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

HQ Talk:

Foreword

Although the year is only a couple of months young, it is already time for our first issue of 2016. We have planned so many activities for you! It promises to be a very sport friendly year with the European championship football tournament in France and also the Olympic summer games. We like to gamble a bit here at CANNA and will be creating a football pool for you all to get involved in. Please keep a close eye on our website to see how to participate and maybe you will win the grand final prize! There is so much to tell you about but unfortunately not enough space here to do so. To keep updated about all the CANNA activities in 2016, simply sign up at MY CANNA at www.canna-uk.com.

Of course we are also going to be focusing on CANNA products. For those of you who haven´t already seen it, we have recently introduced the new CANNA CALMAG Agent. This product ensures you will be growing at the correct EC level. It is available in 1, 5 and 10 litre bottles.

In this issue, we are going back in time! Do you remember the 10 watering rules of thumb? We have updated this article and have added some extra information for you to digest. Please read it carefully as watering your plants in the correct way is often overlooked and hugely important to a succesful harvest.

We can´t wait for you to have read through this issue. If you have any questions, comments or feedback do not hesitate to contact us via the answering card at the back of this issue, or via the website: www.canna-uk.com

Regards

Karin

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 QUESTION – OR VARIATIONS ON IT – IS THE ONE I HAVE BEEN ASKED THE MOST OFTEN. 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 WATERING AND, TO A LESSER EXTENT, THE AMOUNT OF WATER APPLIED, DEPEND ON MANY OUTSIDE VARIABLES THAT FURTHER COMPLICATE THE ISSUE, AND THIS MEANS THAT THE GROWER HAS TO MAINTAIN AN 'EYES-OPEN' APPROACH IN HIS OR HER GROWING TECHNIQUES.

By Geary Coogler BSc Floriculture / Horticulture

This is the one aspect of the growing process that can make or break a grower. As soon as we move out of a natural growing environment into one of our own design, and then we tend to demand the maximum possible performance from our crops – we open the 'Pandora's Box' of growing. We fundamentally change the 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 can handle this change well. The question of 'which one is right for you' will depend entirely on the type grower you are. Understanding how the pieces of the jigsaw all fit together will give you an indication of which technique should work best with your style. If we modify our approach to watering to allow for all the variables that are affecting our plants and are unique to our particular growing situation, we can achieve the best possible results. The one variable we cannot adjust for is the grower that does not adapt his or her growing techniques, or design their production system around those limitations.

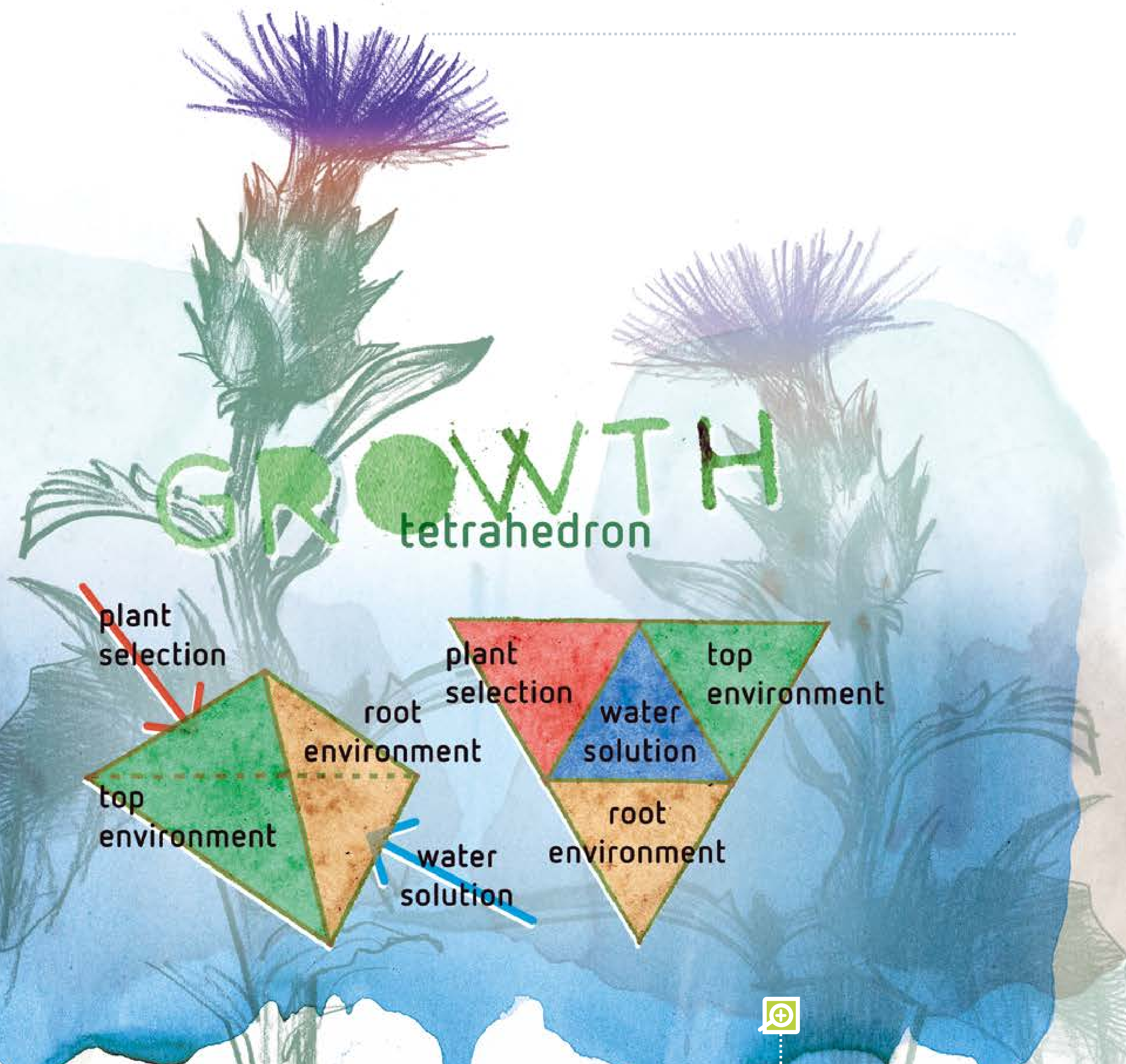


Figure 1: Water use in a square meter is equal and based on leaf coverage not plant count.

Defining the Issue

To begin our discussion on watering, and putting aside the question of the correct nutrients for the time being except for EC as a relative value, we need to keep a few things in mind. (EC is Electrical Conductivity or the ability of a solution to conduct an electrical charge; it increases as the concentration of salts increases: see CANNAtalk 12. To start with, the general water usage for 1 square metre of established plants with 100% canopy (leaf) coverage of that square metre, under high light conditions, is 4-6 litres/m2/day. As a general rule of thumb, we use the figure of five litres per day when calculating 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 square metre. Water usage for new plantings will be in the range of 3-4 litres/ m^2/day while the plants become established.

These values apply under optimal conditions of: Humidity, temperature, air movement (circulation), light levels and root zone salinity. Five important variables that we must keep in mind when designing our watering strategy.

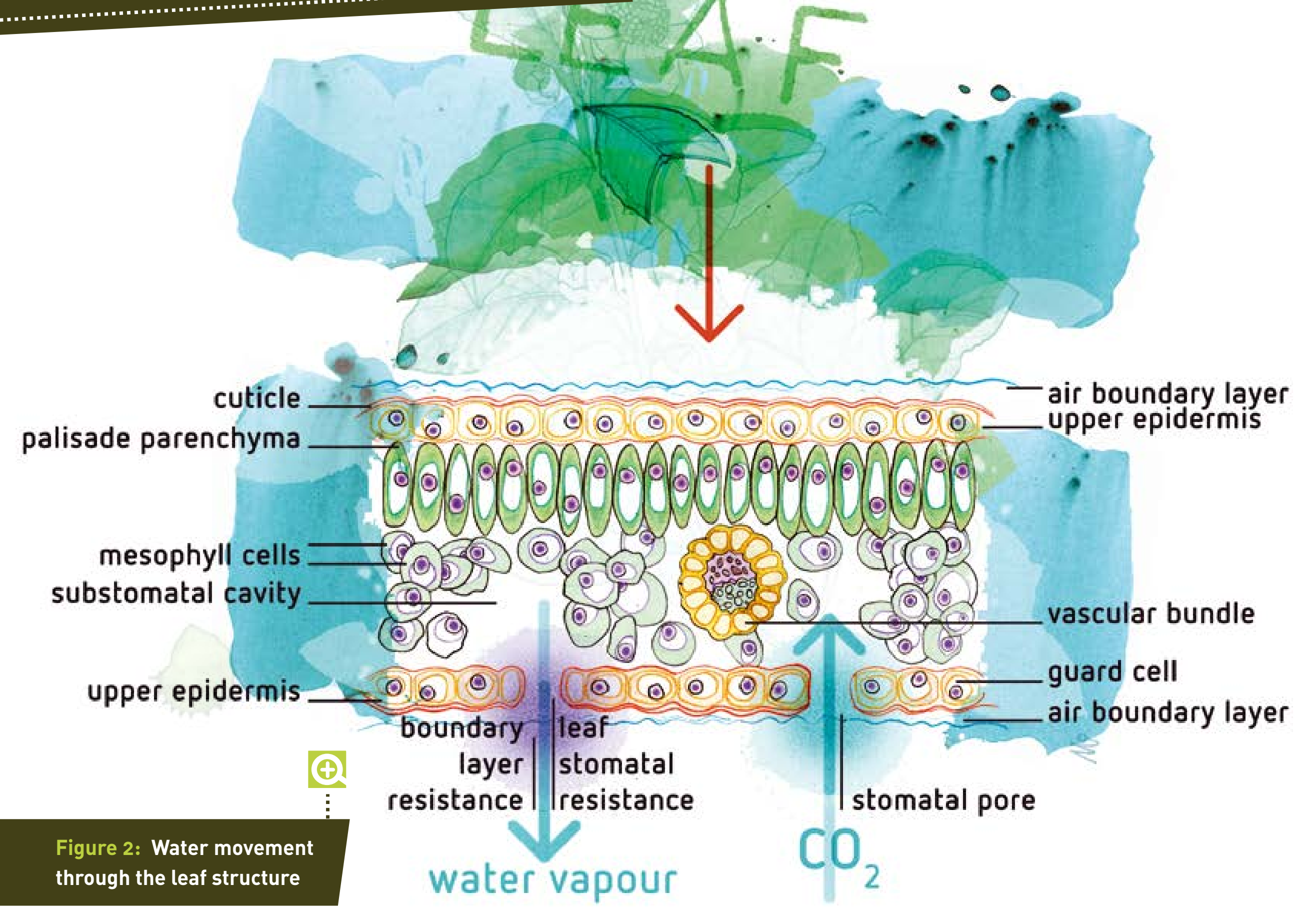


Figure 2: Water movement through the leaf structure

However, it is also true that individual plant species and/or varieties have different optimum levels for these variables. So let's look at each variable briefly in turn, because every grower needs to determine these levels for themselves. The relevant information is available out there for almost all commercially or privately produced crops and plant classes. There are also extremes in nature, of course: a water plant will need to have its roots covered with water all the time, while cacti may reach the permanent wilting point of most plant species before it will need watering (but it will still need to be watered regularly); bromeliads and orchids may not have roots at all and rely on high humidity. However, the vast majority of plants are somewhere between these extremes *(See figures 1 and 2)*.

The five variables

If we look at these variables in terms of a finely tuned automobile, **humidity** acts as the braking system for the energy production cycle in a very noticeable way, and also slows cellular respiration although this is less obvious. The water transportation mechanisms inside the plant are driven by the evaporation of water through the leaves. This process serves four main purposes: it supplies water for direct use by the plant cells, it transports nutrients and other essentials like hormones and carbohydrates around the plant, it cools the plant, and it provides structure through turgidity. If water does not evaporate through the leaves, or does so slowly because the air is close to saturation or 100% humid ('brakes on'), the plant cannot cool itself properly, not enough nutrients will arrive in the places where they are transformed into cellular components, and production at the cellular level drops off. In short, high humidity means that the plant begins to shut down. If the humidity is very low ('brakes off, engine full throttle, pointed downhill'), the water supply cannot keep up, and cells will become damaged through dehydration. Proteins in the cell wall will break down, a phenomenon we sometimes confuse with salt burn or a nutrient deficiency. In reality, this is usually a function of inconsistent watering or pathogens. Oedema (or edema), or very small blisters that form on the leaf surface which then burst and become brown dead tissue, can be caused by inappropriate humidity levels. *(See figure1)*. The correct ambient humidity level ('car on cruise control') is essential to ensuring that the right amount of water moves through the plant, night and day, to power all the plant's processes at the right tempo.

Temperature is what powers the system. Optimum values are again related to plant species, but in all species temperature governs the speed at which various processes can occur. In the presence of light, within the interior of the leaf (mesophyll), a wonderful light focusing element (basically a sponge that absorbs light) will run several degrees higher than the air temperature. The chemical reactions that make up the living plant cell are influenced by various factors – 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 will slow to a stop; too warm and it will speed out of control to a point the plant will just shuts down; just right and the cellular metabolism perks along nicely. Temperature influences rates of evaporation and therefore water usage as the plant tries to cool itself by opening its stomata (specialised openings on the leaf surface that allow 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 lost through evaporation. When the temperature gets too high, the stomata (stoma) close, the movement of water stops, cellular activities cease as the plant begins to cook. *(See figure 2)*.

Micro climates can and do form around the surface of the leaves; this means that these areas have different levels of humidity, temperature and gas concentrations to the ambient air. Carbon dioxide (CO^2) will be less available around 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 will ensure that these microclimates are limited in size and duration; the rate of water evaporation will increase and our engine (the plant's systems) will run nicely.

Light is the spark for energy production in the plant. The plant needs light to produce the storable energy that is used to turn CO^2 and water into carbohydrates, which is how all plant components start their life. The more energy packets of light (lumens) that are delivered to the surface of the leaf, the closer the engine gets to wide open. This is true up to what is known as the light saturation point – the point at which enough energy packets are being delivered to satisfy all the energy 'receptor' sites, (yes Virginia there is a maximum value). The closer we get to that point, the faster the engine runs, and the more water is consumed and used for cooling as this is a warming process (endothermic). Ultimately, these carbohydrates are utilised in a different process by which, in the presence of oxygen, they are made into all the other substances that a plant needs – respiration. This process actually gives off some of the heat it has stored (exothermic). So plants actually consume both CO^2 and O^2 in the course of a day.

Actually the only time that plants consume CO^2 is during the light cycle, while 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 more water will be used and vice versa. A plant that is considered a shade-loving plant will not need to use as much water, and in fact will not be as efficient at moving it.

The final variable is **root zone salinity** (we will use the term **EC**): the fuel and the sludge in the gas tank would be a simple but probably effective comparison. Water moves into the root cells, then passes 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 into the roots 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. These cells then regulate the water uptake. Larger nutrients in ion form are brought across those same membranes through various active transport mechanisms. This is much like Reverse Osmosis filters, which work by using pressure to force water molecules through a membrane but block the larger molecules. Small particles like a water molecule or a potassium ion will pass through the holes, but bigger particles like calcium will not. The plant cell utilises a simple physical law of equilibrium more than pressure *(See figure 3)*.

The Mechanics

In effect, if you take two containers of water, one with a high EC and one lower, and connect the containers with a tube, after some time, the two ECs will balance out to become identical. Ions will move from one tank to the other until they are in 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 one with the higher concentration 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 side of a membrane with the higher EC (this is called osmotic pressure) but only enough presssure to overcome this osmotic movement of water. The greater the difference between outside EC (low) and cellular EC (high), the higher the values will be *(See figure 4)*.

Taken over the entire root mass of the plant, this can be enough to move water (sap) vertically over a distance of 100 feet through the xylem tubes in some species. This is 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' – an area of lower pressure ahead of a column of water – being created inside the water transport vessels (the xylem vessels), which is caused by the evaporation at the other end, through the leaves. This draws the

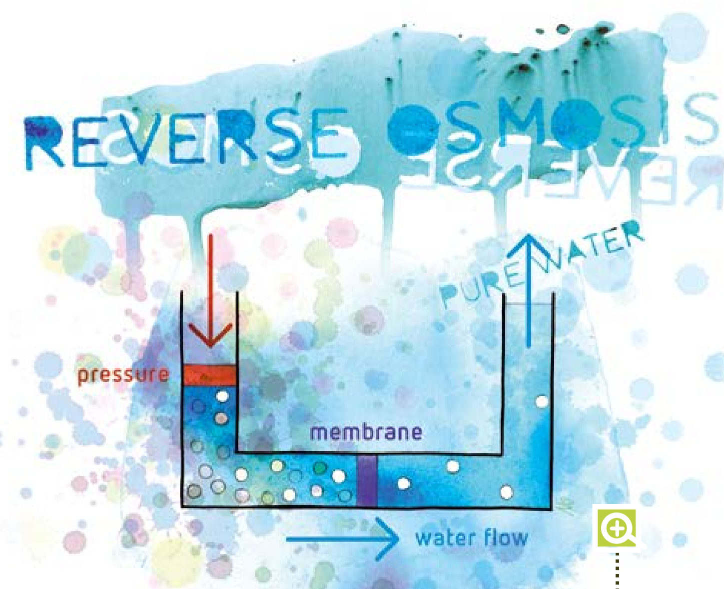


Figure 3: The basic idea in Reverse Osmosis is to pass water through a membrane leaving almost everything behind. Plants do this by natural forces involving gradients. This machine does so by forcing the water through the membrane.

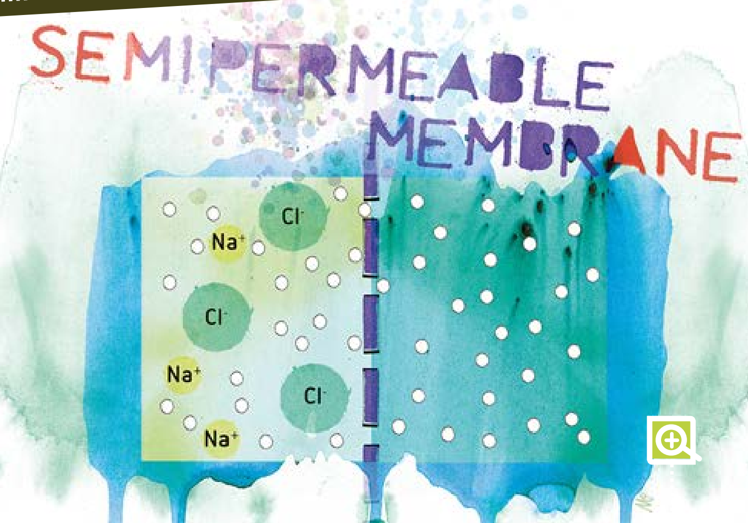


Figure 4: The effect of the plant cell semi-permeable membrane; it allows water to move from and area of higher concentration to one of lower concentration, but blocks the passage of almost everything else.

water entering the root cell through the cortex, into the transport tubes (the xylem tissue) and on to each cell up the line. It is the same effect with a drinking straw: an area of negative pressure created by suction (evaporation at the leaf) is created ahead of the column of liquid (in the xylem of the plant), causing the liquid to rise upwards.

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 the root cell, 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 actually flows out of the plant into the growing medium. This is what causes salt burn. 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 ions that are essential to the plant, like calcium, will stay in the growing medium unless the plant needs them and brings them inside through this process. This will push up the EC of the medium faster. The important thing to take away from this is that as EC increases towards the maximum limit (i.e. the cellular EC value), the rate of movement of the water will slow and at a certain point it will come to a stop and then go into reverse if the EC level of the medium continues to rise. (Incidentally, 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 where they are needed by feeding medium-range nutrients and improving the efficiency of my overall growing system.) By maintaining the right EC values at the root surface, in the water, or on the soil particle, I will ensure that my engine runs clean and runs at peak efficiency.

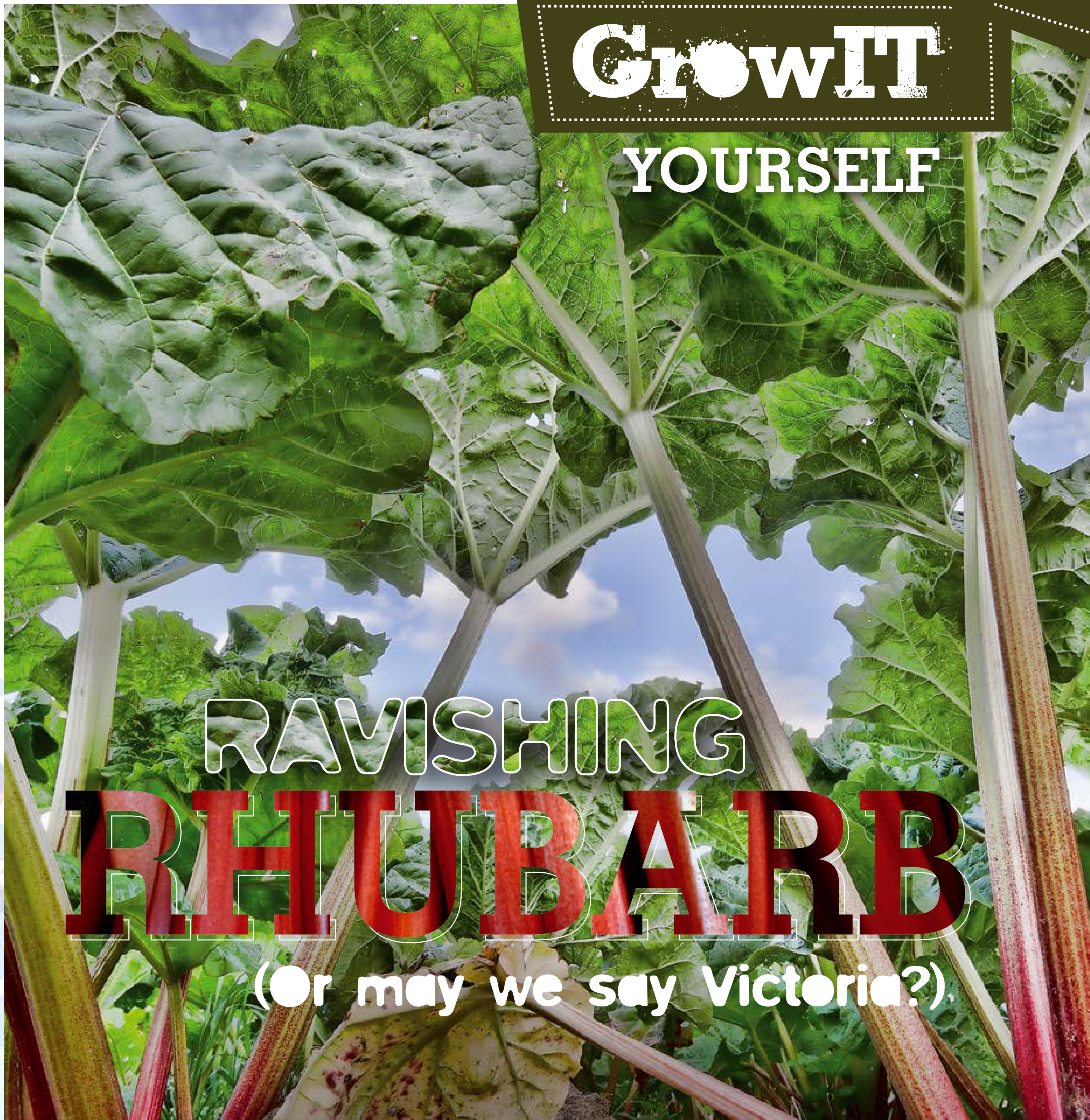
We have probably all seen this effect, but many people may not draw the right conclusion. We should all know that in areas where the EC values of the water are elevated, the addition of fertiliser can push the EC of the irrigation water up to very high levels, and we should keep the crop a little wetter. These are borderline problem rates. If you keep the plant too dry, although this is acceptable, you will see burn. By holding the plants a little wetter, you can avoid this problem, but it may show up again next week, so you need to leach to remove the salts. The problem is that this means keeping the plant as wet as it will go, and you cannot allow it to dry out, so your margin for error has disappeared. Any deviation now will cause problems. Under high salt or EC regimes, we notice that our plants get harder, the colour becomes darker, and the leaves always seem to have a wilted feel to them pretty much all day and especially about 5 hours into the light cycle. Now that we are over-watering slightly, we are killing roots so the uptake of nutrients and water slows down and the plants are starting wilt and turn yellow. So we water more often feed more heavily hoping that it will improve; 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 hydrologic pressure in the system by keeping water in the large pore space longer, as well as temporarily decreasing the EC in the media. If you increase the pressure and increase the water movement across the membrane, you can fix the plant. If you increase the water, kill the root hairs and increase the EC again, the problem will return. Increase the water still further and the roots will rot, water uptake will cease and the plant will fry. Use a good low-salt indexed fertiliser to avoid this and leach occasionally (always use a water-soluble fertiliser and always follow up immediately with a full strength feeding, unless using a dry fertiliser), and use an EC meter to make sure that you stay within the EC limits, 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 determinants of the water used by the system. If all these variables are at the correct values within that square metre, with high levels of light, your water use should average between 4 and 6 litres of water every day. Other factors can play a role, such as disease, but we consider these values to be the right ones. Now, keeping in mind these five environmental factors, which affect both the total amount of water needed and the frequency of applications, we can start looking at the actual process itself.

Final Considerations

There is one overriding consideration that all growers need to remember for any irrigation strategy: consistency. All plants have a proper point of watering; you can keep them a little dry or you can keep them a little wet, but I guarantee that you will have problems if you keep your plants wetter for a week and then you start keeping them drier, or vice versa. Be consistent when watering, and do this at the same point each time. This is not to say it is fine 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, in this issue, to determine the correct point at which to water.•



GrowIT YOURSELF

RAVISHING RHUBARB (Or may we say Victoria?)

LOOK AT HER: LARGE, SUCCULENT STEMS, BRIGHT RED SKIN. A TART FLAVOUR, 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 takes the throne these days, a tidal wave of commemorative memorabilia is unleashed – meagre mementos and tacky porcelain trinkets. But when Queen Victoria first parked her behind on the throne, things were different: to mark the occasion, the British got a startling new variety of rhubarb that was like nothing anyone had ever seen before. Yes, that's right. Rhubarb. Or as the scientists call it: Rheum Palmatum. And it's a vegetable, not a fruit mind you.

Although this plain, unassuming plant 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 flavour

Several species of Rheum filtered through to Europe from China during the Middle Ages. The Chinese had been using the root medicinally for centuries as a purgative. This new variety, dubbed 'Victoria', established the gold standard by which all good rhubarb came to be judged: large, succulent stems in bright scarlet, less stringy than previous varieties, and a tart, apple-gooseberry flavour with a hint of lemon or grapefruit (depending on your soil). It was 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 certainly can be, if not prepared to bring out the right flavours. Sugar helps soften the tartness, but Victoria Rhubarb's ancestors had another sting in its tail...
There was also the 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 acid is also present in the stalks, but at harmless levels. This is why your teeth feel oddly furry when you eat rhubarb.

Runaway smash

The edible stalks, although tasty enough when stewed with sufficient amounts of sugar, would have been stringy and tough before Victoria, depending on the growing conditions and other uncertain variables.

The introduction of the Victoria variety put an end to all that. Victoria Rhubarb was the rhubarb that the 19th century had been waiting for. Easy to grow, reliably robust and consistently sweet and tender, Victoria Rhubarb was the rhubarb that the 19th century had been waiting for: Easy to grow, reliably robust and consistantly sweet and tender. Victoria Rhubarb was a runaway smash from the start; The Victorian obsession with rhubarb began in earnest. The cult of Victoria Rhubarb soon took on mythical proportions and even the harvesting of the plant was shrouded with mysterious and romantic overtones. It wasn't long before British farmers discovered that the sweetest crops were harvested through the practice of "forcing" the rhubarb: that meant cultivating it in complete darkness under carefully controlled conditions. Any strong light could damage the plants, it is even harvested at night, by torchlight.

Healthy lady

And despite the toxic 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. These precious health-giving components include dietary fibre, 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.

The health benefits of rhubarb include its ability to: aid weight loss, improve digestion, prevent Alzheimer's disease, stimulate bone growth, avoid neuronal damage, promote skin health, prevent cancer, optimise the metabolism, improve circulation and protect against various cardiovascular conditions.
Let's zoom in on two of those benefits for a moment. Rhubarb is extremely low in fat and cholesterol, the vegetable poses no threat to cardiovascular health, but it can also actually increase levels of 'good cholesterol' due to the presence of dietary fibre, which is known to dissolve excess cholesterol from the walls of blood vessels and arteries. Furthermore, rhubarb's impressive levels of antioxidants ensure that free radicals don't cause heart disease and a wide range of other dangerous health conditions.

Looking to lose a little excess weight? Rhubarb is one of the lowest calorie 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 piling on the pounds. The impact that the various organic compounds in rhubarb have on the body's metabolism can also dramatically increase the rate at which the body burns fat, thereby helping you lose weight in another way. Just watch out with the added sugar though.

Grow it yourself

Rhubarb is probably one of the most adaptable garden crops that you can grow and deserves a place in anyone's vegetable plot. In return for minimal attention and skill, rhubarb will continue cropping happily for a decade or so, providing 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 six centimetres below the surface of the soil. Space the roots one metre to one metre twenty apart in rows ninety centimetres apart. Good garden drainage is essential when growing rhubarb. Planting on raised beds protects against rotting of the crown.

Refrain from picking in the first year and harvest only lightly in the second to allow the plant to get properly established. After that, the stalks can be harvested from April onwards. Grasp them at the base and pull with a little twist, rather than severing them with a knife. Always leave half a dozen stalks: stripping the plant completely will weaken 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 flavourful the stalks are likely to be. Medium sized stalks are generally more tender than large ones, which can 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? Remember: darkness and protection from the elements produces blanched growth and stalks that are sweeter and more tender. These pale pink stems are yummy.

To force your own rhubarb, 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 you come to remove the bin 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 delightfully tart flavour.

- Servings: 8
- 2 cups rhubarb, roughly chopped
- 1/2 cup sugar
- 1 1/2 cup whipping cream
- 450 grams of Greek yogurt

Place the rhubarb in a pan with the sugar over low heat. Continue to simmer, covered, until tender. Remove the lid and turn up the heat to medium and allow some of the juice to evaporate. Set aside to 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 CANNA COCO A & B. I have a 5L container of CANNA COCO A & B and I still have over 50% left but the best before date is next month. I want to give my plants the freshest nutrients. Assuming that the nutrients have been stored in ideal conditions, how much longer after the best before date would you recommend using the nutrients?

Answer

CANNA COCO A & B contains mineral ions and chelated iron. The minerals will keep forever as long as they do not crystallise (you can see any crystals at the bottom of the container). The organic chelate, however, will break down over time with exposure to UV light. Under normal circumstances the shelf life is guaranteed at 100% availability until the best before date. After that date, the chelate will break down and the iron will oxidise becoming rust and sinking to the bottom. Provided you can't see anything at the bottom, the product is okay to use, even after the best before date. Always shake the bottle, even if you are not using the product, to make sure the minerals stay in solution and avoid crystallisation. Store at room temperature and avoid exposure to light.
http://www.canna-uk.com/faq question 8

Question

I use your products all the time and have been growing for two years. Recently I have had a problem with my 4-5 week healthy cuttings going into shock after I transplanted them into larger containers. Do you have a product that could help save them?

Answer

CANNA RHIZOTONIC should do the job! Transplanting is a difficult stage for your plants. Many roots die back when exposed to the drier air, including the newly grown root hairs, and it can take them 3-5 days to recover. Too much water during this time, either due to the larger container size or over-watering can lead to root rot and other problems, making the situation worse for the newly transplanted seedlings. We recommend that you reduce the light levels by using a light shade, reduce the number of lights or increase the distance between the lights and the plants. This will also help reduce transplant shock. As soon as the leaves are standing up again, you can remove the light shade or reset the light setting for normal growth (but do so right before the dark period to allow for a transitional phase). When the leaves are ridged again (standing up), this means the roots have begun to function once more providing lots of water for the top part of the plant. CANNA RHIZOTONIC will speed up the recovery process, reducing the number of days and hours that it takes.

Question

I've just bought some CANNA Terra Professional. My question is when I should begin using CANNA Terra Vega. Or should I not use it at all?

Answer

The first time you wet the substrate, you can use plain water, but we recommend using some nutrients to make sure the ratio of the nutrients in the CANNA Terra Professional stays where it should, and that all the elements, even those that do not attach to holding sites, remain readily available to your plants.
You can find the dose recommendation on: www.canna-uk.com/growguide.

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 whether these products would be good for this system?

Answer

You will need BIOCANNA (Vega and Flores) with their additives (BIORHIZOTONIC). These products have been approved as organic input materials, checked by the OMRI and the CU (independent institutes) and certified by many different organic programmes. You will also need an organic peat-based medium such as Bio Terra Plus. An organic nutrient can be used in an ebb-and-flow system, but organic nutrients will start to decompose quite rapidly once they are mixed in with the 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 CANNA TERRA for 4 years now and it has always been excellent. My room is spot on, but I have just started getting a problem with some of my plants. They were all lovely and dark green during the vegetative period for 4 weeks, then I switched to 12/12 and after about two weeks I noticed that a few of them were a lighter shade of green and not 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. I checked with an expensive pen.
I use CANNA Terra Vega and Flores, CANNA RHIZOTONIC, CANNAZYM, etc., and all in CANNA Terra Professional soil. Any ideas...?

Answer

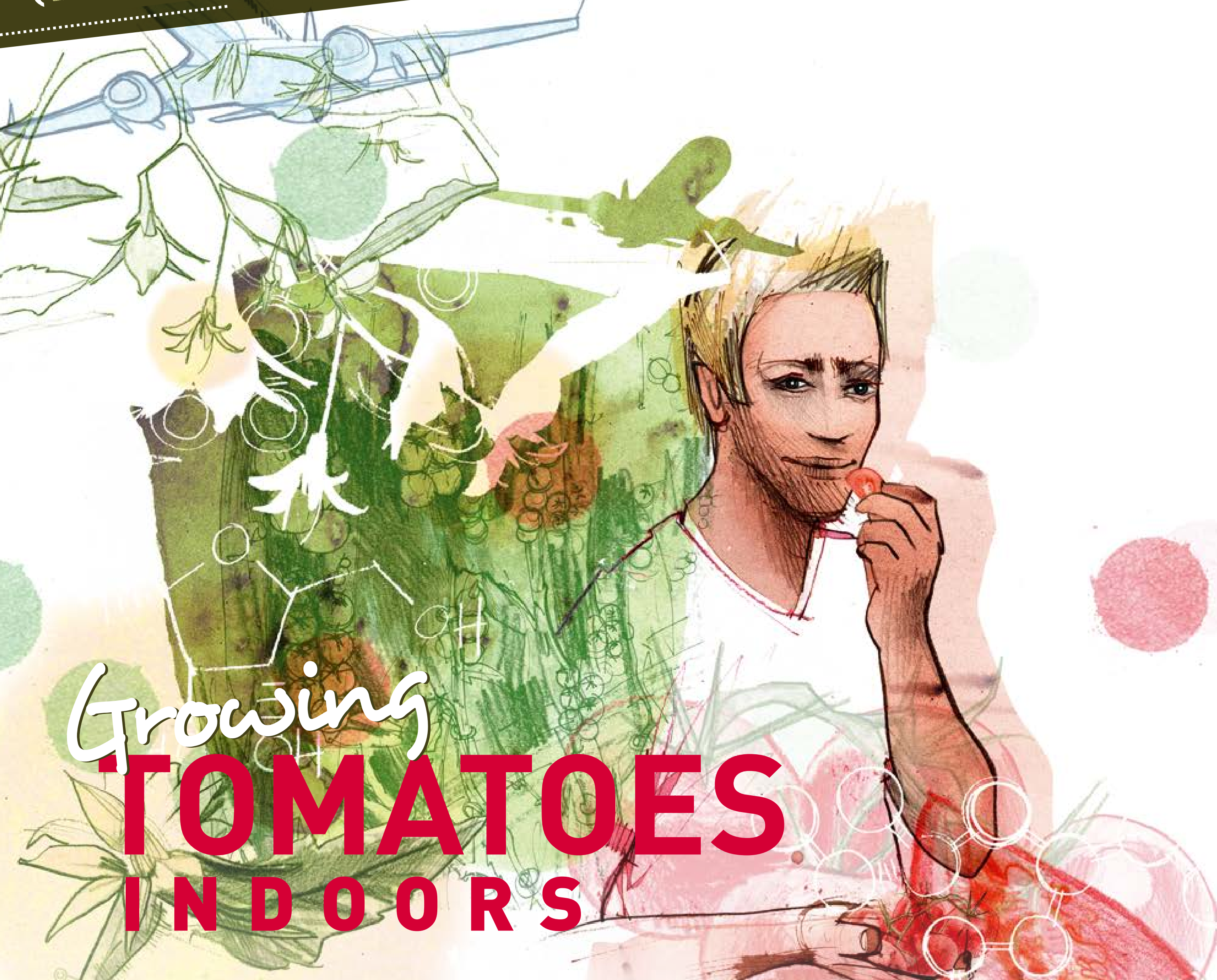
This certainly is strange. During the vegetative period, when nutrients are being taken up, the pH level will rise. As soon as you go into the flowering phase, pH will fall due to the uptake of potassium. The TPP has lime in it to compensate for that root activity and will maintain pH at 5.8-6.2.
So what could have gone wrong? Here are some things you can check and ways to try to fix the issue.
1. A problem with the liming of the TPP
Check the pH of the TPP - it should be around 6.1 when new.
Tell us the batch code and we will check our sample from this batch.
I don't think this is the issue, however, because we check these values using many samples before accepting them.
2. You have reused the TPP, and you have used up all the lime for your previous crop.
Try to get some lime into the Terra without damaging the roots (1 gramme for every litre of Terra)
Use new Terra next time
3. Microbial life is affecting the pH results.
There are algae or bacteria living in the reservoir or the container which you captured the run-off water in. Make sure these remain clean.
Make sure you measure the pH as soon as the water runs off.
4. Check your pH measuring equipment (calibrate regularly with the full range suggested). Remember that the pH probes must be changed regulalry. They can be extremely variable in accuracy, even when calibrated correctly and even when using a more expensive unit. Always try to verify a reading with a second calibrated pen.
You also need to understand that any changes to the plant, including day length, will affect the roots. During the change in light, the root function slows down as the plant needs less as the structure modifies and growth slows slightly. If these plants have been even slightly over-watered or if they have gone from the correct level of moisture to wet with the slow-down, the medium remains wet, the pH will fall due to anaerobic processes such as the build-up of ammonium. An additional issue that can affect both pH and the symptoms that you are seeing is adding beneficial microbes too frequently. The build-up of these organisms enables this process to speed up as the microbes out-compete the plant for the available nutrients, depriving the plants of what they need. If you must add these microbes, add them once at the start. Flush with water that is pH adjusted to a higher level. Follow this up immediately with a full nutrient feeding. On Terra (with low pH), this will not be enough to lift the pH in the substrate, but during the change from high pH to low pH, the plants can take up some nutrients.
This is about all we can think of. If the problem persists, then please use the technical form and indicate all the room conditions and anything else that might be affecting your plants. Having a fuller picture will enable us to give you a better answer.

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 and sturdy looking plants, each about a metre in height, basking under the combined output of a double ended 1000w HPS and a 315w CMH, spread over an area of around two square metres.

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 discolouration 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!

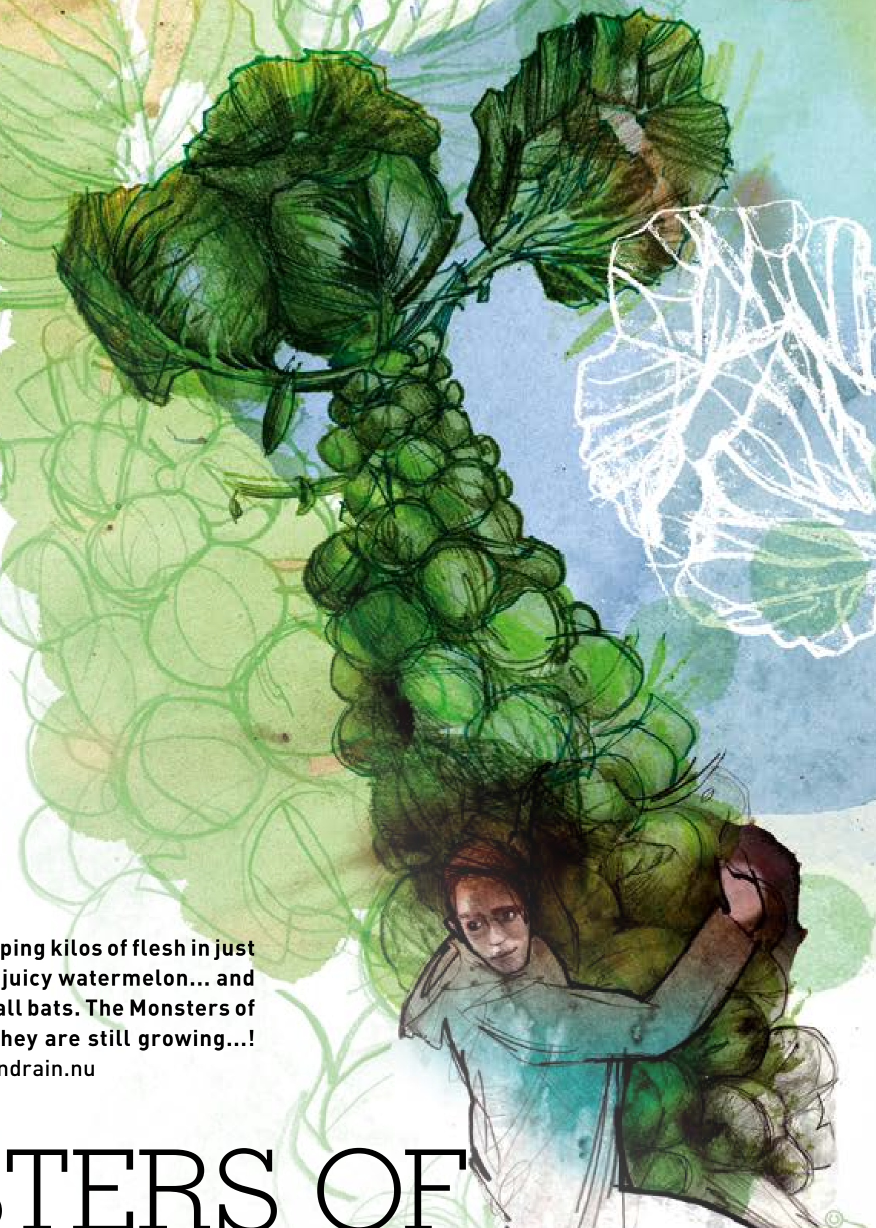
I spoke to a tomato expert and he suggested that my plants weren't able to build sufficient sugars in my less than ideal environment. I decided to switch them to tap water (no nutrients at all) for a week and let them continue to ripen—just in case they sweetened up. And guess what? I've just been downstairs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

Photo courtesy of Diego Lopez Alvarez.

RIO TINTO

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

- The cracked soil of the Rio Tinto riverbed proves that harshness can be stunningly beautiful.
- The Rio Tinto, or Red River, originates in the Sierra de Huelva mountains of Andalusia, in the town of Nerva.
- The river and its naturally red waters are characterised by very high acidity of between 1.7 and 2.5 pH. The water contains high levels of heavy metals, mostly iron, copper, cadmium and manganese.
- The Rio Tinto is often considered to be 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.
- The river's mines were abandoned for centuries until they were rediscovered and re-opened by the Kingdom of Spain in 1724.
- Large-scale excavations by British companies in the 19th century made the river extremely dangerous for people due to the high levels of acidity.
- The high acidity keeps normal people away from the waters, but attracts many scientists. There are micro-organisms living in the water that feed only on minerals and have adapted to extreme habitats.
- NASA chose this habitat to study the potential similarity to the atmosphere on Mars.
- The water provides conditions similar to Jupiter's moon Europa, which is thought to contain an acidic ocean underneath its surface.
- The presence of life in the Rio Tinto – bacteria that 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 sea in the Gulf of Cadiz at Huelva.



Oh my! An enormous 766 whopping kilos of flesh in just one pumpkin... or 122 kilos of juicy watermelon... and cucumbers the size of a baseball bats. 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 worryingly massive but they don't mean any harm, so don't fret. Many a gardener enjoys entering competitions to see who can grow the largest vegetables, and some take a lot of pride in their techniques, although it is as much good luck as it is hard work and experience. Either way, there are written accounts of giant vegetable competitions dating way back into history. Through years and years of selective cross-breeding between large pumpkins and giant pumpkins, for example, world records are constantly being smashed.

But the road to achieving that legendary giant fruit or vegetable is tough and fraught with perils. Initial enthusiasm frequently gives way to tragedy as insects, rot or an assortment of four-legged pests threaten your gentle giants as they swell up to enormous proportions. It is lovely to watch a giant grow to its full potential. You can literally watch your giant pumpkin grow as it gains an extra thirteen kilos on a nice sunny day in August. Would you like to give it a go? Well, here are five steps to success.

Pick the right 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 into the varieties that are most likely to produce giants, but the name will usually give it away. There's the Russian Mammoth Sunflower, for example, which grows up to six metres tall. Check out the inset for more promising varieties.

Give Them a healthy start

Boost your soil well before you put your plants in. Spread manure or compost during the autumn prior to planting. Make it comfy for them. You might want to have a soil test done and replenish any nutrients and micronutrients that are lacking. Giant vegetables are hungry little darlings so they need lots and lots of yummy food, make sure they get enough. Slow-acting organic fertilisers added as you plant will be like a bowl of nutritious soup for your gentle giants as they need it. Know what type of fertiliser your plants need. If you're growing the plant for the fruit, like pumpkins and tomatoes, you'll need a fertiliser that's high in potassium and phosphorous. If you're growing a leafy vegetable, like cabbage, you'll want a fertiliser high in nitrogen.

Water them right

Giant vegetables are not only hungry but thirsty too. Spoil them rotten (but not literally!). You'll need to provide regular and deep irrigations or your little treasures 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 sit in a water-logged bed.

Only leave the best fruits

The more fruits there are on your plant, the smaller they will be in the end. If the fruits have to compete for nutrients, they are not going to be as big as you want them to be. They might taste good but they just won't have what it takes to be world champions. Remove all but the three or four largest, healthiest-looking fruits. Later in the season, you might want to thin down to just one, but keep a couple of extras at the start just to be sure. Don't worry about too much foliage - foliage is what feeds your fruits and helps them grow larger.

Keep your eyes peeled, worry non-stop, but keep your hands off

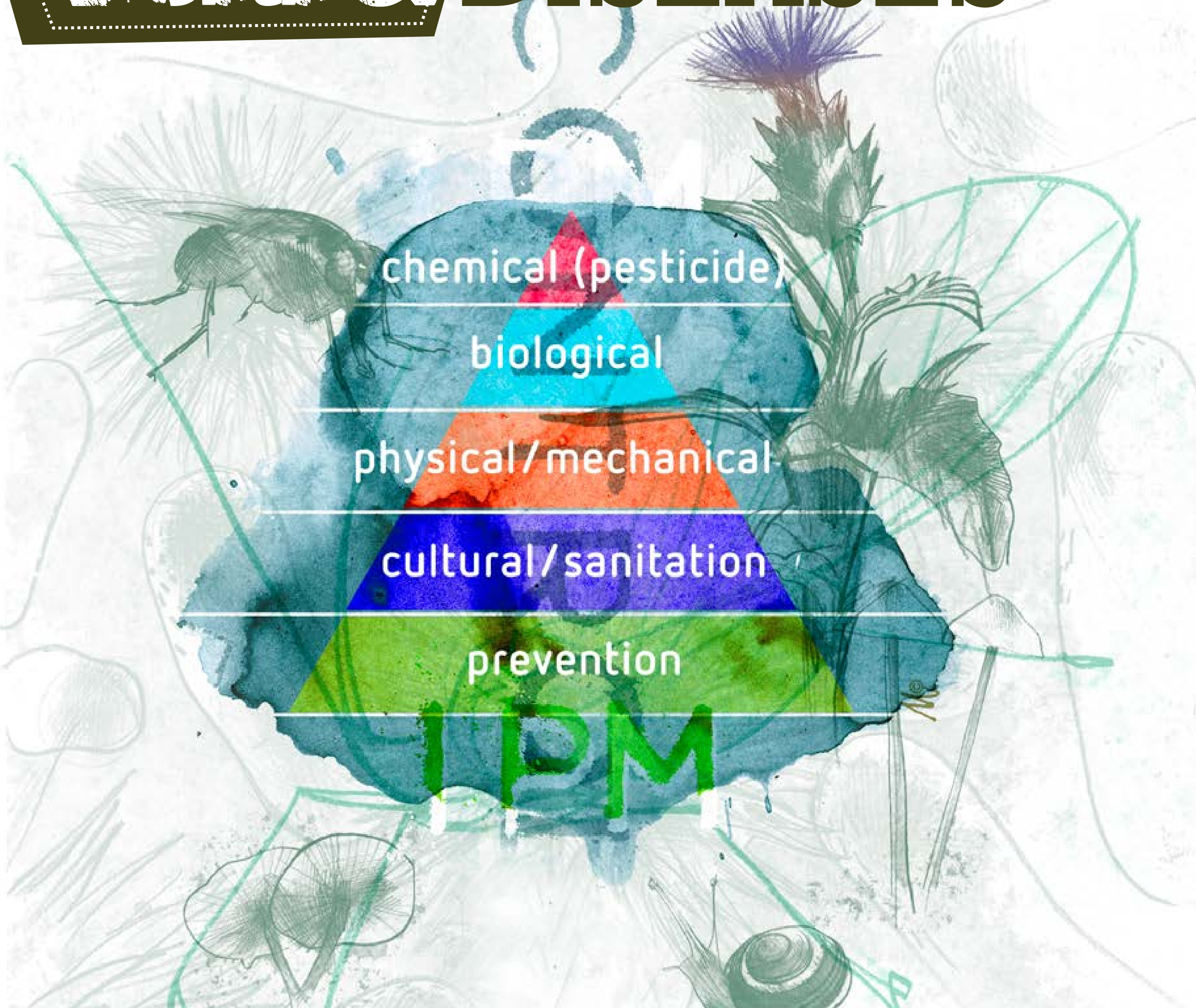
Pests, diseases and culture problems can move in quickly and ruin an entire crop before you know it, especially when there is only a handful of fruits to begin with. You have a lot to worry about. So check the plants daily and act as soon as action is needed. Otherwise, just sit back and let your babies grow and become those beautiful veggies that you always knew they could be. Don't fuss too much as plants like it quiet. Admire your fruits from a distance but try not to touch them, unless necessary.

As you wait and watch your plant go from big to huge to ginormous, try to make some new friends. You will need them to help you eat those 876 litres of pumpkin soup, or similarly vast quantity of coleslaw. 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 ambition, you might not have the time. Luckily you can buy seeds with the right genes to set that new world record. Here are some varieties to look out 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



INTEGRATED PEST MANAGEMENT (IPM)

Pests are living organisms that damage or interfere with desirable plants in our fields and orchards, landscapes, or wildlands, or that 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 of 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, and this can cause confusion when the generic term "pesticide" means "insecticide" to some people. For this series of articles, we make a distinction between pests and diseases: pests are animals or insects and diseases are fungi, bacteria and viruses (pathogens).

Integrated Pest Management (IPM)

The UN's Food and Agriculture Organisation defines Integrated Pest Management (IPM) as "the careful consideration of all available pest control techniques and the 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 minimise risks to human health and the environment. IPM emphasises 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 (otherwise known as a proactive approach or prevention) are a key part of Integrated Pest Management, rather than having to take more drastic action (such as chemical intervention) at a later stage in order to resolve a pest problem. In other words: prevention is better than cure.

The most effective, long-term method of managing pests is by using a combination of methods that work together and reinforce one another. Approaches to pest management are often grouped into the following categories.

Cultural controls

Cultural controls are practices that help to stop pests: establishing, reproducing, dispersing and surviving. For example: Changes to irrigation practices can reduce pest problems, since too much water can promote root diseases and weeds. Also, too much nutrient load can give a plant softer leaf tissue making it more attractive to leaf sucking insects. Optimising 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 optimised for the plants.

Mechanical and physical controls

Mechanical and physical controls kill a pest directly or make the environment unsuitable for them. Traps for rodents are examples of mechanical control. Physical controls include mulches for weed management, steam sterilisation of the soil for disease management, or barriers such as screens to keep birds or insects out. Cutting off and removing parts of a plant that have been infected with a disease is also a form of physical control and can help reduce the spread of diseases.

Biological control

Biological control is the use of natural enemies—predators, parasites, pathogens, and competitors—to control pests and the damage that they cause. Invertebrates, plant pathogens, nematodes, weeds, and vertebrates have many natural enemies.

The natural enemies of insect pests are known as biological control agents or beneficials and include predators, parasitoids, and pathogens. The 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 among infested crops, while others occur naturally. Not all naturally occurring beneficials can be bred and therefore cannot be purchased.

Chemical control

Chemical control is the use of pesticides. In IPM, pesticides are only used when they are really needed and in combination with other approaches for more effective, long-term control. Pesticides are also selected and applied in a way that minimises the 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 use as many non-toxic forms of pest control as possible, while monitoring the pest populations, and establishing population or activity thresholds before going to the next level of control. These thresholds represent the point at which action must be taken to avoid unacceptable economic loss. Of course some loss is inevitable and must always be allowed for in your production scheme, but by using these techniques losses can be reduced and the need for toxic substances can also be minimised to only when this is absolutely necessary. The next few editions of CANNAtalk will examine these different pest-control resources closely, how to employ them, and what we can reasonably expect from using them. •

Figure 5: Common beneficials, both naturally occuring and commercially bred for crop protection.

THOUGHTS ON WATERING PLANTS

PART 2 PUTTING IT TOGETHER

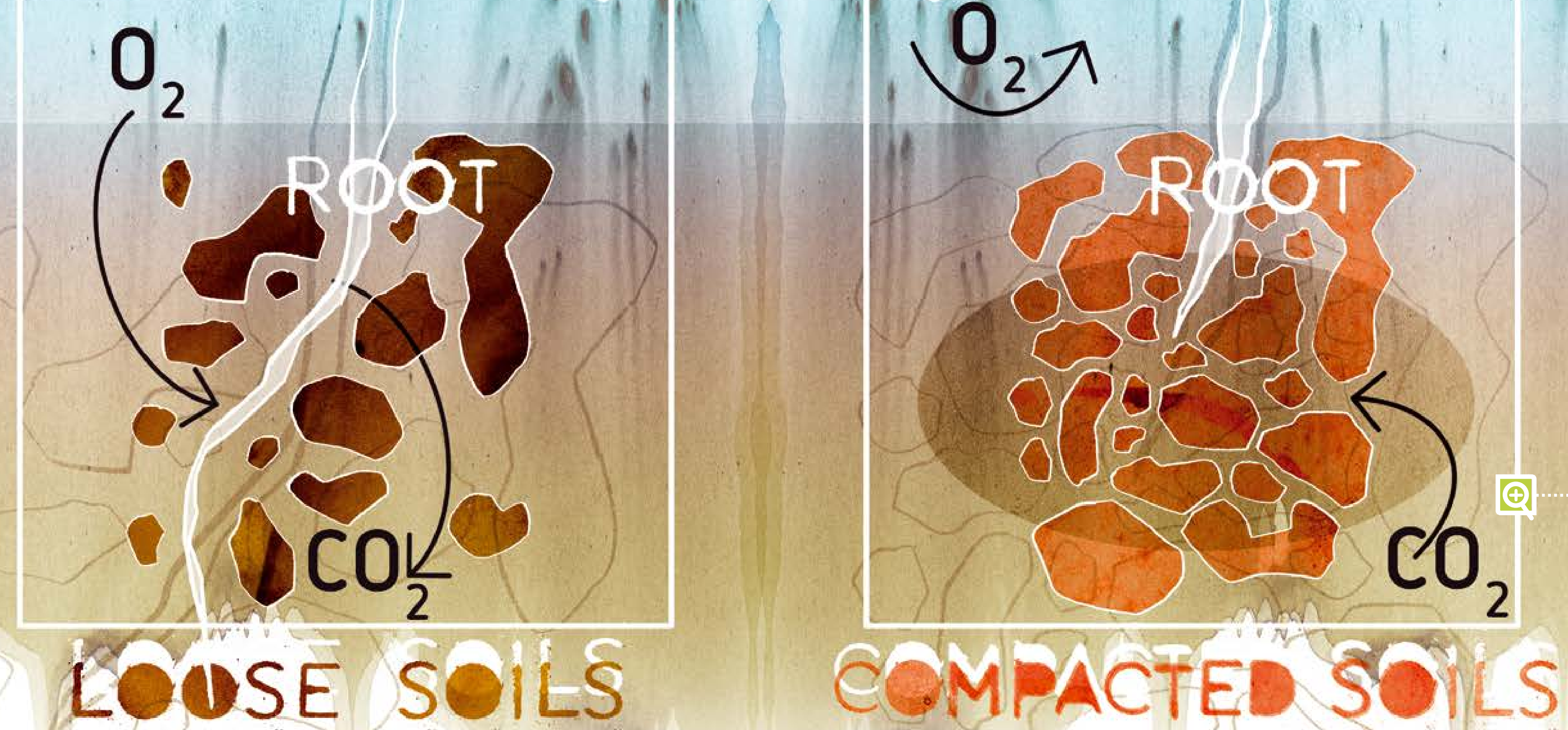


Figure 6: The effect of compaction and decreased porosity on root growth and gas transfer.

NOW, EVERYTHING WE TALKED ABOUT IN PART I WAS RELATED TO EXTERNAL CONSIDERATIONS OR FACTORS THAT AFFECT THE USE OF WATER IN OUR GROWING SYSTEM. THE ROOT SYSTEM IS THE INTERFACE FOR WATER UPTAKE AND NEEDS TO BE FUNCTIONING PROPERLY. IF A PLANT SITS IN WATER FOR TOO LONG, THE ROOT SYSTEM WILL FUNCTION LESS EFFECTIVELY, AND IF IT BECOMES WATER-LOGGED, IT WILL BEGIN TO DIE OFF. IF THE ROOT SYSTEM DRIES OUT TOO MUCH, ON THE OTHER HAND, THE STOMATA WILL CLOSE IN RESPONSE TO THE LACK OF WATER IN THE SYSTEM, THE ROOT HAIRS WILL DIE OR STOP FUNCTIONING AS WELL AS THEY SHOULD. IT IS ALWAYS A FINE BALANCE BETWEEN RIGHT AND WRONG, BUT LUCKILY WE HAVE SOME LEEWAY ON EITHER SIDE; HOWEVER, THIS IS A MATTER OF MINUTES NOT HOURS. EVERY DAY, THE GROWER HAS TO ADAPT. IF YOUR HUMIDITY DROPPED TOO LOW FOR AN HOUR LONGER DURING YOUR LAST WATERING PERIOD, YOUR TIMING WILL BE OFF.

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 colour becoming a little duller, especially in splotches? Don't be afraid to delay or shorten a cycle when needed, and base all decisions on an average of the whole crop. Treat your whole crop as one container with a bunch of cells. Figure out why one plant 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 moment just before water is no longer freely available (based on the needs of each species) and is related to the medium or the humidity dropping to less than 100% at the root surface, which will start to kill the root tips and root hairs. But how do we know when this point is? Fortunately, you can water the plants before this point is reached. The key line of reasoning that I hope you take away from this is aeration.

Aeration is basically how much air there is around the roots. Roots require oxygen to function, but not CO^2. Aeration can be expressed as the ratio of small pore space (which contains water) to large pore space (which contains air), or as a percentage by volume. It can range from 0 to 100%, with the lower values being non-aerated water and the higher values Aeroponic systems. Aeration is essential to understanding watering.

Mediums vary in composition but the basic function remains the same: to provide support for the plant and its root system. The medium functions both as a mechanical anchor for the plant and as a reserve containing the water/nutrient buffer. Not all mediums are created equal. Some have physical or chemical limitations that must be overcome before use. But all mediums function to anchor the plant and most hold some moisture and/or nutrients. Porosity defines how much space within the medium can hold air and how much holds water. It is porosity that determines root functionality. *(See figure 6).*

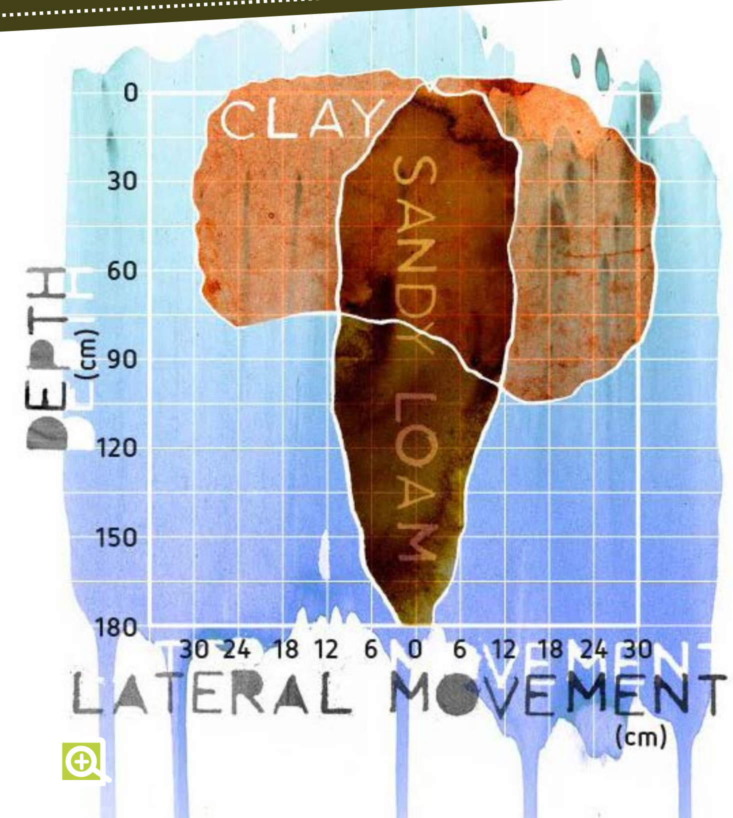


Figure 7: Comparison of soil water movement in different porosity soils with clay (particle size ↓ .002 mm) porosity of 45% with ↓20% air or large pores, and sandy loam (particle size 0.002 to 0.5) porosity of 48% with ↑ 40% air or large pores.

Pore Structure

There are two main types of pores and four subtypes. Megapores, or large pores, are defined as pores bigger than 0.05 mm and these allow water to move down through the medium by gravity, as well as gas diffusion throughout the medium. Micropores, or small pores, are smaller than 0.05 mm and hold water against gravity (capillary water). There are four classifications of small pores but the two that we are concerned with hold available plant water: mesopores (0.03-0.05 mm) and micropores (0.005 – 0.03 mm). The mesopores accommodate fungi, root hairs and water, while the micropores hold water and bacteria but are too small for fungi. All these pores of differing sizes contain the water reserve for the plant. Excess water will drain away. The more aerated the soil is, the faster it will drain away *(See figure 7)*.

We can employ a wide range of methods to get the aeration we need: we can increase the fibre size in peat or coco, we can change the density of rockwool, or we can increase the size of clay pebbles. All this depends on the particular growing system we are using and/or the grower's own preferences. So, whether that medium is fresh air (aeroponics), mineral soil or any other type of medium, there are three things that are always present in a growing container: air, water and solids. The solids are (of course) the roots themselves, the particles of growing medium, and anything else that is not air or water. These are the factors that influence how much water the root zone environment will hold.

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 coco.

Figuring it Out

If I have a true 10 litres container, holding coco mulch, and my porosity is 60% with a ratio of 60% large space, I know that a total of 60% of the volume, or 4.8 quarts, is pore space, and 60% (2.88 quarts) of those are large pore spaces that will hold only air (after the excess water has run off). On this basis, I can see that the most water that this root system environment will hold is 2.18 litres total. This is what the container will hold in total, 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 have about 2 litres of water available. You cannot put more water in, because it will simply drain away. And it cannot physically hold any more unless the porosity changes (in fact, it will change over time if you are using a degradable material like peat or coco). You can put 5 litres in the container at one watering but a maximum of 2.18 litres will stay in the container after the excess has drained off. This excludes continuous watering. There is some lateral movement in the medium, and how much this occurs will depend on the porosity of the medium. This will influence the number of drippers and/or their 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 two or more drippers *(See figures 8 and 9)*.

This determines the duration of your watering. If my system provides 1 litre per minute from one emitter, then I will run the irrigation system for 2.4 minutes to get my 2 litres of useable water and saturate my container, and add about 20% more to ensure that I have wetted the entire medium and helped wash away some of the salt residues. Now, from what we have learned already, if that 7.5 litres container contains an established plant and canopy that occupy one square metre, I can reasonably expect to water that plant three times in 28 hours for 3 minutes using a 1 litre/minute dripper. But since I have to work with a 24-hour clock, I will set it up to run at least twice during the periods when it is receiving light. Always try to water when the lights are on, but no later than about one hour before the dark cycle is due to start. Only water at night if the plants are 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 the number of applications over time because as the roots grow, they will take up some of the volume of the container, so the container will be able to hold less water and subsequently require more frequent watering with decreasing amounts (the square metre will still require approximately 5 litres of water over the 24-hour period). Older plants that occupy the same area will not necessarily use more water just because they need watering more often; it is more likely that the water 'buffer' will decrease as the plant root system grows, actually preventing some areas within the root balls from getting water (we know this condition as 'root' or 'pot binding'). So we have now discussed all the variables that you need to take into account when deciding how often to water, and we have also answered the question of how much water to apply.

It's important to remember that as the properties of the growing medium change, we will need to adjust our calculations too. If you are growing in air – aeroponics for instance – there is only air: water availability is a function of the surface water tension and can be measured by looking at the humidity or free moisture. In this environment, we will need to water frequently but the duration will be short, just enough to wet the roots until water drips from them. It is important to remember that when applying irrigation water in any system other than true aquaculture, the root water should always contain the right concentration of oxygen, and the roots should never be covered for more than 30 minutes. More than this will kill the root cells. If we apply water to the top of a container for 3 minutes, it will drain away under the force of gravity and the roots will not remain covered with water for more than a few minutes. The only reason to oxygenate your water using DO (dissolved oxygen) systems or air stones is when your roots remain covered for longer than 30 minutes. That should only happen in an aquaculture system. (In this author's opinion, using this technique in any other system would be a waste of resources because the oxygenated water is not around the root cells long enough to really make a difference, as long as you are irrigating correctly. In addition, it will force pH changes in the reservoir which is important when using better grades of nutrients. Additionally, if you are using an air stone and pump, and drawing air from a CO^2-enriched environment, you will actually drive oxygen out of solution and replace 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 mineral or organic-based soils or soilless mixes. These mediums will hold water for a time and you simply need to determine when they have dried out enough to water the crop again. In hydroponics, on the other hand, we time how long it takes to dry out to the point at which damage occurs down to the minute. And this really does vary continuously according to relative humidity and air movement and it will fluctuate over the 24-hour period. It is easier to tell when it is time to water in a soil or soilless mix.

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?

With systems based on a water-retaining medium, you have various options for determining the frequency of watering. You need to let the medium dry out. As we said in the previous part of this article, if we keep our crops a little drier, they will be able to handle drought conditions a little better and harmful pathogens will have a hard time taking hold. You can do this mathematically, as we showed you above, you can look at the colour changes (a less reliable method) *(See figures 10 and 11)*, or you can go by the weight of the container. If your container weighs 32 grams bone dry and 62 grams wet, you should allow it to drop to around 40-45 grams at least before watering. This will change as the plant grows. Good growers will develop a feel for this through hands-on experience. *(See figures 12 and 13)*.

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.

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

What you have to do as a grower is recognise what is occurring and know what you need to do about it. There is no easy solution when it comes to watering. You have to figure it out for yourself, and hopefully this article will provide some useful information to help you to realise what it is you are trying to achieve, and how your situation will affect that. All the factors that we have mentioned can and will change daily, and I mean daily, and must be factored in for a successful irrigation strategy. It sounds complex, and there is a lot to remember, but if you pay attention to the variables and techniques that we have discussed, and adjust them as needed, you will have mastered the most difficult part of growing. Irrigation makes the difference between a bad grower and a good one; and between a good grower and the best grower. •

TIPS

Here are some pointers for you to remember when devising your irrigation strategy:

- Water consumption increases with increasing temperature and decreasing humidity.
- Water consumption decreases with decreasing temperature and increasing humidity.
- Higher temperatures require more frequent watering with higher volumes to reduce unwanted salt build-up.
- Higher humidity requires less frequent watering and lower total volumes, but keep an eye on the build-up of salt.
- The smaller the container, the less moisture it will hold and the quicker it will dry out.
- Low-drainage substrates need watering less frequently but with higher volumes.
- High-drainage substrates need watering more frequently but with lower volumes.
- Higher-drainage substrates require more drippers or the use of spray stakes to ensure the lateral movement of water in the substrate (less capillary action).
- Lower-drainage substrates require fewer drippers because the water stays around long enough to move laterally (more capillary action).
- It is better to start with a smaller container and allow the root system to develop before potting up to an intermediate size pot or to the final size. (A three-inch cutting should not be potted directly into a 27 litre pot; use a three or four-inch pot first, long enough for a decent root system to develop, and then pot up.)
- DO NOT turn on the irrigation clock and forget about it; this is a living system that changes daily. Make sure the plant is drying out before the cycle starts AND that it is not drying out 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 we need to drink the right amount of water to stay healthy. Not enough of it and we can develop problems like kidney stones (accumulations of salts). Too much of it will disrupt our digestive system. And way too much of it can even kill us. See where I am going? There is a balance that needs to be found, and that applies to gardening too. Our bodies give us plenty of clues about when we need to drink but by the time our plants give us those clues, it's often too late, the damage has been done and crop potential suffers as a result. So the question: " When should I water my plants?" Remains as relevant as it always was. Unfortunately, there are no magic numbers here. You can get advice from lots of people, but beware of anyone who tries to give you a simple answer like every three days!

The factors that determine the answer to that question are numerous. There is the size of your plants, and the containers they're growing in. There is the issue of how much water the growing medium can hold. Then there's the climate, of course: the intensity of the light and how much wind there is will play a dramatic role. Above all, there's the matter of which type of plant you're growing.

Sometimes growers worry about putting too much water in the container. So let's clarify this: it is impossible to put more water in a container than it can hold. As soon as the medium reaches saturation point, any excess water will flow out from the bottom of the container, as long as it has proper drainage. As the excess water drains away, the growing medium will rebalance itself back to its normal physical water and air retention characteristics, pulling in beneficial fresh air.

So, if the plant is the right size in relation to the growing container, it should never be exposed to too much water. On the other hand, if the container is too big or if the medium holds too much water for the kind of plants that are being grown, then yes, you could drown the plants. We cannot stress enough that most plants benefit from frequent repotting. Another great and common way of drowning a plant is to allow the container to sit in a water filled saucer. This means that a good portion of the growing medium stays saturated with water, depriving the plant's roots of oxygen for an extended period of time.

Assuming that all the parameters are correct, most plant problems associated with apparent nutrient deficiencies are actually caused by watering problems - usually over-watering or under-watering. Some emotional growers are even liable to do both, so that they encounter a lot of plant problems with confusing symptoms!

Over-watering does not mean 'giving too much water', it means watering too often.

Similarly, under-watering means watering not often enough. If you are growing in containers, it is very seldom that all your plants will need watering at the same time on the same day, even if you are growing similar-sized plants. If you water all your plants according to 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... Always try to group together plants with a similar performance and only water those groups when they need it.

When you do water your plants, give them enough nutrient solution to reach run-off point and make sure that the run-off... well, runs off! This will improve your control of salt levels and also ensure better oxygenation in 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 LITRE BOTTLE OF **CALMAG AGENT**

	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 is enough for us to check), and if we pick your name,

A BOTTLE OF CALMAG AGENT COULD BE COMING YOUR WAY.

Winner puzzle#30

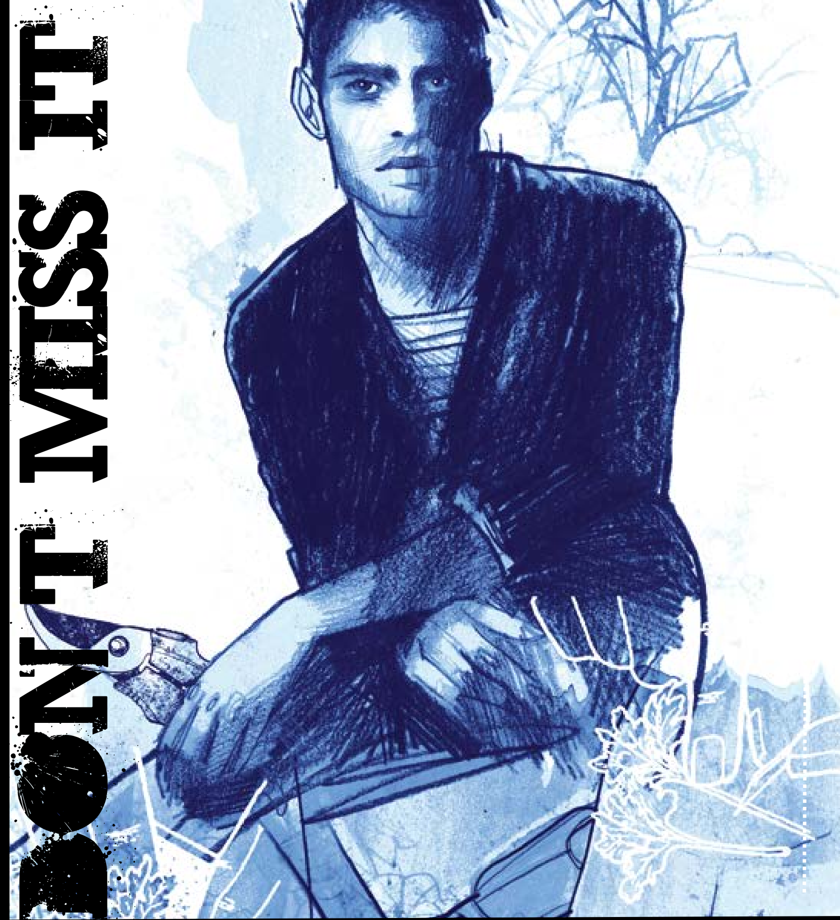
The winner of last Sudoku is **Mr. Evans**. Congrats on your 1 litre bottle of CANNA RHIZOTONIC.! We will contact you as soon as possible to make sure you receive your prize. Enjoy!

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.

Are you ready to put new plants in your garden? In the next edition we will spill the beans on, well, how to grow beans. Don't miss it.

DON'T MISS IT



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

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

Request information

- [ ] AQUA Fertilisers (Recirculating systems)
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- [ ] List of shops in my area
- [ ] Send me a CANNA Calendar 2016. I've secretly enclosed 10 pounds in this envelope to pay for it.

Solution to the puzzle:

#32

SERIOUS GROWERS

CANNAtalk:

- Is published by CANNA BV, a company dedicated to finding the best solutions for growth and bloom.
- Is distributed through local UK retailers and wholesalers.

Editor: Karin Brinkman
E-mail: info@CANNAtalk.com
Phone UK office: 0870 240 2991
Printed by: Koninklijke Drukkerij E.M. De Jong

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