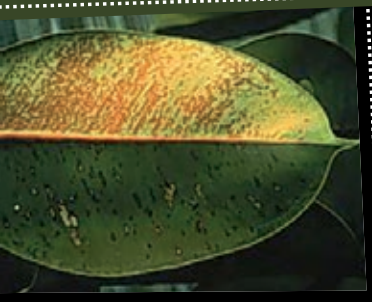
CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

ISSUE 32 2016

H2O: FRIEND OR FOE?

Ultimate watering tips

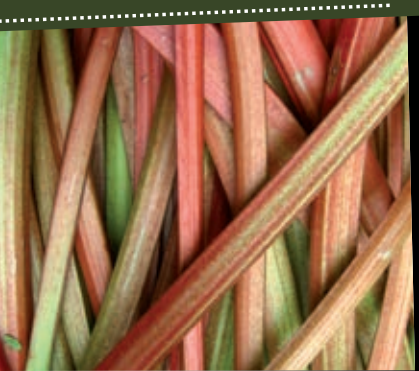


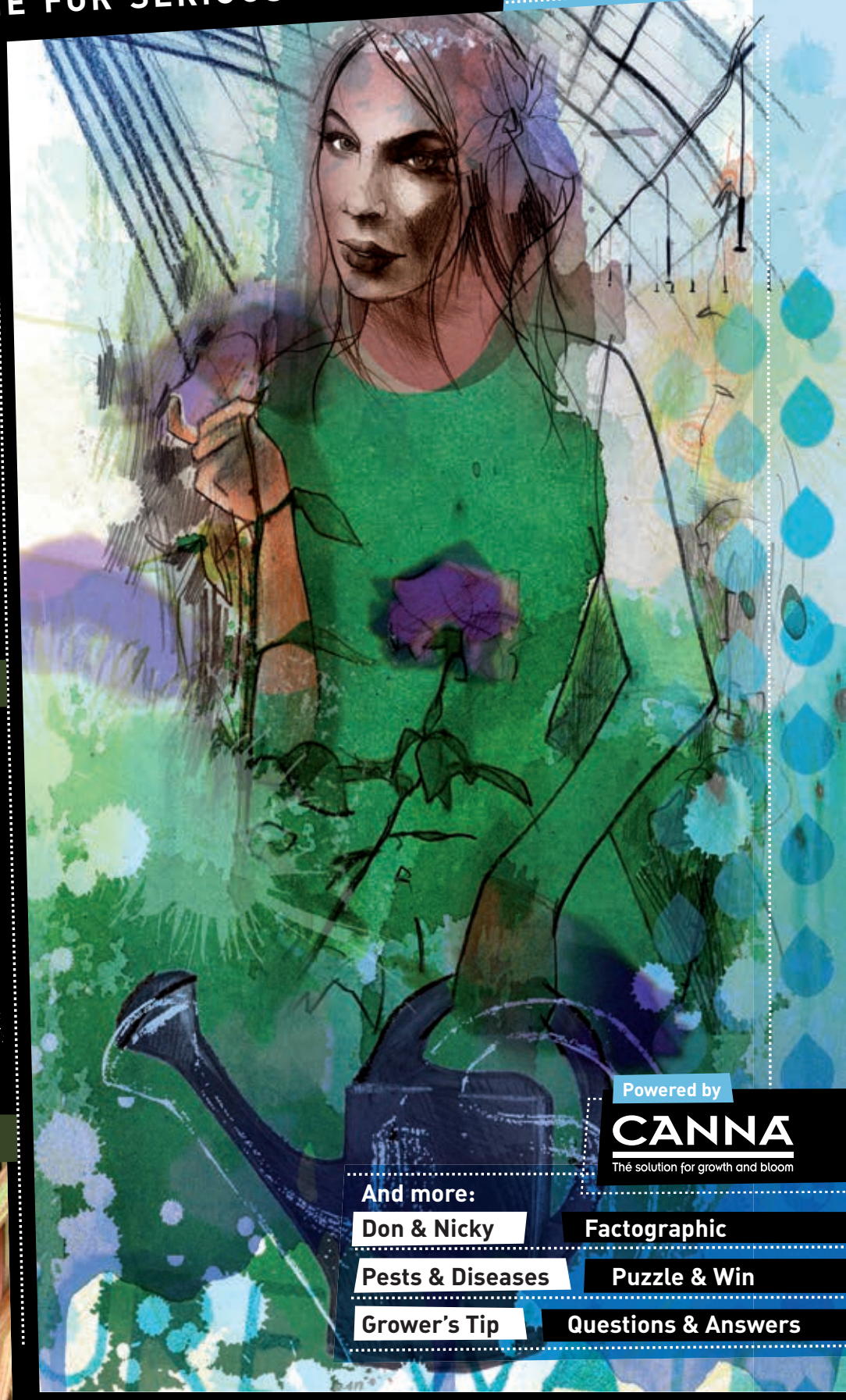
MONSTERS OF VEGGIE

Here come the giants

RAVISHING RHUBARB

It's cool to be tart





And more:

HQTalk:

Water. You got to love it. I think its great fun for surfing and swimming, not to mention floating on. It is a fact that we exist for up to 60% percent of that clear liquid and some plants even up to 90%. It is scientifically extremely safe to say that there would be no life without water. Problem is, we land creatures and plants need water, but too much of it will kill us.

So how much water do your plants need to make them cozy and happy so they reward you with abundance? In our research article 'Thoughts on Watering Plants' we went to the bottom of, well, watering plants through thirty years plus of gardening experience from our researchers. For great results be sure to read their twelve tips on page 26. Your crops might be better than ever tanks to this this issue of CANNAtalk.

You might want to read the article on watering while sipping some bubbly water yourself. May I suggest adding a dash of rhubarb juice to the water? The delightful tartness of rhubarb creates a summery drink so light and refreshing you will start singing happy songs just for the fun of it.

How to grow rhubarb you'll find on page 9 of this issue. But be sure to water them right.

Cheers,

Jeroen

Contents

THOUGHTS ON WATERING PLANTS

PART 1

WHAT IS THE BEST WATERING FREQUENCY TO USE FOR MY SYSTEM? IN MY 30 PLUS YEARS OF WORKING IN THE GREEN INDUSTRY, THIS, OR SOME DERIVATION, IS THE MOST ASKED QUESTION I HAVE SEEN. IT IS ALSO THE HARDEST ONE TO ANSWER. THERE IS ABSOLUTELY NO EASY RESPONSE, BUT ONLY ONE RIGHT ONE: WHEN THE PLANT NEEDS IT. BOTH THE FREQUENCY OF WATER APPLICATIONS AND, TO A LESSER EXTENT, THE AMOUNT OF WATER TO APPLY, ARE DEPENDENT ON MANY OUTSIDE VARIABLES THAT FURTHER COMPLICATE THE ISSUE, THUS REQUIRING THE GROWER TO MAINTAIN AN 'EYES ON' APPROACH IN HIS OR HER GROWING TECHNIQUES.

By Geary Coogler BSc Floriculture

This is the one area in the growing process that makes or breaks a grower. Once we moved out of a natural setting into one of our own design, and began demanding the best performance from those crops we produce, we opened the 'Pandora's Box' of growing. We fundamentally changed water relations between the plant, the medium, and the grower. To fix this problem, the industry has developed a wide variety of mediums and systems that work well with the change. The question 'Which one is right for you' is answered entirely on the type grower you are. Understanding how the pieces act when they come together will give you an indication in what method should work best with your style. We modify our approach to watering to adjust for all the variables our plants may see that are unique to our growing situation, and we will achieve the best results possible. The one variable we cannot adjust for is a grower that does not adapt his or her growing techniques, or design his/her production system around those limitations.

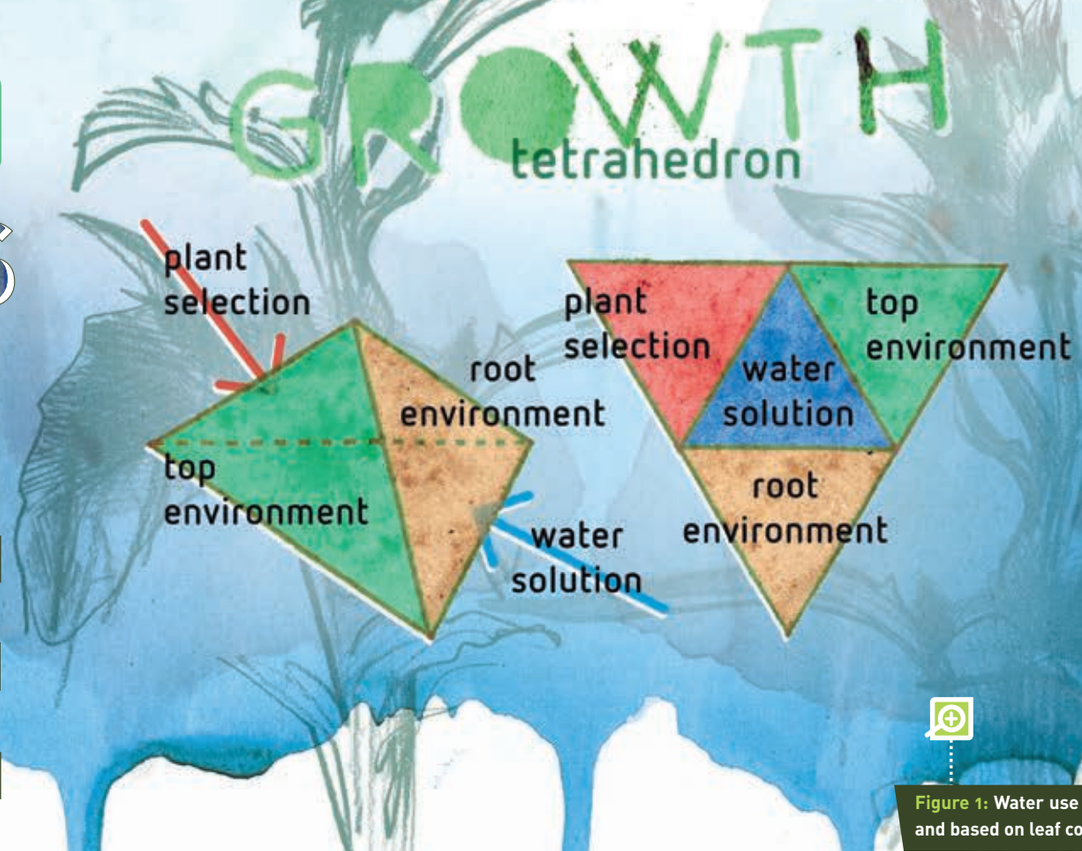


Figure 1: Water use in a square meter is equal and based on leaf coverage not plant count.

Defining the Issue

To begin our discussion, on watering and not concerning ourselves with correct nutrients at this point only EC as a relative value, we want to keep a few things in mind. (EC is Electrical Conductivity or the ability of a solution to conduct an electrical charge which increases as the concentration of salts increases: see CANNATalk 12). To start with, the general water usage for 1 square meter of established plants with 100% canopy (leaf) coverage of that square meter, under high light conditions are 4-6 liters/ m2/day. We use, as a general rule of thumb, the figure 5 liters per day in computing system requirements. This is true whether there is one plant or 15 plants in that square meter, as long as the canopy covers the entire m2. Water usage for new plantings through early establishment will range from 3-4 liters/ m2/day. These values are under optimal conditions of **humidity, temperature, air movement (circulation), light levels,** and **root zone salinity**, five important variables we must keep in mind when designing our irrigation strategy. Yes, based on individual plant species and/or variety, there

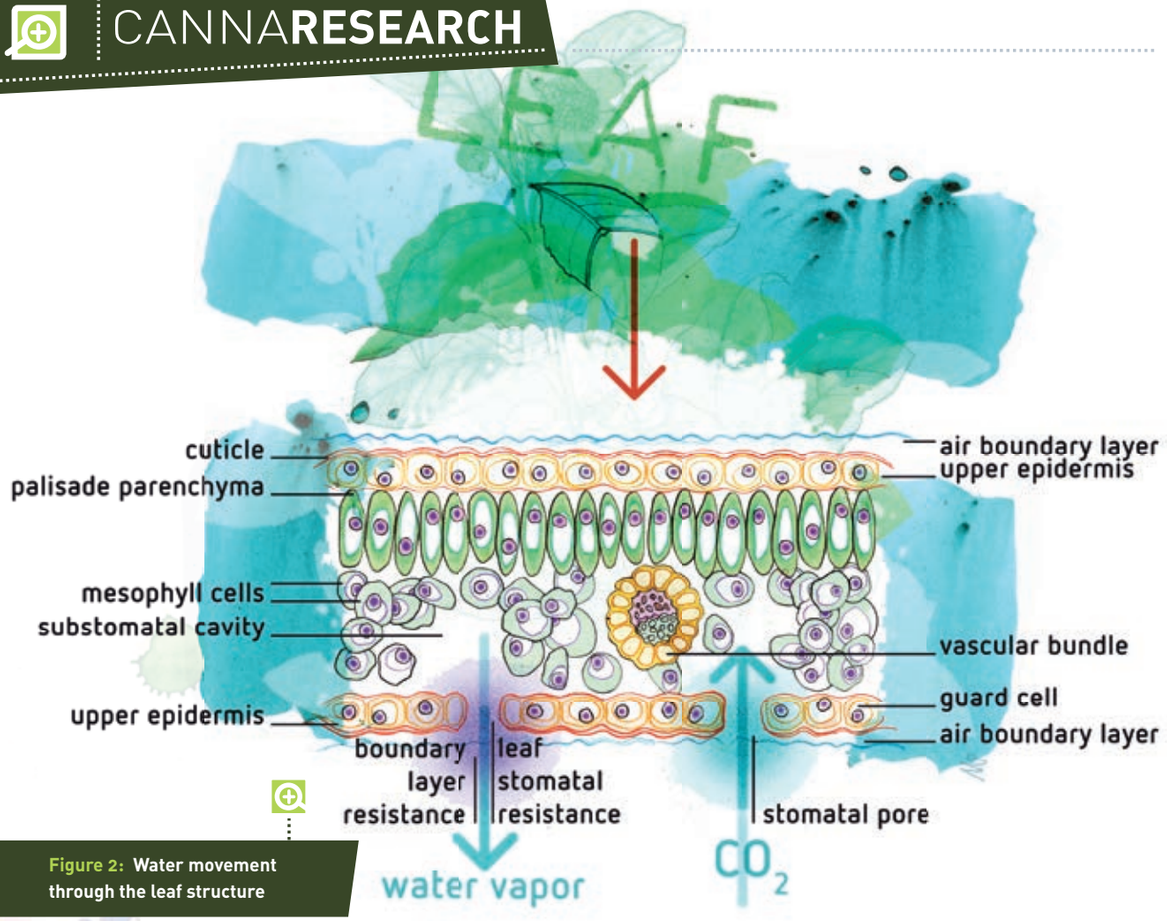


Figure 2: **Water movement through the leaf structure**

are optimal levels for these items. Let's look at each variable briefly as every grower has to determine, for themselves, these levels. The information is available out there for most all commercially or privately produced crops and plant classes. There are also extremes in nature, a water plant wants its roots covered with water all the time, cacti may want to see the permanent wilting point of most plant species before watering (but still watered regularly), bromeliads and orchids may not have roots at all and depend on high humidity: however the vast majority of plants do not exhibit such extremes. *(See figures 1 and 2).*

Factors

If we look at these variables in terms of a finely tuned automobile, Humidity is the braking system for the energy production cycle in a very noticeable way and in cellular respiration in a less noticeable way. The water transportation mechanisms of the plant are driven at the leaf by water evaporation. This performs four main functions, to supply water for direct usage by the plant cells, to transport nutrients and other essentials like hormones and carbohydrates around the plant, to cool the plant, and to provide structure through turgidity. If water does not evaporate or does so slowly when the air is near saturation or 100% humid (brakes on), the plant does not cool properly, nutrients do not arrive on time at the sites where they are transformed into cellular components, production at the cellular level drops off, the plant begins to shut down, and so on. If the humidity is very low (brakes off, engine full throttle, pointed downhill), the water supply cannot keep up with the need, and cells become damaged from dehydration and proteins breaking down in the cell wall, a condition we sometimes confuse with salt burn or a nutrient deficiency. While mostly a function of non consistent watering practices or some pathogens, oedema (edema), or very small blisters that form on the leaf surface then burst and become brown dead tissue, can be caused by humidity relations. Correct humidity (car on cruise control) is essential in insuring the plant moves the optimal water level, night or day, to perform all the tasks it needs.

Temperature drives the system. Optimal values are again related to plant species, but in any species temperature serves to govern the speed at which various processes can occur. In the presence of light, the interior of the leaf (mesophyll), a wonderful light focusing element (a light sponge basically), will run several degrees higher than the air temperature. The chemical reactions that are a living plant cell are influenced by various things from the availability of component building blocks, to the proper chemical catalysts being present, and the entire system is affected by temperature. Too cool and the system slows to a stop, too warm and it speeds out of control to a point it just shuts down, just right and cellular metabolism perks along nicely. It influences the rates of evaporation and subsequent water usage as the plant tries to cool itself through its stomata, or specialized openings in the leaf surface that allows for the evaporation of water and the exchange of gases like CO^2 and oxygen. In fact, 90% of the water used by the plant is through evaporation. When the temperature gets too high, the stomates (stoma) close, water movement stops, cellular activities cease and the plant cooks.

Micro climates can and do form around the surface of the leaves; these then have different levels of humidity, temperature, and gas concentrations, such as CO^2, than ambient air. Carbon Dioxide (CO^2) will be less available at the stoma for use in sugar production. Humidity will be higher, and because heat is coming off the leaf, the temperature will be higher as well. Proper air circulation insures these microclimates are limited in size and duration. Water evaporation will consequently be higher and our engine (the plant's systems) will run nicely.

Light is the spark for the energy production engine of the plant. It is making the storable energy that will be used to turn CO^2 and water into carbohydrates which is how plant components start their life. The greater the amount of energy packets of light that are delivered to the surface of the leaf, lumens, the closer the engine gets to wide open. This is true up to what is known as the light saturation point, the point where enough energy packets are being delivered to satisfy all the energy 'receptor' sites, (Yes Virginia there is a maximum value). The closer we get, the faster the engine runs, the more water is consumed through usage and cooling as this is a warming process (endothermic). Ultimately these carbohydrates are utilized in a different system where, in the presence of oxygen, it is made into all the other things a plant needs, respiration. This process actually gives off some of the heat it stored (exothermic). Yes plants use both CO^2 and O^2 in the course of a day.
Actually the only time it uses CO^2 is during the light cycle, but oxygen is used all day at fairly constant values. (Additionally, all carbon that is assimilated by a plant comes from the leaf and CO^2). The higher the light level, the higher the water usage and vice versa. A plant that is considered a shady plant will not need to use as much water, in fact will not be as efficient at moving it.

Finally, **root zone salinity** (We will use the term **EC**) is the fuel and the sludge in the gas tank, a simple but probably effective comparison. Water moves into the root cells, then is passed along through other cells until it reaches the xylem transport vessels and is moved, ultimately, to the leaves. Initially, water moves from the root zone across a semi-permeable membrane, which limits the size of any particle that can move through it. The water is forced to move from the epidermis into the stele (the inside of the plant) through the cytoplasm of the endodermis cells by the casparian strip. They will then regulate water uptake. Larger nutrients in ion form are brought across those same membranes by various active transport mechanisms. This is much like Reverse Osmosis filters which work by using pressure to force water molecules through a membrane but blocking larger molecules. Small particles like a water molecule or a potassium ion will pass through the holes but bigger items like calcium will not. The plant cell utilizes a simple physical law of equilibrium more than pressure. *(See figure 3).*

The Mechanics

In effect, if you take two containers of water, one at a high EC and one lower, and connect the containers with a tube, after a little time, the two EC's will become identical. Ions will move from one tank to the other till they balance. If I put a membrane between the two containers that allows only water to pass, then water will move from the container with the lower concentration to the higher concentration side in an attempt to achieve equilibrium. Actually water is the only thing moving here in both systems, but it carries along the ions until they equal out. This effect will create a greater pressure on the higher EC side of a membrane called osmotic pressure, but only enough pressure to overcome this osmotic movement of water, the greater the difference between outside EC (low) and cellular EC (high), the higher the values. *(See figure 4).* This can be enough, when combined with the entire root mass, to move water (sap) vertically in the xylem tubes near 100 feet in some species, very noticeable in the spring with species like Sugar Maples. Remember, a large part of the journey has already occurred getting from the root tips to the start of the above ground section. The system then depends on a 'sink', or area of under-pressure ahead of a column of water, being created inside the water transport vessels (xylem vessels), which is caused by the evaporation on the other end, at the leaf. This moves the water entering the root cell, through the cortex and into the transport tubes, xylem tissue, and on to each cell up the line. It is

Figure 3: **The basic idea in Reverse Osmosis is to pass water through a membrane leaving almost everything behind. Plants do this by natural forces involving gradients. This machine does so by forcing the water through the membrane.**

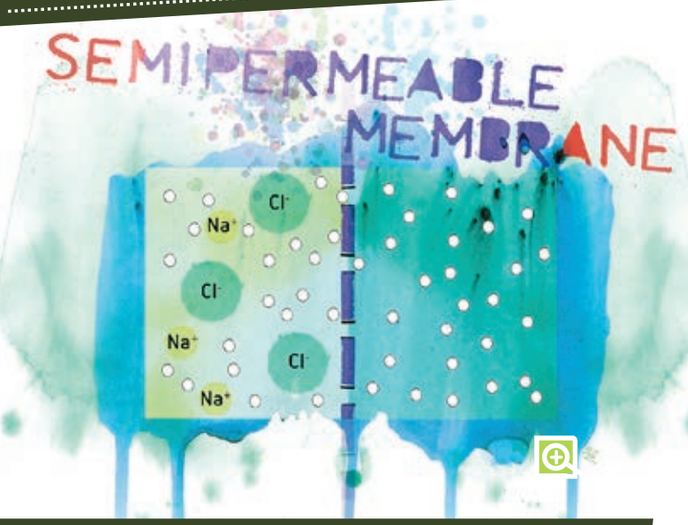


Figure 4: The effect of the plant cell semi-permeable membrane; it allows water to move from and area of higher concentration to one of lower concentration, but blocks the passage of almost everything else.

the same effect with a soda straw, an area of negative pressure, suction (evaporation at the leaf), is created ahead of the column of liquid (in the xylem of the plant), causing the liquid to lift.

If the EC values are the same outside and inside the root cells, very little water will move. Water only enters the root cells in response to this gradient. If the values are lower outside of the root cell, then the water will successfully move into the plant cells as long as the plant is 'requesting' it through an active 'sink'. If the EC level is higher outside the root than inside, the effect is reversed and water flows from the plant to the outside. This is where salt burn occurs and why. As I add more water to the system and it is pulled into the plant, anything not water or not used by the plant, like sodium, is left behind. Even plant essential ions like calcium, unless the plant needs it and brings it inside through an active process, stays in place thereby increasing the EC of the media faster. The important thing to take away from this is that as EC increases towards the maximum limits, or cellular EC values, then water rate of movement slows to the point it halts and will then reverse as the EC level of the medium continues to rise. (An interesting aside, this is why it does not always pay to pump the upper limits of EC to a plant, it may be that I can move more water and consequently more nutrients to the utilization sites by feeding a medium range nutrients and improving the efficiency of my overall system for growing.) By holding proper EC values on the root surface, in the water, or on the soil particle, I insure that my engine runs clean and is working at peak efficiency.

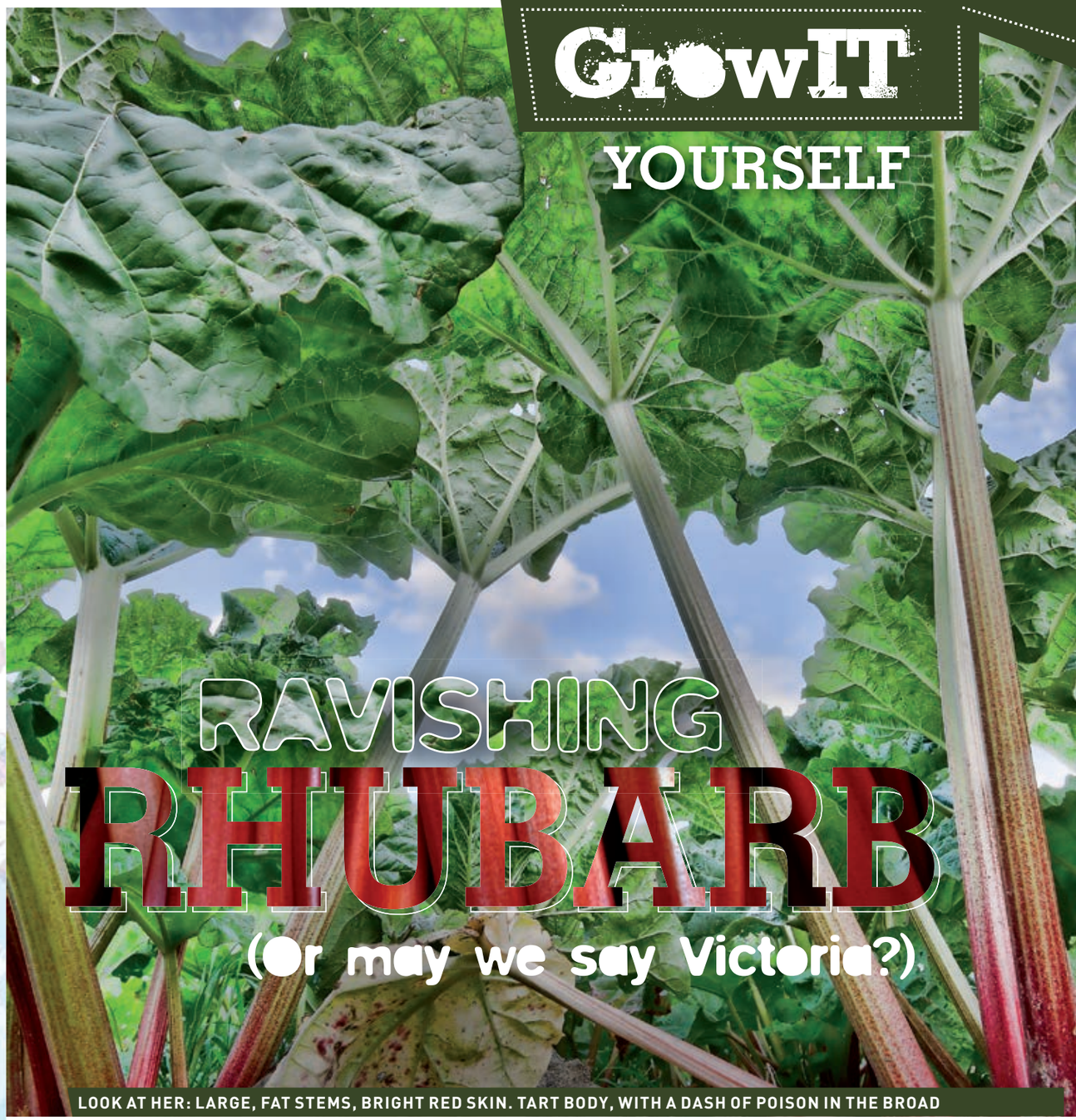
We have probably all seen this effect, but maybe you did not draw the correlation. We should all know that in areas with high EC values in the irrigation source water where the addition of fertilizer can raise the overall irrigation water to very high EC values, we should hold the crop a little wetter. These are borderline problem rates. If you run the plant too dry, although acceptable, you can see burn. By holding them a little wetter, you can avoid this, but maybe it shows again next week, so you leach to remove the salts. Problem is, now you are holding the plant as wet as it will go, you can't let it get dry, so your margin for error has disappeared. Any deviation now causes problems. Under high salt or EC regimes we notice that the plants get harder, the color can go much darker, but the leaves always seem to have a wilted feel to them pretty much all day and really showing about 5 hours into the light cycle. Now that we are over-watering slightly, we are killing roots so nutrients and water are slowing in uptake and the plants start wilting and yellowing. So we water more often feed heavy and it gets better; but no, it goes bad again!

What we are doing here is running high EC values, and to compensate for the slow down in natural water uptake through the osmotic gradient between the roots and root environment, we increase the pressure in the system (hydrologic pressure) by keeping water in the large pore space longer, as well as temporarily decreasing the EC in the media. Up the pressure, up the water movement across the membrane, fix the plant. Up the water, kill the root hairs and increase the EC again, problem returns. Up the water again, the roots rot, water uptake stops and the plant fries. Use a good low salt indexed fertilizer to avoid this and leach occasionally (always with a water soluble fertilizer and always follow up immediately with a full strength feeding, unless using a dry fertilizer), and use an EC meter insuring that you stay inside the boundaries for EC, especially in areas where irrigation water is a concern.

So, these variables, humidity, temperature, air circulation, light, and root zone salinity are the really important effectors of total water used in the system. If all of these variables are at the correct values, in that square meter, given a high light plant, your water utilization should average between 4 and 6 liters of water per day. Other things can play a role such as disease but we are considering all values as being good. Now, keeping in mind these five environmental factors that affect both the total amount of water needed and the frequency of applications, we will jump off into the process.

Final Considerations

There is one overriding consideration the grower must strive to make in a correct irrigation strategy, Consistency. All plants in a particular situation have a proper point of watering; you can keep it a little dry or you can keep it a little wet, but I guarantee you will have problems where you are holding your plants wetter for a week and then you start running it drier, or the other way. Be consistent when you apply water, as close as you can to the same point each time. This is not to say it is ok to over-water the plant all the time or never water it at all; there is a correct point at which to water. Continue to Part II, **on page 22** in this issue, for determining the correct point to water.•



RAVISHING RHUBARB

(Or may we say Victoria?)

LOOK AT HER: LARGE, FAT STEMS, BRIGHT RED SKIN. TART BODY, WITH A DASH OF POISON IN THE BROAD LEAVES. AH, VICTORIA RHUBARB. SHE IS THE DAME AMONGST VEGGIES. READY TO GET ACQUAINTED?

By Marco Barneveld, www.braindrain.nu

When a new king or queen rises to power it usually unleashes a tidal wave of commemorative memorabilia, mostly meager mementos and tacky tidbits. But when Queen Victoria put her behind on the throne there was a true standout: a startling new variety of rhubarb that was like nothing anyone had ever seen before. That's right. Rhubarb or as the scientists call it: Rheum Palmatum. A veggie, not a fruit mind you.

Although this plain, unassuming vegetable had been a staple of British cooking for some time, it wasn't until 1837 that the plant truly took the English-speaking world by storm. In fact, the introduction of this quirky coronation

commemorative marked the beginning of what would be a long and passionate love affair between the Victorians and rhubarb. That, and the fact that new overseas colonies made sugar more readily available.

Apple-gooseberry flavor

Several species of Rheum filtered through to Europe in the Middle Ages from China, where the root had been used medicinally for centuries as a purgative. But this variety, dubbed 'Victoria', established the gold standard by which to judge good rhubarb: large, fat stems, bright red skin, lack of stringiness, and a tart, apple-gooseberry flavor with a hint of lemon or grapefruit (depending on your soil). Used in everything from jams and fruit tarts to soups and sauces and yes, even ice cream and lemonade. Some might call it excruciatingly sour, which it could be, if not prepared to its greatest advantage. Sugar helps tartness, but Victoria Rhubarb's ancestors did not just come with that one easy problem.

How about poison, for instance. The broad, flat leaves are terribly poisonous, packed as they are with toxic levels of oxalic acid. On no account eat the leaves. Some, though harmless, is still present in the stalks. That is why your teeth feel oddly furry when you eat rhubarb.

Runaway smash

The edible stalks, though tasty enough when stewed with sufficient amounts of sugar, would still be stringy and tough before Victoria, depending on growing conditions and other uncertain variables.

The introduction of the Victoria variety put a stop to all that. Victoria Rhubarb was the rhubarb the 19th century had been waiting for. Easy to grow, reliably robust and consistently sweet and tender, Victoria Rhubarb was a runaway smash hit from the start. And the Victorian obsession with rhubarb had truly begun.

The cult of Victoria Rhubarb soon took on mythic proportions, and even the harvesting of the plant was shrouded in mysterious and romantic overtones. It wasn't long before British farmers discovered that the sweetest crops were generated from the practice of "forcing" rhubarb: by cultivating it in complete darkness under carefully controlled conditions. Because any strong light could damage the plants, harvesting was conducted at night, by torchlight.

Healthy lady

Although there is still a bit of oxalic acid in the leaves, one of the main reasons why people cultivate and eat rhubarb is actually for its astounding nutritional value. Rhubarb is packed with minerals, vitamins, organic compounds, and other nutrients that make it ideal for keeping our bodies healthy. Some of these precious components are dietary fiber, protein, vitamin C, vitamin K, B complex vitamins, calcium, potassium, manganese, and magnesium. In terms of organic compounds, rhubarb is a rich source of polyphenolic flavonoids like beta-carotene, lutein, and zeaxanthin, Now, let's see how those components add up to the long list of health benefits that lady Rhubarb can impart.

Some of the health benefits of rhubarb include its ability to aid weight loss, improve digestion, prevent Alzheimer's disease, stimulate bone growth, avoid neuronal damage, increase skin health, prevent cancer, optimize metabolism, improve circulation, and protect against various cardiovascular conditions.

Let's zoom in on two of these. Rhubarb is extremely low in fat and cholesterol, the vegetable poses no threat to cardiovascular health, and it can actually increase the levels of good cholesterol due to the presence of dietary fiber, which is known to scrape excess cholesterol from the walls of blood vessels and arteries. Furthermore, the impressive amounts of antioxidants in rhubarb ensure that free radicals don't cause heart disease and a wide range of other dangerous health conditions.

Looking to lose that little extra fat? Rhubarb is one of the lowest caloric vegetables on the market, and as such, it is often recommended for people who are struggling to lose weight, but still want to remain healthy. 100 grams of rhubarb contains only 21 calories, so feel free to load up on the rhubarb without packing on any pounds. The impact that the various organic compounds in rhubarb have on the body's metabolism can also dramatically increase the rate that the body burns fat, thereby helping you lose weight in another way. But watch out with the added sugar.

Grow it yourself

Rhubarb is probably one of the most adaptable garden crops you can grow. She deserves a place in anyone's plot. In return for minimal attention and skill she will stay happy and cropping for a decade or so, and provide the first 'fruit' of the year by some weeks.

The plant is tough and unfussy, but performs best in rich, well-drained soil in a sunny, sheltered spot. A young container-grown plant can be bought and planted at any time of year.

Plant her roots with the crown bud 2 inches below the surface of the soil. Space the roots 36 to 48 inches apart in rows 3 to 4 feet apart. Good garden drainage is essential in growing rhubarb. Planting in raised beds ensures against rotting of the crown.

Refrain from picking in the first year and harvest only lightly in the second to allow the plant to establish properly. After that, stalks can be harvested from April. Grasp them at the base and pull with a little twist, rather than severing them with a knife. Always leave half a dozen: completely stripping a plant weakens it. Stop picking in early July to allow the plant to recover and reward it with a liquid feed. Follow this with a heavy dressing of manure or compost each winter.

Getting hungry yet? The deeper the red, the more flavorful the stalks are likely to be. Medium-size stalks are generally tenderer than large ones, which may be stringy. For storage, first trim and discard the leaves. The freshly harvested stalks can be kept in the refrigerator, unwashed and wrapped tightly in plastic, for up to three weeks

Force it yourself

Remember we told you about forcing? Reminder: darkness and protection from the elements produce blanched growth that is also sweeter and tenderer. These pale pink stems are yummy.

To force your own, simply cover a mature rhubarb crown with a thick layer of straw for insulation in January or February, and then place a big bucket or bin over the top (only force one year in three to avoid exhausting the plant). The moment when the bin is removed to reveal its gleaming contents is always rather magical. As a treat, may we recommend dipping them in sugar and eating them raw? Or try this fool!•

RECIPE EAT FOOL!

No, we are not calling you names. We wouldn't dare. Fool is a traditional English dessert that was popular throughout the 19th century on both sides of the Atlantic. This version calls for sweetened Greek yogurt and whipped cream in place of custard, which lends the dish a delightful tartness.

- **Start to finish: 2 hours**
- **Servings: 8**
- **2 cups rhubarb, roughly chopped**
- **1/2 cup sugar**
- **1 1/2 cup whipping cream**
- **16 ounces Greek yogurt**

Place the rhubarb in a pan with the sugar over low heat. Simmer, covered, until tender. Uncover, turn up the heat to medium and allow some of the juice to evaporate. Set aside and cool. Whip the cream until it forms soft peaks, and then carefully fold in the yogurt. Loosely swirl in the cooled rhubarb and chill in refrigerator for at least an hour. Dig in.

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 have a question about the shelf life of Coco A/B product. I have a 5 Liter can CANNA Coco A/B with over 50% left and the use by date is next month. I want to give my plants the freshest nutrients. If we accept that the nutrients have been stored in ideal conditions, how much longer after the use by date would you recommend using the nutrients?

Answer

CANNA COCO A+B contains mineral ions and chelated Iron. The minerals you can keep forever as long they don't crystalize (seen at the bottom). The organic chelate, however, will break down over time by UV light. Under normal circumstances the shelf life is guaranteed for 100% availability until that date. After the date the chelate can and will break down and the iron will oxidize becoming rust and sinking to the bottom

As long as nothing is seen in the bottom, the product is OK, even after the shelf life date. Always shake the bottle, even when you don't use them, to make sure the minerals stay in solution and avoid crystallization. Store at the room temperature and avoid light.

Question

I use your products all the time and have been growing for 2 years. Recently I have a problem with my 4/5 week healthy clones going into shock after transplanting into larger containers.

Do you have a product that would help recover them?

Answer

CANNA RHIZOTONIC should do the job!

Transplanting is a difficult stage for the plant. Many roots die back once exposed to the drier air, including the beginning root hairs, and it can take 3-5 days to recover. Too much water during this time, from the larger container size or over application, can lead to root rot and other problems causing the situation to get worse.

We recommend that you reduce the light level by applying a light shade, reducing the number of lights, or by increasing the distance of these lights to the plants. This will also help reduce transplant shock. As soon as the leaves are standing up again, you can remove the shade or reset the lights for normal growth, but do so right before the dark period for a bit of a transition stage. When the leaves are ridged again (standing up), the roots have begun to function once more providing lots of water for the top. RHIZOTNIC will speed up that recovery reducing the number of days and hours for recovery.

Question

I just bought a bag of CANNA Terra Professional Plus soil. My question is when should I begin using the Terra Vega nutrient or should I not use it?

Answer

The first time you wet the substrate you can do so with plain water, but we do recommend using some nutrients to make sure the ratio of the nutrients in the TPP (Terra Professional Plus) stays where it should, and that all elements, even those that do not attach to holding sites, remain readily available to your plant.

You can find the dose recommendation on: www.cannagardening.com/growguide. Here you can create your own personalized feed chart.

Question

I want to grow my plants organically in an ebb and flow hydroponic system. Can you tell me what products I need to buy please and if these products would be good for this system?

Answer

You will need BIOCANNA nutrients (Bio Vega and Bio Flores) with the BIOCANNA additives (BIORHIZOTONIC). These products are acceptable organic input materials. This is checked by OMRI and the C.U. (independent institutes) and certified through many different organic programs. You will also need an organic peat based medium. An organic nutrient can be used for a ebb and flood system, but organic nutrients will start to decompose quite rapidly once they are mixed in water (max. 1 week), so you will not want to make too much stock solution. We also recommend using a high (tall) and narrow reservoir (tank) to limit air exchange.

Question

I have been using the TERRA line now for 4 years and it has always been excellent. My room is spot on etc., but I just got a problem with about 10 of my plants. They were all lovely and dark green in veg for 4 weeks, then I switched to 12/12 and after about 2 weeks I noticed about 10 of them were a lighter shade of green, weren't doing as well as the others and not drinking as much.

I just checked the run off from the pots and its right down at pH 4.7. I can't understand why because I always pH my feed to 6.1, checked with an expensive pen. It has all Canna.... Vega , Flores, Rhizotonic, Cannazym, etc., and all in canna terra pro plus soil... any ideas?

Answer

This is strange indeed. In the vegetative period, with the uptake of nutrients, the pH will rise.

As soon as you go into flower, the pH will go down by the uptake of potassium. The TPP soul has lime in it to compensate for that root activity and will keep it at 5.8 - 6.2

So what could have gone wrong? These are some things you can check or do to fix the issue.

1. A problem with the liming of the TPP soil

Check the pH of the TERRA soil, it should be around 6.1 new. Send us the batch code and we will check our sample of this batch. I don't think this is the issue because we check these values across many samples before accepting them.

2. You re-used the TERRA soil and the lime was used in your previous growth.

Try to get some lime into the TERRA soil without damaging the roots (1 gr / L TERRA). Buy new one next time.

3. Microbial life is affecting the pH results.

There is algae or bacteria living in you reservoir or where you captured the run-off water in. Make sure these remain clean. Make sure you measure the pH direct during run off of the water.

4. Check your pH measuring equipment (calibrate often with the full range suggested).

Be advised that pH tips must be changed often and that pH pens can be extremely variable in accuracy even with proper calibration, even with expensive units. Try to verify with another calibrated pen.

Also, you must understand that any changes to the plant, including day length, will affect the roots. During the change in light, the roots slowdown in function as the plant requests less while structure modifies and growth slows a bit. If these plants were even slightly over-watered or if they went from being held correct and then wet with the slowdown then the medium remains wet and the pH will fall as more anaerobic things happen such as a build-up of Ammonium, and then the pH will drop.

Additional issues that will affect both pH and the symptoms you are seeing is the regular addition of "beneficial microbes". The build-up of these creatures allows this process to hasten while the microbes out-compete the plant in consuming the same nutrients that the plant needs. If you must add them then add once at the start.

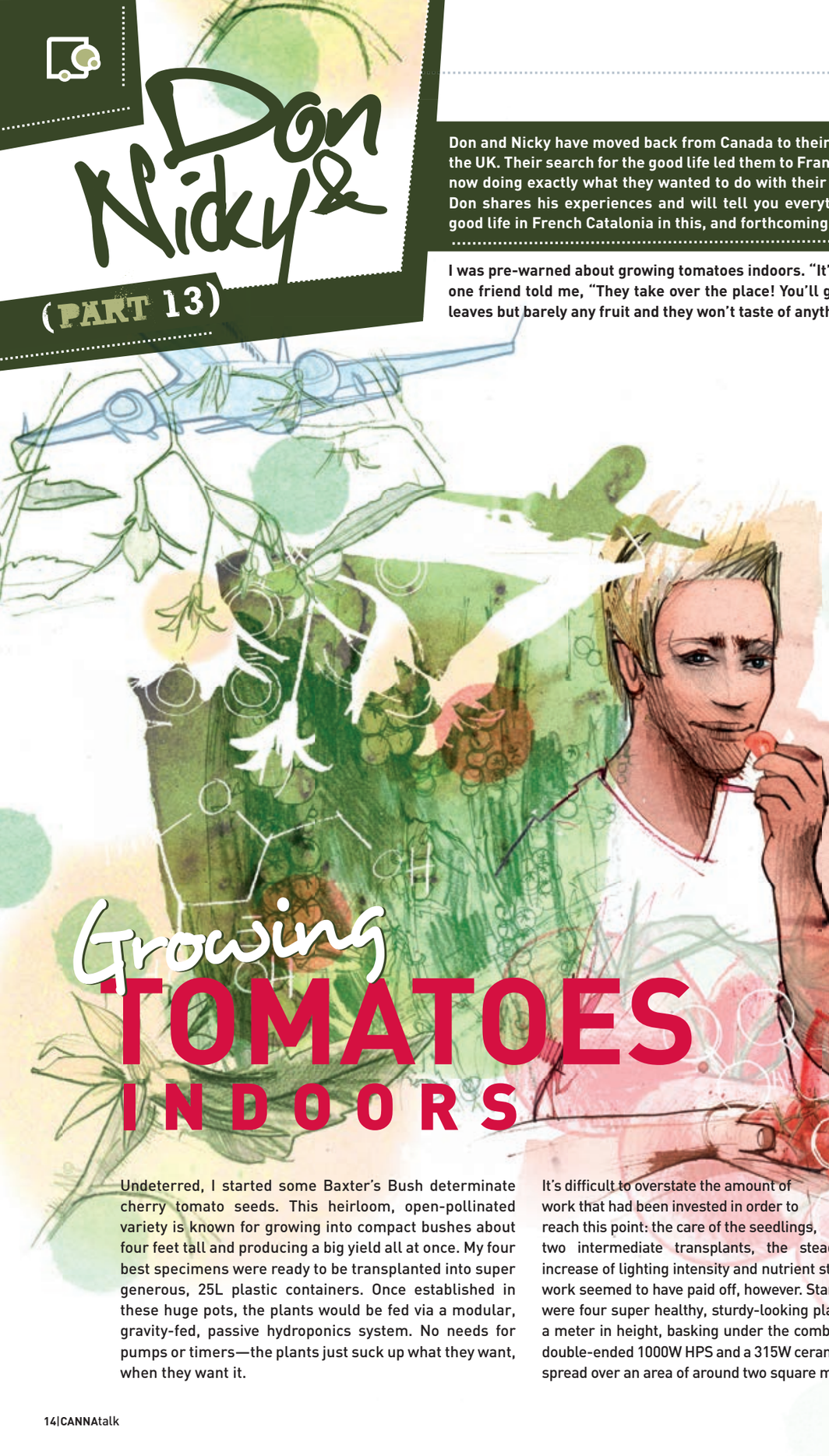
Flush with water that is pH adjusted to a higher level. Then follow up immediately with a full nutrient feeding. On TERRA (with low pH), it will not be strong enough to lift the pH in the substrate, but during change from high pH to low pH, the plant can take up some nutrients. Otherwise, this is about all we can think of. If the problem persists, then you really should use the technical form on the CANNA website (www.cannagardening.com/contact/research) and indicate all the room conditions and anything that might affect the plant. The fuller picture we have, means a better answer for you.

Don & Nicky

(PART 13)

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 was pre-warned about growing tomatoes indoors. "It's really tricky," one friend told me, "They take over the place! You'll grow a jungle of leaves but barely any fruit and they won't taste of anything!"



Growing TOMATOES INDOORS

Undeterred, I started some Baxter's Bush determinate cherry tomato seeds. This heirloom, open-pollinated variety is known for growing into compact bushes about four feet tall and producing a big yield all at once. My four best specimens were ready to be transplanted into super generous, 25L plastic containers. Once established in these huge pots, the plants would be fed via a modular, gravity-fed, passive hydroponics system. No needs for pumps or timers—the plants just suck up what they want, when they want it.

It's difficult to overstate the amount of work that had been invested in order to reach this point: the care of the seedlings, two intermediate transplants, the steady increase of lighting intensity and nutrient strength. My hard work seemed to have paid off, however. Standing before me were four super healthy, sturdy-looking plants, each about a meter in height, basking under the combined output of a double-ended 1000W HPS and a 315W ceramic metal halide, spread over an area of around two square meters.

1 Four Baxter's Bush in 15L basking underneath an air-cooled DE-HPS and ceramic metal halide.

2 Some of the first fruits start to ripen.

3 The harvest came in thick and fast. Taste was so much sweeter after ten days' flushing.

Clusters of yellow flowers were just beginning to form when suddenly it was time for me to head for the airport. Yes, just at this crucial point, it was now necessary to jump on a plane and travel half way around the world to California, leaving my precious plants nearly 9,000 kilometres away back in my cellar in France. I don't want to sound overly dramatic but my transatlantic trip was urgent, last minute, and unavoidable. To make matters even worse, there was little chance of returning in under two weeks! What could I do?

Fortunately help came in the form of my mother in-law. She agreed to come and stay at the house to tend my plants. What a godsend! I took her through the grow room ritual. Top up the tank, every day, with pure water and add coco-specific nutrients to bring the conductivity levels up to between 2.0 and 2.5 mS. To her credit, she followed my instructions to the letter. It's just a shame that they were wrong!

My error? Reading books—or rather, the wrong ones! I'd taken my target conductivity levels from greenhouse growing guides, rather than indoor grow room, controlled environments. They actually recommended higher levels but I'd lowered them on account of my choice of determinate / bush varieties. While my light levels were very high, my relative humidity was quite low (around 50%) compared with greenhouse recommendations (around 70%). Also, I failed to allow for the fact that I was using a passive, wicking system rather than a re-circulating system. In short, my recommended feed levels were way too high.

I returned to a jungle of tomatoes. The plants were about to take over the entire basement, just as I suspected. There was lots of production too—my mother in-law had clearly been busy with an electric toothbrush to aid the pollination process. All I could see was truss after truss of cherry-sized fruits, all at various hues. The leaves, however, were all showing signs of toxicity build-up, with severe discoloration at their tips and margins. My nutrient feed was at 2.0 mS. I checked the conductivity of the feed in the plant trays and that was up to 2.5 mS!

In an effort to fix the situation I diluted the nutrients down to 1.5 mS to try and counteract the salt build-up. After a few days I even notched it down even more to 1.0 mS but the toxicity signs were so established they weren't going anywhere.

My low humidity and high light levels had conspired to exacerbate the adverse effects of my high nutrient strength.

In these conditions, my plants actually wanted more water and fewer nutrients! If only I'd been around to respond to these signs earlier—oh the wisdom of hindsight!

A few days later the first red fruits looked ready to pick. With a great sense of anticipation I popped the first tomato into my mouth. It was utterly tasteless—perhaps the least juicy, saddening, and deeply disappointing tomato I've ever tasted. And I had hundreds of them!

I spoke to a tomato expert and he suggested that my plants weren't able to build sufficient sugars in my less than ideal environment. I decided to switch them to tap water (no nutrients at all) for a week and let them continue to ripen—just in case they sweetened up. And guess what? I've just been downstairs to check and they taste amazing—all they needed was a little extra time!•

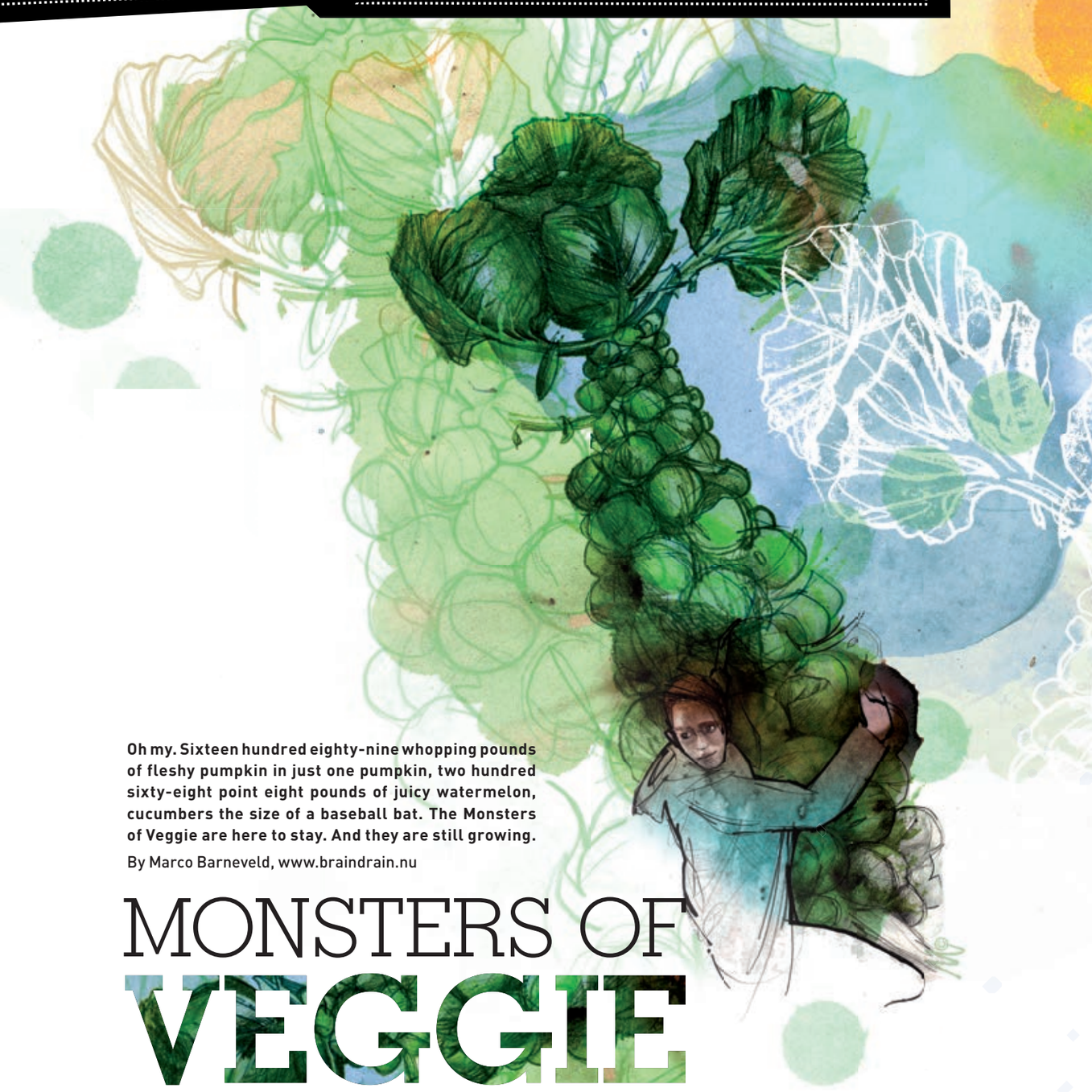
RIO TINTO

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

* This cracked soil of the Rio Tinto riverbed proves that harshness can be gorgeous.
* The Rio Tinto, or Red River, originates in the Sierra de Huelva mountains of Andalusia, in the town of Nerva.
* The river and its natural red waters are characterized by a high acidity of between 1.7 and 2.5 pH with high content of heavy metals of mostly iron, copper, cadmium and manganese.
* The Rio Tinto is often considered the birthplace of both the Copper Age and Bronze Age.
* The Iberians and Tartessians in the area began mining the river in 3000 BCE, followed by the Phoenicians, Greeks, Romans, Visigoths, and Moors.
* For hundreds of years, the river's mines were abandoned until rediscovered and operated by the Spanish government in 1724.
* After large-scale excavations by companies from the United Kingdom in the 19th century made the river extremely dangerous for people because of the high acidity level.
* The high acidity keeps people away from the waters, but draws scientists in. In its waters micro organisms live that feed only on minerals and adapt to extreme habitats.
* NASA chose its habitat to study the possible similarity to the Mars atmosphere.
* The water provides conditions similar to Jupiter's moon Europa, which is thought to contain an acidic ocean underneath its surface.
* Life in the Rio Tinto - the bacteria feed on iron and sulphide minerals in the river's subsurface rocks - make the likelihood of life on Europa all the more possible.
* The Rio Tinto reaches the Gulf of Cadiz at Huelva.

Photo courtesy of Diego Lopez Alvarez.

What's HAPPENING



Oh my. Sixteen hundred eighty-nine whopping pounds of fleshy pumpkin in just one pumpkin, two hundred sixty-eight point eight pounds of juicy watermelon, cucumbers the size of a baseball bat. The Monsters of Veggie are here to stay. And they are still growing.

By Marco Barneveld, www.braindrain.nu

MONSTERS OF VEGGIE

They might be massively massive but they are quite gentle, so don't fret. Many a gardener enjoys the competition of growing the largest vegetables. There is pride in good gardening although it is as much good luck as it is hard work and experience. But even way, way back in history there are written accounts of giant vegetable competitions. Through years and years of selective cross breeding between large pumpkins with giant pumpkins for example, world records are continually being smashed. But the journey towards being that legendary giant garden is tough and full of dangers. Early enthusiasm gives way to early defense, as insects, rot and an assortment of four-legged pests threaten your growing gentle giant. But it is lovely to watch a giant grow up to its full potential. You can literally watch a giant pumpkin grow as it can grow twenty-six pounds on a nice sunny August day. Would you like to start? Well, here are five easy steps toward success.

Pick that **Seed**

Easy does it. Some varieties simply grow larger than others. You can start your own giant lineage by selecting a promising variety, like Atlantic Giant Pumpkin or Old Colossus Heirloom Tomato and then saving the seeds from your largest fruits for planting next year. You may have to do some research on varieties that dependably grow into giants, but the name usually gives it away. Like Russian Mammoth Sunflower, that grows upwards of six meters tall. Check out the box for more varieties per vegetable.

Give Them a **Healthy Start**

Boost up your soil before you even put the plant in. Spread manure or compost the autumn prior planting. Make it a comfy bed. You might want to have a soil test done and replenish any nutrients and micronutrients that are lacking. Giant vegetables are hungry little buggers so they need lots and lots of yummy food. Make sure there is enough. Slow acting organic fertilizers added at planting time will be like a bowl of nutritious soup for your gentle giant when it needs it. Know what type of fertilizer your plant needs. If you're growing the plant for the fruit, like pumpkins and tomatoes, you need a fertilizer that's high in potassium and phosphorous. If you're growing a leafy vegetable, like cabbage, you want a fertilizer high in nitrogen.

Water it right

Giant vegetables are not only hungry they are also thirsty. Spoil them. You have to provide regular and deep watering or your growing sweeties will either languish or split. You might want to use drip irrigation on a timer that compensates for rain, because as much as your plants need regular water, they really don't like to lie in a wet bed.

Just the Best **Fruits**

The more fruits on your plant, the smaller they will be in the end. If they have to compete for nutrients, they are not going to be as big as you want them to be. They will definitely not be world champions. Take out all but the three or four largest, healthiest looking ones. Later in the season, you might want to thin down to just one, but keep a couple of extras at the beginning just to be sure. Don't worry about too much foliage, the foliage is what will feed the fruits and help them grow larger.

Worry and act

Pests, diseases and cultural problems can move in quickly and ruin an entire crop, especially when there are only a handful of fruits to begin with. You have a lot to worry about. So, check the plants daily and act as soon as your attention and care is needed. Now, sit back and enjoy. Let it grow and become that beautiful veggie you knew was inside. Don't fuss too much as plants like it quiet. Look but try not to touch, unless necessary.

So while you wait while your plant races from big to huge to massive, find some extra friends. You will need them to help you eat your eight hundred seventy-six liters of pumpkin soup if that was your vegetable of choice. Oh well, may you dream of Monsters of Veggies and wake up with a smile. •

GIANT SEEDS

Crossing seeds and plants until you have your own giant cabbage takes a lifetime. Even if you have the wish, you might not have the time. Luckily you may buy seeds that might contain the world record. These are some varieties you want to look for:

Cabbage: Northern Giant Cabbage
Carrot: Japanese Imperial Long Carrot
Cucumber: Mammoth Zeppelin Cucumber
Gourd: Giant Long Gourd
Onion: Kelsae Sweet Giant Onion
Pepper: Super Heavyweight Hybrid Pepper
Pumpkin: Atlantic Giant Pumpkin
Squash: Show King Giant Green Squash
Sunflower: Grey Stripe Giant Sunflower
Tomato: Old Colossus Heirloom Tomato
Watermelon: Carolina Cross (Giant) Watermelon

Pests & DISEASES

INTEGRATED PEST MANAGEMENT (IPM)

What is a pest? Pests are living organisms that damage or interfere with desirable plants in our fields and orchards, landscapes, or wild lands, or damage homes or other structures. Pests also include organisms that impact human or animal health. Pests may transmit disease or may be just a nuisance. A pest can be a plant (weed), vertebrate (bird, rodent, or other mammal), invertebrate (insect, tick, mite, or snail), nematode, pathogen (bacteria, virus, or fungus) that causes disease, or other unwanted organism that may harm water quality, animal life, or other parts of the ecosystem. By CANNA Research

It is a loosely defined term, often overlapping with the related terms vermin, weed, plant and animal parasites and pathogens. It is possible for an organism to be a pest in one setting but beneficial, domesticated or acceptable in another. In the past, the term might have been used for detrimental animals only, thus for example, causing confusion where the generic term "pesticide" meant "insecticide" to some people. For this series of articles we make a distinction between pests and diseases; where pests are animals or insects and diseases are fungi, bacteria and viruses (pathogens).

Integrated Pest Management (IPM)

The UN's Food and Agriculture Organization defines Integrated Pest Management (IPM) as "the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms."

Integrated Pest Management (IPM) is a continuous process of controlling pests (weeds, diseases, insects or others) in which pests are identified, action thresholds are considered, and all possible control options are evaluated and considered. Precautionary principles or proactive approach or prevention is a key part of Integrated Pest Management. Rather than having to take stronger action (such as opting for chemical intervention) later to handle a pest problem. In other words: prevention is better than cure. The most effective, long-term way to manage pests is by using a combination of methods that work better together than separately. Approaches for managing pests are often grouped in the following categories.

Cultural controls

Cultural controls are practices that reduce pest establishment, reproduction, dispersal, and survival. For example, changing irrigation practices can reduce pest problems, since too much water can increase root disease and weeds. Also, too much nutrient load can give a plant softer leaf tissue making it more attractive to leaf sucking insects. Optimizing climate and light are also cultural measures. In field crops, climate and light cannot be influenced but in greenhouses and indoor growing both can be controlled and optimized for the plant.

Mechanical and physical controls

Mechanical and physical controls kill a pest directly or make the environment unsuitable for it. Traps for rodents are examples of mechanical control. Physical controls include mulches for weed management, steam sterilization of the soil for disease management, or barriers such as screens to keep birds or insects out. Cutting off and removal of disease infected plant parts are also a form of physical control and can help reducing the spread of diseases.

Biological control

Biological control is the use of natural enemies—predators, parasites, pathogens, and competitors—to control pests and their damage. Invertebrates, plant pathogens, nematodes, weeds, and vertebrates have many natural enemies.Natural enemies of insect pests are known as biological control agents or beneficials and include predators, parasitoids, and pathogens. Biological control agents of plant diseases are most often referred to as antagonists. Biological control agents of weeds include seed predators, herbivores and plant pathogens. Some beneficials are bred especially for release in infested crops others are occurring naturally. Not all naturally occurring beneficials can be bred and are therefore not for sale.

Chemical control

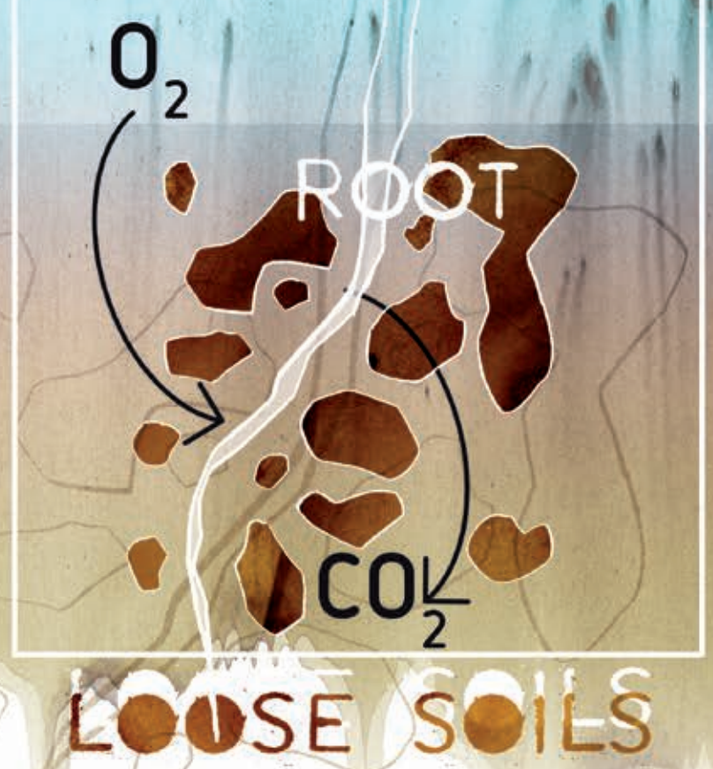
Chemical control is the use of pesticides. In IPM, pesticides are used only when needed and in combination with other approaches for more effective, long-term control. Also, pesticides are selected and applied in a way that minimizes their possible harm to people and the environment. With IPM you'll use the most selective pesticide that will do the job and be the safest for other organisms and for air, soil, and water quality; use pesticides in bait stations rather than sprays; or spot-spray a few weeds instead of an entire area.

These form the basis of Integrated Pest Management, the art of pest management. The idea is to employ as many non-toxic forms of pest control while monitoring the pest populations, and establishing population or activity thresholds before going to the next level of control. These thresholds are the point where action must occur to avoid larger than acceptable economic loss. Some loss must always be planned in the production scheme, but by employing these techniques, cost can be kept down and the need to go to the toxic remedies reduced to absolute need only. The coming CANNAtalk editions will closely examine these different assets, how to employ them, and what can reasonably be expected by utilizing them. •

Figure 5: Common beneficials, both naturally occurring as being commercially bred for crop protection

THOUGHTS ON WATERING PLANTS

PART 2 PUTTING IT TOGETHER



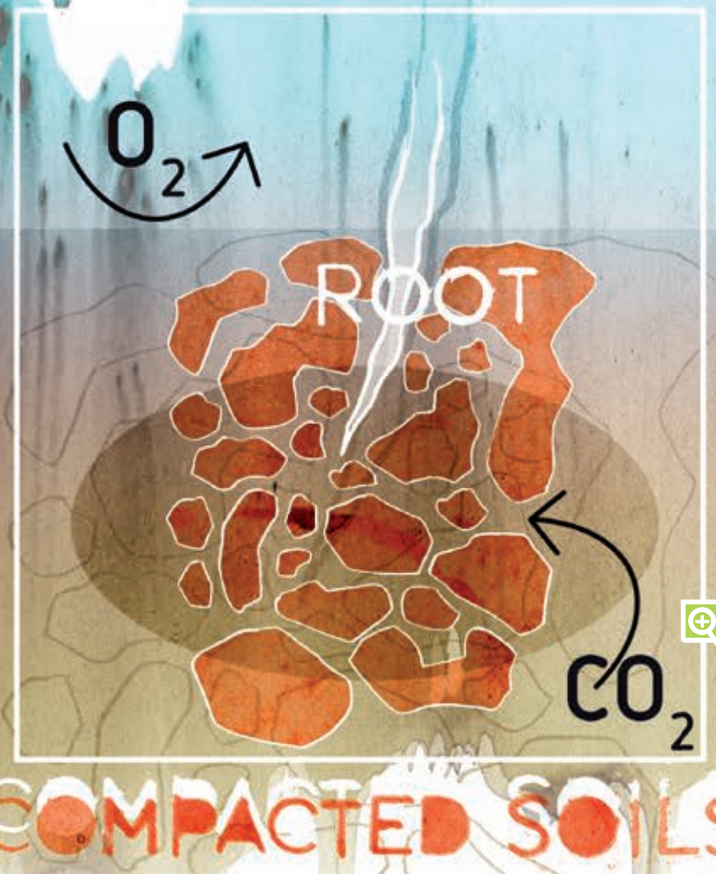


Figure 6: The effect of compaction and decreased porosity on root growth and gas transfer.

NOW, EVERYTHING WE HAVE TALKED ABOUT SO FAR IN PART I ARE EXTERNAL CONSIDERATIONS OR FACTORS THAT AFFECT OUR GROWING SYSTEM'S USE OF WATER. THE ROOT SYSTEM IS THE INTERFACE FOR WATER UPTAKE AND MUST FUNCTION PROPERLY. IF THEY ARE SITTING IN WATER FOR TOO LONG, THEN THE ROOT SYSTEM IS REDUCED IN FUNCTION AND, BECOMING WATER LOGGED, BEGINS TO DIE OFF. IF THEY DRIED DOWN TOO MUCH, THE STOMATA CLOSE IN RESPONSE TO THE LACK OF WATER IN THE SYSTEM, THE ROOT HAIRS DIE OR THEY DO NOT FUNCTION AS WELL. IT IS A FINE BALANCE BETWEEN RIGHT AND WRONG, BUT WE CAN BE OFF A LITTLE EITHER SIDE WITHOUT CAUSING ECONOMIC OR QUALITATIVE CONCERNS; BUT THAT IS A MATTER OF MINUTES NOT HOURS. EVERY DAY THE GROWER HAS TO BE THE ADJUSTING FACTOR. IF YOUR HUMIDITY RAN AT THE LOW POINT FOR AN HOUR LONGER DURING THE LAST WATER PERIOD, YOUR TIMING WILL BE OF. By Geary Coogler BSc Floriculture / Horticulture

Probably no more than a few minutes but maybe enough to make a difference. Look at the plant and let it tell you. Is the cuticle thinning? Is the color dulling out some, especially in splotches? Do not be afraid to delay or shorten a cycle when needed, and base all decisions on an average of the whole crop. Treat the whole crop as one container with a bunch of cells. Figure out why one stays drier and fix it. The overriding concern in root health is water relations; what is our irrigation strategy? *[See figures 8 and 9 page 24].*

The Ideal

The correct point for watering occurs at the exact moment right before water is no longer freely available (based on what each species sees as available) and is bound up to the medium or the humidity drops to less than 100% at the root surface killing the root tips and root hairs. Yeah, right, but how do we know? Fortunately, you can and should be earlier. The key line of reasoning I hope you take away from this is aeration. Aeration is basically how much air the roots will see. Roots require Oxygen to function. They do not require CO^2. Aeration can be expressed as a ratio of small (water holding) pore space to large (air holding) pore space, or as a percent by volume. It can range from 0 to 100% with the smaller being non-aerated water and the larger in Aeroponic systems. Aeration is at the root of understanding watering. *(see figure 6)*

Mediums vary in composition but the basic function remains the same, support for the plant and its associated root system. It provides mechanical as well as reserve functions, anchoring and providing a water/nutrient buffer. Not all mediums are created equal. Some have physical or chemical limitations that must be overcome before use. Still all function to anchor the plant and most hold some moisture and/or nutrients, kind of like a refrigerator. Porosity defines how much space is allocated to hold air and how much holds water. This determines root functionality.

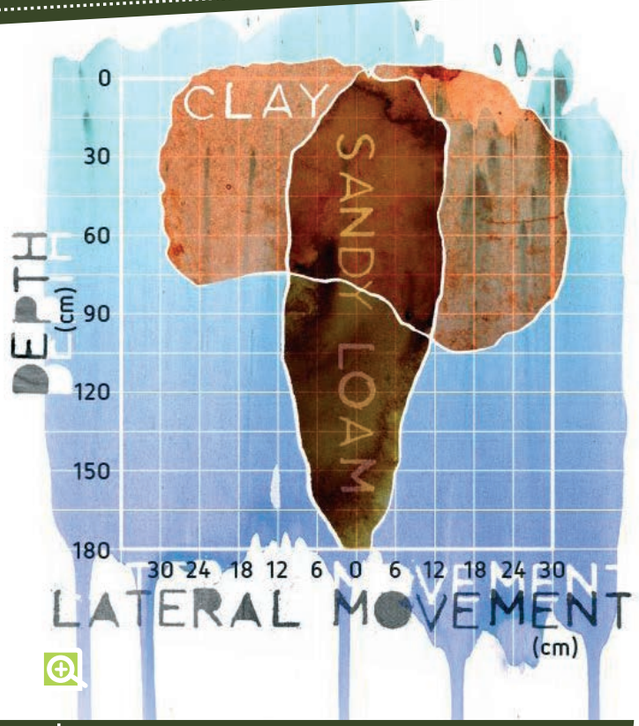


Figure 7: Comparison of soil water movement in different porosity soils with clay (particle size ↓ .002 mm) porosity of 45% with ↓20% air or large pores, and sandy loam (particle size 0.002 to 0.5) porosity of 48% with ↑ 40% air or large pores.

Pore Structure

There are two types of pores and 4 subtypes. Megapores, or large pores, are defined as pores exceeding 0.05 mm in size and allow for water movement through the media by gravity, and gas diffusion throughout the medium. Micropores, or small pores, are smaller than 0.05 mm and hold water against gravity (capillary water). There are 4 classifications of small pores but the two we are concerned with hold available plant water, mesopores (0.03-0.05 mm) and micropores (0.005 – 0.03 mm). These hold water and the larger accommodates fungi and root hairs where the smaller holds water as well but are too small for fungi but will accommodate bacteria. This is the water reserve for the plant; gravity water drains away as fast as aeration dictates, the larger the aeration the faster the drain. *(See figure 7).*

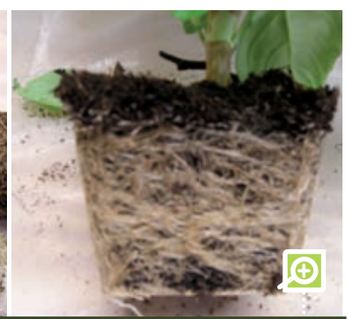


Figure 8: (L) Healthy root mass fills the medium profile top to bottom.
Figure 9: (R) Healthy root mass of Marigold var. Dwarf Bolero grown in coconut.

Now, we employee a large variety of tools to get the aeration we need such as increasing the fiber size in peat or coco, changing the density of rockwool, or increasing the clay pebble size; each particular to a growing system and/or grower style. So, there are three things we see here that are in a container of medium whether it is nothing (aeroponics) or mineral soil: air, water and solids. The solids are, of course, the roots, the actual media particles, and anything else that is not air or water. These are the things that influence how much water the root zone environment will hold.

Figuring it Out

If 1 have a true 2 gallon (8 quarts) container, holding coco mulch, and my porosity is 60% with a ratio of 60% large space, I know that 60% or 4.8 quarts are in total pore space, and 60% or 2.88 quarts of that is large pore spaces holding only air. Using this I see that the most water this root system environment will hold is 1.92 quarts or 2.18 liters total. This is what it will hold totally, including what is in the unavailable smaller pore spaces we did not mention. Of this portion, depending on the medium, the plant will probably only see about 2 liters of available water. You can not put more in, it will drain out. It will never hold any more unless the porosity changes which it will do over time if it is a degrading material like peat or coco. You can put 5 liters in the container at one watering but only a max of 2.18 will stay in the container after gravity draining. This excludes continuous watering. There is some lateral movement in the medium; how much is dependent on the porosity of the medium. This influences dripper number and or dripper dispersal pattern. If the medium has enough large pore space to drain from the bottom of the container before it reaches the outside of the root ball, use 2 or more drippers. *(See figures 8 and 9).*

This is the duration of your watering. If my system applies 1 liter per minute from 1 emitter, than I will run the irrigation system for 2.4 minutes to get my 2 liters of useable water to saturate my container, plus about 20% more to insure I have wetted the entire medium and helped wash away some of the stay behind salts. Now, from what we've learned before, if that 2 gallon container with a plant and canopy that occupies 1 square meter, and my plant is established, I can reasonably expect to water that plant 3 times in 28 hours for 3 minutes with a 1 liter/minute dripper, but since I have to work with a 24 hour clock, I will set it up to run at least 2 times during the lighted times. Always try to water when the lights are on, but no later than about 1 hour before the dark cycle starts. Water only at night if the plants are showing up too dry when the lights first come on. (This will, of course, change to watering at night, but less frequently than day, when in air or an extremely light mix like clay pebbles). You will actually increase applications over time because, as the roots grow, they are solid and take up space, so the container should hold less water and subsequently have to be watered more often with decreasing amounts (the m2 will still require approximately 5 liters of water for the 24 hour period). Older plants that occupy the same area are not necessarily using more water just because they need watering more often; it is more likely that the water 'buffer' is decreasing as the plant root system grows, actually isolating areas inside the root balls from seeing water (we know this condition as 'root' or 'pot binding'). This, with all the variables just discussed being correct, should be how often to water. We have also answered the question of how much to apply.

Keep in mind that as the media properties change, we must also adjust our calculations. In air, aeroponics for instance, there is only air, water holding is a function of surface water tension and can be measured by humidity or a free moisture observation. In this environment we need to have many 'ON' times but the duration will be short, just enough to rewet the roots till they drip well. It is important to remember that in applying irrigation water to any system other than true aquaculture, where the root water should always be at the right oxygen concentration, the roots should never be covered for more than 30 minutes, ever. This will kill the root cells. If we apply water for 3 minutes to the top of a container, gravity pulls it through to drain and the roots should not remain covered for more than a few minutes. The only reason to oxygenate your water by using DO (dissolved oxygen) systems or air stones is when your roots remain covered for longer than 30 minutes, which would make them an aquaculture system. (In this authors opinion, this would be a waste of resources as the oxygenated water in any other system is not seen at the root cell long enough to really make a difference when irrigated correctly. In addition, it is forcing pH changes in the reservoir which will become highly noticeable with better grades of nutrients. If you are using an air stone and pump and drawing air from a CO^2 enriched room, you are actually driving the oxygen out of solution and replacing it with carbon dioxide, something the roots do not need).

Determining the Need

If you are a hobbyist growing in a true hydroponic system, you will find these concepts difficult to apply and get right; it will take some effort. Those who use an organic medium such as peat or coco will have a much easier time getting it right. This is because of the buffer effect of the mineral or organic based soils or soiless mixes. These will hold water for a time and you only have to determine when they have dried enough to risk watering again. In hydroponics, we time, in minutes, how long it takes to dry down to the damage point. This really varies continuously based on relative humidity and air movement and will fluctuate throughout the 24 hour period. It is easier to tell when it is time to water in a soil or soiless mix.

With water holding medium based systems, you have options in determining the frequency to water. You want to let it dry down. Once again going back to a previous part of this paper, if we hold our crops a little drier, they will handle drought conditions a little better and harmful pathogens will have a hard time gaining a hold. You can do it mathematically as above, you can look at the color changes (not as reliable) *(See figures 10 and 11)*, or you can go by weight. If our container weighs 32 grams bone dry and 62 grams wet, we will allow it to drop at least to around 40-45 grams before we water. This will change as the plant grows. Good growers know by hands on experience when a container has lost enough weight to water again. *(See figures 12 and 13)*.

Figure 10: (L) Visual water clues are hard to read, these are not ready yet.
Figure 11: (R) These plants are ready to water, can you tell the difference?

Another method is by feel which actually is the most reliable of the general feel tests but can also be difficult to judge *(see figures 14,15 and 16)*. Various water meters work off and on as it depends entirely on all the other factors like porosity and (EC in a large way) that we have mentioned.

What you have to do as a grower is marry the understanding of what is occurring with what must occur. There is no easy

Figure 12: (L) This container is ready for watering, notice the weight.
Figure 13: (R) The same container fully watered, again notice the weight difference of approximately half.

From top to bottom:
Figure 14: The Feel Test: Looks like time to water.
Figure 15: The Feel Test: Feels cool and damp.
Figure 16: The Feel Test: Not yet ready for water.

'Light Switch' answer to when to water. You have to figure it out yourself using the above mentioned thoughts as a guide to knowing what it is you are trying to accomplish, and how your situation will affect it. All these factors we have mentioned can and will change daily, and I mean daily, and must be taken into account for an irrigation strategy to be successful. It sounds very hard, with much to remember, but if you pay attention to the variables and techniques we discussed, and adjust as needed, you will have mastered the most difficult part of growing. This is the difference between a bad grower and a good one; a good grower and the best one.•

TIPS

Some points or tips for you to remember in devising your irrigation strategy are:

- With increasing temperature and decreasing humidity, water consumption increases.
- With decreasing temperature and increasing humidity, water consumption decreases.
- Higher temperatures require more frequent watering with higher volumes to decrease unwanted salt buildup.
- Higher humidity requires less frequent watering and lower total volumes, but watch the salt buildup
- The smaller the container, the less moisture it will hold and the quicker it will dry down.
- Low drainage substrates are watered less frequently but with higher volumes.
- High drainage substrates are watered more frequently but with lower volumes.
- Higher drainage substrates require more drippers or the use of spray stakes to insure lateral movement of water in the substrate. (lower capillary action)
- Lower drainage substrates require fewer drippers because the water stays around long enough to move laterally. (higher capillary action)
- It is better to start with a smaller container and allow the root system to develop to the smaller size before potting up to another intermediate size pot or to the final size. (A 3 inch cutting should not be directly potted into a 7 gallon pot, it is too much, use a 3 or 4 inch first long enough for a decent root system to develop then pot it up.)
- DO NOT turn on the irrigation clock and forget it; this is a living system that changes daily, make sure the plant is drying down before the cycle starts AND ensure that it is not drying down too much before the cycle starts.
- BE CONSISTENT

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Grower's TIP #32

By your friend SEZ

WATERING

We all know that great health requires drinking water, not enough of it and we may get issues like kidney stones (salt accumulations) and too much of it will disturb our digestive capabilities, way too much of it may even kill us. See where I am going? There is a balance that needs to be found, with ourselves as much as in our gardening practices. Our bodies do give us plenty of clues about when to drink, however when plants do give us those clues it is often too late, damage has been done and crop potential is reduced. So the question remains "when should I water my plants?" No magic numbers here, Lot's of people can guide you, but certainly beware of anyone who would have a clear-cut answer like "every 3 days"!

The parameters that define the answer to that question are numerous and include sizes of the plants and that of the containers they're grown in, and the water holding capacity of the growing medium. Of course climate, including the intensity of light and wind, plays a dramatic role in this and above all, these have to fit the type of plant you are growing.

Sometimes growers fear putting "too much water" in the container. Let's clarify this: it is impossible to put more water in a container than what it can hold. As soon as the medium reaches saturation point, any amount of water that is extra, will flow out from the bottom of the container, if this one has proper drainage. As the extra water finishes draining out, the growing medium will balance itself back to its physical water & air retention characteristic pulling in beneficial fresh air. Therefore, if the plant is the proper size in relation to its growing container, it shouldn't be exposed to "too much water". On the other hand if the container is too big or it's medium holds too much water for the kind of plants being grown, then yes, you could "drown" those plants. We cannot stress enough that most plants benefit from transplanting often. Another great and common way of drowning a plant is to let its container sit in a water filled saucer, which may keep a good portion of the growing medium over saturated with water, depriving roots of oxygen for an extended, undesirable, period of time.

Assuming that parameters of everything are correct, most plant problems, often associated with apparent nutrient deficiencies, are caused by water delivery problems, likely by over-watering or under-watering. Some emotional growers are even able to do both, hence are exposed to a lot of plant problems with misleading symptoms.

Over-watering, is not "giving too much water", it means watering too often,
and under-watering means watering not often enough. When growing in containers, it is very seldom that all plants will require watering on the same day at the same time, even when growing similar sized plants. If you water all of your plants based on a calendar, there is a good chance that you will end up with the emotional growers wondering why your plants are not doing so well... Try to always group plants of similar performance together and only water those groups when they need it.

When you do choose to water, give enough nutrient solution to reach run off point and make sure the "runoff" well... runs off! This will improve control of salt levels and also ensure a better oxygenation of the root zone.

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 CANNABOOST

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

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 32 is enough), and if we pick your name,

A BOTTLE OF CANNABOOST COULD BE COMING YOUR WAY.

Winner puzzle#30

The winner of last Sudoku is **Mr. Evans**. 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

SUGAR IN SEEDS

A team of scientists led by Carnegie's Wolf Frommer has discovered that a sugar-transport protein in maize and rice called SWEET4 is both necessary for successful seed filling and shows genome changes that indicate domestication by humans.

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.

WILD TOMATOES MIGHT PROTECT AGAINST SPECK

Genes from wild tomato species may one day protect against devastating bacterial speck disease.

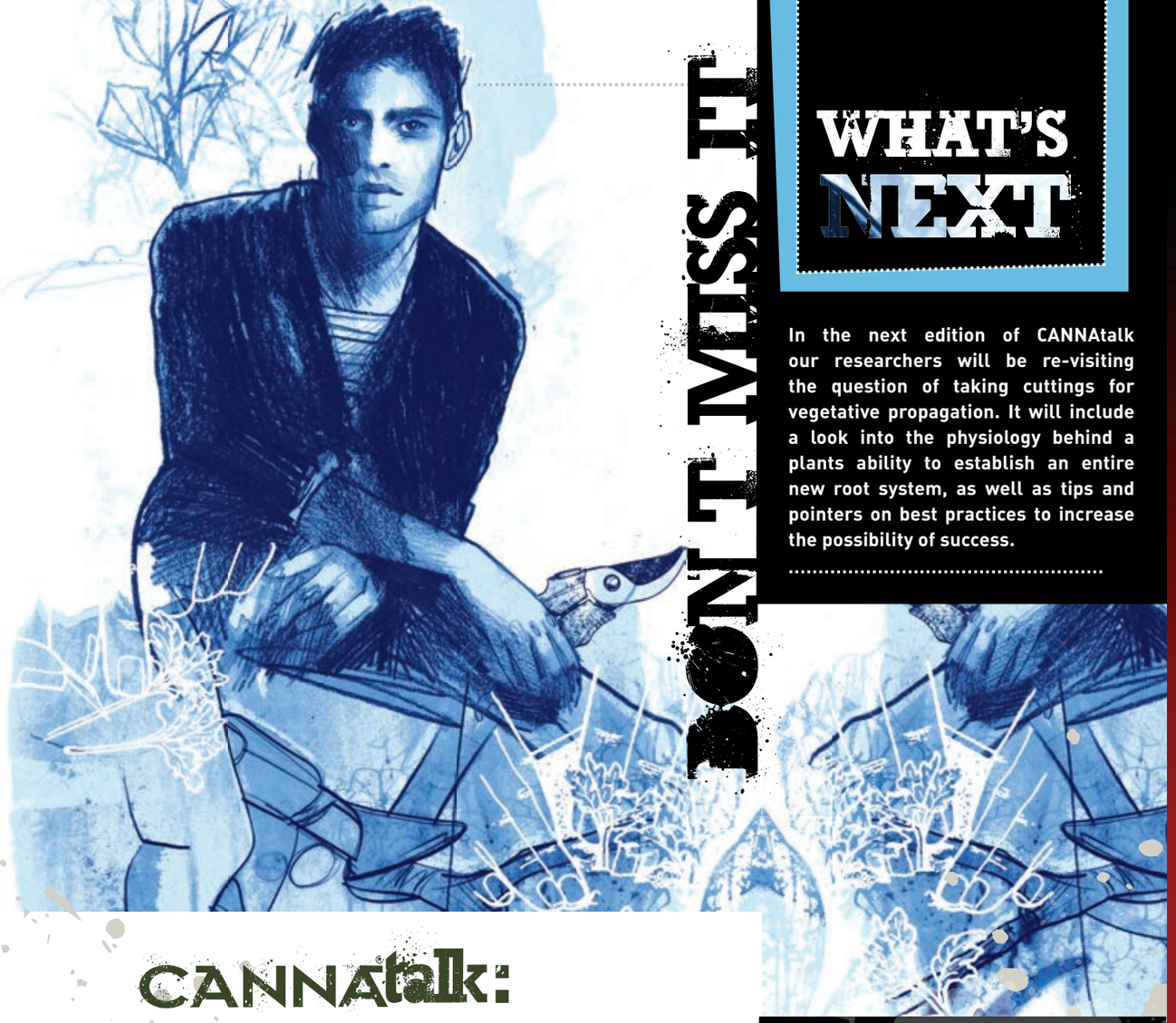
The 2015 growing season was a tough one for tomato researchers at the Boyce Thompson Institute, as bacterial speck disease descended on their field, but those infected plants may one day save others from a similar, spotted fate. "The outbreak gives us the opportunity to observe if any established or experimental varieties have resistance to the local strains of the bacteria," says BTI Professor Greg Martin. Martin specializes in the study of tomato's interactions with the bacterium that causes speck, Pseudomonas syringae pv. tomato. Martin and Smart plan to use the speck-infested Freeville field next year to field-test different plants' resistance to the natural speck strains there. With any luck, they'll find resistance genes in wild tomato plants that may spare future New York farmers from plowing under a speckled crop.

IT'S ALL IN THE SOIL

Great civilizations have fallen because they failed to prevent the degradation of the soils on which they were founded. The modern world could suffer the same fate.

This is according to Professor Mary Scholes and Dr. Bob Scholes who have published a paper in the journal Science, which describes how the productivity of many lands has been dramatically reduced as a result of soil erosion, accumulation of salinity, and nutrient depletion. "Activities associated with agriculture are currently responsible for just under one third of greenhouse gas emissions; more than half of these originate from the soil," says Bob Scholes, who is a systems ecologist at the Council for Scientific and Industrial Research.

"To achieve lasting food and environmental security, we need an agricultural soil ecosystem that more closely approximates the close and efficient cycling in natural ecosystems, and that also benefits from the yield increases made possible by biotechnology and inorganic fertilizers."



DON'T MISS IT

WHAT'S NEXT

In the next edition of CANNAtalk our researchers will be re-visiting the question of taking cuttings for vegetative propagation. It will include a look into the physiology behind a plants ability to establish an entire new root system, as well as tips and pointers on best practices to increase the possibility of success.

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