CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

ISSUE 28 2015

THE EFFECT OF PH ON CROP RESULTS

All pH ins and outs

DISTILLING SPIRITS

Hot as the sun on fire

KALE

King kale has it all

HQTalk:

CANNAtalk always strives to bring you the best information so you can achieve the optimum growing results. Recently we've told you all about lighting, nutrients, organic growing and much and much more. In this issue of CANNAtalk we want to talk to you about the question of pH. The pH of your soil and your feeding water are essential aspects of a good fertilisation plan. pH has an indirect effect on the availability of the nutrients for the plant. The research articles in this edition will tell you all about pH levels and soil, as well as what the ideal pH level is.
And from pH levels we move on to alcohol levels: in our What's Happening? feature you can read about the new micro-distilleries that are springing up all over the place and the success that they are enjoying. Maybe it's something you could do while you wait for your plants to grow...?
Just as in every issue, there is a Pests and Diseases section, and this time it's all about mealybugs. Did you know they are called mealybugs because the females are covered with a white, wax-like substance? In the Q&A section you can read all the questions that we receive personally from growers, and of course Don is here with an update on his house and cellar. Last but not least, you can read about the new wonder-vegetable: kale. How can you grow kale yourself? Did you know that we Dutch love to eat this crop in the wintertime? When the days are short and it's freezing outside, nothing is better than a plate of kale and mashed potatoes, which we call boerenkoolstamppot - yummie!

So there's plenty for you to read, as always! If you think we have missed out a topic or you have a question or comment, please don't hesitate to contact us. You can visit www.cannatalk.com or complete the answering card in the back of the magazine.

Have fun!

Regards,

Karin

Contents

INTRODUCTION

THE PH OF THE SOIL AND THE FEEDING WATER ARE ESSENTIAL ASPECTS OF A GOOD FEEDING PLAN. PH DOES NOT HAVE A DIRECT EFFECT ON THE PLANT, BUT IT DOES DIRECTLY AFFECT THE AVAILABILITY OF THE NUTRIENTS FOR THE PLANT. THE PLANT, IN TURN, CAN ALSO INFLUENCE THE PH OF THE SOIL IN THE AREA CLOSE TO THE ROOTS, AS WE WILL DISCUSS LATER IN THIS ARTICLE.

CANNA Research

Figure 1: This is a coloured scanning electron micrograph (SEM) of mycorrhizae; a symbiotic association between a soil fungus and the roots of a vascular plant. The fungus is able to access nutrient forms unavailable to the plant, process them and pass them on to the roots. Mycorrhizae prefer a slightly acidic environment for optimum growth.

To better understand the effect of pH on your crop yields, we first need to define pH.
The pH scale, the standard measurement of acidity, was developed by the head of Carlsberg Laboratory's Chemical Department in 1909. It basically means 'the power of hydrogen', because the scale provides a simple and universal measurement of the amount of hydrogen ions there are in a solution. These ions affect its acidity and how the solution will react chemically. pH is defined as the negative logarithm of the hydrogen ion concentration. It is a result of the presence of anions (negatively charged nutrients) and cations (positively charged nutrients). The pH scale goes from 0 (acid) to 14 (alkaline) with pH 7 as the neutral point.

The plant can influence the soil life in its rhizosphere

The rhizosphere is the narrow region of soil that is directly influenced by root secretions and associated soil microorganisms. Plants respond to nutrient deficiency by altering their root morphology, recruiting the help of microorganisms and changing the chemical environment of the rhizosphere. Components in root exudates help plants to access nutrients by acidifying or changing the redox conditions within the rhizosphere or chelating directly with the nutrient. Exudates can liberate nutrients via the dissolution of insoluble mineral phases or desorption from clay minerals or organic matter, whereby they are released into the soil in solution and can then be taken up by the plant.
When preparing a nutrient solution, a grower ensures that the pH of the water is within a certain range. This range will preferably be that at which most nutrients are available to the plant, which is 5.2-6.2. If necessary the pH of the fertiliser solution can simply be adjusted by adding an acid to lower the pH or a base to increase it. But in the rhizosphere, the direct surrounding of the living roots, things become very different. The roots excrete many substances that alter the pH in the substrate.

The pH in the rhizosphere can be very different from the pH which is measured in the nutrient solution. The principal cause of this is that the plant has to remain 'neutral'. When they are dissolved in water, all nutrients are present as ions. Those ions always have a positive or a negative charge. Positively charged ions, like K^+, are called cations. Negatively charged ions, like NO_3^-, are called anions. Some nutrients can be present in multiple forms. For example phosphates, which can occur as PO_4^{3-} , HPO_4^{2-} and $H_2PO_4^-$. However, only this last form can be taken up by the roots. The surface of the root is negatively charged. In this state, the negatively charged ions such as $H_2PO_4^-$ will be repelled from the root surface like two magnets that have the same pole. Plants have developed several ways of facilitating anion uptake. For every anion the plant takes up, it excretes an anion such as a hydroxide (OH^-) or bicarbonate ion (HCO_3^-). Similarly, for every cation it takes up, the plant excretes a cation as a H+. In this way, the plant's charge remains balanced. However, a side-effect of this is that the excreted ions influence the pH of the rhizosphere in the substrate. By excreting a cation, the pH near the roots decreases (it becomes more acid). The excretion of anions will raise the pH near the roots (it becomes more alkaline).

It is well-known that nitrogen fertilisers have an effect on the pH near the roots. That insight is important because the plant takes up so much nitrogen that the effect can be considerable. But this effect occurs with every nutrient or fertiliser.
As a grower, you can add nitrogen in different forms. Ammonium (NH_4^+) has an acidic effect in the soil. Nitrate (NO_3^-) has an alkaline effect. One might easily assume that the answer to this is to fertilise with ammonium

Figure 2: Each soil particle contains a net negative electrical charge and therefore has the ability to attract and hold positively charged elements like potassium and calcium. These elements are attracted and held to the surface of the soil particles like a magnet. Clay and organic matter have a higher net negative electrical charge and therefore have more capacity to hold positively charged ions or cations. Negatively charged ions such as nitrate and phosphate will normally be repelled.

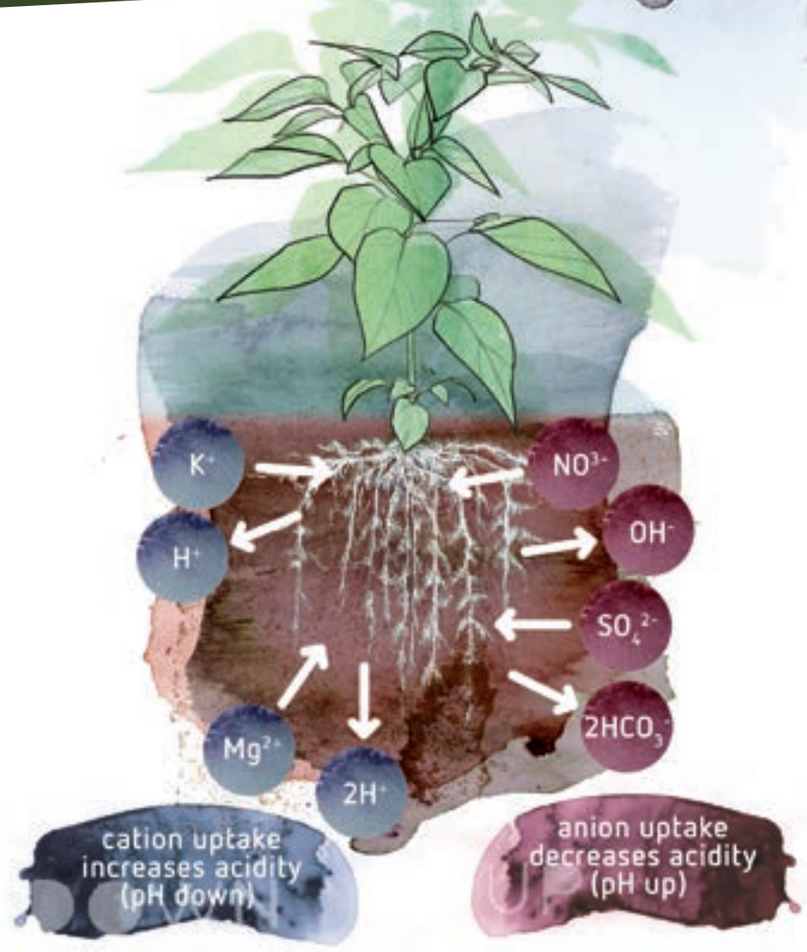


Figure 3: **This image shows you that for every cation (blue) that a plant takes up, it excretes a cation as H+. For every anion (red) a plant takes up, it releases a hydroxide (e.g. OH-) ion. In this way, the plant's net charge always remains in balance. A side-effect of this is that the excreted ions influence the pH of the rhizosphere in the substrate. When the plant excretes a cation, the pH near the roots decreases. The excretion of anions will raise the pH near the roots.**

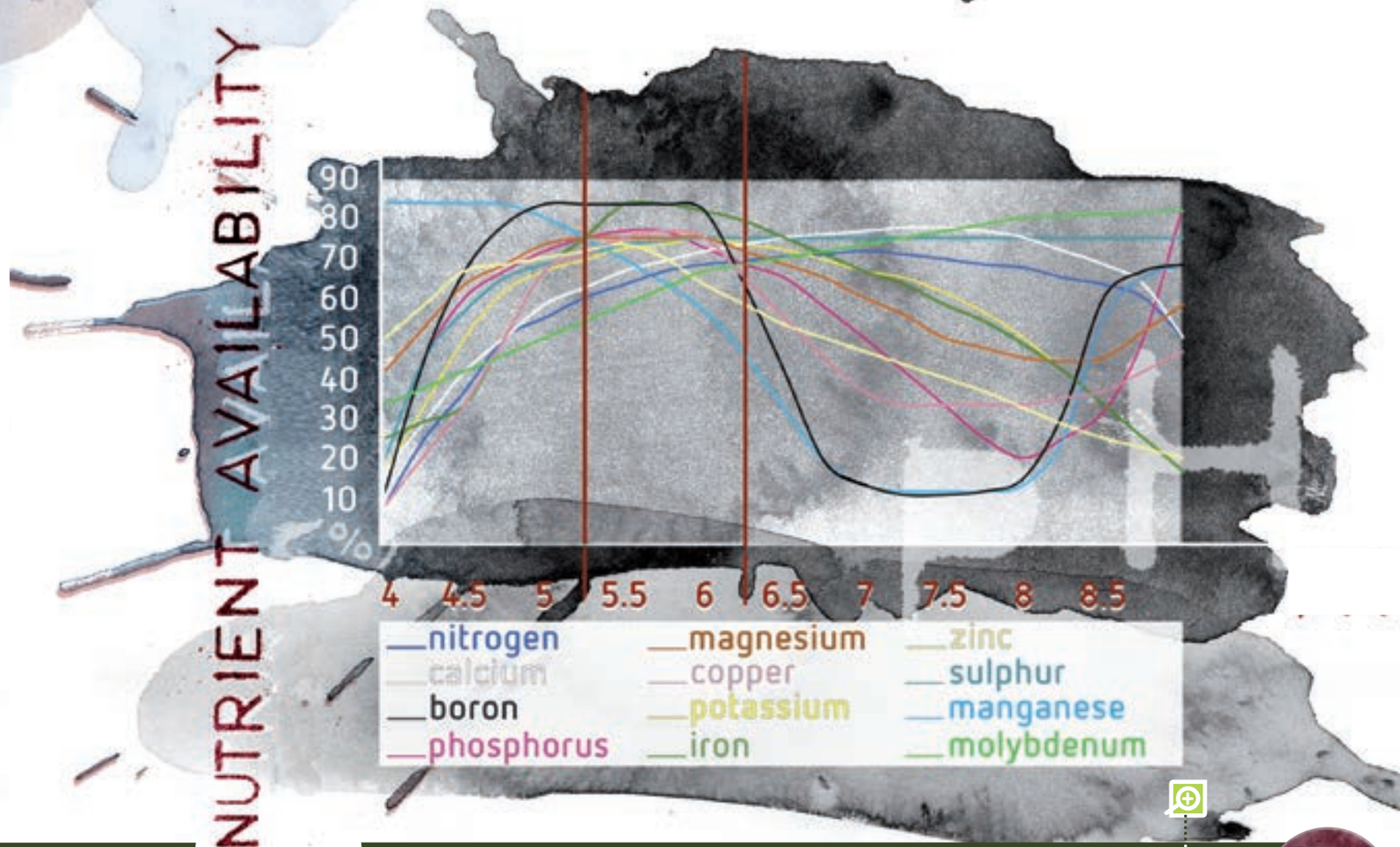


Figure 4: **Most nutrients for plants are available in the pH range of 5.2 and 6.2.**

nitrate (NH_4NO_3). But it isn't that simple. The ammonium will be taken up much faster by the plant compared to nitrate, and the result in the end will be acidification of the soil. All these reactions need to be taken into account because every nutrient has its own optimum pH-range in the soil with respect to plant availability. For some elements, this is a narrow pH-range and simply measuring the pH in the nutrient solution will not tell you what is really happening down in the rhizosphere.

Exudates

In the past, it became clear that roots excrete many substances in order to influence the soil-life directly around the surface of the roots. These substances are known as 'exudates'. The main exudates are sugars and organic acids. Acids such as citric acid, oxalic acid and malic acid are present to a large extent in the cell moisture of the roots. These elements also can have an influence on the pH in the soil but how strong this influence is will vary in every plant. If the acids are excreted from the roots, they are dissolved as anions and will make the soil near the root more alkaline, like other anions. Usually these exudates will have a minor influence on the pH compared to the strong effect of H^+ ion excretion. What is remarkable, however, is that not every piece of the root system acts in the same way. At the tip of the root, more H^+ ions are excreted, while a bit further down the root, more anions are excreted. This is probably connected to the differences in the uptake of fertilisers.

pH levels affect the availability of nutrients and the growth of the plants

The pH level influences the availability of nutrients and, indirectly therefore, has an effect on the growth of the plants. pH can also affect the absorption of nutrients by plant roots. Not every nutrient is affected equally, but most nutrients are available for plants in the pH range of 5.2 – 6.2 (see figure 4). Before a nutrient can be used by the plant, it must be dissolved in the soil solution. Most minerals and nutrients are more soluble, and thus available, in slightly acid soils than in neutral of slightly alkaline soils.

In neutral to slightly alkaline soils some elements can become 'inactivated' and will no longer be available to the plant. These elements include iron, manganese, copper, zinc and boron. In very acidic soils, on the other hand, the solubility of phosphorus, calcium and magnesium solubility decreases. Phosphorus is never readily soluble in the soil but is most available in soil with a pH range of around 6.5. This value varies between different substrates.

Acid soils (pH 4.0-5.0) can have high concentrations of soluble aluminium, manganese and iron, which may be toxic to the growth of some plants.

Nutrients for healthy plant growth are divided into different categories: macro nutrients (elements needed in larger amounts), which are also subdivided into primary and secondary nutrients and micro nutrients or trace elements (elements needed in very small amounts). Most secondary nutrients and micro nutrient deficiencies can be corrected easily by keeping the medium around the optimum pH range.

Low pH values (3-5) in combination with a high temperature (above 26°C) can also influence the growth of some fungal diseases.

In highly acid soils the activity of the bacteria that decompose soil organic matter can be impeded. This prevents organic matter from breaking down, resulting in an accumulation of organic matter and the non-release of nutrients into the soil, particularly nitrogen, which is locked inside the organic matter. As a result, the growth of the plants can be negatively affected.

In organic soil substrates, there are beneficial fungi called mycorrhizae. These micro-organisms prefer a slightly acidic environment for optimum growth.

The alkalinity of the water is also a relevant factor. If the alkalinity of the water is over 200-250ppm $CaCO_3$, then acid should be added to minimise the influence on the pH of the growing medium.

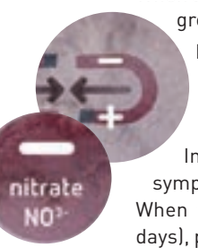
Figure 5: This chart will help you to identify nutrient deficiencies.

How and why the pH often changes in hydroponic growing systems

The uptake of anions (negatively charged nutrients) and cations (positively charged nutrients) by plants can cause substantial shifts in pH in the growing system. If more cations are absorbed in relation to anions, the pH will decrease. If more anions are absorbed than cations, this leads to an increase in pH. Since nitrogen (an element required in large quantities for healthy plant growth) can be supplied either as a cation (ammonium - NH_4^+) or as an anion (nitrate - NO_3^-), the ratio of these two forms of nitrogen in the nutrient solution can have a major effect on both the rate and the direction of pH changes over time. Shifts in pH can occur surprisingly rapidly.

Most varieties of vegetable grow best in a nutrient solution with a pH between 5.2 and 6.2 and at a temperature between 20°C and 22°C.

When little light is available (on overcast days or in indoor growing environments), plants will absorb more potassium and phosphorous from the nutrient solution, increasing the acidity (pH will drop). At low light levels the transpiration rate is also lower, which in turn decreases calcium uptake. In combination with a low pH in the substrate, symptoms of calcium deficiency may appear.



When there is plenty of intense light (on clear sunny days), plants will take up more nitrogen from the nutrient solution. As a result, acidity decreases (pH rises).

What happens if pH is too high or low and how to recognise symptoms

The first symptoms of a nutrient deficiency will show up in the leaves. An iron (Fe) deficiency, for example, can occur very fast. At pH values of 7 or over, less than 50% of the Fe will be available to the plants. At pH values of 8.0, just a tiny amount of Fe is left in solution due to iron hydroxide precipitation ($Fe(OH)_3^-$ which eventually converts to rust).

Figure 5 can be used as a tool to identify nutrient deficiencies in plants. Chlorosis is the yellowing or bleaching of green plant tissue due to the loss of chlorophyll. Necrosis is the death of plant tissue and shows as a dark brown discolouration e.g. on a portion of the leaf.

The place on the plant where the symptoms occur (old versus young leaves) will depend on the mobility of the element in the plant. Elements with very low mobility are boron, calcium, copper, iron, manganese, molybdenum and zinc. Deficiencies of these elements will first be seen in the younger leaves. These elements are transferred with the sap-flow to the young leaves. They do not move around within the plant. More mobile elements are nitrogen, potassium and magnesium. Deficiency symptoms of these elements are seen in the older leaves of the plants because the elements relocate from the older leaves to the younger leaves, which need more nutrients for the growing process. •

KING KALE

KALE HAS IT ALL. NOT ONLY IS IT NUTRITIOUS AND EASY TO GROW, IT'S DAMNED ATTRACTIVE TOO. KALE IS FIERCELY FLAVOURSOME AND GENTLY GENEROUS. IT'S THE COOL WEATHER GREEN THAT JUST KEEPS ON GIVING, A LEADER AMONG VEGGIES THAT JUST CANNOT BE DENIED. ALL HAIL, KING KALE. By Marco Barneveld, www.braindrain.nu

Are you one of those health-loving, smoothie-sipping kale lovers? Are you a proud muncher of raw kale? Well, you're not alone. Kale has got celebrities and even presidents under its spell. Kale is the natural-born leader of the veggie revolution. Raw, blended, sautéed or in chip or crunch form, it seems that kale is the munch of choice for the great and the good: Gwyneth and Jennifer can't get enough of it and Kevin Bacon recently declared: "It's the age of kale. A day without kale is like a day without sun." Bette Midler says: "Kale is burning up the veggisphere." Hell, even the Obamas dined on kale salad at their Thanksgiving feast, notes The Washington Post. With such powerful friends in all the right places, world domination must surely be just around the corner for these mighty green leaves.

Farmer's cabbage

A member of the brassica family, kale has a good pedigree as well. Cabbage, broccoli, cauliflower and even run-of-the-mill root veggies like turnip are all part of this great big green family. Kale is also known as borecole, which means 'farmer's cabbage' in Dutch. Many varieties are now available, the most common being Scotch kale with its frilly, tightly curled leaves.

Like broccoli, cauliflower, and collards, kale is a descendant of the wild cabbage, a plant that is thought to have originated in Asia Minor and to have been brought to Europe around 600 B.C. by groups of Celtic wanderers. Curly kale played a major role in early European dishes, having been an important crop in ancient Roman times and a popular vegetable among the peasant classes in the Middle Ages. English settlers brought kale to the United States in the seventeenth century, the smart buggers.

Super greens

Yes, everyone loves kale, that much is clear. But even though it's the hottest vegetable on the scene, many of its healthful

Photo courtesy of Jan Martin, thesnailofhappiness.com

Figure 6: **Not only Kevin Bacon, Bette Midlet and the Obamas can't get enough of kale; these small white and large white caterpillars are great kale lovers!'**

Figure 7: **Kale has more vitamin C than an orange. One cup of chopped kale has 134 percent of your recommended daily intake of vitamin C, while a medium orange has 113 percent of the daily C requirement.**

attributes remain a mystery to the general public. Well, we're about to change that. Dark leafy greens like kale are important for the health of skin, hair and bone, and they provide protein, iron, vitamins and minerals. These super greens are positively packed with nutrition that puts them high up on the list of the world's healthiest foods. Even spinach cannot come close in comparison to the number of nutrients that kale provides.

More vitamins than an orange

Did you know that kale has more vitamin C than an orange? One cup of cooked kale has over 1000% more vitamin C than a cup of cooked spinach but it also beats oranges. One cup of chopped kale has 134 percent of your recommended daily intake of vitamin C, while a medium orange has 113 percent of the daily C requirement. And what's more, a cup of kale weighs just 2.4 ounces, while a medium orange weighs 4.6 ounces. In other words? Ounce for ounce, kale has more than twice the vitamin C of an orange.

And then there are the fats that kale contains. 'Fats?' we hear you ask... Yes, fats - the good kind though. We don't typically think of our greens as a source of any kind of fat, but kale is actually a great source of alpha-linoleic acid (ALA), which is a type of omega-3 fatty acid that's essential for brain health, reduces the risk of Type 2 diabetes, and boosts cardiac health as well. And then, kale is also the king of vitamin A. It has 133 percent of a person's daily vitamin A requirement – that's more than any other leafy green. And you thought that you should drink cow's milk to satisfy your body's need for calcium? Well think again. Stop stealing milk from those poor old cows because kale beats milk for calcium content.
The possible health benefits of consuming kale include improving blood glucose control in diabetics, lowering the risk of cancer, lowering blood pressure, improving bone health, lowering the risk of developing asthma and more. Are you hungry yet?

Grow it yourself

So you want to get down and dirt up with this veggie hero, yeah? Well, you can grow kale from seeds sown directly into prepared soil, but especially in spring it's best to start seeds indoors and set them out under protective cloches four to six weeks before your last spring frost. As long as they are protected from cold winds, kale transplanted into cool soil will quickly establish itself and start growing. Kale prefers cool temperatures. Frost will sweeten its taste, but warmth will turn it bitter. Sow in February-March for a winter harvest. Ideally, choose an area with full sun and rich, well-drained soil with a pH of 6.0-7.0. If the soil is too acidic, add lime. If the soil isn't rich enough already, dig in some compost or well-rotted manure. Since you're growing kale for its foliage, a high nitrogen content is recommended.
Your kale plants can either be seeded directly into the garden or transplanted as seedlings. For direct seeding, sow about 0.4 inch deep and about 12-18 inches apart. Three or four seeds can be planted together and thinned out at the two-leaf stage. As long as you ensure that the soil doesn't dry out, your seeds should germinate in about 5-8 days.
Transplanted seeds should also be spaced 12-18 inches apart, giving them room to spread. Choose healthy plants and keep them slightly moist. Keep young plants well watered. In combination with cool temperatures, moisture will encourage tender, sweet leaves.

Liquid fertiliser

Apply a mulch to keep the soil moist and cool, control the weeds and protect the plants from late summer heat. Kale will also benefit from regular applications of liquid fertiliser during the growing season.

Your kale should be ready for harvest within around two months, depending on the weather conditions and the variety you choose. Begin harvesting when the leaves are larger than your hand, and simply break off the older, bigger leaves, as you need them for cooking. Younger leaves are good to use fresh in salads and the mature leaves can be used for cooking. New leaves will continue to grow from the centre of the plants. After the plants reach a harvestable size, most varieties will yield three leaves per plant every five days.

Leaf quality is best in the fall, after the plants have been exposed to a few light frosts. These are the best leaves to blanch and freeze for long-term storage.
You can harvest the lower leaves regularly, allowing the centre of the plant to continue to produce. Alternatively, you can wait until the plant is mature and harvest all at once.
Kale is easy to grow but it can fall victim to many of the pests and diseases that the brassica family are susceptible to, such as the cabbage moth, aphids, snails, slugs and some soil-borne diseases. Healthy kale grown in rich, well-drained soil will be able to withstand these problems better. Crop rotation is also strongly recommended, meaning that members of the cabbage family should not be grown in the same place in the following year. This reduces the likelihood of pests and diseases building up in the soil. We want to keep king kale as healthy as he is himself.

Eat it yourself

So now that you are fully clued up about kale – what's the best way to eat it? Well how about a nice kale, apple, and pancetta salad? With the slight bitterness of the kale and radicchio, the crispy-salty pancetta, the tart apples and the sweet maple syrup, this hearty salad hits all the right taste buttons. And it looks great on the table too.
Here's what you'll need:

RECIPE

Photo courtesy of Jennifer Segal, onceuponachef.com

KALE-APPLE PANCETTA SALAD

- **A little extra virgin olive oil**
- **7.1 oz diced pancetta**
- **A dash of champagne vinegar**
- **1/4 cup pure maple syrup**
- **1/4 teaspoon salt**
- **1/4 teaspoon freshly ground black pepper**
- **1 small head radicchio, shredded**
- **1 bunch kale, stems discarded, leaves shredded**
- **2 tart yet sweet apples, sliced into thick matchsticks**
- **1.8 oz pecans**

Ready? Steady? Let's cook... Heat the olive oil in a small pan and add the pancetta at a medium heat. Stirring frequently, sauté until the pancetta is golden and crispy. Strain the pan drippings into a small bowl and place the crispy pancetta to one side to cool. Add the champagne vinegar, maple syrup, salt and pepper and whisk well. Combine the radicchio, kale, apples and pecans in a large bowl. Add the dressing little by little, while tossing the salad until it is completely dressed. Taste and adjust the seasoning with salt and pepper. Garnish the salad with the golden crispy pancetta. Grab a plate. Open up a nice bottle of oaky red wine. Pour into glass. Light the fire in the hearth.

Enjoy!

Questions & Answers

We receive a lot of questions about growing. Of course, our researchers are more than happy to answer them! Just go to the contact page on our website, www.canna-uk.com, to submit your question.

Photo courtesy of Rebecca Partington

Question

I am growing lettuces, tomatoes, cucumbers, strawberries, broccoli, cauliflowers and peppers using the CANNA AQUA line of products, along with CANNAZYM, CANNA RHIZOTONIC and CANNABOOST. I am topping up nutrient levels on a weekly basis and flushing out the reservoirs every month. I am using reservoir tanks for a small number of plants in order to reduce temperature and pH fluctuations. I know the general advice for smaller growers is to change the nutrients every week (although larger growers never cycle their water). Although I am able to measure EC to get an idea of nutrient uptake, I am unsure how to work out how much of the CANNAZYM, RHIZOTONIC and CANNABOOST to add during top-ups. Do these products get used up at about the same rate as the nutrients, or will they just stay around in the water meaning that when I add more each week I am just boosting the concentration? I've been getting great results with CANNA products, and am planning on making a video about mixing up the nutrients at some point in the near future, but I wanted to check my facts with you guys before I open my mouth to the general public.

Answer

Although the fluctuations in temperature and pH are smaller in a larger tank, the disadvantage will be the change in the EC level. Actually, you should never alter the EC level by adding more water or more nutrients to your tank. If you have to do this, it means that the plant evaporate more water compared to the nutrient uptake in grams (or vice versa). The EC is the amount of salts dissolved in one litre of water. But if you often add water to lower the EC, you will add more and more salts from the tap water, because tap water contains sodium and chloride. A build-up of these elements can make your solution toxic.

To answer your question: all additives are given in terms of ml/litre (not by EC). So if you add extra water, you have to calculate to what you need to add (example: a 90-litre tank needs 10 litres extra, so you add 10x 2ml CANNABOOST). Keep in mind that most active ingredients in our organic additives RHIZOTONIC and CANNABOOST are taken up by the plants. The presence of these components in your nutrient tank is limited and they start to break down as soon as they are diluted in water. The enzyme activity in CANNAZYM is limited and the enzymes will also break down once you put them into the water, a process that can be noticed easily because the solution starts to smell bad. This is the main reason we recommend changing the tank at least every two weeks (max).

Question

I am a novice grower on my first grow using CANNA Terra Professional. I am about three weeks from harvest and putting CANNABOOST, CANNA PK13/14 and CANNA Terra Flores in my water, using your schedule. What I am nervous about is how often I should feed and water. I have been reading about salt build-up which has made me nervous as I water every other day using the nutrients as stated. Is it also possible for you to give me more details on the use of CANNA FLUSH before harvesting with this medium?

Answer

A build-up of salts can occur with Terra Flores and PK13/14 when the doses you give are too big. In the last three weeks, the plant needs a smaller amount of nutrients, so there will be a build-up in the substrate if you continue to give the same doses as in the first weeks. You can recognise a 'build-up of nutrients' by curled, burned and discoloured leaves.

After week three, start to give less Terra Flores (no more PK13/14). You can continue to give the CANNABOOST because it contains no salts and will give your plants more and bigger flowers with a better taste. In the last week(s) you can give plain water (with CANNABOOST) to lower the EC in the substrate. You can increase the speed at which this occurs by adding CANNA FLUSH to this plain water.

Question

I recently bought some CANNA Mononutrients to help correct any future deficiencies and I have some questions.

1) Can I foliar spray with all your CANNA Mononutrients instead of using them as a root drench when trying to fix a deficiency? Or do you only recommend nitrogen and magnesium supplements for foliar spraying?

2) For how long should I add CANNA Mononutrients either through foliar spraying or by root consumption when trying to correct a deficiency? Is a week long enough or do you suggest longer?

Answer

1) No, only nitrogen, magnesium and iron can be absorbed via the leaves. All other elements need to be taken up by the roots.

2) Actually you should not need Mononutrients, but sometimes it can go wrong. If you have resolved the problem, adding for five days is enough. If you have not resolved the problem, you will have to continue. So it depends on the problem and whether you have resolved it.

Keep in mind that deficiency symptoms may also result from (severe) root damage. In that case, a drench application will not improve your crop, but a foliar application may.

Most common mistakes:

Use of extremely soft water such as reverse osmosis water (calcium and magnesium)

- Reuse of CANNA TERRA substrate (calcium)
- Bad cleaning with reuse of substrates (any)
- High pH during the vegetative period (nitrogen, phosphor)
- Low pH during the generative period (potassium)
- Overdosing when using mixing brand, wrong levels of PK or mononutrients

CANNA Mononutrients are optimised for drench application (for use in your nutrient tank). This means that the relevant nutrients are taken up the best using substrate application. Nitrogen, magnesium, iron and other trace elements can also be applied as a foliar spray.

Photo courtesy of Tico

Question

Can you please tell me if your CANNA Aqua Clay Pebbles are suitable for ground coverage to prevent weed growth as an alternative to bark or stone chippings?

Answer

You can use Aqua Clay Pebbles to cover the ground. You should realise that if you use it in pots, you will need less soil and you should water more frequently (but using less water). Make the layer of Aqua Clay Pebbles 1 to 2 inches thick.

Question

Do you know why my CANNA Hydro Flores B goes 'bitty' and cloudy at the bottom? Is this a problem? Do I need to replace it?

Answer

Mineral nutrients should, by definition, produce a clear solution without any deposits, but with organic additives, a small amount of deposits may form. There are a few common reasons why these deposits can form:

- The shelf life has expired. This is the date printed on the packaging. Beyond this date, the effectiveness of the product can no longer be guaranteed and it is advisable to replace it.
- CANNA always advises storing the bottles in a cool, dark and dry place (see the product label on the back of your bottle), but at no less than 4°C. At lower temperatures, the products may become unstable. The nutrients will re-dissolve when you warm the product. To do this, place the bottle in a warm water bath and shake it for a while. This will not affect quality.

Don & Nicky

(PART 9)

Don and Nicky have moved back from Canada to their home country, the UK. Their search for the good life led them to France and they are now doing exactly what they wanted to do with their lives: growing. Don shares his experiences and will tell you everything about the good life in French Catalonia in this, and forthcoming editions.

After a long, hard slog I'm where I want to be. I feel as if I've spent the last few months battling my way through a jungle with a blunt, rusty machete. Finally I've found my beach: immaculate, white, soft sand, a nice shady spot to rest and some cool coconut water. Yes, my indoor garden is finally thriving! Like I said, it hasn't been an easy hike but at least now it actually feels as if I'm relaxing and having some fun.

The GARDEN OF HIS DREAMS

The biggest challenge was perhaps the easiest to overlook: water quality. Here in Catalan country, it's hard –really, really hard. My starting EC was, wait for this, 0.8 mS! This left precious little 'room' to add any real, mineral nutrition from a bottle –even using special 'hard water' formulations. This hurt me most during propagation, just when your spirits are high and your enthusiasm tanks are full. My rock wool pepper seedlings quickly became unhappy, their leaves curling upwards like taco shells and their stems turning purple. Most peppers really don't want anything higher than 0.8 - 1.0 mS when they're very young so what's a grower to do? Adding barely any mineral nutrients deprived my seedlings of essential elements, whereas a 'normal' dosage inevitably created a calcium overload and lock-out. In short, hard water really sucks!

Late one night I remembered an old American friend of mine from New Mexico. She's been sending me care packages of her homemade, smoked chilli powder for years now –a sweet old lady who also happens to be an expert hydroponicist. She'd often joke about the hardness of her 'desert water' –how did she overcome it? She emailed me back almost immediately with a surprisingly simple answer: reverse osmosis water filtration. She recommended installing a pre-softener to lengthen the life of the RO filter so out came the battered credit card again and a week later I had a 200-litres reservoir full of the purest H_2O imaginable. Incredible! Where had this been all my life?

1 I picked my best tomato plant for a deep water culture experiment and it went nuts in its very own 'VIP' bubble bucket!

2 My Tokyo Hot chillies formed long, green fruits.

3 A pruned main stem of one of my 'Tokyo Hot' chilli peppers.

I started a fresh batch of seedlings –'Tokyo Hot' chilli peppers, Sub Arctic Plenty determinate tomatoes and some Wautoma cucumbers. Suddenly my garden sprang back into life! I really cannot overstate the difference that pure water seemed to make. It was as if I'd discovered the secret 'missing link' to hydroponics! But just weeks later I was faced with yet another problem –my plants were growing so fast that space had quickly become a major issue. The dripper system I'd set up for my cucumbers (in rock wool) and the flood and drain table for my chilli peppers (in coco coir and perlite) were doing their jobs a little too well. Drastic action was needed.
At times like these I call in my wife, Nicky, who is a lot more pragmatic and, dare I say it, brutal than my good self. Whereas I want to save every plant and give it a chance Nicky is a lot more ... Darwinian.

"You need more light. Spread the plants out. Lose about seven of them."

Nicky, seeing my pained expression, helped out by snapping some stems. It felt like she was breaking my babies' arms. "Ditch these," she declared heartlessly, "They're going nowhere." After the initial shock I started to see what she was getting at. I rigged up an extra 600-watt HPS, moved my grow tables apart, re-potted my three best Tokyo Hot peppers into luxury-sized fabric containers, spread them out with some soft-mesh netting, pruned away the lower foliage and picked my best tomato plant for a deep water culture experiment. Suddenly my grow room could breathe again!

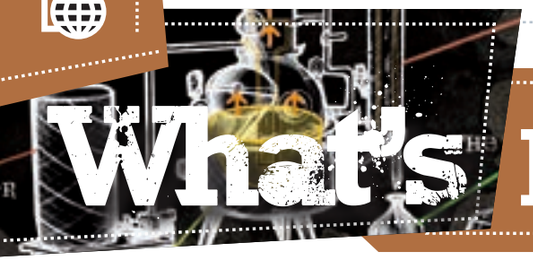
I've learnt that growing indoors is a totally different ball game to outdoor antics. You have to let the plants know who's boss (Nicky is, clearly!). Productivity under grow lights is all about manipulating your plants to produce a low, wide canopy. The last thing you really want is a classic 'Christmas tree' form as this forces you to raise your lights up relatively high, leaving most of the mid to lower portions of the plant languishing in sub-optimal light intensity. I trained my Tokyo Hot chillies so that they formed a egalitarian 'screen' of foliage with my flowers and fruits all at the same height, basking under the high-pressure sodium lamp. Long, green fruits began to proliferate, meanwhile my single Sub Arctic Plenty tomato went nuts in its very own 'VIP' bubble bucket hooked up to a small aquarium chiller.

I'm not out the woods yet. I forgot to hand-pollinate my cucumbers on time and I didn't realise that deep-water culture requires much lower nutrient concentrations. Oh, and Nicky found the credit card statement and the plasma light I'd ordered while drunk. For the sake of marital relations it looks like I'll be making use of their 60-day return policy after all.•

BLUE FIRE

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

- This impressive photo was taken at the Kawah Ijen volcano on the Indonesian island of Java. The blue glow that you can see is not lava, but light created by the combustion of sulphurous gases.
- These gases escape through cracks in the volcano and are released at high pressure and high temperatures (up to 600°C). When the gases come into contact with the air, they spontaneously combust, sending blue flames up to 16 feet high into the atmosphere.
- Some of the gas condenses into liquid sulphur and this also burns as it continues to flow down the sides of the volcano. This makes it look like there is molten lava flowing down its sides.
- This phenomenon occurs twenty-four hours a day, but only becomes visible at night. The Kawah Ijen volcano is the largest 'blue flame area' in the world. The locals also call it 'the blue fire'.
- The Kawah Ijen volcano is Indonesia's main sulphur-producing area. Every day, people here, gather large quantities of the yellow crystallized lumps of sulphur, which they sell or make souvenirs from.
- The Kawah Ijen crater lake is the largest acidic lake in the world. In 2008, George Kourounis managed to measure the lake's pH – which was just 0.5. The reason that the lake is so acidic is because in the past the volcano gave out hydrogen chloride gas. This reacted with the water and formed highly concentrated hydrochloric acid with a pH close to 0. The acid makes the water in the lake appears green.
- The Kawah Ijen volcano is officially dormant. The last eruption of magma was in 1817, and the last phreatic eruption (steam, ash and rocks) was in 2011. However, at times the volcano still gives out so much smoke that it is inaccessible to tourists.
- The blue fire, the crater lake and sulphur mines all go to make Kawah Ijen a real must-see for visitors, but a visit to the volcano is not without its risks. It's a tough climb to reach it and the sulphur fumes are not good for your health. It is advisable to take a tour with a guide and you should also cover your mouth with a scarf or wear a mask or a respirator.



What's HAPPENING

Forget microbreweries. Let's get into something stronger with traditionally distilled spirits. Because moonshining is as hot as the sun on fire. Come again? Your artisanal product is locally produced, traditionally distilled and highly intoxicating? Please, just take my wallet. By Marco Barneveld, www.braindrain.nu

DISTILLING SPIRITS HIP AGAIN

It's a gorgeous day in the summer of 2013. Somewhere in the city of Utrecht, in the middle of the Netherlands, a single drop of alcohol falls from a pot still. It's a historic drop. It's the re-birth of Staffhorst Jenever. The great great grandfather of Bastiaan Staffhorst set up a distillery in the 19th century. "He made beautiful gins, genevers and brandies," says Bastiaan. The family company was sold in 1974, one year before Bastiaan was born. It seemed like the end of an era.

Tones of Cardamom

"I work as an advisor for a construction company. The distance between my career and what we're doing now couldn't be much bigger. But my urge to revive the family tradition of distilling just kept getting stronger. A year ago I spoke to a passionate distiller with a licence about making Staffhorst Jenever again. That day we opened the last remaining bottle of genever to be produced in my family's distillery. History rolled over our tongues. The genever was still beautiful - soft and smooth with tones of cardamom. We immediately agreed that we should recreate this wonderful genever based on 100% malt wine." The Dutch press loved Bastiaan's nostalgic story and things have really taken off. "At first we produced 861 bottles thinking that would be enough. But people just keep calling."

From New Jersey to Amsterdam and Berlin, micro-distilleries are popping up like mushrooms in the woods on a moist autumn day. Moonshiners are taking their hobby just a tad further and creating art in a bottle. With almost spiritual devotion, they are producing their spirits in their traditional, small-scale distilleries. It's a slow process, steeped in local traditions. With brands like Bacardi churning out millions of litres every day, people wonder where all the artistry went, the concern for quality, the authenticity. Well, you'll find all those qualities in the micro-distilleries – in spades.

Kyrgyzstan

Industrial designer Sietze Kalkwijk found himself involved in an experiment that gave birth to a vodka distilled in Kyrgyzstan named Bishkek. "It was great fun to make. I got a taste for distilling," Kalkwijk says. Together with Leo Fontijne, owner of the Van Toor distillery in the Dutch city of Vlaardingen, he created VL92.

VL92 Gin was born of the quest of the two entrepreneurs to make their ultimate gin. Distilled from malt wine, VL92 Gin has its roots in the tradition of Dutch genever. The malt wine is what gives it its boldness, while its complexity derives from the interplay between botanical elements that finish with the eccentric, citrusy endnote of perhaps the most surprising ingredient: coriander leaf. The gin is named after a historic Dutch sailing ship that brought back exotic spices from the orient that were too daring for the local genever recipes, but just perfect for the wilder VL92 Gin. "We are now selling nine thousand bottles a year," he smiles proudly.

Sip-smiths

Traditionally distilled spirits are all the rage. Not only amongst the Dutch. London is home to the Sipsmith micro-distillery, which makes some remarkable gins. Sam Galsworthy is one of the founding fathers of Sipsmith: "After years working in the drinks industry, we struck out on our own to pursue our passion for beautiful handmade spirits. We persuaded the government to give us a distiller's licence, which wasn't easy. It was the first one granted in London for about 200 years and no one knew what was involved. Once they saw we were serious they gave us the licence, but it took two years. We call ourselves 'Sipsmith' to celebrate the artistry involved in distillation and our traditional methods. Perhaps the most important member of the team is Prudence, our one-of-a-kind copper pot still, designed in conjunction with Germany's oldest distillery producers."

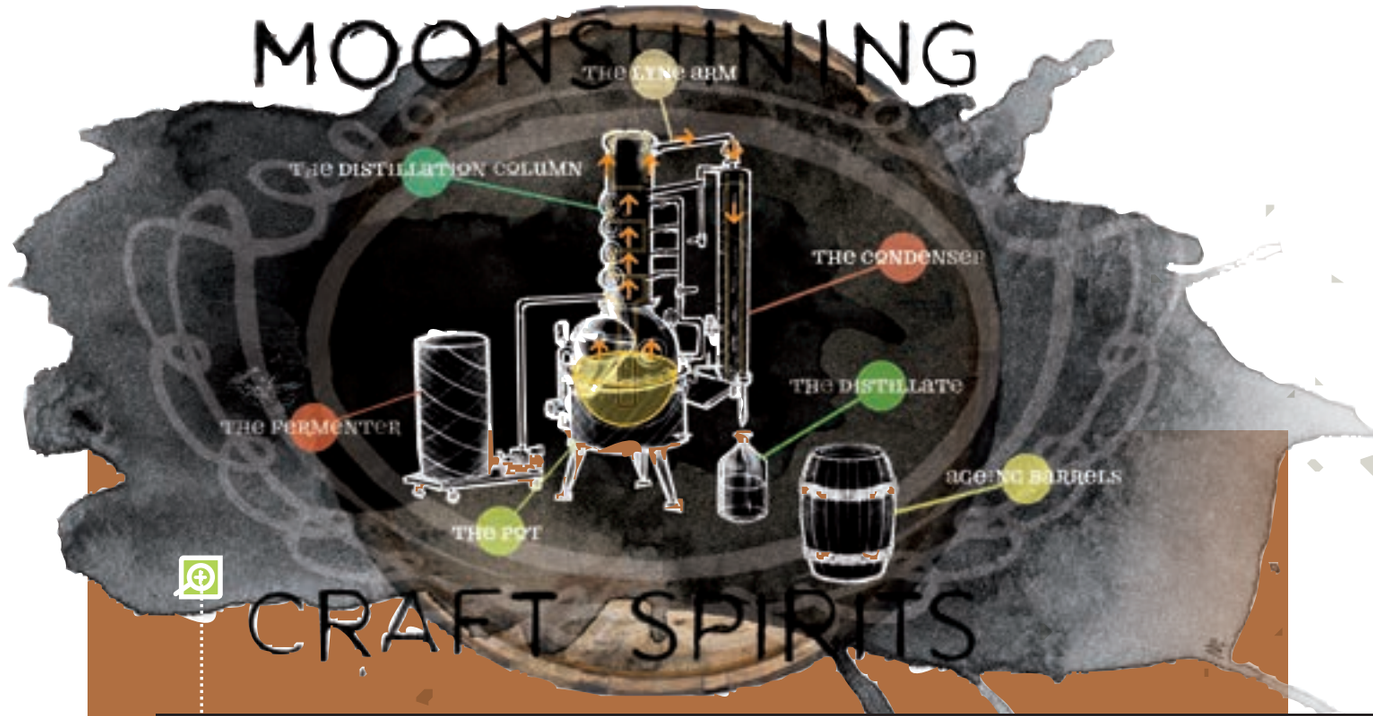


Figure 8: **This illustration shows you the distillation process, step by step (first make sure making your own booze is legal where you live).**

1. Mix together yeast, water and sugar or a sugar-containing grain in a **fermenter** or mash ton. After three to seven days of fermenting furiously, the yeast will have consumed most of the sugar, turning the mash into a wash of about 10 or 12 percent alcohol.
2. A boiler pumps steam into a jacket, or a two-walled metal sleeve, which surrounds the bottom of the **pot**. The heat builds for a half hour or so to raise the wash to its boiling point.
3. As the mixture of alcohol vapor and water vapor rises from the pot, it enters a cool **copper column**. Most of the vapor condenses and falls back into the pot as reflux. Flat copper condensing plates can span the column, controlling the speed at which the process takes place and the taste of the product. The vapor with the highest alcohol content, and thus the lowest boiling point, continues to the outlet at the top of the column.
4. Concentrated alcohol vapor enters a horizontal pipe called a **lyne arm**. A precise temperature is key. Too hot and the vapor will contain excess water; too cool and not enough vapor will enter the arm.
5. The vapor in the lyne arm flows into a vertical chamber, where a pipe of cool water surrounds a pipe of alcohol vapor. As the alcohol vapor cools, it condenses into liquid ethanol, which drips from **the condenser** into a collection vessel.
6. The first five percent of the run, called the 'fore shots' or 'heads', contains large amounts of congeners, or volatile chemical compounds such as acetone, aldehydes, esters, and fusel oils. Next comes the 'hearts', the high-proof alcohol base. Distillers mix the hearts with small quantities of the heads, and the blend is diluted and aged to make spirits. If the percentage of congeners is too high, the drink will taste rough. With too little congeners, it will be bland. The last bit, the 'tails', is a low-proof mix that is often set aside and **redistilled** later.
7. The clear liquid emerging from the still goes by many names; malt wine, new spirit, moonshine, white dog or white lightning. It is colourless and harsh. But after a few years in oak barrels, it takes on colour, richness, and complexity of flavour. Bourbon whiskey is aged in new but charred oak barrels. Scotch whisky is **aged** in old bourbon **barrels**, and Irish whiskey ages in used sherry casks.

Black Forest

In the US, the number of small distilleries has risen from less than fifty in 2005 to five hundred today. But even that is nothing compared to Germany, where every month a hundred new gins come onto the market! Micro-distillation is only small in Germany when you look at the size of the companies. Around the Black Forest alone, there are about a thousand traditional small-scale distilleries. Meanwhile, Berlin seems to be becoming a focus for the hip new distilling scene. And it is there that we find Arthur Christea with his bar Der Hof. He creates his own extracts, sometimes using the herbs he finds growing in the streets of Berlin.

Real taste

Berlin is also home to Theo Ligthart, a Dutchman living in Berlin and the creator of Steinreich42, a schnapps that has won a number of prestigious prizes. "It's great I won those prizes," says Ligthart. "But I won't rest until that 'more-for-less' ethos of the larger companies over the last hundred years has been forgotten. That capitalist, profit-maximising mind-set has ruined so many of our traditional crafts. My fight is for the appreciation of quality and the way that something really tastes. I'm pretty sure that's what makes people smile. That's why I do what I do." •

Pests & DISEASES

MEALY BUGS

One of the more common scale insects that attacks ornamental plants is the mealybug. Mealybugs tend to live together in clusters in protected parts of plants, such as on the leaf axils, leaf sheaths, between twining stems and under loose bark. Their wax covering and preference to stay tucked away out of sight make them difficult to eradicate. Several species of mealybug occur in greenhouses or on houseplants. These include Pseudococcus calceolariae (Glasshouse mealybug), P. longispinus (long-tailed mealybug) and Planococcus citri (citrus mealybug). Within the Planococcus genus, the citrus mealybug Planococcus citri is a particular problem. The citrus mealybug has been recognised as a problem for citrus and ornamental plants in Europe since 1813 and in the United States since 1879.

By CANNA Research

Photo courtesy of Sonya Broughton

Photo courtesy of Scot Nelson

Figure 9: **Predatory insects, such as the mealybug destroyer (right), prey on outdoor mealybugs (left) and can often keep their numbers down.**

Figure 10: **Mealybugs tend to live together in clusters in protected parts of plants.**

Appearance

Mealybugs derive their name from the fact that from the third larval stage onwards, the females are covered with a white, wax-like substance.

The adult females have flattened oval-shaped soft bodies between 0.10-0.16 inches long and 0.08-0.12 inches wide. They are sometimes pink in colour but usually appear whitish due to the white, waxy powder that covers their bodies. Waxy filaments project from the edges of their bodies. Male mealybugs are small, winged fly-like insects that are rarely seen.

Life cycle

Most species are egg layers, although some, especially under greenhouse-like conditions, bear live young. Breeding continues throughout the year in greenhouses, but slows during the winter. Outdoors, two generations a year are common, while in optimal greenhouse conditions eight generations in a year are possible. Several developmental stages can usually be found simultaneously. Normally, females lay about 500 eggs in a cottony ovisac beneath her body. The eggs hatch in 6 to 14 days and the first instars or 'crawlers', as they are commonly called, disperse to suitable feeding sites on new plant parts or hosts. Some mealybugs, like the long-tailed mealybug, do not lay eggs, but bear young as active crawlers.

The instars resemble adult females, but after that the males and females develop differently. Female nymphs increase in size with each moult, reaching adulthood in about a month. In contrast, male mealybugs go through two or so moults and then enter a pupal state in a flimsy cocoon before hatching as a tiny, fly-like, two winged adult. Adult males have no functional mouthparts, live only a day or two, and exist solely to fertilise the females.

Damage

The damage caused by mealybugs feeding on host tissues is mainly due to the injection of toxins or plant pathogens into host plants. In addition, mealybugs secrete a waste product, honeydew, which is a syrupy, sugary liquid that falls on the leaves, coating them with a shiny, sticky film. This honeydew serves as a medium for the growth of sooty mould fungus that reduces the plant's photosynthetic abilities and is unsightly. Feeding by mealybugs can also cause premature leaf drop, dieback, and may even kill plants if left unchecked.

Control

Most mealybugs thrive in warmer conditions, which is why they are not usually a problem on outdoor plants. On houseplants and in greenhouses, on the other hand, mealybugs can be active all year round.

Provide proper cultural control so that the plants are vigorous and can tolerate moderate mealybug feeding without suffering too much damage. Do not over-water or over-fertilise — mealybugs are attracted to plants with high nitrogen levels and soft growth. Removing overwintering sites, such as loose bark, can help to reduce mealybug numbers. Predatory insects, such as lacewings, syrphid flies, ladybirds, and several small parasitic wasps, prey on outdoor mealybugs and can often keep their numbers down. An introduced beetle, Cryptolaemus montrouzieri, the mealybug destroyer, is available commercially for release in greenhouses. Avoid the unnecessary use of insecticide to minimise any adverse effect on these beneficial insects. Manage ants, which are attracted to honeydew produced by the mealybugs and will inhibit the activities of natural enemies.

Mealybugs are difficult to control with insecticides, protected as they are by their wax-like exterior and their knack for hiding themselves away. The crawler stage is when they are at their most vulnerable and then they can be controlled quite easily. Insecticidal soaps will help to reduce numbers as the soap reacts with the waxy layer, dissolving it and drying out the insect. Insecticides will not work against the eggs and will have to be reapplied regularly. •

THE IDEAL pH LEVEL

IT IS PERHAPS ONE OF THE MOST OVERLOOKED ASPECTS OF GROWING, BUT PH IS VERY IMPORTANT IN HYDROPONIC AND SOILLESS SUBSTRATE HORTICULTURE. SOIL HAS A GOOD CAPACITY FOR BUFFERING PH. THIS MEANS THAT EVEN IF THE PH LEVEL OF THE WATER IS NOT IDEAL, THE MAKE-UP OF THE SOIL ACTS AS A BUFFER AND BALANCES OUT THE PH OF THE INCOMING WATER TO A LEVEL THAT IS GENERALLY ACCEPTABLE. HOWEVER, WHEN YOU ARE GROWING WITHOUT SOIL, IN A HYDROPONIC SYSTEM FOR EXAMPLE, IT IS IMPORTANT TO ADJUST THE PH OF THE HYDROPONIC NUTRIENT SOLUTION BECAUSE THERE IS NO SOIL TO ACT AS A BUFFER AND CORRECT THE PH LEVEL IF IT BECOMES UNBALANCED. PH IS MEASURED ON A SCALE OF 1-14, WITH 7 BEING NEUTRAL. ACIDS ARE LOWER THAN 7 AND ALKALIS (BASES) ARE ABOVE 7. THERE ARE PLANTS, SUCH AS HEATHER OR RHODODENDRON, THAT THRIVE AT LOWER PH LEVELS (PH 4.2 – 5.0), WHILE OTHER PLANTS THAT PREFER AN ALKALINE GROWING ENVIRONMENT WITH A MUCH HIGHER PH (>PH 7). IN GENERAL, THOUGH, MOST PLANTS PREFER A SLIGHTLY ACIDIC GROWING ENVIRONMENT.

By CANNA Research

Figure 11: If you want pink hydrangea blooms, make sure that your plant does not take up aluminium from the soil. A few tricks: 1. Add dolomitic lime several times a year. This will help to raise the pH. Aim for a pH of about 6.0 to 6.2. Since hydrangeas take up aluminium best at lower pH levels, raising the pH will help to keep the bluing effect of aluminium out of the hydrangea's system. 2. Use a fertiliser with high levels of phosphorus. Phosphorus helps to prevent the aluminum from creeping into the system of the hydrangea. For blue flowers, aluminium must be present in the soil. To ensure that there is aluminium present, you can add aluminium sulphate to the soil around the hydrangeas (adding organic matter will also lower the pH). To make the aluminium available to the plant, the pH of the soil should be between 5.2 and 5.5. Also, a fertiliser that is low in phosphorus and high in potassium is helpful in producing a good blue colour. ***Source: hydrangeashydrangeas.com***

For any plant's roots to be able to absorb nutrients, these must be dissolved in a solution. If the pH is not at the right level, the plant will lose its ability to absorb some of the essential elements required for healthy growth. Most minerals and nutrients are more soluble – and thus more available to plants – in slightly acidic solutions than in neutral or slightly alkaline solutions. If the pH is too high or too low, nutrients become insoluble and precipitate out. The process of precipitation (the reverse of dissolving) results in the formation of solids in the nutrient solution, and means that the nutrients are no longer available to the plants. Not all the precipitates sink and settle at the bottom of the feed tank. Some precipitates are suspended in the liquid and are so fine that they are invisible to the naked eye. Once the nutrients have precipitated out of solution, your plants can no longer absorb them and will suffer from nutrient deficiency. Eventually they will die if this deficiency is not corrected. Apart from the problem of individual nutrient precipitation due to an incorrect pH, there is also the added problem of nutrient interaction, which can cause one or more nutrients in a fertiliser solution to become unavailable.

Plants let us know their problems (e.g. iron deficiency) through leaf symptoms, but by this time unfortunately it is too late. Although it is only required in very small amounts, iron is one essential plant nutrient whose solubility is greatly affected by pH, which is why it is added in a chelated form (or daily). Iron deficiency symptoms occur easily. At pH values of over 7, less than 50% of the element iron is

THE IDEAL pH LEVEL

step 1

Equipment necessary to check the pH value of your soil.

step 2

Take a sample of the soil.

step 3

Add demineralised water to the sample until the soil is saturated.

available to plants. At pH 8.0, nothing is left in solution due to precipitation of the iron as iron hydroxide, Fe(OH)3 - which eventually converts to rust. As long as the pH is kept below 6.5, over 90% of the iron is available to plants. By adding iron in chelated form, the sensitivity of the iron to pH levels is lessened, depending on the chelate form. For example, the chelator EDDHA keeps the iron available in a pH range of 4-9, while DTPA only works between pH 3.0 and 6.5. Iron chelated with the more expensive EDDHA is often referred to as 'red iron', while iron chelated with the cheaper DTPA is called 'yellow iron'.
Every nutrient deficiency has its own way of manifesting itself in discolouration or malformation of the leaves. You can read more about nutrient deficiencies and macro- and micro-elements, in edition 24 of CANNAtalk.

How often do you need to check the pH of your solution?

The pH of the nutrient solution tends to rise over time, either due to nutrient uptake by the plant or, more importantly, through the diffusion of gasses. As a result, pH needs to be checked periodically and adjusted if necessary. To start out, check the pH on a daily basis. Each system will change pH at a different rate and this will depend on a variety of factors. The type of growing medium used, the weather, the kind of plants and even the age of the plants all effect pH variations in both soil and fertiliser solutions. Once you have become familiar with the pH levels and the changes that occur in your system, you can start to do a less frequent pH check. Measure the pH of your tap water (this should be stable), the feeding-water and the soil. Note the results of these measurements and, if necessary, the adaptations you have made. In this way you can learn from your experiences and you will not have to measure so frequently in the future. Keep a close watch on the plants, too. If you see any abnormalities in the growth, the shape of the leaves or the colours of the leaves, check whether this might have been caused by a nutrient deficiency as a result of a pH that is too low or too high.

How can you check the pH and what are the advantages and disadvantages?

There are several ways to check the pH of the nutrient solution in a hydroponic system or in soil. The pH of soil can be checked with a pH-meter or with pH-indicators either directly in the soil or by testing a soil sample. The most accurate method of determining soil pH is by using a pH meter in soil sample. For this you take a sample of the soil, preferably from different spots, and mix these samples together thoroughly. Take one cup of the mixed soil sample and add 1.5 cups of de-mineralised water. Mix this well and leave it to stand for approximately 1 hour. Filter the mixture into a clean vessel to separate the water from the solids. You can measure the pH in the water.
Paper test strips are probably the least expensive way to check the pH of a nutrient solution. These paper strips are impregnated with a pH sensitive dye which changes colour when dipped into the nutrient solution. Universal indicators will change colour to indicate a range of pH levels from about pH 2 to pH 10. You can compare the colour with a standard colour chart to see what pH the solution is to the nearest whole number. The paper test strips are inexpensive, but they can be harder to read.

Liquid pH test kits are also available. You add a few drops of a pH-sensitive dye to a small amount of the nutrient solution and then comparing the colour of the resulting liquid with a colour chart. This method is slightly more expensive than the paper test strips, but it is easier to read, reasonably accurate and reliable.
A more high-tech and accurate way to check pH is to use a digital meter. These meters come in a wide range of sizes and prices. One of the more affordable types of pH meter is the digital pen. These pens are manufactured by several different companies and are very handy and easy to use. You simply dip the electrode into the nutrient solution for a few moments and the pH value is displayed on an LCD screen.

pH meters are fast and accurate. However they need to be cared for properly and calibrated to maintain their accuracy. The meters usually need calibrating frequently because they can drift and to ensure accuracy you also need to check them often. The glass bulb electrode must be kept clean, and in some models they must be kept wet at all times. The pH meters are actually very sensitive volt meters and are susceptible to problems with the electrode.
Because pH meters have a reputation to stop working without warning, it is a good idea to keep an emergency back-up method for checking pH (paper test strips or a liquid pH test kit), just in case.

How can you adjust pH levels?

The pH scale is logarithmic, which means that each unit of change equals a tenfold change in the concentration of hydrogen or hydroxide ions. To put this another way, a pH 6.0 solution is 10 times more acidic than a pH 7.0 solution, and a pH 5.0 solution would be 10 times more acidic than the pH 6.0 solution and 100 times more acidic than the pH 7.0 solution. This means that if you want to adjust the pH of your nutrient solution by 2 points (for example from 7.5 to 5.5), you would have to use 10 times more adjuster than if you were moving the pH value just 1 point (7.5 to 6.5).

step 4

Stir the mixture well and then let it stand for an hour.

step 5

Pour the mixutre through a filter and catch the resulting liquid in a container.

step 6

You can now measure the pH of the mixture you have filtered.

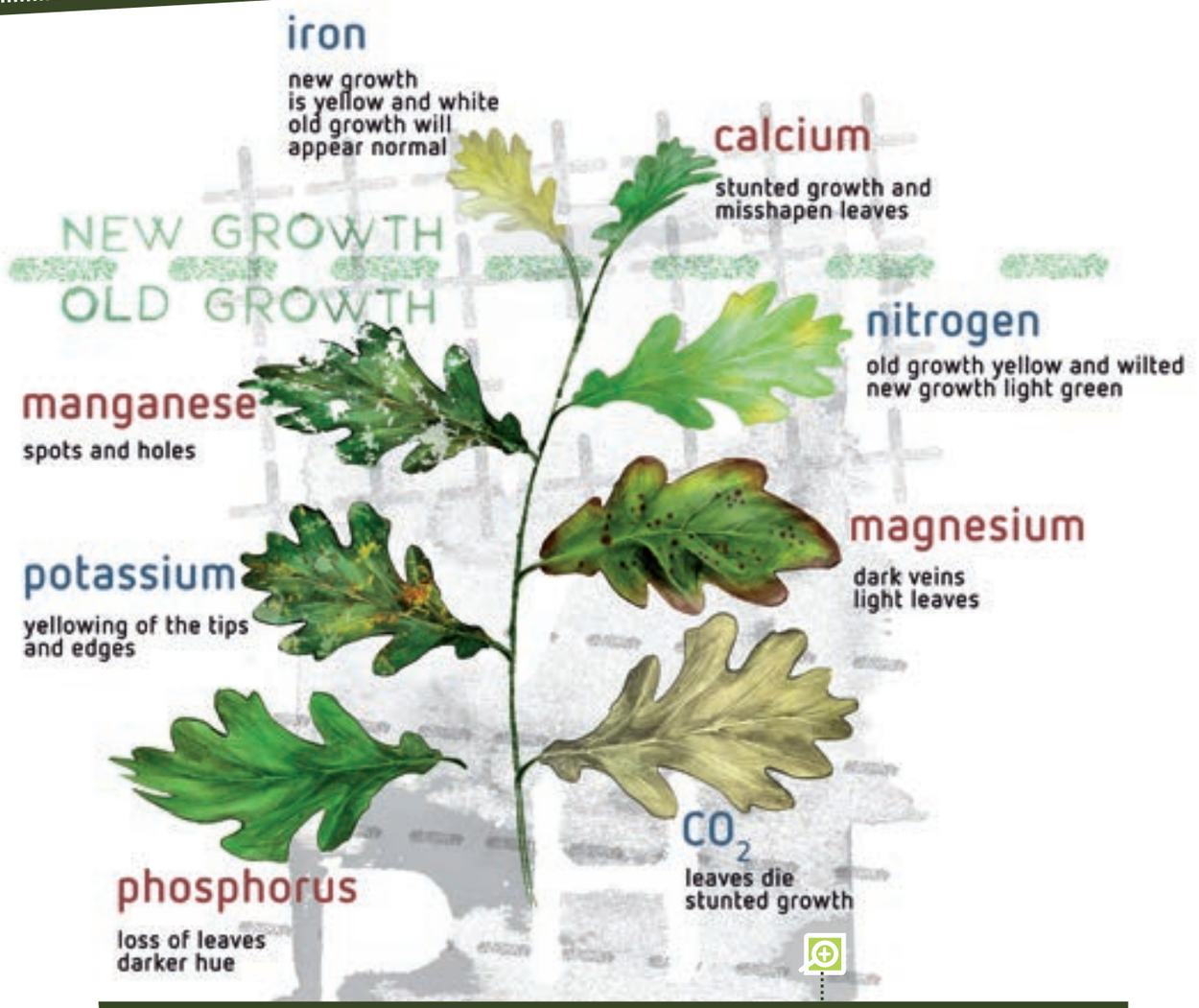


Figure 12: **You can use this image to diagnose and identify which nutrient deficiency your plant is experiencing. Always make sure that the pH is at the right level. An incorrect pH can mean that your plant is no longer able to absorb some of the essential elements required for healthy growth.**

Always add the nutrients to the water before checking and adjusting the pH of your solution. The nutrients will usually lower the pH of the water due to their chemical make-up. After adding the nutrients and mixing the solution, check the pH using whichever method you prefer and decide whether you need a product to raise or lower the pH. Add small amounts of pH adjuster. Stir very well and check the pH again. Repeat the above steps until the pH reaches the desired level.

The pH of the nutrient solution can be adjusted by adding acids or alkalis.
Products used to raise pH are generally based on 2 alkaline ingredients: caustic potash or potassium carbonate. Potassium carbonate has a buffering effect when used to adjust pH compared to caustic potash. Using caustic potash will cause fluctuations in the pH levels. Using potassium carbonate results in fewer fluctuations and a more steady pH due to the bicarbonate that is in the potassium carbonate.
Products used to lower pH are always acids. Nitric acid, phosphoric acid or sulphuric acid can all be used, and these acids contain nitrate, phosphate or sulphur, respectively. It depends on the growing stage of the plant which product is the best to use. Most commonly, nitric acid is used when the plants are in the vegetative growth phase. Phosphoric acid is used when the plants are in the flowering stage. •

Grower's TIP #28

By your friend SEZ

pH - JUST HOW PRECISE DO YOU NEED TO BE?

Back when I was running a hydroponics shop, we often had to handle distressed customers who had questions like 'my friend says to pH at 5.8 but my other friend swears by 5.5'. Substitute here any value between 5.2 and 6.5... every friend had the ultimate magic number.

The reality is that you don't need to worry about getting your pH as accurate as growers often think. First, let's keep in mind that pH meters are not as precise as we might like to think they are. The accuracy of even the more expensive meters will not be beyond +/- 0.1 pH. Of course, this means for a solution with a pH of 6.0, the measurement may read 5.9 one minute and 6.1 a few minutes later (please forget about the hundredth of decimal precision your pen may display, it ain't happening). After a few months of use in the real world, that accuracy range will be closer to +/- 0.2 because many things will alter the precision of the meter, not least lack of care by the user. Let's be honest, the garden is not the best place for fragile laboratory equipment like pH meters.
Most pH meters used in the hobby industry use the same technology to get their reading. This consists of a glass bulb containing an electrolyte solution. These are reliable, affordable, but extremely fragile. The tiniest shock will create micro fractures and slowly but surely, the electrolyte solution will leak out making the measurement less precise over time. Also, they cannot be allowed to dry out too often, because the electrolyte inside the microscopically porous glass probe will gradually leak out through the glass. Each time you let the meter dry out will shorten its lifespan. Other factors will influence these readings, like how clean the probe is, the lifespan of batteries, temperature etc. It is important to verify calibration often and re-calibrate as needed.

In the end, growers need to understand that their plants will not really notice a difference between a 5.8 or a 6.2 nutrient solution, provided they are growing in a good-quality growing medium like CANNA Terra Professional Plus or CANNA COCO. In actual fact, growers can cause more harm than good when they fuss around trying to get the 'perfect' pH value. Dropping acids and bases into the nutrient solution, trying to achieve the desired pH, not mixing properly or allowing the pH fluctuations to stabilise completely – all of this will have a much more detrimental effect on the plant's roots than being off a few tenths of a pH point. Always dilute your pH correctors before adding them to your nutrient solution, wear protective gear like gloves before handling them and avoid repeatedly tweaking the pH of your solution up and down. The inappropriate addition of pH correctors will end up changing the nutrient ratios and this is more damaging than being a bit off the desired pH.
Adjusting a nutrient solution takes time. Equip your reservoir with a recirculation pump that will draw water from the bottom and push it back on top and let it mix the solution for a while before measuring and correcting again. The harder the water is and the more nutrients it contains, the longer it will take to mix properly. Take your time, and once you have reached a point somewhere between 5.8 and 6.2, let it go! Your pH does not need to be perfect. •

Puzzle&WIN

We know... you guys just can't get enough of this old favourite! So especially for you, we have a new Sudoku puzzle – not too hard, but certainly not too easy either. Never done a Sudoku before? Here's what to do: each row, column and 3 x 3 grid must contain all the numbers between one and nine, once only.

WIN A SET OF CANNA PH-SERIES

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

Great PRIZES

So get your brains working out those numbers, and don't forget to let us know what your solution is (sending the middle part of the puzzle is enough for us to check) and maybe **YOU will be the lucky one who wins a set of CANNA pH-series.**

Winner puzzle#26

We picked a winner at random from all the correct entries we received, and we would like to congratulate **Mr. Moody.** Congratulations on your set of CANNA AQUA Flores and AQUA Vega. We will contact you as soon as possible to organise the dispatch of your prize.

WHAT'S NEXT

Phosphorus - a complicated story? Not after you've read our CANNA Research article about this element. Our researchers will explain whether plants really need the levels of phosphorus that are generally recommended, how to interpret labels, and what your plant really needs in the way of phosphorus. All of this will be followed by a practical Grower's Tip. The issue will also include a new adventure written by Don, a Pests and Diseases article about physiological disorders in plants and a Grow it Yourself feature all about lettuce. Don't miss it!

PHOSPHORUS

CANNAtalk IS your magazine, YOUR VOTE COUNTS!

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

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

Request information

- ☐ AQUA Fertilisers (Recirculating systems)
- ☐ HYDRO Fertilisers (Run to waste systems)
- ☐ COCO Fertilisers (Coco Coir)
- ☐ TERRA Fertilisers (potting mix)
- ☐ Additives (Optimizing your yields)
- ☐ List of shops in my area
- ☐ Send me a CANNA Calendar 2015. I've secretly enclosed 10 pounds in this envelope to pay for it.

Solution to the puzzle:

#28

CANNAtalk

SERIOUS GROWERS

CANNAtalk:

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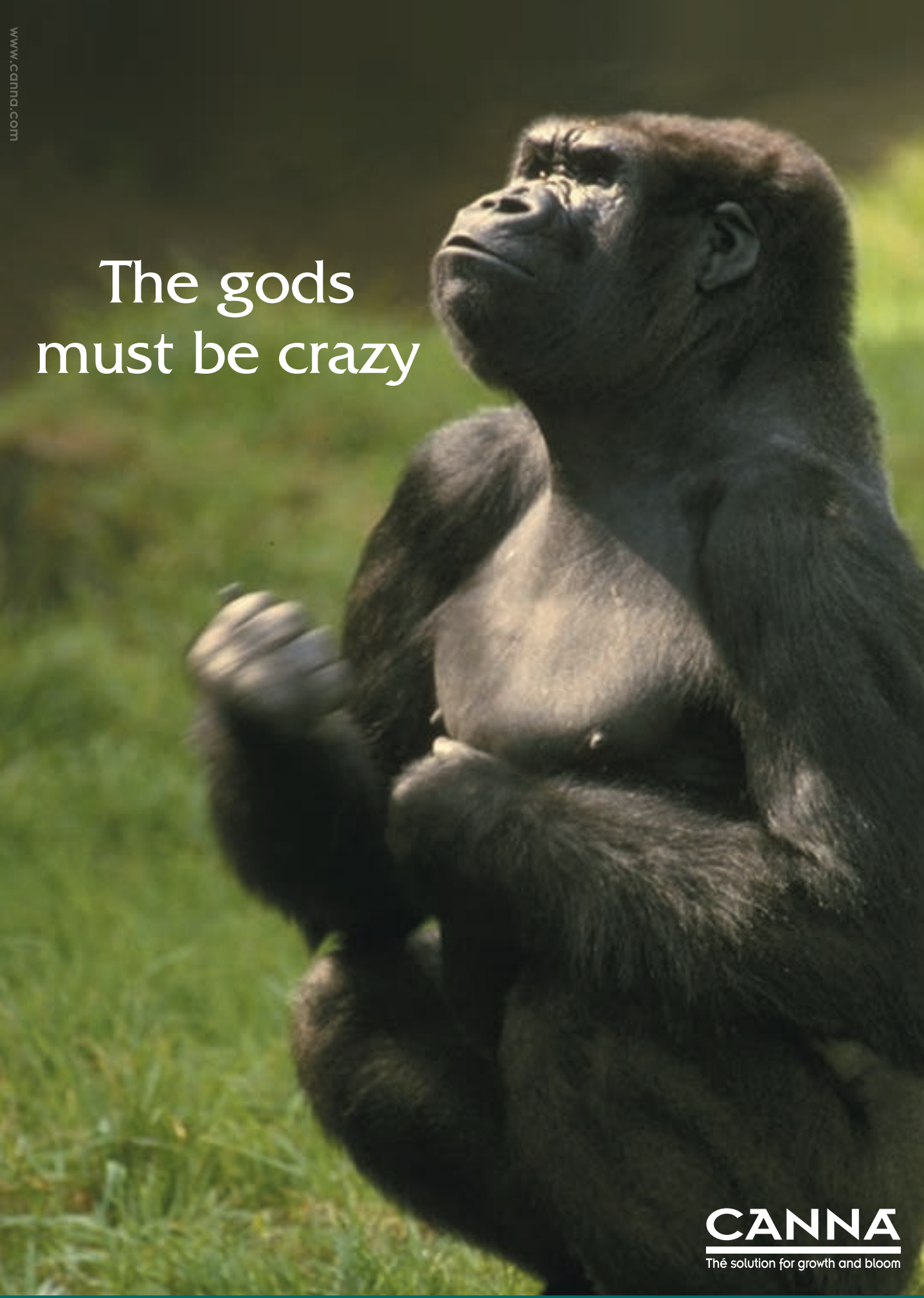

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Thé solution for growth and bloom