

CANNAtalk[®]

MAGAZINE FOR SERIOUS GROWERS

ISSUE 15 2012

RUN-TO-WASTE

A basic primer



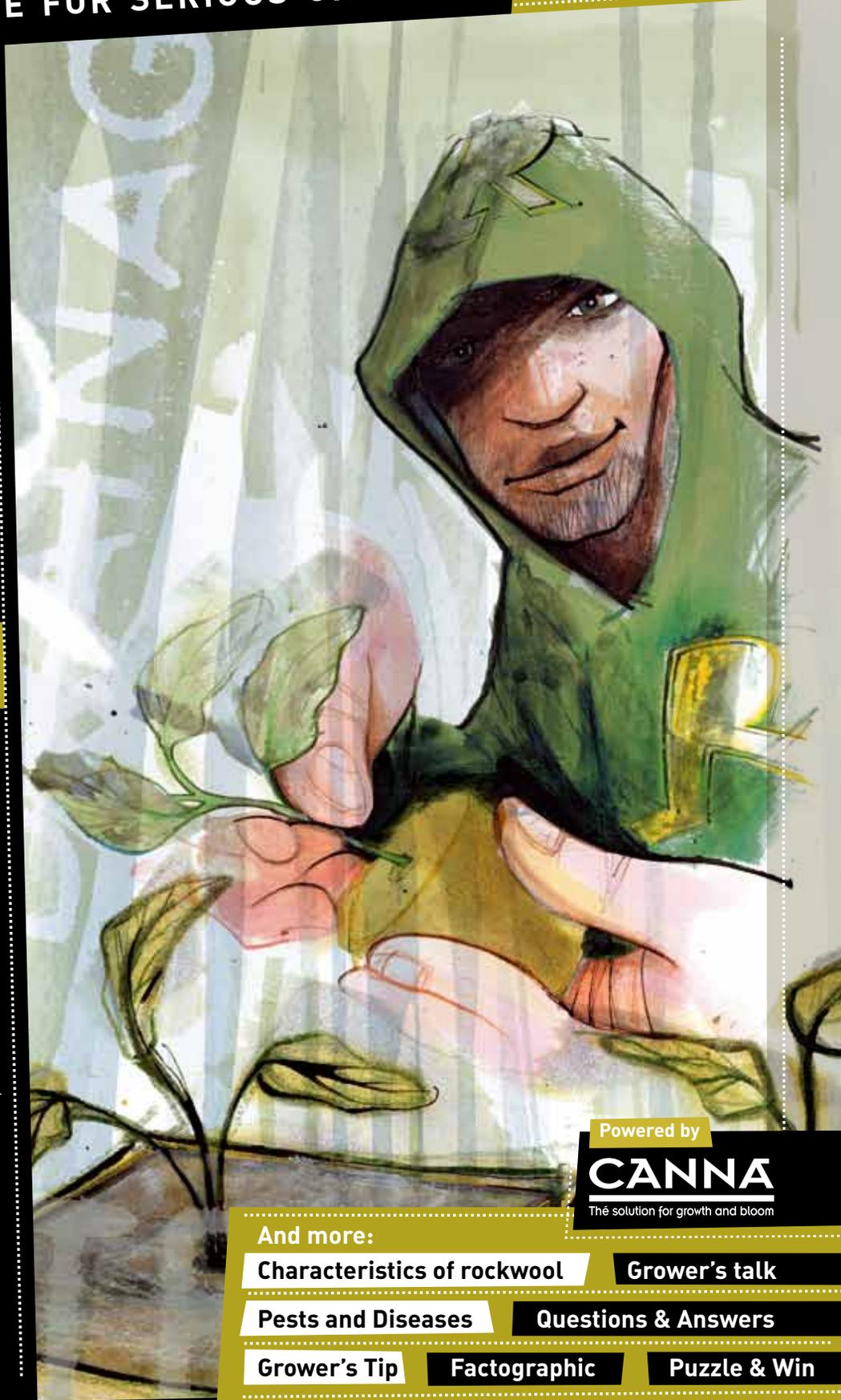
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HOTalk:

This is the first CANNATALK issue of the new year. 2012; a special year. Will this be the end of time? Will earth be destroyed? Is it the dawn of a new era? Were the Mayans, Nostradamus and Charlie Frost (Woody Harrelson in the movie) right? Or will it turn out to be a whole lot of BS? I guess we have to wait and see. Until then I would make sure to make the most of life, just in case. So enjoy, you never know if and when that day will come.

Here at CANNA we are excited that another new year started. We are full of ideas for CANNATALK magazine to inform and help you with everything you always wanted to know about growing.

This issue has two interesting Research articles; one about Run-to-Waste and the other about Rock wool. As usual there's a practical tip for you to try on page 23. The Q&A section just might answer one of your own questions. If not, write us through our website www.canna-hydroponics.com. We'll be happy to help you.

We hope this issue contributes to your joy in growing and we look forward to continue that in and after 2012! Have a wonderful year!

Enjoy reading,
Jeroen

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Figure 1: Illustrated example of a run-to-waste system (RTW). A RTW system is a style of watering where the water flows through the medium and passes out of the system to never return.

RUN-TO-WASTE (RTW) IS A SIMPLE CONCEPT WHEN APPLIED TO HORTICULTURE THAT MEANS EXACTLY WHAT IT SAYS; IRRIGATION APPLIED UNTIL IT MOVES OUT OF THE ROOT ZONE AND IS DISPOSED OF. IT CAN ALSO BE CALLED NORMAL, OR NATURAL, SINCE IN THE OUTDOORS, WATER MOVES THROUGH THE SOIL PROFILE. IT IS THE ONLY NATURAL SYSTEM FOR THOSE PLANTS THAT EVOLVED UNDER THESE CONDITIONS.

By Geary Coogler, BSc Horticulture

RUN-TO-WASTE

A BASIC PRIMER

The definition requires that water moves into a root system then flow out of the root system, usually on saturation. Crops in the fields are watered from above and the water moves into and through the root zone, and then exits the root zone once the root zone is saturated. It works the same in potting mix and containers watered from above. It can also be argued to include aquatic plants grown in moving waters such as streams, rivers and shore lines.

Run-To-Waste is an irrigation system or style of watering, nothing else, but meaning more. It also implies that nutritive elements are delivered to the plant in the water flow and picked up by the root system, deposited in the root system, or passes through the root system. Even where dry fertilizer is used in the mix, the water would dissolve it and deliver it to the next step: a process known as Mass Flow. It applies because in reality the system is



Figure 2: Sprouts germinated on rockwool.

RUN-TO-WASTE

A BASIC PRIMER

named after the way water (irrigation) is applied to a root system and dealt with afterwards. It flows through the medium (peat, rock wool, clay, even air), delivers its load of nutrients while collecting the excess and passes out of the system to never return. Even if no nutrients are put in the water, unless the water is pure, whatever is in it will

stay behind the same as the nutrients might have. The other system is recirculating where the drainage from the root zone is collected and sent back into a storage tank for re-application.

This is all there is to it, simple and effective, but as a growing concept it usually means much more.

First, an understanding of irrigation and fertigation is in order.

Irrigation is the provision of water to a crop. There are many ways to do this such as by hand, through an automatic system, or by natural rainfall. Which method is used depends on needs and budget, as automatic systems can be expensive and allowing nature to do the watering is a big risk. All of this, however, amounts to the same thing, delivering water to the root system. **Fertigation** is the application of fertility or nutrients in the irrigation water. This is an easy and cost effective way of accurately applying fertilizer to the crop. It combines both watering and fertilizer applications and is done on the normal schedule. There are two methods that can be used here: one is intermittent feeding and the other is constant feeding.

Intermittent feeding is where fertilizer is applied through the irrigation system once then only water is applied for a specific number of times after. This method can only be used in systems where there is the ability for elements to be stored and gradually released back to the medium's soil solution (water present in the medium); thus an affecting medium. An affecting medium is a medium with a buffering ability (it binds nutrients and releases them). This method leaves a longer period of time where the levels of available nutrients are gradually used up. The concentration of nutrients applied has to be stronger than optimal levels to get through the period of time where no additional nutrients are applied. A period of time exists where the level of nutrients is less than optimal.

Constant feeding is where fertility is applied with every watering cycle. This method can be used on any system and any medium. Concentrations applied are done at lower levels than intermittent applications and the amount of time medium fertility levels are below optimal is greatly reduced. Plant growth is less affected by decreased availability of optimal levels of nutrients.

All plants are grown as either a Run-to-Waste system or as a recirculating system.

There is no other way to do it short of beaming the water and nutrients into the plant directly. There are hybrid systems out there that have a hard time falling into one or the other but, in the end they are hybrids of the same two systems. These hybrids include Ebb and Flow (Flood and Drain), Aeroponics (air based), and Aquaponics (deep water culture). Air Based would be recirculating if the run off were re-pumped to the plant or RTW if not. Deep Water would tend to be recirculated depending on the size and type of the system and the number of plants in it. Flood and Drain is more of a Run-But-No-Waste system as the water moves up into the column of medium carrying its nutrient load and excess salts left over to the top of the column then leaves it there while it drains back down into the tank to be applied again and partially redistributing the salts as it retreats.



Figure 3

Figure 3 & 4: Growing hydroponically requires that the fertility is supplied in a water solution either directly in the solution or in an inert medium that exhibit no effect on the nutrients or the plant (figure 3). Where the plants are in an organic soil substitute it can no longer be considered hydroponic (figure 4).



Figure 4



Figure 5: Waste water is drained from strawberry production.

RUN-TO-WASTE

A BASIC PRIMER

Run-To-Waste is the most used system in cultivation and nature. There are two basic means of growing plants, the first is in a soil or soil-less organic medium, the other is hydroponically. Just because the fertility is applied in a liquid solution does not make it hydroponic. Growing hydroponically requires that the

fertility is supplied in a water solution either directly in the solution itself or in an inert medium such as clay, gravel, perlite, sand, mineral wool, or other materials that exhibit no effect on the nutrients or the plants. Inside of the hydroponic method of growing, the system can be either recirculating or run-to-waste. Where the

plants are in an organic soil substitute or mineral soil, it can no longer be considered hydroponic. Mediums that are capable of acting on the solution or plants, such as mineral soil or soil-less growth mediums, have multiple layers of influence where hydroponic only has one, the solution. These mediums will affect different aspects of what the plant 'sees', including pH changes, nutrient storage and release, water retention, and plant support. These variables can be difficult to predict, change, or mediate because even the smallest thing can affect them such as temperature, irrigation frequency, time, and a host of other variables.

Hydroponics depends on exact control to achieve its results where variables like solution temperature, selective uptake of particular elements, and others have to be monitored for optimal results. In an affecting medium, these things are controlled (buffered) more by the medium including pH buffering, slower temperature deviations, porosity for air and moisture control, and a continuous supply of nutrients. A big influence is on the structure of the root itself with hydroponic roots developing differently than medium based roots. Even though both roots may grow in a medium, inert mediums do not, by definition affect anything and show the roots only the solution. Plant roots that develop in mineral (soil) mediums or organic substitutes (soil-less) generally tend to allow greater uptake of water and nutrients where inert medium based roots develop the ability to restrict this uptake.

In the end, research has repeatedly shown that there is no appreciable increase in the size or quality of yields in hydroponics over growing in an affecting medium, it just serves different needs. Hydroponics is for specific situations where growing in typical systems is difficult, the grower has a good deal of knowledge on application of the principles, and has a great deal of time or the specialized equipment to monitor the system. Both systems use the principle of Mass Flow to provide a nutrient load. In order for an available nutritive element to be taken up by a plant, it has to be suspended in liquid; water. When an element is released from the natural breakdown or given off a Cation Exchange Site, it does so into a fluid matrix and becomes available to the plant in solution. In a hydroponic system, they are only supplied and available in solution. In an affecting medium such as mineral soil or a soil-less peat mix, it moves into the soil solution in response to concentration equilibrium where an equal amount moves onto the medium particle as remains in solution, or vice versa. As this solution moves to the root surface, in either system, it becomes available to the plant, a concept known as Mass Flow. With any method, the principle remains the same: nutrients have to be in solution to be taken up. They have to be in the correct amounts in relation to themselves as individual elements and to the needs of the plant. They also have to be in the correct form (ion) which is why pH is so important.

Which is the best system to use for growing; recirculating or Run-To-Waste?

There really is no right or wrong answer here; it is more a matter of convenience. Run-To-Waste systems require less effort but do generate a disposal problem. In any system, plants work with ratios of all the nutrients to themselves. If one nutrient, even a trace element like Molybdenum, is less than the plant needs, it becomes the limiting element. And all the remaining elements are in excess and will cause accumulation issues within the plant because they cannot be used. The plant will also develop slower because, while the amount of fertilizer may be at optimal levels overall, the limiter reduces what the plant can use and enters a deprived state. This results in a deficiency usually seen in the plant overall, but not always if it is a part of a process. (Chlorine, a critical component in the splitting of a water molecule for photosynthesis will show in an overall reduced energy state of the plant showing slower development.) Any elements left behind, good or bad, remain to affect this ratio the plant will see and thus can change the overall ratio of the plant. It is important that these excesses are removed from the medium through the drainage process. The drainage now has a different ratio in total so should not be re-applied to the plant to avoid the previous issues.

Recirculating systems have the same drainage concerns but are sent to a tank then re-applied. On passing through the root zone, the plant selectively removes the elements they are looking for while depositing other non-needed products and waste in the flow, and removes as much or as little water as it requires. This results in the nutrients becoming imbalanced and either weaker or stronger than is optimal. Recirculating tanks have to have both the pH and the concentration monitored on an ongoing basis. Optimal growing requires that the grower test the solution every so many hours and replace those elements that are used to maintain optimal balance in the solution. Then there is still a disposal issue since the storage tanks have to be drained periodically to remove the progressively higher waste products problem otherwise the concentration remains high but of no value to the plant.

In the end, it should be apparent that a plant responds to optimal conditions. The system should match the way a plant evolved with aquatic plants in a water medium and dry plants in a dry condition. Systems are different mostly for the grower's ease or needs. The needs of the plant in all aspects of growth must be maintained. The ideal method for growing is a marriage between what the plant needs and the grower can offer. •

Questions

Answers

Here's another bunch of grow-related questions that reached us through the website WWW.CANNA-HYDROPONICS.COM

As always, CANNA Research is more than willing to advise!

Question

Hi there. I have recently started using CANNA COCO and the matching nutrients and I had a couple of questions that I hope you can help me with.

- 1) When using COCO and the matching nutrients, is it still advisable to flush the soil mix with water every 2 weeks (for example) to make sure there is no build up of toxins in it?
- 2) I am still a little confused about the correct quantities of solutions I should be using as the bottle states 16 ml per Gallon but the chart on-line gives different values for different times such as 13 - 19 ml per Gallon. That is quite a difference so I am unsure what amounts to be using.

Answer

- 1) Leaching is only necessary if you have an excess of nutrients in the medium. So if you apply correctly, it is not needed. Flushing is done in the final 3-7 days prior to harvest to get all the remaining nutritive elements used up so they do not affect taste and quality after harvest and is done by stopping all fertilizer applications just prior to harvest and using plain water to remove remaining salts in the medium.
- 2) We always mention our doses in milliliter per Gallon. Even with a CANNA COCO A&B solution we mean 13 - 19ml /Gallon for example; 13 ml A and 13 ml B in 1 Gallon. If the plant needs more, you can give 19 ml A and 19 ml B in 1 Gallon of water. With the calculator, we can work with exact numbers, but on the chart you have to make the choice.



Question

My pH seems to be rising very fast above 7 in the slabs unless I check it twice a day, in 8 hours it's up from 5.8 to 6.5 no matter what I do. I just keep adjusting them with water taking samples from multiple places in the slab. The run-off is about 30%. I don't know what I'm doing wrong, they do grow but not optimally and there is yellow discoloration on the new growth as well as a little burned tips but not much, stems got a little purple in some places, but that's down on the plant, upper part look healthy except from the yellowing of the newly formed leaves older leaves seem fine.

Answer

Rockwool is basaltic. This means it will cause and increase in the pH. This is why you have to water the slabs first for 24 hours with water and CANNA Substra Vega (EC 1.2) and at a pH of 5.2. After this you open the slabs and start to water always with 5.2. Don't grow too wet in the beginning. The roots should take the pH in the root-zone down. Usually, the pH in the substrate likes to move down after the first few weeks. As time passes, you adjust your pH as needed, and at the end of your culture you will be applying the nutrients at a pH of 6.0. The high pH will indeed cause the discoloration. This should resolve in a week after you use CANNA Substra Flores.



I have 12 plants in a 3x3 tray, which have just passed

Question

I have a general question concerning CANNA PK 13/14. The instructions say to use the product for one week only during the bloom cycle. I want to confirm that I am only to use PK 13/14 at the beginning of the bloom cycle for 1 week, and to not use this product during the entire time.

Answer

The usage period for PK 13/14 is, in fact, only a 7-10 day window. Finding the window is something entirely different. It does not start at the beginning of the bloom cycle. It does occur within 3-7 days from the point you see a change in the growth of the plant to flowering, about the time you see the first flowers forming. From this point, in your first attempt, use it for about 3 weeks along with the other nutrients. PK is not a stand alone product, follow the feed chart. After the first crop, for subsequent crops, you might have to start it a day sooner or a day later and you can begin to shorten the time it is used. Ultimately you will find the window of about 7-10 days and the right point to start. It varies with each variety of plant and grower technique along with growing conditions can also delay or speed up the appearance of the window.

Question

I am using CANNA Aqua Vega A & B, Aqua Flores A & B and clay pebbles with an ebb & flow application. Couple questions about this system & nutrients: Currently I have been watering every 4 hours (4 times in a 24 hour light period) with great results. I just switched over to a 12/12 light schedule. Should I be watering the medium during the dark cycle? My concern being the plants may not use water or less water during the dark cycle, but I'm not sure. 2nd question: I've been following the nutrient schedule you provide. Since I just flipped my light cycle I am switching from the Aqua Vega to Flores. Should I cut off the AQUA Vega entirely when I start using the Flores, or ease the transition by using half Vega, half Flores for a week or so?

Answer

You do have to pay attention to the water needs of the plants in the dark. You are right to assume they do not use as much. It will depend greatly on the environment and age of the plant. As long as the plants are fine and roots moist overnight, you should not water then. When you do water at night insure it is fully watered and not partially. When changing the cycle, the time to change from a vegetative nutrient to a floral nutrient must be done as soon as you see the growth stagnate and the plant just begins to change appearance. Then switch completely over, not half and half.

We have a few questions that would really help us. 1) On your 1

is yes, you can use your water with

OTOTO

Question

I have just purchased CANNA AQUA for my recirculating system. What would be the ideal pH for this system?

Answer

The ideal pH for an AQUA system is between 5.2 and 6.2. In the beginning of your crop, the pH increases. Later on, especially when you use PK 13/14, the pH likes to drop. We advise to set pH at 5.2 in the beginning and increase it as the crop gets older. You should correct your pH only when you make a new nutrient solution, never adjust the pH in your reservoir during the cultivation, as long it stays between 5.2 and 6.2 it will work nicely.

Question

I would like to use CANNABOOST as a foliage spray. Could you please suggest the dosage of such applications during flowering phase? Should I pH balance the solution? Thank you!

Answer

Yes you can use it as a foliage spray. Use it at the low range of 8 ml/Gallons then you can adjust the pH to around 6 - 7. You can find more info on this subject at www.canna-hydroponics.ca/cannaboost





GROW IT YOURSELF

THE SWEET STENCH OF THE STINKING ROSE

AH, THE STINKING ROSE WITH ITS PENETRATING PERFUME. FOR THOSE WHO MIGHT BE WONDERING WHAT WE'RE REFERRING TO, HERE'S A CLUE. IT'S THE PUNGENT PLANT THAT'S REPUTED TO WARD OFF VAMPIRES. GARLIC, OF COURSE! LONG LIVE THIS DELICIOUS BULB, WHICH IS PACKED WITH HEALTH BENEFITS AND IS SAID TO BRING A SWIFT END TO A HOST OF ILLNESSES - AS WELL AS A COUPLE OF DATES!

Text: Marco Barneveld , www.bqurious.nl

Garlic has a long history of cultivation, having been grown for a variety of uses for millennia. Archaeologists have discovered clay sculptures of garlic bulbs and paintings of garlic in Egyptian tombs in El Mahasna dating from about 3200 BC, while a recently discovered Egyptian papyrus from 1500 BC recommends garlic as a cure-all for over 22 common ailments, including lack of stamina, heart disease and tumors. It's been said that the Egyptians fed garlic to the slaves who built the pyramids to increase their strength. But garlic was a food for everyone, equally fit for a pharaoh, and Tutankhamen was sent into the afterlife with bulbs of garlic at his side.

In ancient Greece and Rome, garlic also had a great many uses – from repelling scorpions to treating dog bites and bladder infections, curing leprosy and relieving the symptoms of asthma. It was even presented as an offering to the Greek goddess Hecate. Early Greek military leaders fed garlic to their troops before battles to give them courage and inspire them to victory, and Greek Olympic athletes ate garlic to enhance their performance. In medieval Transylvania, home of the legendary Count Dracula, garlic was found to be an effective way of warding off not only vampires, but also another blood-thirsty nocturnal visitor – mosquitoes! In the Middle Ages garlic was believed to help

guard against the plague and was hung in braided bunches in front doorways to prevent evil spirits from entering the home. While modern science cannot confirm garlic's effectiveness when it comes to evil spirits, we can be sure that garlic will usually prevent a goodnight kiss at the end of a romantic date.

Ironically, then, in many cultures garlic is also considered a powerful aphrodisiac and even an organic alternative to Viagra. Some say it will boost a man's sperm count and in Palestinian tradition, a groom who wears a clove of garlic in his buttonhole is guaranteed a happy wedding night.

Malodorous trivia

The word garlic comes from the Old English garleac, meaning "spear-leek." Dating back over 6,000 years, it is a native plant of Central Asia and has long been a staple in the Mediterranean region, as well as a frequently used seasoning in Asia, Africa, and Europe. Garlic (*Allium sativum*) is actually a member of the lily (Liliaceae) family and a cousin of onions, leeks, chives and shallots. The plant's edible bulb is made up of several smaller cloves. It is a root crop, and the bulb grows under the ground. Garlic crops are harvested in mid-July and then hung in sheds. Then they reach their best in late July or early August.

Over 300 varieties of garlic are grown around the world. American garlic, with its white, papery skin and strong flavor is one of the most common varieties. Italian and Mexican garlic, both of which have pink or purple-tinged skins, are slightly milder-flavored varieties.

Where does that garlicky aroma come from?

When garlic cells are ruptured by cutting or pressing, they release an enzyme called allinase. This enzyme chemically changes the inherent alliin into allicin, a sulfur-containing molecule that gives off the heady, pungent aroma that is the mainstay of kitchens around the world. When garlic is consumed, those sulfurous compounds are absorbed into the bloodstream and escape through perspiration and when air is exhaled from the lungs. That's the source of garlic breath. In people who consume massive quantities of garlic, a noticeably garlicky bodily odor can also be the result.

Want to get rid of the smell of garlic?

If you're a garlic lover, first of all it's wise to surround yourself with others who also enjoy garlic. Otherwise, try munching on parsley to neutralize the lingering garlicky smell on your breath. Getting rid of the smell of garlic from your hands after peeling and chopping is much easier. Rinse your hands and then simply rub your clean hands on a metallic surface such as a kitchen sink. It works like magic!

Brimming with health benefits

Aside from the wonderful flavor it can give to your cooking, the 'Stinking Rose' has been used for its remarkable medicinal properties throughout the ages. In Egypt, it was revered as a physical strength enhancer; in ancient Greece, its laxative properties were praised. It was even nicknamed "Russian penicillin" due to its effectiveness as a topical antibiotic for use on battle wounds.

This is more than just superstition. Modern scientific research has confirmed what our ancestors believed about the health benefits of garlic. In 1858, Louis Pasteur documented that garlic kills bacteria, with 0.03 fl oz of raw garlic juice proving as effective as 2.12 oz of penicillin. During World War II, when penicillin and sulfa drugs were in short supply, the British and Russian armies used diluted garlic solution as an antiseptic to disinfect open wounds and prevent gangrene. Though not completely understood at the time, contemporary research has confirmed that garlic's healing powers come from the hundreds of volatile sulfur compounds that are found in the vegetable, including allicin, (which gives garlic its distinctive odor), alliin, cycloalliin, and diallyl disulphide.

The allicin in raw, crushed garlic has been shown to kill 23 types of bacteria, including salmonella and staphylococcus. Heated garlic gives off another compound, diallyl disulfide oxide, which has been shown to lower serum cholesterol by preventing clotting in the arteries.

The vitamins present in garlic including A, B, and C help the body fight carcinogens and get rid of toxins, and they may even help prevent certain types of cancer, such as stomach cancer. Garlic's sulfurous compounds help regulate blood sugar, stimulate and detoxify the liver and stimulate circulation and the nervous system.



Figure 7: Garlic cloves planted upwards in rows. The cloves are planted in a not too damp soil one inch under the surface.

Growing garlic at home

Growing your own garlic at home can be fun and relatively easy, even if you're not blessed with green fingers. A new garlic plant will grow from each clove, and each new plant will produce a new bulb, in turn containing up to twenty cloves. This growth cycle makes garlic self-sustaining. Garlic's unique fungicidal and pesticide properties can also help keep neighboring plants healthy.

Garlic typically enjoys a Mediterranean climate, but can be grown in cooler climates as well. Choose a spot in the garden where the soil is not too damp and there is plenty of sunshine. Plant the cloves individually, pointing upwards and about an inch under the surface. Cloves should be planted about 4 inches apart, with rows about 18 inches apart. The best time to plant garlic in the USA or Europe is early spring or late autumn/early winter. Although knowing when to pick garlic is not an exact science, a good rule of thumb is to harvest your garlic when half the leaves around the base of the bulb are green and the other half are turning brown and dying back. After harvesting, take your garlic inside straight away, brush off any dirt, and store in a cool, dry place.

Garlic has an amazing array of nutritional and medicinal applications, and it continues to provide health benefits for many to this day. So grab a bulb and enjoy nature's oldest super-food: garlic.

GARLIC TEA for coughs

Garlic can be used in almost any meal. But if you have a persistent cough, this soup or tea recipe is the one for you.

Recipe:

Cut a bulb of garlic into quarters and add half a gallon of water. Cook on a low heat for at least one hour. Strain and sip slowly.

Believe it or not, this warm garlic tea has a very pleasant taste ...but don't forget to buy yourself some parsley. To your very good health!



A word from
A GROWER

Growers' TALK

Mark from San Antonio, TX

I started growing about four or five years ago, when I was recovering from a car accident. Partially disabled, I had a lot of free time on my hands and since I am a really keen cook, I thought I could try growing my own peppers. I encountered some big problems in the beginning, but growing soon became a great passion of mine.

I decided to use granular rock-wool using a run-to-waste system. I'd heard run-to-waste systems were the easiest and cheapest way to grow and would give me good results. I used the feeding schedule on the CANNA website for CANNA SUBSTRA. The four bottles of CANNA SUBSTRA (Ed: Substra Vega A&B + Substra Flores A&B) should do the trick, or so I thought.

I grew twelve plants. I watered my plants 6 times a day for 2 minutes from my nutrient reservoir using a dripper which I attached to a timer. But every time I added the advised amount of nutrients and water to my nutrient reservoir, I noticed the pH value would drop to around 4 – much too acidic. So I added lots of bicarbonate to get the pH up to 5.6.

At this point, my plants were doing fine. They looked great – healthy leaves with a good green color. Nothing out of the ordinary. But when the flowering period started and the

first peppers appeared, I noticed some brown, soft spots on the tips of the fruit. I looked it up on the internet: it was blossom end rot!

I went to the hydroponic store and explained my problem. The owner told me that blossom end rot was caused by calcium deficiency. He asked me about the air humidity in my grow tent. I told him it was always around 50 to 65 % and he said that couldn't be causing the problem. Then he asked me about the system I was using. I told him I was using run-to-waste and CANNA SUBSTRA nutrients. I also told him about having to add a lot of bicarbonate every time I made a new mix of water and nutrients. "I think you have soft water," he said. This was a surprise because I'd always thought my tap water was hard. That's why I'd chosen the hard-water version of the CANNA SUBSTRA! But it still wasn't clear why I had a problem with blossom end rot even after correcting the pH. He explained that the problem was not only the low pH. If you increase the pH of your nutrient solution by adding more bicarbonate, your calcium level still stays too low.

So I switched to CANNA SUBSTRA Soft Water, which contains extra calcium to make up for the low calcium content of soft water. I was told it is also less acidic, so you don't have to use as much bicarbonate. My plants are doing fine now! My next crop of peppers was one of the best I'd ever tasted! •

I thought my water was hard



Product

FLASH



Easy2GrowKit

The easy2grow Kit is AutoPot's best selling product and offers maintenance free and optimum growing without wasting a single drop of water. The easy2grow Kit requires only gravity pressure from a reservoir or tank to water and feed your plants, with no need for pumps, timers and electricity. There is no recirculation of nutrient, once you set the pH and EC in your reservoir it remains set. Whether using the easy2grow starter Kit or multiple easy2grow Extension Kits on a vast commercial scale this system provides everything the plant requires. The easy2grow Kit can be used to grow any crop variety, whether edible or ornamental and is considered one of the most water efficient irrigation systems worldwide.



The heart of the system

The AQUAvalve is supplied with all AutoPot Watering Systems and is at the heart of the easy2grow Kit. Once connected to a tank the AQUAvalve will open and allow water to fill the tray to a preset level of 20mm. The AQUAvalve will not refill the tray until all the water has been used allowing the plant to go through a wet & dry cycle. Once all the water has been used by the plants the AQUAvalve will re-open and refill the tray. The AQUAvalve is tried and tested to deliver consistent and unprecedented results time and time again, by making the irrigation process simple there are minimum aspects that can default or break...the more control you give to the plant, the easier and better your crop will be!



There really is no Limit!

The easy2grow Kit can be infinitely extended to fulfill any grower's requirements. It's simply a matter of adding more easy2grow trays and larger tanks. AutoPot has a number of commercial grow sites worldwide where several hundred easy2grow trays are connected to large reservoirs to produce crops 365 days a year. The easy2grow system is extremely adaptable, simple and above all produces bumper crops time after time!

www.autopot.co.uk mail@autopot.co.uk





Coral Reefs

DID YOU KNOW THAT....?

- Coral reefs are sometimes called the 'rainforests of the sea' and form some of the most diverse ecosystems on Earth.
- A coral reef is made out of living animals called polyps. They provide a home for twenty-five percent of all marine species.
- The Great Barrier Reef near Australia is the world's largest reef system, stretching for over 2,600 kilometres over an area of approximately 344,400 square kilometres.
- In the last thirty years, 25 percent of the world's corals have been lost, primarily because of rising sea temperatures and increased carbon dioxide levels caused by global warming.
- 500 species of seaweed and marine algae live on the Great Barrier Reef. They are used for all kinds of things, including in puddings, dressings, printer ink, pharmaceuticals and plant fertilizers!
- Sea grasses are found on coral reefs. Sea grasses are different from seaweeds and algae because they have true roots and are the only flowering plants in the sea.
- Tiny algae called zooxanthellae live in the flesh of most corals. The algae photosynthesize and transfer energy into the coral. Just like other plants, these algae require light to survive.



Pests & DISEASES

When we use the term thrips, we are referring to a wide group of insects of the order Thysanoptera. A thrips is characterized by its small size and long flat shape. The adult thrips has four feathery wings. They can vary from grey to yellow or brown in colour. Those found in crops can be dangerous pests and the thrips mainly belong to the genus *Frankliniella* and *Thrips*. **By Iñaki García**

THRIPS



Figure 8: Example of a chili thrip. Chili thrips prefer new growth. An infestation can cause wrinkled leaves and brown scars on leaves, fruits and flowers.



Figure 9: A “Texas Star” infected with thrips.

Although there are species that are crop-specific, others are polyphagous – they feed on various plant species. Among these polyphagous thrips is *Frankliniella occidentalis* (western flower thrips), which will live on various hosts including many ornamental plants and vegetables, and *Thrips tabaci* (onion thrips) which attacks vegetables such as onions and garlic and some ornamentals plants.

Symptoms and damage

The feeding of the adult thrips is varied and based mainly on pollen, but the larvae feed on plant tissues and it is the larvae that are responsible for the majority of plant damage. The larvae suck the liquid from plant cells, mainly from the leaves, but also the petals, shoots and fruits. A stylus is used to tear the surface layer off the plant tissue and then suck the liquid from the plant cell (prior to sucking, the thrips produces and releases saliva). Early symptoms include an almost transparent or clear discoloration of the leaf with black dots (which correspond to fecal secretions). Because certain toxic substances are present in the saliva of thrips, some deformations may occur in the shoots or flowers of affected plants. In cases of very severe infestation, the leaves may dry up entirely. At the same time, some thrips like *Frankliniella occidentalis* secrete a few drops of a substance when they are threatened by predators. These excretions contain decyl acetate and dodecyl acetate – pheromones that serve as a warning signal for other nearby thrips.

Thrips are carriers of viruses, mainly of the genus *Tospovirus*. These viruses cause significant crop loss and they are incurable. A plant infected by any of these viruses will remain a carrier for life. Thrips may also be carriers of dangerous pathogenic fungi such as *Fusarium*. Conidia, which are the spores of these fungi, penetrate the plant easily through the wounds caused as the thrips feed, accelerating the infection of the plant.

Life cycle

The first stage of the thrips’ life cycle is the egg, which will hatch much more quickly when temperatures are higher. The females lay the eggs within plant tissues. The larvae that emerge from the eggs feed on the surrounding tissues. One of the characteristics of these insects is that they make the transition from pupa to adult in the soil or in lower leaves. The larvae live in the leaves, but as soon as they reach the appropriate stage of development, they fall to the ground or lower leaves where they live during the pre-pupal and pupal stages until a reproductive adult appears with fully developed wings. The whole life cycle lasts only a few weeks.

Although adults have two pair of wings, their flight is very limited and they often travel only short distances. However, if the wind conditions are right, they can travel much further. Adults can also run very fast, dispersing quickly within greenhouses.

Methods of control

Because of the thrips’ ability to transmit viruses, it is important to monitor our crops for thrips and detect them as early as possible. The classic method for doing this is using adhesive traps. These traps are blue in color, since thrips are strongly attracted to blue.

The traps should be examined every few days using a magnifying glass to see if any thrips (usually winged adults) have become stuck to them. If so, appropriate treatments need to be administered to minimize the risk of an infestation. These treatments include ecological insecticides like potassium soap or plant extracts with pyrethrin, where these are allowed by law. Plants must be sprayed thoroughly all over because the thrips will take refuge under the veins of the leaves, making it difficult for the insecticide to come into contact with all the insects. In cases of severe infestation, several chemical insecticides are approved for use against thrips.

Biological control Several predatory mites of the genus *Amblyseius* and bugs of the genus *Orius* are used as predators against thrips. However, their effectiveness can depend on which type of crop is cultivated – for example, *Amblyseius* does not perform well and may even die on tomato plants.

It is also possible to use entomophagous fungi to combat thrips. Many of these fungi are naturally present in the soil. Thus, when the pre-pupa falls to the ground, some will be infected and perish. However, in greenhouse crops, the culture media employed often lack these types of fungus and they must be introduced specially. *Beauveria bassiana* is one of the fungi typically used to combat thrips. •



Figure 10: Basil plant infected with the toxic saliva of the chili thrips. In this stage the basil plant is deformed and some leaves are completely dried out.





What's HAPPENING

The joy of moving totally freely, that's what it's all about. If you want to get from point A to point B, why should you confine yourself to the roads and paths that everyone else takes? Why not just take the direct route? Or are you one of those people who lets society push you around and tell you where you can go, and where you can't? By Paul van de Geijn



FREEDOM OF MOTION

There is no way the men and women who practice parkour and free running will ever allow themselves to be restrained by the urban straightjacket of roads and pavements. On the contrary, for these real-life spidersmen and spiderswomen – who are also known as 'traceurs' and 'traceuses' – the more obstacles that stand in their way, the happier they seem to be! "You should never allow yourself to be hemmed in by the walls around you", says the French parkour legend David Belle, summing up the essence of parkour. "You just have to use all the elements of the city around you, including those areas where people normally never set foot."

David Belle, the godfather of parkour

So what exactly is parkour? It's a kind of urban acrobatics and the nimble traceurs who practice it try to jump over all the obstacles in their way as elegantly as possible ...or slide ...or climb ...or move any way they can. That's really the beauty of it. It's up to you how you move from one place to the other. It's the ultimate freedom of motion! Parkour first began in the early 1990s in the suburbs of Paris. David Belle (born 1973) is seen by many as the inventor of parkour. His father was a believed passionately in physical fitness and he brought his son up to live the same way. David took this lifestyle out onto the streets. At first, parkour was called l'art du déplacement, or the art of getting around. Its other name, le parcours, came from le parcours du combattant or military obstacle course. In fact, the sport is mainly derived from classical military exercises.

"Military training in an urban environment." That's how David Belle described it in an interview with the French director Mathieu Kassovitz. According to Belle, parkour is "useful because it trains people to gain self-confidence and know their limits". The philosophy behind parkour is similar to the philosophy behind many martial arts, says the Frenchman: "It's all about being confronted with obstacles. In martial arts, it's about beating your opponent, but with parkour you're testing yourself." One special characteristic of the sport is that it's not about who is the best. Parkour is the absolute opposite of competitive sport and rivalry. According to traceur Erwan LeCorre, competitive sport forces people to fight against each other for the pleasure of the crowd and the profit of a few businessmen. In parkour, by contrast, the more artful your movements, the more love you are showing for the sport.

However, beauty is not the main goal. It's actually more a by-product. According to David Belle, parkour is "just like a puma crossing a river, it looks beautiful, but the goal of the puma isn't to look beautiful, but to get from one side to the other in the most efficient way possible."

Free running: parkour plus

The terms free running and parkour are often used interchangeably, but they're actually two distinct sports. Free running is a sort of extension of parkour. David Belle describes free running rather dismissively as "parkour with unnecessary additional movements". In free running, the beauty of the movements is paramount. You can see

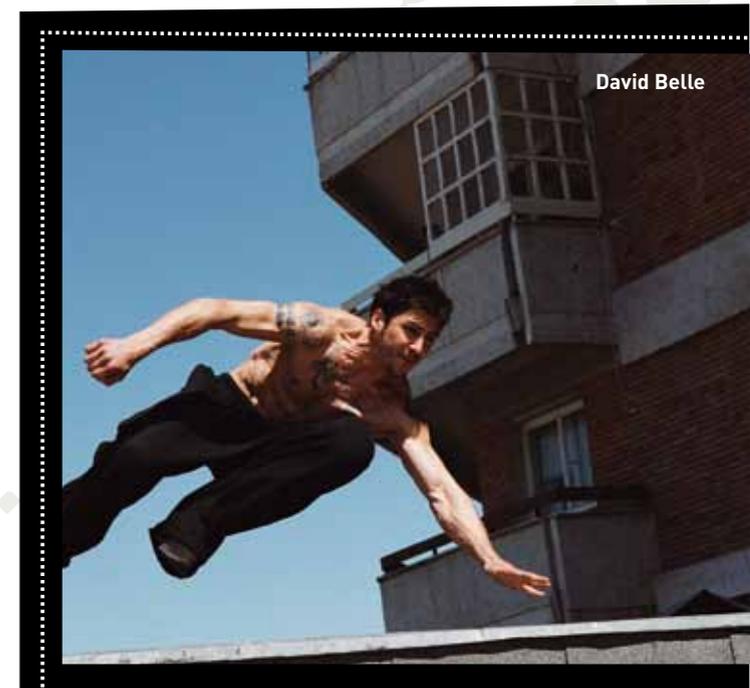
that in the Wall Spin movement, for example: you run towards a wall and push both hands against it while throwing your feet and legs up in the air and doing a 360° loop next to the wall, landing in exactly the same position that you started in, with both feet square on the floor. Great visual impact, but not very efficient.

The name 'free running' was also invented to introduce parkour into English-speaking countries. Since the television documentary 'Jump London' was made in 2003, parkour and free running have become popular all over the world. The program was shown on Channel 4 in the UK, and followed three French free runners as they performed some spectacular stunts.

Mainstream

But the real global breakthrough for parkour and free running only came with the James Bond film 'Casino Royale'. This brought the sport to international attention for the first time. Free runners also appeared in the Bruce Willis film 'Die Hard 4.0'. "Is the circus in town?" asks Bruce as he sees a free runner swinging through the town like a monkey, pursued unsuccessfully by a speeding car. You can also see free runners in the Harry Potter films 'Deadly Hallows' 1 and 2, including the British parkour legend Chase Armitage and the traceurs of the Apex Movement.

However, the spontaneous improvisation ethos of early parkour and free running already seems to be fading. Nowadays you can even take courses. Regular sports are boring, say the instructors of the Apex Movement, who run courses in parkour and free-running in Colorado, USA. "Exercise should not mean suffering through 30 minutes on a stationary bike, only made bearable by the TV on the wall and the headphones over your ears." In contrast, parkour is "fitness at its purest roots: movement".



David Belle



FREEDOM OF MOTION

Fitness

But you'll still need to do some boring exercises if you want to become a traceur. In the words of the Apex Movement, "these movements are just the same as what we all used to do when we were kids" – but even so, most people haven't moved like that for years. No wonder most people suffer from aching muscles aching when they try it for the first time. In fact, you'll only be ready to jump from rooftops or flip yourself over walls when you can do 50 pull-ups in the rings and squat 500 lbs.

Moves

So what kind of moves are there in parkour and free running? Well, there's the Wall Run, for example.

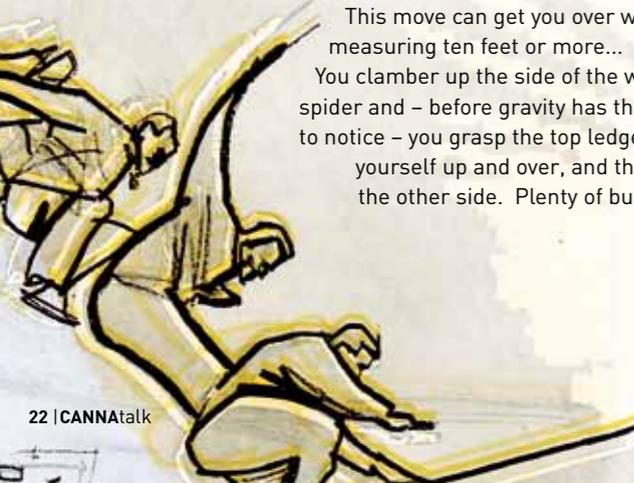
This move can get you over walls measuring ten feet or more...

You clamber up the side of the wall like a spider and – before gravity has the chance to notice – you grasp the top ledge, pull yourself up and over, and then down the other side. Plenty of budding

free runners must have broken their ankles trying to perfect the Kong To Precision. This move involves jumping over a wall like a monkey and then landing with both feet on a lower wall some distance away on the other side. If you're just slightly off-balance or if your aim is a little bit out, the landing can be pretty painful.

Some of the other 'precision' moves are even more hair-raising: for example, jumping from one railing to another, landing with both feet on the top rail and staying balanced there. Or sprinting, jumping and landing with both your feet on a concrete ball. One wrong move and you can break your ankles or more. But then that's why they call this technique 'precision'!

So... what are you waiting for? Forget those 'no entry' signs! Next time you're walking to the shop, why waste precious time? Just jump those railings, sprint through the back gardens, slide over the shed roof and you'll be half way there! And after all that exercise, you'll have earned yourself a nice packet of potato chips! •



Grower's

TIP #15

KEEP YOUR WATER FRESH ... Your plants will thank you!

If you use a recirculating system, make sure that you replace all the water in your reservoir at least every two weeks. This means draining away all the old water and filling up with fresh water.

You should also do this when you switch from one nutrient to another - from the growing to the flowering nutrient, for instance, or if you start adding a PK additive. This is because the plant has different needs when it switches to another phase and it's not sensible to mix flowering nutrients with vegetative nutrient residue, for example.

If you don't change your water, there is a good chance that your plants will eventually wither and die. This is because the rising concentrations of sodium and chlorine in the water make it more and more difficult for the plants to take up nutrients.

This works as follows: the water level drops as the plant takes up more and more water which evaporates off through the leaves. Many growers then just top up with tap water but tap water contains toxic salts like sodium and chlorine. These build up and will eventually cause malnutrition because they stop the roots from taking up nutrients. In the end, the roots will simply be unable to take up any more nutrients and the plant will starve.

Growers sometimes also add water to bring the EC level down. But the problem with this is that the EC drops because of the rising concentration of sodium and chlorine. Topping up with tap water will only increase the sodium and chlorine concentration in the end.

The first sign that this is happening is discoloration of the leaves. They will look like they have been scorched. The leaves at the bottom of the plants will start to die first. Perennial plants will lose more and more leaves until they die. Of course, plants need their leaves to survive.

So, remember to change the water in your water tank every two weeks. It's a little extra work, sure, but you'll be rewarded with healthy plants and bigger and better crops.

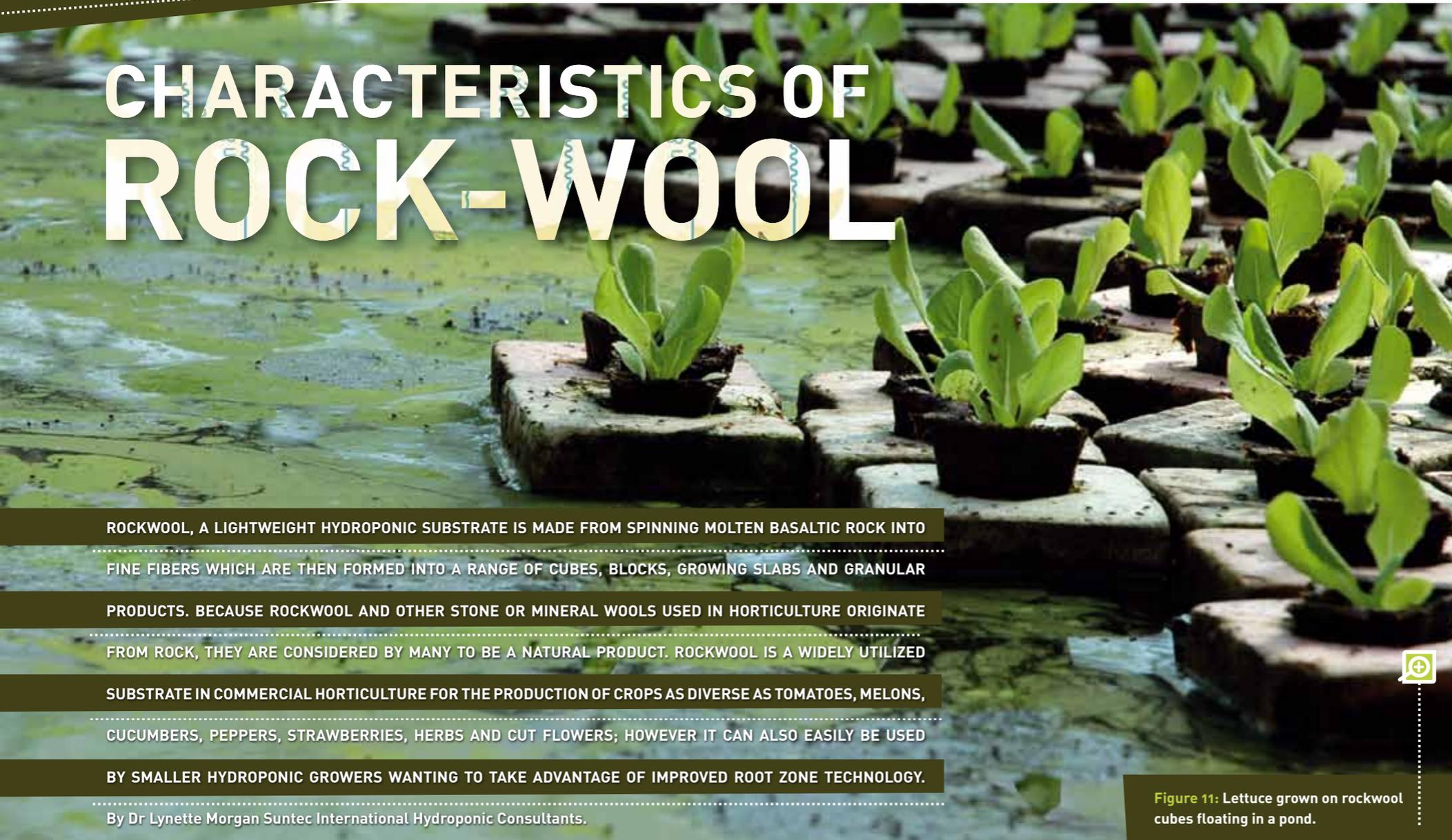
The grateful gardener



The Grateful Gardener By Georgia



CHARACTERISTICS OF ROCK-WOOL



ROCKWOOL, A LIGHTWEIGHT HYDROPONIC SUBSTRATE IS MADE FROM SPINNING MOLTEN BASALTIC ROCK INTO FINE FIBERS WHICH ARE THEN FORMED INTO A RANGE OF CUBES, BLOCKS, GROWING SLABS AND GRANULAR PRODUCTS. BECAUSE ROCKWOOL AND OTHER STONE OR MINERAL WOOLS USED IN HORTICULTURE ORIGINATE FROM ROCK, THEY ARE CONSIDERED BY MANY TO BE A NATURAL PRODUCT. ROCKWOOL IS A WIDELY UTILIZED SUBSTRATE IN COMMERCIAL HORTICULTURE FOR THE PRODUCTION OF CROPS AS DIVERSE AS TOMATOES, MELONS, CUCUMBERS, PEPPERS, STRAWBERRIES, HERBS AND CUT FLOWERS; HOWEVER IT CAN ALSO EASILY BE USED BY SMALLER HYDROPONIC GROWERS WANTING TO TAKE ADVANTAGE OF IMPROVED ROOT ZONE TECHNOLOGY.

By Dr Lynette Morgan Suntec International Hydroponic Consultants.

Where did rockwool originate from?

Rockwool originally started as a thermal insulation material in the construction industry, its lightweight but highly aerated nature helps keep heat inside buildings, while being easy to handle, cut and install. Towards the end of the 1960's trials were carried out in Denmark to test the possibility of using stone wool as a substrate for hydroponic plants and since then rockwool as a growing media has seen continuing development and improvement. Rockwool is used by both large scale commercial producers and small growers alike. Rockwool has also developed into a range of products each with different advantages and applications. Apart from the selection of different sized rockwool cubes, blocks and plugs for propagation, growing slabs and granulated rockwool exist for the production of longer term crops and fruiting plants.

Characteristics of rockwool

The way in which the molten rock fibers are stacked and the density inside the rockwool product determine the

properties of the growing media such as the moisture holding capacity, the aeration or air filled porosity and the moisture gradient from the top to the base of the cube or growing slab. By altering these properties, rockwool products for different applications have been made available to growers. One product for example maintains a slightly drier root zone and helps steer crops away from overly vegetative growth, while another is designed for ultra quick root growth and development. This allows growers to choose the rockwool product which best suits their system, crop, irrigation strategy and environment to maximize plant growth and development.

The moisture gradient characteristics of rockwool. Standard rockwool products drain freely after irrigation and will then typically contain 80% nutrient solution, 15% air pore space and 5% rockwool fibers, although these ratios differ slightly between rockwool brands and products. A typical rockwool slab, such as those used for tomatoes and other fruiting crops, contains around 2.4 gallons of nutrient

solution immediately after irrigation, despite the drainage holes allowing free drainage of excess solution. One of the most important characteristics of rockwool is plants are still able to extract water for growth at very low moisture tensions in the media. That means that plants can easily extract water when the rockwool is saturated from recent irrigation and when the rockwool slab has dried down considerably and lost as much as 70-80% of its moisture content, levels which in other growing media would cause severe wilting in the crop.

The moisture gradient between the top and base of a rockwool growing slab, cube or block is one of the important characteristics of the product. At the base of the rockwool there is plentiful moisture after irrigation, usually at media saturation levels, while the upper layers of the rockwool are held in a drier condition and hence have access to plenty of aeration and oxygen for root uptake and respiration. It is this moisture gradient from top to bottom of the rockwool material which make it such a good hydroponic substrate,

but at the same time growers who are not aware of this property can make the mistake of thinking the rockwool is too dry on the surface and over irrigate the plants despite having plenty of nutrient solution help deep down in the root system. Rockwool, when irrigated correctly should not sit in a pool of nutrient and be completely saturated from top to bottom like a sponge. It is essential that the rockwool is allowed to completely drain so that excess nutrient solution after being applied, leaves the slab or cube under the pull of gravity, in doing so, fresh air is drawn into the top layers of the material providing fresh oxygenation for the root zone. By allowing rockwool to drain freely, over watering becomes more difficult.

Irrigation and EC management characteristics of rockwool.

Irrigation of rockwool is a little different to other solid substrates because of the way the material is manufactured to have just the right degree of moisture gradient and because it does give a limited root zone for plants that eventually grow fairly large. For this reason, most rockwool products are best irrigated with short, frequent applications of nutrient solution, with just enough at each irrigation for the rockwool to reach 'field capacity'. Field capacity is a term which means the substrate has drained fully but is still holding a good level of moisture for the plant roots to access until the next irrigation. At each irrigation, there should be some drainage from the rockwool material, however this shouldn't be excessive. Having around 10-35% of the nutrient solution fed to the plants, drain from the rockwool at each irrigation is considered optimal. This amount of drainage of solution flushes fresh nutrient solution right through the rockwool slab and usually keeps the EC in the slab fairly stable.

Checking the EC in the root zone is important with rockwool just as it is with any other substrate. While rockwool doesn't contain any naturally occurring minerals or salts which may influence EC levels, the EC of the nutrient solution inside the growing substrate changes as plants extract different ratios of water and nutrients from the root zone. Careful monitoring and control of both the EC and pH in the nutrient solution in recirculating rockwool systems is just as important as with any other growing media. Under warmer growing conditions, plants can extract high levels of water from a nutrient solution, thus increasing the EC rapidly and requiring the addition of greater amounts of top-up water in the nutrient reservoir. Under cooler and/or humid conditions, the EC may drop as plants extract nutrients but don't require as much water, making frequent checks and adjustment of EC levels important for maintaining growth control.

Rockwool has the characteristic of allowing a grower a greater degree of control over the root zone and this can be used to help 'steer' plants into either a more vegetative or generative/reproductive growth. Drying back of the rockwool slab by increasing the time between irrigations and allowing the EC in the root zone to increase pushes plants such as tomatoes into a more generative state with less leaf growth and more assimilate being directed into the fruit. A higher level of moisture maintained in the rockwool and a lower EC pushes the plants towards more lush vegetative growth.

Figure 11: Lettuce grown on rockwool cubes floating in a pond.



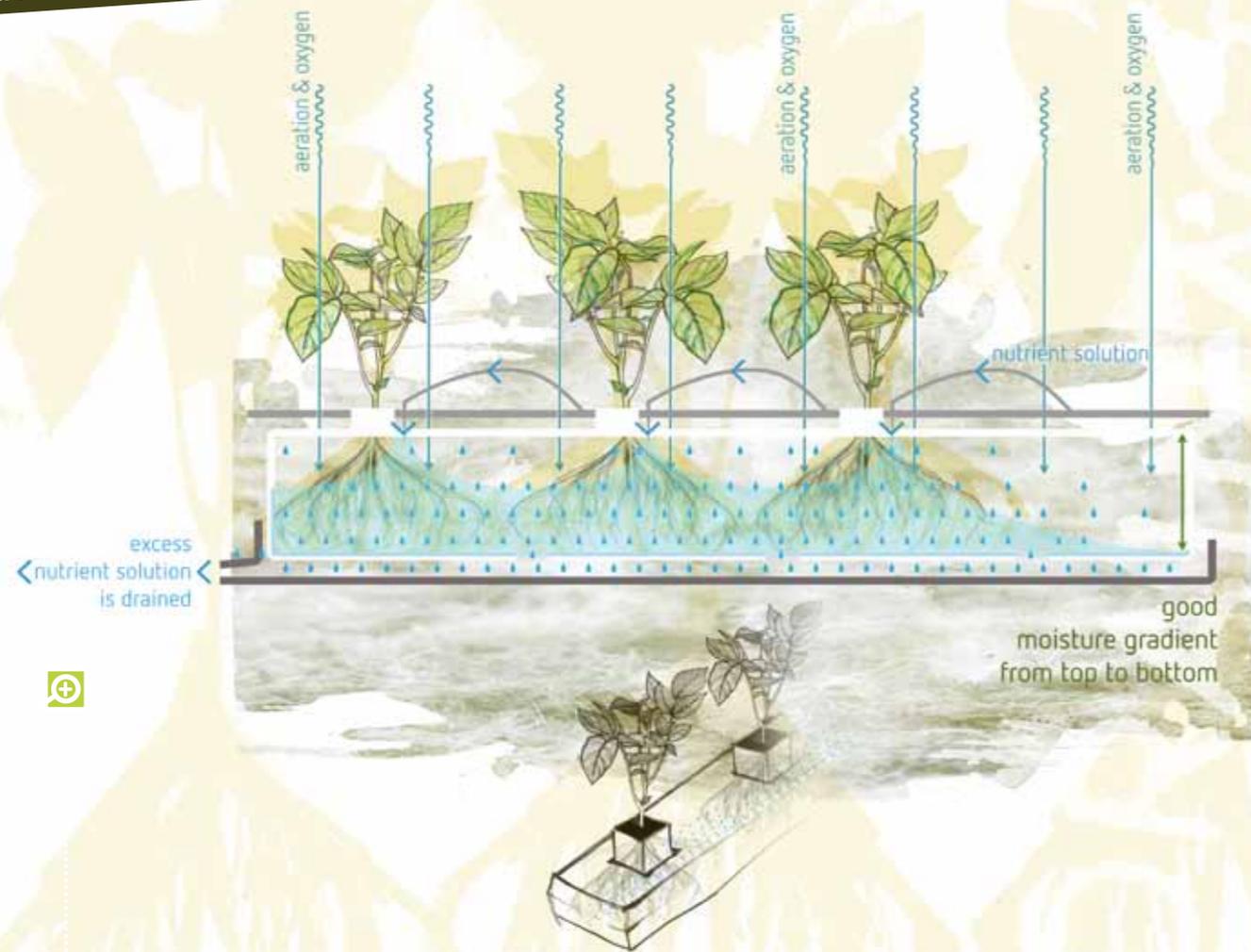


Figure 12: Make sure you don't over irrigate the plants. At the surface of the slab the rockwool may seem dry, but at the bottom there is plenty of nutrient solution.

Skillful growers use these techniques in rockwool growing media to direct their crop and control leaf, flower and fruit growth at different times.

Microbial characteristics of rockwool

Rockwool, being a 'sterile' product (only directly after production) does not contain any naturally occurring beneficial microbial populations when first planted out, however research has shown that microbial life does develop in rockwool substrates in the same way as other more 'organic' mediums such as peat and coco. This build up of beneficial microbial populations however is generally slower in rockwool as there are initially limited carbon sources for the microbes to feed on. As root systems develop and produce organic exudate, microbial life inside rockwool gradually build, however rockwool can be inoculated with microbial products to assist this process and help develop a healthy root zone. The high level of oxygenation in a well managed rockwool system also help with the establishment and multiplication of beneficial microbe populations.

Re-usage characteristics of rockwool

Rockwool, being essentially rock does not decompose, fracture or break down over time, hence growers can use it

for many successive crops. However it is recommended that rockwool is steamed or at least treated with boiling water before replanting to help prevent any carry over of root disease pathogens. A thorough leaching with clean water also helps remove any excess salts from the previous crop. Some smaller growers use chemical disinfectants to treat rockwool before use, however care needs to be taken to completely rinse these from the material before replanting and steam or hot water is seen as a much safer option. Eventually used rockwool material has to be disposed off – often growers simply dump this, however it is possible to shred the material and re use it in other growing mixes, or incorporate it into outdoor soils and gardens as a soil conditioner.

Pros and cons of rockwool Advantages

Rockwool has many advantages for hydroponic production: the manufacture of the rockwool fibers from molten rock and plastic wrapping of growing slabs ensures the product is sterile, and free from weed seeds, pests and pathogens. High quality rockwool brands, being a manufactured product are also consistent in quality and don't decompose or break down over time in the way that many other natural

growing substrates do. Rockwool maintains its physical properties over time and with successive crops. Rockwool is light weight and thus easy to handle and shift into place, once fully irrigated however it becomes heavy and provides stability to the crop.

Rockwool comes in a convenient range of sizes from small 2-3 cm propagation plugs joined in sheets for direct sowing crops such as lettuce and other seedlings, to large cubes of over 10cm for more advanced transplants. Rockwool plugs are often used for cuttings where they maintain the ideal levels of aeration and moisture for rapid root development. Rockwool can be inoculated with beneficial microbes such as Trichoderma in much the same way other substrates like coco are, however more frequent applications of microbial products are recommended with rockwool substrates. Most rockwool products and reliable brands don't have any major influence on the EC, pH or composition of the nutrient solution applied. Since rockwool provides no naturally occurring nutrients a well balanced nutrient product applied will give optimal growth.

Rockwool is manufactured to give a close to ideal level of moisture and aeration in the root zone, this helps prevent over watering and root suffocation from a lack of oxygenation.

Rockwool can be used for successive crops as its structure does not tend to break down rapidly with use or over time. Some commercial tomato growers re use good quality rockwool for as many as 6 successive crops with use of steam sterilization to control root pathogens between plantings.

Rockwool products and growing slabs come ready to use, the substrate only needs to be thoroughly wetted before planting. Rockwool can be monitored with a water content meter which gives accurate measurement of the water content,

EC and temperature in the plant's root zone environment. These assist with fine tuning the application of nutrient solution to just the right level for each stage of growth.

Disadvantages

Rockwool, despite being light weight, is bulky to transport and store, unlike coco slabs which can be highly compressed and then expanded with water before use. Rockwool needs to be placed on a fully leveled surface to allow the moisture gradient inside the product to be even and prevent any saturated or overly dry patches from developing.

Despite being usable for more than one crop, and some recycling programs developed for used rockwool, disposal can still be a problem for many growers as rockwool does not decompose or break down over time. The fibers of rockwool can irritate the skin and a face mask is recommended if handling granulated rockwool or disposing of old rockwool products.

New or inexperienced growers need to determine the right frequency and amount of irrigation for rockwool systems as this can differ somewhat from other substrates such as perlite and coco.

Rockwool contains no naturally occurring nutrients (coco often contains levels of potassium and sometimes other minerals which are used to pre-condition the substrate), hence the plants are totally reliant on a well balanced and complete hydroponic nutrient solution at each stage of growth.

Rockwool being an inert substrate made from rock doesn't contain naturally occurring growth stimulants such as humic acid, other organic compounds or naturally occurring beneficial microbes, although these can be added with the use of good quality hydroponic supplement products. •



Figure 13: Rockwool is sterile and inert and thus makes an excellent seed germination and growing medium.





Puzzle & WIN

great prizes

Win a set of CANNA Substra Vega & Flores



Can you spot the 5 differences?
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P.S. Please let us know in your email if your water is hard or soft, so we can send you the hard-water or the soft-water version of CANNA SUBSTRA.

Winner puzzle #13

We picked a winner at random from all the correct entries we received, and we would like to congratulate **C. Koch.** Congratulations on your bottle of CANNA Start! We will contact you as soon as possible to organise the dispatch of your prize.

WHAT'S NEXT

In these days of genetically modified crops, mass production and pollution, it's difficult to be sure that the products you buy in the supermarket are healthy. That's why an increasing number of people are choosing organic food and produce. Some of us are also growing our own organic veggies. You can read all about this in the next issue of CANNAtalk. Of course, there'll be other features too. Next year an important world event will be taking place - the London Summer Olympics! Ah, there is nothing like relaxing in front of the telly and watching some obscure sport you've never heard of before... Expect lots of crazy and not-so-crazy facts about this almost 3000-year-old sporting event in our 'What's Happening?' section!

HYPERGENIC



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CANNAtalk

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