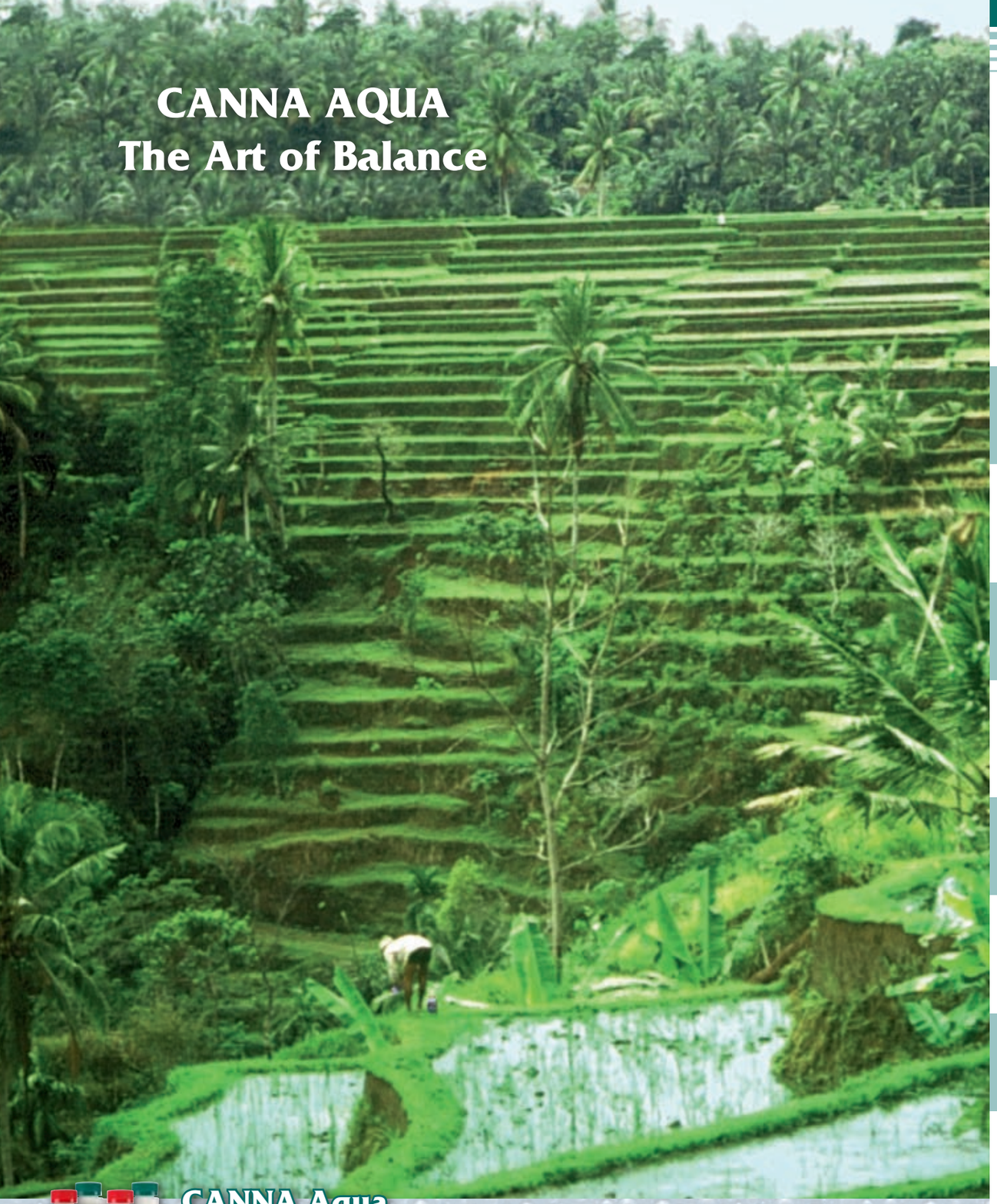
CANNA Talk
Issue No. 5, Volume 2

Which way to grow?

Disasters Dissolved
Nitrogen deficiency

Research
Acidity (pH), what it does to your plants

What's New!
Substra InfoPaper, Terra Professional Plus



CANNA Aqua

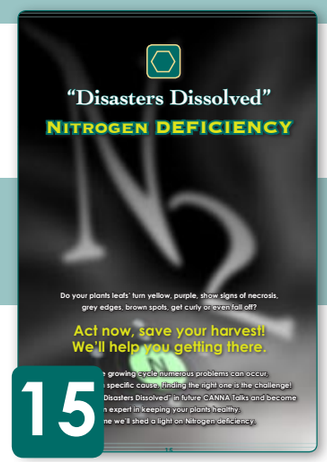
In the Far East they understood it thousands of years ago; the concept of inner balance. It is considered the key to quality life. Their ancient rice terraces have had water circulating through sophisticated irrigation systems for centuries. Even today, these terraces are still a significant resource in local food production across South East Asia. CANNA has applied the ancient concept of balance to modern technology to develop a state of the art line of nutrients for your hydroponic system: CANNA AQUA. Unique chelating agents ensure that, in any closed hydroponic system, nutrients are available to your plants for longer periods of time. Special pH buffering technology keeps your pH exactly where you want it to maximize your plants nutrients uptake. At the same time, your system will stay remarkably clean.

Let your plants experience The Art of Balance with CANNA AQUA.

CANNA
Thé solution for growth and bloom

www.canna-hydroponics.com

Table of Contents



HQ's Talk:

In the world of indoor growing and hydroponics there is a lot of diversity! In everything; types of growers, types of systems, types of media, types of nutrients. It all revolves around one thing: Result! That's the common divisor. But if we all want the same thing, why don't we all do the same thing? The answer is easy: diversity again!
Every grower is different with different wishes, capabilities and available means. The diversity in growers contributed to a flood of diversity in products. It is great that everyone can choose the system or medium that fits him or her best. But what actually fits you best nowadays? And how do you choose from the enormous flood? And if you finally chose a medium or system, which nutrient and possible additive do you use with it?

This edition of CANNA Talk attempts to get a grip on the diversity and helps you in choosing the right growing method for you. More important, when you choose, choose a concept; combine products that are designed to be used together! Companies don't spend years on developing a Coco nutrient, to name one, just to have a wider range of products. They do so, because every medium works differently. Therefore, each one influences a plant differently, causing the plant to have different needs from a nutrient in one medium or the other. So there's a reason why there's a different nutrient for each growing method.

Our main article "Which way to grow?" (page 5) sets out the most important growing methods and concludes with a table to ease the decision making.

Like is the case with everything in life, there are always exceptions to the rule! So is the case with North American grade potting mixes which are very different from European ones. Read all about the differences and which nutrient is right when you are indeed using a bulk mix on page 12. When you want to read a growers experience and his opinion about combining the right medium with the right nutrient, read page 11. Looking for a scoop? Check out the latest new on page 14. On page 15 you will find the first in a series called "Disasters Dissolved". Here we will discuss one of the problems, diseases or deficiencies you might get to face during your cycle and help you in dissolving them to ultimately saving your harvest. This first one is about nitrogen deficiency which could occur when a nutrient contains insufficient nutrient elements. Our very own research department contributed to this issue with an article on acidity (pH) which you can find on page 18. In the back you'll find our usual Growers Tip and cartoon.

We hope to be anything of a signpost to you so you'll find your way in the big diversity!
If there is anything you wish to share with us, please write us at editor@cannatalk.com. We'll be waiting to hear from you! A digital version is also available at www.canna-hydroponics.com/cannatalk

Cheers,
Jeroen, CANNA Headquarters

In the Spotlight

Which way to grow?

How to choose your medium

Geary Coogler, B.Sc. Horticulture

If you ask the average person on the street how to grow a plant in a container, they will undoubtedly tell you that you to put some dirt in a bucket or container and then the plant, water it regular and throw some fertilizer on it occasionally and away you go. Those who grow know it is not that simple (or accurate). Once someone decides to grow a plant or a crop and decides what they are going to grow, then they have to decide many other things like how hey will do it, where they will do it, and, most importantly, what they will grow in. Half of the plant will be in this medium/container for its life and changing is seldom an option. The choice has to be right first time.

The first choice to make is the target plant to grow. This determines everything else the grower will do. It will determine what conditions have to exist in the root zone for the root zone to work correctly. Plants have evolved root systems to work with the environments they evolved in. Plants from arid regions have roots that do not do as well in water based systems like clay pebbles or gravel, they would do much better in an organic medium where the roots will see longer cycles between watering where as a tropical plant would prefer a shallower soil system with frequent watering in very well drained soils and so may do very well in these water based systems. It does not mean that they will not perform, but the troubles that can be associated with these systems are not worth the effort, compared to being grown under ideal circumstances.

The KISS principle

The style the grower wants to use, field grown, hydroponic run-to-waste, hydroponic recirculation, or organic based medium (i.e. peat lite mixes, coco, mineral soil) has to be determined in the context of: first the plants capabilities and second the growers ability. These two things will determine the best container to use as well as the appropriate medium to grow in. Elaborate systems do not make better growers, they only make things difficult. Sometimes a grower has to use them to overcome obstacles (both physical and economic), but any design should be built with the KISS principle, Keep It Simple Stupid. A good grower will work with his or her attributes and limitations. If time is an issue, automate. If the grower is experienced and wants to 'play' then try advanced techniques. If the grower is new, leave it in a forgiving medium. Use what works but use it right.

Roots are somewhat adaptive to a variety of conditions, from low to high values in many areas including pH, fertility, moisture, and aeration. They will grow and generally look good, but it is overall functionality that is affected by these conditions. Plants have exactly one function, to reproduce.

The wrong pH values will change the ratio of nutrients that become available to the plant, yet as long as they stay within reasonable limits, it will flower well. Low fertility will affect the growth and vitality of a plant but it will flower. As long as some moisture is available to a plant it will flower. Air is critical to a root systems surviving not just working. Make sure the medium fits the drainage and water retention characteristics the plant needs. These characteristics equate to one thing, porosity.

Porosity

Porosity is the value given for the amount of open spaces in the medium. This allows for three types of pores, large pores, small pores, and micro pores. Large pores are too big to hold water against gravity and are therefore considered air spaces, although some water will be found there clinging to the walls or immediately after watering. Small pores hold water against gravity under capillary action. These pores will also hold micro life such as fungi and bacteria, and the water in them remains accessible by the plant. Micro pores are very small pores that hold water which is not available to a plant and only the smallest of micro life will be found in them. When we speak of porosity of a medium it is in terms of percent (%) porosity. This percent is further broken down into percent large pores vs. percent small pores. A decent medium for container gardening will have a minimum of about 30 – 50% porosity of which about 17 - 25% is air space. This will vary based on the needs of the plant as some prefer less air and others much more. The advantage is that, after draining a newly watered container, the roots will see good air supply and still have a nice water buffer. So porosity also relates to drainage as well.

Which way to grow? How to choose your medium - By Geary Coogler, B.Sc. Horticulture

Container Size

The medium to use is based on all these considerations. Which container to use is based on plant size, medium used, and the growing environment. Remember that the root system mass should equal the top mass. A tree getting to 5 feet tall will have many problems in anything less than a 5 gallon (20 liter) container. If the crop can produce when smaller then use a smaller container and flower earlier but increase the number of overall containers. Sand will wash out of a container where soil or soilless mix will be better, sand will work well in a slab under NFT conditions where soil or soilless mix would compact and give mixed results. In short, pick the container size based on the crop and the medium. The system to use will be based on all this information.

Container size based on the crop

Potting-up

Remember this: it is always better to 'pot up' plants than to start big. Potting up refers to taking a smaller container and moving it to a larger container. Un-rooted cuttings are 'stuck' into mediums or rooting trays, but rooted cuttings are potted up to beginning containers then potted up to their final home. This does several things including not overpowering a small plant with a large volume of medium. Excess medium does several things: it increases the amount of water that the plant will see, it takes longer to root into the container so this condition persists, the roots will use all the available nutrients around them but can't be replaced because the medium remains wet, and it occupies more room which means more resources in space, light, energy and material. Start small; when a cutting is stuck leave it just until the new roots reach the outside of the new rooting plug, about an inch long. Then pot up this cutting to a smaller container based on the final container it will go in. For example, use a 2.5 inch square pot for planting to a 6 8 inch container, use a 4 inch container if the final home is 10 – 14 inch. You might need an intermediate potting up stage as well if the target plant is especially susceptable to these issues. Also use similar materials throughout, rock wool if the final medium is inert, coco or peat or sand if organic. This keeps the roots working on the same level and avoids big delays in production and survivability.

"The right set of nutrients composed correctly with correct ratio's of fertilizer will produce similar results in any medium"

Table 1 gives a very brief rundown of some of the types of medium currently available. There are many additional characteristics that can and should be taken into account when choosing. How much labor is required to use a medium, what effects will the plant produce, how much time can be spent monitoring the crop, and how is it disposed of after use, are but a few of the questions a grower must answer with the choice of medium. How to crop and grow a plant are just a couple of questions to answer in addition to the ones just mentioned when picking a container to use.

Table 1 also lists the mediums in order of ease-of-use. A clay/sand soil will have the greatest buffers for nutrients and water; aeroponic systems will have the least. Rockwool takes more time to prepare and will have recurring pH issues. Inert mediums can have decent water retention with no nutrient buffering. Organic materials add back to drain water and should not be recirculated. Inert mediums require monitoring and precise measuring of nutrients and pH; this cost money in specialized equipment to monitor these components as well as increased labor costs. A beginning grower should start with an organic medium which will provide the greatest margin for error and only progress to the next one once all the elements of good growth are understood and achieved such as light, water intervals, temperature control and humidity levels. In short, keep the system simple, grow in an easy medium and the right size container, and enjoy the garden. Some growers think that the best system to use is the one they will try next. Keep it simple; achieve your results first before moving on. Remember that it is not the system that makes the plants, it is the grower and the choices made by the grower that determine success. The right set of nutrients, composed correctly with correct ratios of fertilizer will produce similar results in any medium as long as all the other variables are in line; it is the mistakes that limit production.

TABLE 1

Medium	Drainage	Support	Aeration	Suitable Systems	Notes
Mineral Soil	low to high	excellent	low to high	Container, bed, Run to Waste	Many types and compositions
Soilless Mix, Peat based	low to high	medium to excellent	low to high	Container, bed, Run to Waste	composition of aggregates determine porosity, low pH
Soilless Mix, Coco	low to high	medium to excellent	low to high	Container, bed, Run to Waste	Age of Coco an issue, chemical composition issues, pH stable, aggregate and mulch size determine porosity
Inert Mediums, sand, perlite, vermiculite etc.	high	low to medium	medium to high	NFT, container, bed, Run to Waste	pH stable, higher the aeration less water buffer
Inert Mediums, rockwool	medium	medium (light and depends on size)	medium	Ebb and Flood, containers, Run to Waste	High initial pH, pH can rise again after buffering, solid blocks restrict additional aeration,
Gravel, pebbles	high	little	high	Hydroponic recirculation in containers	neutral pH, wash before use, reusable, requires constant monitoring, no nutrient or water buffer
Water	none	none	none	Hydroponic recirculation in a tank	pH varies widely, need aeration pumps, continuous nutrient monitoring, fast negative effects
Aeroponic	high	none	high	Hydroponic recirculation in special systems to confine water	pH varies widely, continuous nutrient and water monitoring, no buffers, chemical composition varies with air quality, no root temp buffering

Climate parameters:
keep an eye on them ...

Temperature, relative humidity and CO2 levels in a grow room can make or break success at harvest. These three parameters enable your crop to maximize photosynthesis, facilitate uptake and utilization of nutrients, fight off disease and increase both quantity and quality of the produce. Growing your crop either below or above these parameters will have a negative affect. It reduces growth rate, affects overall health and undermines harvested yields.

It also creates opportunities for unwanted insects as well as soil- and plant diseases. When you reflect upon this, it makes a lot of sense; you wouldn't expect a marathon runner to break records when it is pouring rain or scorching hot either.

Most small to medium grow rooms use exhaust and intake fans to regulate temperature and relative humidity levels and to replenish the room in carbon dioxide (CO2).

The number and size of fans needed is determined by the amount of heat that is generated by the grow lights, and the quantity of moisture given off by the growing crop.

More important, the temperature and moisture content of the supply air (brought into the room by the intake fans) greatly influences the resulting growing environment.

Both seasonal changes and changes inherent to the succession of nights to days could expose a grow room to one or more of the following situations:

- If the outside temperature is extremely cold, the fans will be very efficient and maybe even overly so; causing them to switch ON and OFF repetitively and causing significant precipitous temperature variations.
- If the incoming air is too hot, the fans may not be able to cool down the grow room sufficiently when the grow lights are lit; heavy plant damage can occur.
- If the incoming air is too dry or too moist the room's relative humidity might be very hard to regulate making it harder for the plants to perform optimally.

GROZONE CONTROL

A grower must choose the right type of quality environmental controllers to face such occurrences and of course to repeatedly create successful yields.

Rooms equipped with forced air ventilation need a temperature controller with the smallest operating differential. The differential is the resulting variation in temperature, usually 5 to 10 degrees Fahrenheit. The controller senses the ambient temperature for changes and turns the fans ON or OFF according to a user defined set-point (nerd term for temperature set).

A new kind of temperature controller is offered by GROZONE. The TEMP-1V is a temperature driven fan speed controller. It can be used with all magnetic type axial fans. It finds the right fan speed at which optimal respect to the user set-point is achieved, often yielding temperature variations lower than 1 degree Fahrenheit. The remote temperature sensor looks for minute changes in the room and reacts by slightly modifying the speed of the fans. While doing so, it analyses the rooms' performance and finds the optimal speed to maintain. Keeping the fans running facilitates relative humidity control since air exchange is ongoing. The carbon dioxide content of the grow room remains at its highest at all times. The unit makes it easy for a grower to set up a constant negative or positive pressure in the room which ensures proper ventilation. This unique innovation can truly contribute to maximizing the entire grow room potential throughout all seasons.

For more information: www.grozonecontrol.com

GROWERS-TALK

A word from a grower

On the website www.canna-hydroponics.com we get a lot of stories and questions from growers: funny enough they are not always CANNA growers. Nonetheless we'll always try to help the grower out and are interested in every single story. Just like you, we are learning ever day.

This time we chose to publish an incoming email that suits the Growing Concepts theme of this CANNATALK. We had to shorten this growers' experience some to avoid this CANNATALK becoming a book. Sorry, Paolo.

.....

Hi, my name is Paolo. I have been growing herbs for many years now, for my own use and to supply some restaurants in Humboldt County, restaurants with true passion for food grown with love and in a natural environment. Something you rarely see anymore in other places these days. Originally I am from Italy but I would not want to go back for the world. I came to LA in the sixties and ended up in the upper North of California, my final destination.

I started growing long before the hydroponic store appeared. Actually I had never been to a hydroponics store until 4 years ago. I always managed to grow high quality herbs and plants with the stuff I got from local nurseries and catalogues.

Paolo supplies restaurants with his garden herbs

`there is a reason why medium brands and nutrient brands are carrying the same name.`

Therefore I was (and still am) very skeptical towards all the ridiculous names and formulas I found in hydroponics stores. A friend advised me to check out coco medium but I was successful on my soil, it was working perfectly fine. Coco was too expensive in my opinion. After continuous suggestions, and other friends suggesting, I tried out a couple of bags and was fairly happy with the result. Over the last 3 years I have switched more and more production to coco until the soil in my garden has almost all disappeared.

Initially I tried using my dry powder on the coco; later on I switched to a 3 part nutrient formula to improve results. My friend and the local hydroponics store owner kept on insisting I should try out coco nutrients on my coco medium. "All marketing", I replied until the owner gave me a sample bottle, as a true Italian you do not refuse that so I gave it a try. Nice results. I got more and more curious and started to try out different combinations of nutrients vs. medium and even included additives in the recipes. I started to feel like a real scientist searching for the perfect combination: the Eureka moment. After many attempts I soon realized that Eureka is in my backyard and the testing was costing me a fortune!

The conclusion: there is a reason why medium brands and nutrient brands are carrying the same name. There is a reason why it is advised to use coco nutrients on coco medium and organic nutrients on soil. It simply gives you the best results. I am stubborn, I found out the hard way but I am man enough to admit that I was wrong. I have to congratulate your company with realizing the relationship of nutrients to medium and engineering the appropriate nutrient set for each type.

Peace,
Paolo

North American Grade Potting Mixes and Mediums

North America enjoys much diversity in what it provides to gardeners for use in their gardening activities in the way of soil amendments and potting mixes. So many different names, types, and promises out there that quality becomes lost in the mix. Since selection of the roots new home is as important as choosing the plant itself, it would be better to keep an eye on the quality of the medium, and not let it drift to a 'price only' consideration. Yes, price does not always mean quality either.

Let's start out with a simple look at what we are talking about. The range of products used in the industry runs from coarse, long fibered sphagnum peat moss to complex potting blends. All have or can have a purpose, but none are complete as a single raw material. The attempt is made to adapt materials into a suitable replacement for natural mineral soils, or, in the case of specialized plants such as orchids, replace and commercially supply an environment for them that closely approximate their preferred growing locations. To this end, several materials are adaptable to these purposes, some better and some easier to use than others. Peat moss forms the base of almost all potting blends available in North America.

Additional components included many things including composted bark (for porosity, bulk, and chemical attributes), leaf mold (fertility and organic complexes), perlite (for porosity), vermiculite (for nutrient holding, CEC), sand (porosity), Styrofoam (porosity), clay pebbles (porosity), bagase (sugar cane pulp), rice hulls, charcoal, lime (pH control), saw dust (not recommended), and many others. All of this adding up to creating a proper mineral soil substitute. Very little mineral soil is ever used in potting blends outside of sand, or, in some instances, organic rich topsoil. The denser the material, such as sand or clay, the more money it takes to ship so it has lost much of its popularity. When these items are combined correctly, then can form the base for a great soilless system for growing, and then fertilized to match the crop.

The green industry in North America is very large and very diverse. Many views are held by growers all over as to how they can best produce a crop. Many different crops can also increase the number of combinations which could be desired by a grower. Growers may prefer a different pH or a different porosity and getting special blends made is costly. The market developed basic mixes to be used as just that, a general purpose mix that can be altered to fit a growers needs. These are known as Bulk Mixes since they are always sold in volume. The individual components, such as sphagnum moss, peat, and bark, are also sold in bulk even on the retail market. The bulk mixes are what were known as a modified Cornel Mix consisting of 2 parts white peat 1 part perlite. To this, lime is added so that the pH is buffered to around 6.0 (if you are lucky) and sufficient trace elements are added to give an even pallet in their ratios to one another. The lime for pH control is very seldom adequate to get past 3 months of growing, the fertility is nothing, and porosity is governed by the area of the field the peat came from plus the perlite. So what do you do?

CANNA SUBSTRA is your choice, in either hard or soft water versions. CANNA SUBSTRA will provide the correct elements in the right ratios while helping control the pH and getting past the pH issue. The components in the nutrient mix will fill the CEC sites in the bulk mixes providing for the correct results. The TERRA line is designed to work with better pH buffering found in higher quality CEC mediums, and with a corrected and stable initial nutrient ratio. So, CANNA SUBSTRA for bulk mixes, usually sold in large bales of compressed mixes, and CANNA TERRA for the better quality mixes.

What's New!

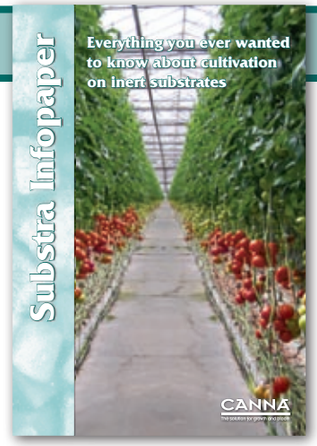
CANNA TERRA PROFESSIONAL PLUS

We are proud to announce CANNA Terra Professional Plus is now available!

This special formula was developed to fulfill the desire of creating the purest soil mix possible and to obtain the best effects with CANNA TERRA nutrients.
Exclusive, high value organic ingredients such as airy peat moss and different types of tree bark (as a substitute for perlite) which have an antiseptic effect are components of CANNA Terra Professional Plus. These have a direct result in promoting exceptional root development and formation of thicker stems, while faster metabolism combined with low sickness rates ensure an increased production. It is enriched with special feeding mixes, containing all the elements plants need during their first week, meaning no additional feeding is needed at that time!

CANNA Terra Professional Plus differs from Bio Terra Plus in that it is specially designed to work with our CANNA Terra nutrients whereas Bio Terra Plus is designed for organic growing in combination with our BIOCANNA nutes. Combining Bio Terra Plus and TERRA nutrients (or Terra Professional Plus with BIOCANNA nutes) has proven to work as well. But if you wish to grow 100% truly organic, Bio Terra Plus combined with BIOCANNA nutes are your choice. Furthermore Terra Professional Plus is most suitable for indoor growing , especially when using drippers. Bio Terra Plus can be used both in- and outdoors and because of its self regulating capacity, it is most suitable for growers who manually water their plants.

SUBSTRA INFOPAPER



Finally, it's here! The SUBSTRA InfoPaper is an 8 paged folder comprising everything you ever wanted to know about cultivation on inert substrates! It sheds a light on different inert substrates, tells a bit of history, gives an overview of (dis)advantages and clarifies the hardness of your water and the way in which it influences your plants, system and in addition the exact type of nutrient you need. It also amplifies the possible impact on the environment as well as the use of fertigating systems such as drippers. Finally, you'll also find all kinds of practical tips and a Grow Schedule in it for your convenience.

For this or one of the other available InfoPapers, go to your local gardening store or check out www.canna-hydroponics.com

"Disasters Dissolved"

NITROGEN DEFICIENCY

Do your plants leafs' turn yellow, purple, show signs of necrosis, grey edges, brown spots, get curly or even fall off?

Act now, save your harvest!
We'll help you getting there.

During the growing cycle numerous problems can occur, all with their own specific cause. Finding the right one is the challenge! Keep an eye on "Disasters Dissolved" in future CANNA Talks and become an expert in keeping your plants healthy. This time we'll shed a light on Nitrogen deficiency.

Nitrogen

Nitrogen (N) is one of the crucial necessities a plant needs. It is an important part of proteins, chlorophyll (leaf green), vitamins, hormones and DNA. Because it is a component of enzymes, nitrogen is involved in all enzyme reactions and plays an active role in the plant's metabolism. Nitrogen is mainly absorbed by the plant in the form of nitrate (NO3-) and ammonium (NH4+). Nitrogen can also be absorbed through small organic molecules. It is important that the balance between nitrate and ammonium is correct in the feeding otherwise the pH in the rhizosphere (the environment immediately surrounding the roots) will become too high or too low[1]. Plants with nitrate as their source of nitrogen have a higher organic acid content. This has an influence on the taste and preservation of the crop. Nitrate is converted into ammonium in the plant by the nitroreductase enzyme. Ammonium is then assimilated into organic molecules. Nitrogen has a positive influence on the plant's growth. The plant gets bigger leaves, more branches and the vegetative period is extended. This phenomenon is often used in practice by reducing the nitrogen dosage during cultivation, which causes the plants to flower earlier. Earlier flowering is a consequence of increased production of abscisic acid[2], a plant hormone.

Deficiency stages

When a Nitrogen shortage is the case you will find your plant going through the next cycle:

I. Stalks on larger leafs in the lower parts of the plant turn purple, quickly followed by larger leafs in the middle and top parts of the plant.
II. The plant turns a lighter color as a whole.
III. Larger leafs in the lower part of the plant turn pale green. The leaf's stalk of the smaller leafs now also turn purple. Typical vertical purple stripes appear in the stem.
IV. Leafs in the lower part of the plant turn more yellow and then become white. Finally, the leafs whither and fall off.
V. The growth is visibly inhibited giving shorter plants, thinner stems, less- and smaller leafs.
VI. Further yellowing and whitening occurs in the top and middle parts of the plant.
VII. Leafs on growing points remain green longer but they are a lot less green opposite to normal nitrogen levels.
VIII. Forced flowering will start and there's substantial leaf loss.
IX. Substantial reduction in yield.

Development of a deficiency

Nitrogen deficiency slows down protein synthesis which prevents the plant from performing optimally. In order to continue to meet its nitrogen requirements the plant breaks down its own proteins. This breakdown produces a carbohydrate surplus which causes leaf stalks and the stem to turn purple. The chlorophyll is also broken down eventually which leads to the typical bleached green to white-yellow leaf color and finally the leaves wither and fall off.

Reasons for a deficiency

Mild forms of nitrogen deficiency can occur during fast growth under full light. Due to the increased rate of photosynthesis and the formation of new cells, the demand for nitrogen at this time is more than the roots can provide. The nitrogen deficiency is generally corrected when growth stagnates. Nitrogen deficiency can also be caused by incorrect feeding, mostly when giving feeding that contains insufficient nutrient elements. This could be the case when using a nutrient developed for a certain type of substrate but applying it to another one. Certain diseases that affect the plant's transport system, such as Fusarium, can cause nitrogen deficiency symptoms to arise. These are however, accompanied by the base of the stalk becoming woody and rotting and by roots turning brown. Substrates that contain a lot of fresh organic material can cause nitrogen deficiency because microorganisms bind the nitrogen. A lot of nitrogen can be bound, particularly in the first weeks; this is released later but it is generally too late.

Resolve a deficiency

- Go to your local gardening shop for expert advice. They have the right products available. A correctly composed fertilizer contains sufficient nitrogen;
- Raise the EC of the feeding and rinse the substrate well with it;
- Add nitrogen yourself by using urea, blood meal, semi-liquid manure or by using a special "mono nitrogen" product. Fertilizers containing nitrate rise the pH at the roots, fertilizers containing ammonium lower the pH;
- Because both the roots and leafs absorb nitrogen, it is recommended to add nitrogen to the feeding and that a diluted nitrogen solution is used for spraying the leafs. Spray the backside of the leaves in particular because that is where the 'stomata', through which nitrogen can be absorbed, are located. Spray at the end of the day just before lamps are turned off. Be careful not to cause burning;
- Treat deficiencies as quickly as possible.

Nitrogen deficiency by Brassica oleracea

CANNA Research

pH-Acidity

What it does to your plants

D. Kroeze MSc, CANNA Research

In this article we will look at pH and acidity and what this means for a plant and the growing environment.
First of all, we'll look at what acidity and pH really are.

Annotations can be found at the end of this article on page21

What is acidity?

Acidity is essential for life on earth. Acidity often determines the characteristics, quality, absorbability and solubility of many substances. This is how enzymes, which are responsible for almost all biological processes in organisms, work, but only with the correct acidity[1]. A small fluctuation in the blood's acidity is deadly.

What is pH?

The pH (pondus Hydrogenii) indicate s a solution's acidity or alkalinity[2]. The pH value usually varies between 0 and 14. A solution with a pH value between 0 to 7 is acid and one between 7 to 14 is alkaline. Vinegar and cola have a pH value of less then 3. Soda and soap have a pH value higher than 8. A pH value of 7 is considered neutral. Pure water at room temperature has a pH of 7. The pH of tap water is generally a little higher due to the presence of calcium.

Many natural environments such as our skin, plant substrates and nutrient mediums are mildly acidic and have a pH value of between 5 and 6.5. If we look at the things people like we see that they are generally mildly acidic or neutral substances such as water. Plants also prefer mildly acidic substances. A pH value of around 5.5 occurs so often in nature that some plant experts regard this value as "neutral".

Why is acidity important?

Acidity has a substantial influence on the absorbability and solubility of a number of food elements (see figure 1).

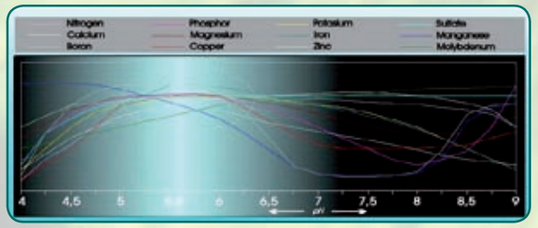


Fig 1

In addition acidity has considerable influence on the structure, breakdown of organic substances, and the micro life in the ground. The pH also influences the way in which food elements, heavy metals, and pesticides are flushed out of the ground.

A pH value that is too low or too high can be detrimental to your plants, so it is important to get it right. But how do you know when the pH is wrong? By experience! So to help you, we've set out some of the symptoms you might observe:

Symptoms of a pH that is too low (substrate is too acid)
- Most nutrients can be dissolved easily, which can cause an excess of manganese, aluminum and iron;
- Phosphorus, potassium, magnesium and molybdenum deficiencies can be caused by excessive rinsing;
- Magnesium deficiency, especially in cold substrates;
- The soil is generally poor;
- Soil life is inhibited.

Symptoms of a pH that is too high (substrate is too alkaline)
- Most nutrients dissolve less easily, causing calcium, iron and phosphate compounds to precipitate;
- Reduced absorption of manganese, phosphate, and iron in particular but also copper, zinc and boron. This will cause deficiencies, particularly in wet, cold growing mediums.
- In sandy soils the breakdown of organic substances increases considerably if the pH is high.

What determines the pH?

One of the most important factors determining the pH value in a solution or in the substrate is the buffering capacity. The buffering capacity in this instance means that there is a sort of balance present that continually restores itself. For example, if one puts a drop of acid into 1 liter of tap water that has a pH of 7 it will have little influence on the acidity. However, if one puts one drop of acid in 1 liter of de-mineralised water (battery water), the pH will immediately fall dramatically. This is because tap water contains bicarbonate while de-mineralised water doesn't. Bicarbonate is the most important buffering substance for pH values between 5.5 and 7.5 in water[4].

Bicarbonate binds itself to acid in the solution which releases carbon dioxide into the atmosphere. This is how the acid is neutralized and the changes in the acidity will only be minor so long as there is still bicarbonate present. With a pH value of 5.3 all the bicarbonate has been used up and the solution has no more buffers. The pH is now unstable and it will change immediately if acid is added (see figure 2). The amount of acid that is needed to get a feeding solution to the correct acidity can therefore be calculated based on the bicarbonate content. The bicarbonate content of tap water is generally given by the water company in milligrams per liter[5].

The buffering capacity and the substrate's acidity depend on its composition and freshness. The presence of organic material, calcium and bicarbonate generally determine the pH. Clay always contains calcium carbonate and has a relatively high pH value which is difficult to change, while peat and sandy soils are acidic[6].

The plant itself also has great influence on the acidity. The roots will secrete either acid or alkaline substances depending on the crop's stage of development, the food available, the differences in root temperature and light intensity. So you see why the pH of the root environment can constantly fluctuate. A sophisticated feeding balance during the different phases of development will keep the pH in the root environment within acceptable limits. Micro life, CO_2 levels, and algae growth can also have an effect on the acidity of the root environment and the nutrient tank[7].

Measuring the pH value

It is quite easy to measure the pH – you need some pH indicators such as litmus paper or a pH testing set. These are relatively cheap but are not always accurate and can sometimes deviate by 1 to 2 pH units. All pH meters are generally more expensive and the accuracy depends on the type of meter and regular calibration with calibration fluid.

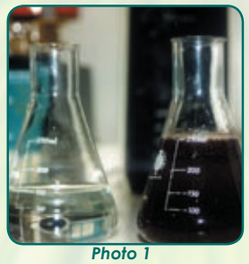


Photo 1

Taking samples

The pH of the water used to irrigate plants is important but the acidity around the roots is essential. So when you measure the pH it is very important to take the sample in the correct way to get good results. The sample has to represent the average acidity in the root environment.


Photo 2

It is easy to take samples and measure the pH in a recirculation system, simply measure the recirculated feeding solution.

In substrate systems without recirculation, feeding solution is drawn out of the substrate (rockwool, agrofoam, etc.) at a number of locations. Experts have been discussing the question of where to take the samples from for a year and a day. We recommend, just like a number of reputable laboratories do, taking samples from the places where the roots are which is under and around the drippers. Take small samples from as many places as possible. Always take all samples at the same time and preferably after the second drip-feeding during the light – daytime – cycle.

In soil, coco and peat substrates just take a small amount of substrate from several locations.

You can best measure the acidity of your sample using the "1:1.5 volume extract" method. You can easily do this yourself by making the growing medium so wet that the water runs through your fingers when it is kneaded and squeezed quite hard (photo 1). Use a 250 ml measuring beaker for example. Fill the measuring beaker to 150 ml with de-mineralized water. Add growing medium until the volume is 250 ml (photo 2). Shake it well and let it stand for a few hours. Then filter it and measure the pH.

The correct pH values for every medium

When cultivating in substrate pH values of between 5.0 and 6.4 are fine for the root environment. There will not be any adverse effects if the values are a little higher or lower. Immediate adverse effects will only be seen with values lower than 4 and higher than 8, a pH value lower than 4 often causes immediate damage to the roots. In addition, heavy metals, including manganese and iron are absorbed so well that they can poison the plant (necrosis). Values between 7 and 8 are not immediately harmful for the plant. Nutrients such as iron, phosphate, and manganese are less available then which will lead to deficiencies (chlorosis and development problems) in the long run.

Correcting the pH value

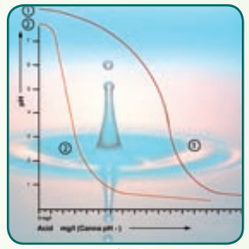


Fig 2

If the acidity in the root environment is between 5 and 6.4 then the pH of your growing environment is OK and you do not have to take any corrective measures. Try to avoid correcting the pH unless it is really necessary. It's more likely to do harm than good; the plant likes its peace and quiet. It is more important to monitor how the acidity changes over a longer period. If the value falls below pH 5 or rises above pH 6.4 then it is advisable to gradually start making adjustments (see figure 3).
Correcting the acidity is most easily done by lowering the acidity of the feeding solution with nitric acid during the growing phase and phosphoric acid during the flowering phase or, as the case may be, to raise it with caustic potash, potassium bicarbonate of soda[8] and CANNA Rhizotonic.
Ensure that the pH in the solution that is used does not fall too far below 5.0. When growing in

pH-Acidity - What it does to your plants - D. Kroeze MSc, CANNA Research

Rockwool the fibers will be harmed causing a lot of alkaline material to be released at very low pH values. In addition, the pH is more difficult to control due to the absence of bicarbonate. A high pH in the root environment can also be caused by bicarbonate that has built up. To remedy this, maintain 20% drainage or rinse through with a more acid solution.
It is useful to note the pH measurements from both the solution added and the feeding solution in the substrate. You will get a good idea of the progression of the pH and the effect of the measures taken.

NOTES

[1] Protein splitting enzymes need an acidic environment (gastric juices) and carbohydrate splitting enzymes need an alkaline environment (saliva).

[2] The acidity of a solution is determined by the ratio of hydrogen ions (= acid) and hydroxide ions (= alkaline).

[3] Shortages can occur because the plant has to secrete protons to be able to absorb these molecules. A growing medium with a low pH already has a very large quantity of protons. These elements also get rinsed out because the protons repel the molecules from the medium in the substrate.

[4] Bicarbonate is the substance that, when combined with calcium, is responsible for scale. In combination with sodium, bicarbonate is used in medicaments to counter excess gastric acid (Alka-seltzer).

[5] Some laboratories also work with the bicarbonate hardness. In order to translate this to mg/l bicarbonate you must multiply the bicarbonate hardness by 21.8.
For example: the bicarbonate hardness is 11, then 1 liter of water contains (11 x 21.8=) 240 mg/liter bicarbonate.

[6] Sandy ground:

grass land	pH 4.6…5.2,
building land	pH 5.0…5.6

Clay:

sea clay	pH 6.0…7.2,
river clay	pH 6.2…6.4

Peat:

unprocessed	pH 4.0

[7] If there is significant algae growth then the pH will increase because carbon dioxide will be removed from the solution. Bacteria can transform certain forms of nitrogen so that they have an acidifying effect. Large amounts of CO2 in the air generate more carbon dioxide in the feeding solution and vice versa.

[8] Only use soda in small quantities, because it contains sodium, and plants only need a very small quantity of sodium. Remember, high concentrations of sodium will damage the plant.

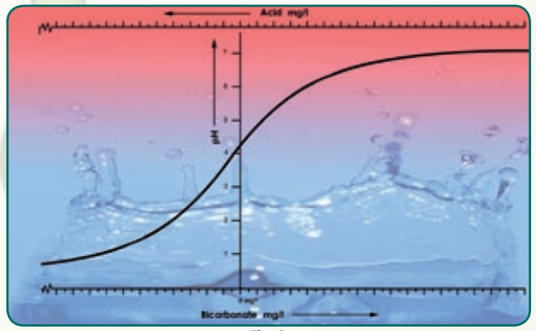


Fig 3

Figure 2: illustration of the pH values of tap water from various areas with differing levels of bicarbonate. We added 33 ml of nitric acid (38%) to each 100 liter sample of each water type. The pH curve drops faster after pH 5.3 because for this type of water the acid neutralises all the bicarbonate. Below pH 5.3 the acidity level will accelerate fast.

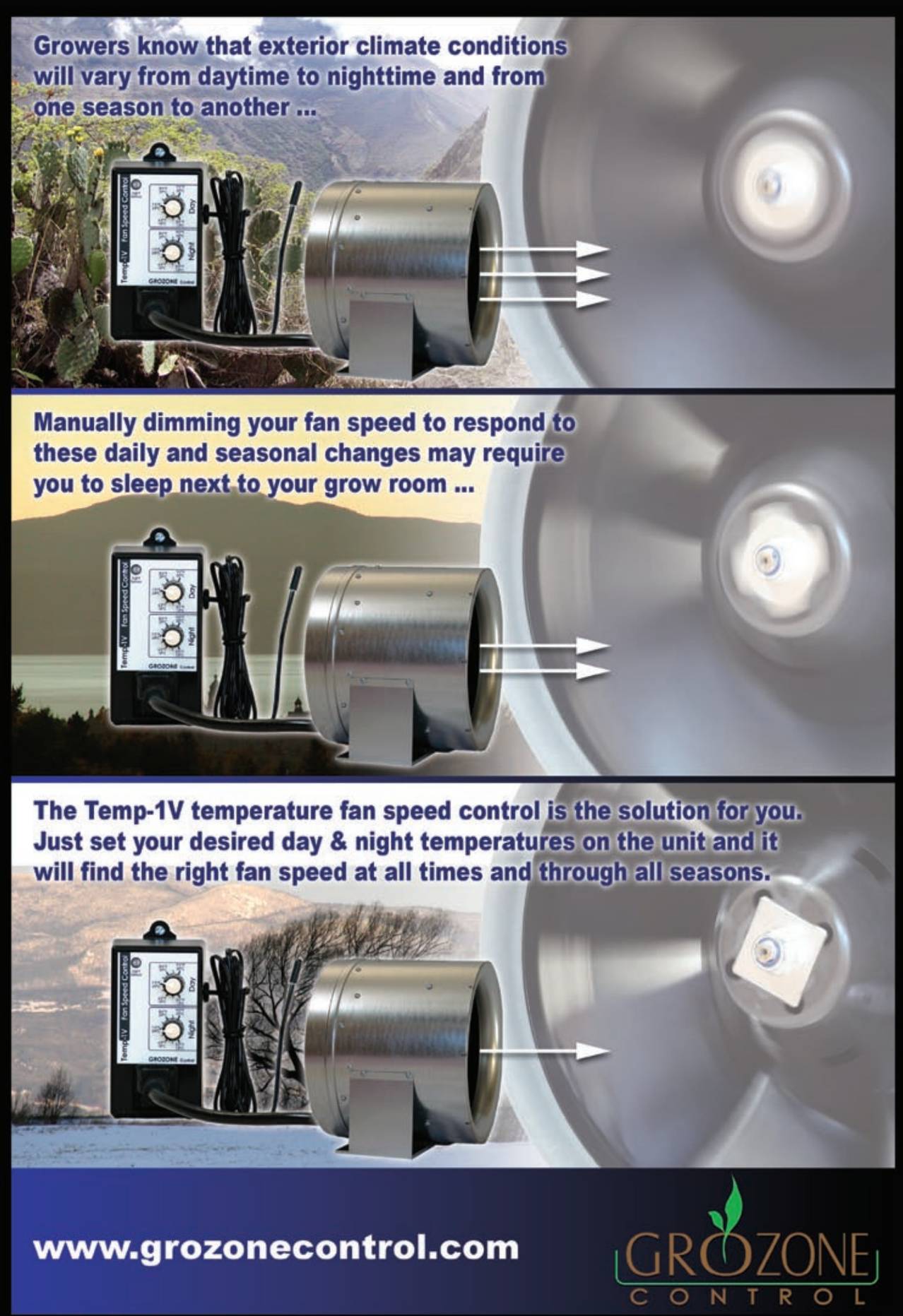
Growers Tip #5

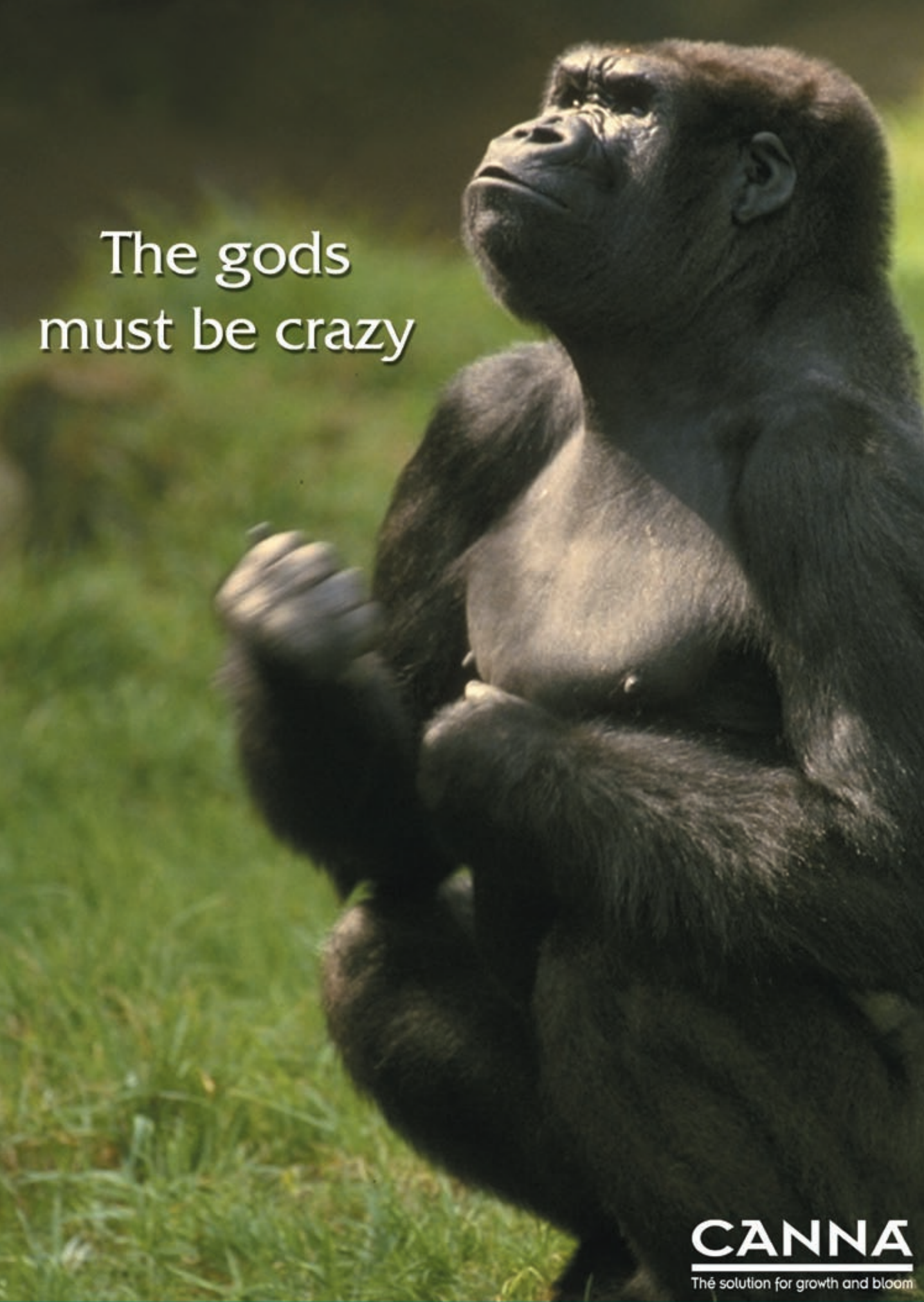
the 20 minute rule

Correct water relations is the name of the game when it comes to successfully finishing a crop. It is only 25% dependent on water itself. It is equally dependent on the root environment, the top environment, and predicated on plant selection. All these points have equal bearing on the success of the crop for the grower. Choose the right plant and crop that fits with the environment you can provide in the top and bottom (root) halves of the entire plant. Then match what the plant needs in these environments and provide the amount and composition of water in nutrient mix and pH that these plants want. There is a lot to say about what a plant wants or needs. It is quite obvious that under- or over watering should be prohibited at all time. A general advice applicable in most situations would have to be to never let roots stay submerged for more then 20 minutes (unless you're growing on a deep-water culture of course).

Roots require oxygen to do their job. This oxygen comes through diffusion at the root surface. When a lack off oxygen occurs, roots will die back causing limitations to further development and possibly the plant will die off in the end. The only thing left to provide is the grower and his or her habits which have to change to fit the four important needs of the plant in water, plant selection, top and root environments.

© CANNA US-CT 102008





www.canna-hydroponics.com