

CANNA

Issue No.3 - Winter 07/08

Talk

10 Rules

of thumb on watering plants

Growers Tip

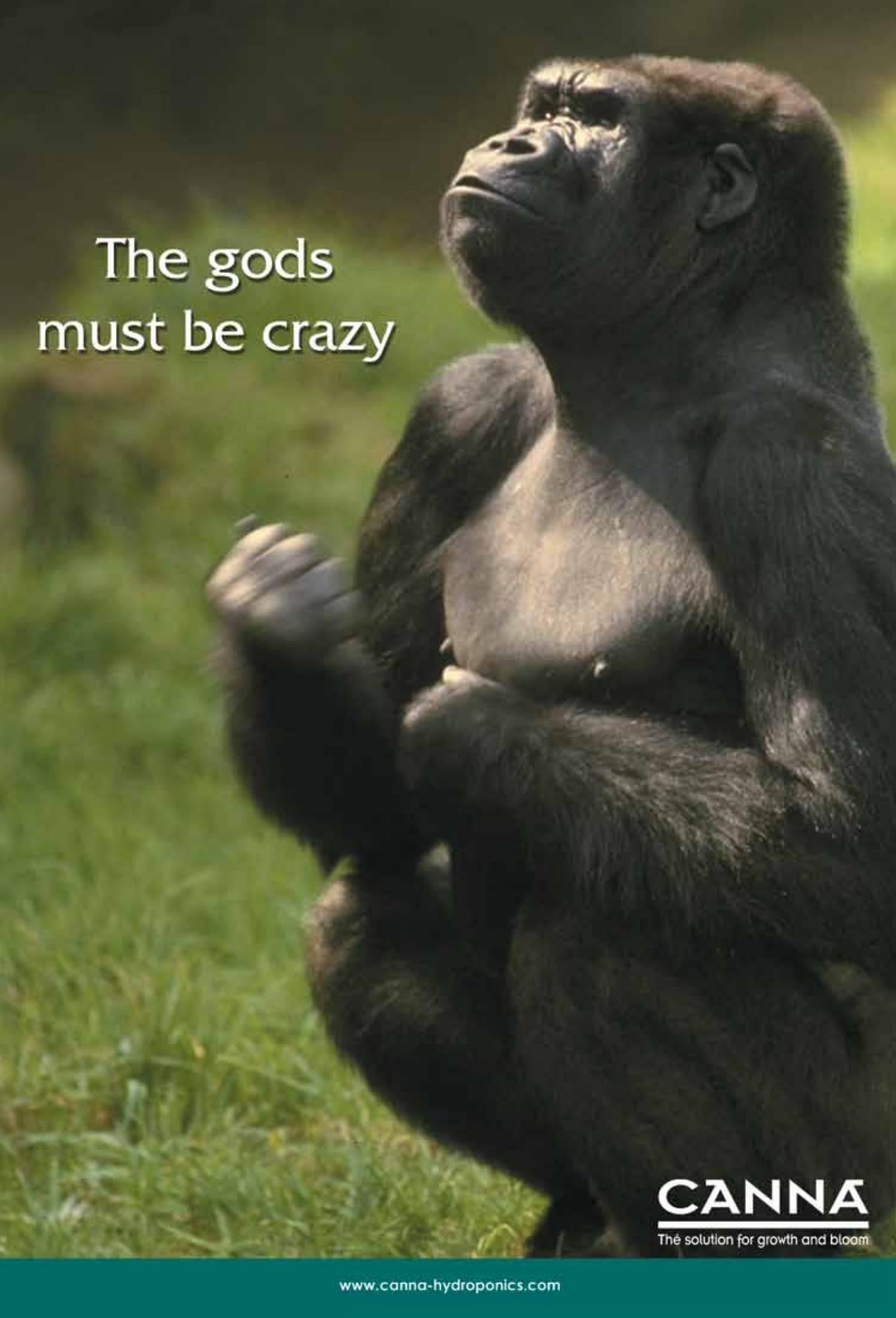
EC Values

Research

Music and Plants

What's New?

Get updated with
the latest news



The gods
must be crazy

CANNA

The solution for growth and bloom

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Sheds a light on which watering strategy you should choose and the many variables influencing this.

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Average tomatoes? Stop using an average Grow Guide. We made specific ones for specific crops.

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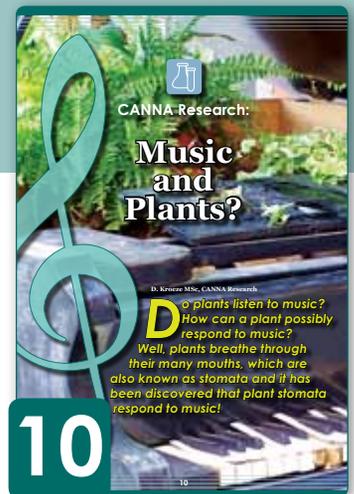
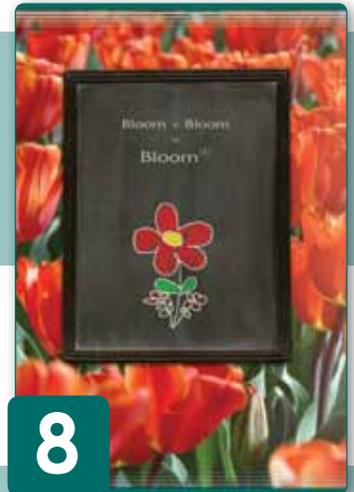
Continuation of In the Spotlight:

We'll pick up where we left off on page 7 with the story on watering strategies and continue with 10 rules of thumb.

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Growers Tip:

Get advised by a fellow grower and utilize his tip on EC values to your own situation.



HQ's Talk:

Some growers buy all the needed equipment for growing their crop, start the growing cycle and kick back with a cold drink. Sure, of course they will fill them up with all the nutes and additives they assume are needed, measure some pH or EC values in the beginning and truly expect a miracle in growing. Well, all nutes, additives and latest gadgets in the world may well be a waste of effort and money if this is the growers' intention. He or she will never get successful.

Like so many things in life, success is dependent on different factors and influenced by several criterion. They all have to come together to make it work. Maybe one thing seems more important than the other but in the end it turns out they have to run simultaneously to achieve what you had in mind. Last but not least, maybe you even play the most important role in achievement yourself.

As said before, to achieve success, you got to factor in multiple influences. One of them is watering strategies. In this 3rd edition of CANNA Talk you can read about the influences on your achievements in growing and watering strategies is being emphasized here. The section "In the spotlight" is written

by Horticulturist G. Coogler and sheds a light on the growth tetrahedron and sets out 10 rules of thumb that help you in achieving success. Our very own research department supplied us with quite an amazing article based on a scientific study that shows plants are being influenced by music!!! Furthermore, you will find a testimonial, a news fact and a grower's tip.

With long winter night's knocking on our doors we hope to entertain you with this edition of CANNA Talk. We definitely enjoyed working on it and already are looking forward to further development. Hopefully you'll love what we have in store for 2008. Your satisfaction and success in growing is most important to us, so if you have any ideas, suggestions or maybe complaints whatsoever please let us know. Appoint your browser to our website and feel free to contact us.

Cheers,
Jeroen, CANNA HQ's





In the spotlight

Thoughts on watering plants

By: Geary Coogler, BSc. Hort

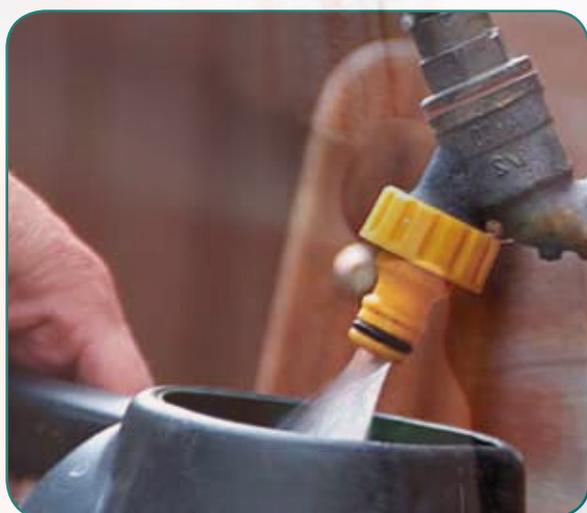
What is the best watering frequency to use for my system? In my 30 plus years of working in the green industry, this, or some derivation, is the most asked question I hear.

It is also the hardest one to answer. There is absolutely no easy response, but only one right one: when the plant needs it. Both the frequency of water applications and, to a lesser extent, the amount of water to apply, are dependent on many outside variables that further complicate the issue, thus requiring the grower to maintain an 'eyes on' approach in his or her growing techniques.



Thoughts on watering plants - Geary Coogler, BSc. Hort

This is the one area in the growing process that makes or breaks a grower. Once we moved out of a natural setting into one of our own design, and began demanding the best performance from those crops we produce, we opened the 'Pandora's Box' of growing. We fundamentally changed water relations between the plant, the medium, and the grower. To fix this problem, the industry has developed a wide variety of mediums and systems that work well with the change. The question 'Which one is right for you' is answered entirely on the type grower you are. Understanding how the



pieces act when they come together will give you an indication in what method should work best with your style. We modify our approach to watering to adjust for all the variables our plants may see that are unique to our growing situation, and we will achieve the best results possible. The one variable we cannot adjust for is a grower that does not adapt his or her growing techniques, or design his/her production system around those limitations.

THE GROWTH TETRAHEDRON:

Let's begin our look at watering by accepting a small fact: The successful completion of a plant crop is predicated on the successful implementation of the growth Tetrahedron (see Figure 1-1). The tetrahedron has as its sides the 4 primary components of achieving growth. Each side is equal in importance and must be optimized to fit with the other sides. As you can see the base of the pyramid is water (as a solution or pure) because it exists in all the sides as well. The Plant Selection will determine both the

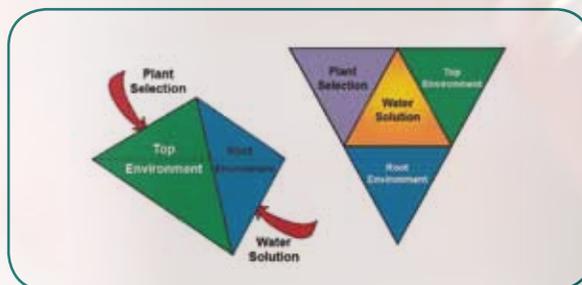


Fig 1-1 Growth Tetrahedron

root environment (and consequentially the system or medium that will be used), and the top environment that will be needed (sides 2, 3 and 4). It takes all four sides to make the tetrahedron and each determines the limits of the others.

The plant or crop is the first side and the first decision. Based on what you want to grow will determine how to grow it; on which root environment and top environment to use is predicated on the chosen plant. In addition, choices are made based on the grower's knowledge of the system, the crop, strengths and weaknesses, and the remaining two sides. It makes no sense to attempt tomatoes if the environment does not have sufficient light. It makes equally little sense to grow Orchids when the water solution is scarce. While lettuce may be grown successfully in peat or coco, it can be grown as well in an NFT system while decreasing the time, costs, and environmental area it occupies. Just because you can grow leaf lettuce in your grow room, does not mean you can grow head lettuce successfully unless you can drop the temperature in the room to cooler levels. Choose your plant carefully, both type and variety, as all are different and will respond different. .

The second side is the Root environment which determines the system to employ in growing. What will best fit with the other sides? The System determines the root environment or medium to use. This is how we not only prepare, present, and store water, food and air for the plant, it also serves to protect and shelter half the plant. Roots work differently then the top but in conjunction with and influenced by the top at the same time. The medium serves to provide support both physically and materially for the plant. The type medium pretty much is deter-

“Understanding how the pieces act when they come together will give you an indication in what method should work best with your style”

mined by the needs of the crop and grower. While soil or soilless mix mediums will provide long term storage of food and water, and physically support



Thoughts on watering plants - Geary Coogler, BSc. Hort

the plant making the life of the grower easier (while reducing headaches), for the grower it makes little economic sense to grow lettuce in peat filled containers. Roots also require the correct proportion of air to water in the medium based on the type plant it is. All roots require oxygen to function. Plants do not have lungs and a true circulatory system to move oxygen from the leaves to the roots, oxygen has to diffuse through the plants tissue. While most carnivorous plants require little air, cacti and succulents require lots of air. Most plants fall in the middle. Steady temperature and correct humidity are key components in root development and function; they are influ-

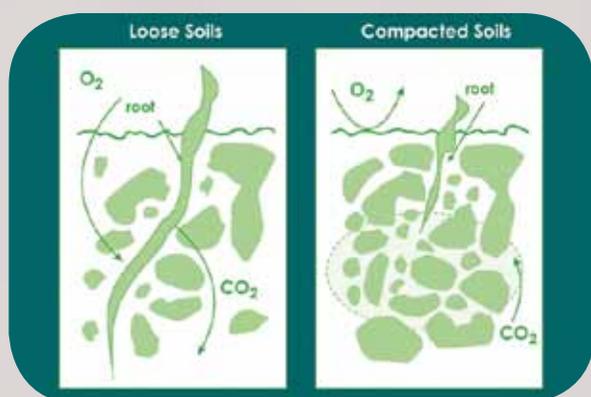


Figure 1-2 Air relations and Pore Space

enced by the type medium used. (Fig 1-2)

The Top Environment is everything that the plant above the crown or soil line sees. This includes correct temperatures for the particular plant grown. In addition, light intensity (including composition, duration and penetration), the air (its component gases, their movement, and their ratio), and relative humidity are all integral components of this environment (to a lesser extent, this includes pathogens and external stresses as well). While skewed values in any of these values will do great harm, all mitigate each other to an extent. The plant assimilates carbon atoms, the basic building block for life as we know it, only from this side as a constituent of the air, CO₂. Its' not so much the effect of one component that makes the difference, it is how all these components come together that affect the efforts, including driving the final side, Water.

Water, the universal solvent, comprises our final side, the base, and exists as a solution. I refer to it in a broad sense from the individual atom to the complex slurry that moves nutri-

ents to the root surface in a mass flow, and subsequently up the stem to the rest of the plant. Water sees action in all sides, as humidity in the top environment, moving nutrients and supporting other media activities in the medium, directly controlling all activity in the plant, and supplying the necessary nutrients to the final use sites in the plant cells through transporting them. Water has to be correct for every side, for every side to be correct. It is required in the initial stages of converting light to energy, and the final stage of respiration. It has to match the needs of the plant. Plants that prefer dry feet should not be in an Aquaculture system; aquatic plants should not be held with dry feet. The chemical composition of the water is critical in its performance and must be matched and balanced to work correctly. While a plant will usually adapt to limitations in the other sides of our growth tetrahedron (it won't be as pretty or as productive, but it can survive and multiply, the only true goal of any plant), it will not tolerate water depletion. Limit the water and its functions decrease or cease, forcing it dormant or killing it outright. Getting it right is the hardest thing to teach and the easiest to screw up.

The thought to take away from this is that remove one side of the Tetrahedron and nothing works, cheat one side and, even if the other sides are right on, you will short-change the crop. A change in any side in quantity, quality, composition, or availability, and you will have to affect change in at least one other side to compensate. Information on all the needs of a plant for each side is pretty much known and achievable with current technologies: the question is 'is it obtainable by the grower given his time, knowledge, budget, workload, or temper.'

10 rules of thumb:

Now, let us get down to it by understanding and accepting a couple of key points and rules-of-thumb.

Please continue reading on page 13 where the 10 rules of thumb will be amplified.

“Plants that prefer dry feet should not be in an Aquaculture system; aquatic plants should not be held with dry feet.”

Bloom + Bloom

=

Bloom⁽²⁾





GROWERS-TALK

A word from a grower

CANNABOOST vs. PK 13/14

"When I heard CANNA was going to launch a booster, I was totally surprised. I had been using CANNA nutrients for a couple of crops to my full satisfaction but was looking for something more and began using various booster products from different companies. Something was still missing so I wrote CANNA through their website to ask what else could be done. I admit, I was not following the entire feed schedule and the tech recommended using the PK 13/14 supplement. CANNA informed me that it all works together and is necessary for a short time to increase fruit size. No other additives are necessary said the CANNA man. They explained to me that this additive contains Phosphate and Potassium. Phosphorus improves cell expansion and potassium is needed for water transportation and production of carbohydrates. There was definitely an improvement to my harvest and exactly what I wanted to achieve.

You can probably imagine my astonishment a year later when I read CANNA was going to launch a booster after all, since I was under the impression a booster isn't needed when using PK 13/14. Again I contacted the CANNA guy and he informed me that it was a truly unique product that worked on the photosynthesis and energy pathways that would increase all the products of photosynthesis and enhance the energy creation/utilization by the plant. I decided to give CANNA the benefit of the doubt and gave CANNABOOST a try instead of the PK 13/14. My harvest was still above average, no real reason for complaints, but it just didn't match my expectations, which were pretty high because of my experiences with CANNA products and the fact that CANNABOOST is not exactly a bargain. I did notice a great increase in aromas and essential oil production (exactly what I always wanted to achieve) but the



fruits were not as big, just heavier somehow it seemed.

I switched back to PK 13/14 again but since I still had some CANNABOOST leftovers I thought it couldn't do much harm to use both, so I did. This really was a significant change! I was truly astonished now! The fruits were fuller and harder than all the previous crops and the additional changes noticed by the CANNABOOST remained.

CANNA taught me that because PK 13/14 works the carbohydrate system while CANNABOOST works the photosynthesis/energy systems of the plant, they combine perfectly. You could say they complete each other and that shows!!! The fruits have never been this large and full ever before. While I have to spend more on 2 products instead of one, it is all worth it and I will never turn back to just one of them. To me they are the excellent match for an excellent result".

Kind regards,
Henry H.

‘CANNA informed me that it all works together and is necessary for a short time to increase fruit size.’



CANNA Research:

Music and Plants?

D. Kroeze MSc, CANNA Research

Do plants listen to music?
How can a plant possibly
respond to music?

Well, plants breathe through their many mouths, which are also known as stomata and it has been discovered that plant stomata respond to music!



Music and Plants? - D. Kroeze MSc, CANNA Research

A few years ago, scientists at the University of California, San Diego discovered a signal mechanism that controls a plant's stomata. The two cells that form the stoma consist of specialized cells (guard cells) that are tuned to the resonant frequency of calcium. When exposed to this frequency the stomata close. However, if the frequency is not exactly right the cells will open again within an hour. This happens even if the concentration of calcium is high enough that the stomata would normally close. Experiments have shown that exposure to high tones was more or less directly responsible for increased gas exchange, and not just after an hour.

Music increases growth

When specific music, high tones or bird songs cause the plant to vibrate, but not at the exact frequency for calcium resonance, the stomata will open after a lapse of time, even though the plant would keep them closed under normal circumstances.

Testing has shown that a leaf fertilizer applied to the plant will have more effect on the development and growth of the plant if its stomata are wide open. This is quite logical, because plants absorb the leaf fertilizer through their stomata. Combinations of frequency and leaf fertilizer are available for many different crops.

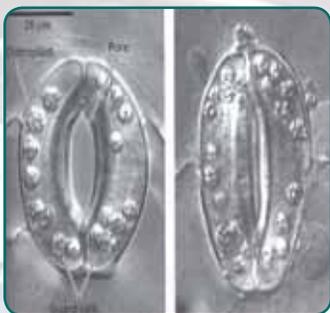
There are still some catches to this method. If the stomata are forced to remain open, the plant will not be able to control the amount of water lost through perspiration and so it risks dehydration. As a result exposing your plant to music for over 3 hours a day could endanger its health.

Don't overdose on music

There could also be negative effects on your favorite plants if the volume or frequency is too high. An effect that cannot yet be explained based on the opening and closing of the stomata. The negative influence of a frequency which is too high could possibly be explained by using a technique known as shell resonance.

Shell Resonance

Besides resonance, which causes stomata to open under the influence of music or specific tones, there is another technique that might be able to explain the effects of music on our plants. This technique is known as shell resonance and it stimulates or inhibits the synthesis of proteins in plants.



Various tones have a role to play here. The theory behind this is that proteins, which consist of amino acids, are synthesized in tune to the vibration. Each amino acid should have its own frequency and

therefore, each protein its own range of frequencies. So theoretically, the correct sequence of tones should stimulate the creation of proteins by resonance.

The influence of resonance in the human body is also subject of research. Transcutaneous Electro



Neural Stimulation or TENS is a technique that utilizes a specific frequency to stimulate the generation of specific substances in the body. For example, a frequency of 10 Hz is thought to stimulate the creation of the neurotransmitter serotonin (the same frequency as a-waves). And guess what? Serotonin is an amino acid.

The reason that different tones could be such an influence on plants is because hormones, such as auxin, which is one of the substances responsible for cell extension and fruit formation, only consist of two amino acids. Allowing the plant to vibrate just long enough at the frequencies of these two amino acids should increase the production of desirable plant hormones thus resulting in bigger shoots.

Music could also have an influence on seed germination. A publication in the 'Journal of Alternative and Complementary Medicine' describes an experiment in which music resulted in a higher germination percentage ($P < 0.002$) and in faster germination ($P < 0.000002$). It appears however that sound did not have any significant effect on germination. So it seems here that multiple frequencies are significant and because germination is all about hormones, it is very likely that shell resonance has a role to play here.

Plants Prefer Classical Music...

A possible explanation for plants reacting positively to classical music, and not to heavy metal for instance, is that purer tones are being used in classical music, while heavy metal is full of guitar effects such as distortion and overdrive which we certainly cannot consider pure tones!

Green Ears

Even though techniques to encourage plant growth have been around since the time immemorial, the art itself is dying and present-day growers only have a fraction of the knowledge of their forefathers. Yet, at the moment it is not exactly clear how music influences the development and growth of plants, but more and more is being discovered about resonance physics and we are closer than ever to solid scientific proof and theories in this area. Maybe, in twenty year's time people will laugh if you say that plants don't have ears!

By: D. Kroeze MSc.
CANNA Research

What's New!

Basil on Coco

Light per day (hours)	COCO A/B (ml/GAL)	RHIZOTONIC (ml/GAL)	CANNAZYM (ml/GAL)	PK 13/14 (ml/GAL)	EC+
11	8-10	10	-	-	0.8-1.1

Cucumbers on Coco

Light per day (hours)	COCO A/B (ml/GAL)	RHIZOTONIC (ml/GAL)	CANNAZYM (ml/GAL)	PK 13/14 (ml/GAL)	EC+	PFM**
9	-	-	-	1.0-1.2	-	700-840
9	-	-	-	1.0-1.4	-	700-1120
9	-	-	-	1.2-1.6	-	840-1120
9	-	-	-	1.2-1.6	-	840-1120

Tomatoes on Coco

Light per day (hours)	COCO A/B (ml/GAL)	RHIZOTONIC (ml/GAL)	CANNAZYM (ml/GAL)	PK 13/14 (ml/GAL)	EC+	PFM**
14	8-10	10	-	-	0.8-1.2	560-840
14	10-15	5	9	-	1.2-1.6	840-1120
14	10-16	-	9	-	1.2-1.8	840-1260
14	10-16	-	9	-	1.2-1.8	840-1260
14	10-16	-	9	-	1.2-1.8	840-1260

CANNA
The solution for growth and bloom

GROWGUIDES!

In the previous edition of CANNA Talk, we mentioned the Grow Guides and Nutrient Calculator on our website designed to help you in growing your crop customized to the medium you wish to use.

We use these two instruments ourselves as our guidance in growing. The more we used it, however, the more we found that the advice you get from them, while quite good and works well in practice, is also general in nature. This is why we tried to develop some specific Grow Guides for specific crops on a specific medium to help you get the best results possible. At the moment there are three different specified guides available which are all meant for growing on CANNA Coco.

Tomatoes on Coco

So, if you will be growing basil, tomatoes or cucumbers on Coco in the near future, and wish to have guidelines tuned to that specific crop, please visit our website.



10 Rules of thumb on watering plants

Here we'll pick up the story where we left off on page 7, by setting out 10 rules of thumb on watering plants.

1 To begin, herbaceous root systems require near 100% humidity, ideally, at all times, otherwise the root tips die back. The root tip is the very small end of the root that is divided into 3 zones. The length is variable based on many considerations such as plant variety, temperature, water levels past, and many more. This tip is responsible for the taking up of the vast majority of minerals and water. Root hairs facilitate this uptake and occur in the last or third zone. After the third zone the root tissue begins to lignify and become more impervious to water and nutrients. Kill the tips and the root has to regenerate one before going forward.

2 Roots grow in response to depletion zones, or areas where the root has absorbed all the minerals and water located there. When the material is not replaced, the root extends to find more. Roots have to grow. When nutrients and water are abundant, the root system does not develop in balance with the shoots and a carbohydrate limited condition presents itself weakening the plant. Allow the plants time to dry and thus use up the minerals present. Conversely, hold them too dry and a condition known as chronic underwater or underfeed can manifest. The root tips will also die back limiting further plant development. (Fig 1-3)

3 Over-watering is accomplished by keeping the roots submerged in water without allowing them to see oxygen. This is more a function of time and drainage and less about volume. With the possible exception of deep-water culture, a neat thing to see but pretty useless for any but the most experience



Figure 1-3 Good Strong Roots in Coco

growers, never let roots stay submerged for more than 20 minutes, even then you will get some die-back. Remember, roots require Oxygen to do their job, which comes through diffusion at the root surface. Well drained medium can have water applied for a longer period (ON time) because the excess drains quickly from the medium when the application ceases. Poor drained mediums have much shorter application time (but application rate has to be slower for absorption) because it will take longer to drain the excess water away from the root surface. (Very poorly drained mediums are impossible because the rate of application has to be slow to absorb and with the drainage time, can never be watered throughout). (fig 1-4)

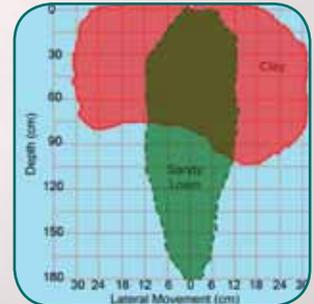


Figure 1-4 Irrigation Depth Profile and Soil Type

4 The general rule of thumb for determining the root health and irrigation needs of a system is that 1 square meter of bench top, covered with leaves, will use 4-6 liters of water a day. New plants, or where the square meter is not covered totally with leaves, will use about 3 liters a day on average. This is true whether there are 2 plants or 20 in the square meter. Build the system to be able to supply this amount across each watering and for however long you want to go without mixing more. Use this figure to decide how well the plants are working. If it is using less, either the roots are having a tough go, the humidity could be



Thoughts on watering plants - Geary Coogler, BSc. Hort

too high, the temp could be too low, and so on

5 When figuring water cycle on a crop of more than one plant, base times on an average of all the plants. For instance, we want to water most mediums (except aeroponics) when about 50% of the total volume of the water is used or gone. Set automatic systems to turn on when 50% of the crop is ready. To accomplish this, keep everything the same; medium, plant age and size, light exposure, air currents, and so on. Above all else, keep the crops developing equally.

6 With organic or inert medium, water when 50% of the water you applied last time is gone. In some instances, the grower can weigh the container bone dry, water to drainage and weigh again. The difference is how much water the container will hold. Water when the scale reaches half this amount lost. After planting, the same will hold true through the early stages. By then, the grower should be able to tell, as long as they realize that the plant is gaining weight as well. (Fig 1-5, 1-6)

7 In aeroponic systems, you have to be good at judging when the root surface has just lost the free moisture on it while not falling much below 100% humidity (air). This will require constant monitoring especially where the roots are exposed to free air.

8 Roots like the dark and really try to grow away from light. Keep them as lightless as possible in systems that are thin walled PVC, or an air chamber.

9 Remember, in a container with medium and drainage holes, you can not put in too much water, just too long an application. For example; a 5 gallon pot can have 3 gallons applied in 5 minutes or 20 gallons (if the medium does not flush away) but there will be the same amount left in the container ten minutes after stopping application and this is the only important point.

10 Cycles have to be adjusted during the dark period of the lighting cycle because the plant is using much less water.



Figure 1-5 Just watered weight



Figure 1-6 Time to Water

The dark cycle is critical to plant development. This holds true for cloudy days or high humidity periods. Media that holds water (peat, rock wool, etc), seldom if ever need watering during the night as long as the grower adjusts the irrigation cycle to water in the last half hour of light or first half hour. Aeroponics or clay pebbles will need an infrequent application a few times during the night.

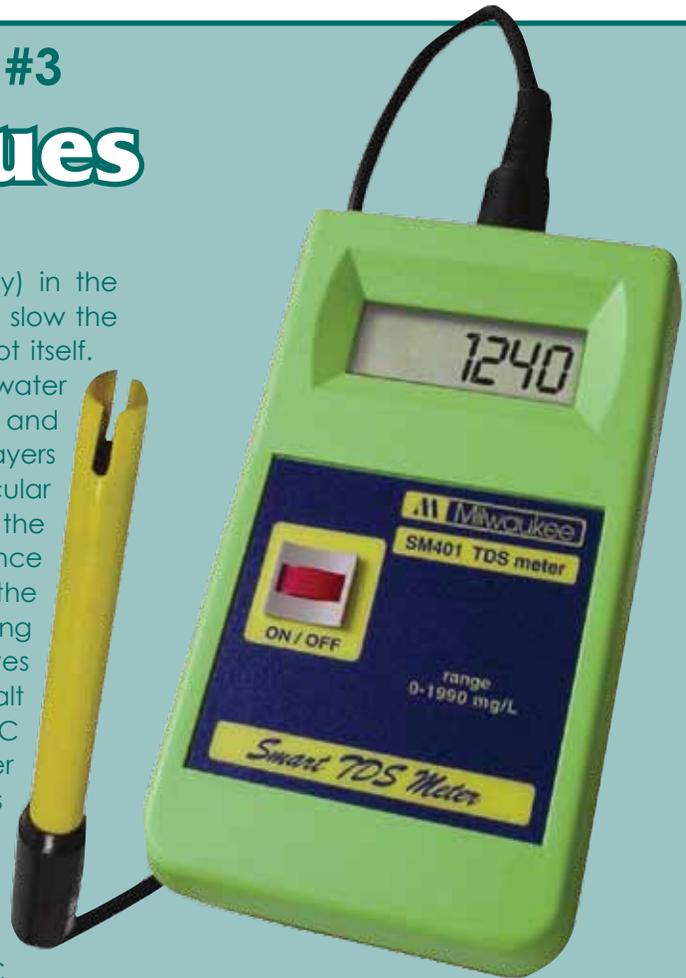
The final pleading of this story is to be found on our website where all this comes together in a final summary.

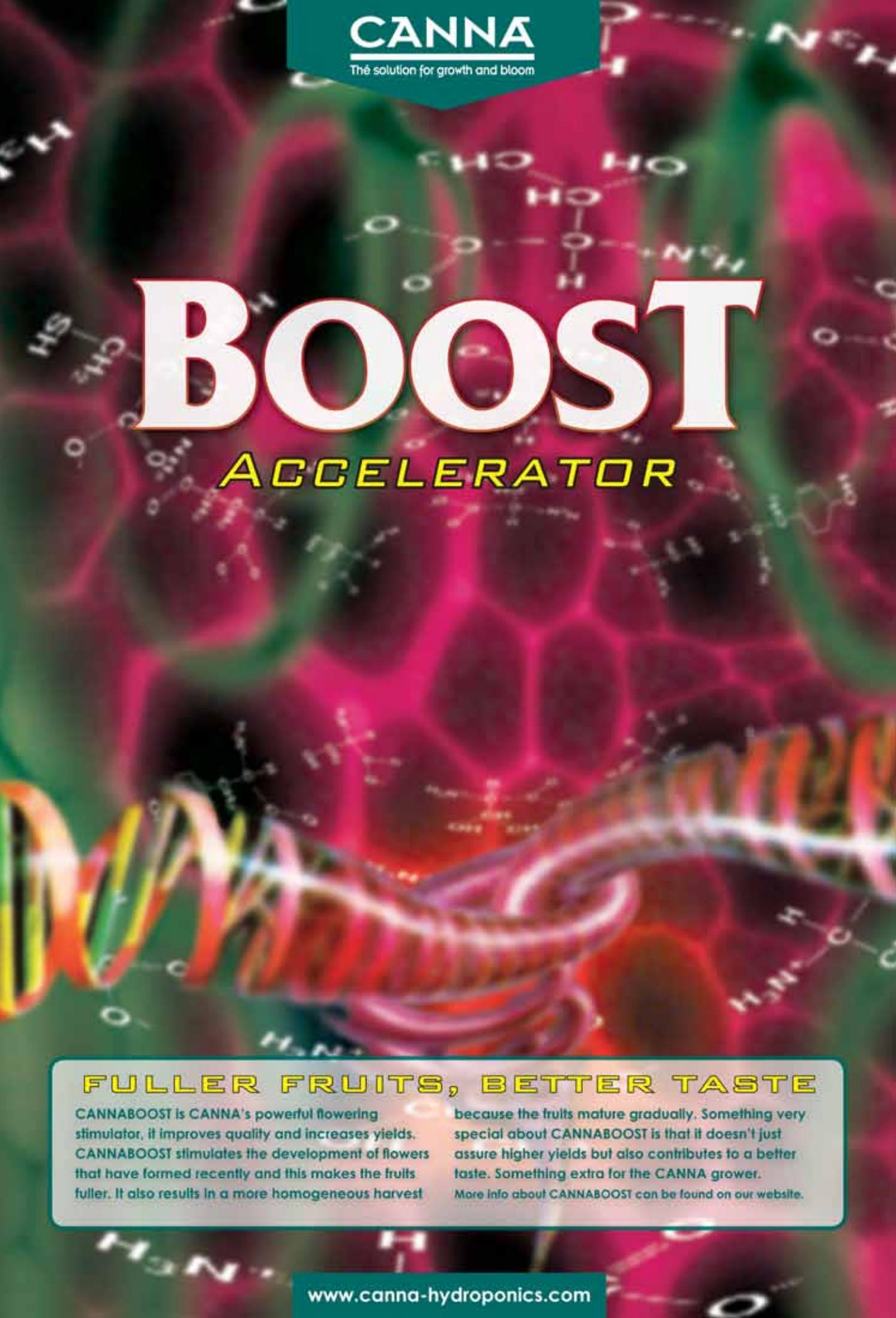
Please go to canna-hydroponics.com to check it out.



Growers Tip #3 EC values

High EC (Electrical Conductivity) in the root zone or irrigation water will slow the movement of water into the root itself. Osmosis is the process by which water moves into a plant root cell and through the different tissue layers before it arrives in the vascular system for transport throughout the plant. This works by a difference in the salt concentrations in the plant cells versus the surrounding environment. Water moves from an area of low EC or salt concentration to one of higher EC or salt concentration. The closer the EC of the environment gets to the EC of the cell contents, the slower water can and will move across those membranes. Work on keeping maximum water flow by controlling the EC of the solution or root zone. Then the plant will efficiently move nutrients to their sites of utilization. Feeding the maximum EC a plant will handle without burning does not mean the correct amount of nutrients will be available to the plant.



The background of the entire page is a vibrant, abstract composition of glowing green and red hexagonal cell-like structures. Overlaid on these are various chemical and biological diagrams, including a DNA double helix in the lower half and several complex molecular structures with atoms labeled 'H', 'O', 'N', and 'C'. At the top center, there is a dark teal banner containing the brand name 'Canna' and its tagline.

Canna

The solution for growth and bloom

BOOST

ACCELERATOR

FULLER FRUITS, BETTER TASTE

CANNABOOST is Canna's powerful flowering stimulator, it improves quality and increases yields. CANNABOOST stimulates the development of flowers that have formed recently and this makes the fruits fuller. It also results in a more homogeneous harvest

because the fruits mature gradually. Something very special about CANNABOOST is that it doesn't just assure higher yields but also contributes to a better taste. Something extra for the Canna grower.

More info about CANNABOOST can be found on our website.

www.canna-hydroponics.com