CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

ISSUE 29 2015

PHOSPHORUS

A complicated story

WORLD WONDERS

Are there just 7?

LETTUCE

More than rabbit food

And more:

HQTalk:

Summer is almost here again. Almost time for what should be the hottest season of the year! The season of long days, BBQ evenings, and most importantly holidays! A nice week or two on the Med recharges all our batteries. Yes, we all need a holiday for some new energy. We can't give our plants a holiday, but they have their needs too. Depending on the stage in which the plant is, it will need different nutritional elements. In this issue, we explain all about phosphorus. Phosphorus is needed by the plant in different amounts and at different times. Many companies offer phosphorus products these days, but what exactly are they offering you? Our research article 'Phosphorus - a complicated story' will explain everything.
As well as info about phosphorus, we also have a Pests and Diseases feature about physiological disorders in plants, a Grow It Yourself article about the low-calorie vegetable lettuce, and much more besides.

Read CANNAtalk and get yourself some knowledge... because the more you read the more you know!

If you have any questions, comments, recommendations or anything else please feel free to contact us using the answer card in the back or through the website www.cannatalk.com.

Regards,

Karin

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Figure 1: Sample of phosphorus (P). In elemental form it has several allotropes (forms): white, black, red and violet. This is the violet (purple) form. Phosphorus compounds are used in fertilisers, detergents, pesticides, nerve agents, and matches. It is also one of the elements found in many biological molecules that are essential for life.

WHAT IS ALL THE NOISE ABOUT PHOSPHORUS THESE DAYS? THIS IDEA THAT PLANTS DO NOT NEED THE LEVELS OF PHOSPHORUS THAT ARE GENERALLY RECOMMENDED? THE AMOUNTS RECOMMENDED BY AGRONOMISTS AND PLANT PHYSIOLOGISTS ARE ACCURATE; THE PROBLEM COMES IN THE INTERPRETATIONS MADE BY THE MARKETING DEPARTMENTS OF SOME COMPANIES OR IN THE MINDS OF CERTAIN SELF-PROCLAIMED EXPERTS.

Geary Coogler, BSc Horticulture, CANNA Research

Nutrient recommendations are made with numerous variables in mind, including the composition of the medium, plant variety, pH, temperature, moisture, nutrient interactions, plant requirements, economics, and so on. These recommendations are not just plucked out of the air, and nor are they based on a lay person's understanding of karmic forces or scientific data.

Beginning look

The best place to begin understanding the phosphorus needs of a plant is with the basics, and the basics include many processes as well as other nutritive elements. Firstly, we need to understand a few basic relationships.

Each element has its own weight, which is different from the weight of all the others: one atom of nitrogen weighs less than 1 atom of oxygen which weighs less than one atom of magnesium which weighs less than one atom of phosphorous and so on. Molecules are combinations of atoms which are expressed as the combined weight of all the elements in the molecule. Fertility components may be based on pure elements (based on a pure form of a nutrient, such as Calcium) or compounds (based on a combination of atoms, such as Nitrates, Sulphates, or Phosphates). This is how the plant takes up the nutrient components. This may also be how these are reported on labels or in scientific reports. Few, if any, nutritional elements are taken up by the plant as they are applied: they must either change form, change ionisation properties, or disassociate. This is especially true of phosphorus since it requires a special pathway (known as an H^{+}-HPO_4^{2-} symporter) that takes it up as a phosphate ion after activation.

All the nutritional components applied are subject to competition in the root zone, not only from the plant but also the environment through factors such as temperature, pH, interaction with other elements, and other life forms. Understanding how measurements and samples are taken determines how data sets must be interpreted. Most elements are more concentrated in certain areas of the plant based on the plant itself: for example, leaf tissue (mesophyll) will have as much iron and manganese as it does sulphur and magnesium. Phosphorus, meanwhile, is present in larger amounts in roots and flower tissues (especially seeds). The only way to obtain a complete picture of the composition of the plant is to analyse the entire plant, roots, stems, leaves, shoots, flowers and seeds

Important estimates can be made, however, by looking at specific tissue analysis, and individual metabolites are usually sought in those areas where they concentrate.

Even the way that components are gathered, the time spent in storage or transport, the extraction method used, or the machines used to analyse them, will vary greatly with certain methods being more accurate than others. Sample size is critical in the statistical analysis of the results; the more plants or repetitions in the data set, the more accurate the statements about those data sets are. Accurate results in the data and the interpretation of the data depend on a clear understanding of all the elements involved in the sample; compare Granny Smith apples to Granny Smith apples, not Granny Smith apples to Macintosh apples. Know what you are looking for: looking for sharks in the desert may reveal a few leftovers from a time past when the dessert was a sea, but will not answer the question of how many sharks currently inhabit the planet.

Phosphorus is used by the plant to produce compounds such as sugar phosphates (which is used to store and transfer energy), nucleic acids, nucleotides, coenzymes, phospholipids (membranes), phytic acid, and high energy phosphate bonds (ADP, ATP). The main entry point into the assimilation pathways of phosphate occurs during the formation of ATP (adenosine triphosphate), which acts as the energy currency of the cell.

ATP provides the energy for almost every process in the plant, from uptake of nutrients, and the conversion of nutrient complexes such as nitrates to release the nitrogen that they contain, through to production of DNA and cell division. Photosynthesis is a well-known general process that produces ATP through a process known as **photophosphorylation.** Respiration is a process that produces ATP through an oxidative process known as **O oxidative phosphorylation**. Power used in homes and industry is measured in Watts which gives a value for the amount of energy needed to make things work; ATP is used by biochemists to indicate the energy needed to make biological processes occur.

The phosphate group is energy that, once incorporated into ATP, can be converted to energy or transferred by many different processes to form all the phosphorylated compounds present in a plant. These groups may also form other energetic compounds that function in the same basic way as specific processes. The entire pathway and its many routes are known as phosphate assimilation. Phosphate is required to transport most elements into the roots, through cell membranes, and to change nutrients into usable forms; without it, the plant would starve, or rather, cease to grow or function.

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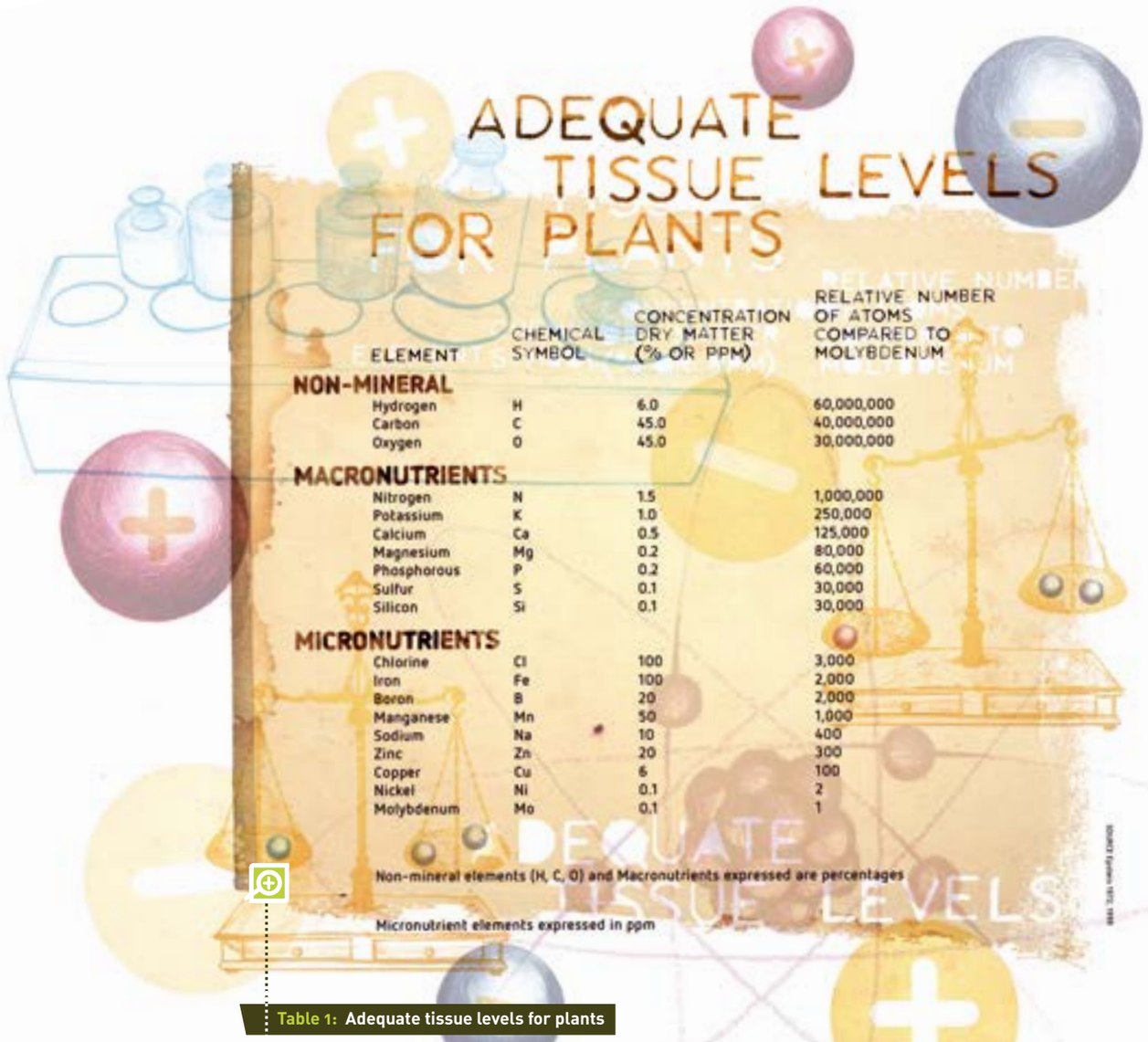
Many different elements go to make up plant tissues. Some elements like sodium are specific to certain plants, such as cacti and grasses, while others such as nitrogen, carbon, phosphorous and potassium, are required by all life forms. Concentrations of elements in plant tissues are expressed in terms of **'Adequate Levels',** which means that enough ions of an element are present to ensure availability when the element is needed for the many processes and metabolites present in plants. When the levels of certain elements are too high, especially nitrogen and heavy metals, this can cause problems, sometimes to the plant itself but usually to animals and life forms that feed on the plant. Table 1 gives a general but fairly accurate idea of the elements needed and the concentration that they should be used in. The table shows that while some elements are equal in terms of percentage composition, there are differences in the actual number of atoms. This relates to the first point made here that each atom has its own unique mass – they do not all weigh the same. Hydrogen, carbon and oxygen are considered critical nutrient elements for the plant but are obtained through water or the air and so are not applicable to applied fertilisers.

Label discussion

The next critical aspect of this discussion concerns labels: how to interpret them and what they mean. There are as many fertiliser label requirements as there are countries in the world and, in the United States, as many states. Labels are used to show the grower the contents of the nutrients and other constituents of a mixture, slurry, or homogenous blend of nutrient or nutrients. A general discussion of labels used around the world is not the goal of this article; North American markets will be used solely in this discussion. The reader must be aware of the differences across all markets and adapt this knowledge to each different situation. In most cases, these labels are legally acceptable, but not necessarily scientifically acceptable, and sometimes they are based on archaic methods of measuring and, in the case of phosphorus, based on the by-products of burning the compound in enriched air. Science, unhindered by politics, seeks to come as close as possible to an accurate reflection of true events. There are several accurate methods of representing the content of these fertilisers, and several legally acceptable methods. These are mass/mass (m/m) or mass/volume (m/v); in North America, and most other countries around the world now, this is done mass/mass or grams of element per kilogram of fertiliser. The other method is mass/volume or grams/litre.



ELEMENT	CHEMICAL SYMBOL	CONCENTRATION DRY MATTER (% OR PPM)	RELATIVE NUMBER OF ATOMS COMPARED TO MOLYBDENUM
NON-MINERAL			
Hydrogen	H	6.0	60,000,000
Carbon	C	45.0	40,000,000
Oxygen	O	45.0	30,000,000
MACRONUTRIENTS			
Nitrogen	N	1.5	1,000,000
Potassium	K	1.0	250,000
Calcium	Ca	0.5	125,000
Magnesium	Mg	0.2	80,000
Phosphorous	P	0.2	60,000
Sulfur	S	0.1	30,000
Silicon	Si	0.1	30,000
MICRONUTRIENTS			
Chlorine	Cl	100	3,000
Iron	Fe	100	2,000
Boron	B	20	2,000
Manganese	Mn	50	1,000
Sodium	Na	10	400
Zinc	Zn	20	300
Copper	Cu	6	100
Nickel	Ni	0.1	2
Molybdenum	Mo	0.1	1

Non-mineral elements (H, C, O) and Macronutrients expressed are percentages

Micronutrient elements expressed in ppm

Table 1: Adequate tissue levels for plants

A 50-pound container of liquid-based fertiliser with the N – P – K values 10 – 20 – 10 (which, you might assume, implies a 1:2:1 ratio) include the following additional information in the Guaranteed Analysis section:

Total Nitrogen (N)..... 10%
10% Nitrate Nitrogen
Available Phosphate (P2O5).....20%
Soluble Potash (K_2O).....10%

This means that 10% of 50 pounds (22.6796 kg), i.e. 5 pounds (2.268 kg), is elemental N since it is listed as N not as a compound that contains N; 20% of 50 pounds, or 10 pounds (4.5359 kg) is P_2O_5; and 10% of 50 pounds, or 5 pounds (2.268), is K2O. These are the commercial percentages listed on the fertiliser packaging. However, to derive the elemental percentages, a conversion is required since both the K and P weights include oxides. In this example, the percentage of actual P in the oxide form P2O5 is 44% and the percent K is 83%, so the actual weight of elemental P is 4.4 pounds (10 x 0.44) and the weight of K is 4.15 pounds (5 x 0.83) (P is 1.9958 kg and K is 1.8824 kg). So the corrected numbers would read 10% – 8.8% - 8.3%.

So the actual ratio in the fertiliser of single elements in this example is 1.0:0.88:0.83 N – P – K, not the 1:2:1 that the label implies. All other elements given, whether they are actually taken up as a complex like sulphates, or in elemental form, are expressed on the label as the elemental version like nitrogen.

Using different measures of mass/volume, the numbers would be different and are also based on specific gravities. An example would be a Root/Flower additive fertiliser for which the North American mass/mass convention would show a 0 – 10 – 11 NPK value, but the mass/volume percentages may be expressed as 0 – 13 – 14, depending on the compounds used in the fertiliser. The ratio is what is truly important, how much of each element is provided; using higher or lower numbers is relevant to the amount applied, provided the ratio is close.

Each species or, sometimes variety of plant, has a ratio specific for its needs even though many plants have identical needs and are sometimes grouped according to these needs. So given three different fertilisers labelled 0 – 10 – 11, 0 – 20 – 22 and 0 – 30 – 33, the ratio stays close and only the amount applied needs to be adjusted on the basis of the requirements of the crop. This is because, in the end, the root zone needs to have a certain amount of nutrients available for the plant when the plant needs to take it up, but many variables can and will affect this requirement as a nutrient moves from the bottle or bag to the utilisation sites in the plant.

Currently, nutritional elements are classified as either **macro** or **micro elements** based on the relative amounts of the component used by the plant. The term 'component' is used deliberately here because it may be a compound that is measured rather than a single element; for example phosphorus (P) is measured as phosphate pentoxide (P_2O_5), and potassium (K) is measured as potassium oxide (K_2O). This means that the percentage weight refers not only to that particular element but includes the additional elements in the compound, in this case oxygen (O). Nitrogen (N), on the other hand, is listed as just the atom 'N', but the Guaranteed Analysis section will state what this nitrogen is derived from and give this as a percentage of the nitrogen component derived. Different forms of nitrogen act differently and have different properties. So while the percentages are listed correctly on the label, the reality is more complex and a calculation is needed to ascertain the actual amount being applied. When two or three parts are used, such as with some liquid fertilisers, add the similar element numbers together to calculate the correct concentration.

Here is an example for the calculations needed to determine the actual concentrations of nutritive elements taken from North American or European labels where the percentages listed are mass/mass.

Limiting values

Limiting values are the speed limits on the growth and development of a plant or any other life form. These limits are determined by a range of factors, from carbon dioxide (CO_2) in the air, to water in the soil, or the availability of a single element. All these factors limit availability, which determines the potential of the plant's development. They are known as limiting agents, perfect ratios and the amounts of fertiliser can be applied to a plant, but if the available carbon (C) is limited by a lack of CO_2 in the air,

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the plant will not be able to utilise all the nutrients applied and nor can structural elements develop or other processes occur, and the plant will fails: the limiter is carbon.

In any growing system, the goal is to ensure that adequate levels of all the input components are maintained over time and adjusted when necessary because a plant requires different levels of particular elements at different stages in its development. Most nutritive elements should, as mentioned, be kept close to the required levels, rather than exceeding them, because they tend to accumulate in the tissues of the plant where they can become toxic to the plant or to animals that consume it. The ratio in the root zone closely matches overall composition of the plant tissue; it is the concentration that causes problems with salt burns. Also, other factors can greatly influence nutrient availability to the plant, such as pH or substrate composition and nutrient formulation. It does no good to apply the correct ratio of NPK if the pH is out of the correct range since these nutrients will be made more or less available to the plant and will express this difference in tissue composition.

There are many ways of engineering a fertiliser; for instance, nitrogen can be applied as ammonium nitrate, potassium nitrate, calcium nitrate, urea, and so on, but each form is different and each brings other components along with it. Phosphorous can be applied as superphosphate, triple superphosphate, mono-potassium phosphate, ammonium phosphate, or bone meal, to name but a few. Each of these substances needs to be 'activated', broken down or form shifted (ionisation) in the root zone, so that it can be taken up in one of the three forms of phosphate that can be taken up by a plant. The pH of the environment will affect the form that the phosphates take and can ultimately limit the availability of the desired monovalent form $H_2PO_4^-$ at normal pH ranges between 5.2 and 7.2 by converting the phosphates into the unusable form H_3PO_4 or the less desired divalent form HPO_4^{2-} *(see Figure 3)*

The phosphates will also bind other available elements as well as to substrate particles and become unavailable to the plant even though they are still detectable in the system. So fertilisers must be designed not only to provide the right ratios of elements in the right amounts, but also to be compatible with a dynamic environment in terms of temperature, pH fluctuations and different substrates.•

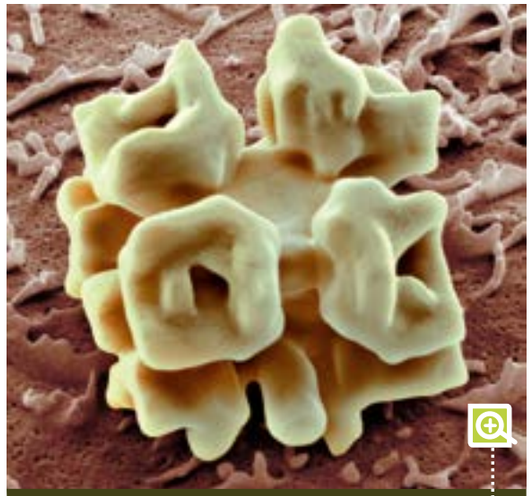


Figure 2: A Scanning Electron Micrograph (SEM) of a single phosphate crystal. A phosphate is an inorganic substance and is a salt of phosphoric acid.

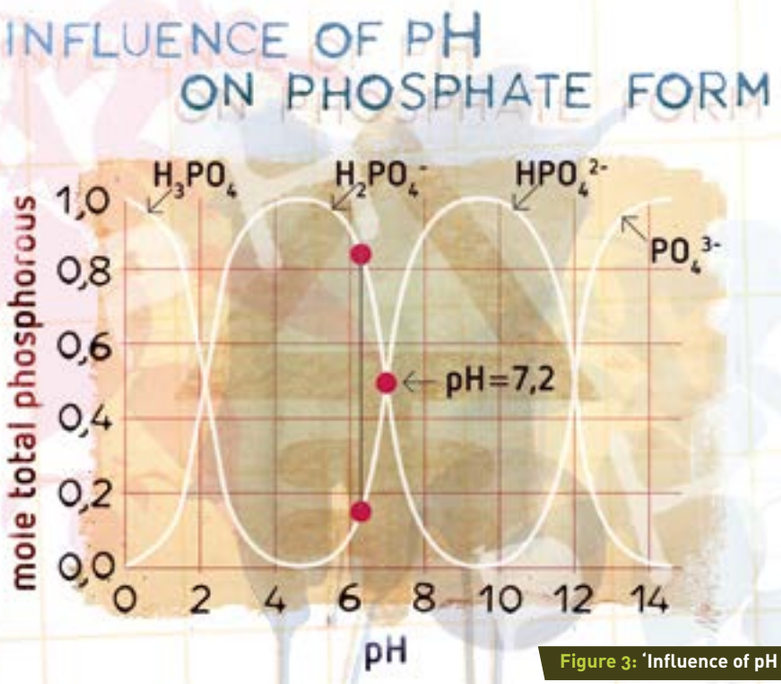


Figure 3: 'Influence of pH on Phosphate

GrowIT

YOURSELF LOVELY LUSCIOUS LETTUCE

SOME UNENLIGHTENED PEOPLE REFER TO OUR FRIEND THE LETTUCE AS RABBIT FOOD. LITTLE DO THEY KNOW...

THE ANCIENT EGYPTIANS MIGHT HAVE HAD A FUNNY WALK BUT THEY KNEW. OH, DID THEY KNOW. WITH 20% PROTEIN LOCKED INSIDE ITS SUCCULENT LEAVES, NO WONDER LETTUCE WAS THE SACRED PLANT OF MIN, THE GOD OF MALE SEXUAL POTENCY. PRAY TO YOUR LETTUCES.

By Marco Barneveld, www.braindrain.nu

Ah, nicknames. You have to love them. Lettuce has been called, besides rabbit food 'the perfect weight-loss food'. They might be right since there are very few calories in this plant. Lactuca Sativa is the scientific name for this salad crop. Lac meaning milk in Latin, which alludes to the white substance that oozes from the cut stems.

Sexual potency

That milky white substance might have been what triggered the overactive imagination of the ancient Egyptians, who started cultivating lettuce around 2800 years before they say Christ came into our world. The Egyptians started growing it to produce oil from its seeds. And they were so

smart that they bred it into a plant with edible leaves.
The milky substance that dripped from its stems when cut means that it came to be considered the sacred plant of the god of reproduction, Min. This god of male sexual potency was represented in many different forms but most often in male human form, shown with an erect penis, which he holds in his left hand. Min was honoured during the coronation rites of the New Kingdom, when the Pharaoh was expected to sow his seed and thus ensure the annual flooding of the Nile. I can just hear all you guys thinking 'seeds, Nile, flooding, milky stuff...' and you are entitled to those thoughts. The ancient Egyptians probably had the same thoughts.

Naked

At the beginning of the harvest season, his image was taken out of the temple and brought to the fields in the festival of the departure of Min, when they blessed the harvest and played naked games in his honour. And the most important game, I kid you not, was the climbing of a huge pole. And to finish our detour through ancient Egypt, our friend the lettuce was carried during Min's festivals and placed near his images. The plant was thought to help the god perform the sexual act untiringly.

Health and the lettuce

And when you consider all the health benefits of lovely green lettuce, they might have been right about that too. But first set some things straight. There are many types of lettuce. But the main ones are Romaine, Iceberg, Butterhead and Red and Green Leaf.
Choose Romaine lettuce if you can, rather than iceberg, because Romaine has one of the highest nutritional values in the lettuce family. Iceberg lettuce, on the other hand, has the lowest nutritional value. When we compare the two lettuces, Romaine and Iceberg, we find that Romaine has fewer sugars and sodium, twice the amount of protein, twice the calcium, three times the vitamin K, four times the iron, eight times the vitamin C and seventeen times the vitamin A, compared to Iceberg.

Good for losing weight

But in general, all lettuces have certain special health benefits. Lettuce has only 12 calories per one shredded cup. This is why it is so good for weight loss. It contains fibre and cellulose which stop you feeling hungry and fill you up, and the fibre improves your digestion. Improving your digestion may not sound like a good thing for losing weight, but it is actually essential for long-term weight control. Fibre also helps to remove bile salts from the body. When the body replaces these salts it breaks down cholesterol, which is why lettuce is also good for your heart. The vitamin C and beta-carotene in lettuce work together to prevent the oxidation of cholesterol, and this prevents the build-up of plaque.

Help with insomnia

The white fluid that you see when you break or cut lettuce leaves is called lactucarium. It actually has a soporific (relaxing and sleep-inducing) effect similar to opium, but without the strong side effects. Simply eat a few leaves or drink some lettuce juice for a great night's sleep.The minerals in lettuce help remove toxins from your body and keep your acid/alkaline balance in order. Once you are balanced at this level, there are a host of other benefits including higher energy levels, improved brain function, deeper and more restful sleep, and younger-looking skin.

Grow it yourself

Ready, steady, grow! All types of lettuce grow best in cool weather, so plan to add them to your garden in the spring or autumn, in soil that is kept constantly moist.

When to Plant

In spring, sow lettuce in cold frames or tunnels six weeks before the date of the last frost. Start more seeds indoors under lights at about the same time, and set them out when they are three weeks old. Lettuce seeds typically sprout in two to eight days. In autumn, sow all types of lettuce at two-week intervals starting eight weeks before your first autumn frost. One month before your first frost, sow only cold-tolerant Butterheads and Romaines.

FACTS

- Lettuce is part of the same plant family as the daisy and the thistle.
- Lettuce was served on the tables of the Persian kings in the 6th century B.C.
- The Greeks and Romans revered the leaf as a basic food and medicine.
- Emperor Caesar Augustus built a statue praising lettuce, since he believed eating it had cured him of an illness!
- The Chinese consider lettuce good luck and eat it on special occasions.
- None other than Christopher Columbus introduced lettuce to North America.
- Wild lettuce is common around the globe.

Figure 4: Make sure that the seedlings are hardend off for at least two to three days before transplanting.

Figure 5: The most well known lettuce varieties are Iceberg, Butterhead and Green and Purple leaved lettuce and romaine.

How to plant

Prepare your planting bed by loosening the soil to a depth of at least eleven inches. Mix in about an inch or so of good compost or well-rotted manure. Sow the lettuce seeds a quarter of an inch deep and half an inch apart in rows or squares, or simply cast them over the bed.
Indoors, sow lettuce seeds in flats or small containers kept under fluorescent lighting. Harden three-week-old seedlings for at least two or three days before transplanting. Use shade covers, such as pails or flowerpots, to protect transplants from the sun and wind during their first few days in the garden.

Pest and disease prevention tips

Slugs chew smooth-edged holes in the outer leaves. Collect them with a gloved hand during drizzly weather, or trap them in small pit traps baited with beer. You also can spray cold coffee on slug-infested plants to stop them feeding.

Tips for growing lettuce

As the seedlings grow, thin leaf lettuce to 6 inches apart, thin Romaines to fifteen centimetre and allow eighteen centimetre between heading varieties. After thinning, mulch between plants with grass clippings, chopped leaves or another organic mulch to deter weeds and retain soil moisture.
In late winter, grow lettuce inside a cold frame or plastic tunnel. Seedlings often survive temperatures below 20 degrees when they are protected with sheet plastic or glass. If your garden is small, try miniature lettuce varieties. Never allow the soil to dry out while lettuce is growing. In most soils, you'll need to water lettuce every other day between rains.

Harvesting and storage

Harvest lettuce in the morning, after the plants have had all night to plump up with water. Wilted lettuce picked on a hot day seldom revives, even when rushed into the refrigerator. Uproot (and eat) the younger plants until you get the spacing you want. Gather individual leaves or use scissors to harvest handfuls of baby lettuce. Rinse the lettuce thoroughly with cool water, shake or spin off excess moisture, and store it in plastic bags in the refrigerator. Lettuce often needs a second cleaning when being prepared for the table. So clean once again and take it to the kitchen.

Eat it yourself: Caesar Salad

Probably the best salad in the world. You'll need Romaine. And dressing. Enough said. •

RECIPE

CAESAR SALAD

Ingredients

- **3 garlic cloves**
- **3 anchovy filets**
- **Juice of 2 lemons**
- **1 egg yolk**
- **1 teaspoon Dijon mustard**
- **1 teaspoon dry mustard**
- **6 tablespoons freshly grated Parmesan cheese, cold**
- **Some olive oil, cold**
- **A bit of salt**
- **A dash of black pepper**

Directions

Place the garlic and anchovies in the mixing cup and mix them until they form a paste. Add the lemon juice and egg yolk and process them until they are well incorporated. While the machine is running, gradually add the oil, Parmesan cheese, salt and pepper. Use immediately on Romaine lettuce, garnished with croutons and Parmesan cheese. *Lettuce eat.*

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.

Question

I'm growing in 10-litre pots filled with Cultilene mini rockwool cubes. I feed manually when they dry out quite a lot, which is about once a week and drain at least 20%. I've been using CANNA AQUA (with no issues), but should I be using Hydro as this is technically run-to-waste even though it's not on drippers? CANNA AQUA is more pH buffered I know, but I don't see how that would be a bad thing for run to waste or growing in rockwool.

Answer

The way you grow now, you should indeed use the CANNA HYDRO version. Your water quality will determine whether you need the soft water version or the hard water version.

Bear in mind that rockwool is a substrate that doesn't hold as much water as coco or soil. In general you have to water more often and when the plants are big, this can be several times a day. Serious root damage may occur and we think you will limit your plants' in transpiration and nutrient uptake. In the end they will produce less. The plants evaporate between 8 and 10 litres a day per m². You know they evaporate well, but of course this also relates to how much light power you give them per m².

Anyhow, if you start to water more often, you may get a higher drain too. That means a waste of water and nutrients (and money). With that way of growing, the grower might decide to re-use the drain water. If you decide to grow in that way, you need CANNA AQUA. Because it is designed for recirculation.

Question

How long do I leave CANNA FLUSH in before I rinse out with just water? Because last time I left it in and the crop tasted fowl like it had been bleached and turned white.

Answer

If you make use of CANNA FLUSH, you do it after one day. CANNA FLUSH needs time to work (minimum 12 hours), but it needs to be rinsed out the system again. This is not because CANNA FLUSH is toxic, but because it will free all the old nutrients and waste in the substrate. This will produce a temporarily high EC in the substrate. So, in general the next watering after you give CANNA FLUSH, should be the rinsing one (or day) with plain water. This could be the next day, but it should happen when the substrate needs water again.

Question

I was planning to re-use my CANNA COGr Slabs for a second time. I've removed most of the roots and I pumped water with CANNAZYM through them four times a day, for many days. But now I have noticed a bad smell coming from one of the slabs. They are all connected via the same tank, so if one slab has got mouldy or something has gone rotten, the water from it will surely have spread to all the slabs. So, should I throw away all the slabs now and get new ones or could the bad smell be from something else that is not bad for the new plants? Can I do something to salvage the situation?

Answer

No, CANNAZYM doesn't kill the beneficial bacteria or fungi. As a matter of fact: it helps them to do their job. Some of the beneficial micro-organisms produce enzymes. By adding more enzymes you help them and the effect is to speed up the break-down process of the dead (hairy-) root matter, but also other processes that occur around the root. So you did the right thing, especially if you want to reuse the coco.

Question

I'm new to the whole hydroponics game, so I was wondering if you could help me with a query... I'm using a guide from CANNA which is telling me to put X amount of food into the system. It seems to be too strong, however, and burns are appearing on the plants - they're turning yellow at rooting stage after they only are a few days old. I'm using aeroponics. Could you help with an estimated food ratio for 3-5 day stage / early vegetative stage and how soon should I start increasing the food? Also, on a side note, CANNA personalise a feeding schedule on their website and offer the option of how often I feed my plants - the options are 'light feeding / normal feeding / heavy feeding' - I'm wondering what constitutes each.

Answer

In general you start with a low EC of 0.8 - 1.2, depending on your tap water. If the water is 0.4 then you should make this up to 1.0, so you add 0.6 (called EC+) on top of your water. For the first 3-5 days, you need to make sure that the humidity in your room is high. If you don't have a humidifier, you can cover the plant with a small plastic tent, 10 cm above the plants. Hang the lights as far away as possible from the plants to decrease the light intensity. When you see the plants are standing straight up, you can start increasing the light intensity, lower the humidity (first open the tent and remove it 2 days later) and increase the EC little by little. The feeding options relate to your tap water, the kind of plant, the climate and the experience of the grower. In general, we start with normal feeding.

Aeroponics is the most difficult system in growing. It can produce the highest yields, but the chance of problems is high. In general we recommend starting with CANNA TERRA, because the product has a buffer so that if the grower makes some mistakes, it will not ruin the plants immediately. On the other hand, if you succeed the next time, aeroponics is the most beautiful challenge.

Question

I'm using the BIOCANNA range and my tent is covered in black flies. When I opened the bag of soil and banged it, a lot of flies came out of the bag. Is this usual for your product?

Answer

BIOCANNA potting mix is a 100% organic product which contains organic fertilisers. Unfortunately the product also attracts these black flies, especially when it is stored wet.

Although we produce the product in a clean way, after production it can become infected by these flies during transportation, storage or even at your place. CANNA TERRA substrates, like the CANNA Terra Professional and the CANNA Terra Professional Plus, are less interesting for these flies. So if you are less concerned with 100% organic products, they can help in future (make sure you clean the room properly).

Although not fully organic, a dry top layer of CANNA AQUA Clay Pebbles (or an alternative) may help.

Dry CANNA AQUA Clay Pebbles are less attractive to the adult flies and their eggs may dry out and die.

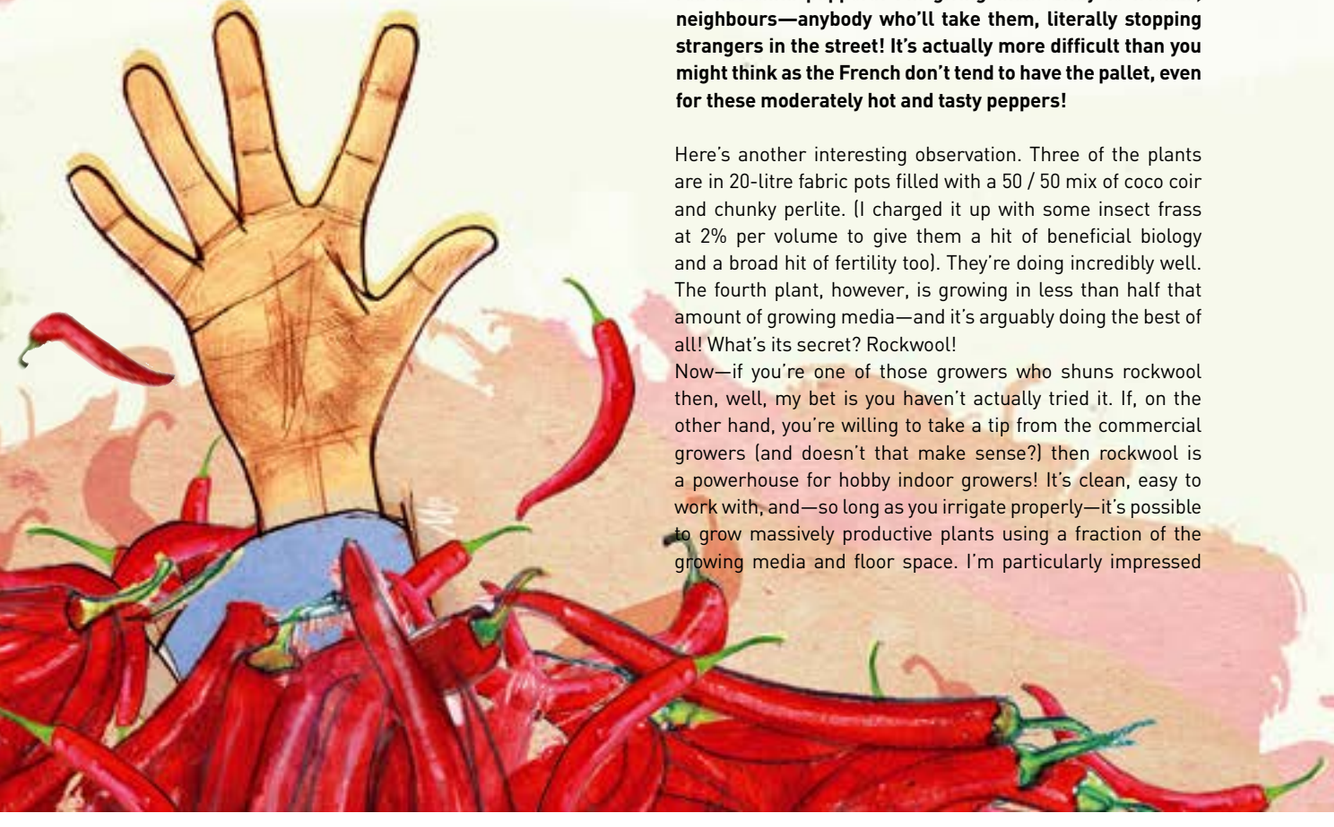
If you want to continue to grow 100% organic, the alternatives are:

- Cover the surface of the BIOCANNA with plastic, so the flies cannot lay eggs in the soil any more.
- Grow using less water.
- Put a lot of yellow stickers in the room to capture the flies.

Don & Nicky (PART 10)

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.

DON IS A LITTLE TOO SUCCESSFUL GROWING Chilli PEPPERS



Help! I'm drowning in peppers! My four Tokyo Hot chilli plants are now in full production mode and it's just incredible! My plants are basking under a single 600W high-pressure sodium grow light. This incredibly efficient light source is beaming down vast amounts of PAR energy (photosynthetically active radiation) that's being gobbled up by a vast, trained and even canopy of hungry leaves transforming them into beautiful, classically-shaped, red hot chilli peppers! I'm giving them away to friends, neighbours—anybody who'll take them, literally stopping strangers in the street! It's actually more difficult than you might think as the French don't tend to have the pallet, even for these moderately hot and tasty peppers!

Here's another interesting observation. Three of the plants are in 20-litre fabric pots filled with a 50 / 50 mix of coco coir and chunky perlite. (I charged it up with some insect frass at 2% per volume to give them a hit of beneficial biology and a broad hit of fertility too). They're doing incredibly well. The fourth plant, however, is growing in less than half that amount of growing media—and it's arguably doing the best of all! What's its secret? Rockwool!

Now—if you're one of those growers who shuns rockwool then, well, my bet is you haven't actually tried it. If, on the other hand, you're willing to take a tip from the commercial growers (and doesn't that make sense?) then rockwool is a powerhouse for hobby indoor growers! It's clean, easy to work with, and—so long as you irrigate properly—it's possible to grow massively productive plants using a fraction of the growing media and floor space. I'm particularly impressed with Grodan's "Unislab" – a sort of mini rockwool slab designed to grow a single plant. They offer more stability than the larger grow blocks and, because they're not high off the ground, it's possible to irrigate them in a flood and drain table if top-feeding with drippers isn't your preference.

1 Another discovery I've made recently is ceramic metal halide – also known as 'light emitting ceramic' – a new type of grow lamp. I'm using an American fixture that houses the 315W lamp vertically, a little bit like those old-style parabolic reflectors.

2 Investing in a LightRail – an ingenious device that moves your grow light back and forth along a two-metre track – has helped me a lot with heat stress issues.

3 I have so many beautiful, classically-shaped, red hot chilli peppers, I'm even giving them

One day I noticed that some of the leaves looked a little dry and lack-lustre.

I made a guess that I needed to increase irrigations so I added a few more flood cycles on the timer. Turns out that this was a mistake. In hindsight I think I should have just given them all a simple foliar feed! With their root-zones permanently moist, thanks to the extra cycles, my peppers sprang back into vegetative mode and started sending out dozens of fresh shoots towards my grow light, causing me some difficulties with vertical space. It was amazing to see how I could "steer" my plants (albeit accidentally) through irrigation alone—basically I'd tricked them into thinking it was springtime (or rainy season) again!

I hacked back a huge amount of new foliage, reverted to my previous irrigation cycles to keep the plants' root zones drier, and invested in a LightRail—an ingenious device that's a longstanding favourite with energy-conscious indoor growers. It moves your grow light back and forth along a two metre track, increasing your footprint and helping to mitigate localised heat stress issues when plants inevitably venture too close to your lamps. It really is an ingenious device and has helped me squeeze even more efficiency out of my HPS grow lamp. I definitely recommend looking into these if you grow with the higher power (600 and 1000W) grow lamps.

Another discovery I've made recently is ceramic metal halide—also known as "light-emitting ceramic"—a new type of grow lamp. I'm using an American fixture that houses the 315W lamp vertically, a little bit like those old style parabolic reflectors. More or less all of the light received by the plants beneath is reflected—with very little radiant heat detectable directly beneath the lamp itself. This makes for a very "friendly" grow light for vegetative growth—ideal for powering fast, lush growth with minimal stretching without being too tough on young plants. I'm hugely impressed with this light (and it's a good deal cheaper than Light Emitting Plasma (LEP) too) and the PAR levels and coverage are amazing.

I have so much more to learn and dozens of species on my "grow next" list: turmeric, ginger, basil and more tomatoes, that's for sure. Nicky can't get enough of the Sub Arctic Plenty tomatoes which has helped her to partially forgive me for spending all our spare cash on hydroponics equipment! I concede it's time for me to consolidate what I've learned and enjoy my grow room at its current size before any further expansions occur! Four grow lights are enough to keep me very busy! •

FLY GEYSER

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

- Fly Geyser is located in the Black Rock Desert region about 20 miles north of Gerlach, Nevada in the USA. These hot springs are sited on Fly Ranch, which is private property.
- A collision of human error and natural geothermal pressure created this rainbow-colored geological wonder in the 1960s. A geothermal company drilled a well to test for a possible energy source. Since the water was not hot enough to suit their purposes, they abandoned the well. It is not quite certain whether they capped it and the cap started to leak or whether it was left uncapped, but since then it has since built up a mineral cone several meters high with multiple water geysers constantly spewing over 74 acres.
- The Fly Geyser has grown substantially over the last 40 years as minerals from the geothermal water pocket build up on the desert surface. The geyser is covered with thermophilic algae, which flourish in moist, hot environments, resulting in the many bright hues of green and red that add to its out-of-this-world appearance.
- The geyser looks like a small erupting volcano because water is continuously released about 1.5m in the air.
- The ponds form an ecosystem of their own. Small fish (introduced by some unknown human hand) breed in the ponds and they attract a number of birds such as swans, mergansers and mallards.
- The owners of Fly Ranch do not welcome sightseers, and do not want to sell the parcel on which the geyser sits. It is unlikely that the geyser will be opened to the public any time soon.

What's HAPPENING

The world is full of wonders. But which wonders are the most wondrous, Bernard Weber wondered. So in 2000, he started a project called The New7Wonders Foundation, and got hundreds of millions of people to vote for different kinds of wonders – wonders in cities, wonders of nature and the new Seven Wonders of the World. We think it's just wonderful. By Marco Barneveld, www.braindrain.nu

Photo courtesy of SF Brit CC BY 2.0

In ancient times there were the Seven Wonders of the World, including the Hanging Gardens of Babylon and the Great Pyramid of Giza. They were awe-inspiring wonders, of which only the Great Pyramid are still standing strong today.

Global democratic exercise

Swiss-Canadian Bernard Weber has started the New7Wonders of the World. "In 2000, I started New7Wonders as a millennium project," he explains. "For the first time in human history, a global democratic exercise, a worldwide voting campaign, was technically possible using the internet. The idea was simple and powerful: to ask the people of the world to choose and elect the new man-made seven wonders of the world, the rightful heirs of the ancient seven wonders. I called this simply the Official New 7 Wonders of the World – official because we wanted to recognise the ultimate authority and legitimacy granted to us by the people's free choice and democratic will."

Natural equilibrium

With a series of global voting campaigns, New7Wonders is inspiring and making people more aware of what we are leaving behind for our children and future generations.

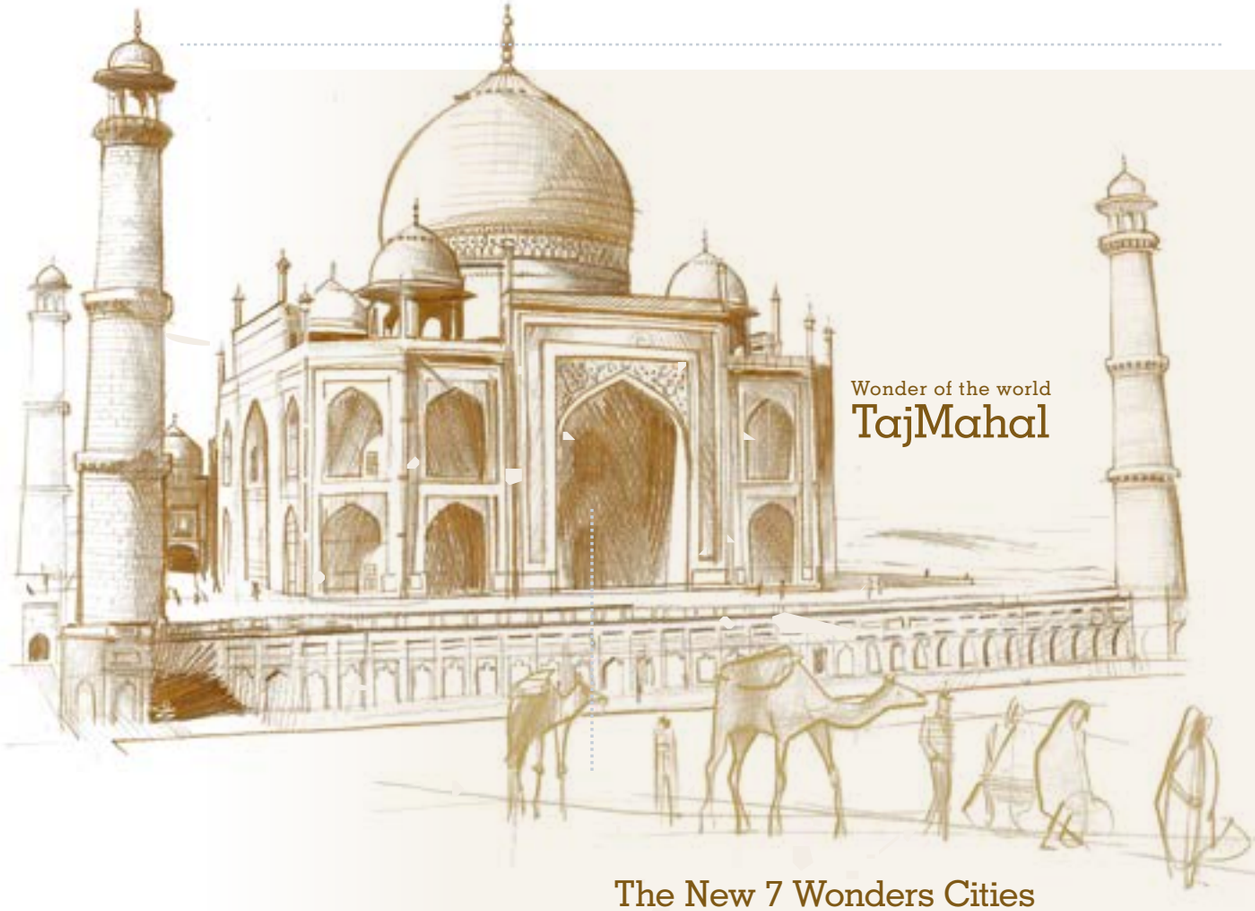
The first vote on the new Seven Wonders was a huge success, with more than one hundred million people choosing their favourite wonder. Because of this grand success Weber followed the up with a brand new vote to celebrate the beauty of our planet, thus fostering greater respect for the earth's fragile natural equilibrium.

New7Wonders Cities was the third global vote organised by New7Wonders. "New7Wonders Cities will be a forum for discussing everything from urban planning to metropolitan governance, from tourism to architecture," said Bernard Weber, launching the campaign in 2012.

1,200 nominees

"We began with more than 1,200 nominees from 220 different countries. For the first time in human history, more than half of our planet's population lives in cities and this election emphasises the dramatically challenging character of our changing world."

There are the great historic cities of Jerusalem, Venice and Kyoto, and the alpha world cities of London, New York, Mumbai and Shanghai. They have all enriched human civilisation immeasurably. Newer metropolitan areas, from Dubai to Seoul to Cape Town to São Paulo, have become magnets for millions of people, and new megacities, which most of the world is not yet even aware of, are springing up across Asia and Africa. For the first time in history, the majority of the world's population now lives in cities and New7Wonders Cities is the platform that enabled everyone to vote for the seven which they think are simply the best.



The New 7 Wonders Cities

- Vigan: Philippines
- Kuala Lumpur: Malaysia
- Durban: South Africa
- Doha: Qatar
- Havana: Cuba
- Beirut: Lebanon
- La Paz: Bolivia

The New 7 Wonders of Nature

- Amazon: South America
- Ha Long Bay: Vietnam
- Iguazu Falls: Argentina/Brazil
- Jeju Island: South Korea
- Komodo: Indonesia
- PP Underground River: Philippines
- Table Mountain: South Africa

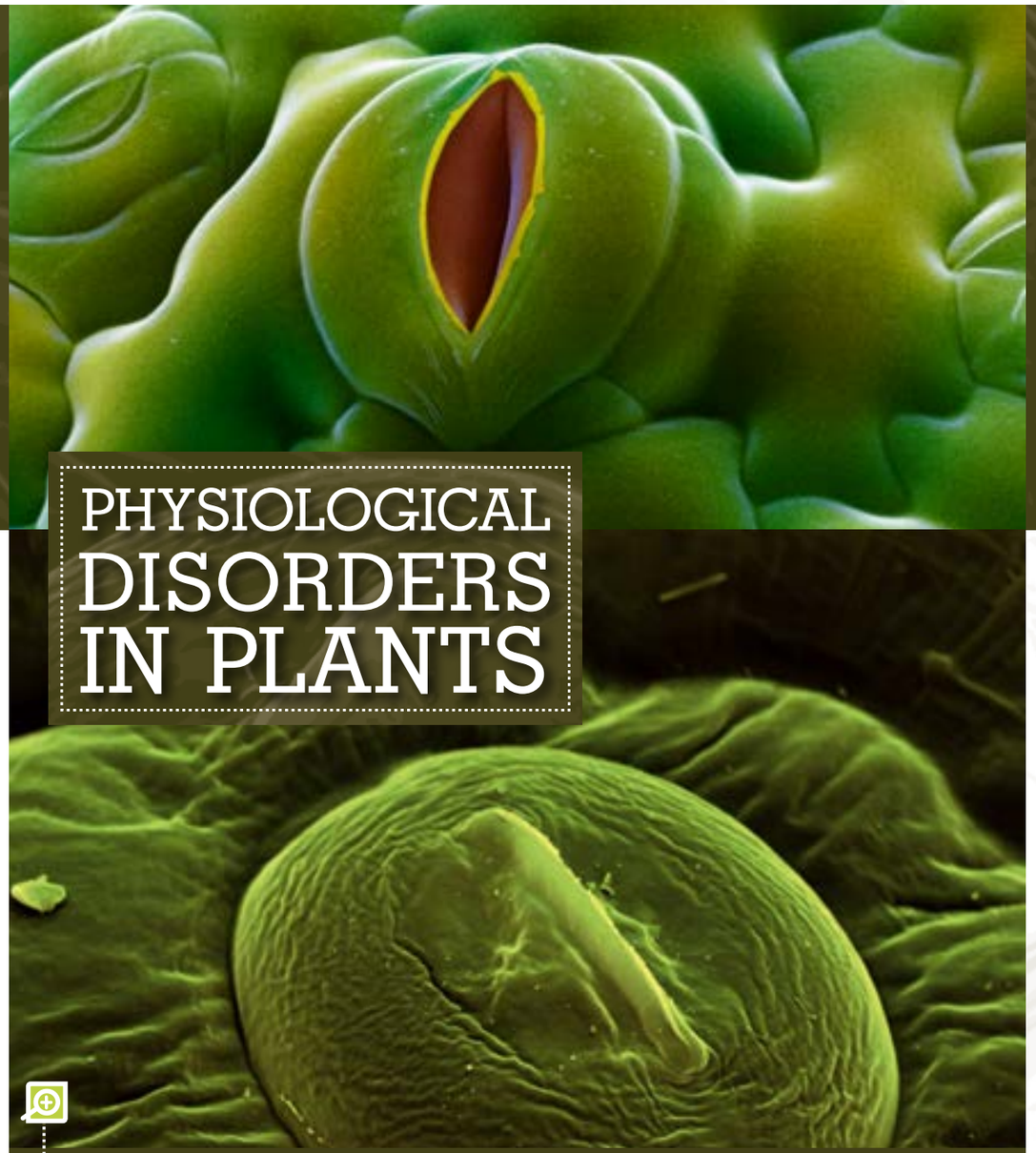
The New 7 Wonders of the World

- Christ Redeemer: Rio de Janeiro, Brazil
- Great Wall of China: China
- Machu Picchu: Peru
- Petra: Jordan
- Pyramid at Chichén Itzá: Yucatan Peninsula, Mexico
- Roman Colosseum: Rome, Italy
- Taj Mahal: Agra, India

This latest vote in the series of wonders ended in December 2014. And the building projects, nature reserves and cities chosen are gorgeous and remarkable. Were they your choice as well? Just something to ponder and wonder about, if you didn't vote.•

Pests & DISEASES

Plant physiological disorders are also known as abiotic disorders and are distinguished from other disorders by the fact that they are not caused by living organisms (such as viruses, bacteria, fungi, insects etc). By CANNA Research



PHYSIOLOGICAL DISORDERS IN PLANTS

Figure 6: A Scanning Electron Micrograph (SEM) of an open stoma on the surface of a tobacco leaf (above) and a closed stomato on the surface of a Sorrel leaf (down). Even moderate stress can cause the stomata on the leaves to begin to close, reducing photosynthetic production.

They are either the result of the environmental and cultural factors on plant development or genetic mutations. Physiological disorders are often caused by a shortage or excess of something that supports life. The effects of physiological disorders range from subtle symptoms, which may not be visibly apparent, to severely stunted and malformed growth. Unfortunately, physiological disorders are usually difficult to identify and most are irreversible.

Physiological disorders can affect plants in all stages of their life. They occur without the presence of infectious agents and therefore cannot be transmitted. Physiological disorders are serious in themselves, but they also often serve as an open door by which pathogens can enter. Dealing with physiological disorders often means dealing with the consequences of a past event.

Figure 7: This is a group of discoloured, bruised tomatoes that have been damaged by frost. The tomato plant (Lycopersicon esculentum) is a bushy annual native of South America. Unlike temperate species, it is unable to withstand the ravages of frost, which causes ice crystals to grow inside the plant and rupture the cell walls. The damaged tissue releases enzymes that further degrade the affected area, exposing the tissue to agents of decay.

Abiotic disorders are usually classified by the causal factor or symptoms. In this article we will give a short description of some environmental, cultural and genetic disorders.

Environmental stress

Plants can be subjected to numerous environmental stresses — drought, extreme temperatures, and excess light can all affect plant growth and quality. Environmental stress is very difficult to control when growing in the field. Greenhouse growing can make these environmental factors less severe but it cannot exclude them completely.

Flooding and drought

Water is essential for plants to take up nutrients from the soil and transport them throughout their system. A shortage of soil moisture can greatly inhibit plant growth. Even moderate stress can cause the stomata on the leaves to begin to close, reducing photosynthetic production. Wilting is the most common initial symptom of drought stress.

However, over-watering can kill a plant more quickly than lack of water. In waterlogged soil there is not enough oxygen for the roots. Without oxygen, anaerobic respiration will occur in the roots, producing toxic compounds in the plant. The symptoms of overwatering can include wilting, yellowing of leaves, root rot or stunted growth.

Cold injury and frost

Cold and frost are major causes of crop damage in tender plants, although hardy plants can also suffer if new growth is exposed to a hard frost following a period of warm weather. Symptoms will often appear overnight, and can affect many types of plants. Leaves and stems may turn black, and buds and flowers may become discoloured. Flowers that have been affected by frost may not produce fruit.

Heat stress and scorching

Extreme heat can damage plants directly, but usually heat damage occurs through increased water loss and plant moisture stress. Plants can also become sunburned when shaded foliage is exposed to sunlight during hot, dry periods. When temperatures are extremely high, plants need to bring water from the roots to the leaves and stems, which then exits the plant through the stomata as water vapour - a process known as transpiration. This cools the leaves and plant parts and prevents damage from heat stress. However, if there is not enough water for this process, the plant will sacrifice some of its leaf surface.

Cultural factors

Cultural factors are those that arise from growing a particular plant in a particular place for a particular purpose. Cultural practices are designed to promote and maintain plant growth and development. However, the same practices can at times be the cause of abiotic problems.

Nutrient deficiency or excess

Every plant reacts to extreme highs or lows in the level of nutrients available. Some reactions are very obvious, and others less so. Plants can be stunted, deformed or display leaf damage. Different nutrient imbalances will produce different reactions and an imbalance of one nutrient can make another nutrient unavailable.

Chemical damage

Any kind of chemical applied in the wrong dosage or at the wrong time is capable of physically damaging the plant. Most chemical damage comes from pesticides applied excessively, at the wrong time or during the heat of the day. Careless use of herbicides may also inadvertently damage or kill non-target plants. Spray drift is often the cause of unintentional damage to plants. Chemical damage may appear as red, yellow or brown spots on leaves, leaf tips turning brown, stunted or misshapen plants or widespread browning and death.

Mechanical stress or physical damage

Physical damage can be caused by people, machinery, wind, animals and so on. It can lead to tissue injury which can be a potential entry point for diseases. Differences in air movement, vibration or handling of plants can cause mechanical stress. Shaking or flexing a plant for only a few minutes each day can reduce stem elongation and the weight of the plant, both fresh and dry.

Genetic or hereditary disorders

Although this is an internal factor and not an external cause of damage, plants can do strange things when their genetic system goes wrong. The symptoms can range from variegated leaves, distorted stems, colour changes in seeds and flowers, dwarf growth etc. Some of these mutations have been exploited and selected to create new varieties but most of the commercially available variegated or otherwise different plants are not the result of a natural genetic defect but the result of the careful crossing and breeding of plants with the desired traits. •

PHOSPHORUS

A COMPLICATED STORY

PART 2

Figure 8: A Scanning Electron Micrograph (SEM) of a section through cells in leaf tissue from an Aconitum sp. plant. In the middle is a cell nucleus with it's nucleolus (red). The chloroplasts are green. The yellow structures are constituents of the vacuole

RATIOS ARE THE TRUE INDICATOR OF THE CORRECTNESS OF THE FERTILISATION PROGRAMME. WHEN DESIGNING A FERTILISATION PROGRAMME, IT IS CRITICAL TO KNOW ALL THE SOURCES OF NUTRITIONAL ELEMENTS AVAILABLE TO A PLANT, AND WHAT THOSE RATIOS AND CONCENTRATIONS ARE. BY KNOWING THESE, THE REST IS A QUESTION OF MATHEMATICS.

Geary Coogler, BSc Horticulture, CANNA Research

Ratios

If the grower is using a medium that has a starting fertility ratio of NPK, of 0 – 1 – 0.5, and the plant shows a total tissue ratio of 4 – 2 – 3, then the grower will have to add a ratio of 4 – 1 – 2.5 to get the correct level of nutrients needed. However, it must be remembered that this assumes perfect values of pH, temperature, and across the growth cycle, and the values are seldom perfect.

Plants seldom take up nutrients equally and they will influence the root zone to acquire more of the nutrients that they need at any given time. These needs will change slightly as they develop, while tissue analysis only gives a snapshot picture of what is happening in the plant. Tissue taken at the end of the crop cycle will show the cumulative value of all the various stages and will not reflect how a plant absorbs these nutrients over time. Juvenile plants take up a different ratio of nutrients to flowering plants; when a plant is preparing to seed, it will begin to accumulate phosphates.

In a situation where all the nutritive elements are correct except one, which is low, then the low element will be the limiter. When this is a minor element (or micro element) that is only needed in a few processes, say sodium for example, then the effect, although real, will be minimal. In a situation where a major element is the limiter, say phosphorous, then the effect can be dramatic because all those compounds made from phosphorous will be incomplete, and those processes that depend on phosphorus will not occur, including vital functions like nutrient uptake, transport, and conversions. By applying sufficient concentrations of these elements in the correct ratio, and providing the right environment, there will be no limiting agent and growth will proceed at the maximum rate that is genetic possible.

It is important to apply sufficient concentrations of these elements, but it is also important not to apply too much; and here, both high concentrations and incorrect ratios can play a role. Just because there is a shortage of one nutrient does not mean the plant will stop itself absorbing the other elements provided. These unused elements usually find their way into the vacuole of the cell and remain there. Vacuoles not only provide water storage and structural support, they also serve as garbage dumps. Heavy metals will accumulate there, such as copper, boron, molybdenum, and manganese, and these can cause issues in any animals that then consume the plants. Plants will also accumulate non-nutritive elements such as lead and uranium if they are present in an available form in the root zone. Where not enough ATP is available to totally convert nitrates into usable N, then nitrites can accumulate. Excess ammonium shunted into the vacuole converts to nitrites and nitrosamines, a cancer causing agent. Keeping these ratios close, while avoiding limiting values, is the ultimate goal of a plant nutrition programme, and the best way to keep consumers consuming.

Plant needs

So what does a plant need in the way of phosphorus, how do we provide this, and what can we expect over time and development? The best way to know a plant's needs is to know what makes up the plant and the ratio of these elements within the plant. Once you know this, and you have some information about the substrate, it is fairly easy to apply this ratio by using several known fertilising materials. However, it is also important to monitor these values at the various stages of growth and to make adjustments at each stage as required.

The other way is to use a product that was designed on the basis of the plant itself after thorough research done manufacturer (a 'complete fertiliser'), and adapted to the substrate involved. Care must to be taken by the grower to ensure that all the variables correct, such as pH and temperature, or at least to follow the manufacturer's guidelines. It is equally important to use the substrate that the fertiliser was designed for, since the substrate can cause the ratios discussed earlier to change once applied. The grower must be sure to follow the manufacturer's guidelines closely, taking care not to substitute products because most will provide different levels of the components or a different form.

What is equally important, from the nutrient balance point of view, is to provide the ratio that the plant needs, when it needs it. A plant's need for phosphorus goes up during the earlier stages of flowering then falls back; but still its appetite for phosphorus has been escalating throughout the plant's development. This is known as the phosphorus utilisation curve, which on a graph looks like a bell curve. The only additional phosphorus that a grower needs to apply is any extra amount that the plant requires that is not provided by the main fertiliser, and that will vary over time: the ratio game again. The plant will change the environment around the root zone in order to activate phosphates to make them available to the plant. The total need for phosphorus in the root zone will ultimately be based not only on the needs of the plant, but

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A COMPLICATED STORY

also with the level of activity that the environment will have on the ultimate availability of phosphate.

Special Considerations

The Phosphorus Pathway in the plant is wide and all-encompassing. Phosphorus starts out in the seeds at high levels to ensure the plant has enough to initiate all the metabolic processes it will require as well as the growth processes. ATP is used to build structure, chemical compounds, and take up the other elements needed for these processes. More phosphorus is found in the root tissues because relatively large amounts are needed to move nutrients into the plant and into the transport pathways. It is turned into ATP for local use or transported to other cells to be transformed into ATP or used directly as ATP (assimilated). Once it is the form of ATP or one of the other energy components, it is released for energy by way of many activities and is then free to be used in the formation of other phosphorylated compounds. It can also be converted back into ATP. More phosphates are also found in the flowers themselves because of the decrease in locally produced ATP and because the plant accumulates phosphorus for the seeds and other energy-intensive requirements of the flower tissues such as pollen production.

In some substrates, such as mineral soils, roughly 50% of the phosphates applied are rendered immobile and fixed permanently in the medium. As a result, more needs to be added to the medium, so while the amount added is higher, the amount realised is lower. Plant mediums that have active micro-life will also see a depletion of the available phosphorus occur, because it is consumed by the micro-life who also use ATP. The pH of the soil solution will affect the available phosphorus, as will temperature and overall concentrations of other elements such as potassium, a synergistic effect which is also a ratio issue. The grower needs to be aware of all these variables when designing a nutrient programme for the crop. Most nutrient lines are designed with this line in mind: in other words, the ratio, composition, source, and application rate of each component product adds to the final ratio of every nutrient that would be required by the plant.

The marketing effect

The noise level about phosphorus amounts to just that - noise. Numbers on fertilisers are legitimate in most incidents, especially where regulations are in place. The numbers are not wrong and all they do is to indicate the concentration of the constituent elements. The type or source of these elements can be the essential factor in determining the final availability of the nutrients based on the overall system. The grower is the final determining factor in how much to use. Complete fertilisers are designed to provide the correct ratio of the elements required when the entire line is mixed according to instructions; the concentration is affected by the application rate.

The problem with phosphorus is knowledge, and old legislation relating to how the element must be measured and reported. When viewed correctly, phosphorus should be in the correct range as adjusted for the root zone environment. Knowing how to read and accept both the labels and reported findings, and interpret the data, is crucial in determining the truth behind the advertising and statements made about products and results.

In the end, all this noise is about marketing. Some companies will produce products without putting much thought into their composition, selling them as more than what they are - simple fertilisers. Some companies will take advantage of a confusing situation and lack of knowledge to promote a myth and tout a weaker product. Other companies actually do their research and know what standards they are designing too, understand the relationships that influence nutrient availability, and actually design a product line that works together.

What to look for

What should growers be looking for? Firstly, a grower must decide if they are going to use an off-the-shelf version

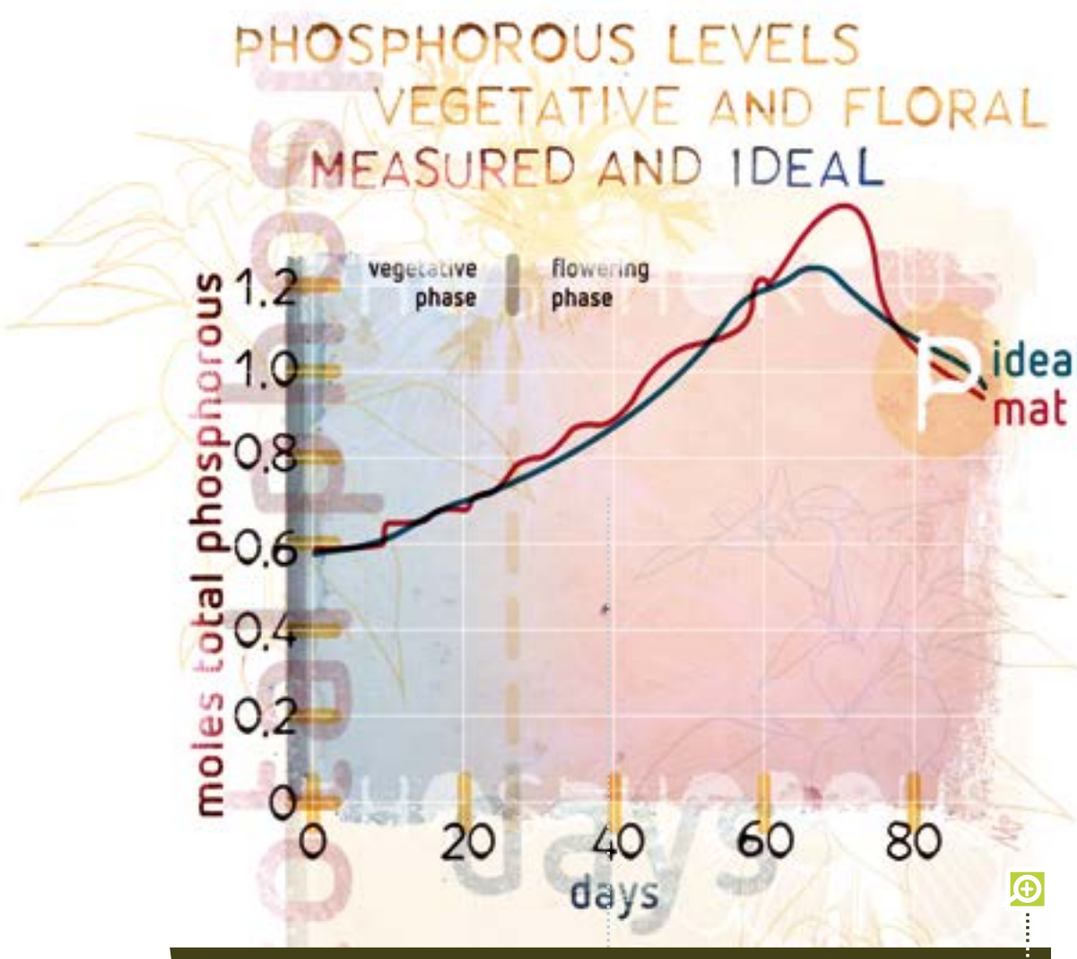

Figure 9: An example of Phosphate needs on a plant crop from start to finish showing both Observed (P mat) and the correct level to provide (P ideal)

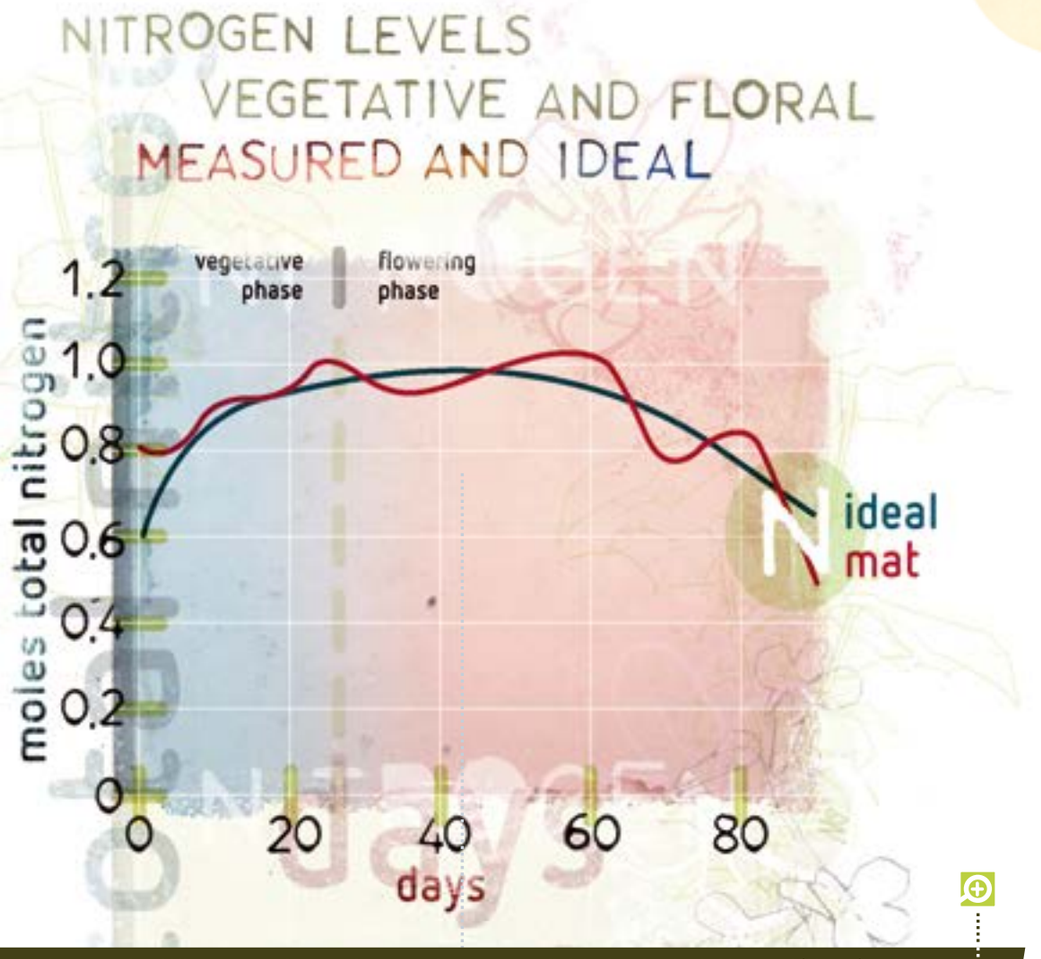

Figure 10: An example of Nitrogen needs on a plant crop from start to finish showing both Observed (N mat) and the correct level to provide (N ideal).

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or a complete fertiliser, or mix their own. Off-the-shelf products must be designed for a particular plant and the particular growing method that will be used. Mixing your own fertiliser requires extensive knowledge of chemistry and horticulture and is generally not the best method for growers of smaller commercial operations or hobbyists.
Phosphorus can be applied in many formulations on the basis of the base mineral that it is derived from. Base minerals are also associated with other elements, some good, and some not-so-good. For example, mono-potassium phosphate with an NPK ratio of 0 – 10 – 11 (commercial) and 0 – 4.4 – 9.13 (elemental) includes beneficial potassium too. Sodium nitrate, meanwhile, with an NPK ratio of 15 – 0 – 0, provides beneficial nitrates, as well as sodium (which is less beneficial).
The bigger the phosphorous number, the less of it will actually get used. Make sure that the number is small enough to not make costly mistakes when applying smaller measured amounts. Bigger numbers may or may not bring down the unit cost of phosphorus since it is based on a different mineral which sometimes has other more costly materials attached. Diammonium phosphate has an NPK of 21 – 53 – 0, but the nitrate is expensive and the composition of the product means that it needs some balancing with other components and care in application because it forms an acid very easily. Using an off-the-shelf version will probably offset most of these issues and result in an easier application process. The grower should be aware of two issues: the first is nutrient contamination and the second is the fact that nutrient sources will always vary in characteristics and availability. Nutrient constituents can become contaminated with other elements during either the mining or the manufacturing process. Contaminants such as lead or other heavy metals can accumulate in the plant and cause damage to the plant or to consumers. Some nutrient constituents can have adverse effects on pH, be less soluble and therefore less available, or can come in a less than optimal form. The ammonium ion, although it is an acceptable source of nitrogen, becomes less acceptable as the concentration increases to the point of toxicity. So growers should look for nutrients that are high quality, clean, and well formulated. Find or request a heavy metal analysis for the nutrient line before use - this will show how clean a fertiliser is.

For complete fertilisers, the grower should deal with a quality company that has their success in mind, that does research when developing its products in a legitimate manner, and that maintains high quality standards. This holds true for both approaches to fertilising crops. For complete fertilisers or fertiliser lines, the company should also understand all the relationships that affect the provision of nutrients to the plant and should never ever attempt to sell their products based on shortcomings in the knowledge of the consumer.
A good company will educate its consumers and stay true to the science. Companies with an overactive marketing department and no research department will, out of necessity, seek sell the glitz by straying into the realms of science fiction. •

Photo courtesy to Scot Nelson by CC BY 2.0

Figure 11: Phosphourus holds a key position in both cell processes and total energy transfer of the plant. It's also an essential building block for cell walls and DNA. This plant has a phosphourus deficiency, recognisable by the purple/black necrotic leaf parts. The leaves are becoming malformed and shrivelled.

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Grower's TIP #29

By your friend SEZ

PHOSPHO-BOOM!

Years ago, I read an article named "The unending abuse of phosphorus to enhance flowering" and even back then the article was already dead on! Growers were under the spell of an unstoppable frenzy. Only one thing in mind: how many types of phosphorus can we get our hands on and how soon can we start...? Nutrient manufacturers and their marketing people quickly caught on...

Sadly, things have not changed much since. Maybe it is marketing propaganda, which shamelessly portrays phosphorus not only as a way to boost yields, but also simply as the gasoline, the nitro, the rocket fuel of your success. Or perhaps just an antedote to a general lack of horticultural knowledge?
Truth is, plants do require phosphorus in large quantities, but it is not used in the same way that our bodies use sugars. Phosphorus is not a 'fuel' to be 'burned', but it actually gets recycled inside the plant. So giving your plant more does not provide a bigger 'boost', because a plant can only use a certain amount of it in relation to its size and constitution. And in any case, base fertilisers usually supply plenty of it. CANNA nutrients certainly do.
It's not all propaganda though. It is completely true that certain crops may require more phosphorus at certain points in their production cycle, usually when they are in mid bloom. As the amount of plant material increases in quantity, a little extra must be applied, since more phosphorus is required for all the different biological processes to happen in as efficiently as possible throughout the whole plant.

However, when too much unneeded phosphorus is applied, many things may happen - namely:
- growers waste their money;
- salts build up in the growing medium, leading to many other problems;
- other essential nutrients like calcium become less available;
- crop quality goes down;
- phosphorous gets leached out into the environment.

That last point should have all you phosphorus addicts concerned, because we are seeing more and more lakes and waterways being 'off limits' and fresh water supplies being shut down because of cyanobacterial blooms (also known as blue green algae). Now, those algae really are phosphorous addicts and they can never get enough of your Phospho-Booms. And we all need fresh water. So think well, use well.

Good luck and happy gardening.*

*Author unknown. This article has been shamelessly recopied all over the web with several people claiming to be the original author. Well, whoever the real author is, kudos, because way back then you already saw this issue with clarity. Cheers from your friend SEZ. •

Puzzle&WIN

Here's a brand new Soduko for you guys, and it's not too difficult! So you can probably claim your prize already! If you are lucky enough to be picked, of course. But if you don't try your luck, you will never win. So make yourself a cup of tea and get your brain in gear.

WIN A 1-LITRE BOTTLE OF **CANNA PK 13/14.**

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

PRIZES

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, with each number occurring once only.
Let us know what your solution is (sending the middle part of the puzzle is enough for us to check) and you could be the lucky winner of a 1-litre bottle of CANNA PK 13/14.

Winner puzzle#27

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

WHAT'S NEXT

The theme of our next edition of CANNAtalk will be plant stress and how this can cause problems for growers. In the first research article, our researchers will explain the basic structure of plants, while in the second article they will go into more detail about plant stress – for example, how do plants respond to too much or too little water, or water that is too salty? About what about too little or too much light?

Plus, we'll also have some more Grower's Tip for you, as usual, and Don will tell us about another of his adventures. We also have a Pests and Diseases article about fungus gnats. Don't miss it!

DON'T MISS IT!

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:

#29

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SERIOUS GROWERS

CANNAtalk:

- Is published by CANNA BV, a company dedicated to finding the best solutions for growth and bloom.
- Is distributed through local UK retailers and wholesalers.

Editor: Karin Brinkman
E-mail: info@CANNAtalk.com
Phone UK office: 0870 240 2991
Printed by: Koninklijke Drukkerij E.M. De Jong

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