CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

ISSUE 18 2012

Interactions between NUTRIENTS

MANGA

Not just for kids and geeks

SPINACH

Popeye's favourite fuel

And more:

HQTalk:

We should probably mention all the unseasonable weather we have been having this summer, but that's getting quite boring, so let's not dwell on that...!
What a great summer it was again! We have all been away and recharged our batteries and we're ready for the new season! And what a great season it will be... The theme for this issue is nutrients. We will explain all the interactions that occur between the nutrients using the Mulder Chart. That's not all. We'll also explain how ammonium nitrate affects plants and how certain environmental factors can impact on your plants as they develop. As in every issue, we have a Grower's Talk article, a Pest and Diseases section looking at broad mites, and we will tell you everything you ever wanted to know about Popeye's favourite food, spinach!
I also want to make it clear that you can still collect CANNA points on all the CANNA nutrient bottles. So visit the CANNA website and start collecting for great CANNA prizes!

While you're there, why not let us know what you think of the magazine. We always love hearing from our readers. So visit www.cannatalk.com and send us a message!

And remember, the more you read the more you know!

Cheers!

Karin

Contents

INTERACTIONS BETWEEN NUTRIENTS

MOST GROWERS KNOW THE IMPORTANCE OF APPLYING THE RIGHT AMOUNT OF MACRO- AND MICRONUTRIENTS, AND THERE ARE SEVERAL WAYS OF KNOWING WHETHER A PLANT IS LACKING ANY OF THESE ELEMENTS. HOWEVER, SOME OF THESE DEFICIENCIES – OR EXCESSES ON OCCASION – ARE NOT CAUSED BY A SHORTAGE OF THE ELEMENT IN QUESTION BUT RATHER BY A POOR COMBINATION WITH OTHER NUTRIENTS, EITHER IN THE POTTING MIX, IN THE PLANT OR BOTH. IN THIS ARTICLE, WE ARE GOING TO LOOK AT THE IMPORTANCE OF THE INTERACTION BETWEEN DIFFERENT NUTRIENTS AND HOW IT CAN AFFECT THE FINAL CROP. By Inaki Garcia, CANNA Research

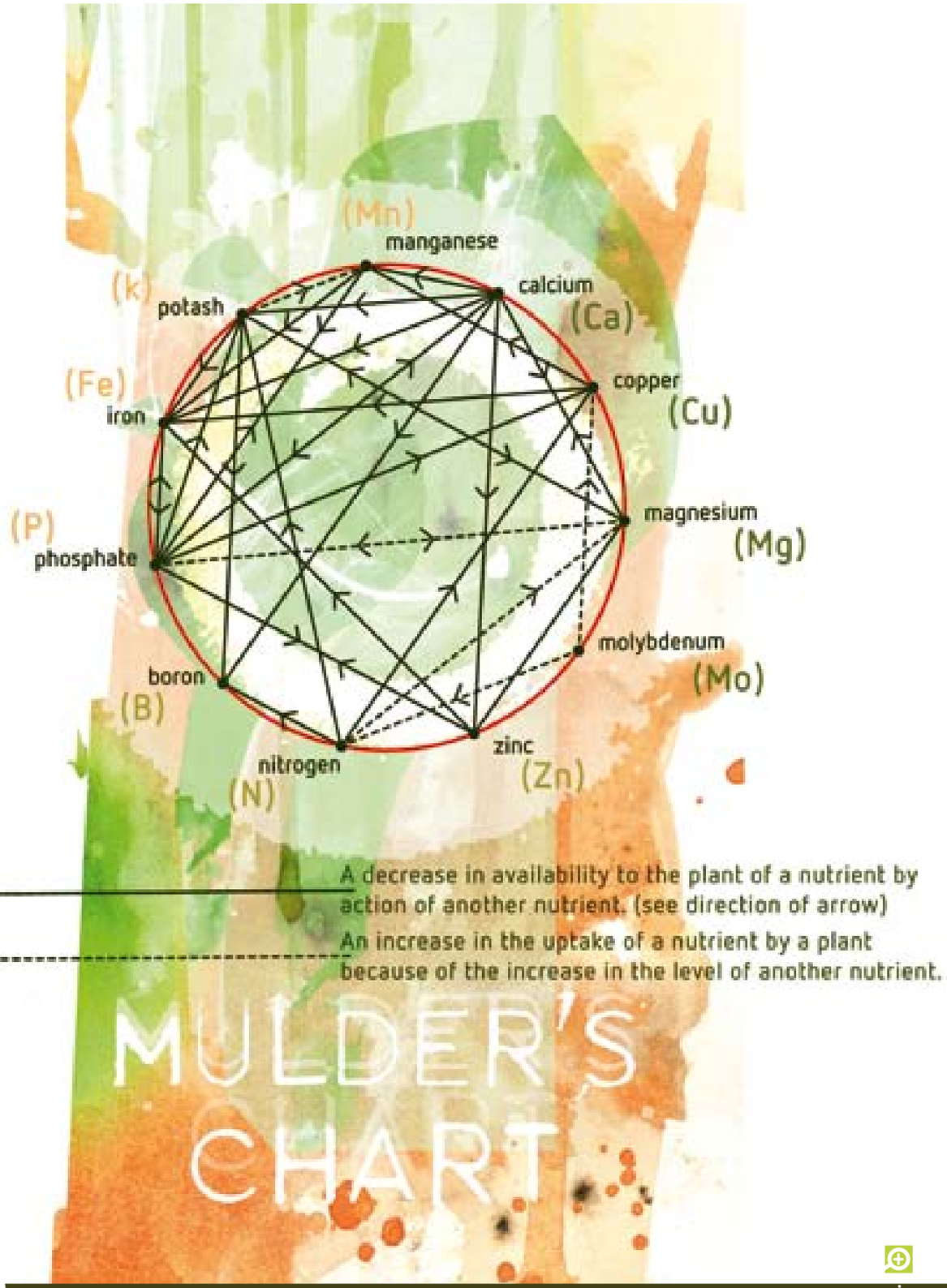


Figure 1: The Mulder's Chart shows how elements interact. The dotted lines show which elements enhance each other. The solid lines show which elements antagonize each other. For example, calcium can cause a magnesium deficiency, while nitrogen can solve this deficiency. So adding extra magnesium isn't necessary!

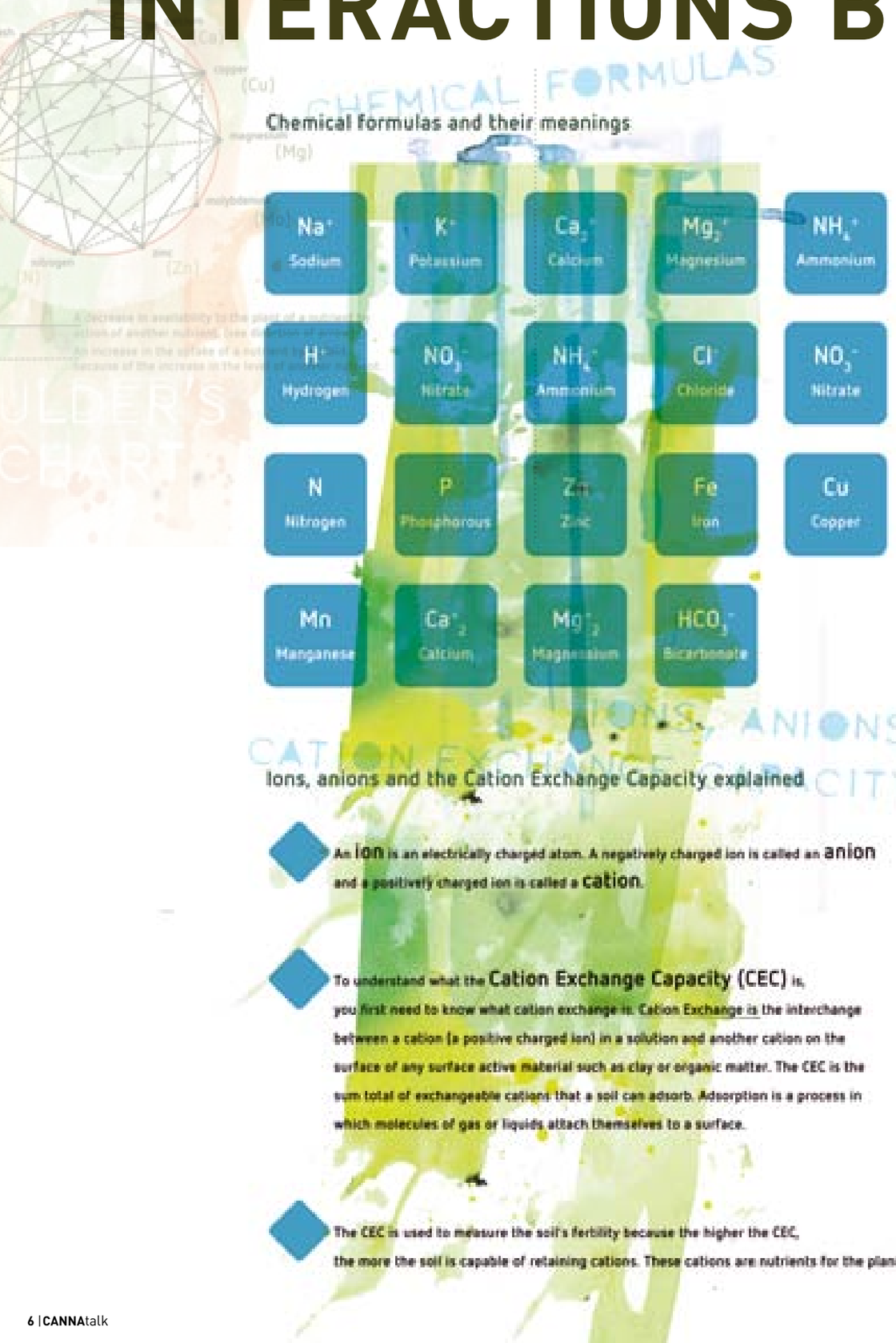
In 1953, D. Mulder published his "Les elements mineurs en culture fruitière", one of the first studies of how different nutrients interact. The study included a graph, which is now commonly used. Over the years, other researchers have added other possible synergies and antagonisms.

Clearly, studying the interactions between nutrients is essential for improving crop yield.

The relative proportions of different nutrients has a direct effect not only on plant nutrition, but also on the substratum in which the plant grows. Cations (positively charged elements) are to a greater or lesser extent retained by the negative charges in certain soil components, such as clay and organic matter. Cations include Na+, K+, Ca2+, Mg2+, NH4+ and H+ (sodium, potassium, calcium, magnesium, ammonium and hydrogen). Plants absorb elements that are dissolved in water, which means that elements trapped in the soil cannot be used directly. In some cases, however, these elements can filter into the water in the substratum and thus be assimilated by the plant. The more cations that the soil or substratum can hold, the greater its 'Cation Exchange Capacity' (or CEC). The proportion of cations in the soil directly influences the texture of the soil or substratum.

On the next page you will find the most important interactions between nutrients.

INTERACTIONS BET WEEN NUTRIENTS



Nitrogen

When in the form of ammonium, NH4+, nitrogen interacts negatively with the plant's uptake of calcium, magnesium and potassium, particularly when the NO3- (nitrate)/NH4+ (ammonium) ratio is low. As a result, excess NH4+ can lead to a deficiency in any of these three elements. This is an important problem in hydroponic growing, which normally uses an inert growing medium with a low or zero CEC index; here the quantity of available calcium, magnesium and potassium depends solely on what is in the nutrient solution, unlike soils or substrata with high CECs which normally hold a large quantity of these elements. More information on the ammonium/nitrate ratio can be found on page 24.

There is also an antagonistic interaction between the anions Cl- and NO3- . Excess Cl- (very common in saline and/or sodic water) can reduce the plant's absorption of NO3- .

The N/K ratio is also crucial when plants are passing from the growth (vegetative) phase to the generative (flowering or fruit-bearing) phase. The primary stimulus for a short-day or long-day plant to go from vegetative to generative is the number of consecutive hours of darkness. However, other stimuli, such as the N/K ratio, also affect these phenological states to some extent.

Fruit contains an abundance of potassium, and it is therefore essential to ensure a proper supply of potassium during generative periods. Yet regardless of how much potassium there is, if the ratio to nitrogen is too low, this can lead to a reduction in flower formation and plants with many vegetative parts (leaves and branches) and few generative parts (flowers and fruit).

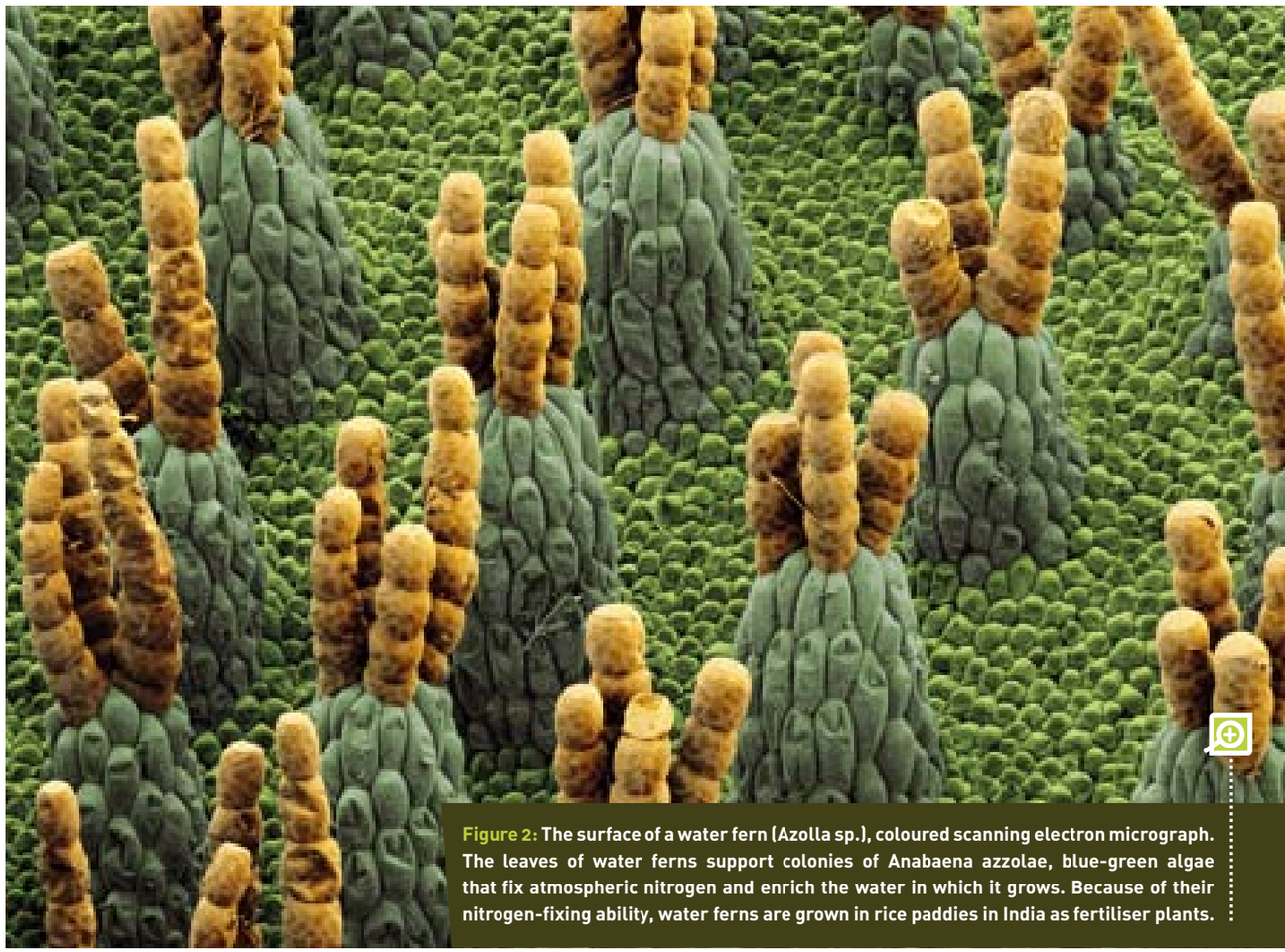


Figure 2: The surface of a water fern (Azolla sp.), coloured scanning electron micrograph. The leaves of water ferns support colonies of Anabaena azzolae, blue-green algae that fix atmospheric nitrogen and enrich the water in which it grows. Because of their nitrogen-fixing ability, water ferns are grown in rice paddies in India as fertiliser plants.

INTERACTIONS BET WEEN NUTRIENTS

Potassium

It is essential to get the proportion of potassium right, since it interacts both in the soil and in the plant with phosphorus, sodium, calcium and magnesium.
In clay soils with a high CEC, when the plants are irrigated with fertiliser solutions in which the potassium is dissolved in its ionic form, some of the potassium is adsorbed by the mineral and humic parts of the soil. If you irrigate with a low-potassium solution, the potassium held in the soil is released for uptake by the plant. This exchangeable potassium and the solution are known as available potassium. As its name suggests, it is this kind that the plant absorbs most readily.
However, the potassium also comes in non-exchangeable forms which are strongly fixed to the soil components. In this case, it is not directly available to the plant and only enters into the solution when levels of exchangeable potassium are very low. The problem of using this potassium is that it takes a long time to go from its fixed state to the interchangeable state, which means that it is not readily absorbed by the plant.
Applying too much calcium and magnesium can cause a potassium deficiency; the K/Ca and K/Mg ratio should always be kept above 2 (but below 10, since too much K can hinder the absorption of calcium and magnesium). Too much potassium can also prevent the absorption of certain microelements, such as zinc. It is particularly important to take account of this interaction when using very hard water with a high calcium and magnesium content.

Phosphorus

An excess of phosphorus interacts negatively with the majority of microelements (Fe, Mn, Zn and Cu). In some cases, this is due to the formation of insoluble precipitates and in other cases, to metabolic processes in the plant which prevent the transfer of the nutrient from the root to other parts of the plant. This is the case, for example, with the P/Zn interaction. The P/Fe interaction appears to be negatively regulated at the cellular level and by the formation of insoluble complexes. The P/Cu interaction normally involves the formation of precipitates in the root area.

Genetic interactions can vary from one species to another and even between different varieties of the same species. For example, in some species a positive effect has been observed between the amount of available phosphorus and the plant's resistance to salinity, meaning that an increase in this element leads to greater resistance. Other studies, however, conclude that the effect is negative.
There have also been reports of a reduction in the availability of sulphur and calcium when large quantities of phosphate are applied. In the case of calcium, this is caused by the formation of insoluble phosphates.
In contrast, phosphorus favours the absorption of magnesium, so a shortage of phosphorus could also lead to a magnesium deficiency if the latter is present in small quantities.

Both NO3- and NH4+ facilitate the absorption of phosphorus. In the case of NH4+, the reason appears to be the excretion of H+ ions by the plant when nitrogen is administered in this form in significant quantities. These H+ ions cause a slight acidification of the root area, which can favour the solubility of some phosphorus salts which would otherwise be trapped or remain in an insoluble form.

Magnesium

It is also important to take account of the Ca/Mg ratio. Its most important effect is its influence on the soil structure. Calcium in the soil tends to improve aeration, while Mg favours the adhesion of soil particles. Thus, if the Ca/Mg ratio is very low, which means that much of the exchange complex will be occupied by these Mg ions, the soil becomes less permeable, harming the development of the crops. Because of this, the Ca/Mg ratio should always be kept above 1.

This ratio is also important for the mineral balance within the plant. The Ca/Mg ratio in the leaves of some plants is about 2:1, which means that it is necessary to apply greater quantities of calcium than magnesium via the nutrient solution.

Magnesium uptake is also influenced by Zn and Mn levels in the growing medium; an overdose of these microelements, as well as being toxic, could also reduce the plant's absorption.

Interaction of Sodium with Calcium, Magnesium and Potassium

Sodium has a negative effect on most plants due to its toxicity, when it accumulates in certain tissues of the plant, and its capacity to harm the soil structure by competing with other cations for adsorption (the adhesion of the cation to the surface of some soil components). When a soil contains a level of sodium that might prove harmful to crops, it is said to be sodic. Soil sodicity should not be confused with soil salinity, which refers to the total quantity of salts in the soil, without specifying which salts are more prevalent.
There are two ways of determining where there is a risk of harm from excess sodium. One is by calculating the ratio between the sodium and other dissolved cations that will be absorbed by the plant. This is known as the sodium adsorption ratio or SAR. The formula is as follows:

$$\frac{[Na^{+}]}{\sqrt{\frac{[Ca^{2+}]+[Mg^{2+}]}{2}}}$$

Irrigation water with an SAR over 18 is considered as having a high sodium content.
Another way is by calculating what proportion of sodium cations is retained in the exchange complex, as compared to others. This is known as the exchangeable sodium percentage (ESP).

$$ESP = 100 \times Na / CEC$$

A soil is considered sodic if it has an ESP of over 15%.
Finally, the ratio between calcium, magnesium and sodium can be altered by the presence of carbonates and bicarbonates. In other words, even if there is initially more Ca and Mg than Na – in principle a good ratio for avoiding problems – if you irrigate with very hard water containing large quantities of carbonates and bicarbonates, they can make the calcium and magnesium precipitate in the form of insoluble carbonates, tipping the scales in favour of sodium and increasing the SAR.

This is known as the residual sodium carbonate (RSC) index. The formula is as follows:

$$RSC=(CO3^{-}+HCO3^{-})-(Ca^{+2}+Mg^{+2})$$

Tap water with values over 2.5 should not be used, as it can cause problems. •

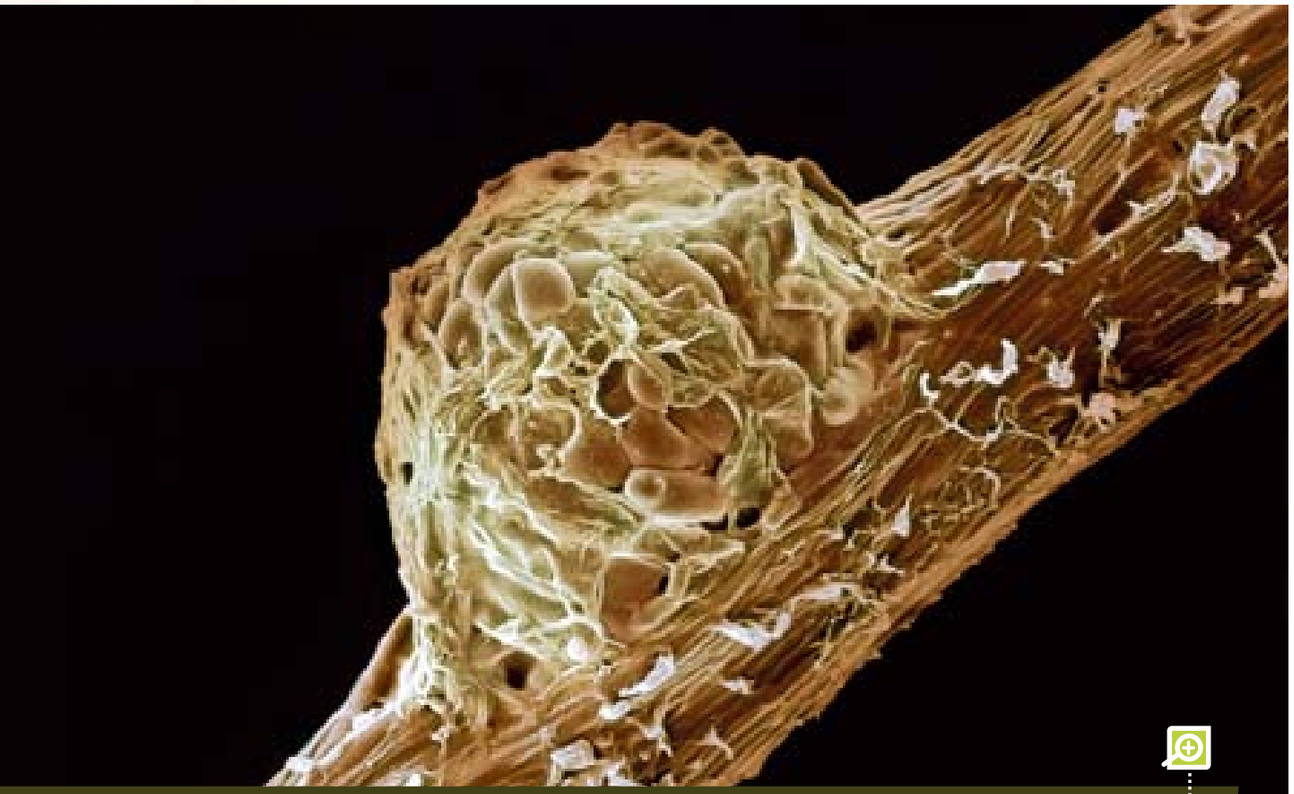


Figure 3: Root nodule. Coloured Scanning Electron Micrograph (SEM) of a root nodule on a pea plant (Pisum sativum) caused by the nitrogen-fixing soil bacteria Rhizobium leguminosarum. The plant and the bacteria have a symbiotic relationship. The bacteria convert ('fixes') atmospheric nitrogen in the soil to ammonia. The plant cannot carry out this process itself, but it is vital for the production of amino acids, the building blocks of proteins. In return, the plant passes carbohydrates produced during photosynthesis to the bacteria for use as an energy source. The bacteria enter the plant through its root hairs, where an infection thread leads it to the nodule.

Questions & Answers

Our inbox has been flooded with growing-related questions again. Of course, our researchers are more than willing to help you out!

Question

I was told that by using CANNA PK 13/14 all the way through to the ripening stage, I will greatly increase my yield. Is this true?

Answer

Use of CANNA PK 13/14 through entire ripe stage, offers no advantage. Provided all conditions are correct including environmental ones, the nutrient line provides enough for all the plants needs. That is provided you hit the correct spot. On an 8-week flower response, from light change to harvest, it falls about week 4.5 and goes to about week 6.

Question

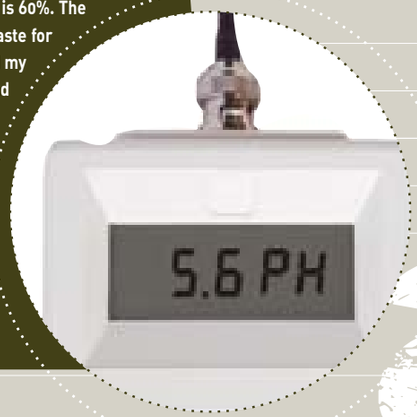
What is the mix ratio when using Boost as foliar spray? How often should it be used, at what pH, and is a wetting agent helpful? How about adding folic/humid acid also?

Answer

If you use CANNABOOST as a foliar application, don't use more than 2 ml/litre. You can adjust the pH to around or slightly below 7.0, and it can be used up to three times per week. It is not as effective as root application, but it does work. Wetting agents are always helpful. And in spite of all the hype, there is no proven value to adding organic acid to the leaves as its function resides totally within the medium.

Question

My medium is 60% coco and 40 perlite. I'm using all CANNA products, CANNA Coco A&B at 12 ml with chart recommendation. I'm in my first week of flowering. I use lights and a CO_2 supply. Humidity is 60%. The temperature doesn't exceed 27°C. My issue is I'm losing control of my pH. I feed run-to-waste for 3 times a day at 5.2 pH and my waste is 6.2 – 6.3 pH. I have over 20% waste. My EC is 1.7 and my waste is 1.3. I've also ran water to have 50% waste then, Re- pH waste back down to 5.2 and add more fresh nutes then re-circulate and repeat 4 times (up to 3 cycles doing that). Only then can I get the pH down to 6.1. My plants are exploding but lower growth is burning and some upper growth as well. What can I do to have better control and lower my pH? Should I bring my pH lower than 5.2 or perhaps use a constant drip system?



Answer

No, bring the pH up a bit to 5.6, then DO NOT water coco with plain water, it wipes out the buffer and along with your lower pH ranges forces the availability of potassium upwards which is probably where the burn is coming from. So only water with nutrients all the time.

Question

I would like to know about CANNA Coco A&B nutrients. Do I add both A and B to the water tank from day 1 in veg., or do I just feed A in the veg. stage and B in the flowering stage?

Answer

You use CANNA Coco A&B through the vegetative and flowering stages. You first add Coco A to the tank water, stir it well and then you add Coco B to your tank water.

Question

I'm getting lots of little white spots in the leaves of the lower growth. What are those?

Answer

The little white spots could be a variety of things but I would need a little more detail to diagnose them accurately. It is probably endema which is caused by watering, which means either there was a period when the plant dried up a little too much before water was re-applied, or the plant held dry then kept wet for a cycle or two and then dried back up, or a plant held wet but was allowed to dry down, etc. Plants like consistency in seeing their water always a little wet or always a little dry but not bouncing between the two extremes.

Question

I'm a conventional soil-based grower. I wanted to use CANNA RHIZOTONIC to improve the root development of greenhouse grown brassicas (soil in plastic cell packs). I can't find a dilution rate anywhere so I don't know how much to buy. Can you help me? Is there a better CANNA product for root development?

Answer

The maximum advised dilution rate is 1:420 and the typical rate is 1:1890. This equates to 2.4 ml/litre maximum to 0.5 ml/litre average. I find the best rate initially is between these two for the first application, and then the second feeding is done at lower range. This is the product that influences root growth in new seedlings going into a cell pack. I would be cautious in using it beyond weeks 2-3. Be sure to use with the appropriate fertiliser for your program as it must be used in conjunction with a regular feeding regime.

Question

I have noticed lately that if my CANNA Hydro Vega mix (A&B, RHIZOTONIC, CANNAZYM) sits in an aerated barrel overnight, it becomes cloudy. Can you tell me why this happens and if the nutrients are still good to use like this?

Answer

The answer is because you are aerating it. Forcing air, with all its accompanying gases such as oxygen and CO_2, through a chemical slurry causes the many different and highly available ions to begin forming various compounds such as calcium, phosphate and so on. The answer is - do not aerate it. Aeration is only needed in deep water culture nothing else. As for the effectiveness of using it, it can be used but the ratios will all be out of position and a weaker mix will then be needed.

Question

I am growing tomatoes, peppers, chillies and cucumbers in air pots using CANNA Coco Professional Plus. My question is what is the best moment to add CANNA PK13/14 to the nutrient tank when growing crops like tomatoes? I am asking this because you recommend using PK13/14 once, for 1 week, 3 weeks before harvest, but tomatoes grow for a longer time.

Answer

I presume that you are growing these vegetables as they are grown in the horticultural sector. The plants produce fruit all the time, but they also grow vegetatively all the time to create new flowers. In this case we only advise using CANNA PK 13/14 when you need to help growing generatively, which means when you have a lot of flowers and not many fruits. Normally this only happens in the beginning and if the plants get out of rhythm. The best action is: Remove a few flowers and small fruits and give PK 13/14 in order to create fewer but larger fruits. Once you get into the rhythm of a few flowers at one time, plus a few small fruits and a few big fruits, you don't need PK 13/14 anymore. If you grow tomatoes during the season (most fruits will be harvested in the same weeks), the best period is to give PK 13/14 when the small fruits start increasing in size. Warning: don't give too much PK 13/14 or for too long. Actually it is only to force the plants into the generative phase.

POPEYE'S FAVOURITE FUEL

REMEMBER POPEYE? WITH HIS TOBACCO PIPE AND HIS BULGING ARMS? BUT SURELY THE THING THAT MOST PEOPLE REMEMBER ABOUT HIM WAS HIS FAVOURITE VEGETABLE - RIGHT? "I WANTS ME SPINACH!" AND AS HE SQUEEZED A CAN OF SPINACH INTO HIS MOUTH, HE'D INSTANTLY DEVELOP EXTRA MUSCLES AND SUPER-STRENGTH. IF POPEYE WAS AN EARLY SUPERHERO, SPINACH WAS HIS FUEL. BUT WHAT HE DIDN'T KNOW WAS THAT HE MIGHT ALSO HAVE BEEN PROTECTING HIMSELF AGAINST VARIOUS ILLNESSES AND AILMENTS. WELL HOW ELSE COULD HE STAY YOUNG FOR OVER ALMOST A HUNDRED YEARS?

By Marco Barneveld, www.bqurious.nl

In fact, our spinach-munching hero with his soft spot for Olive Oyl did something for this leafy green vegetable that no marketing campaign has ever achieved for any flowering plant. Sales of the Spinacia oleracea went through the roof every time Popeye knocked Bluto - his underhand nemesis - off his feet after a healthy dose of spinach. Consumption of this leafy vegetable shot up by 33 percent in the United States between 1931 and 1936 as Popeye gained in popularity. Spinach-growing communities erected several statues in honour of Popeye and the huge boost he was giving their industry.

Vitamin A

For Elzie Crisler Sega, the creator of Popeye, spinach was no random choice. He was a well-read man. Some say that Sega's choice of spinach as a strength-giving food for Popeye was based on faulty calculations of its iron content. According to the story, a scientist misplaced a decimal point in 1870 when calculating the iron content of spinach, giving it ten times more iron than it really had. This slip-up was not noticed until the 1930s. Although this story was in circulation for a long time, recent study has shown that this is a myth, and that in fact Sega chose spinach as Popeye's superfood because of its high vitamin A content. But whatever the truth behind the story, spinach does contain iron, vitamin A and loads more good stuff. Don't worry, we'll come to all that. But first, a potted history of this delicious leafy vegetable.

Persian vegetable

Spinach is thought to have originated in ancient Persia. Arab traders took spinach to India, and from there it spread into ancient China, where it was known as "Persian vegetable". The earliest available record of the spinach plant was recorded in Chinese, stating it was introduced into China via Nepal in 647 AD.

In 827, the Saracens introduced spinach into Sicily. The first written evidence of spinach in the Mediterranean area comes in three 10th-century works, the medical work by al-Razi (known as Rhazes in the West) and in two agricultural treatises, one by Ibn Wahshiya and the other by Qustus al-Rumi. Spinach became a popular vegetable in the Arab Mediterranean, and had arrived in Spain by the late 12th century, where the great Arab agronomist Ibn al-'Awwam called it the "captain of leafy greens". Spinach was also the subject of a special treatise in the 11th century by Ibn Hajjaj.

The prickly-seeded form of spinach was known in Germany by no later than the 13th century, though the smooth-seeded form was not described till 1552. It is this smooth-seeded form that is used in modern commercial production. If you run into the prickly-seeded ones, please give us a shout because we've never seen any of these. Spinach first appeared in England and France in the 14th century, probably via Spain, and it quickly gained popularity because it appeared in early spring, when other vegetables were still scarce. Spinach is mentioned in the first known English cookbook, The Forme of Cury (1390), where it is referred to as spinnedge and spynoches. It seems they didn't know which name they preferred yet. Smooth-seeded spinach was first described in 1552.

Royal greens

Popeye was not the only one to help spinach become a popular vegetable. Europe's royal families also did their bit. In 1533, Catherine de' Medici became queen of France and she was so keen on spinach that she insisted that it be served at every meal. In fact, to this day, dishes made with spinach are known as "Florentine" in her honour, since Catherine's was born in Florence.

The benefits of spinach are many. During World War I, wine fortified with spinach juice was given to French soldiers who were weak after losing blood. Leafy greens like spinach provide more nutrients than any other food, when compared calorie for calorie. Here are some spinach facts to consider.

Spinach is a very nutrient-dense food. It's low in calories yet very high in vitamins, minerals and other phytonutrients. When you eat spinach, you don't need to worry about putting on any weight but you will take in plenty of nutrients. Spinach is an excellent source of vitamin K, vitamin A, magnesium, manganese, iron, calcium, vitamin C, vitamin B2, potassium, and vitamin B6. It's also a very good source of protein, phosphorus, vitamin E, zinc, dietary fibre, and copper. Plus, it's a good source of selenium, niacin, and omega-3 fatty acids.

Available everywhere

Another benefit of spinach is that it is readily available nearly all over the world. With its amazing nutrient profile, spinach sounds like an amazing super food, but it's still easy to find in the market or grow yourself. It's cheap too, and versatile in the kitchen. You can eat it raw in a salad, as part of a green smoothie, boiled or steamed, or added to soups and other dishes.

And we're not done yet. The green greatness of spinach goes on and on. Spinach is loaded with flavonoids which act as antioxidants, protecting the body from free radicals. Researchers have discovered at least 13 different flavonoid compounds that act as anti-cancer substances. The various nutrients offer much in the way of disease protection.

Eating more of this food can help protect your gastrointestinal health and the beta-carotene and vitamin C work to protect the cells of the body's colon from the harmful effects of free radicals. Spinach may slow the age-related decline in brain function. So, eat your greens and keep doing those crossword puzzles to keep your brain young and agile. And what about iron - which everyone thought Popeye was eating it for? The mineral iron is particularly important for menstruating women and growing children and adolescents. In comparison to red meat, spinach provides a lot less calories, contains zero fat or cholesterol and is an excellent source of iron. Because iron is a component of haemoglobin, which carries oxygen to all body cells, it's essential for good energy levels. So while you won't pop out of your T-shirt like Popeye did, in the real world, spinach is pretty much as good as it gets!

Grow the captain of greens yourself!

Well now you know all there is to know about spinach. It's cheap in the supermarket but maybe you fancy growing some yourself? If you love spinach salads and eggs Florentine, perhaps it's time to grow yourself a big patch of spinach so you always have some around.

Spinach needs cool weather to thrive, but if you choose planting times carefully and look for heat-resistant varieties, you can grow it anywhere in the world. So get some seeds! Choose a spot that gets full sun in cool weather and partial shade in warmer temperatures. The soil should be light, fertile and moisture-retentive.

Sow the spinach seeds directly into the soil as soon as the ground can be worked, normally anywhere from four to eight weeks before the last expected frost. Plant the seeds 1.3 cm deep and 5 cm apart in wide rows. For a continuous harvest, sow every two weeks until daytime temperatures start to average 23°C. Begin sowing fall crops in mid-August in cooler climates, or later in warmer ones. Keep the soil moist, and feed the plants manure tea or fish emulsion every 10 days until they're 15 cm tall. Cut the spinach leaves from the outside of the plant as you need them, or harvest entire plants when they reach maturity and before they begin to flower. However, if you see buds starting to form at the centre, cut the whole plant immediately.

POPEYE'S

Garlic Spinach for two

And here is a delicious recipe to help you use all that spinach. Use one tablespoon extra-virgin olive oil, a bag of fresh spinach, three medium-large garlic cloves, peeled and cut into very thin slices, a dash of sea salt and one teaspoon of unsalted butter. Heat the olive oil in a skillet over medium-low heat. When the oil is hot, add the garlic slices and cook until light brown. Add half the spinach and the salt and stir until most of it is dark green. Add the other half of the spinach and stir well again. Take the pan off the heat, add the butter and serve! Now where's me next plate of garlic spinach, harharhar! •

A word from A GROWER

Growers TALK

William, Somerset

When I first started experimenting with microbes back in 2011, I had no idea what micro-life in the medium was all about. I just knew that the bloggers and the wizards of the indoor growing world were all singing the praises of adding microbes to the plant roots; did not matter what system, what crop, or what medium, just pump in the microbes. I grow in potting soil in containers on a run-to-waste system and, just before I wrote, I started using a product that needed to be applied every week, which I did.

I guess I am lucky we figured it out before too much damage was done. I was using CANNA's Terra line of nutrients, which I had 2 years of experience with and was just looking for that little bit more. Although I felt I had micro-life in the pots, I never really thought about it so I decided to add more. If a little works well then a lot will do even better right? Wrong! I found out about some things called pools and just what a hungry microbe is.

About 3 weeks into the grow, I was already pretty maxed out on the fertiliser concentration but the plants were not looking as good as they usually looked. They were dull overall, growing but always looking like they needed a little more. I began to see what I thought was some curling growth on the lower leaves, some splotching, and maybe some yellowing overall. Then the main stems began to turn purplish in colour. All I could do was pump up the nutrients, then I tried flushing, nothing was working, and all the while I was steadily adding the microbes.

A guy at CANNA explained to me, slowly and over several emails, the nutritive elements that are available to the plant build up in the media, a process known as pooling, and form nutrient pools from which the plants can slowly take up what they need. In a controlled environment where there is ample food for the numbers of microbes that are active, then the microbes release more nutrients into these pools. He explained to me how these microbes eat faster than plants and are looking for the same things, in competition with the plants. While some, general feeders, would prefer a nice piece of plant tissue to consume, they will make do with the already processed food that is in the nutrient pools. When activated and added beyond the ability of the container to provide food, they can out-compete the plants. This is exactly what I was seeing, a bio-system out of control and on steroids.

In short, I was killing my plants by repeatedly adding general feeding microbes. There was no easy solution. I leached a bunch, added some controls that I thought might work, and stopped adding more problems. The crop finished, far from my best but it did begin to come back around. Once the house is infested, there is not much you can do with the family living there. The next crop, I went back to my tried and tested methods and I just finished another great crop. Thanks to CANNA for looking after me when I stray. From now on, when I add life to my soil, I will do so very sparingly. •

EXTREME TREES DID YOU KNOW THAT....?

- Trees can grow in the strangest places. Even in sandstone, like this pine tree (pictured) in the German Bastei Mountains. The biggest tree type in the world is the giant sequoia. The largest tree in the world is known as General Sherman and is a giant sequoia in California. It has a height of 83.8 metres and a diameter of 7.7 metres. It's approximately 2,200 years old and each year, the tree adds enough wood to make a regular 18-metre-tall tree!
- Arguably, the baobab is the strangest shaped tree in the world. These trees are native to Madagascar and their swollen trunks are actually used for water storage. The baobab tree can store as much as 120,000 litre of water, enough to endure harsh drought conditions. Some baobabs take the form of skulls, bottles, and even teapots.
- Some trees can get unbelievably old. Methuselah, a Great Basin Bristlecone Pine is 4,843 years old, which makes it the world's oldest known living organism. The exact location of this Californian tree is kept secret to protect it against vandalism.
- Maybe even older is the Sunland Baobab in South Africa. This tree might be more than 6,000 years old. The strange thing is that a bar is located inside the tree. However, the tree did not suffer any damage for this. The bar was made in a natural hollow, which old baobabs develop over the course of time. There's even one baobab with a built-in toilet!
- The Chandelier Tree in California is another tree curiosity. This sequoia is so thick that it has a hole,1.83 metre wide by 2.06 metre high, cut through its base to allow a car to drive through. But this isn't the 'fattest' tree in the world. That record goes to the Árbol del Tule. The Tule Tree is an especially large Montezuma cypress near the city of Oaxaca, Mexico. This tree has the largest trunk girth in the world at 58 metres, and the largest trunk diameter at 11.3 metres. The Tule tree is so thick that people say you don't hug this tree, it hugs you instead.
- The most isolated tree on the planet was the Tree of Ténéré or l'Abre du Ténéré, an acacia that grew in the Sahara desert in Niger, Africa. It was the only tree for over 400 km. Its roots went down as deep as 36 metre below the ground to reach the water table. Unfortunately, even though it was the only tree in an empty desert, a drunk Libyan truck driver managed to drive his truck into it, knock it over and kill it in 1973.

THE BROAD MITE
POLYPHAGOTARSONEMUS LATUS

The broad mite (Polyphagotarsonemus latus), also known as the "yellow tea mite", "yellow jute mite", "broad spider", "tropical mite" and "broad rust mite", is under 0.2 mm in length — less than half the size of the red spider mite (0.5 mm).

By Iñaki García, CANNA Research

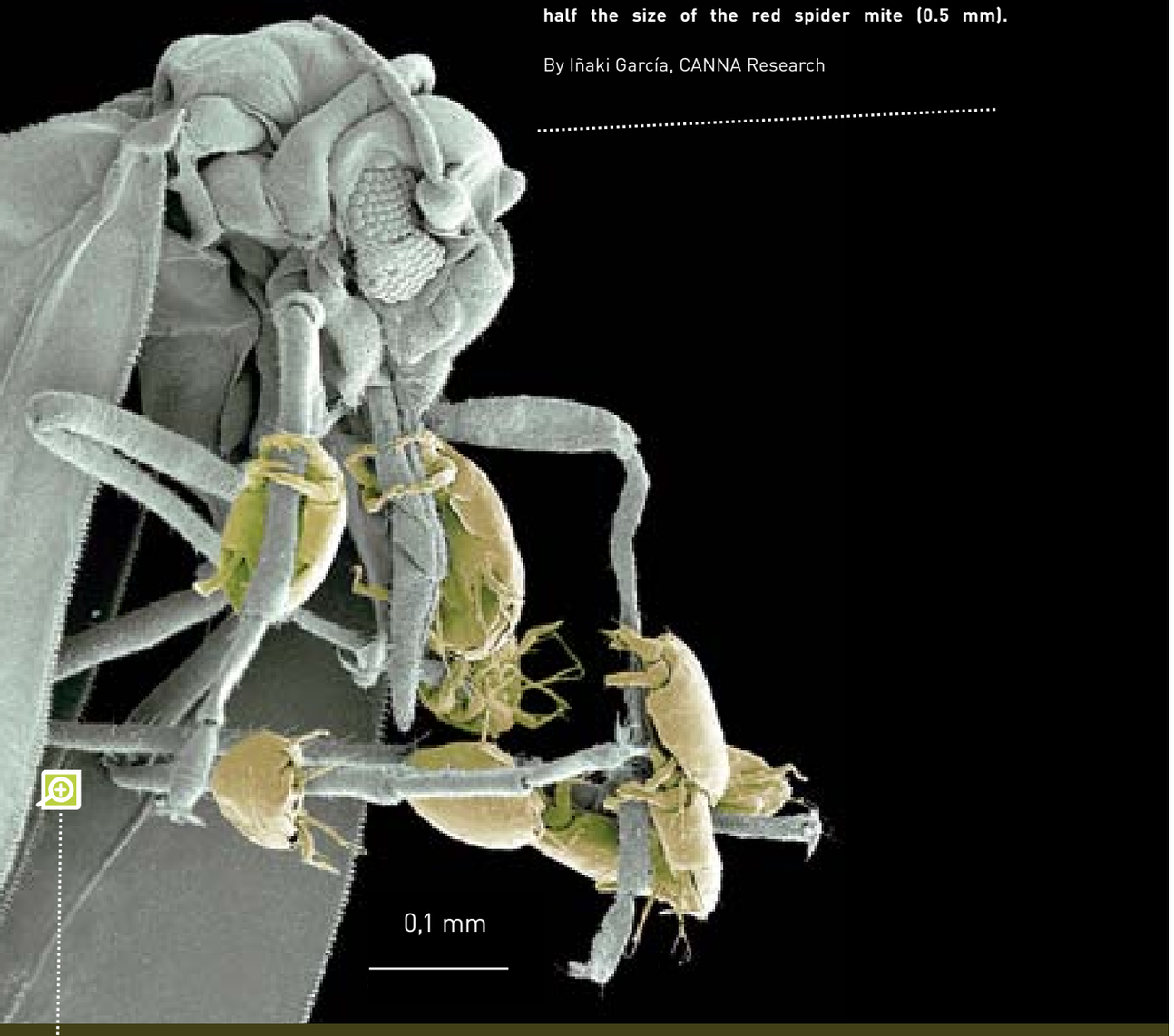


Figure 4: To give an idea how small broad mites are; here are nine broad mites hitching a ride on a whitefly.
Photo Courtesy to DEWalter

Indeed, it is so small that it is only visible under a strong magnifying glass. Unlike red spider mites, broad mites do not spin a tell-tale web; they also move very quickly, making them even more difficult to spot. They are translucent white or yellowish in colour, although on occasion they are other colours. With a strong enough magnifying glass, you can see their distinctively oval-shaped eggs with concentric protuberances on the surface, sticking tightly to the leaves. Adult broad mites have a dark stripe across their back, which widens at one end.

Symptoms in plants

Broad mites are mainly found on the younger parts of the plant. They are particularly fond of shoot apices. They usually develop on the underside of the leaf, making the leaves curl downwards, a symptom which can easily be mistaken for nitrogen overdose. However, in the case of broad mite infestations, there are also visible protuberances on the surface of the leaves as well as dead or dark brown areas and misshapen flowers. Broad mites damage plants directly when feeding. However, the most important harm comes from the toxic substances they excrete, which cause necrosis and other physiological disorders. These toxic substances can remain in the tissues for several days, so the symptoms of infestation can last for some time after every last broad mite has been eliminated.

How do they get onto the plants?

The broad mite is not confined to a single species; it feeds on a variety of plants, some horticultural (peppers and melons), some ornamental (e.g. camellias) and some woody (e.g. citruses and vines) and many others. They are commonly wind-borne and can come from the nearest garden, balcony or vegetable garden. They can also be carried by humans (for example, if you brush against an infected plant in a park before going into your grow room). Broad mites have also been shown to use other winged insects for dispersal, including plant lice, flower thrips (Frankliniella occidentalis) and especially whitefly (Bemisia tabaci and Trialeurodes vaporariorum). Only adult females move around in this way.
One distinctive feature of broad mites is that they cannot survive without a living plant. This means that the first step in future prevention is to destroy any infected plants of whatever type.

Ambient conditions

Broad mites cannot survive at very high temperatures and only lay their eggs at temperatures below 33ºC. Unlike the red spider mite, a combination of high temperatures and a dry environment is lethal to the broad mite. At 30ºC with a relative humidity of 30%, nymphs and eggs of P. latus will not develop. However, in environments with mild temperatures and high relative humidity – typical conditions in many greenhouses – broad mites can reproduce quickly. At the other end of the scale, temperatures below 14ºC hinder egg development and will thus prevent the infestation from spreading.

Control mechanisms

As always, the best policy is prevention. If you know there are broad mites in the area (from remarks from other growers, the presence of greenhouses with Solanaceae or ornamental crops, etc.), you should take special care to avoid introducing other pests such as thrips, whitefly and aphids – since these are all possible carriers of broad mites. Use flypaper to detect their presence.

If you decide to tackle the problem biologically, the predator mite, Amblyseius californicus, feeds not only on red spider mites but also on other mites, including P. latus. However, if you are using it for preventative purposes, remember that if it does not find any mites, it is unlikely to settle on your plants, leaving in search of others with an available food supply. A. californicus can also feed on pollen. •

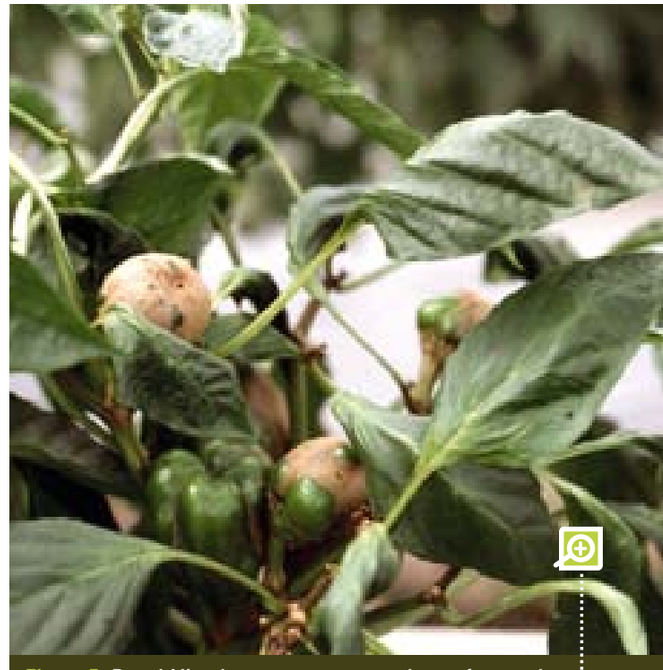
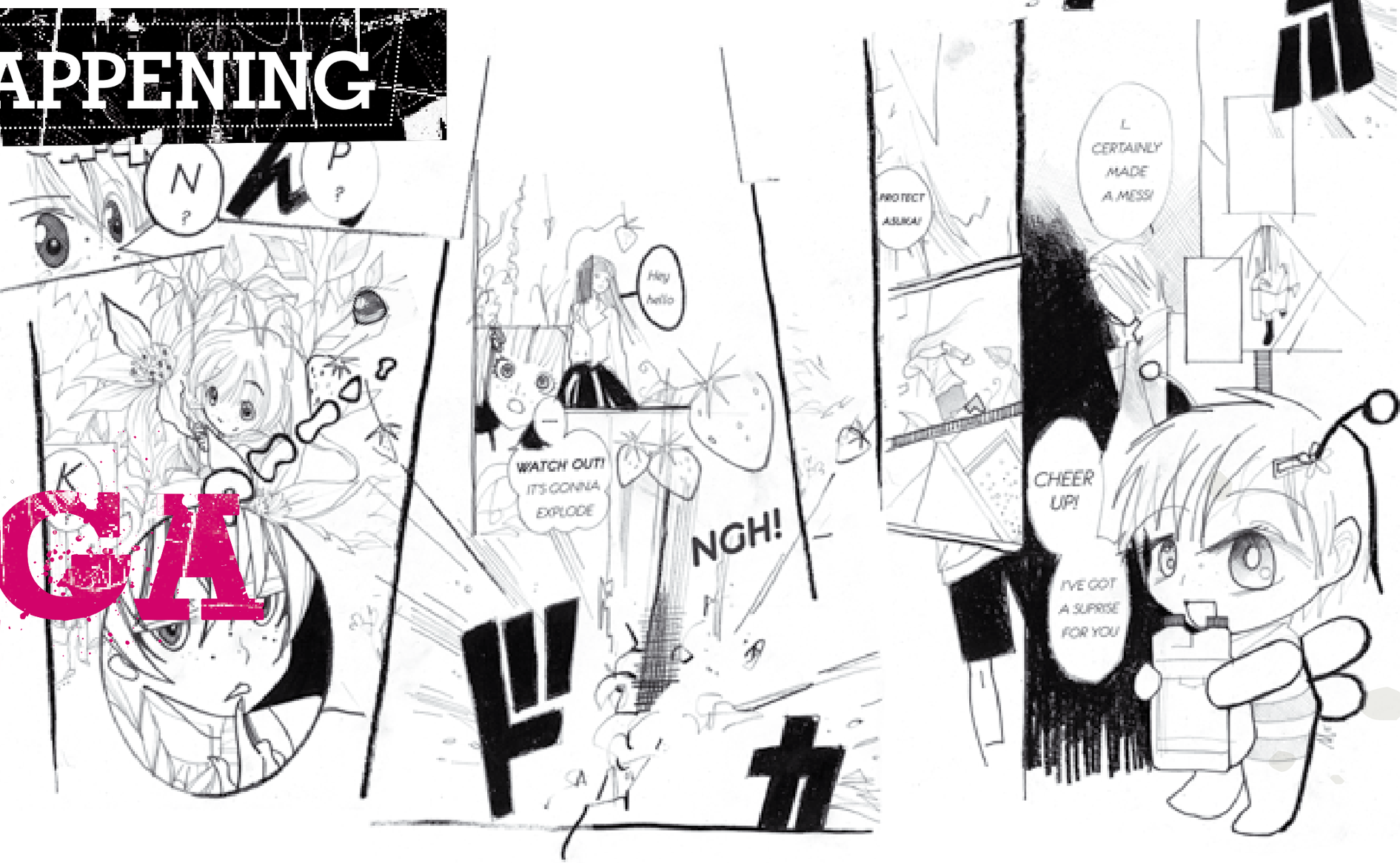


Figure 5: Broad Mite damage on a pepperplant a few weeks after infestation.

Photo Courtesy to David Rily under CC license by 3.0

THE UNIVERSE OF MANGA



Manga is an universe in itself. Enchanting drawings, cruel violence, over-the-top characters, compelling storylines and sheer craziness - manga has it all. These Japanese comics have been around for at least 150 years and are still evolving. And if you think you don't know any manga, well, you might well know more than you think. Almost everyone has seen at least one anime show on television (anime is animated manga) like Pokemon or Dragonball Z. And you have probably heard of a little film called The Matrix. By Paul van de Geijn

Well, The Matrix is heavily influenced by the manga series Ghost in The Shell, especially the style and look of the film. And what about The Lion King? Some say that's a rip-off of Kimba the White Lion, created by the God of Manga, Osamu Tezuka. Disney denies everything, but the similarities are stunning, right up to the dead-father-in-the-clouds scene.

Manga for everyone

Over the last few decades in particular, manga has skyrocketed. In Japan alone, manga represents a $5.5 billion market. And that market isn't just confined to lonely teenagers and 42-year old virgin geeks who live in their mom's basement, as is the case here in the West. No, in Japan everybody reads manga, from little kids to 45-year-old businessmen and from schoolgirls to grandmothers. And there is a genre of manga for each demographic group. Shonen manga is manga for boys in the age range 8 to18. This is the most popular type, and accounts for almost 40% of the total sales of manga magazines. The genre includes action-packed, dramatic and humorous stories about sports, adventure, superheroes and sci-fi.

'Shojo manga' is manga for girls and women, written by girls and women. There's no equivalent of this in the West. In the West, women who read (or write) comics are a minority within a minority, but in Japan it's girls who don't read comics who are in the minority!

For older boys and men there is 'Seinen' manga, which includes all kinds of adult themes ranging from the avant-garde to the pornographic. The female equivalent is 'Josei' manga. The stories tend to be about the everyday experiences of women living in Japan. There are also 'Yaoi', comics about gay males and gay romances. And then there is 'Hentai' manga, which is basically cartoon porn.

The ancient art of Manga

The golden age of manga began in around 1950, but the art form is much older than that. Manga has been around for at least as long as western comics. Maybe longer, since the earliest examples of what could be considered the first manga date from the 11th century. Back then, Toba Sojo, a priest, made a picture scroll of cartoon-like animals fooling around, like rabbits riding donkeys, a hare on its hind legs holding a rod chasing a monkey. This might be one of the earliest 'picture stories' ever, if you discount prehistoric cave paintings. It shows a progression of events, happening one after another as the scroll is unrolled from right to left. This system of reading images from right to left – the exact opposite to western comics – continues today in modern manga. So if you're reading a manga and you have no clue what the story is about, don't just dismiss it as a failure of intercultural communication. You might just be reading it in the wrong order!

Another influence was Shunga. This was early erotic art featuring exaggerations like extremely large penises. This kind of exaggeration is still seen in most manga today. If a manga character is sad, we see buckets of tears flowing from their cheeks. If a character is happy, suddenly half of the character's head is a mouth and the eyes are reduced to slits. Angry and we see their heads turning red, with sweat running from the temples and eyes spitting fire. This kind of exaggeration is almost one of the most typical features of manga – along with the big eyes, the small mouths and the batshit crazy hairstyles.

The 19th century woodblock printing artist Katsushika Hokusai was one of the first to use the word 'manga' - or 'playful sketches' - to describe his humorous images.

MANGA

These images were initially for his students only, but were soon distributed throughout Japan.

East meets West

Modern manga originated in the early 20th century. Huge changes were underway in Japanese society as this once isolated nation came into contact with Western culture. Manga artists responded enthusiastically to imported artistic styles and began mixing Western comics with Japanese ideas. Some say that the typical manga 'big eyes' are a result of this western influence. It was a way to give manga characters a western look. Others say the wide eyes mimicked characters in American and European cartoons of the time, such as Betty Boop and Felix the Cat, who had disproportionately large eyes. Another explanation is that the big eyes serve to make the characters cuter and their expressions more pronounced.

The God of Manga

And then Osamu Tezuka appeared on the scene. He's the creator of 'Astro Boy'. Astro Boy is a robot-boy who gets into all kinds of shenanigans. Some call Tezuka the Japanese Walt Disney, or the God of Manga. He was the first to use cinematic techniques. He used angles, close-ups and many panels to faithfully capture movements and facial expressions. This paved the way for many modern mangas to come - from the adventure mangas Naturo, to Slam Dunk, to the epic vengeance-tale Lone Wolf & Cub and the girl's coming-of-age-manga Nana.,

Manga must-reads:

As you might have guessed by now, there are tons and tons of manga comics out there. So if you're not a manga addict and you know practically nothing about manga, where do you start? Well, for starters, you could go and see the anime Spirited Away by Hayao Miyazaki (2001). Now this isn't manga, nor is it anime based on a manga original. But it is the most famous and critically acclaimed anime film out there and it gives you a good example of the spirit of the unlimited fantasy world that is manga. Spirited Away feels like a weird dream. It's about a 10-year old girl who moves to a new town, gets trapped in a parallel reality and meets all kinds of mildly annoying monsters, gods, and witches. The film grossed over $274 million worldwide and won many awards, including an Oscar for best animation.

A little bit less girlie than Spirited Away is the manga series Akira (1982), which was made into an anime film in 1988. Akira is written by Katsuhiro Otomo and it was the first anime that broke through into the (Western) mainstream. It's a story that begins with the nuclear annihilation of all the world's major cities. Then we cut to 38 years later. In a dystopian version of the city of Tokyo, called Neo-Tokyo, bikers Tetsuo Shima wrestles with his psychic powers. Meanwhile, the biker gang member Shotaro Kaneda tries to prevent Tetsuo from releasing the dangerous psychic Akira. It's a beautifully drawn, epic tale about social isolation, corruption and power.

Ichi the Killer (1999) was also remade into a film, but just a regular film, not an anime. It's an unbelievably gory comedy that revolves around a killer who has sexual issues about violence and always cries when he kills. But even more delightful is the antagonist Kakihara, a yakuza (Japanese mobster) for whom life is cheap, including his own. He glorifies pain. At one point, he mock-apologises to a mobster (whom he had wrongfully tortured using boiling cooking oil) by cutting of his own tongue. After that, his phone goes and he answers: "Hewwo?" Hilarious. And, way before The Dark Knight was out in cinemas, Kakihara sliced his own cheeks to give himself a diabolic smile.

Uzumaki (1999) is an eerie horror manga by Junji Ito, beautifully drawn and infused with a dream-like melancholy. A little like those scary Japanese horror movies, the ones with a lot of tension and scary little dead girls who haunt electronic equipment. The story concerns the inhabitants of a small Japanese town that seems to be cursed by supernatural events involving spirals. Many people become obsessed or paranoid about spiral shapes, and this leads to some gruesome deaths.

Make your own Manga!

So where can you get hold of these mangas? Try your local comic book store or just search the internet. For example, you can read Uzumaki for free online. And if you want to write mangas yourself, go ahead. It so happens that there is also so-called 'Amerimanga'. This is manga made by Americans and other Westerners. So pick up a pen and start drawing! Lose yourself in the massive and wonderful universe that is manga! •

Source: Manga.about.com,
A History of Manga – Matt Thorn

Grower's TIP #18

INVEST IN YOUR DRAINAGE SYSTEM!

Don't skimp on drainage, you could end up paying big in the end. Most of the systems in use are run-to-waste systems that require a drainage system of some kind. Some growers think they are immune to the effects of poor drainage. They add lots of aggregates such as perlite to their potting mix, including stuff that is not really needed, yet they don't seem to mind about allowing back-up from accumulated irrigation or slow drainage, which defeats the whole point of the system. Growers apply only so much water to avoid drainage issues, but you can do significant damage.

Soils (mediums) accumulate salt, plants give off waste, and the medium gives off waste; in nature this is washed away as it rains, but in a container it must be washed away too, because when these substances accumulate, the plant suffers. The plant's roots need to see air again within 20 minutes of being submerged in a watering event or they die. The drainage system has to flow freely, be able to accommodate a minimum of 25% of what you apply with all containers receiving water till it is running out of the container. It then needs to be collected by the drainage system by gravity, and transported out of the system entirely.

Skimping on drainage will lead to problems and reduced production. It will harm the plants and diminish the quality. Do yourself a favour, put as much effort into the drainage system as you do into the irrigation system – you'll be glad you did!

The grateful gardener

HOW THE AMMONIUM-NITRATE RATIO AFFECTS YOUR PLANTS

AND THE IMPACT OF ENVIRONMENTAL FACTORS ON PLANT DEVELOPMENT

IT'S A WELL-KNOWN FACT THAT PLANTS NEED SUFFICIENT NUTRIENTS TO GROW AND THAT THESE NUTRIENTS NEED TO BE APPLIED IN THE RIGHT PROPORTIONS. TOO MUCH OR NOT ENOUGH OF ONE OR SEVERAL NUTRIENTS MAY INTERFERE WITH THE PLANT'S DEVELOPMENT. By Ron Galiart , CANNA Research

Figure 6: Plants of the legume family live in symbiosis with micro-organisms called Rhizobia that are able to 'fix' atmospheric nitrogen into a form that is useable for the plant. The Rhizobia are in the roots of the plant, especially in protrusions called nodules. When the plant dies, the roots remain in the soil and as they decompose, the nitrogen they contain is released and will be used by the next crop.

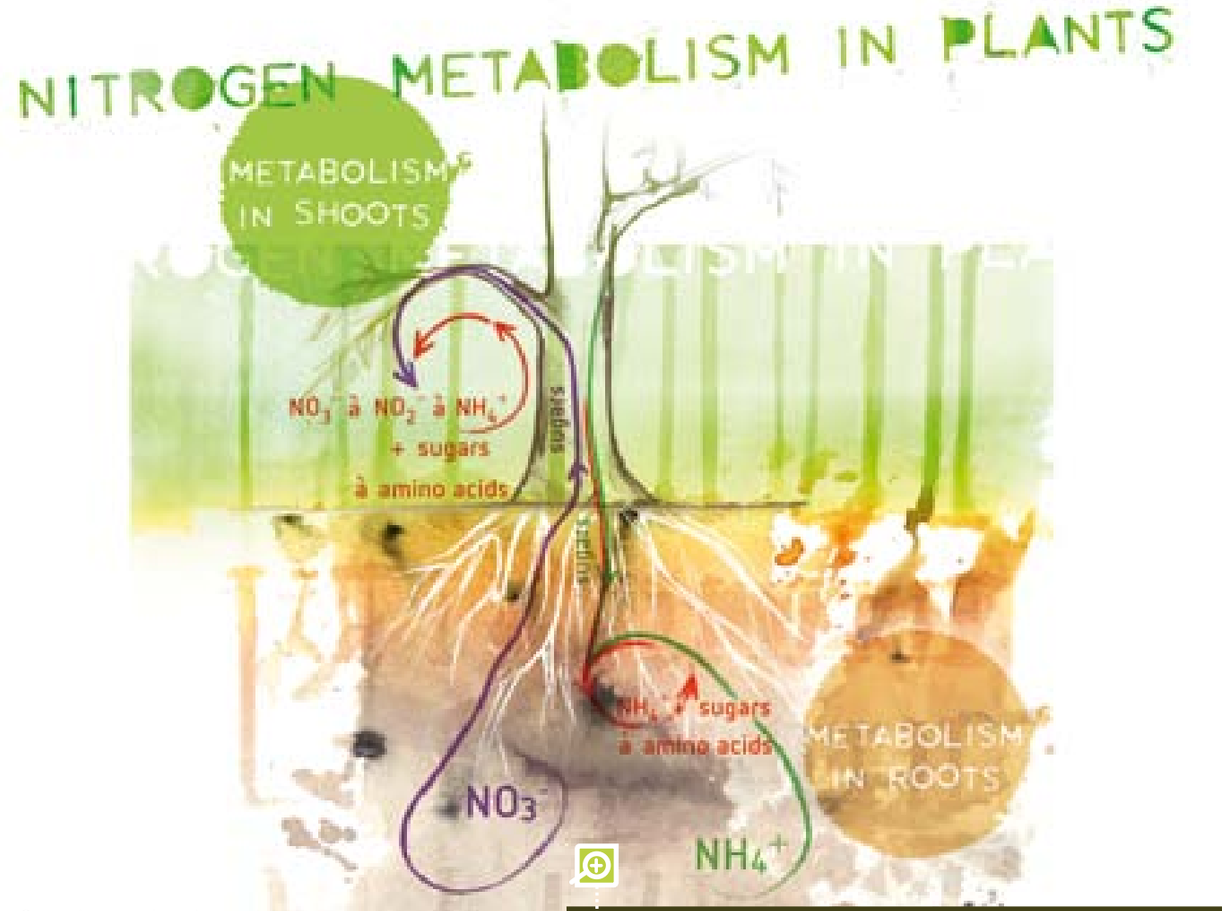


Figure 7: Most plant species can metabolize nitrate in both leaves and roots. Whether the nitrate is metabolised in the roots or leaves depends on several factors, including the level of nitrate supplied to the roots. At limited levels of nitrate, it is quickly metabolised in the roots. At greater proportions, the nitrate is transported to the shoot and metabolised there.

Sometimes reduced growth is not caused by a shortage of the element in question, but by environmental factors that may play an even more important role.

In this article, we are going to look specifically at the effect of the ammonium/nitrate ratio and its effect on the growth and development of the final crop and environmental factors like temperature, root zone pH and soil bacteria that may alter ammonium and nitrate availability. Nitrogen is the building block of amino acids, proteins, enzymes and chlorophyll. Plants can absorb nitrogen either as nitrate (NO3-) or ammonium (NH4+), and so the total uptake of nitrogen usually consists of a combination of these two forms. It's no surprise, then, that the ratio between these two forms of nitrogen is highly significance, and affects both the plants and the medium.

For optimal uptake and growth, each plant species may require a different ratio of ammonium to nitrate. As we will see, the correct ratio also varies with temperature, growth stage, pH in the root zone and soil properties.

Nitrogen metabolism in plants

To better understand the effect of nitrate and ammonium uptake by the plant, we need to understand the different ways that these two forms of nitrogen are metabolized.

In most plant species, both the roots and shoots can convert the nitrates taken up by the plant; first into nitrite and then into ammonium. These processes are controlled using enzymes. Whether the nitrate is metabolized in the roots or shoots depends on several factors, including the amount of nitrate supplied to the roots and plant species. When levels of nitrate are limited, it is quickly metabolized in the roots. When there are greater proportions, the nitrate is transported to the shoot and metabolized there.

The intermediate product nitrite is highly reactive and potentially toxic to the plant. It is therefore quickly transported to specific parts in plant cells to separate the nitrite from other vital processes in the cells. These parts are plant cell organelles called plastids. They can be found in almost every cell in the plant, from the roots to the top leaves. In the roots, plastids are often used for sugar storage. In leaves, the most common plastids are the chloroplasts where the process of photosynthesis takes place. Nitrite is converted to ammonium in the plastids.

The conversion of nitrates to ammonium that occurs in the leaf is a process fuelled by solar energy, which makes it an energy-efficient process. However, ammonium in the roots has to be converted into organic N-compounds

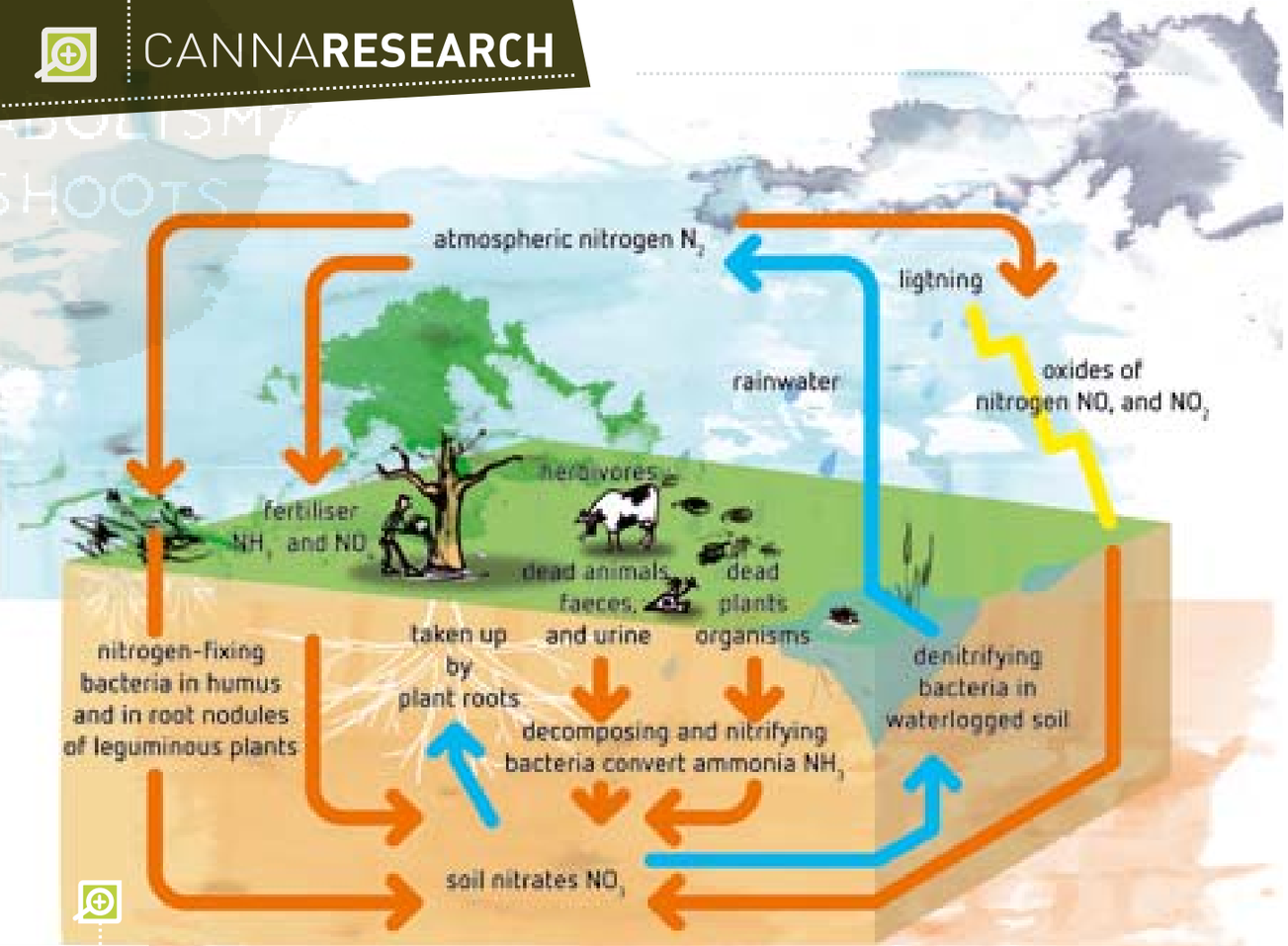


Figure 8: Process of nitrogen passing through the ecosystem. Nitrogen (for example applied by fertilisers) is absorbed by plants and turned into organic compounds (such as proteins) in plant tissue. Ultimately, the nitrogen is returned to the soil. When organisms die, it's converted back to inorganic forms by decomposers. metabolised there.

first. This process is fuelled by carbohydrates and thus occurs at the expense of other plant life processes, such as plant growth and fruit production. These sugars have to be delivered from their production site in the leaves, down to the roots first.
The final step in nitrogen metabolism is the relatively rapid conversion of ammonium into glutamate, a major amino acid which can be used as a source for other amino acids and as a building block for proteins and enzymes.
In the article on page 4, you can read about the effect of the ammonium/nitrate on the uptake of other nutrients. We will now discuss other environmental factors that influence plant growth and development.

The effect of temperature on the absorption of nitrogen

Higher temperatures usually increase the metabolism of plants and hence its energy use. This process is also known as respiration. Sugars are consumed faster, making them less available for metabolizing ammonium in the roots. At the same time, at high temperatures, the solubility of oxygen in water decreases, making it less available as well. Thus at higher temperatures, a lower ammonium/nitrate ratio seems an obvious choice.
At lower temperatures, ammonium nutrition may be a more appropriate choice, because oxygen and sugars are more available at root level. Additionally, since the transport of nitrate to the leaves is restricted at low temperatures, fertilisation based on nitrates will only delay the growth of the plant.
The effect of the substrate temperature also depends on plant species.

Plant species specific nitrogen uptake

When ammonium levels are higher, sugars need to be transported down from the leaves to the roots to metabolize the ammonium. In flowering and fruiting plants, such as tomato and cucumber, and plants where the majority of the growth is in the leaves (e.g. cabbage, lettuce, spinach), sugars are consumed quickly near their production site and are much less available for transport to the roots.
In this case, ammonium will not be efficiently metabolized and the use of a lower ammonium/nitrate ratio is preferable.

The effect of the ammonium/nitrate ratio on pH in the root zone

The electrical balance in the root cells must be maintained, so for each positively charged ion that is taken up, a positively charged ion is released into the soil and the same is true for negatively charged ions. This means that when the plant takes up ammonium (NH4+), it releases a proton (H+) to the soil solution. An increase of the proton concentration around the roots decreases the pH around the roots (more acidic).
Similarly, when the plant takes up Nitrate (NO3-) it releases bicarbonate (HCO3-), which increases the pH around the roots (more alkaline).
The effect of ammonium and nitrate uptake is especially important in soil-less media, where the roots can affect the pH of the medium more quickly because their volume is relatively large compared with the volume of the medium. To prevent the pH of the medium from changing too rapidly, an appropriate ammonium/nitrate ratio and substrate temperature are essential, according to the plants growth stage.

Nitrogen conversion processes in the soil

As explained earlier, ammonium uptake usually makes the soil pH in the root zone fall, while nitrate uptake raises the soil pH. Under certain conditions, however, the pH may not respond as expected due to microbial activity around the roots. Most of the processes that involve ammonium and nitrate are part of the nitrogen cycle (see figure 8 on page 26). The most important step is the biological oxidation of ammonium to nitrate, known as nitrification. This process consists of various steps and is mediated by autotrophic, obligate aerobic bacteria, meaning that oxygen is required. The plants take up their nitrogen source as nitrate rather than ammonium, effectively increasing the pH in the rooting zone.
The nitrification process can easily be disturbed, and such disturbances usually result in ammonium accumulation in the soil. One of the causes is a low soil pH, which limits the nitrogen conversion by depressing the microbial oxidation of ammonium.
Secondly, as mentioned earlier, converting ammonium to nitrate in the soil requires oxygen. In very wet soils, the air content drops which often means less oxygen available in the soil. In the absence of oxygen, microbial activity is usually low, meaning less ammonium is converted to nitrate and an accumulation of ammonium.
The soil micro-organisms need organic matter (dead plant material, humus) as a source of carbon. In poor soils with little organic matter like sandy soils, microbial growth and thus nitrification is limited. A low soil temperature can also depress nitrification, due to low soil micro-organism activity.

Achieving an optimum nitrate / ammonium ratio in hydroponics

In hydroponics, the standard quantities of NH4+ added to nutrient solutions for soilless culture make up between 5 and 10% of the total N supply, they will seldom exceed 15%. For roses this tends to be around 25% during the vegetative stage, whilst for melons it tends to be 0% during fruit development, for example. The fine-tuning of the levels of NH4+ supplied during crop growth simply occurs in relation to the pH levels in the root environment. The addition of NH4+ lowers the pH in the root environment, because of the boost to the cation (NH4+) uptake and a reduction in the anion (NO3-) uptake. When NH4+ is taken up, the plant releases H+ in order to maintain the plant's electrical neutrality, which causes a lower pH in the root environment. Optimum pH levels in the substrate solutions range from 5 to 6 for almost all crops.

As explained earlier, the addition of NH4+ as a replacement for NO3- in substrate systems can reduce the uptake of other cations, like K+, Ca2+ and Mg2+, which can be explained by cation competition between NH4+ and these cations. The extent of this effect depends on various factors such as the crop, the growing conditions and the adjustments made in the ionic balance of the nutrients. Careful use of NH4+ is therefore recommended for crops which are sensitive to calcium deficiency. This is especially true when such crops are grown under climatic conditions that reduce the calcium transport to fruits. Good examples of this are the production of tomatoes and sweet peppers under dry and hot conditions. Both crops are sensitive to blossom-end rot, caused by calcium deficiency in the fruit, which is stimulated by a hot and dry climate. Under such conditions every reduction in calcium uptake becomes dangerous and this includes the use of NH4+ too. •

Figure 9: This lettuce root is discoloured because of ammonium toxicity. Ammonium toxicity occurs when soils are cool and the soil surface is sealed or compacted, resulting in slow nitrification rates. This disorder can also occur in fields with poorly drained, waterlogged soils. The use of fertilizers that contain ammonium can contribute to ammonium toxicity as well.

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Steve Hannon

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WHAT'S NEXT

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You can read everything about this subject in the next edition of CANNAtalk.

Micro-organisms

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Solution to the puzzle:

#18

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