CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

ISSUE 30 2015

BASIC PLANT STRUCTURE

Forms of plant stress

ROOF GARDENING

Veggies from the roof

GARLIC CHIVES

Wonderful edible flowers

And more:

HQTalk:

Oh no.... it's that time of the year again! Summer is behind us and when we look ahead, we can see the autumn and winter approaching. It is always nicer to look forward to some nice weather than the cold, dark days of winter. But to give us a better feeling let's just focus on the great summer we had. A summer full of joy! CANNA was present at Boardmasters where the best BMXers and Skaters showed off their most amazing tricks on the CANNA Midi Ramp and where you could relax and enjoy the lovely views of Watergate Bay. What a great time we all had down on the Cornish coast. But now it's back to business again as we have been preparing a lot this summer....
Especially for you, the CANNA Researchers woke up early in order to handle the heat in the greenhouses and finish writing all their articles in time. They might have suffered a little pre-deadline stress but did you know a plant can also suffer from different forms of stress and physiological disorders? Yes, it's true! Plants have feelings too! Our researchers will go into quite some depth on this subject. You can also read about garlic chives, which are more than just pretty flowers, and in the Pests and Diseases section we will tell you all about gnats - fungus gnats to be precise!

And there's even more to read too... But don't forget we are always happy to hear your comments, feedback and ideas, and you are more than welcome to send these to us via the answering card in the back of the magazine or by visiting www.cannatalk.com.

Regards,

Karin

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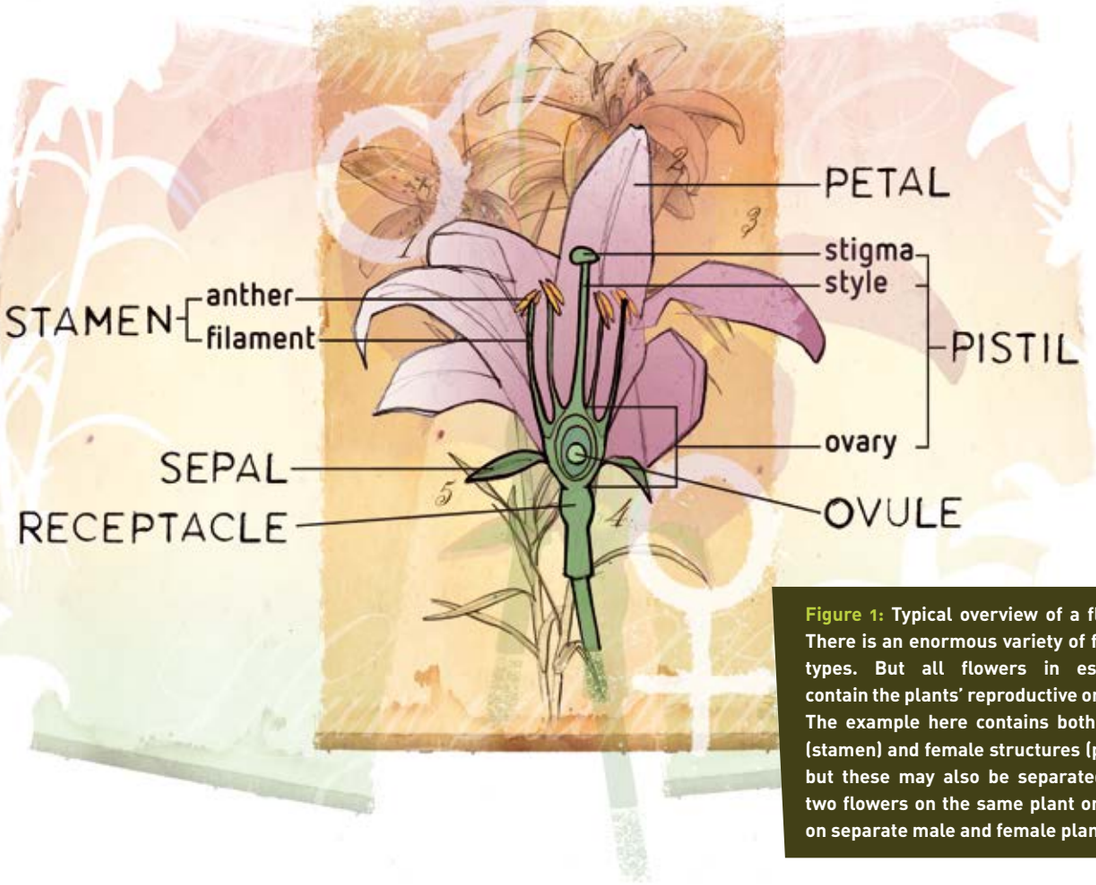

Figure 1: Typical overview of a flower. There is an enormous variety of flower types. But all flowers in essence contain the plants' reproductive organs. The example here contains both male (stamen) and female structures (pistil), but these may also be separated into two flowers on the same plant or even on separate male and female plants.

UNLIKE ANIMALS, PLANTS CANNOT RUN AWAY FROM ENVIRONMENTAL STRESSES THAT MAY CAUSE TISSUE DAMAGE. NOR ARE THEY ABLE TO ESCAPE FROM THE NUMEROUS PESTS AND DISEASES THAT CAN AFFLICT THEM SUCH AS VIRUSES, FUNGI AND INSECTS. BUT DOES THIS MEAN THAT PLANTS ARE HELPLESS? OF COURSE NOT... AFTER ALL, EARTH IS KNOWN AS THE 'GREEN PLANET' AND MANY PLANT SPECIES ARE ABLE TO CO-EXIST WITH THEIR NATURAL ENEMIES AND EVEN IN THE MOST HOSTILE PLACES ON EARTH. By CANNA Research

Throughout evolution, plants have developed numerous traits to cope with these environmental stresses. They have done this in two main ways: by adapting the plant basic structure, and by producing chemical compounds - which are often species-specific.

In this article we try to describe some of the most commonly occurring forms of plant stress that you may or may not have already seen and the physiological disorders the plant may suffer from. And last but not least, we will look at some of the 'tricks' that plants have learned to cope with stress.

Now what is 'environmental stress' about? It usually includes all the non-living environmental factors that can negatively affect the growth and productivity of plants. A lot of scientific research has been done on drought stress, the effects of flooding or submergence, salinity stress and extreme temperatures (both high and low). But for growers, well-known issues such as high light intensity and deficiencies in inorganic nutrients (such as nitrogen, phosphorus, potassium) are included. The main reason for this is the key role of this type of stress in reducing yields in agricultural or industrial crops worldwide.

The basics of plant structure

To understand the issues described further on in this article and the follow-up on page 22, it is important to understand the basics of plant structure. Possibly the most remarkable difference between plants and animals is plants' ability to use sunlight as a direct energy source to produce all the chemical compounds needed to grow,

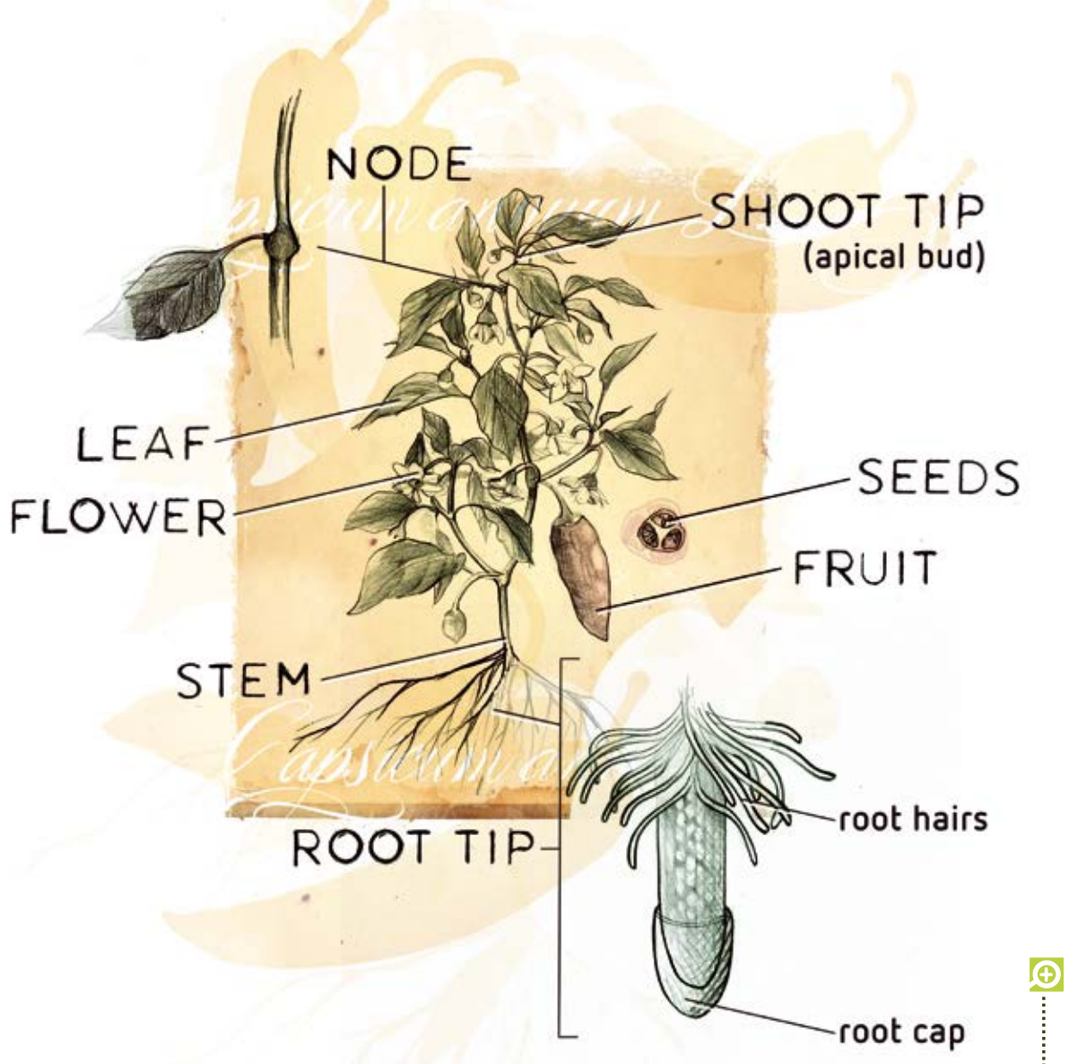

Figure 2; Overview of a plant (chilli) with the typical organs. In general, a plant has a section below ground and a section above the ground. Below ground we find the roots. Their basic functions are to provide stability in the soil and absorb water and nutrients. These water-soluble nutrients are transported to the sections of the plant above the ground via the stem to any location where nutrients are needed: to the leaves, the shoot tip, flowers and fruits.

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survive and reproduce. It is no wonder, then, that the basic structure of plants has evolved to facilitate this energy factory.

Below the ground...

In general a typical plant has a section below the ground and a section above the ground. Under the soil we find the roots, of course. Their basic functions include anchoring the plant firmly in the soil and taking up water and nutrients. Water-soluble nutrients are transported to the rest of the plant above ground via the stem to any location where the nutrients are needed: the leaves, the shoot tips, or the flowers and fruits (flowering and fruit-setting plants of course, see figure 2).

The process of taking up nutrients involves a number of steps. The first requirement is that the nutrients themselves can move through the soil or substrate in the rhizosphere so that they can find their way to the roots. Then the nutrients need to pass several 'root barriers' – namely the cell walls, and then the cell membranes. Once inside the plant, the nutrients need to be transported through the plant's vascular tissue (called the xylem), followed by cell-to-cell transport. (See figure 6)

The biggest barrier is usually the cell membrane, which is highly selective. The basic structure of a cell membrane is the phospholipid bilayer, which has very low permeability for most nutrients. Carbon dioxide, oxygen, water and some neutral molecules like urea are the only products that can pass easily through the lipid layer of the membrane by diffusion.

All other essential mineral nutrients are absorbed as ions (with the exception of boron). This means that all nutrients (except boron) need membrane transporters. These are transport proteins embedded in the cell membrane which control the intracellular environment (the spaces between the plant cells).

Above the ground...

The section of the plant above the ground includes the stems, leaves, reproductive organs (flowers, fruits) and shoot tips, which contains as yet undifferentiated plant cells waiting for specific specialization (later they will become a leaf or stem tissue).

After the roots take up the water and nutrients, there are several pathways for nutrient transport within the plant. The most common route is by 'long-distance transport' via the xylem vessels to the leaves and flowers (or any other plant organs). Two driving forces play a key role in this long-distance transport: the water potential gradient and the root pressure. Root pressure occurs when osmosis drives water from the soil into the roots. This is effectively because plants accumulate the nutrients taken up in the xylem tissue.

As we will see later in this article, various types of environmental stress can seriously affect this neat transportation system. For most plants (except for parasitic plants, which do not use sunlight as an energy source) one of the most vital organs are the leaves with the chloroplasts that contain the cells that the plant needs to photosynthesise. This includes everything needed to convert solar energy into bond energy and fix this into sugars. The chloroplast contains an extensive system of internal membranes, which are called thylakoids. The actual chlorophyll is located within this membrane system. (See figure 5)

Most chloroplasts can be found in the mesophyll tissue of the leaves. Chloroplasts are thin-walled, metabolically active cells that are not only vital for photosynthesis, but also for the storage of sugar. The leaf mesophyll tissue is surrounded by intercellular spaces, spaces that contain air and are in contact with the atmosphere. Plants can regulate air exchange using their stomata - specialist cells that can open and close, actively closing the leaf off from the atmosphere at times. Close contact with air is required because photosynthesis requires the uptake of carbon dioxide and the release of oxygen. A cross-section of a typical leaf shows the location of these cell types (figure 3).

It is worth having a closer look at the stomata. These cells not only play a crucial role in photosynthesis, but they also allow the plant to increase or reduce the rate of evaporation. Stomata are specialist cells on the lower side of the leaf. They typically consist of two cells that can vary in water content. These cells are called the guard cells. The amount of water in the cell determines whether the stoma is in the open or closed position. The guard cells of a closed stoma contain relatively little water and appear to be shrunken and shrivelled. The cell walls of each of the two guard cells make contact over the full length of the cells. To open the stoma, the plant has to increase the water level in the guard cells. The driving force behind this flow of water is osmosis: the plant actively increases the potassium level in the guard cells. As a response to the increasing potassium content, water starts to flow into the cells, causing them to swell. The contact between the two guard cells is reduced so that only the cell wall

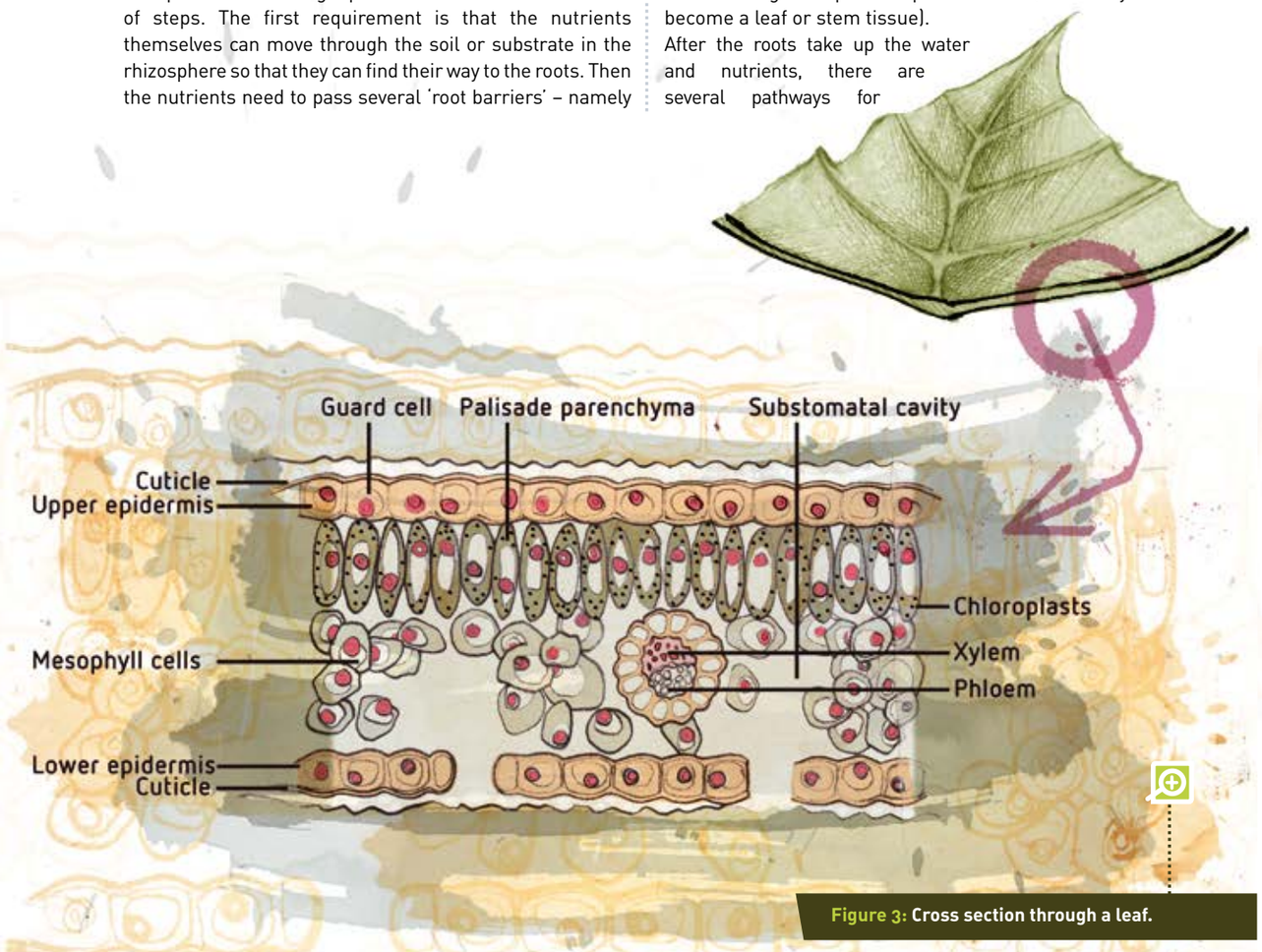

Figure 3: Cross section through a leaf.

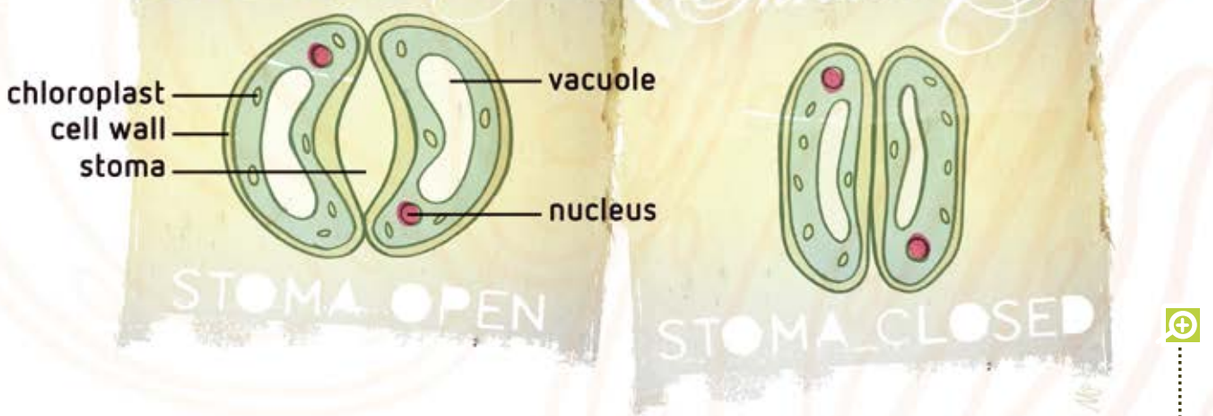

Figure 4: A schematic overview of a stoma. Left: an open stoma consists of two swollen guard cells. These cells contain extra water, creating an empty space (stoma) in the middle. Right: a closed stoma consists of two 'relaxed' guard cells. The cell walls of both cells stick together, effectively closing the inside of the plant from the external environment.

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at the top and bottom of the cells are touching, leaving a space - the stomata is now open. (Figure 4) By precisely controlling the water content in the guard cells, a plant can determine whether most of the stomata should be closed (no contact between the internal plant parts and the external atmosphere) or open (maximum plant-air contact). As we will see, this process plays a crucial role in plant stress responses, particularly in relation to water and drought stress.

In order for a plant species to survive over generations, flowering is a crucial process for reproductive success. While photosynthesis provides energy for the plant throughout its whole life cycle, the transition from a vegetative to generative stage marks a dramatic change in the plant's energy investment.

This transition is characterised by the induction and development of the meristem of the inflorescence, which produce flowers (or one flower, where only one is produced) (see figure 1). This change contains both endogenous and exogenous elements; for example, in order for the change to begin, the plant must have a certain number of **leaves** and have reached a certain total **biomass**. Certain environmental conditions may also be needed, such as a characteristic **photoperiod**. This is most often the transition to long or short days. Even an internal 'genetic' trigger or circadian clock in the plant may cause the plant to flower. **Plant hormones** play an important part in the process, with the **gibberellins** having a particularly important role.

So far in this article, we have described some of the most important plant parts and the specific function that these parts have in plant growth and survival - under ideal circumstances, that is. As we will see in the next part of this article, plants also have to deal with many less than ideal circumstances that can push the plant to its limit in order to survive.•

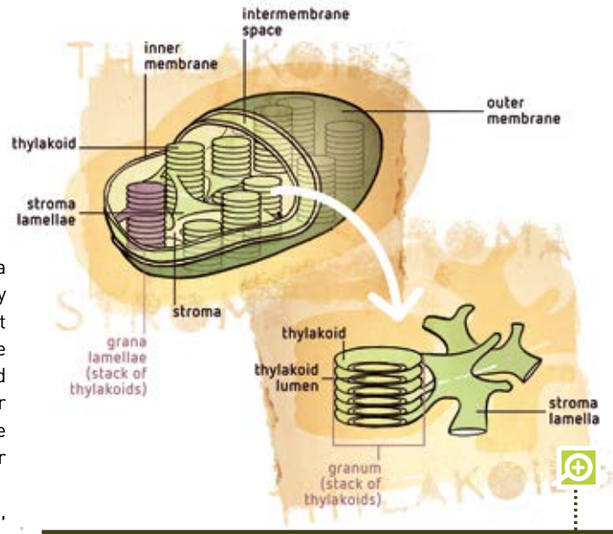

Figure 5: Schematic representation of the overall organisation of the membranes in the chloroplast. The chloroplast of higher plants is surrounded by inner and outer membranes. Light energy is fixed in the thylakoids. Carbon fixation (the production of the sugar) occurs in the stroma, the space in the chloroplast outside the thylakoids.

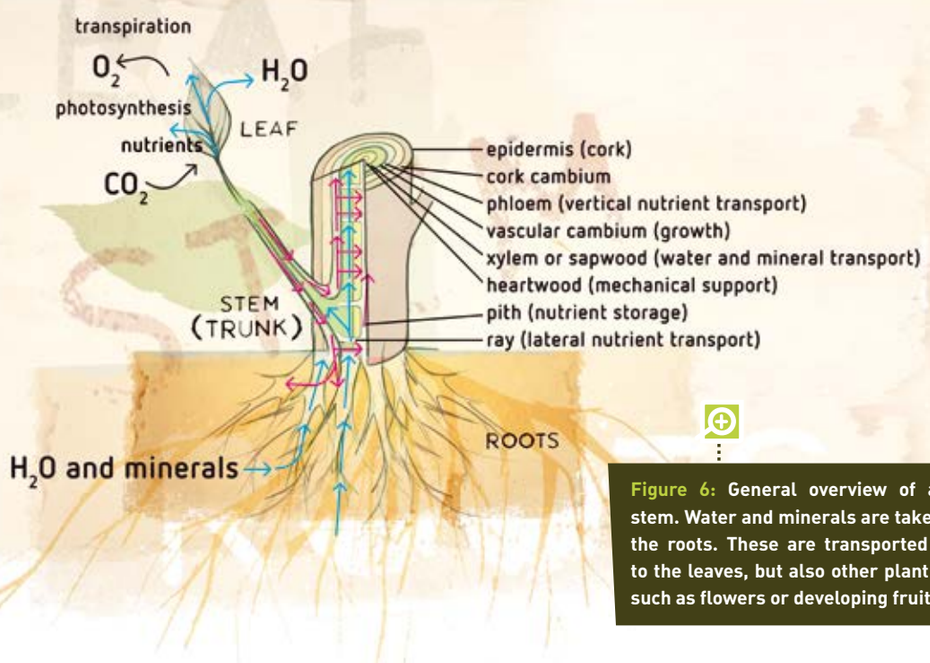

Figure 6: General overview of a plant stem. Water and minerals are taken up by the roots. These are transported mainly to the leaves, but also other plant organs such as flowers or developing fruits.

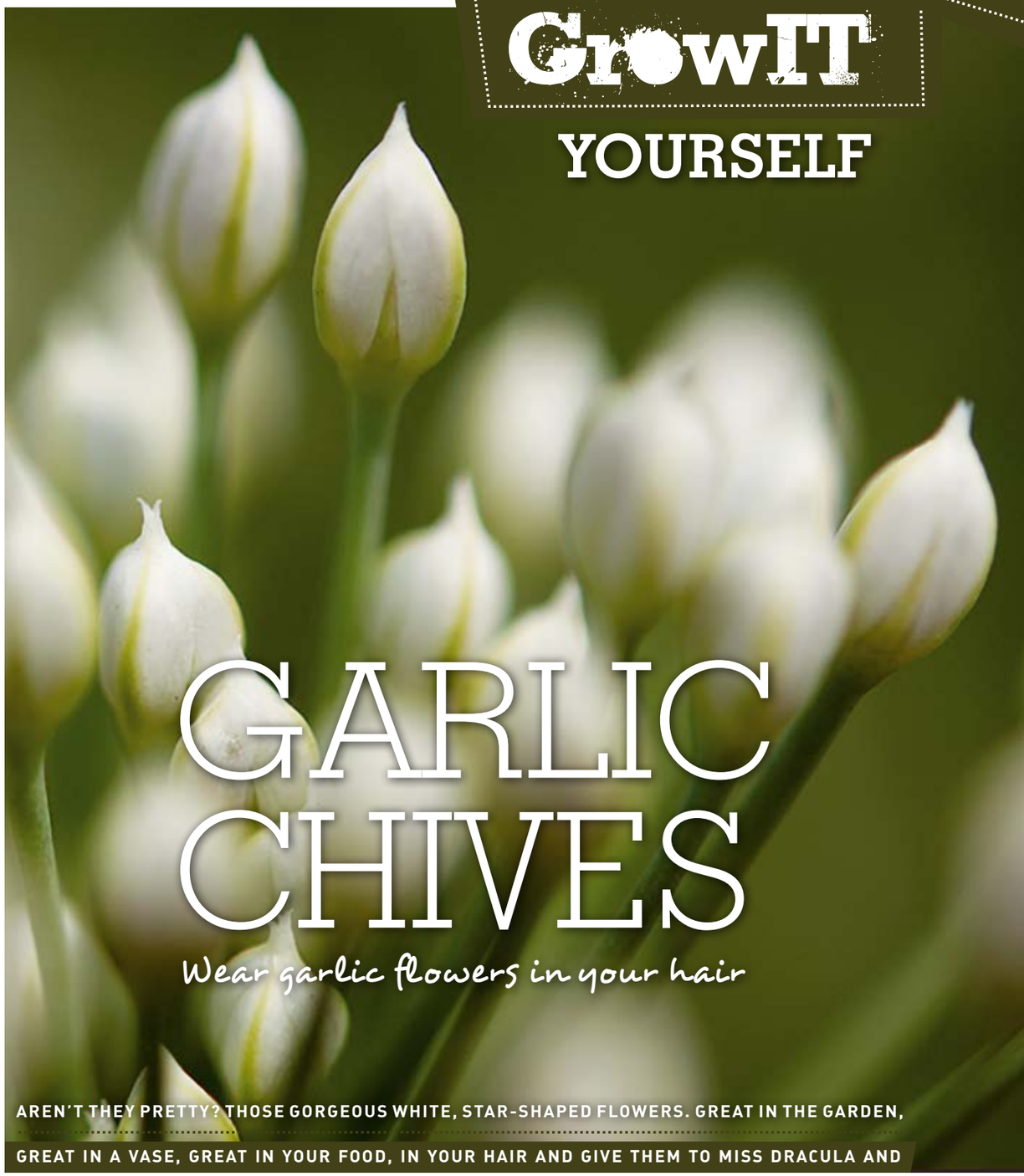

Photo courtesy of Kanegen under CC by 2.0

GARLIC CHIVES

Wear garlic flowers in your hair

AREN'T THEY PRETTY? THOSE GORGEOUS WHITE, STAR-SHAPED FLOWERS. GREAT IN THE GARDEN, GREAT IN A VASE, GREAT IN YOUR FOOD, IN YOUR HAIR AND GIVE THEM TO MISS DRACULA AND SHE'LL BE CHARMED INTO HER OWN DEATH. MWHOAHAHAA. MEET GARLIC CHIVES AND THEIR WONDERFUL EDIBLE FLOWERS.

By Marco Barneveld, www.braindrain.nu

Right, it looks like an onion chive but it tastes like garlic, although it belongs to the onion family. Nature's inventions are all here to please us.

Its scientific name of Allium tuberosum is indicative of its oniony roots and it falls into the family of Liliaceae. Unlike onions or other types of garlic, however, the fibrous bulb is not edible and this plant is grown for its flowers and stems. They are also often referred to as Chinese chives and were first recorded between 4,000-5,000 years ago in China.

GARLICCHIVES

Hardy

You might wonder why garlic chives are not as commonly grown as regular chives (Allium schoenoprasum). We don't know, but we hope that this article will help to raise the profile of garlic chives and let people know how wonderful they are, so that everyone, including you, starts growing them. Garlic chives are a hardy perennial and just as easy to grow as the normal chive. Like regular chives they spread quickly and can sometimes become too much of a good thing. But if you develop a taste for them, you can sprinkle garlic chives over almost any meal in great abundance, and stop them from taking over the whole garden.

More garlicky than oniony

It is easy to differentiate between onion chives and garlic chives. Garlic chives have a flat, grass-like leaf, not a hollow one, like onion chives. Garlic chives flower towards the end of the summer. The florets of garlic chives are petite, white and star-shaped, appearing in loose bunches. And the flavour is more garlicky than oniony, though it is not as harsh as a raw clove of real garlic. You might say it has just that sublime subtlety that makes your taste buds tingle.

Of course, its ornamental properties are truly sublime, and it also attracts butterflies. Yes, you read correctly. They attract butterflies. Need any more reasons to start growing? Well, here are some more.

Stops bleeding

Since ancient times, garlic chives have been consumed in many ways, including as a natural medicine. And no wonder. The herb is rich in Vitamin C, which aids the prevention of the common cold and fever. It is rich in riboflavin, potassium, vitamin A, iron, thiamin, and beta-carotene. It is a good tonic herb to take regularly. These elements help to increase blood cell counts, maintain blood pressure, and increase immunity. It is low in fat, thus is safe for those who suffer from obesity. The herb has high percentage of dietary fibre and protein and helps to maintain a healthy and balanced metabolism. Cooked garlic chives help to treat digestive, kidney, and liver problems. Garlic chives are consumed to reduce stress and fatigue. Do you have enemies who are always trying to poison you? Well, garlic chives have been used since ancient days as an antidote to poisons that are injected into the body. And surprisingly, a paste of the herb is used on wounds, and cuts. It heals them faster and stops bleeding.

Grow it yourself

We are absolutely sure that everyone will want to know how to start growing wild garlic chives in their herb garden. So let's start growing. Garlic chives grow between fifteen to eighteen inches high and make a lovely flower in a border or container plant, and they also work well in the herb garden. They can be planted along a path or as a dense ground cover. The small, star-shaped flowers are usually cream-coloured and grow on sturdy stems in June. The flowers can be eaten or dried and made into floral arrangements.

Garlic chives germinate from seeds. Sow the seeds into a pot. The soil temperature should be kept to room temperature for the first six weeks. Then, once the seeds start germinating, take them and plant them outdoors. These little perennials can be planted in full exposure to the sun and in rich, well-draining soil with a pH of 6.0.

Chives are related to onions and will grow well with many of the same plants as their relative - namely beet root, carrots, tomatoes, strawberries, potatoes, rhubarb, kohlrabi, parsley, broccoli, cabbage, aubergine, mustard and peppers, and are thought to enhance their flavours and growth intensity. Garlic chives discourage the spread of Japanese beetles, slugs, and cabbage worms, so place them where plants in full sunlight have a problem with these insect infestations. Garlic chives also repel aphids, which are known to be a problem for grapes; so planting these two in the same area is a good idea. Avoid putting garlic chives near asparagus, peas, spinach and beans, as they will compete for similar soil nutrients.

Looking after garlic chives is pretty straightforward. Water when needed. Although these plants are drought tolerant, they do enjoy moist soil around their roots. Other tips for looking after garlic chives include fertilising them at the start of the growing season with a slow release fertiliser. After a long spell of freezing temperatures, garlic chives will often die back and return again come springtime. Clip the stems either all the way to the ground or with 2 inches remaining to allow the herb to grow anew.

Garlic chives are essential in Asian culinary. However, in Asian countries people only use the fresh garlic chive leaves, which are usually fried with meat and vegetables. In Japan, garlic chives are a staple in Miso soup. The little garlic chives bulbs can also be used in the same way as you use garlic, particularly in dishes that require a more subtle flavour than regular garlic.

The flower buds of garlic chives can be eaten in the same way as those of onion chives. The flowering stems can also be used to season dishes.•

RECIPE

STIR-FRIED GARLIC **CHIVES WITH CHILLI**

We like to keep things simple. In this ultra simple recipe, it's the garlic chives that shine like the bright little stars they are. Do overindulge.

- **1-tablespoon peanut oil**
- **2 lbs green garlic chives, flat parts only cut into pieces**
- **1 teaspoon dried hot red pepper flakes**
- **A bunch of garlic chive flowers**
- **Rounded 1/4 teaspoon salt, or to taste**
- **Special equipment:**
  a well-seasoned 14-inch flat-bottomed wok
- **Goes with steamed white rice**

Heat the wok over high heat until a drop of water vaporizes instantly upon contact. Add oil and swirl to coat the wok evenly. Heat until hot and just smoking. Add chives and red pepper flakes and stir-fry, letting chives rest on bottom and sides of wok several seconds between stirs, until chives are tender and slightly browned, 2 to 4 minutes. Stir in salt. Serve over rice. Sprinkle with flowers and put the last flower in your hair, you flower-child you.

Enjoy !

Questions & Answers

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

Question

I am using all your BIOCANNA products with BIOCANNA Bio Terra Plus soil. I am germinating seeds and providing pure water before germination. The pH of my reverse osmosis water is 5.6 or 5.7. Do I need to adjust the pH? Also, when I start using your BIOCANNA Bio Vega and BIOCANNA Bio Flores, will I need to adjust the pH at all?

Answer

Don't give the seeds any nutrients until they germinate. After that, give them the recommended dose, but don't adjust your pH. We recommend not using 100% RO water because it will make the pH value of the water used for the feed solution unstable. BIOCANNA nutrients are based on 'normal' water, which has an EC level of 0.4 So make a mixture of RO water and your regular tap water.

Tap water EC	Mixture tap water /RO
0.6	66/33 %
0.8	50/50 %
1.0	40/60 %
1.2	33/66 %
1.6	25/75 %

This water has still some calcium and magnesium dissolved in it, as well as some bicarbonate which makes the pH more stable in this water mixture. You can add the normal dose of BIOCANNA nutrients according the growing guide on top of this water.

Question

Which of your composts would you recommend for flower hanging baskets? I want to make around sixteen large hanging baskets containing double petunias and after twenty years I'm still looking for the perfect compost. Have I found the right one with yours?

Answer

Well actually, we don't sell compost. Compost is an organic substitute to a potting soil like our CANNA TERRA. Unfortunately compost can also contain a lot of heavy metals. That's why most Terra suppliers add only a small amount of compost to their Terra.

A possible alternative for you is our BIOCANNA Terra. It is based on 100% organic fertilisers and it will make sure your petunias thrive and stand out.

Question

I would like to ask you If I can use a chemical fungicide if I have used trichoderma. Is there a way to kill trichoderma using chemical fungicide in coco?

Answer

Yes, you can kill trichoderma with chemical fungicides too. But this depends on whether the fungicides are toxic to the trichoderma. As long as you use the fungicide as a leaf spray and no drops get into the substrate, the trichoderma will be safe. If a few drops get into the substrate, water the substrate immediately to dilute the fungicide. Make sure that watering time is after the application, because otherwise you will have roots problems too due to overwatering. So spray just before watering.

Question

My tomato and chilli plants are still seedlings and I have recently planted them in 10 litre plant pots after they survived the germination stage. I am using all your BIOCANNA nutrients and BIOCANNA Bio Terra soil and my problem is that when I feed them, the pH is fine (6 to 6.5). Two to three days after the pH rises to 8 (I used a soil pH probe to measure this) and they are showing signs of a nutrient lock-out, pH problems and a manganese deficiency. Can you help me?

Photo courtesy of regan76 under CC License 4.0

Answer

Is your water harder than you thought it was or are you using a bubblelator? If the water is hard (pH 7.4 in general isn't), it will always go to higher numbers over time.

If it reaches 8 or higher, you can lower it to 6.5 -7.0 again, with pH minus bloom (if you don't mind doing this in a mineral way) or an organoacid (if you want to grow 100% organic).

Question

For the first time I am using CANNA Coco A & B for growing tomatoes on coco. My feed solution is 10ml A and 16ml B, tap water 0.3 and total 1.8 EC. Is a ppm calculator available? I would like to know how many ppms of N or P or K I am using. That information would be helpful if I wanted to increase the K or Ca for my veggies.

Answer

If you visit canna-uk.com/grow guide, you can fill in ppm values instead of the EC values. However, that won't give you the amount of N, P and K in ppm. You can calculate this, but it's a complex process.

However, we also think you could be making a mistake in how you are thinking about our coco nutrients and coco substrate. Coco is a substrate which absorbs a lot of calcium, magnesium and nitrogen when you add an average amount of nutrients. The coco substrate locks in these elements and releases potassium (K) and phosphorus instead.

Our CANNA Coco A & B contains a lot of Ca, Mg and N to compensate for this absorption process. This means that you make the flowering nutrient in the substrate, so always dose the A and B at the same levels. If you are not happy and you think that the coco is not releasing enough P and K, you can add PK 13/14 to your nutrient solution. In general, the coco releases more than enough P and K itself, so keep your dose A and B at the same amounts.

Question

I am a salad grower based in the UK. We are looking for an organic liquid food range that is suitable for use in hydroponics to support baby leaf salad growth. Are your products suitable and do you have any guidance on dosage for hydroponic methods?

Answer

If your hydroponic system includes a substrate based on coco or inorganic substances such as rock wool, clay pebbles (or no substrate at all), we don't recommend an organic fertiliser. If you use a (BIO-)Terra, we have a 100% ecological liquid nutrient range, which we call BIOCANNA. Please visit our website www.bio.canna-uk.com for more details.

Photo courtesy of sally_monster under CC license 4.0

Question

I'm just about to start my first auto-flowering grow. I was wondering if there is any advice you can offer me with regards to the best medium. Ideally I will be planting germinated seeds straight into their finishing pots so I don't want a mix that is too rich while they are seedlings. Would you recommend either CANNA Coco Natural or the CANNA Terra Professional?

Also, what ratio of perlite do you recommend adding to the mix? Any advice welcome.

Answer

That choice is up to you. Terra substrate will not produce as much, but will provide a bigger buffer. So the plant will always produce something, provided you don't make a lot of mistakes. Coco can produce more, but the buffer is not as large. That is one of the reasons you have to check the EC and pH level of your nutrient solution before giving it to the plant (pH and EC control is recommended when using Terra too). Perlite is generally not needed unless the substrate stays wet due to the ingredients of the substrate (ex. black peat) or your watering system (e.g. flood systems). Although it is possible to sow directly into the final pot (and medium), this generally means a lower germination rate. The seeds do not have good contact with the water due to the larger fibres in the substrate, and the substrate usually already contains some nutrients which also decrease the germination rate. Germination in small pots in special medium can improve the germination rate. If you choose Terra, start with Terra seed mix or peat pots. If you choose Coco, start with coco plugs or rock wool if you cannot get these plugs.

Don & Nicky (PART 11)

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.

A lot has changed here -both indoors and out. I've shut my indoor garden down for the summer to take a breather and enjoy a vacation with all the lights off. Outdoors I've been growing a massive crop of potatoes, fertilised with insect frass, seaweed and worm castings, and some tomatoes too – all ancient varieties – with generous gloops of liquid organic feed in my watering can so that I might stand a slim chance of making my allotment neighbours jealous (no luck yet -his are bigger! He must be on the minerals!).

From INDOOR GARDEN TO TROPICAL PARADISE

After drying the last of the harvest from our four indoor Tokyo Hot chilli trees I pruned them all back to barely anything more than just stem and distributed them throughout the village to enjoy a second season outdoors. Most are now installed in neighbours' gardens, still in 42 litre fabric pots, but one has been transferred to a concrete planter in front of the local library where it enjoys a beautiful southern exposure. I optimistically donated some coco-specific nutrients to the librarians but they really sucked at even keeping the roots moist (to encourage re-growth for the second season), let alone mixing up a two part feed -so now I visit the library often armed with an A and a B, a pH pen and an EC truncheon. The library's chilli plant is already bursting with new growth and I can't wait to see what she produces in the next three or four months -invariably the second year is better than the first for chillies. Locals are confounded by the plant's thick main stem, apparently unaware that chillies are perennials, not annuals.

Word has been spreading throughout the village about my subterranean indoor garden. I drank too much one night with a local restaurant owner and hastily agreed to grow herbs for him without even asking exactly what he wanted. I remember slurring, "I can grow anything you like!" and now I've got to soberly walk the talk.

1 One of my Tokyo Hot chilli tree in front of the local library where it enjoys a beautiful southern exposure.

2 Outdoors I've been growing a massive crop of potatoes (right), fertilised with insect frass, seaweed and worm castings, and some tomatoes (left) too.

Furthermore, it turns out that he's fairly well travelled and, as well as the predictable staples of mint and basil, he also wants some fairly exotic stuff including curry leaf (Murraya koenigii) and Chinese Coriander (Eryngium Foetidum – literally 'foul-smelling thistle') aka Culantro, something I've always found difficult to germinate, let alone grow!

So, with my indoor garden emptied for the summer, cleaned from top to bottom, and complete with a new level concrete floor, a plan is taking shape for a truly tropical indoor garden! That means elevated relative humidity in the 70 – 75 percent zone at least with stable, warm temperatures in the mid to upper 20s, and the ability to cater for a wide variety of light requirements from low-level, forest floor dwelling species such as turmeric and ginger, to tropical light-guzzlers such as pineapple, yes pineapple! My plan is to buy a load from the market, chop off the crowns, and root them in my aerocloner. Apparently it's possible, I'm just a little worried about any bugs that might hitch a free ride into my pristine new indoor garden. I'll take precautions by rooting them in another room and spraying them liberally with a neem oil solution.
I intend to make Don's Indoor Garden 1.1 a more automated affair with pH dosers and auto-topping up on my reservoirs. I sorely need an in-garden drainage point too and a reverse osmosis water purifier / reservoir in the room itself, rather than relying on pumps and hoses. I also need to reduce my energy consumption.

The electricity company got in touch recently and suggested a new monthly payment of £364.

Nicky freaked out. I told her that there must be some mistake, but secretly I'm worried that having a 1000W metal halide switch on 24/7 for six weeks might have something to do with it. In any case, it's certainly prompted me to investigate lower wattage lighting solutions including LEDs and T5 Fluorescents for leafier crops. I also sourced a 270-watt full spectrum plasma light with enhanced UV-B levels. This should be awesome for producing more essential oils in my crops. I'm especially excited about my mint and basil, or should I say, mojitos and pesto, but not in the same glass.
Anyway, wish me luck and hopefully I'll have the beginnings of a tropical paradise in just a few months.•

BIOLUMINESCENT PLANKTON

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

- The blue glow you see in the water is caused by bioluminescent plankton. A common example is sea sparkle (Noctiluca scintillans), which is responsible for the 'lights of the sea', which can be seen both near the coast and out in the open water.
- The word bioluminescence comes from the Greek word "bios" for life and the Latin word "lumen" light.
- Bioluminescence is the production and emission of light by living organisms. It occurs in certain bacteria, fish, octopuses, jellyfish, corals and plankton. There are also some species of insects and fungi that produce light.
- The emission of light occurs when a pigment called luciferin and an enzyme called luciferase come into contact with oxygen when the plankton become stressed or stimulated due to movement in the water. This is why the light becomes brighter in breaking waves or where the water hits the side of a boat.
- In some organisms bioluminescence has a specific function. This can be camouflage (jellyfish), distracting predators (centipedes) or attracting others of the same species (fireflies).
- This photo was taken on the island Vaadhoo in the Maldives, but bioluminescent plankton are not confined to tropical areas. Sea sparkle, for example, sometimes occurs near the Belgian and Dutch coast, especially in shallow waters during hot weather.
- Have you seen the film 'Life of Pi', by director Ang Lee? (highly recommended!) The movie includes a scene inspired by 'Bioluminescent Bay' on the coast of the Puerto Rican island of Vieques. In the film, there are jellyfish that emit light, but in Bioluminescent Bay is the plankton that give out an ambient glow.

Photo courtesy of Ivan Lim bij Ivan Photography

What's HAPPENING

If you live in an apartment or flat you might be looking out over empty roofs. Now wouldn't it be nice if you would be looking out over fields of green? And this could happen sooner rather than later. The rooftop gardening revolution has just started. By Marco Barneveld, www.braindrain.nu

VEGGIES FROM THE ROOF

There is high chance that you live in an urban environment and, for most urban dwellers, visiting a working farm requires a journey into the countryside. But the rooftop gardening revolution has begun and things are about to change.

Entire **farms**

If you live in an urban area, you might grow the occasional tomato or vegetable on your balcony like many other people. But in cities like Singapore, Amsterdam, Hong Kong, Tokyo, Montreal and New York entire farms are now being set up on top of buildings.

More oxygen

Green roofs use plants and flowers to provide insulation, create a habitat for local wildlife, help control run-off water and pump more oxygen into the atmosphere. Oh, and they look great too. Rooftop gardening just makes plenty of sense all round, and the big question is actually why are there not many more farms in cities?

Reduce your **footprint**

Gardening on rooftops in increasingly dense and sprawling cities is an original way of taking back unused and sterile spaces like rooftops, patios and balconies and transforming them into liveable spaces that are lush, productive and purifying.

Get started

Rooftop gardens can provide an oasis in an otherwise built-up urban setting but there are several things to consider about urban gardening before you start planting. If you've gone through the logistics and have decided to create your own rooftop garden, here is how to get started.

Containers

Containers are one of the most expressive components of a rooftop garden. This is where you can really give the garden your own style. That's not to say you need to spend a fortune on them, although you easily could. Besides aesthetics, the two things to keep in mind when choosing your rooftop containers are size, weight and material. You will need containers large enough for the roots of whichever plants you choose. The amount of potting mix required will vary, so research your choices, before you plant them. You will find many plants labeled as great for containers.

The weight of the container becomes an issue if you are worried about how much your rooftop can support. Remember, containers get even heavier when you water them. Traditional materials, like clay, terra cotta and cement, can be quite heavy. Plastic pots and the newer synthetic containers are light enough to lift. But you also need to consider balancing the height of your plants. A tall or top heavy plant, like a small tree or a tomato plant full of ripening fruits will topple over in a lightweight pot. If your rooftop garden is windy, heavier containers will be a must.

Remember, when the pot heats up, the potting mix and roots heat up, requiring more frequent watering. You can help a little by creating shade and mulching the top of the containers, but drip irrigation will make your life much easier. At least consider self-watering pots.

Potting **mix**

Potting mix is often the last thing to interest a new gardener, but it is the most important part of your garden. Good potting mix means healthy plants and less work for you. If you are growing in containers and raised beds, you will have the advantage of being able to bring in new potting mix. The potting mix in containers needs to be replaced periodically, usually every spring. You can lift and repot or simply top dress the existing potting mix.

Fertilisers

Fertilisers are important too. Even a great potting mix will become depleted over time, as plants take up the nutrients and the water leaches them out. The larger a plant grows, and the more water it takes up, the faster the potting mix will be depleted. The type of fertiliser you use will determine how often you will need to fertilise.

Plants

Now get some Plants. You can plant virtually anything in a container. There is no list of certified rooftop hardy plants. Your choice of plants will require some trial and error. But to be honest, with the exception of tall trees, there is little you can't grow on a rooftop. Many rooftops have their own microclimates and can overwinter plants that would not be hardy at ground level. And if you have the space and are willing, you can also bring tender plants indoors for the winter. Annuals will require more frequent watering, but will thrive on the sunlight.

Tools

You'll need far fewer tools for a rooftop container garden than you would for a traditional ground level garden. You'll be doing a lot of scooping and filling. A trowel and perhaps a potting mix scoop, are the first tools you'll need. A small tarp will come in handy when you are emptying potting mix, to minimise the mess. Now you are good to make your first steps as an urban farmer. Perhaps you'll inspire your whole neighbourhood. Perhaps you'll be living in an urban oasis pretty soon. Now wouldn't that be cool? •

Tips:

- Create better drainage by using pot feet that will lift your pots off the floor.
- A kiddy pool makes a wonderful raised bed, suitable for growing just about any kind of vegetable.
- If you are going to be moving plants around or moving them from inside and to outside, place them on locking dollies.

GNATS, WHAT'S THAT?

Photo Courtesy of Jean-Raphaël Guillaumin under CC BY-SA 2.0

So, what is a gnat? First and foremost, among the hundreds of species of gnats in the world today, only one variety gives growers nightmares: the fungus gnat. The fungus gnat (chiefly Bradysia spp. or Orfelia spp.) is a fly in the Sciaridae family that is also an integral component of the organic food chain, although not one that is welcome in indoor growing situations. By Ralph B. BSc Horticulture

The fungus gnat is often confused with the shore fly (Scatella stagnalis). It has the same four life stages as a fly: egg, larvae (maggot), pupae, and adult. It is the larval stage that does the damage and the adult stage, which is the most annoying.

Identification

Fungus gnats typically measure 1/16th inch to 1/8th inch (1.6 – 3.2 mm) with some species as big as ¼ inch or bigger (6 mm +). They are typically light or dark grey but may appear tannish. They have long legs that give them a mosquito-like appearance, and long segmented antennae. The larvae have four stages of growth known as instars. During the fourth instar, or final instar, the larvae are white with a dark head, legless, about ¼ inch long (6 mm). The adults are weak fliers, seldom venturing far from where they reside, but are attracted to light and will accumulate in windows and light fixtures.

These gnats are, literally, everywhere. They will appear as if by magic in apparently clean situations. Populations can suddenly explode and then they will fade away. They are small enough to fly through a screened vent or hitch a ride into the growing area on a coat sleeve. If there is any organic debris in the grow area, on a table, in a tube, under an irrigation line, or on the floor or drain, there is a very real possibility that they will visiting soon.

Damage

The larvae are what cause the damage. The maggots will eat a variety of organic components including leaf mould, organic mulch, grass clippings, compost, root hairs, and, of course, fungi. When populations become large, healthy root tissue may also be attacked. Most of the resulting damage occurs when secondary infections, like pythium, enter the damaged tissue sites. Heavily damaged plants will exhibit signs of over-watering such as wilted or discoloured leaf tissue. This is because the plants will usually be overwatered, since dead and damaged roots rot, stop functioning correctly, and then the problem becomes a dual threat from a pathogen and an insect. Small numbers can inflict little damage and plants can overcome this easily, but with larger populations, in combination with moisture and certain temperatures, damage can be expected. Adults fly around and lay eggs when the time is right. They do not eat, bite or harm anything but can be annoying when flying in mass. The adults have a very short life cycle (ten days max) and the gnat actually spends much more time in the larval and pupal stages than as an adult.

Life stages

Fungus gnats like moist conditions - the moister, the better. Eggs are laid by the female in wet organic materials, in groups of up to thirty in the surface cracks in the medium, and they can lay 300 or more during their short adult lives. These hatch in four to six days becoming larvae with a large appetite. The larvae eat and grow for about twelve to fourteen days then become stationary as they pupate, or change form from a worm into what we know as a gnat. This process lasts about four to six days and results in the hatching of many adult gnats.

Treating the adults will only take care of that generation, and not those of the next few days. It is best to deal with the larval and pupal stages of this insect since this is the time they are the most active, feeding or stuck in one place for some time. Expect an entirely new population every fourteen to sixteen days.

Control

It is best to control the pest before a population gets established. This can be done by carefully monitoring the moisture level in the plant medium, and checking for populations of the insect. Keeping the soil moisture under control is a good way to control the pest without resorting to pesticides. Having a few gnats are natural and they will not cause issues with your plants. Monitoring for the pest allows the grower to know if the population is growing or declining and make treatment decisions based on how quickly changes are occurring. Slow changes can be dealt with by adjusting watering patterns, or using natural controls. Targeting adults is temporary at best. Targeting the larvae requires treatment in the medium and the surface of the medium.

The use of yellow sticky cards hung on and around the soil surface of containers will help monitor the pest by enabling you to count the number of adults. While these cards trap and hold flying adults, for some controls this is not considered an effective treatment.

In addition to yellow sticky cards which attract adult gnats and trap them, the population can also be monitored using pieces of peeled potato cut into 1 inch diameter plugs about ½ - 1 inch thick. These are placed at random throughout the crop and placed on the medium surface. Potatoes are fungus gnat larvae magnets. Count how many are on and in each piece of potato and estimate the population accordingly. Replace the piece after checking and disposing of the larvae.

The controls used are mainly preventative and involve dealing with the conditions that best suit the pest. Correct irrigation procedure is probably ninety percent of the battle. This cannot be overstated. Adding too much manure, blood meal, or other organic components such as comp tea can will provided bases for the population to grow. Learn what the population size can be without possible stress on the crop. Do not overfeed with organic products. However, when approaching these population limits, it is possible to use natural controls (see table 1).

While it is not the intention of this author to ever recommend the use of chemical controls, benefits have been seen using products such as pyrethroids, which are lower toxicity products. These must be applied to the soil or medium. As with any pesticide, you should verify both the label listing of the system to be used and that their specific crop is listed among the approved uses.•

Photo Courtesy of Whitney Cranshaw under CC BY 3.0 US

CONTROL	NOTES
Hypoaspis miles (Predatory mite)	A predatory mite that feeds on larvae and pupae of fungus gnats, thrip pupae, and sometimes springtail larvae. Make applications to already potted plant mediums that are moist.
Steinernema feltiae	Very effective nematode that is usually good for the entire crop cycle as long as temperatures remain optimum. Actively reproduce and search for pests. Some restrictions on application methods should be followed to insure success.
Atheta coriaria (Rove beetle)	Adults are about 1/8th inch long, dark brown to black and feed fungus gnats, shore fly, and thrip pupae, larvae are cream to brown. Live yearlong in greenhouse but populations may fluctuate. Are compatible with nematode.
Hunter flies (Coenosia attenuata)	Resembles house fly but much smaller, adults feed flying gnats, shore fly, whitefly, and leaf miner. Larvae feed on larvae of gnats and all other insects in the soil.
Synacra paupera	A parasitoid fling insect where the female seeks out and lays an egg in a fungus gnat larvae that hatches and eats the larvae. The gnat larvae lives until pupation then dies. Population of the parasitoid grows faster than the gnat at normal temperatures.
Bacillus thuringiensis subspecies israelensis (Bti)	A naturally occurring spore forming bacterium that provides temporary control of and is toxic to the larvae of mosquitoes, black fly and fungus gnats. This product may or may not be registered in Europe, the grower will need to check.

Table 1: Natural insect controls for fungus gnats

Figure 7: This is a coloured scanning electron micrograph (SEM) of a leaf from the succulent plant Kalanchoe blossfeldiana, showing a closed stoma (centre). Stomata are the pores through which gaseous exchange occurs in plants. The opening and closing of the stomata is controlled by semicircular guard cells. When the guard cells are turgid, the stomata are open and when they are flaccid the stomata are closed. K. blossfeldiana is adapted to hot, arid conditions and opens its stomata at night, which is the opposite of most plants, to prevent water evaporation. It absorbs carbon dioxide through the stomata at night and converts it to an organic acid for storage. When the plant starts photosynthesising during the day, it uses the stored carbon dioxide. The flecks on the surface are wax.

THE MOST OCCURRING FORMS OF

PLANT STRESS

IN THE ARTICLE ON PAGE 4 WE HAVE DESCRIBED SOME OF THE MOST IMPORTANT PLANT PARTS AND THE SPECIFIC FUNCTION THAT THESE PARTS HAVE IN PLANT GROWTH AND SURVIVAL - UNDER IDEAL CIRCUMSTANCES. AS WE WILL SEE IN THIS PART, PLANTS ALSO HAVE TO DEAL WITH MANY LESS THAN IDEAL CIRCUMSTANCES THAT CAN PUSH THE PLANT TO ITS LIMIT IN ORDER TO SURVIVE.

By CANNA Research

Environmental stress

Environmental stress or more specifically abiotic environmental stress includes all the non-living environmental factors that can negatively or even harmfully affect the growth and productivity of plants. A lot of scientific research has been done on drought stress, effects of flooding or submergence, salinity stress and extreme temperatures (both high and low). But for growers well known issues as high light intensities and deficits of inorganic nutrients (for example nitrogen, phosphorus, potassium) are included. The main reason for this would be their key roles in producing yield loss of agricultural or industrial crops worldwide.

Mechanical Stress

One of the stress types that occurs as soon as you enter your greenhouse or field is mechanical stress. Plants in general are very sensitive to mechanical stress. Experienced growers may know that if they walk through their fields or touch their plants too often, this can result in shorter plants. It can also lead to tissue injury, which is a potential entry point for diseases. Differences in air movement, vibrations or too frequent handling of plants can all cause mechanical stress. Shaking or flexing a plant for just a few minutes each day can reduce stem elongation and the weight of the plant, both fresh and dry.

This has also been studied in lab conditions, where young Arabidopsis thaliana (Rock cress) plants were subject to stem rubbing a couple of times daily. This resulted in shorter plants compared to the control group, which were not touched (*see figure 12*).
Mechanical stress cannot be prevented completely, but keep in mind when visiting your plants, either indoors or in the field, that they will be affected by your visit. So keep direct contact with your plants to a minimum.

Drought stress

On sunny, dry days, or when the light in a greenhouse is very intense, plants may wilt because the rate of water loss through transpiration exceeds the rate at which the root system is absorbing water from the soil. In other words, there is not enough moisture in the soil, which can greatly inhibit plant growth. However, plants have control systems that enable them to cope with less extreme water deficits.
Many of a plant's responses to a lack of water help it to conserve water by reducing the rate of transpiration. A lack of water in the leaves causes guard cells to become less turgid, a simple control mechanism that slows transpiration by closing the stomata. A lack of water also stimulates synthesis and the release of abscisic acid in the leaf; this hormone helps keep stomata closed by acting on the guard cell membranes. The leaves respond to a lack of water in several other ways. Leaves of many plant species, such as grass species, roll into a tube-like shape that reduces transpiration by reducing the area of the leaf surface that is exposed to dry air and wind. Although this leaf response conserves water, it also reduces photosynthesis, which is one of the reasons why drought diminishes crop yield.

Root growth also responds to a lack of water. The soil or any substrate a plant grows in typically starts to dry from the surface down. This inhibits the growth of shallow roots, partly because cells cannot maintain the turgidity required for elongation. Deeper roots, which are surrounded by moister substrate, are still able to grow. The root system proliferates in a way that maximises exposure to soil moisture, but this demands more of the plants' energy, which is eventually lost for potential yield.
The key to drought stress (or lack of water) is to protect the plant from drying out while maintaining photosynthesis. Closing the stomata results in decreased carbon dioxide

Figure 8: Cold and frost are major causes of crop damage in tender plants.

Photo courtesy of lovestruck under CC License 3.0

Figure 9: This bramble is suffering from nitrogen deficiency; an example of 'environmental stress' (non-living environmental factors that can negatively affect the growth and productivity of plants). This also includes deficits of inorganic nutrients.

STRESS PLANT

availability for the plant. And the chemical reactions of the photosynthesis system cannot be switched off on demand, unless the light source is switched off, of course. A shortage of carbon dioxide due to the closure of the stomata results in a build-up of free radicals in the chloroplasts. A complex cascade of chemical reactions, called signal transduction, is responsible for this. The plant responds to these free radicals by producing antioxidants to neutralise them. Without going into too much detail, some plant hormones and free amino acids are often involved and help to plant to build up some tolerance to the drought, which was the initial cause of stress to the plant.

A grower may experience that, as soon as the drought stress is over, wilted leaves seem to recover quickly. However, within a few days to a week the affected plants will show leaf senescence. This is actually a process in which the leaves age rapidly and become yellowish because the chlorophyll has broken down. This is partly a result of irreversible damage by the free radicals mentioned earlier.

Over-watering

Over-watering a plant can kill it more quickly than lack of water. In waterlogged soil there is not enough oxygen for the roots. This is because oxygen diffusion through water is about 10,000 times slower than through air. Without oxygen, anaerobic respiration occurs in the roots, producing toxic compounds in the plant. The symptoms of overwatering also include wilting, yellowing of leaves, root rot and stunted growth.

The central issue in over-watering is oxygen deprivation. This triggers many plant species to produce ethylene, which causes some cells in the root to undergo apoptosis - the process of controlled cell death. The destruction of these cells creates air tubes, which can fill with air from the sections of the plant that are above ground. In this way, roots can receive the necessary oxygen even when the soil is still too wet to contain enough air.

The mechanism described above may help in crops such as corn or rice, but most commercial greenhouse crops are not able to maintain the internal oxygen levels. The roots start to rot fast and even if the grower responds quickly to water-logged substrate, the yield loss can be devastating.

Salt stress

An excess of sodium chloride or other salts in the soil threatens plants for two reasons. First, by lowering the water potential of the substrate, salt can cause a water deficit in plants even though there is plenty of water in the soil. As the water potential of the substrate becomes more negative, the water potential gradient from substrate to roots is lowered, thereby reducing water uptake.

Another problem with saline substrates is that sodium and certain other ions such as chloride become toxic to plants when their concentrations are so high that they overwhelm the selective permeability of the root cell membranes. In other words, the plant is unable to selectively absorb the right nutrients, and only the sodium is taken up by the plant.

Many plant species can respond to moderate substrate salinity by producing solutes that are well tolerated at high concentrations. It has been demonstrated that strawberry is able to produce 'phenolic compounds'. These compounds are believed to restore or maintain the water potential of plant cells, as compared to the substrate, without admitting toxic quantities of salt. This is only a temporary aid, however, because production losses will occur. If the salt stress takes too long, the plant will eventually die.

Heat stress

Extreme heat can damage plants directly, but usually heat damage occurs through increased water loss and plant drought 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. This water then exits the plant through the stomata as water vapour - a process known as transpiration. Transpiration cools the leaves and other 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, allowing it to burn up.

Cold and frost damage

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 warmer 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. Some flowers that have been affected by frost may not produce fruit.

Chemical damage

Any kind of chemical applied at the wrong dosage or at the wrong time is capable of damaging the plant physically. 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 a 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.

Photo courtesy of Gerard Holmes

Figure 10: These squash plants are wilting due to drought. As soon as the drought stress is over, wilted leaves are able to recover quickly. However, affected plants will show signs of leaf senescence.

STRESS PLANT

Figure 11: Strawberry plants are able to produce compounds which are able to restore or maintain the water potential of plant cells without admitting toxic quantities of salt.

Figure 12: The golden daisy on the left is a healthy one, the one on the right is not. This is a typical example of a plant that is suffering from over-watering. If you did not know any better, you might well assume that this was a typical case of mechanical stress. Touching plants every day will also lead to shorter plants.

In this article we have tried to describe the most important plant parts and their role in some of the most obvious environmental stresses that plants may suffer from. However, the world is much more complex than this. As we have seen in this article roots, leaves (especially the stomata) and the photosynthesis used in apparatus play crucial roles in the specific response of a plant to a stress situation. These responses are often remarkably similar, such as the plant's response to drought stress or salt stress. Both situations result in a reduction in the plant's capacity for water uptake.

A lot of research is currently being carried out into exactly which processes underlie the plant's perception of stress factors and which chemicals in the plant are crucial in making the plant more tolerant to the various forms of environmental stress. •

FURTHER READINGS:

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Grower's TIP #30

By your friend SEZ

KNOWING ABOUT **PLANT PHYSIOLOGY** IS YOUR QUICKEST AND SAFEST ROUTE TO **EASY PLENTIFUL YIELDS!**

If your goal is to harvest plentiful yields every time, find out exactly what your crop needs, and provide it. On the other hand, if a few failed crops, lower than expected quality or other disappointment are not going to push you into bankruptcy, go ahead and learn by trial and error. Grow that cactus in stale water and see how that goes.

As you probably know, water moves up from the roots through the stems and then evaporates out through the leaves, carrying along nutrients and other things that the plant needs. Each type of plant has evolved in different versions and each has its own system for this to work. That's what we call 'physiology'. The roots will 'push' a certain amount of water upwards depending on a range of factors such as the temperature, salt levels, oxygen availability, and so on. The leaves, meanwhile, will release water depending on factors such as the atmospheric temperature, humidity, light levels, etc. All of that, of course, requires nutrients, but the quantities and ratios will differ and is up to each plant to decide, not the grower.

Today's lesson: more food does not make you more hungry.

Overtime, shoving more food into your mouth than you need will make you unfit and unhealthy. This applies to plants too: providing more fertiliser than plants can use will not increase yields; it will likely do the opposite.

While you cannot control a plant's appetite for fertiliser, when growing indoors, you do have a great deal of control over plant's thirst. If it is hot and dry, plants will drink more; cold and damp, less.
But drinking more water does not necessarily mean 'eating' more! A subtle difference that requires your full attention since you provide food and water together. Consider lowering the amount of fertilisers you add if you can't control the heat or low humidity; on the other hand, increase the dosage if you can't control the cold and high humidity. This is one of the reasons CANNA feed charts suggests amounts as a range (i.e. 20-30ml/10L) rather than a fixed amount because CANNA cannot know your current growing conditions.

Plants aren't so different from us: we eat pretty much the same amount of food year round, but we do drink more water in the summer than we do in winter, simple as that.
Give the plants what they need, monitor the EC in your reservoir in re-circulating gardens, or the solution that you put in and get out in run-to-waste scenarios. Carry out growing medium tests if you are doubtful about the results.

You have the power to control climate, so focus on making it as much like the plant you are growing prefers it to be. The same goes for your growing methods, remember oxygen loving plants will never give you their best if you try to grow them in a swamp - they'll be just like fish out of water.

Good luck and happy gardening! •

Oops...
Due to a mistake of the editorial team, the Grower's Tip in CANNAtalk 29 contained a mistake. The article that the author referred to is in fact entitled: *'The never ending abuse of phosphorus to enhance flowering'* and not: 'The unending abuse of phosphorus to enhance flowering'. Apologies on behalf of the editorial team!

Puzzle&WIN

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

WIN A 1 L BOTTLE OF CANNAZYM

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

PRIZES

So get your brains working out those numbers, and don't forget to let us know what your solution is (sending the middle part of the puzzle is enough for us to check) and maybe **YOU will be the lucky one who wins a 1 L bottle of CANNAZYM!**

Winner puzzle#28

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

WHAT'S NEXT

As a grower, the word ventilation can mean two things: replenishing the fresh air in your grow room, and moving the air around the grow room using fans. Both aspects are important for a healthy plant. The next edition of CANNAtalk is all about ventilation, the do's, the don'ts and the equipment basics. You will also read this and that about light control and different set-ups. All of this is followed by a practical Grower's Tip. Besides the popular research articles and Grower's Tip, this CANNAtalk also has all its regular features and articles like Grow it Yourself (carrots), Pests and Diseases (green lace wings), Don and Nicky and a lot more. This is another issue that you simply can't miss!

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.

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- ☐ 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:

#30

SERIOUS GROWERS

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