot judiciously!

Know when to re-pot your bonsai. Because bonsai trees are kept in pots, eventually the root system will fill the container, causing the plant to become 'pot-bound'. You'll know this is happening if you see long roots circling the root ball or the inside of the pot. During re-potting, you'll be able to prune the root ball. The best time to re-pot a bonsai tree is during its dormant period or during a time of slower growth. •

May your bonsai live for ten thousand years!

Photo courtesy of Jennifer Boyer

Photo courtesy of Jennifer Boyer

A word from A GROWER

Grower's TALK

Elton from York

I've been growing for quite some time now, but I'll tell you this: trying to maintain the right pH can sometimes be downright frustrating. Until recently, I had a huge problem with the pH of my reservoir constantly going and staying above 6.5. No matter what I did, it was impossible to get it to stay down in a better range. For example, if I adjusted it to 5.6, it would move right back up! I was afraid that these higher pH values were going to lock out my nutrients.

I currently use the CANNA AQUA line of products. Only recently I switched over from the CANNA TERRA line. I had the same issues with the TERRA line, but the changes in pH were much slower. When I was using TERRA, I figured the ever-rising pH levels were caused by the nutrient pushing it to take care of the normally acidic peat base. But when I switched to AQUA, I noticed that this wasn't what was causing it, because with AQUA the pH levels were rising even faster!

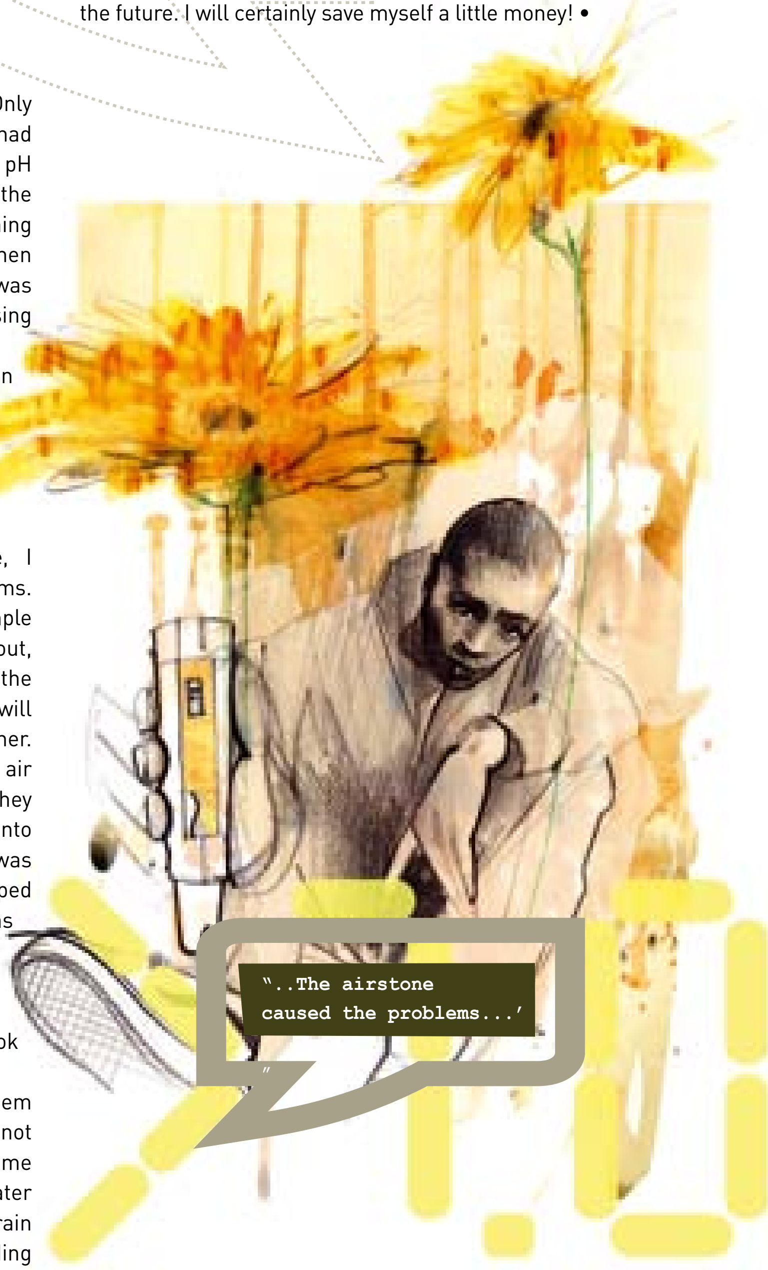
My latest set-up is a simple hydro with a drip irrigation system on clay pebbles in net pots set up to recirculate. I also use an air stone in the tank to provide oxygenation for the solution for the roots.

This was also the same system I used when I was growing on dirt but the containers were different.

After contacting the folks at the CANNA website, I found out that it was the system causing the problems. More specifically, it was the air stone! The fix was simple and saved me some money in the process. Turns out, CANNA AQUA has a buffer to help the grower maintain the pH balance and this is a simple carbonate buffer that will take the pH up or down based on the balance in the container. By forcing air into the solution, the carbon dioxide in the air was making the buffer stronger and pushing the pH up. They also informed me that the extra oxygen being forced into solution was also affecting the individual elements. I was fighting against nature. The fix was easy and as I dripped the liquid solution through the clay pebbles, aeration was unnecessary since the roots were not sitting in solution and were receiving plenty of oxygen naturally. I just stopped the aeration and got rid of the air pump. The pH fell to correct and controllable levels and my plants took off.

Seems this was also the same issue with my older system as well, only not as fast, because CANNA TERRA does not have the buffers but the science is the same. The only time bubbling air through a solution is necessary is in deep water culture systems, otherwise the simple water and drain features in a container system pulls fresh air in providing plenty of oxygen for the roots. The real key is ensuring that the roots do not remain saturated or underwater for more than 20 minutes.

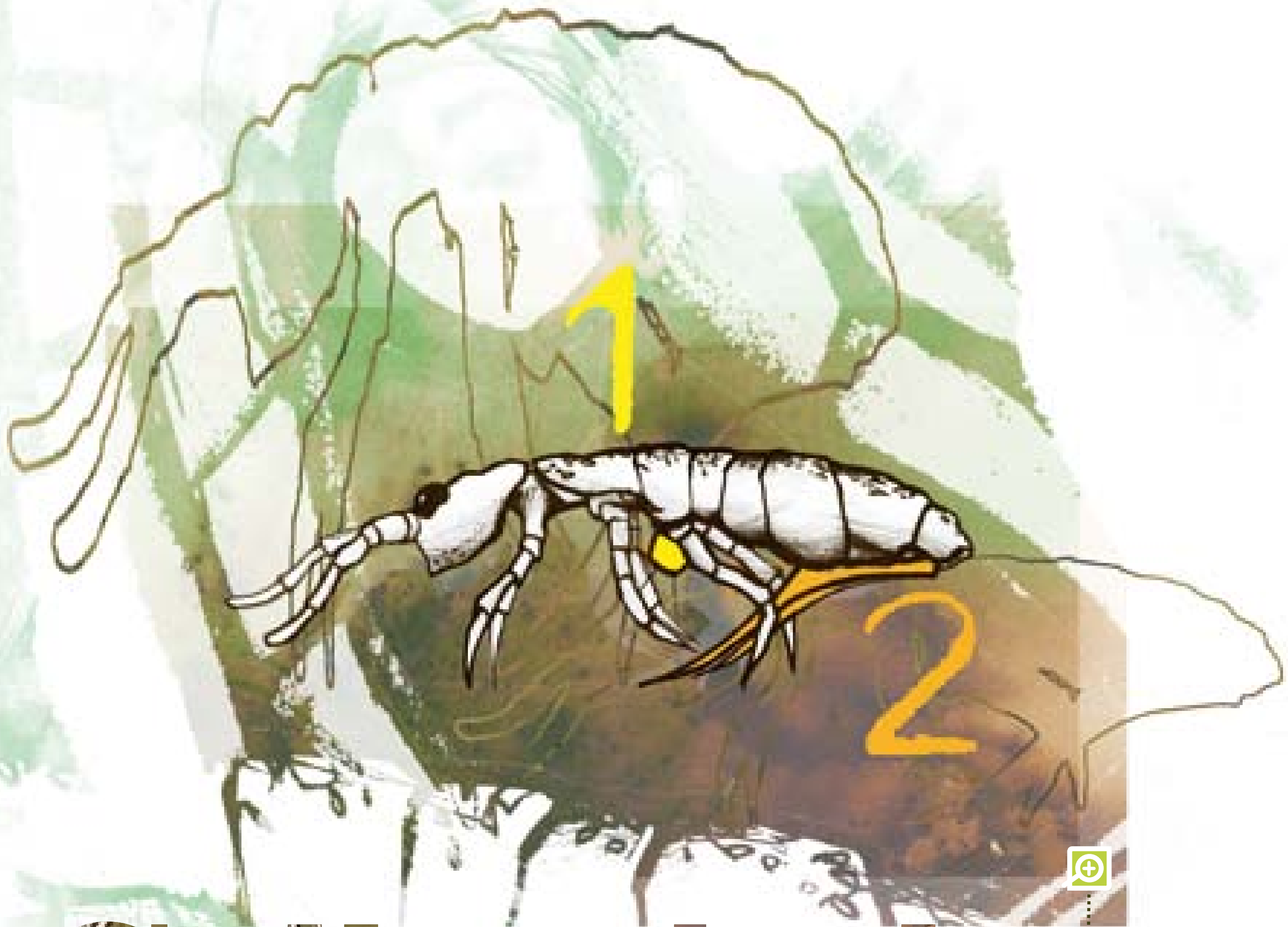
The CANNA technicians saved my crop and my sanity. I cannot begin to tell you how great this service is. From now on, before I make any changes, I will be asking CANNA's opinion. Maybe I will save myself a little headache and frustration in the future. I will certainly save myself a little money! •



CAVES DID YOU KNOW THAT....?

- Caves are formed by various geological processes. This means a combination of chemical reactions, erosion by water, tectonic forces, micro-organisms, pressure, atmospheric influences, and even digging by humans or other animals. Most caves are formed in limestone through the action of CO_2 dissolved in water.
- The cave pictured here isn't technically a cave. Antelope Canyon in Arizona was formed by water. The canyon is in a very dry area, but during the rain season there is so much rain that the water overflows the enormous basin above the canyon. It picks up speed and sand as it rushes through the narrow channels, and over time the corridors become deeper and the rough edges become completely smooth. This is what gives these rocks their distinctive, flowing shapes.
- The only place in a cave where plants can survive is next to the entrance or some other place where the sunlight can penetrate. For instance, in the eastern United States, cave entrances are most frequently populated by the bulblet fern, Cystopteris bulbifera, which can grow very thick. In the deeper recesses of a cave, no plants can survive without sunlight. However, caves are a great place for mushrooms. Mushrooms require warmth and moisture, and thrive in dark, damp and sheltered environments like caves.
- The cave system with the greatest total length of surveyed passages is Mammoth Cave in Kentucky, USA at 628 kilometres in length.
- The largest cave space ever discovered is the Sarawak Chamber, on the border of Indonesia and Malaysia on the island of Borneo. This chamber is about 700 by 400 metres and 80 metres high.

Sources: Wikipedia, Thenakedscientists.com, Gardenguides.com



Collembola SPRINGTAILS

Collembola, otherwise known as springtails, are one of the largest groups of insect-like organisms found in the soil. A close relative of silverfish, these arthropods include over 6000 separate species world-wide. They are no longer considered insects but remain arthropods for classification purposes. They are named Collembola because each sports an appendage known as a collophore or tube (1) from the first abdominal segment. The common name 'springtail' comes from an additional forked appendage located on the forth segment known as a furcula (2) which is locked into another appendage on the third segment known as a tenaculum.

Geary Coogler, BSc Horticulture

It is held in place by this locking mechanism until it is released against a hard surface causing the animal to 'spring' into the air some 20cm. This is not controlled movement but a survival mechanism.

Springtails are wingless hexapods (six-footers) with incomplete metamorphosis. There are no larval or pupae stages; the newly hatched springtails resemble the adults. They molt several times during their life cycle. They are typically small (less than 6 mm), feed on decaying vegetation and organic matter found in the soil, and require high humidity to survive. They will also feed on the recently dead springtails from the groups. They are not usually considered a major plant pest unless populations are so high that they begin feeding on soft plant tissues. At least one important species is a garden or greenhouse pest because it will feed on pollen and soft flower tissues. Soft tissues especially involve flowers or florets and they seem more attracted to plants with lighter colours. There are also at least two other species that tend to be crop-specific pests. They prefer cooler conditions, need moisture, and come in a wide range of colours. Some are known as 'Snow Fleas' because they appear in early spring on the melting snow. There are 4 important families in this group, which have been found at extremely high population densities of over 750 million individuals per hectare. Although they seldom cause problems, they have been known to become an issue in human habitations when populations are very high, but again they need an organic food source and high moisture levels to survive.

Diseases

They are not known to harbour any particular disease or pathogens, nor are they a primary vector for disease. Insects with chewing mouthparts, such as springtails, seldom are. They may well carry fungal or bacterial spores from their soil habitats and initiate secondary infections at the feed sites through this mechanism. To determine the presence and density of existing populations in outdoor gardens or indoor growing areas, you can place a pan of water on the growing medium or soil below the plants prior to irrigation. The insects cannot control their jumping and some will land in the water and drown, so that they can be counted later.

Control methods

Springtails can best be controlled through modifying growing practices. Over-watering, plant and soil debris left on floors or bench tops, and poorly aerated mediums are all factors that contribute to population increases. While insecticide controls are available, the best form of control is using proper cultural practices. Control is best achieved through sanitation before, during and after cropping. Proper soil drainage is critical to ensure that the plant mediums are not saturated and can dry between applications of water. Use new medium and avoid adding organic material from outdoor sources. For rooms that have been contaminated, it is usually enough to carry out a thorough clean-up after the crop and allow a brief dry period when everything in the room is allowed to dry totally with slightly elevated temperatures. Avoid re-contamination with the next crop. •

Figure 6: Isotoma habitus. Most springtails have a collophore, a tiny tube on the abdomen. With this tube springtails maintain optimal water balance, but in some species it also functions as a sticky appendage for sticking to surfaces. You can see the collophore of this springtail in the picture if you look closely.

THE FUTURE OF HIP HOP

Is hip hop dead? Music lovers have asked this question countless times during the almost 30 years of the genre's existence. In fact, in the very beginning, many people (mostly of an older generation) never considered hip hop to be alive in the first place. They didn't see it as music at all – ghetto kids mumbling words over beats that some other band or artist had made... Anyone could do that!

By Paul van de Geijn

They were wrong of course. Not just anyone can do it. Not in a way that sounds good, anyway. Rapping is not just 'words over beats'. It's more like a raw form of poetry. The best rapping plays the role of an extra percussion instrument, enhancing the flow of the beat. Hip hop can be a true art form. And as with any exciting form of art, people love it ...or hate it. Or they declare that it's dead.

The Old Skool

Hip hop has its roots in the streets of 1970s New York, and more specifically the poverty-stricken borough of the Bronx. DJs played funk and soul music at black parties and began specializing in isolating the percussion breaks from popular songs. DJ Kool Herc and others extended these breaks using two turntables. They were often accompanied by a MC (Master of Ceremonies), who tried to encourage people to dance by shouting simple rhythmic rhymes like 'throw your hands in the air and wave 'em around like you just don't care'. They were the first rappers.

In the 1980s, hip hop broke through into the mainstream, with Grandmaster Flash, RUN DMC, Public Enemy and N.W.A. to name but a few. These artists gave poor African-American young people a voice. The genre got even bigger in the early 1990s, when Dr. Dre introduced G-funk – or West Coast gangsta rap – with his album The Chronic. This hip hop style consisted of smooth, funky beats and lyrics that glorify the life of a gang member. They depict violence, drug use, treating women as sex objects and excessive materialism, and as such they were on the receiving end of criticism from concerned parents. On the United States' East Coast, the sound was rougher. Over there, the Wu Tang Clan dominated. There was a lot of rivalry between the two coasts - so much that it led to the murders of 2Pac Shakur (West Coast) and Notorious B.I.G. (East Coast).

The popularity of hip hop music continued into the 2000s. Dr. Dre discovered Eminem, a poor white kid from a trailer park who had mighty rapping skills. Eminem was the first white rapper to gain massive respect from the black rap community, which was always the wet dream of every wannabe white suburban rapper. Eminem became one of rap's biggest stars ever. The genre has also become popular in Europe, with each country spawning their own brand of hip hop. In the UK it merged with drum and bass and other dance genres, producing grime and garage, with stars like Roots Manuva and Dizzee Rascal.

The Death of Hip Hop?

Since the second half of the 2000s, many in the game have been proclaiming the death of hip hop. The rapper Nas even released an album named 'Hip hop is Dead' in 2006. Hip hop had certainly drifted away from the rough, sample-driven beats of the 80s and 90s and started to resemble commercial dance music with electronic beats and synths, simplistic lyrics, often sung, lazily using 'auto-tune' technology. According to pop critic Simon Reynolds, hip hop wasn't 'even dominating the pop charts anymore' and neither was it 'irrigating the mainstream with new beats, styles and slanguage'.

But hip hop isn't quite dead yet... There's hope for fans of inspired old skool hip hop. In the last few years, a new breed of alternative hip hoppers has emerged, recreating

the urgency and excitement of hip hop's heyday. We will highlight a few of 'em: Das Racist, Lupe Fiasco, Tyler, the Creator and M.I.A. They're not all hit parade material, but they do show that the genre is still evolving. Even after almost 30 years!

Tyler, The Creator

Tyler, The Creator is the 21-year-old front man of a Los Angeles rap group with the catchy name OFWFKTA (Odd Future Wolf Gang Kill Them All). The names of the (many) members involved are just as quirky: Earl Sweatshirt, Left Brain and Matt Martian to name but a few.

OFWFKTA's concerts have frequently been compared to punk rock shows, with stagediving, moshing and insulting the crowd. This punk rock attitude translates itself into the music as well. For example, in the track 'Tron Cat' from Tyler's album Goblin (2011), Tyler goes out of his way to shock everyone. Cannibalism, rape, sex with dolphins – Tyler leaves no stone unturned trying to shock our sensitive ears! As 'Tron Cat', Tyler actually resembles Eminem's alter ego Slim Shady, who also tried to shock his audiences.

Tyler won Best New Artist for Yonkers at the 2011 MTV Video Music Awards. In the music video, Tyler is seen eating a cock roach and vomiting all over the floor. Not something you see in most rap videos... Congratulations on thinking outside the box, Mr. The Creator!

Das Racist

This trio stems from Brooklyn, New York. Three bearded weirdoes looking like Taliban warriors. Some think of them as annoying hipster poseurs who make 'hipster hop'. Others consider them to be the saviours of hip hop. They seem to be especially popular among fashionable white urban hipsters.

Well, they do have an original approach to hip hop. Their name Das Racist comes from 'that's racist', and they choose this name to help 'take all the seriousness out of making legitimate commentary on race, because all this seriousness can get very annoying'.

They have a very relaxed and humorous approach to themselves and to music. Sometimes they don't even seem to trying at all. For example, in a track from their mix-tape Sit Down Man they sample a cheesy Enigma song and just mumble along with the melody. But it's still great!

Probably their best song is the Punjabi Song from their debut album Relax (2011). This one has a chorus that's sung by a real Punjabi singer, Bikram Singh! It's a highly danceable, hypnotic song that could set dance floors alight all over the world.

M.I.A.

And from the Punjab it's not a such a huge leap to Mathangi 'Maya' Arulpragasam, or M.I.A. (also known as Missing In Action). This British-Sri Lankan rapper has been around for a while as an artist, but she's still worth mentioning as an original voice. The 36-year old recording artist, songwriter, painter and director was one of the first artists to achieve fame through the internet, using the website MySpace.

She started out rapping over dancehall-like electro beats, but she has developed a layered, multicultural sound. Her biggest hit so far has been Paper Planes, which has a laid-back, Asian-sounding beat and an almost joyfully melodic hook. M.I.A.'s third album Maya was released in 2010 soon after the controversial video-film short Born Free, about the fictional genocide of ginger people. This became her highest-charting album in the UK and the US.

Lupe Fiasco

This one is a versatile little genius. He's actually not a hip hopper in the purest sense of the word, but neither is anyone else on this list. As it happens, Lupe's also the front man of rock band Japanese Cartoon. His sound is fresh and appeals to rock fans as well as hip hop fans. Fiasco initially didn't even like hip hop music! He thought it was vulgar. In fact, he preferred to listen to jazz and idolized clarinet player Benny Goodman. His struggle to learn to play an instrument led him to write poetry instead, which led to his interest in the lyrical aspects of music. Hardly a stereotype of hip hop, is he?

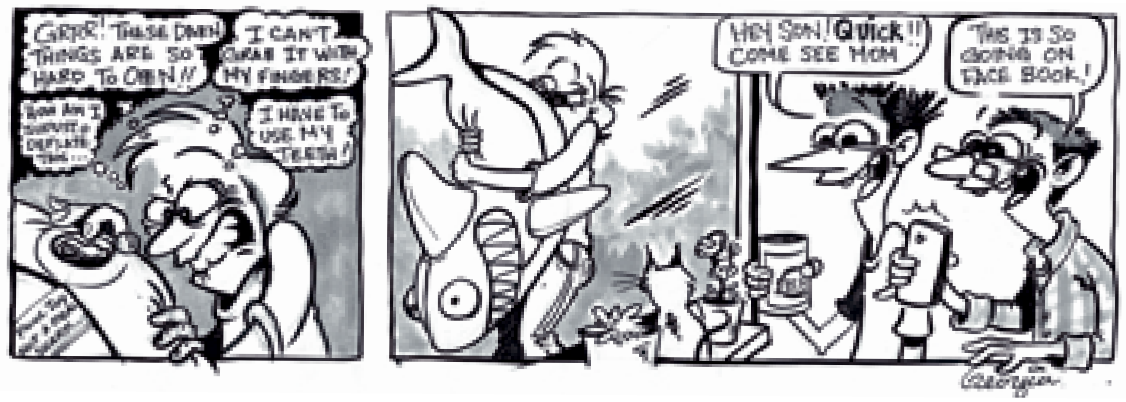
One of his best songs is Kick Push (2011). In this song, he returns to the hip hop of the 1990s. It has a real street feeling to it and Lupe Fiasco's rapping flows like raps in the days of KRS One.

So there you have it. Hip hop dead? Not on your nelly! Not as long as young people still dream of becoming rap stars. And not just ghetto kids either... Hip hop now transcends race, class, and musical boundaries. Future rappers will have to be creative to stand out from the crowd and get themselves noticed. And this guarantees that hip hop will always keep reinventing itself! So keep practising those rhymes... Maybe one day, you'll shine too! •

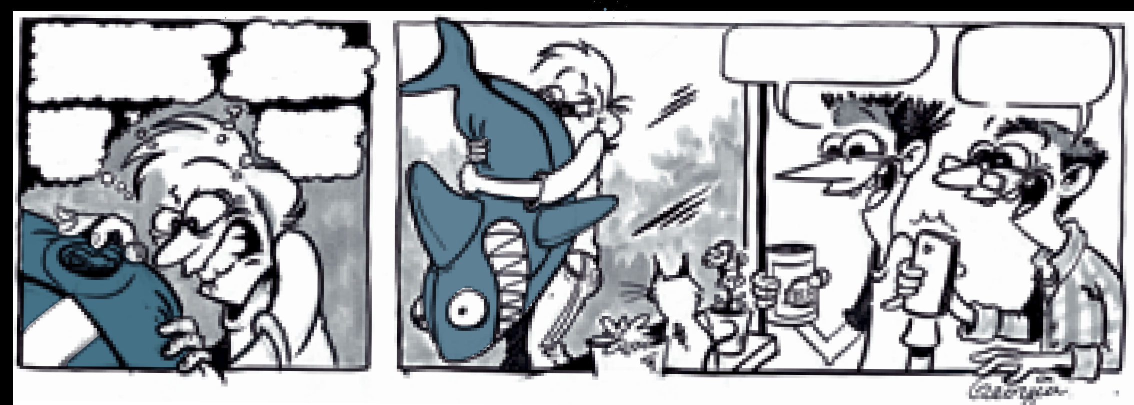
Grower's TIP #17

CALIBRATE YOUR CO_2 SENSOR

Your CO_2 sensor needs calibrating at least once a year. A CO_2 sensor measures how much CO_2 there



The grateful gardener



CARBON DIOXIDE

APPLICATIONS IN INDOOR GROWING

CARBON DIOXIDE IS ESSENTIAL TO THE PROCESS OF PHOTOSYNTHESIS. MOST PLANTS GROWN INDOORS REQUIRE A MINIMUM CO_2 CONCENTRATION OF 330PPM TO ENABLE THEM TO PHOTO SYNTHESIS EFFICIENTLY AND PRODUCE ENERGY IN THE FORM OF CARBOHYDRATES. THESE CONCENTRATIONS OF CO_2 ARE ENOUGH FOR PLANTS TO GROW AND DEVELOP NORMALLY. LOWER CONCENTRATIONS CAN SERIOUSLY IMPEDE PLANT GROWTH AND GENERAL HEALTH. IN FACT, A DROP OF 25% IN NATURAL CO_2 CONCENTRATIONS CAN EASILY INHIBIT GROWTH BY OVER 50%.

By Freddy F.

Figure 7: This is an extreme close-up of a leaf of a Pelargonium ignes. On top of the lump on the centre left three stomata are visible. These are small openings which regulate gas exchange between the leaf's interior and the atmosphere. Air from around the leaves enters the leaf tissue through the stomata. Once inside, the molecules in the air will dissolve into the fluid around the inner plant cells. The yellow 'pawns' are gland hairs. They produce a strong scent that ward off predatory insects. Small thorns (grey) are also seen.

Consequently, the grow room should be set up to replenish CO_2 levels to at least 330ppm throughout the plant's day time. Natural ventilation (using convection and chimney effects) or forced ventilation (using intake/ exhaust fans) can usually ensure that this objective is met adequately.

A range of factors will affect CO_2 concentrations and how quickly they will fall in rooms without ventilation. These include occupancy (the surface occupied by plants), crop density/population, light intensity, horizontal air movement, light penetration of the canopy. Generally, indoor grow rooms should undergo a complete change of air every fifteen minutes, since CO_2 levels can drop within minutes. During the day, increasing CO_2 concentrations in the grow room to levels higher than the naturally occurring 330ppm can undoubtedly increase growth rates and yields by over 30%. However for this to happen, all the other growing conditions also need to be optimal and favourable to proper plant metabolism. Depending on which plants are being cultivated, the benefits can take the form of higher harvest weights and/or shorter crop cycles. CO_2-enriched grow rooms can also enhance crop quality. For example, edible plants may have a richer nutritional content and more pungent aroma profiles with a longer shelf life.

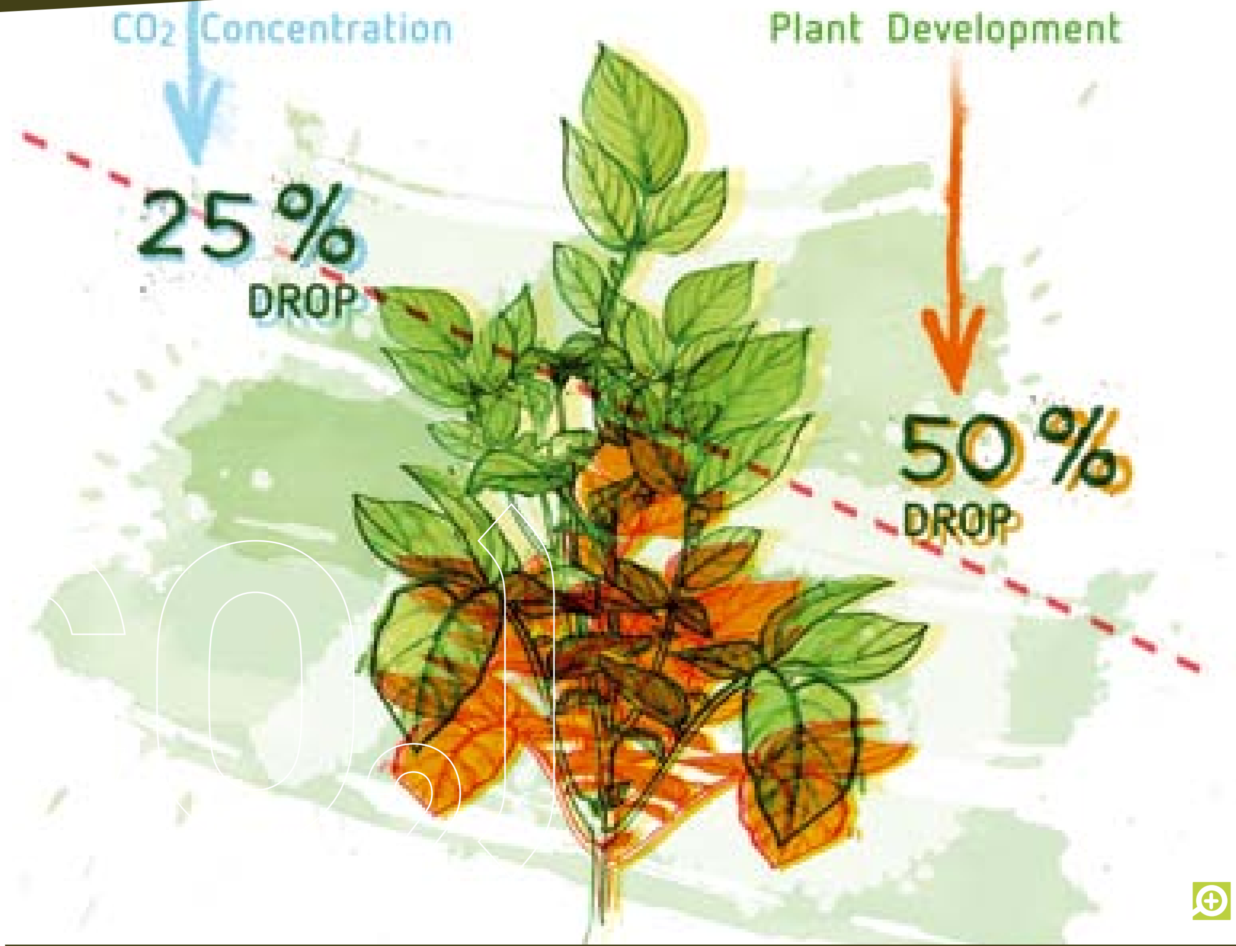


Figure 8: Lower concentrations of CO_2 can seriously impede plant growth and general health. In fact, a drop of 25% in natural CO_2 concentrations can easily inhibit growth by over 50%

Factors to consider when adding CO_2 to ventilated growing areas

Increasing the levels of CO_2 in your grow room can prove challenging. Using air changes to cool and dehumidify grow rooms can seriously hamper attempts to enrich the air with CO_2. In these cases, most of the money spent on CO_2 enrichment will – as it were – float straight out of the window. CO_2 enrichment in such ventilated grow rooms means considering the following:

1) It is usually pointless to add extra CO_2 in rooms that are ventilated constantly. The plants close to the injection point will be exposed to some extra CO_2, but little or no significant increase in CO_2 is likely to show up on the meter and virtually all of the CO_2 will end up outside, where it will also contribute to global warming.

2) Even though CO_2 is a heavy gas, it does not settle close to the floor in a grow room. Well-built grow rooms should have horizontal air flow (e.g. oscillating fans) and that air movement alone will be sufficient to waft any lazy CO_2 molecules up into the higher air strata. It is more efficient if the CO_2 generator releases the gas at the opposite side of the extraction fans in the room. The CO_2 controller (sniffer) should be positioned half-way between those two pieces of equipment, usually right in the centre of the room.

To ensure significant exposure to higher CO_2 levels, the thermostatic ventilation system needs to perform well enough to actually switch off for at least 10 minutes. During that off-time a CO_2 concentration of no higher than 800ppmcan be easily produced. Any level higher than that is very costly. Around 50% of the 30% extra return will actually occur at a concentration of 800ppm. The law of diminishing returns also applies to CO_2 enrichment: adding another 400ppm will yield a smaller result than the first increase. Bear in mind that over the course of a day, the plant will not have had 100% exposure to higher CO_2 levels and less return should be expected. It is for this reason that CO_2 enrichment is rarely used in grow rooms that are ventilated. That said, it is possible to use a small air conditioner to extend the period the ventilation off-times.

Closed room environment

The easiest way to get the full benefit of CO_2 enrichment is in a closed grow room environment – that is, a grow room that uses air conditioning and dehumidifiers to control temperature and relative humidity levels, rather than ventilation to outside. Basically there should be no new air taken in during crop daytime. This is a more costly and energy-intensive approach, but it can guarantee higher levels of CO2 and really will enable the grower to enjoy higher crop yields. Closed room gardens are equipped with air conditioners that provide total management of the garden temperature. Extra dehumidifiers are used to control relative humidity, especially at night when no cooling is active. Throughout the day, the air conditioning performs much of the dehumidification needed in the grow room. These climate-controlled rooms can retain all of the added CO_2, which reduces the cost of providing it, and the constant exposure also maximizes returns. Even so, this approach still requires some extra supervision.

Using an unvented gas burner (propane or natural gas CO_2 generator) in a closed room can be difficult. These generators rely on virtually complete combustion of the natural gas, producing heat, CO_2 and water vapour. A blue flame (with most of the gases used but consult your burner manufacturers guidelines) indicates complete combustion and is pretty safe. If the flame turns to red, orange and yellow, incomplete combustion is taking place and some unwanted by-products are produced such as carbon monoxide, ethylene, methane or unburned gas. All of these by-products are produced in very small quantity but in a closed room system they can build up to toxic levels for plants over the course of the day. There are many symptoms of such exposure: drooping leaves, stunted growth, necrotic dotting of the inter-venal area, yellow or orange leaf spots, dead root tips, leaf-margin burns and tip burns are a few examples.

One easy fix is to perform a small air change every hour or two.

This is usually enough to lower any unwanted gas concentrations. This also replenishes oxygen levels in the room. Nonetheless regular supervision of the burner and the flame it produces is needed. An electric relay should be used to stop the production of CO_2 during ventilation. Oscillating fans should not be directed at gas CO_2 generator as air movement tends to interfere with the combustion process.

Daily checks should be performed to ensure a proper supply of gas to the system because if no CO_2 is supplied in a closed room system, plant growth will come to a halt rapidly. Also, a CO_2 monitor tends to de-calibrate over time. Physical shocks to the sniffing sensor can also skew the readings. These CO_2 sensors (non-dispersive infra-red) will show higher values than the true levels if they are not properly calibrated. Contamination of sensor from fine mist foliar spraying or sulphur burning would also falsify the results and possibly damage the CO_2 sensor.

Another unsuspected challenge with closed rooms is that EXTREME CLEANLINESS at all times is vital. If fungal diseases rear their ugly heads, a closed room system will mean they can spread very rapidly. The same applies to insect pests.

Environmental factors to consider

Plants generally benefit from enriched CO_2 if steps are taken to maximize proper stomata functions (transpiration):

- Temperature no higher than 30°C and no lower than 18°C
- Relative humidity (RH) between 40% (low temp) and 60% (high temp),
- Good horizontal air movement. The plants shimmer and shake lightly once every 30 seconds. An exception to this is in lower than 40% RH, where reduced air speed is better.
- The tighter the crop canopy, the more horizontal air flow is needed. Some air flow should also be directed at the lower part of the main stem.
- Light intensity is essential. The more light available, the more the plant will absorb the extra CO_2 and use it for photosynthesis.
- Reduce the heat caused by light radiation (too close to canopy lighting) which tends to stress plants and reduce CO_2 absorption.
- Control medium salinity (EC in medium). Too high will cause nutrient burns and too low can cause deficiencies.

Figure 9 : A blue flame indicates complete combustion and is pretty safe. If the flame turns to red, orange and yellow, incomplete combustion is taking place and some unwanted by-products are produced. This is not safe!

Is my CO_2 enrichment really benefiting my plants?

The crop should develop and grow faster than usual (i.e. without extra CO_2). If you do not notice any kind of added growth, you need to pinpoint the environmental factor that needs rebalancing and then tweak your equipment accordingly. •

Puzzle&WIN

Great prizes

Win bottles of CANNA Terra Vega &Terra Flores

Summer, summer, summertime... Time to sit back and unwind. If all this talk about CO_2 has you gasping for air, take a break with this puzzle! Can you spot the five differences between these two photos?
The one who impresses us the most with his/her answer wins a set of CANNA Terra Vega and Terra Flores.

So have a nice drink in the sun and get working on those differences!

Winner Puzzle#15

We picked a winner at random from all the correct entries we received, and we would like to congratulate.

Mr. Ashley Taylor

Congratulations on your set of CANNA HYDRO!
We will contact you as soon as possible to organise the dispatch of your prize.

WHAT'S NEXT

To get good results, you need to add the right nutrients at the right time and in the right proportion. If you administer your nutrients at the wrong time or in the wrong proportions, a shortage or excess of certain elements can easily occur in the substrate. The results can be very serious – stunted growth, burned leaves or many other problems.

You can read everything about this subject in the next issue of CANNAtalk.

CANNAtalk IS your magazine, YOUR VOTE COUNTS!

We enjoyed producing this magazine, and we hope you have enjoyed reading it!
Maybe you want to thank us for this magazine, or you just have a question.
Maybe you want to make a suggestion or comment on one of our articles.
Whatever it is, we would like to hear from you. We love to read your comments and find out what issues our readers are facing. So don't hesitate to get in touch!

Write your answers to the puzzle, your comments, questions or suggestions on the answering card below (we'll refund the postage). You can also visit our website or send us an e-mail at info@CANNAtalk.com.

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Send me a CANNA Calendar 2012. I've secretly enclosed 10 pounds in this envelope to pay for it.

Solution to the puzzle:

#17

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