CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

ISSUE 31 2016

AIR IT OUT

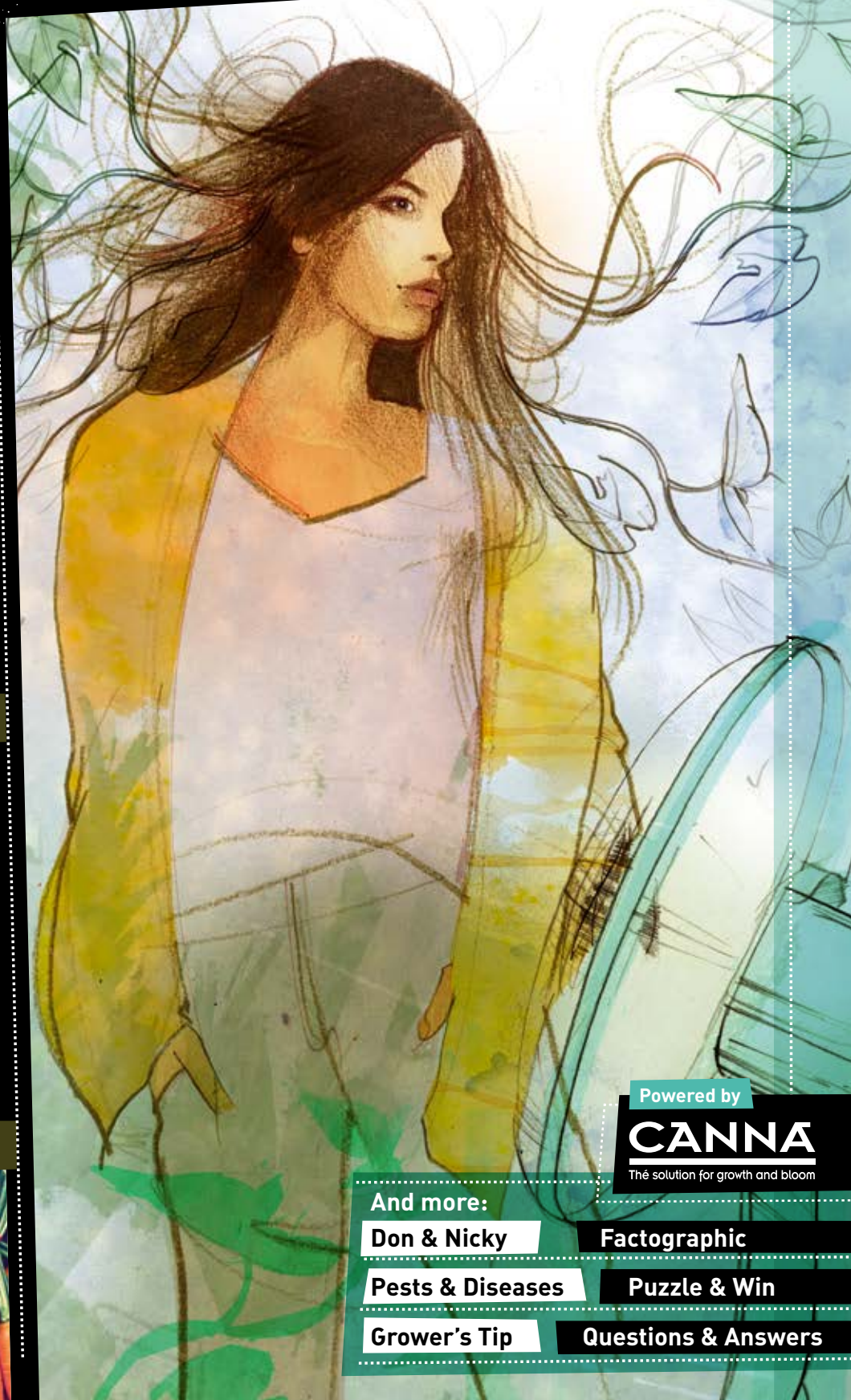
Plants love ventilation

FUJI ROCK

Best Festival Ever

KING OF CRUNCH

Bugs Bunny's favorites



And more:

HQTalk:

When I was just a little boy my favorite cartoon was Bugs Bunny. Oh, that rascally rabbit; always up to no good, chewing a juicy carrot as if it was a huge cigar but healthier, a lot healthier. They are packed with health-promoting beta-carotene, promote good vision, especially night vision and help combat health damaging free radical activity. Just take my wallet please.

Nah, just keep your wallet. Carrots are easy to grow, as you'll find out in this issue. And if you have grown your own carrots why don't you use them in your sushi? Or just fly to Japan and have some sushi? Oh, and while you are there, visit Fuji Rock, the world's coolest festival.

Also find all the ins and outs on ventilation in this issue. And why good ventilation is of the upmost importance in the growing process. Enjoy this issue, and have a carrot.

Cheers,

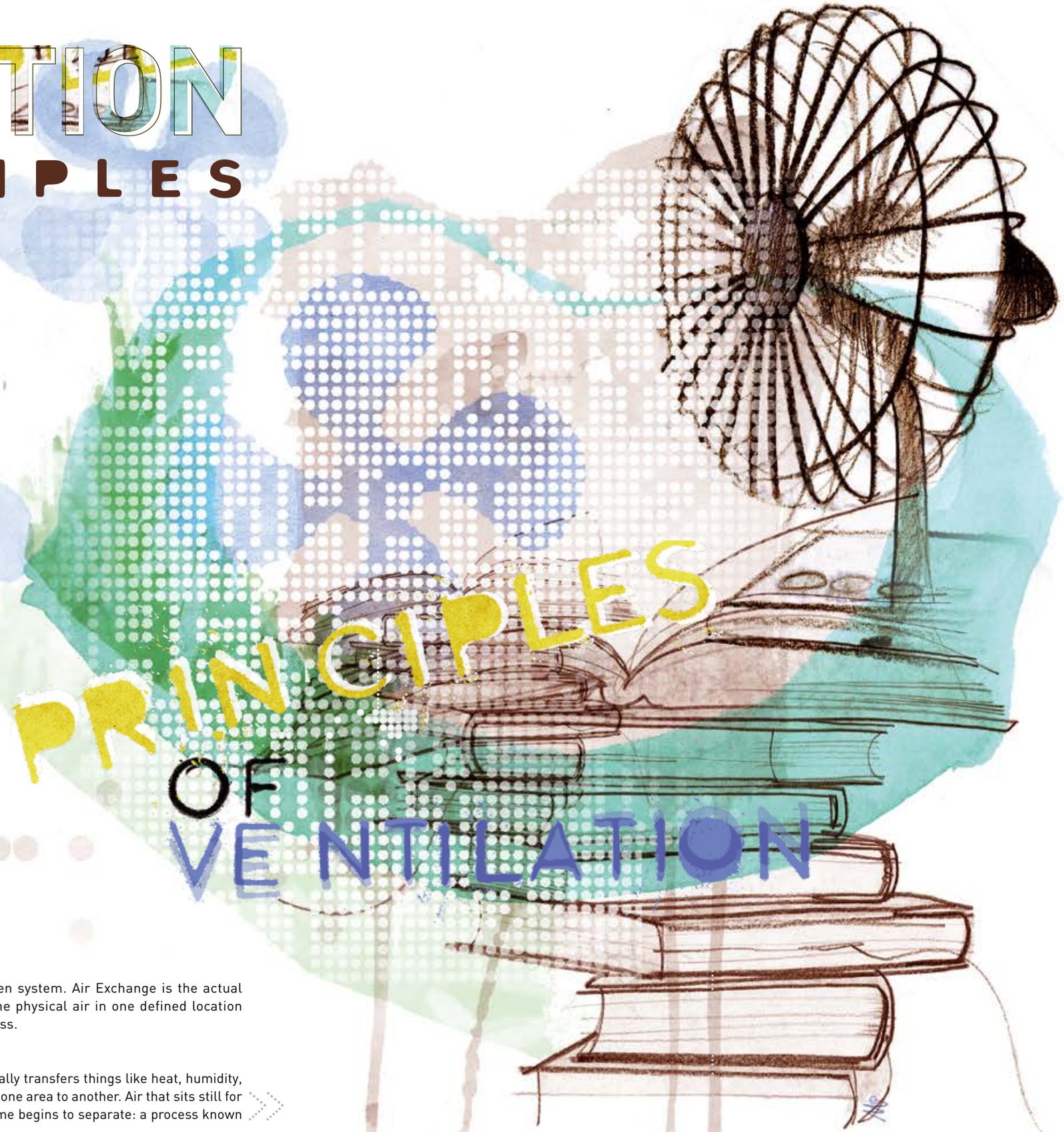
Jeroen

Contents

VENTILATION PART 1 PRINCIPLES

VENTILATION IS ALMOST AN AFTER-THOUGHT WHEN IT COMES DOWN TO DESIGN AND FUNCTION OF A GROWING ENVIRONMENT. THE BEST SYSTEMS ARE GIVEN LOTS OF THOUGHT, ALTHOUGH NOT ALWAYS LOTS OF MONEY, AND THEY ALWAYS START IN THE BEGINNING STAGES OF PLANNING. MOST SYSTEMS, HOWEVER, FAIL TO MEET THIS REQUIREMENT. VENTILATION PROVIDES AND CONTROLS THE ENVIRONMENT THE PLANT AND CROP ARE DEVELOPED AND PRODUCED IN. IT DESERVES A LITTLE BETTER ATTENTION THAN IT TENDS TO GET. THERE ARE TWO PARTS TO THE DISCUSSION, THE FIRST ARE THE PRINCIPLES OF VENTILATION, THE 'WHERE, WHY AND WHAT' PART OF THE QUESTION.

By Geary Coogler BSc Floriculture / Horticulture



What are the goals behind ventilation, what is the purpose? Well, ventilation moves the air around, so how does this help? There are two basic modes of action of ventilation, or rather two basic systems in how ventilation works: the first being an Open system where air is exchanged and the second being a closed system where no air exchange happens. Circulation refers to the movement of the air, achieved either in a closed or an open system. Air Exchange is the actual exchanging of the physical air in one defined location for a new air mass.

Circulation

Circulation basically transfers things like heat, humidity, and biology from one area to another. Air that sits still for any amount of time begins to separate: a process known

VENTILATION PRINCIPLES PART 1

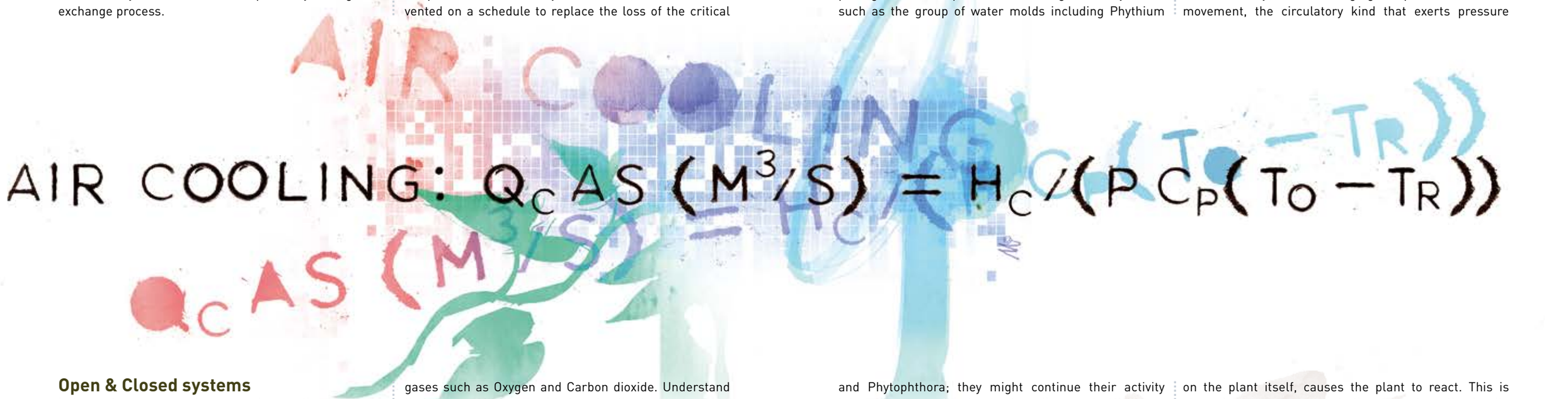
as stratification which effects both temperature and gas composition. This can lead to situations such as thermal layering and deficits of critical gases such as Oxygen or Carbon dioxide.

Air Exchange

Air Exchange, on the other hand, is basically the same thing, well almost. Exchange (Open ventilation system) is used to replace air from one area with the atmosphere from another area, and the air moves around in the process creating circulation. Temperature, gas exchange, and humidity can all be affected positively through the exchange process.

areas at the leaf surface with normal air to insure Carbon dioxide and Oxygen are available for those very basic of life processes. This process does not replace the gases that are used up. It also does not remove the increase in heat packets (BTUs, Britisch Thermal Units), or remove the water from the air; it just mixes it to cut out layering effects or depletion zones.

On the other hand, where a room or area can replace the air in the area of concern with drier air, or cooler air, then the effect is the removal of the moisture or heat from the system overall. Open systems will accomplish both and is based on the air that is replacing the current room. Circulation is used all the time to keep things moving and fairly equal, and air exchange is used to control when the temperature or humidity gets out of hand. Even when a mostly air tight room sits at a perfect temperature and humidity all the time, it still has to be vented on a schedule to replace the loss of the critical



Open & Closed systems

Indoors, in a room or in a greenhouse, the principles remain the same. It is all about growing plants in a controlled area. Plants need light and water to grow and survive. Plants take in light, and take up water, and 'breathe' Carbon dioxide mostly and a little Oxygen and use these four components to produce energy from the light and carbohydrates, to store that energy, to serve as basic building blocks for all the plant to come, and by utilizing the Oxygen in a respiration process that releases the energy when required. In doing this, they cause an imbalance of gases at the leaf / air interface zone, an increase of humidity being richer the closer in to the plant it is measured, and warmer from the light or radiant energy given off by the sun or other light source. In a closed system, the circulatory effect serves to mix these with the air away from the plant(s), but in the same room or vented area, acting to moderate the temperature, equal out the humidity, and replace the depleted gas gases such as Oxygen and Carbon dioxide. Understand that even when the need is to raise the temperature or increase the moisture, the effect is the same since it is based on the air that is replacing the room air and will be affected up or down accordingly.

Unfortunately, when control of a single element is required, it may affect negatively other needs so balance and priority become the by words. If a grower should supplement the Carbon dioxide in the facility to increase the growth rate, then exchanging air becomes harder without decreasing the CO_2 that was released, a waste of both time and money. It might be necessary to work with a prioritized system that gives precedence to one element over another at certain times.

Other functions:

There are other functions that ventilation accomplishes through both circulation and Open / Closed systems.

These secondary items are still based on one of the first 2 effects, that of affecting humidity. These are:

1. Disease control
2. Controlling growth / Evapotranspiration
3. Stress control

Disease control

By controlling humidity and temperature, particularly humidity, the preferred environmental conditions for various disease vectors and pathogens are also limited. Free moisture is kept from setting a film on the leaf surface limiting the ability of the spores from fungi like Powdery Mildew and anthracnose from germinating and gaining entrance into the leaf tissue interior. Hidden environments are also humidity controlled. Spores from various pathogens will degrade as they sit in less than perfect conditions, decreasing effective rates. Some pathogens are disrupted at less than high humidity values such as the group of water molds including Phythium and Phytophthora; they might continue their activity internal to the leaf, but not externally. Insect activity can and will also be affected by humidity levels, which affect general survival and reproduction rates of key problem insects such as the general class of mites as well as less problematic insects such as Fungus Gnats. Humidity also affects another area critical to plant growth and development

Evapotranspiration

A process known as Evapotranspiration is the process that drives and controls the movement of water, or fluid, through the plant from the roots till it exits at the stomata on the leaves. Water, picked up in the roots, and loaded up with nutrients and materials for plant growth are pulled to the top part of the plant by the fluid evaporating from specialized pores on the leaf, stomata (stomates), based on the humidity level in the air at the stoma (stomate), much like water through a straw. The drier the air, the faster the evaporation, the higher the negative pressure at the stoma, and the faster water pulls up to replace it, bringing along the nutrients needed for plant growth. If the need for transport is high and the humidity is also high then the water moves slow and not fast enough for good replenishment of nutrients and water. Also, if the air is too dry then the water moves too fast and the level of ions, that are salts, accumulates in the leaves, or the water just cannot move fast enough and the tissue can and will burn. This process controls the growth of the plant, acting like the throttle on the pipeline that supplies or moves the water and nutrients inside the plant tissue.

Stress

Stress is also a critical component of plant development, exerting both negative and positive pressure on the plant. Some stress is required to grow a strong plant: making plant stems strong, controlling crop growth and uniformity, and encouraging competition. Some air movement, the circulatory kind that exerts pressure on the plant itself, causes the plant to react. This is stress in action. It results in the plant strengthening its supportive tissue as well as doing all those things to increase its odds of survival to flower from developing bigger fruits with faster ripening (with stronger stems for support of those fruit) to increasing the metabolites the plant normally produces to protect it and increase reproductively potential. Too much stress is not so good, too little stress is just as bad. Circulation can help express a 'just right' amount of stress.

Area's and seasons:

It may be the case that instead of an open ventilation system that depends on the exchange of air to accomplish goals in temperature reduction or in humidity control, a closed system would work better. A closed system is used in cases where CO_2 is being replaced internally and temperature is regulated through AC units and heat through heat systems. One or both of these systems, along with humidifying / dehumidifying systems can and

VENTILATION
PART 1 PRINCIPLES

usually are required on most growing setups. In cooler areas, AC is less required and vice versa for warmer areas where heating is a bigger concern. Dehumidifying is typically required in most places; humidifying equipment is usually a need in colder areas during heating seasons, and some other areas that are normally arid locations. In closed loop systems, not only does the temperature burden become much larger, all other elements in a normal atmosphere must be monitored and maintained.

Figuring the Need

Now, the fun part, how to figure out what is needed to do the job. Well, short of a course in Engineering, it is not going to come from a few paragraphs here. The formulations are very specific to the situation and need. Formulas for figuring even simple steps such as the air flow rate needed for cooling (m3/s) qc = Hc/(p cp (to – tr)) mean much to the right people but little to most growers. It is required that many things are known, things like BTU loads, design temperatures, air flow resistance, air density, moisture loads, seasonal averaging, and lots more. The designer of a proper growing concern should consult with proper sources to design what is needed. The cost of throwing money in improper designs, field changes over time, and covering the cost of mistakes in loss production, excessive costs, and lack of consistency will be enough to cover the extra design help and extra cost in installing the correct system that matches the need. Even a little investigation into the need would be better than nothing.

Ventilation has to deal with all those things discussed here. While designing the system to use, keep in mind all the factors that will be affected. Where will the exchange air be pulled from, and where will it be exhausted? How will the use of CO2 be built into a system that also requires a greater heat load during the same period? How large of an AC system or heat system is needed? How will it be controlled? What will the ducting look like and how will it run? These are all questions that the grower needs to know and in doing, guarantee less headaches and an easier run at production. Putting it all together is the practical side of ventilation.

Now that the principles are clear we can move to practices. The story continues on page 22. •

$$\text{DE-HUMIDIFY: } Q_{MD}AS\,(M^3/S) = Q_{DH}/(P(X_1 - X_2)$$

THE KING OF CRUNCH

"IF YOU DON'T GO TO SLEEP, BUGS BUNNY WILL COME AND EAT YOU!" THAT'S WHAT MOTHER CARROT TELLS HER CHILDREN WHEN THEY'RE NAUGHTY. AND THAT'S WHY OUR MISTER CARROT IS A WEE BIT AFRAID OF RABBITS, ALTHOUGH HUMANS ARE ALSO QUITE PARTIAL TO HIS FLAVOR. NO WONDER, WHEN IT'S SO PACKED WITH GOODNESS, GOOD FOR CLEAR VISION AND THE ULTIMATE FREE RADICAL KILLER. LET'S SAY HI TO THE KING OF CRUNCH.

By Marco Barneveld, www.braindrain.nu

Bugs Bunny might scare all the poor little carrots, but he has made sure that generations of kids around the world know that carrots are great for your health. Packed with health-promoting beta-carotene, they promote good vision, especially night vision, and help combat health damaging free radical activity. Easy to pack and easy to carry, carrots are a nutritious, low-calorie addition to your healthiest way of eating, any time of the day.

Edible greens

The King of Crunch, scientifically known as Daucus carota, is a biennial herb in the Apiaceae family grown for its edible root. Not many people know that the root also produces gorgeous flowers if you leave it in the ground for the second year although very, very few carrots ever reach that stage of course. Carrots are related to parsnips, fennel, parsley, anise, caraway, cumin and dill. The foliage of the carrot plant can reach a height of 5 feet when in flower. Carrot roots have a crunchy texture and a sweet and minty aromatic taste, and the foliage is fresh tasting and slightly bitter. Yes, you read it right. The greens are also edible, so stop throwing them away!

Carrots are packed with nutritional value, can be processed into many forms, and can be stored for months – and all this means that they quickly became a popular foodstuff wherever they were taken from their home in Iran and Afghanistan. During their journey across the centuries and continents, countless botanists have managed to improve the composition, look, flavor and size of ancient carrots.

Oh, the Dutch

We are all familiar with King of Crunch's bright orange hue, but the modern-day orange carrot wasn't cultivated until the late 16th century, when Dutch growers took mutant strains of the purple carrot and gradually developed them into the sweet, plump, orange variety that we all know

today. Before this, pretty much all carrots were purple with mutated versions occasionally popping up including yellow and white carrots.

Some think the reason the orange carrot became so popular in the Netherlands was as a tribute to the House of Orange and their struggle for Dutch independence. This could be true, but it also might just be that the orange carrots that the Dutch developed were sweeter tasting and larger than their purple counterparts, thus providing more food per plant and tasting better.

Currently, the largest producer and exporter of carrots in the world is China. In 2010, 33.5 million tons of carrots and turnips were produced worldwide, with 15.8 million tons in China alone.

Healthy little bugger

Forget about those vitamin A pills. With this crunchy orange power food, you'll get vitamin A and a host of other powerful health benefits. And I'll let you in on a little secret: carrots really are good for your eyes. It's not just an old wives' tale. Carrots are rich in beta-carotene, which is converted into vitamin A in the liver. In the retina, that vitamin A is transformed into to rhodopsin, a purple pigment necessary for night vision.

Beta-carotene has also been shown to protect against macular degeneration and senile cataracts. A study found that people who eat the most beta-carotene have a 40 percent lower risk of macular degeneration than those who consumed little. And vitamin A also helps the liver secrete bile and flush toxins out of the body, aiding any natural detox regime. The high fiber content of carrots also helps to regulate the digestive system.

And how about this? Vitamin A promotes healthier skin because it protects the skin against sun damage. A vitamin A deficiency will cause dryness in the skin, hair and nails. Similarly, vitamin A prevents premature wrinkles, acne, dry skin, pigmentation, blemishes, and uneven skin tone.

Would you like one more little tidbit on the benefits of the King of Crunch? Ok, here we go. Carrots help to prevent infection. They can be used on cuts, shredded raw or boiled and mashed. Bet you didn't know that. So are you ready to grow now?

Grow the King yourself

Carrot seeds are best planted in early spring and left till late summer, specifically February, March, April, and August and September. For the best results, carrots should be grown in sandy soil that does not retain water for a long time. The soil should also be free of stones.

To prepare your carrot patch, dig up the soil, loosen it and turn it over. Then, mix in some fertilizer. Weather, soil conditions and age will all affect the taste of your carrots. Experts say that warm days, cool nights and a medium soil temperature are the best conditions for growing carrots that taste great. Carrots benefit from a plentiful supply of moisture and should be provided with 1 inch of water each week. Mulching around the plants helps to conserve moisture and reduce weeds.

Sweet

Carrots need time to develop their full sugar content. This is what gives them their taste. If they are harvested too early, they will not have enough sugar. But carrots also lose their sweetness if you wait too long to remove them from the ground. The best way to judge if a carrot is ready to be harvested is by its color. Usually, the brighter the color, the better the taste.

Most people do not know that carrots can be grown during the winter months. If the winter is not cold enough to freeze the ground, you can grow and harvest carrots in the same way as during the summer months. If the ground does freeze where you are, simply cover your carrot garden with a thick layer of leaves or straw. This will prevent the ground from freezing. You can remove the ground cover and harvest the carrots, as they are needed.

Reaping the harvest

Your carrots will be ready for harvesting about twelve to sixteen weeks after sowing. Harvest carrots as soon as they are large enough to use; don't aim to get the largest roots that you can or you'll sacrifice flavor. Carrots are harvested by gently digging around the plant to expose the top of the root and gently, but firmly pulling the root from the soil by grasping the top of the carrot just above the root. Carrot tops should be twisted off and the roots washed prior to refrigeration in airtight bags. Carrots may also be stored in moist sand to keep them fresh prior to use. •

FACTS

- It is actually possible to turn your skin a shade of orange by massively over consuming orange carrots.
- In ancient times, the root part of the carrot plant that we eat today was not typically used. The carrot plant however was highly valued due to the medicinal value of its seeds and leaves. For instance, Mithridates VI, King of Pontius (around 100 BC) had a recipe for counteracting certain poisons, the principal ingredient of which was carrot seed. It has since been proven that this concoction actually works.
- The Romans believed carrots and their seeds were aphrodisiacs.
- The largest carrot ever grown was ten kilos: grown by John Evans in 1998 in Palmer, Alaska.
- Carrots are the second most popular type of vegetable after potatoes.
- The name "carrot" comes from the Greek word karoton.
- The beta-carotene that is found in carrots was actually named for the carrot itself.

RECIPE

COOK IT YOURSELF: THE SOUP OF KINGS

Can you smell that? It's the smell of carrot soup in the afternoon. If you are not growing your own yet, run off to the farmer's market and buy a bunch of crunchy kings and soup it up.

- **1 bunch medium carrots (any kind, any color)**
- **1 onion, minced**
- **3-4 celery stalks, chopped**
- **2 garlic cloves**
- **1 red pepper, minced**
- **Chicken or vegetarian broth**
- **Salt and pepper to taste**
- **Thyme or other favorite herbs**
- **Lemon juice**
- **A little cottage cheese**

Step 1: **Sauté all the veggies in olive oil until soft. Add chicken or vegetable broth and water to cover vegetables and simmer for thirty minutes or so until soft. Add salt and pepper and your *favorite herbs.***

Step 2. **Puree the soup in blender or food processor until smooth. Return to the pan and heat through. Add a dash of lemon juice and a dollop of cottage cheese. Now that's the way to treat a King.**

Questions & Answers

We receive a lot of questions about growing. Of course, our researchers are more than happy to answer them! Just go to the contact page on our website, www.canna-hydroponics.com, to submit your question.

Question

I use the CANNA TERRA Professional Plus soil mix and the complete CANNA nutrient line as per the feed chart. On the soil bag, and in your literature, it advises to pH the water to between 5.8 - 6.2, however magnesium & calcium lock out below pH of 6.4. What are your thoughts on this and why is this the advice you give?

Answer

Thank you very much for your question.For the uptake (solubility) of nutrients, the best pH is between 5.2 and 6.2, but the medium (TERRA) is made of peat. Peat has a pH of 3.5-4.0. With this pH, you cannot grow most plants (except maybe some plants in the Ericaceae family). So, we add lime to the peat and bring up the pH to 6.0-6.1. To maintain this pH over time, at that level, we give the same pH on Terra, and the plant will influence the pH by the uptake of nutrients. In the vegetative phase, it will bring up the pH and in generative phase it will take the pH down (acidify it). To compensate for this effect, we recommend that you give a slightly lower pH (5.8) during vegetative phase and a slightly higher pH (6.2) during generative phase.

If you grow with organic fertilizers, in the CANNA TERRA medium or in the nutrient tank, the pH is important. As a matter of fact, it is very important, because a low pH (↓6.2) will break down the organic fertilizer. If you do adjust the pH on organic nutrients below this, you make it into a mineral nutrient. (but don't do it).

This is something the roots should do and not the grower that lowers the pH.

So the pH on CANNA TERRA should be:

For mineral growing (CANNA); 5.8 – 6.2

For organic growing (BIOCANNA) ; ↑ 6.2 (no use of pH minus)

As to your concern about the lock out of calcium and magnesium: The chance this will happen in a water solution in combination with Phosphates or Sulfates (gypsum) is bigger at a higher pH.

Question

First, thanks to the technical guys for the response to all my last questions. It is great having a form we can fill out on your website and get the correct information. What drippers or emitters do you recommend for irrigating buffered CANNA COCO slabs?

We have tried soaker hose but they clog. We use CANNA COCO A/B as our nutrient.

Answer

Thanks again for the question. In the buffered CANNA COCO slab, make sure the drains are cut in the bottom of the slab for drainage. Then you can use high volume drippers, about 2 per foot is ideal. But I find the shorter directional spray stakes (2 inch) with a slow feed so you get about a 4 inch circle, enough for about 3 - 4 per slab. If you then apply enough irrigation solution to get about a 10 - 20% drain, there should be enough solution to reach the outsides easily. (The loose Buffered CANNA COCO slabs, like the loose fill Buffered CANNA COCO in bags, have excellent capillary movement to reach the entire medium mass.) Then allow it to lose about half the weight before re-irrigating the same way. This should take under 20 minutes to apply the amount needed and then fully drain. There is sufficient drainage in the medium to not be water saturated after this. Do not overdo the drainage slits, a few is good enough. Hope this helps.

Question

I am using the full CANNA COCO line, what is the appropriate amount of time to feed plain water before harvest? I have heard anywhere from no flush is required to 2 full weeks of feeding just plain pH adjusted water to leech the medium and the plant of nutrients so that the final product will be better. I am at week 7 of a 9 week plant.

Answer

Final flushing is done to force the plant into using up all its nutrient reserves that are moving through the vascular tissues and cells. This would imply that the correct amount of time to do so is to the point problems, usually yellowing, begins to occur. This can and will vary based on environmental conditions, level of fertility, the medium, and good old genetics.

Typically this takes 5-7 days, but it can be shorter in hydro systems and longer in organic mediums and certain varieties, up to 14 days in some reported cases. This is a grower choice based on conditions, crop, and so forth. If organic fertilizer is involved, it is impossible because the nutrition comes available all the time as things that do not leach continue breaking down.

Question

I accidentally used flora nutrients on my clones for about a week instead of vega nutrients. I'm using a PPL system. It's growing but slowly. I'm going to change all the water to the vegetative nutrients. Will it hurt my little clones?

Answer

Thanks for the question. Sorry to hear of the mistake, however there is no great injury here. Just switch to the correct, give it a week and things should be back in balance.

Question

We are using CANNA COCO slabs in an outdoor hydroponic system. These are set up to collect the drain back to the holding tank. Because this is recirculated, we were told to use CANNA AQUA as the nutrient.

We are having problems consistently hydrating coco slabs. We have used drip irrigation but the hydroponic nutrients eventually solidify on the emitters and clog them. We have used soaker hose, but they also eventually clog. We have used water lines without fittings, and they do not evenly hydrate the entire slab and sometimes come out of place. Please let us know how you can consistently, evenly irrigate coco slabs with hydroponic nutrients. Thank you!

Answer

Well, we have three types of coco slabs:

- COGr Board: is close to 3 feet long, dry like a board and is not buffered
- COCO Slab: is about 3 feet long but with buffered coco as a loose fill in it and is already moist
- COCO Brick: the newest innovation which is pre-buffered COCO bit in a dry compressed form that is designed to be broken into smaller pieces.

All three are dealt with a little different.

The COGr Board has to be soaked with CANNA COGr Buffer Agent for 24 hours in the bag or in a trough or something that will hold the buffering solution. Then is drained away after being made totally wet. Then, as long as the slab is set mostly level, the capillary action from 4 to 5 drippers placed evenly across the length of the slab will maintain even moisture in the slab. I prefer to open the top more and use a spray type stake for better dispersion across the coco.

The Buffered CANNA COCO Slabs are pre-wet and all they need is water with nutrients applied. Again, it takes 4 to 5 drippers spaced evenly across the length of the slab. Again, spray stakes are a better option but drippers will work.

The compressed pre-buffered CANNA Coco Brick is dry and sized to fit different sized containers. It can be split into the needed quantity. Water is applied to swell the brick. Then, nutrient solution is used to water in the new transplants.

It is not a really a slab but irrigation is the same as the moisture will move through the slabs by both gravity and capillary action. Once irrigation is shut off after wetting it, the moisture will achieve equilibrium in the medium, as long as the drain holes are cut into the bottom or the slab is oriented with these holes on the bottom, and the water will not accumulate at the bottom.

You might be growing hydroponically (true word use) but the slab is for RTW, therefore the dynamics will be roughly the same as rockwool. Now, in any event, or use of any slab here, the proper nutrient is a coco version (CANNA COCO A/B, or CANNA COGr Vega and Flores) and not CANNA AQUA nutrients. The buffer in aqua, the pH of coco, and other forces will cause emitter issues. Again, just because you think you are growing hydroponically, you are not, no matter how many times you water the coco in a day. CANNA AQUA nutrients is for re-circulated growing on INERT medium like clay pebbles, not organic ones like coco. Coco can be used as a RTW medium like rockwool, BUT it still remains organic and requires the grower to keep it in mind, and still requires a coco designed nutrient.

Don & Nicky (PART 12)

Don and Nicky have moved back from Canada to their home country, the UK. Their search for the good life led them to France and they are now doing exactly what they wanted to do with their lives: growing. Don shares his experiences and will tell you everything about the good life in French Catalonia in this, and forthcoming editions.

I need to make my indoor garden more efficient. Last year's electricity bill nearly killed us and, as we slowly make the necessary additional payments to get our account out of arrears, the issue of my indoor garden's electricity consumption still threatens to drive a wedge between my wife, Nicky, and I who these days likens it to a second mortgage she never signed up for. She kind of has a point too.

NEWS flash

The light on the left is an air cooled 1000W DE HPS, the one on the right a 315W LEC of ceramic halide. I am mixing lights for a fuller, healthier overall spectrum

Lightmeter

In an attempt to placate her, I began to research a little deeper into how much light my plants required at different stages in their lifecycle. I wanted to see if there were any corners I could cut or new efficiencies I could find. I discovered that it all came down to something called DLI—or Daily Light Integral. Each plant species has its own light quota—a bit like the small-print calorie intake recommendations on packets of pork scratchings. "High light" crops such as tomatoes, for instance, enjoy a DLI of 22 -30 mol when mature—sometimes even more. Sweet peppers are also considered high light crops, although they are not quite as greedy for photons as tomatoes. On the other hand crops like Bibb lettuce only need 12 – 14 mol.

Mol (or moles) are a measure of lighting intensity for plants. It's basically a count of photons hitting your plants' leaves over a 24-hour period. I'd just started some determinate bush tomato seedlings and discovered that when they're young, they only require a DLI of 6 mol, rising quickly as they grow.

Now, my PAR meter measures micromols per meter per second—so, in order to determine whether my seedlings were receiving enough light, I needed to multiply this value by sixty for "micromols per minute", then multiply it again by sixty for a "micromols per hour" value, and then a final multiplication by the number of hours my lights are switched on per day—in my case, 18. This final value (a very large number) is then divided by a million to reach the DLI in mol. Easy stuff—especially with a calculator.

I decided to mount my 315W ceramic metal halide lamp on a light rail—this moved the light back and forth allowing coverage of a larger footprint. It also helped to avoid hot spot issues. However, a moving light obviously made taking accurate light intensity measurements a little trickier. I opted to hold the sensor at a given position for three minutes, take a reading every ten seconds, and then finally calculating the average. This turned out to be around 150 micromols.

Applying the aforementioned math: 150 x 60 x 60 x 18 (divided by a million) = 9.72:

in short, I was giving my tomato seedlings about 62% more light than they really needed! Conclusion? Reduce my photoperiod to 11 or 12 hours and save electricity! Day-neutral crops like tomatoes and peppers afford you considerably more wriggle-room when it comes to your chosen day length. Obviously, growers cultivating photoperiodic crops don't have this luxury.

Before long, though, my tomatoes were over a foot tall.

Not only were they screaming out for bigger pots, higher nutrient levels, larger irrigation volumes and more physical growing space, but they craved more light too! Keeping up with the exponential rise in your plants' requirements is a really important skill and one, I think, that can only truly be learned through experience.

I repotted my four best tomato plants from their intermediate 5L pots into 15L pots attached to a gravity fed system. I filled each pot with a mix of 75% coco and 25% perlite, watered them in with nutrient solution at 2.5 mS and positioned a double-ended 1000W HPS lamp above them. I had the light raised up quite high at the beginning to mitigate any transplant shock issues. Now, I know what you're thinking—1000 watts!? But double-ended HPS really is the most efficient way of producing plant usable light (that I know of) so it seemed like a good choice. I supplemented the spectrum with my 315W ceramic metal halide and created a fairly uniform spread of intense light over a 1.5 m x 1.5 m area—averaging out at around 500 micromols. At 16 hours a day, I was pushing 29 mols—a healthy amount for tomatoes entering the flowering and fruiting phase.

My next steps towards a more efficient indoor garden will include lining the walls with highly reflective material and maybe creating some movable reflective surfaces in an effort to bounce every stray photon back towards my light hungry tomatoes. Wish me luck—particularly when Nicky inevitably visits the garden and sees the 1000W HPS. It might spell the end of our joint bank account.•

YELLOW STAGHORN

DID YOU **KNOW THAT...?**

- The fruiting bodies look almost like the antlers of a stag. It's commonly known as Yellow Staghorn, although its color is more often pale orange.
- It is sometimes confused with coral fungi, but its texture is greasier, like wax.
- Its scientific name is Calocera Viscosa. The prefix calo- means beautiful, while the extension -cera comes from ancient Greek and means 'like wax', so that the genus name Calocera translates to 'beautiful and waxy'.
- Viscosa, which is the type species of its genus, simply means viscous, sticky or greasy, and when it is wet, the Yellow Staghorn does indeed have a sticky surface.
- If you find a white example of the Yellow Staghorn you are quite lucky since these are not common at all.
- Calocera viscosa always grows on wood, although sometimes the substrate is not immediately evident if it is buried beneath leaf litter or moss on the forest floor. It particularly loves dead and rotting coniferous stumps and logs.
- Common and widespread throughout Britain and Ireland, this beauty is found in most parts of mainland Europe as well as in many other regions of the world including North America.
- When the weather is really dry, the color can become a beautiful orange-red. Unfortunately this is not often the case in neither Britain nor Ireland.
- You can also eat it, you know. Although this fungus looks suspicious due to its bright yellow coloring, it is in fact harmless. But it's not really a gourmet treat either. It has a rubbery texture and not much flavor at all.
But even so, because of its pretty appearance, it is sometimes used to garnish salads and to add color to other mushroom dishes.

We, the lucky ones, live in the age of festivals. Sometimes it gets hard to choose between all the musical greatness that we are presented with. But forget Glastonbury, forget Burning Man, forget Roskilde. If you could only visit one festival in your life, let it be Fuji Rock. The mountains are alive with the sound of music. By Marco Barneveld, www.braindrain.nu

Fuji Rock

SYMBIOSIS OF **MUSIC** AND **NATURE**

We have a soft spot for Japan. Okay, The Last Samurai was a terrible movie but the samurai are an intriguing part of the history of this country. And somehow, the oldest people in the world live in Japan. And, last but not least, it's the home of sushi. And we love sushi. But we love festivals even more. And Japan is home to probably the best music festival in the world: Fuji Rock.

Dragondola

Right up in the mountains, this is a grand spot. So if you want something different this year, get your travel pants on and head off to Japan for the biggest and most beautiful of Japan's summer music festivals: Fuji Rock. This year it will once again return to Naeba, Niigata Prefectur, and will welcome around 200 bands and artists. The exact dates were not confirmed when this magazine went to the press so check out the Fuji Rock website for the exact dates in 2016. It's well worth it.

Not many festivals require a trip up a mountain by cable car to see a band. But then Fuji Rock is something really special. The twenty minutes of high wire travel in the Dragondola, the longest gondola lift in the world, to reach the Daydreaming stage is a good illustration of the festival's vast size - the largest in Japan - and its beautiful verdant setting in the Naeba resort. In winter, this is the perfect spot to try your skis or snowboard. Thankfully the outdoor Green stage is somewhat more accessible.

You might think Fuji Rock is somewhere close to Mount Fuji, but this is not the case. In 1997, the first year of the festival, it was held on Tenjinyama Ski Resort near Mount Fuji, hence the name. It was in 1999 that the festival found its final home in Naeba. But it still retains its original name.

Disaster

It took two years for the festival to land to its current location. The first year was a massive disaster. Fuji Rock was the first outdoors rock festival in Japan and hopes were high. It was planned as a two-day event, but by sheer bad luck the first day of the event was struck by a torrential typhoon. The Red Hot Chili Peppers, who were one of the headliners, played through a storm even though Anthony Kiedis had a broken arm. You know, this is the stuff rock legends are made of. The festivalgoers were poorly prepared for the heavy rain and strong winds, and many needed medical attention for hypothermia. It was just luck that no one died.

Tokyo

The guys who organized the event decided to cancel the second day, which happened to be one of the most beautiful days of summer that year in Japan. Thus ended Japan's first outdoors rock festival. The organizers were criticized for being poorly prepared for bad weather, and for not organizing enough buses to link the site to the nearest train station. The second year, the festival moved to Toyosu on Tokyo's waterfront. Although the event was a success and there were no typhoons, hypothermia or organizational mishaps, many found the searing heat of mid-summer Tokyo too much to bear. The mountains are always nicer in Japan in the summer and it was decided that the next event would be held in the relative coolness of the mountains. And so it found its home on the Naeba Ski Resort, in Niigata Prefecture.

Every year, Fuji Rock aims for a Symbiosis of Music and Nature and take steps to alleviate the impact of the event on the environment and organize other conservation activities to benefit the future of the planet. So if you are able to get there and you buy something to eat - let's say sushi - you'll find that the plates and utensils are made from the recycled plates and utensils of the year before. Pretty cool huh?

Sparkling streams

There are seven main stages and other minor stages dotted around the site. The Green stage is the main stage and can accommodate almost 50,000 spectators. Other stages include the White Stage, the Red Marquee, Orange Court, and Field of Heaven. The walks between some of the stages can be long, and some of the trails can be hilly, but the walks are beautiful, often taking you through forests and over sparkling streams. The line-up for 2016 has not been published yet, but is of excellent quality every year. For example, last year it played host to headline sets from rock behemoths Foo Fighters and Muse. You could have also been witness to brilliant acts by Deadmau5, FKA Twigs, forgotten rock genius Todd Rundgren and Belle and Sebastian. Plus sushi - lots and lots of sushi! But don't worry; they'll have a new supply of that delicious sushi when you get there this summer.

When: Check fujirock-eng.com
Festival heaven for: Head banging mountain climbers.•

Pests & DISEASES

Figure 1: Eggs of the Green Lacewing

Even though the article series is called Pests & Diseases we have decided to include the opposite of pests as well, namely the natural enemy or beneficial insect. Beneficial insects, Beneficials for short, are insects that kill and control pests on crops. They can be naturally occurring or bought and introduced in the infected crops. The use of biologicals is a form of Biological crop protection and Integrated Pest Management (IPM). In a future article we will explain IPM in more detail, now we focus on one of the lesser known but very effective beneficials, the Green Lacewing.

By CANNA Research

BENEFICIALS

GREEN LACEWING

Green lacewings are insects in the family Chrysopidae of the order Neuroptera, or net-winged insects, which also includes mantidflies, antlions , and their relatives. There are approximately 85 genera and 1500 species of Chrysopidae around the world. Members of the genera Chrysopa and Chrysoperla are very common in North America and Europe. There are also Brown lacewings but they belong to a different family, the Hemerobiidae.

Appearance

Green lacewings are generalist predators and are commonly found in agricultural, landscape, and garden habitats. They are delicate insects with a wingspan of 6 to over 65 mm, though the largest forms are from tropical regions. Adult green lacewings are soft-bodied insects with four transparent wings which have an interconnecting network of fine veins, golden eyes, and green bodies. Adults often fly at night and are seen when drawn to lights. Adult green lacewings are divided into two diet categories: some species of green lacewing adults are predaceous, others feed strictly on honeydew, nectar, and pollen.

Larvae, are pale with dark markings and look like tiny alligators. They are somewhat spindle shaped, with two sickle-like jaws protruding from the head. The body bears many tubercles with bristles.

Lifecycle

Adults are attracted by the odor of aphid honeydew and lay their eggs near aphid colonies.

Females produce 400-500 tiny oblong eggs each. Depending on the species, eggs are laid singly in some species, such as the Common Green Lacewing Chrysoperla carnea, or in clusters. Eggs are suspended individual at the tops of threadlike stalks to protect them from predation by hatching siblings. Eggs are green when laid, then darken before hatching. Lacewings undergo complete metamorphosis with eggs hatching about 4 days after being laid, and larvae develop through three instars.

After this, it will pupate by spinning a cocoon with silken thread .The adult emerges in about 5 days through a round hole that it cuts in the top of the cocoon. It overwinters as a pupa within its cocoon or as an adult, depending on the species.

Use

Lacewings (both green and brown) are important predators in many agricultural systems worldwide. The common green lacewing (Chrysoperla carnea) is the most used and commercially available species and naturally controls many different pests.

As the adults of the common green lacewing are not predators, companies either sell eggs or larvae. Some companies do sell adults but as they easily fly away, they are less effective. The eggs of the green lacewing are shipped loose in an inert medium of for example rice-hulls. The rice-hulls are a distribution carrier to facilitate the proper placement of the eggs.

The larvae are very cannibalistic and must be separated in transit. This is accomplished by means of a frame or hexcell unit. The hexcell unit is comprised of little compartments which can be opened a-row-at-a-time for predator release. Some companies sell the larvae loose in a bottle with buckwheat hulls as means of providing hiding places.

Larvae must detect prey through direct contact. Their senses are weakly developed, except that they are very sensitive to touch. Walking around in a haphazard fashion, the larvae sway their heads from one side to the other. When attacking prey, the larva lunges forward, impaling the aphid. Enzymes are injected through the hollow jaws. After the prey's body contents are digested, they are sucked back through the jaws by the lacewing larva. The long tail section is used as a stabilizing brace when the larva is attacking prey.

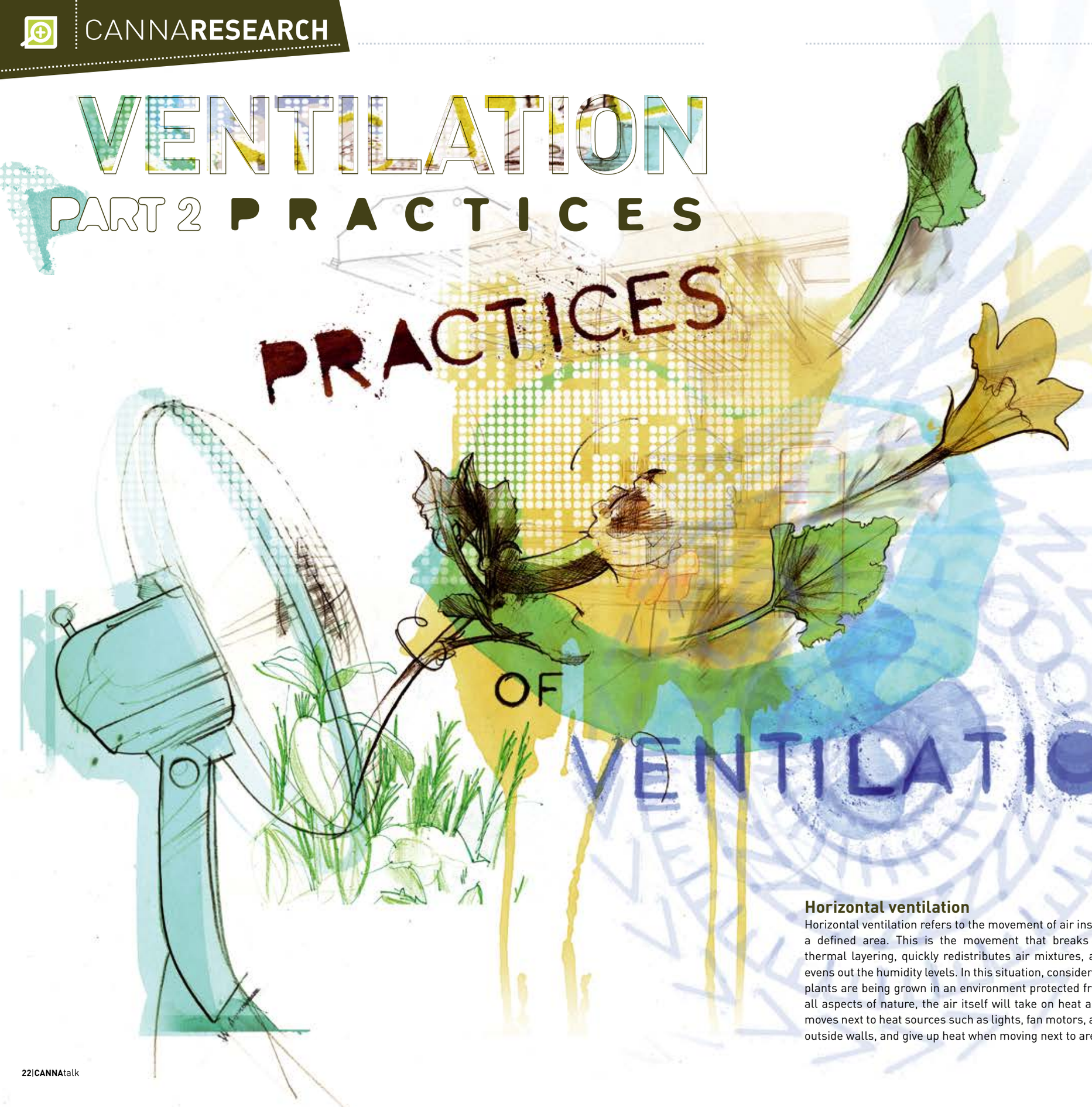
The larvae is also known as the "aphid lion" or "aphid wolf" because of its voracious appetite. Besides aphids, they feed on just about any soft-bodied pest they can "grab," including citrus mealybugs, cottony cushion scale, spider mites, thrips, caterpillars, insect eggs, etc. It is known to be cannibalistic if no other food source is available. During the two to three weeks in this stage it will devour up to 200 victims a week. •

Figure 2: The common Green Lacewing

Figure 3: Larva of a common Green Lacewing Chrysoperla Carnea feeding on an aphid

VENTILATION

PART 2 PRACTICES



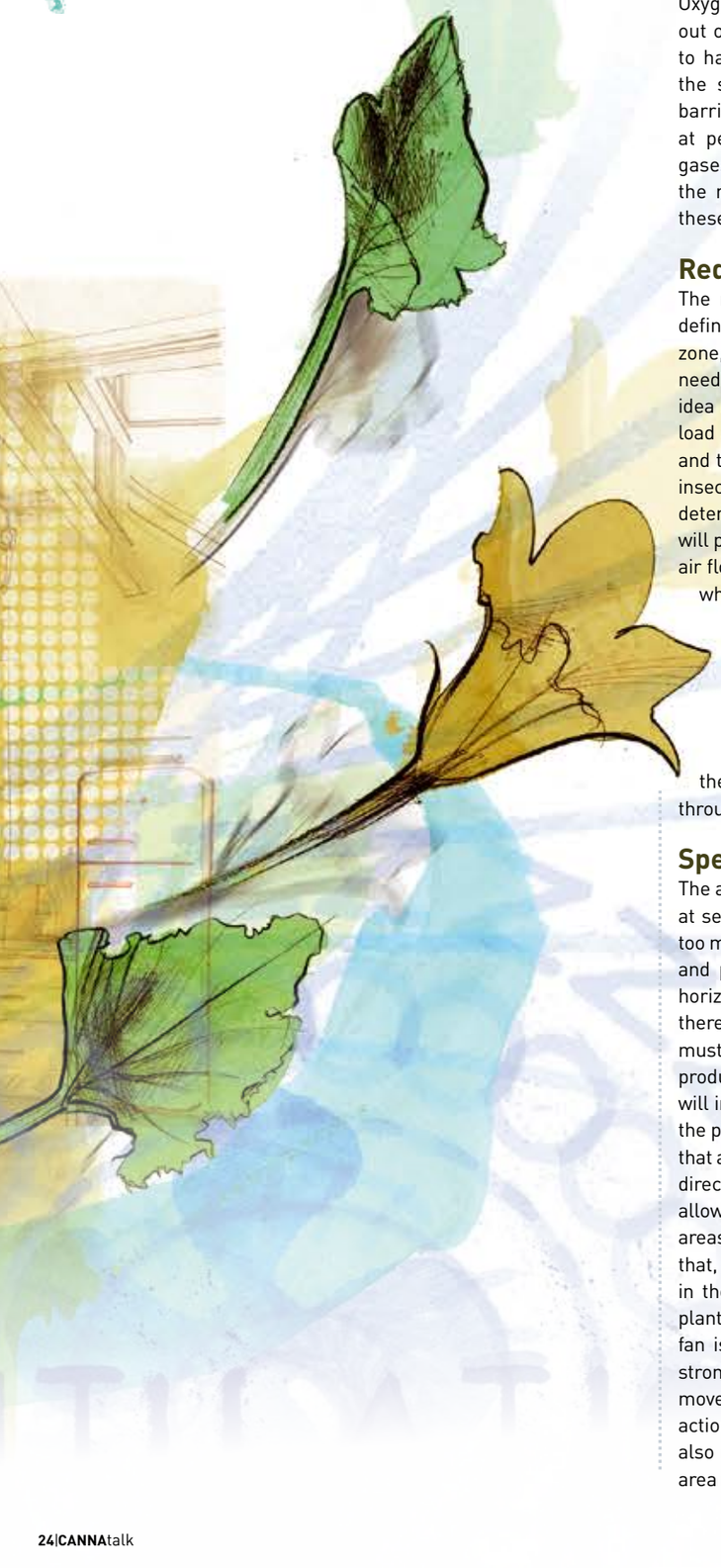
NOW THAT THE BASICS OF THE PRINCIPLES ARE LAID OUT IN PART 1 OF THIS STORY ON PAGE 4, IT IS TIME TO DISCUSS THE DESIGN CONCERNS FOR A PRACTICAL SYSTEM. FIRST THING NEEDED IS TO KNOW WHAT TO DESIGN FOR, WHAT ARE THE INFLUENCES ON THE SYSTEM AND HOW DO THEY CHANGE OVER TIME. AFTER ROUNDING UP ALL THE NEEDED INFORMATION, THE VENTILATION SYSTEM IS DESIGNED AND BUILT ALONG 2 SEPARATE LINES: HORIZONTAL AND VERTICAL VENTILATION.

By Geary Coogler BSc Floriculture / Horticulture

Horizontal ventilation

Horizontal ventilation refers to the movement of air inside a defined area. This is the movement that breaks up thermal layering, quickly redistributes air mixtures, and evens out the humidity levels. In this situation, considering plants are being grown in an environment protected from all aspects of nature, the air itself will take on heat as it moves next to heat sources such as lights, fan motors, and outside walls, and give up heat when moving next to areas and things that are cooler, known as sinks. If allowed to sit without moving, then as they become energetic from the acquisition of heat energy, it will rise and as it loses energy, it will sink, and in the process form layers of like-situated air molecules. This is termed heat stratification, and horizontal movement is required to mix this and allow for even temperature in the area that can be adjusted evenly to cool or heat as the need arises.

VENTILATION PART 2 PRACTISES



Erasing micro climates

The leaf of the plant has micro pores located around it through which water transpires driving the movement of water from the roots to the top and moving nutrients internal to the plant in the process. Plants use both Oxygen and Carbon dioxide as a gas which moves in and out of these pores. It is possible, under calm conditions, to have a backup of these trying to move in and out at the same time. These micro-climates (also known as barriers) have to be erased to allow the plant to function at peak efficiency. To increase the efficiency of these gases moving in and out, horizontal air mixing the air in the room erases these micro-climates and helps drive these systems.

Requirements

The requirements for Horizontal Air Flow are simple to define but less simple to achieve. The air in the growing zone, the area occupied by the plant(s), is the target area needing to be moved. Moving the rest of the room is a good idea but floor circulation at the ceiling will add to the heat load as most of that air is warmer than the growing area, and the floor is liable to harbor more spores tracked in or insects moving in. Also, how the air will be moved is what determines the pressure on the plants this artificial 'wind' will produce. In the end there are really 2 ways to apply this air flow, the first being by the use of air currents produced when removing and replacing the air in the room and the other through a separate, dedicated device such as a smaller fan or the newer High Efficiency Horizontal (HF) Fans that are designed to create a small vortex effect in the target zone. The fact that the air exchange air flow is not going to run constantly where it is also used to affect temperature, and the need for the Horizontal Air Flow is 24 hours a day through the crop cycle, demands a separate device.

Speed level and distribution

The amount of power needed to exchange the air in a room at several times a minute, for cooling, will create entirely too much speed in the air currents causing too much stress and possible damage, to the plants. When using both a horizontal system and a vertical or exhausting system, there can be a cumulative air pressure/ speed effect that must be monitored as well. The ideal speed level should produce a gentle moving of all leaves in the grow zone. This will insure a proper mixing of the air and not uproot any of the plants. Where possible use 2 wall fans in smaller areas that are placed at the level of the plants and face in different directions which will create a rotation in the air mass which allows for the best distribution in the grow zone. In bigger areas, HF fans create a high force but smaller volume so that, while being very effective at creating that circulation in the area, it is not large enough to directly impact the plants and are usually placed so that the flow from the fan is directly above the top of the plants. By creating a stronger vortex just above the plant tops creates the gentle movement in the leaf zone that is desired. This type of action is really impossible with the vertical systems which also must be designed to move all the air in the room or area not just that located in the growth zone.

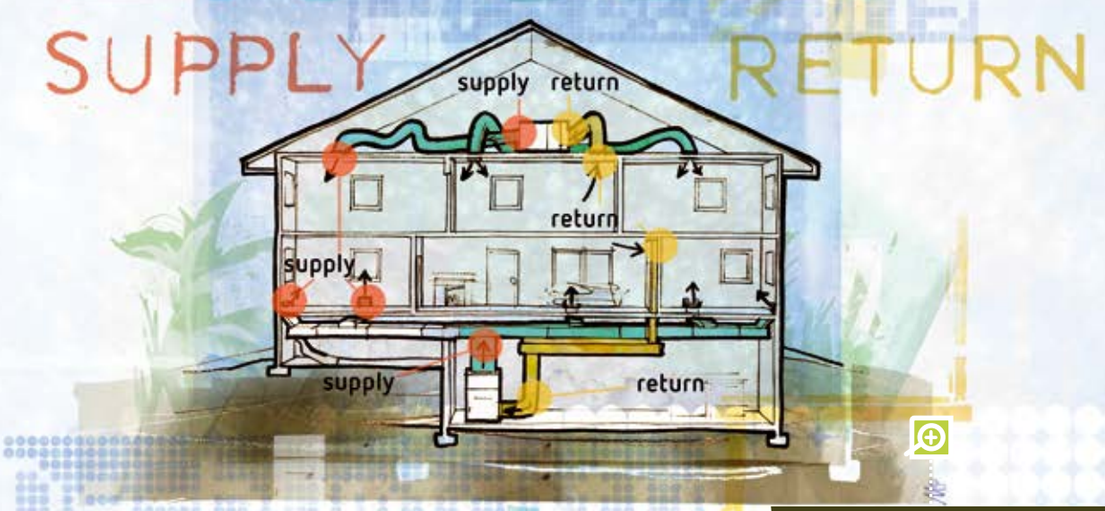


Figure 4: Air supply and return in a house

Vertical Ventilation

Vertical ventilation is a term used strictly in this case to imply air that is moved out of the area and treated to be returned or replaced by air from another location. Unless the designed system supplies and exhausts the air from the floor and ceiling, all air flow is horizontal, so the implication in this system is the air is moved across multi-levels and not across the same level. Air in an area used for plant production must be changed out on a regular basis to avoid many issues. Exchanging the air adjusts the temperature, changes the humidity, and replaces the gases that can be used up in sealed situations, for example Carbon dioxide. While horizontal ventilation will mix the air and thus moderate temperature, humidity and gas ratios by diffusing the changes across the entire room atmosphere, it will not remove or add heat, humidity or replace gases that have been used up. Air exchange is the only real answer.

Open and closed systems

There are 2 ways to view the Vertical system, either open, meaning that either the system draws air from a different area which replaces the air in the target area, or closed, meaning the actual air never leaves the area and is treated in place.

The treatment of cooling or heating, humidifying or dehumidifying and of gas replacement for the air is important in both systems but required in a closed system. Depending on the need of the controls for the environment faced by the growing facility and the needs of the crops produced, the air movement through exchange, in either an open or closed system would determine the exact design of the system.

Closed systems

A closed system would be used in situations where contamination, biological or environmental such as Ozone or other industrial pollutants, needed to be avoided; contact between the environment of the interior and exterior is maintained separately. The area air is removed, treated and returned to the area.

Open systems

An open system pulls its exchange air from an exterior source such as a controlled room or the exterior. It can be treated or used directly to affect change in temperature, humidity, and gas content, or treated to cool, heat, humidify, or dehumidify. This air is then pulled through the area to remove the old air, at a rate of speed that can make a difference. The entire time it is pulling this air out of the room, the factors that caused the undesirable change in temperature or humidity continue to occur. The rate at which this new air can absorb and change or remove these continuing undesired effects plus remove the ones that have built up, determines the needed rate of air exchange. And it must occur fast enough to make a difference. There are formulas for calculating humidity and heat loads and the flow rates needed to affect change.

VENTILATION PART 2 PRACTISES

Designing the system

The designer needs to understand what the heat gain or loss is for the area, usually figured in BTU's or British Thermal Units. Then what BTU's are added or removed to hold or affect temperature and what is the design parameters based on all factors including what the crop needs and what environment the area's system will be working under. Once this is known then the designer builds a system that will be able to hold a given set of values in temperature and/ or humidity based on the difference between the average worst case and where the condition needs to be.

Temperature

If the indoor temperature, for example, under light and in the summer will get to 120° F (49° C) and the maximum the plant should be held at is 90° F (32° C) then the system must be able to affect change for a 30° F (17° C) differential. Heating is the same and humidity is as well although figured differently.

Gas ratio's

Gas ratios in an open system are not really an issue as the ratios will, or should always match what is available outdoors which is always sufficient. In a closed system, it will be required to supplement Carbon dioxide during photosynthesis periods as the existing CO_2 will be used up in a very short amount of time, so fast as to begin to slow down metabolic processes within a couple hours. Oxygen, on the other hand, while used by the plant at normal life levels, is released in heavy enough concentrations during the fixing of the Carbon in the CO_2, as to supply all needed.

What components?

The exact need of the system will determine what components are parts of the system. In a closed system, the ability of the environment will determine if an evaporative cooling system would work well enough or if a HVAC (Heating, Ventilation, and Air Conditioning) unit will be required. The need to move a certain amount of air for these changes will determine the size of the duct work and the fans required. Open systems will work either as directly pulling the air, in whatever state it is in, into the target area. If it needs cooling and humidifying, an evaporative cooling system might be an answer (known as Swamp Chillers, in some locations, and which can also be used in a closed system). The calculations for these type systems should be done and sized correctly to insure that a system is both functional and cost effective. Everything that would affect a system must be known which includes restrictions such as bends in duct work and filters used. It is also usually critical to use fans on both the exhaust and input sides to both insure good air movement as well as balancing the pressure in the room.

Controls

Controls for the automation of these systems are also a big concern and cannot be forgotten in the rush to finalize a system. Unless the grower or a grower's representative can afford to watch a thermometer, a hygrometer, and a CO_2 monitor all day and night, 24 hours a day and 7 days a week for months, there will have to be an allowance for a device to control the operations of the Vertical ventilation based system, open or closed. The horizontal system tends to remain active all the time so a controller is not necessary other than an ON/ OFF switch.

At the simplest, a system will need a thermostat that controls the on/ off operation of a system to control cooling. There will also be the need for one that operates a heat system that may be tied into the vent system. In tight rooms used for growing, a humidistat is also a great idea, one that operates the vent system when the humidity gets above a certain selected level. It might also be desirable to be able to dial in different values for a night cycle, especially in temperature. Some systems, especially at certain times of the year, might require cooling during the daylight and heating at dark, especially in greenhouse environments.

In closed systems, where certain gas products are released to supplement or raise ambient levels, such as CO_2, a gas monitor is also a good idea, especially one that might trigger alarms should the regulation of that gas fail. Adding CO_2, while a positive thing for the crop, can be costly and decreasing in effectiveness if too much is used, and dangerous to employees and growers if it gets too high when people are present. An added value is achieved when the CO_2 controller can change the ventilation pattern so that the gas is not exhausted as it is put in or at a certain time after injection, by a system fighting to hold a certain temperature or humidity.

Keep it simple

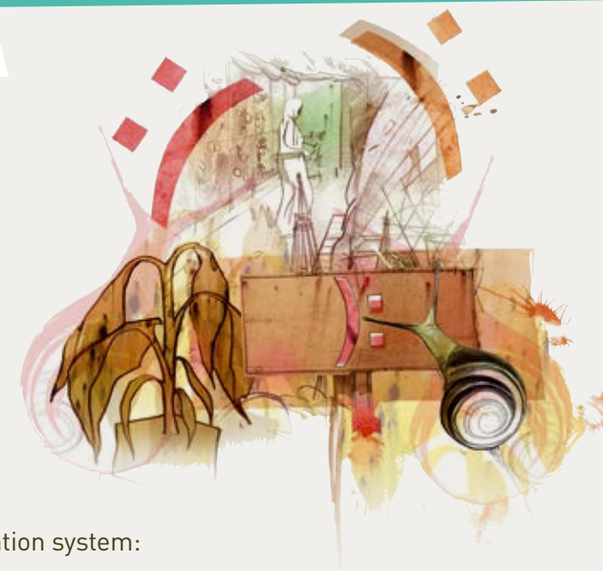
Everything has to work together to be of value or effective for the cropping purposes. It is always best when these controls can be integrated into a single or dual set of controls. It must also be understood that the KISS principle works here as well and the smaller a room, the less complicated the system should be. Also, the less complex controls can be used, and the less complex the less chance for error or failure. Temperature, humidity and gas injection is controlled by the use of set points so that, while a grower requests say a 72° F temperature for cooling, the system will turn on a few degrees warmer and run till it is a few degrees cooler. This allows the system to work more efficiently and strict control is not needed or the system will run all the time clicking on and off within a single degree or less, of change.

Ventilation is not the easiest part of the equation for growing. Ventilation is environmental control and environmental control is one of the largest aspects, most important parts of growing. It cannot be neglected in the rush to produce or in the overall design of the growth facility. Proper care must be taken from the design to the installation to insure function.....and function means success.•

Grower's TIP #31

By your friend SEZ

VENTILATION



When growers ask for advice to increase their yields, they usually get questions in return that are climate related. Knowing that 96% of dry plant tissue is composed of Carbon, Hydrogen and Oxygen; Climate control is no doubt a major factor for high yields.

You will first need to determine the amount of air to be exchanged in your grow room(s) to properly choose your ventilation equipment. Then when it comes to fans, there are many different brands and models on the market. Not to mention the hordes of copycats that mimic looks but rarely provide the power of the originals. For your garden to perform, you need to move air, not dreams. Serious growers always favor buying products certified by credible HVAC associations like « AMCA » along with safety&quality control firms like CSA, ETL or UL. Malfunction of anything related to climate can have disastrous consequences on your yields. Don't cheap out, you might lose way more than you saved!

Three things to consider when setting up your ventilation system:

1st: The CFM number on the front of the box means NOTHING!

That CFM number is usually the maximum measured value obtained at 0 in. wg (zero inches water gauge) meaning no air restriction. This value is useless in the real world, because there will always be air flow restriction caused by ducting, elbows, dampers, etc. Serious fan manufacturers will provide charts indicating real CFM values in relation to air restriction (in. wg). Only with these charts can you best determine what fan size and power you really need. A good idea is also to get fans with more power than needed, as they are easy to dim but impossible to make stronger.

2nd: Size does not always mean performance.

The power of the fan's motor will greatly influence the output of your ventilation setup. You might find two fans of the same size, but one with an 180W motor and the other with a 280W. While both fans may have similar advertised CFM's in free air, only the second one will keep decent output in real world conditions.

Think of it like two Ford mustangs, one with the basic 4 cylinder engine and the other with ford's legendary 5.0L V8. Both will be able to cruise at 100 miles per hour on flat prairie lands, but only the 5.0L will keep that speed going uphill in the Rockies.

3rd: Plan properly.

Keep in mind that each turn your duct run takes has an impact on air movement. Make sure there will not be any unneeded twist and turns and install your ducting as straight as can be.

If energy conservation is a factor, you might want to consider going for the newer « Mixed Flow » fans that, compared to older centrifugal models, are more compact, more energy efficient and more powerful.

Comparison of centrifugal and mixed flow designs*

FAN MODEL	RPM	MAX WATTS	CFMs remaining after air restriction (in. wg)								
			0"	0"	.125"	.25"	.375"	.5"	.75"	1.0"	1.25"
Centrifugal 10"	2760	283	761	761	734	701	665	629	568	505	435
Mixed Flow 10"	2990	228**	1019		985	950	920	885	815	705	535

*Both fans from the same manufacturer **Note how mixed flow designs give more CFMs while using less power

Finally, make sure your climate measuring and controlling equipment is properly positioned in the garden to accurately assess conditions where the plants are. Favor digital controls with remote probes and sensors that can be placed within plant canopy, where it really matters, over wall-mounted models.

Good luck and Happy gardening,

Puzzle&WIN

CANNAtalk wouldn't be complete without a good old Sudoku puzzle. Sit down, relax and train your brain for a moment. It's not too difficult and you could win an awesome prize! Are you new to this kind of puzzle? Here's what to do: each row, column and 3x3 grid must contain all the numbers between one and nine, once only.

WIN A 1 LITER BOTTLE OF CANNAZYM

			3		5	2		9
	4		9	2		8		
3					8	5		7
	5	8		7				
				5		1	7	
6		4	1					3
		5		4	9		8	
9		2	5		6			

PRIZES

You might be lucky this time! Another great prize is waiting for one of you. You just have to send us the correct solution (sending the middle part of the puzzle to editor@cannatalk.com and mention CANNAtalk 31 is enough), and if we pick your name,

A BOTTLE OF CANNAZYM COULD BE COMING YOUR WAY.

Winner puzzle#29

The winner of last Sudoku is **Mr. Campbell.** Congrats on your 1 liter bottle of CANNA RHIZOTONIC.! We will contact you as soon as possible to make sure you receive your prize. Enjoy!

Facts

ANCIENT OCEAN ALGA PRE-SET FOR LIFE ON LAND

A team of scientists led by Dr. Pierre-Marc Delaux has solved a mystery about the first stages of plant life on earth. The team have discovered how an ancient alga was able to inhabit land, before it went on to evolve into the world's first plant. Until now, it had always been assumed that the alga evolved the capability to source the essential nutrients that it needed to survive after it arrived on land by forming a close association with a beneficial fungi which helps plant roots obtain nutrients and water from soil in exchange for carbon. However, scientists were not clear how the algal ancestor of land plants could have survived long enough on land to do this. This new finding appears to show that the alga developed this ability while still living in the oceans. Dr Delaux: "At some point 450 million years ago, alga from the earth's waters splashed up on to barren land. Somehow it survived and took root, a watershed moment that kick-started the rest of evolution. Our discovery shows that the alga already knew how to survive on land even while it was still in the water."

ROOT MICROBIOME ENGINEERING IMPROVES PLANT GROWTH

We have been breeding crops to be bigger and more nutritious ever since the early days of agriculture, but genetic manipulation isn't the only way to give plants a boost. In a review paper published in Trends in Microbiology, two integrative biologists explain how it is possible to engineer the plant soil microbiome to improve plant growth, even if the plants are genetically identical and cannot evolve. These artificially selected microbiomes can then be passed on from parents to offspring. In their own labs, the authors, Ulrich Mueller of the University of Texas and Joel Sachs of the University of California, have successfully used microbiome engineering on Arabidopsis, a close relative of cabbage and broccoli. In the Arabidopsis experiments, bacteria from the roots of the largest plants were harvested with a filter and given to other plants growing from seed. Over time, the plants grew more strongly because of their evolved and improved microbiomes.

PLANTS CALL FOR HELP WITH ODOR

It is only in the past 30 years that we have recognized that plants use odors to communicate with one another and with other species. "Wild plants commonly emit natural odors when they are damaged that attract the natural enemies of pest insects, and even we humans can smell it when our neighbor is mowing the lawn. Odors can carry very precise information," says co-author Martin Heil of CINVESTAV-Irapuato in Mexico. "Agriculture has bred these types of defenses out of crops, and since these odors have no negative effects on human consumers, we want to replace what the plant would already be doing naturally." It's also not unusual for wild plants to produce nectar on their leaves to feed predatory carnivores. When leaf-eating caterpillars or beetles are munching away on plant matter, predatory ants or wasps have a sugary substance to drink and a well-stocked spot to lay their eggs. Heil and others theorize that the reason these rather helpful traits no longer exist in crops is because plant breeders and decision makers in the past did not differentiate between helpful insects and pests. Such defenses involve multiple genes, however, and it won't be easy to bring them back.

DON'T MISS IT

WHAT'S NEXT

The next edition of CANNAtalk will take a close look at two things that most of us growers have been doing for ages, but never knew exactly how. First, our research team will explain everything about taking cuttings. Just taking a pair of scissors isn't enough. Next we'll tell you about watering plants, one thing that can make or break any grower. But how do you get it exactly right? The frequency and the amount of water depend on many outside variables, making this quite a complex subject. Want to put your knowledge into action? The Grow It Yourself is all about rhubarb.

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