CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

ISSUE 19 2012

SOIL LIFE

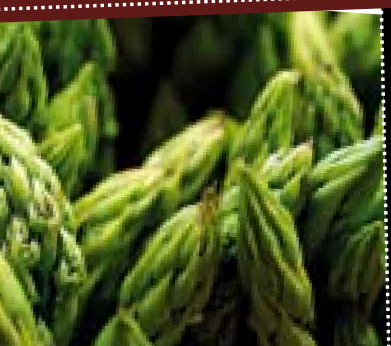
Rhizobacterias

BASE JUMPING

Adrenaline Sport

ASPARAGUS

The aphrodisiac



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HQTalk:

Another year is over! It feels like the years go faster and faster... So many things have been done this year, but there's still so much to do. Over the past year we've brought you four issues of CANNAtalk in the new style, which we are all very proud of and hopefully we will bring you many, many more...

This issue is all about micro-organisms – you know the little creatures which you cannot see with the naked eye. Your substrate is full off micro-organism, some of which are very beneficial for your substrate and your plant. Everything about these little creatures is explained in two research articles from CANNA Research. As you have come to expect, there is also a grow-it-yourself about asparagus, the crop which you can grow in light and in complete darkness. In the Pests and Diseases feature, we explain all about plant viruses, the symptoms to watch for and how viruses can be transferred. And last but not least we meet a base-jumper who we followed for a day in the Netherlands.

Of course we're always interested in your opinion of the magazine. Do you have any questions or comments? Or maybe a suggestion? Well please do not hesitate to contact us using the answering card at the back of the magazine, or by e-mailing us at info@cannatalk.com.

And remember the more you read the more you know!

Karin

Contents

MICRO ORGANISMS

IN THE GROWING MEDIUM

MICRO-ORGANISMS ARE PRESENT EVERYWHERE; IN THE AIR, IN WATER, ON PLANTS AND IN THE SOIL. THEY CAN REMAIN DORMANT FOR LONG PERIODS IN MANY DIFFERENT WAYS, AS SPORES, MITOCHONDRION (A MEMBRANE-ENCLOSED ORGANELLE FOUND IN THE CELLS OF MOST ORGANISMS) OR HYPHAE, AND THEY CAN LIVE UP TO SEVERAL YEARS AND ON A WIDE RANGE OF HOSTS. ALTHOUGH MOST PEOPLE THINK OF MICRO-ORGANISMS AS BEING HARMFUL BY DEFINITION, LIFE AS WE KNOW IT WOULD NOT BE POSSIBLE WITHOUT THESE MINUSCULE LIFE FORMS. IN THIS ARTICLE WE WILL LOOK AT HOW THEY AFFECT THE GROWTH OF PLANTS THROUGH THEIR PRESENCE IN THE GROWING MEDIUM .

By Tanja Roovers, CANNA Research

Micro-organisms include a very broad range of species, and include bacteria, protozoa, algae and fungi. Most of these micro-organisms can multiply rapidly when the circumstances are right and they can have a major influence, both positive and negative, on the development of plants growing in the substrate. The kinds of micro-organism that appear in a given substrate will depend on a number of factors, such as the climate, the properties of the substrate, the plant species and the other organisms present in the substrate.

Peat, coco coir, rock wool or perlite

One of the most important factors that influence micro-organisms is the type of growing medium available to them. The main differences can be found between organic substrates, such as coco coir, peat or soil, and inorganic substrates such as clay pebbles, perlite or rock wool. Micro-organisms that have a high saprophytic capacity (i.e. they live off dead organic matter) will do better in a substrate containing organic material such as peat or re-used substrate. But dead leaves lying on the surface of the substrate or infected plants with necrotic parts will do just as well.

The amount of oxygen in the substrate determines if aerobic or anaerobic micro-organisms will develop. Most plants need oxygen around their roots, so normally aerobic organisms will be present. Plants grown in a substrate with very little oxygen will usually be weaker and pathogenic anaerobic micro-organisms can benefit from that.

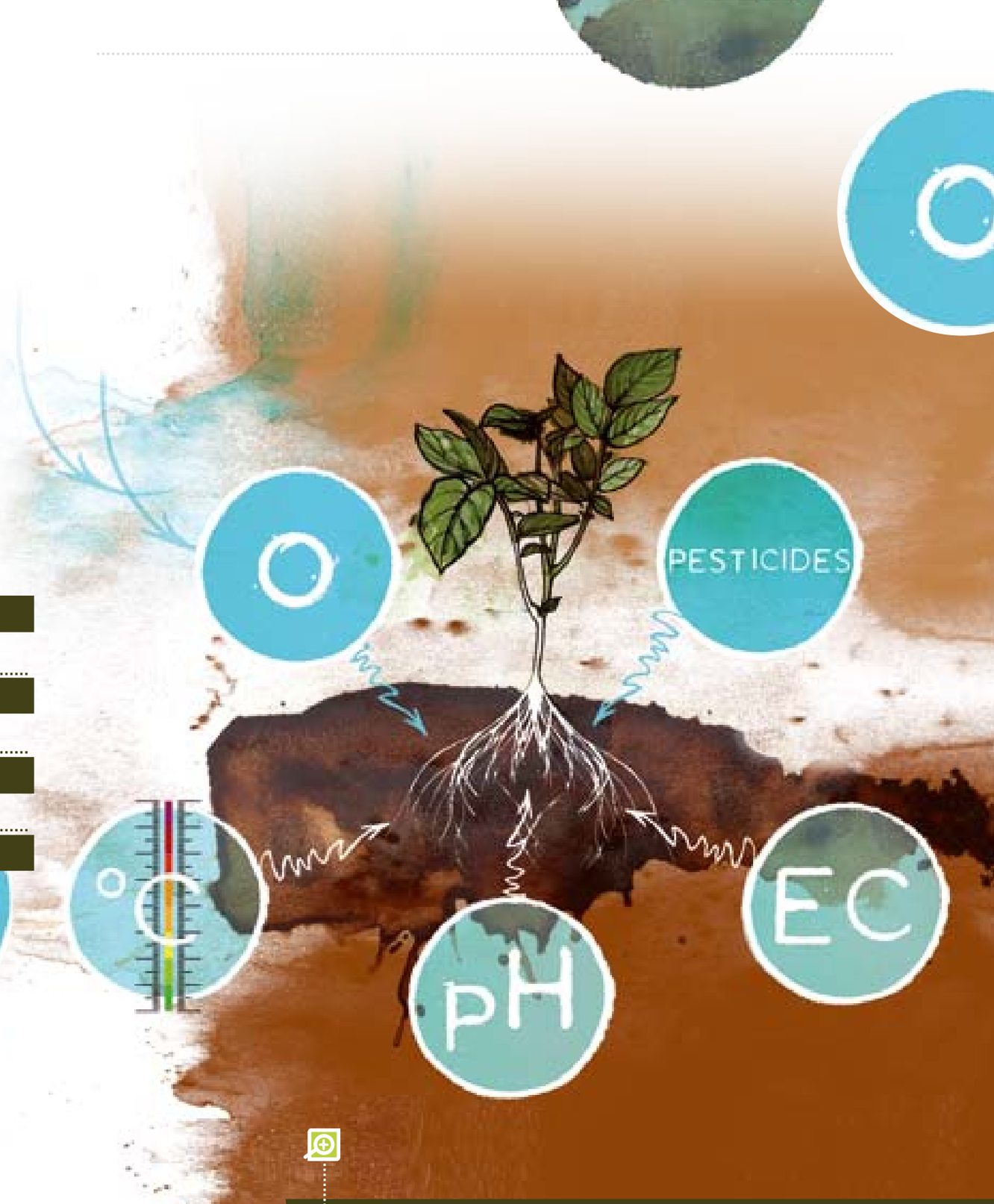


Figure 1: Micro-organisms can significantly affect the development of plants growing in the medium, both positively and negatively. Many factors are important for micro-organisms, such as the type of growing medium. Others include the amount of oxygen, the temperature of the substrate and roots, the pH level and the salinity or EC level in the growing medium. Another aspect that has quite an impact on the micro-life in the growth medium is the presence of pesticides.

All organisms have an optimum growing temperature, so the temperature of the substrate and roots will affect the micro-flora around them. The average temperature and the temperature range (cold nights or a hot summer day) will determine which micro-organisms can survive , as well as the range and frequency of temperature fluctuations.
Just like plants, most micro-organisms prefer an acidity level of between pH 5.5 and 5.8. High and low pH levels, as well as pH fluctuations can disturb the development of micro-flora. Still, some micro-organisms are able to grow or even flourish in extreme conditions.
The salinity or EC level in the substrate will also affect the growth of the micro-organisms, and the type and composition of the salts in the growing medium also has an impact. This is especially true of salts such as Potassium chloride or Sodium chloride that can change the rhizosphere of plants and thereby the kinds of micro-life which will populate the root zone.

In inorganic substrates such as rock wool, clay pebbles or perlite, most micro-life is waterborne. These micro-organisms are introduced via watering systems, air or plants and will survive as long as the moisture level is sufficiently high, even if there are only small pockets of moisture. As with soil-borne micro-organisms, these can also be either beneficial or pathogenic.
Another aspect that has quite an impact on the micro-life in the growth medium is the presence of pesticides. These can build up in substrates or soils that are used for a prolonged period of time. Depending on the kind of pesticides – either herbicides, insecticides, fungicides or bactericides – these will influence the composition of microscopic life in the substrate.

Figure 2: Fungus growth on tomato in rock wool cubes.

One thing that one can rely on is the fact that micro-organisms can adapt to a range of circumstances. A well-known example is the resistance of some bacteria against antibiotics; it only takes a fractional change in their genetic material, but the effect on the resistance can be all-important.

The benefits of micro-organisms

The presence of micro-organisms can have both a positive and negative impact. As such, it is not necessary or desirable to get rid of all micro-organisms. The ability of a crop to defend itself against infections depends largely (albeit not exclusively) on the presence of micro-life in the substrate. It is difficult to quantify this benefit, however, since there are numerous factors on which the micro-life depends. The defence relates to the total microbial activity, the diversity of different groups of functional actinomycetes (rod-shaped bacteria), the total population of actinomycetes and the percentage of cellulose-decomposing actinomycetes.
If there is a good balance of micro-life in the substrate, there will most likely be less need to use pesticides and other measures such as steaming to sterilize the substrate, which will reduce costs. Not only are fewer and fewer pesticides actually permitted in horticulture and other applications, they are also very expensive. Plus, in a sterile substrate the most opportunistic micro-organisms will find a free space with no competitors and unlimited access to space and nutrients. These first opportunistic colonists will not necessarily be beneficial to the crop planted in the substrate. It is wiser to use the correct micro-life from the beginning to produce a healthy crop and good yield. Micro-organisms can even be used to improve the quality of reused substrates, where certain bacteria actually produce enzymes that can decompose accumulated salts.

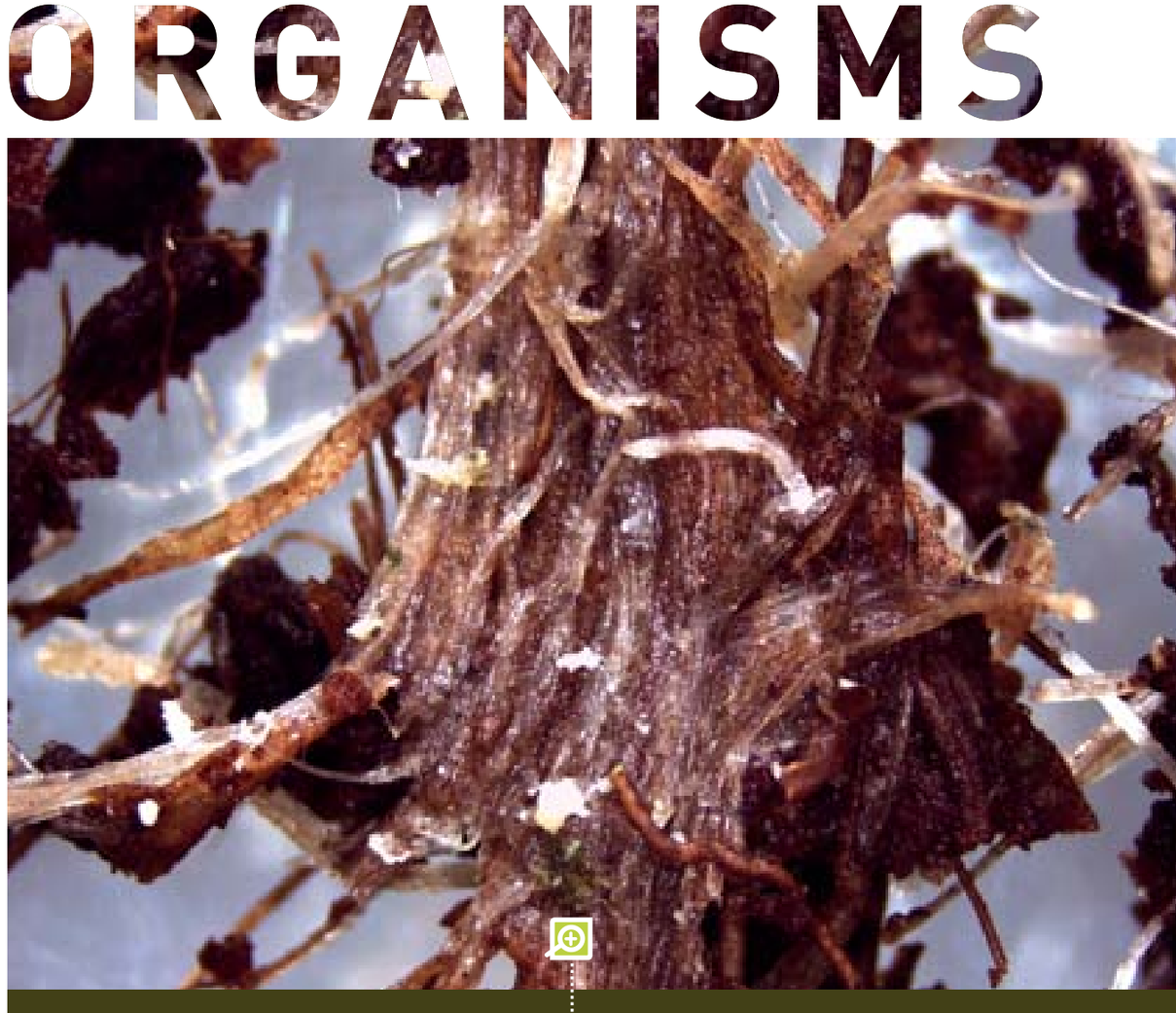


Figure 3: Pythium infection on tomato roots in coco coir.

Substances that are exuded from the root system like sugars, amino acids or phenols can either attract or repel micro-organisms. The position of each species in the competition game that is continually going on between the bacteria can be influenced by these root exudates. Plants can use this to its advantage by exuding substances that attract beneficial organisms, establishing a symbiosis with a particular micro-organism. A prime example is the presence of symbiotic bacteria in the root nodules of leguminous plants such as peas or beans, which convert atmospheric nitrogen into a form that can be absorbed and used by the plant.

Another tactic is to introduce certain benign organisms to suppress pathogens.This works as follows. Some micro-organisms are not very competitive and have a hard time colonizing a substrate that is already occupied by other micro-organisms. This can serve as a mechanism to get rid of pathogenic micro-organisms. By introducing beneficial micro-organisms such as mycorrhiza or trichoderma fungi into a clean substrate, the growing medium will become less inviting for pathogenic micro-organisms, thus protecting the plant from becoming infected.

Beneficial microbes compete with pathogens for nutrients or glucose and some antagonists have their own method of winning a competitive edge. For example, the fluorescent Pseudomonas bacteria can produce proteins that transform slightly soluble iron (Fe) into iron chelate, which it can then absorb much more easily. This then deprives the Fusarium fungi of the iron it needs to grow, preventing it from developing. Competition for glucose can also cause microbiostasis which means that the spores of that pathogenic fungus germinate much more slowly due to a lack of energy from glucose.

Antagonistic micro-organisms can also block one or more stages of the propagation cycle of pathogens. Pseudomonas species P. Stutzeri, for example, interrupts the formation of conidia (asexual spores of several kinds of fungi) and the formation and germination of chlamydospores (thick-walled dormant spore of several kinds of fungi), but has no effect on mycelial growth (mycelial cords are capable of transferring nutrients over long distances). Pseudomonas can also produce antibiotics, which can be another tactic to remove pathogens, while other micro-organisms produce enzymes that attack the cell walls of competing species. Antagonists that produce chitinolytic enzymes have the potential to act against pathogenic fungi. It has also been found that several antagonistic organisms or closely related species can co-operate to fight a pathogen. Other antagonists simply overwhelm a pathogenic micro-organism by multiplying more rapidly and thus depriving all the competition of resources and therefore any chance of survival.

Figure 4: **Algea development in rock wool cubes.**

Pathogenic or harmful micro-organisms

Micro-life in the substrate also comes in the form of soil- or water-borne pathogens. Some of these pathogens can attack over 80 different plant species and their resilience means they can be very important. There are many different harmful micro-organisms which result in a range of infections and symptoms (rotting fruits, fading, and necrosis to name but three).

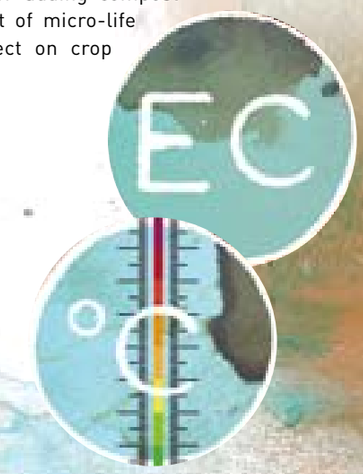
Some pathogens produce micro-toxins which can attack the plant or the micro-life in the substrate. Pathogens can gain an advantage over other micro-organisms when they are able to germinate faster and are able to remain dormant for a longer period when conditions are not optimal. Pathogenic and non-pathogenic species can be very closely related, which makes it hard to use antagonists or other measures. Pathogens can fight back when they are attacked by antagonists. An example is Fusarium, which can produce fusarium acid that affects the plant cells but can also suppress the production of antibiotics of Pseudomonas (this was discovered through research at Wageningen University in the Netherlands).

Balance your micro-organisms

Most infections by pathogens are in fact the result of a plant that was weak to begin with. Healthy plants are resilient and will be able to respond to an infection by micro-organisms. Provided the plant's responses are quick and strong enough, it will be able to overcome such an infection. As such, ensuring an optimal climate and soil conditions for the crop is even more important than optimal growing conditions for (beneficial) micro-organisms.

It is crucial to get a good balance of micro-organisms in the substrate over a prolonged period of time, yet sometimes the growth cycle of a plant is simply too short to achieve this balance. Inoculating the substrate with antagonists is possible and, although the results are not always consistent, in some cases this can have a very positive effect on plant growth and health. In some cases, the results are comparable to the effect of using chemicals like fungicides, although these results may not last throughout the entire growing season.

Micro-organisms in the substrate can be a great help in suppressing plant diseases and a great deal of research is being conducted in this area of horticulture. Although this technology has still not entered the mainstream, research by the Louis Bolk Institute in the Netherlands has shown that introducing beneficial micro-organisms and or adding compost to increase the amount of micro-life can have a major effect on crop performance. •



Questions & Answers

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

Question

I had put my garden on hold for about two years now and recently started growing again. I noticed the expiration date on your CANNA Coco A&B, CANNAZYM, and RHIZOTONIC, and was wondering if it is still safe to use them a year past their expiration dates. I ask this only because I have purchased the 5 litre can, and have only used about a quarter of it. It would be a shame if I had wasted my money.

Answer

Well, some of the organic components, the CANNA RHIZOTONIC and CANNAZYM, will be ineffective. The mineral nutrients like CANNA COCO and CANNA PK 13/14 may still be good. It depends on how they were stored, if they were opened, and if you see any precipitates or cloudiness, in which case it may be not worth using either. Some of the elements would have combined and fallen out of solution so the plant might see several nutrient deficiencies. The problem with physics is that there is no stopping it. Will it harm the plants? No, except that it will not be balanced or have all the elements in the right ratio, nothing harmful will form that might hurt the plants.

Question

What would you recommend for spider mites? I've been using different organic stuff from hydro stores but nothing seems to work during flowering. And the taste is a very important item for me! I am planning to use CANNAZYM and CANNABOOST during the rinse phase.

Answer

The mite problem is one that has plagued us for decades. You have to start treating at the beginning in order for it to always be effective. Staying with safe products is the best thing to do. Bring in predators at the start of the crop. Then keep your environment a little on the side that does not favour the pest. After that it is a matter of sanitation: stay away from other plants and gardens, wash your hands and arms, use coveralls that stay in the room, filter all air input. Make sure your plants are not touching, and sterilize the room after each crop. In your case, since it is late in the game, you have a hard chemical choice to make. We would begin a regular soaping programme, change the environmental conditions inside for the pest, separate the plants, and keep the boost going by way of the roots (it will help). There are less toxic alternatives to sprays and these can be found in garden centres. Just make sure that they can be used on crops for consumption if that is what you are dealing with, and check the waiting period. Then, at the end of the crop, replace your containers, use chlorox and water to sanitize all surfaces in the room including floors and walls after you have removed every last piece of debris from the room. Unfortunately, that's about all the advice we can give you. Start your controls before the crop otherwise you will always be fighting an uphill battle with these creatures.

Question

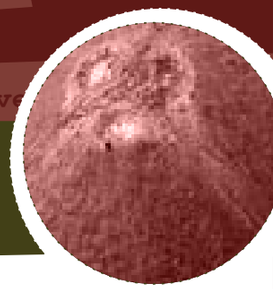
I have a problem with purple on my leaf stems, even down the vein in the middle of the leaf, my ppm coming out is only a little higher than it is going in, but I checked the pH and it is high on the run off. What should it be at for 50/50 peat perlite mix?? I am going in around 6 but it might have been a little higher like 6.2 or 6.3 even.

Answer

We see a few problems; 1) Purple stems. This happens when the plant gets too cold. Maybe the inlet is too cold and the cold air is cooling the plants. But it can also happen when the fans are left running at night. Then the leaves get cold. We think in your case it is the air conditioning system. Try to mix the cold air before it reaches the plants. 2) pH. When it gets colder something changes in the uptake of phosphorus so the pH will climb in the root zone. Because of this the plants get their purple or red colour. But this can also happen when you feed at the wrong (high) pH, or when you give a substitute this can increase the pH in the substrate/ rootzone. Feed at a pH of 5.8 if you measure a pH in the substrate. Curled leaves is another problem. This has to do with the climate. A long story. We think in your vegetative period the humidity at night was too high (caused by the airco) so the leaves were soft. The EC was probably too low. With your light distance, now the plants are too weak and are beginning to curl and most of the time they will burn (tips and border) after a few days. Solution: Increase the light distance. Lower (or maintain) the EC and try to save the plant as much as possible until the last 2 weeks. Reading your story we had the constant feeling, that you may have the problem of toxicity in the air caused by bad plastic (floor foil) or pots, glue or something else. Do you smell a strange plastic smell in the air? So when you see the same problem again in the next crop keep us informed. Good Luck!

Question

Do you recommend rinsing your coco before potting? Or is it ready to use directly from the bag?



Answer

No, do not rinse CANNA COCO, you will wash away the buffer and this will cause problems. Pot directly into COCO right out of the bag, the EC is below 1.

Question

I am currently switching to a CANNA COCO run, and need information on how to set up my watering system... What would you suggest? What works best? How do you run your COCO line? And how often would I have to check my reservoir and things of this nature? Will the nutrient rich water last?

Answer

Well, the first place to start is the CANNA COCO Infopaper available in our stores and also online from the website. Most of these questions are answered there. COCO is best in a Run-To-Waste system with a minimum of 20% drain. Watering from the top and spray stakes work better in this case than drippers. Always run the nutrients in any water applied to the medium at a minimum EC of 0.6. Never run straight water on the coco until the very end of the normal flush period right before harvest. It is best if you avoid soft water including RO water which is very soft. Mix bad tap water to a minimum EC of 0.2 before mixing the nutrients. Water when the plants need it. Use a scale for accurate results, at least until the root mass is well developed. Water when 50% of the water is held by the container after a thorough watering. This may be as much as every 3 days at the start and dropping to every day or better towards mid-crop. Again, DO NOT PUT PLAIN WATER ON THE COCO MEDIUM. We stress this because the balance in the medium will go crazy, you will begin to see issues and it will take about 8 days or more to re-stabilize. That is about it. Remember you can not get accurate results in pH and EC tests on the run-off or drain water. You need to follow the procedure described in the CANNA COCO Infopaper for correct results.

Question

I'm using CANNA Terra Vega for my outdoor plants. My local store is out of stock and they suggested to use CANNA Aqua Vega. Should I or should I wait till they get it in stock?

Answer

We advise staying with the CANNA TERRA line. The source of the nutrients are different enough to be a different ratio in the soil than what you need. If you can get by till they have more in stock, then do that. If you have to have a substitute for short time, we would use the CANNA HYDRO line, hard or soft. That's a better option, but switch back to CANNA TERRA as soon as you can.

GrowIT YOURSELF

THE APHRODISIACAL ASPARAGUS

IT IS SAID THAT THE ASPARAGUS IS A STRONG APHRODISIAC. MAYBE ITS PHALLIC SHAPE HAS SOMETHING TO DO WITH THAT. BUT IN ITS WHITE FORM (WHEN THE ASPARAGUS IS GROWN WITHOUT SUNLIGHT) ASPARAGUS IS ACTUALLY KNOWN AS 'WHITE GOLD' OR 'EDIBLE IVORY'. WELL, WHEN A VEGETABLE COMBINES SEX WITH MONEY WE ARE INTRIGUED, AND SO SHOULD YOU BE; ESPECIALLY WHEN IT MAKES YOUR PEE SMELL SO WEIRD. By Marco Barneveld, www.braindrain.nu

In 1652, Culpepper's Complete Herbal included an entry stating that 'a concoction of asparagus roots boiled in wine and being taken while fasting, several mornings together, stirreth up bodily lust in man or woman, whatever some have written to the contrary.'
And there is scientific proof! The phallic shape of the stalks might put you in the mood for some fun in the bedroom, but they also act as a diuretic that increases the amount of urine excreted and excites the urinary passages.
Asparagus also contains substantial amounts of aspartic acid, an amino acid that neutralizes excess amounts of ammonia which linger in our bodies and can make us tired and sexually disinterested. "Experiments with potassium and magnesium salts of aspartic acid have overcome cases of chronic exhaustion and increased sexual responsiveness," one scientist observes.

Kama Sutra

Probably no other food figures in such explicitly sexual and/or obscene love poetry as asparagus does - from the poems of the early Greeks to those of the Roman Catullus. Similar sentiments are expressed in the literature of China and that of India, whose Kama Sutra advises, "Drinking a paste composed of the asparagus is provocative of sexual vigour."

Stinky pee

But as soon as you mention asparagus, there comes a moment when the conversation moves towards the toilet. Asparagus makes your pee smell weird. How come?
In 1891 a scientist named Nencki had so very little to do that he convinced four guys to eat seven kilograms of asparagus (that's about three and a half pounds each). He collected their urine, worked some medieval magic on it, and concluded that the smell was due to a metabolite called methanethiol. So there you go. Nencki claimed that as your body metabolizes asparagus, it produces this smelly chemical, which your discriminating kidneys see fit to dump into the bladder.

Medicinal powerhouse

But that's not all folks! Not only does asparagus put you in the mood for sex and make your pee smell strange, it also has medicinal powers. Like a spear used as a weapon, asparagus's javelin-shaped form could be viewed as symbolic for its ability to fight ageing and disease. Asparagus is packed with health benefits.
It's loaded with nutrients: fibre, vitamins A, C, E and K, as well as chromium, a trace mineral that enhances the ability of insulin to transport glucose from the bloodstream into cells. It's also a particularly rich source of glutathione, a detoxifying compound that helps break down carcinogens and other harmful compounds like free radicals. This is why eating asparagus may help protect against and fight certain forms of cancer, such as bone, breast, colon, larynx and lung cancers. Plus, asparagus may help slow the aging process and reduce high blood pressure or other heart-related diseases.

White asparagus

And what about this white variety that they love so much in Europe? Well actually it's not a variety! White asparagus is the same as good old green asparagus but it has been blanched. Blanched? Yes, that is covered with

8 inch of mulch to keep sunlight and green chlorophyll-producing photosynthesis away from the ripening spears. The spears are harvested just before their tips break through the surface of the mulch. Try it!

Patience is a Virtue

Remember, asparagus is a perennial plant, so you'll have delicious rewards every year around the end of April or the beginning of May. But if you really want to reap the benefits of having your own asparagus garden, you'll have to wait three years. Then you will see some truly great results. The asparagus spears should not be cut in the first season after planting and only a light crop should be taken in the second year. After that, harvest the asparagus as required from April to mid-June.
For the rest of the summer, the remaining spears should be left to grow into stems and ferny foliage, as this will ensure the plants build-up food reserves for the following year's crop.

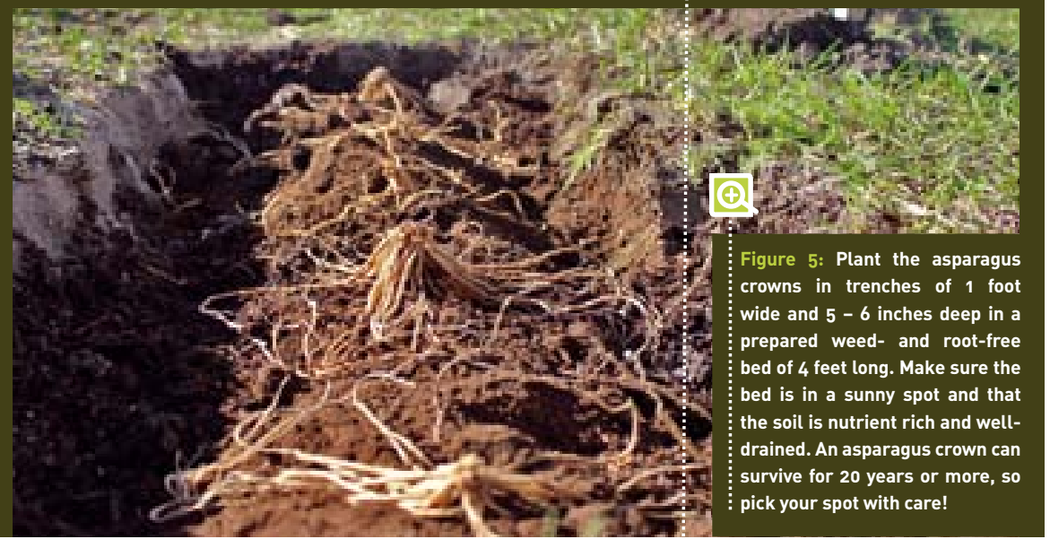


Figure 5: Plant the asparagus crowns in trenches of 1 foot wide and 5 – 6 inches deep in a prepared weed- and root-free bed of 4 feet long. Make sure the bed is in a sunny spot and that the soil is nutrient rich and well-drained. An asparagus crown can survive for 20 years or more, so pick your spot with care!

The young asparagus spears should be harvested when they are 4 – 6 inches in length, by severing the spears 2 inches below the soil surface. The ideal way to do this is with an asparagus knife or a serrated-edged kitchen knife. Asparagus tastes best when eaten fresh but it will usually last three to four days in a fridge.

Tips & Tricks

Leave the beautiful ferny foliage that accompanies asparagus in the ground all year round.
Sunlight is important to all plant life, so growing asparagus plants a little distance from the rest of your garden veggies is a must. Do you have a cold garden with heavy soil? Try the Guelph Millennium variety. It can be planted in autumn or spring. Wood ashes help to repel slugs and also mulching with oak leaves.

Grow it yourself

Asparagus will thrive in any area where the ground freezes in the winter or dry season. The mild, wet regions of Florida and the Gulf Coast are about the only places where it's difficult to grow in the USA.
Growing asparagus from seed is next to impossible. Because it's a member of the lily family, only horticultural professionals can really manage to grow it from seed. Instead, purchase a crown that is at least one year old.
Select and prepare your asparagus bed with care, because this crop will occupy the same spot for 20 years or more. It can tolerate some shade, but full sun produces more vigorous plants and helps minimize disease. Asparagus does best in lighter soils that warm up quickly in spring and drain well; standing water will rot the roots quickly. Prepare a planting bed about 4 feet wide by removing all perennial weeds and roots.
Asparagus crowns are usually planted in late March or April. However, it is possible to plant certain varieties in late autumn, as long as the ground and weather conditions are suitable.
During the growing season, keep the site free of weeds. Weed by hand rather than using a hoe to avoid damaging the emerging plants and water well in dry weather. In autumn, the stems should be cut down. Do this to 2 inches above ground level when the foliage turns yellow-brown.
To plant asparagus crowns, dig trenches 1 foot wide and 5.5 inch deep down the centre of the prepared bed. A few weeks before planting, dig the ground over thoroughly to remove any weeds and large stones and then incorporate plenty of well-rotted garden compost.
Soak the crowns in compost tea for 20 minutes before planting and then fill the trench with soil to just above the level of the crowns. New shoots will soon grow and, as they do, the trench should be gradually (and carefully) filled with fine soil - always leave around 3 inch of the shoots visible. If you have more than one trench, they should be spaced 3 feet apart. Twenty-five plants should do for a household of four.
A thick mulch of garden compost should then be spread around the stumps. In the early spring, give the plants a feed with a general fertilizer.

Succulent sautéed ASPARAGUS

You need three tablespoons of butter, one bunch of fresh green and / or white asparagus, three chopped cloves of garlic and some sea salt. Melt the butter in a large skillet over high heat. Add the garlic and asparagus spears. Throw the sea salt over it. Stir-fry until asparagus is tender and the tips are crispy. Yummm!

Hunter B, Sacramento, California, USA

I've been growing for about 7 years now, and figure I am pretty proficient at it. I have grown using many systems, most of those on the market in fact. I have grown hydro but I found it too demanding, too sensitive, and limited for my tastes. And anyway I never got those giant yields that were supposed to materialize. Over the years I've come to prefer a decent peat potting mix of my own design. I believe in a firm foundation on which to build a crop. I monitor the pH of the medium closely and add several organic products to the soil. I also include selected microbes that work with my medium as well as adding mycorrhizal fungi. I reuse some of my mix each time and am careful to re-adjust the lime for pH control.

Now, my nutrients were also my own design. Yes I admit it, I used most of the CANNA line but included many other products too – either because I was told they were good, or I just felt good about them. I grow fast plants that get really big, really quickly, and they like to be fed; I am usually around 1.4 ml/L (EC=2.0). I push them hard and that's why I spend so much on the mix – better results right? Wrong. There was always some variability in the results and problems during growing, and I was always borderline salt burn unless I flushed every week. I contacted a friend at a university who took several samples of soil from an active crop about 3 weeks into flowering, and gave it the once over. What he found shocked me. I had variable ammonium levels that were way above acceptable limits, almost no microbes present (and those that were present, were highly specific and very common ones). There was no clear presence of mycorrhizal fungi, and I was holding the medium too wet causing a collapse in the soil structure. So I contacted CANNA to complain that their nutrients were toxic.

Thanks to some helpful and patient explanation by CANNA staff, I now understand what was happening. They suggested I start a crop with just the CANNA line in the tank, following exactly the feed chart and weighing my containers before watering. Then I started adding back products till I found the issue. Turns out, the organic food I'd been adding is broken down by the microbes that should be there. But when I ran the total dissolved solids (TDS) up so high, I was actually killing the microbes, and the incomplete conversion of the organic food was causing the toxic levels of ammonium because the converters were disappearing. Then I also discovered that I was running the concentration of phosphate up with all the added products, which, in itself, was responsible for killing a lot of the microbes, especially the mycorrhizal fungi. All these years I'd been adding so much food, and spending so much on nutrients, and all because I believed the hype. But I didn't do my homework and forgot that it is about system balance and not magical elixirs.

So thanks to the CANNA team, I'm back on the straight and narrow with consistent quality, beautiful yields, and much fewer headaches. A small change in the medium, a big drop in the my food bills, and I am a happy camper again! I now actually feed the lower end of the feed chart, I add nothing else, and the plants could not be happier. Can't wait to try the Terra Professional Plus medium which I hope will make things even cheaper and easier for me!

Keep It Coming CANNA,
and Don't Change a Thing!.

OIL GLANDS DID YOU **KNOW THAT....?**

- The photo shows a coloured electronic scan (SEM) of the surface of a lavender leaf. The stalk-like structures are trichomes and can serve as papillae, hair and scales. The spheres you can see are actually oil glands (spheres).
- Oil glands can be used to attract, but also to repel. Attracting often occurs for the purpose of fertilising flowers. Repelling animals serves the purpose of protecting the leaves against illness or damage, for example.
- There are various oil-producing structures within plants. In some of these, production and storage happens inside the oil-producing cells. In others, such as the eucalyptus tree or in the peel of an orange, there are a large number of oil-producing cells around a small cavity where the oil is stored. That's why such a strong smell is released when you peel an orange.
- In lavender, this is different again. The oil glands (see photo) are not within the leaf but are actually on the surface. When you touch a lavender leaf, you actually rupture the spherical oil glands, releasing a very distinctive smell which ends up on your fingers.
- As you can see on the photo, the spherical glands on the upper side of the leaf are attached to the upper skin cells.

Unlike other conditions, if your plant is affected by a virus, this cannot be seen with the naked eye. Not all plant species are susceptible to infection by the same viruses but some viruses can infect several different species. By Iñaki Garcia, CANNA Research

PLANT VIRUSES

SYMPTOMS AND TRANSMISSION

Whether or not a plant infected by a virus (or viruses) shows symptoms will depend on a number of factors. These include the species and variety of the infected plant, the type and strain of the infecting virus, the time of infection and the ambient conditions.

In general, the symptoms of infection include lower yield, slower growth, chlorotic leaves and necrosis. When a virus first penetrates the plant, there will be a series of local symptoms, generally caused by the death of the cells surrounding the damaged area through which the virus has entered. Only later, systemic symptoms will appear in other parts of the plant. Each virus also causes characteristic lesions or symptoms in each different plant species and it is from these that the popular name of the virus is often derived. For example, the characteristic sign of tobacco mosaic virus (TMV) is that the leaves of infected plants develop mosaic-shaped marks. Other symptoms include downward curling leaves (epinasty), variegated leaves, leaves with very fine leaflets, rolling and necrosis.

Figure 6: TABACCO RINGSPOT VIRUS (TRSV) On this leaf the chlorotic ringspots are visible, one of the first symptoms of an infection. With time they will become necrotic.

Photo Courtesy to University of Nebraska

Viruses always penetrate through damage caused in the plant tissues either mechanically (e.g. through friction) or through the action of parasitic vectors (insects and fungi). A virus does not necessarily have to spread to all parts of the plant; it may be limited to the lower parts, or the leaves, for example. It is also important to bear in mind that some viruses can spread to the seeds. The only tissues that are not infected are the meristematic areas (the cells in constant division). As a result, an infected plant can be treated using in vitro cultivation of these virus-free meristematic tissues.

When a virus enters a plant, it comes away from its protective layer and begins to produce viral proteins which begin to replicate themselves together with other proteins produced by the host. It also produces movement proteins, which help it spread systemically to other parts of the plant.

Transmission of plant viruses

The most common form of transmission is through vectors such as insects (especially aphids and whitefly), fungi and nematodes. It is therefore vital to prevent these pests from attacking the plant, because once they have spread the virus to your crop there is no possible solution. However, there are other important modes of transmission which you should watch out for.

Viruses can also be spread by vegetative reproduction. For example, any cuttings you take from an infected plant will also contain the virus. The same thing happens if you graft an infected plant or in the case of plants such as the potato, if you plant infected tubers.

Some parasitic plants such as the cuscuta (or dodder) can also transmit viruses through the damaged parts of the host plant.

Only a few viruses are capable of infecting seeds. However this is where you should establish your first line of defence; a plant grown from an infected seed will become the first inoculate and may well end up infecting the rest of the crop. Sometimes, the virus may not be carried in the embryo of the seed but on the exterior; for example, there may be remains of the original plant stuck to the surface of the seed pod. When the seed germinates, the root comes into contact with these infected remains, resulting in (mechanical) infection through friction. There are a number of treatments which can be used on species whose seed pods are at risk of containing viruses. These include heat therapy (80ºC for 24 hours in dry heat) and chemical treatments (e.g. applying a solution of 2-4% hydrochloric acid onto the seeds). The treatment used will depend on the plant species, since not all seeds support the same treatment. Examples of seed-transmitted viruses include the alfalfa mosaic virus (AMV) and the tobacco ringspot virus (TRSV). •

Figure 7

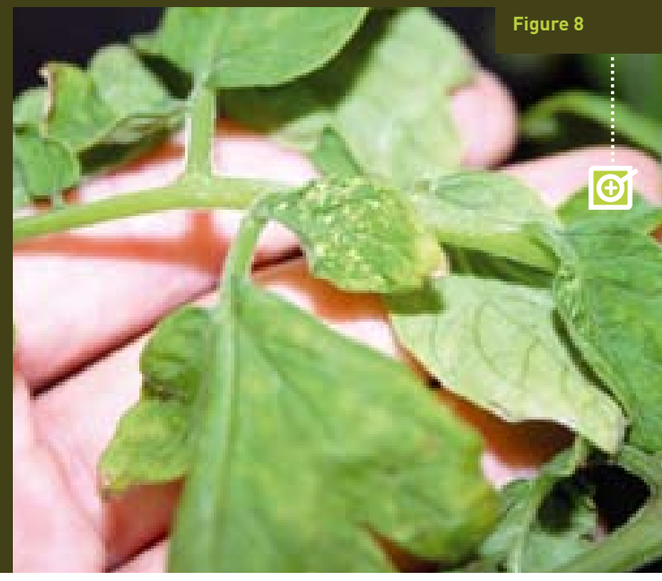


Figure 8

TABACCO MOSAIC VIRUS (TMV) INFECTION. The systemic symptom of this virus disease is light green coloration between the veins of young leaves. This is quickly followed by the development of a "mosaic" or mottled pattern of light and dark green areas on the leaves. These symptoms develop quickly and are more pronounced on younger leaves. (Figure 7: above). Mosaic does not result in plant death , but if infection occurs early in the season, plants will be stunted. (Figure 8: right). Lower leaves are subject to "mosaic burn," especially during periods of hot and dry weather. In these cases, large dead areas develop in the leaves. This constitutes one of the most destructive phases of tobacco mosaic virus infection. Infected leaves may be crinkled, puckered, or elongated.

Obove image: Photo Courtesy to E.lookabaugh
Right Image: Photo Courtesy to University of Illinois Plant Clinic

Sunday morning, eight o'clock. I am on a rusty ladder running up the side of an 80-metre electricity pylon. 80 metres is the equivalent of a small skyscraper. I'm currently at thirty metres. There's no safety equipment. My hands are sweating. Out of the corner of my eye, I can see a yellow sign - 'Danger 10,000 volts'. I dislodge a small piece of grit with my foot. It seems to take forever before it hits the ground below. My fellow climber Ronald Overdijk (41) from Holland is right above me. By Marco Barneveld, www.braindrain.nu

BASE
HOW LOW CAN YOU GO?

We are not just here for the view. Ronald is about to go BASE Jumping. BASE stands for Building, Antenna, Span and Earth. BASE jumpers don't jump from planes but from earth-bound structures like bridges, high cliffs, church towers and so on. Sometimes the distance between the edge from which they jump and the hard ground below is no more than 60 metres. The adrenaline rush is the kick they are seeking.

In the Netherlands the number of BASE Jumpers can be counted on two hands. Worldwide there are only about a thousand jumpers. Being a class A parachute jumper is key. "You might start thinking about doing BASE after about 200 normal parachute jumps," explains Ronald.
Ronald started parachute jumping at 18. "I jumped out of a plane about 4800 times. I've done BASE jumping about 350 times." The list of structures that Ronald has 'conquered' is impressive. The Eiffel Tower, Table Mountain in Cape Town and Euromast and the Dom tower in Utrecht. And I don't think we mentioned it yet, but BASE jumping is usually illegal.

It's all about timing

Ronald and I are driving down a quiet road, somewhere in the Netherlands. He stops at the highest electricity pylon I've ever seen and straps on his parachute. BASE jumpers have a special kind of chute. It's a model that opens quickly but there is no reserve. "You only get one chance anyway," Ronald grins. A BASE jump from a height of 150 metres means you have about 5.6 seconds before you reach the ground if you remain in free fall. Plus, on a BASE jump the parachute must open at about half the airspeed of a similar skydive, and more quickly. Standard skydiving parachute systems are not designed for this situation, so BASE jumpers use specially designed harnesses and parachute containers, with extra-large pilot chutes.

There's a child seat in the back seat of the car. "I have a six year old," explains our jumper. "My wife would like me to stop BASE jumping," says Ronald as he fastens his chute. "But she knows she can't stop me. So she reminds me all the time not to do crazy stuff." Crazy stuff? Like jumping from an electricity pylon you mean? Ronald laughs. "Well, there are safer ways to do it and less safe ways. There shouldn't be too much wind. It is fairly safe up to wind speed of 3 (around 8-12 mph). But more wind than that can be deadly. When you jump off buildings you have to check the air turbulence around them. The parachute should be open at 50 metres, and it should open straight, parallel to the object you're jumping from, so you don't hit against it. Contact with the object is lethal. Period."

We are under the mast. Ronald climbs first. I ask him if he ever got hurt. "I had a hard landing a couple of times," he says with a straight face. Dead calm. This is not a guy who panics easily. "I have never broken anything although I've hurt myself more with BASE jumping than normal parachute jumping."

Fatality list

Ronald is a lucky guy. The statistics make grim reading – it seems that BASE is quite a dangerous sport. Jumpers

Figure 9: This photo was taken at Kjerag Mountain, which is located in Lysefjorden in Forsand, Norway. Its highest point is 1110 m above sea level, but it is its northern drop to Lysefjorden which attracts the most visitors. The drop is 984 metres (3,228 ft) and is just by the famous Kjeragbolten, a 5 m³ boulder which is wedged between two rocks. The area attracts BASE jumpers from around the world, who are enticed by the natural beauty of the Fjords, and the prospect of a long free falls from the towering cliffs.

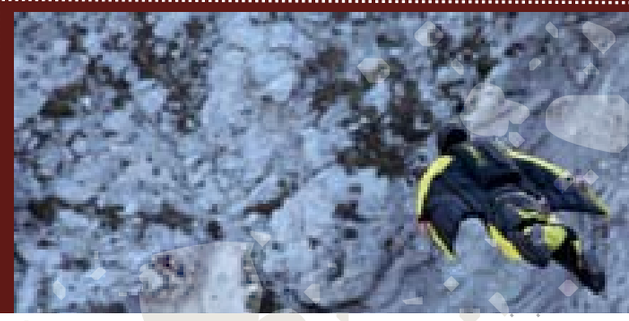


Figure 10: 1999 - World record shortest BASE jump from Christ the Redeemer statue in Rio de Janeiro, Brazil (95 feet).

HOW LOW CAN YOU GO?

have about 5% chance of dying before they stop. 95% of the BASE jumpers spend time in hospital because of their sport. The American Tom Aiello who has done more than 1000 BASE jumps from 200 objects says: "I would not advise anyone to take up this sport, although I truly love it. I've been taken to hospital in a rescue chopper twice, I've been arrested many times. I've broken a lot of bones and been to a funeral once, although it wasn't my own. I've been in intensive care for three weeks and had to have neurosurgery for 18 hours. But I just can't stop."
On the website www.blincmagazine.com every single BASE jumper that has died is honoured. If I count back just one year, sixteen people have died jumping of various structures. Isn't Ronald scared?

Adrenaline **junkie**

"Everybody knows the risks involved in this sport. If you don't want to do it, you definitely shouldn't. And if you do it, be prepared. I have to talk myself around every time. Just climbing up can often be dangerous, as you might notice. You could say I am addicted to adrenaline."
This powerful hormone is part of the human body's acute stress response system, also called the "fight or flight" response. It works by raising the heart rate, contracting blood vessels, and dilating air passages, all of which increases blood flow to the muscles and oxygen to the lungs. "You feel more alert, stronger, faster. Of course I'm scared. Jumping from great heights is a very unnatural thing to do. The moment right before you jump is the worst. But once you're flying, it's gone."
A police car passes along the road beneath us. What we are doing is against the law. We hold our breath. Will this story end in jail? But apparently the policemen are distracted by something else and do not look upwards. They drive off into the distance.
I grasp the rusty stairs. In my mind I see myself falling. I picture myself slipping due to my sweaty hands. At this height, the result would be certain death. If I'd ever thought of becoming a BASE jumper, that thought was receding by the second. Ronald continues to climb higher and higher, but I can't carry on. I'd rather watch Ronald jump with my feet firmly on the ground.

Crunch time

Once I'm on the ground and looking up, Ronald is just a speck, way up at the top of the mast. We can faintly hear him shout: "One, two, three, go!" Then the world stops for just a second. Ronald hardly seems to be moving at all, just hanging. This is because in the first second you only fall 5 metres. In the following second you fall 25 metres and in the third second 60 metres. Ronald only has 1.8 seconds to open his parachute before it is too late.

With relief, we see the white parachute opening and filling with air, and Ronald drifts down gracefully. When he lands, he is a different person. There's a bright excitement in his eyes. He is a lunatic for about twenty seconds. He's had his shot of adrenaline. But quickly he folds up his parachute. The police car that passed by could well have seen him jumping. They could be on their way already. Time to run! •

Grower's TIP #19

THE ADVANTAGES OF MICRO-LIFE

Microscopic life in organic media is critical to maintain a proper balance within the growing medium. Any healthy medium will contain many species of flora and fauna that take raw organic material and convert it into food for themselves, and their waste becomes food for the next level of organisms until all the organic material is gone. In the process, many nutrients are released into the soil pool for consumption by other life forms. This much we know - but how do these micro-organisms get there, particularly in sterile mediums?

Actually, all we need to do is "build a container and they will come". But what are the advantages of accelerating the process by adding micro-life using supplements? Years of research years at several universities has provided equivocal evidence. After using most commercially available microbial additives and tracking both the results and the final populations using various fertility regimes, the results have failed to show any statistical differences between the two methods. This means that the researchers have not issued any advice on adding supplements with microscopic life under normal and correct conditions for growing. The jury remains out.

Perhaps one solution for those who believe in adding such products during the production of a container is to use a starter charge from the last crop. If the previous medium was clean, no high-salt fertilisers were used, and if it was stored correctly between crops, a small amount of the old medium can be mixed with the new, taking the micro life that did such a good job with it. This could cut down on the overuse of these products, reduce costs for the grower, and establish the correct population of microbes.

The grateful gardener

Figure 11: Trichoderma live in soils that are rich in organic plant matter and numerous studies have shown its beneficial effects. In this picture you can see a Trichoderma attacking a plant pathogen. This pathogen will eventually succumb and die. Trichoderma is a biological control agent.

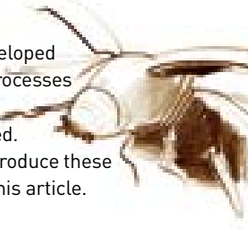
PLANT ASSOCIATED MICRO ORGANISMS

ALL SOILS, PARTICULARLY THOSE USED TO GROW CROPS, ARE HOME TO LARGE NUMBERS OF MICRO-ORGANISMS. MANY OF THESE GROW AND DEVELOP IN THE RHIZOSPHERE – THE AREA OF THE SOIL THAT IS IN CLOSEST CONTACT WITH THE PLANTS' ROOT SYSTEM. THIS WEALTH OF MICRO-ORGANISMS IS THE RESULT OF THE PARTICULAR PHYSICAL AND CHEMICAL CHARACTERISTICS OF THIS ZONE. FOR EXAMPLE, THE ROOTS PRODUCE A LARGE NUMBER OF CARBON COMPOUNDS, WHICH PROMOTES THE DEVELOPMENT OF THIS TYPE OF MICRO-ORGANISM..

By Iñaki Garcia, CANNA Research

Some of these micro-organisms have no effect on the plants and others are potential pathogens. However, many of these rhizosphere-dwellers actually serve to protect crops against other harmful pathogens and can even promote plant growth in a number of ways.

The specific characteristics of the rhizosphere vary from one plant species to another, which favours the development of different types of micro-organism. Bacteria of the genus Rhizobium, for example, only develop in the roots of legumes. The beneficial properties of these micro-organisms for plants can be harnessed to improve crops. Bioprotectors, biostimulants and biofertilisers have been developed that stimulate the plants' defences, improve processes such as rooting and flowering and supply certain nutrients or help them to be assimilated. The micro-organisms in the rhizosphere that produce these beneficial effects are described in the rest of this article.



FUNGI Genus: Trichoderma

Fungi of the genus Trichoderma live in soils that are rich in organic plant matter. They can also establish symbiotic relationships with the roots of the plants growing in these soils.

Numerous studies have shown the beneficial effects of Trichoderma, including:
Helping the plant to defend itself. Unlike animals, plants do not have the ability to produce antibodies to protect themselves against pathogens entering their organisms. However, they do produce other kinds of molecules, especially proteins and phytoalexins (substances with fungicidal and bactericidal properties) which help fight the effects of the pathogen. The plant starts to produce these substances when it detects that it is under attack from an insect or when it suffers damage from rodents or other herbivorous animals, for example.

The Trichoderma fungi secrete a series of substances that cause the plant to produce these defence proteins and phytoalexins even when they are not under attack by a parasite. Many phytopathogenic fungi produce enzymes that break down the cell walls of the plant they are infecting. As these cells decompose, this acts as a signal alerting the plant to the fact that it is under attack. The Trichoderma fungi produce enzymes, particularly cellulases, which break down organic matter (dead roots, remains of other plants, etc). The products of this enzymatic decomposition are very similar to those generated in a pathogen attack and they therefore replicate the signal, inducing the production of resistant substances.

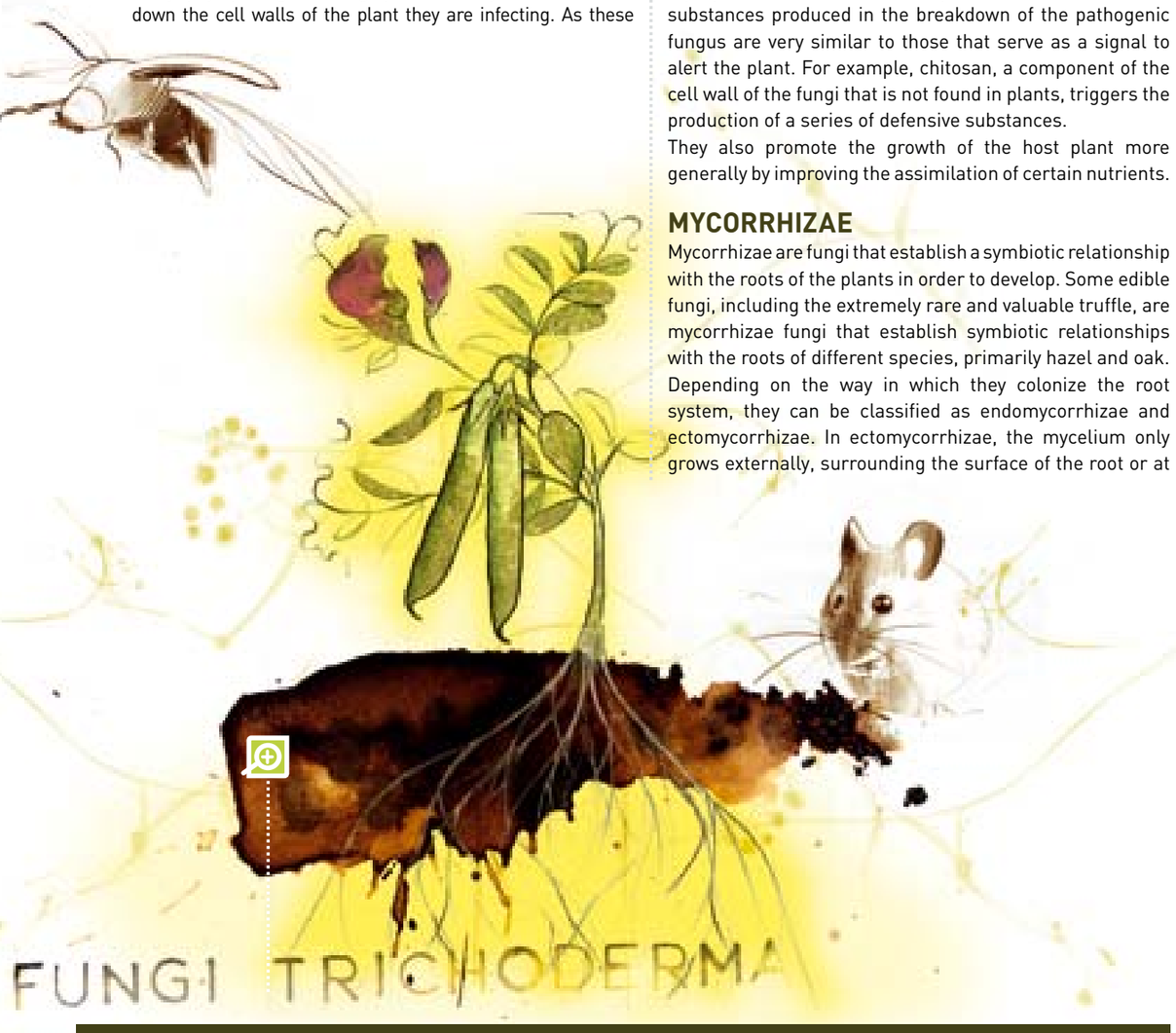


Figure 12: **Many phytopathogenic fungi produce enzymes that break down the cell walls of a plant that has been damaged by rodents, herbivorous animals or parasites. As these cells decompose, this acts as a signal alerting the plant to the fact that it is under attack. The Trichoderma fungi produce enzymes which break down organic matter. The products of this enzymatic decomposition are very similar to those generated in a pathogen attack. They replicate the signal and the production of a resistant substance.**

MYCOPARASITISM

Mycoparasitism is the ability of these fungi to grow and act as parasites on other fungi which may be plant pathogens. For example, some species of Trichoderma can be useful for fighting and preventing Rhizoctonia solani, a fungus that causes damping off and root rot. Because of this, Trichoderma are also sprayed on leaves to fight fungal diseases such as oidium and mildew. In addition, this mycoparasitism stimulates the plant's defences, since the substances produced in the breakdown of the pathogenic fungus are very similar to those that serve as a signal to alert the plant. For example, chitosan, a component of the cell wall of the fungi that is not found in plants, triggers the production of a series of defensive substances.
They also promote the growth of the host plant more generally by improving the assimilation of certain nutrients.

MYCORRHIZAE

Mycorrhizae are fungi that establish a symbiotic relationship with the roots of the plants in order to develop. Some edible fungi, including the extremely rare and valuable truffle, are mycorrhizae fungi that establish symbiotic relationships with the roots of different species, primarily hazel and oak. Depending on the way in which they colonize the root system, they can be classified as endomycorrhizae and ectomycorrhizae. In ectomycorrhizae, the mycelium only grows externally, surrounding the surface of the root or at most penetrating between the cells in the surface layers. As secondary roots grow from these colonized roots, they are also enveloped in the mycelium of the fungus. The plant can use the mycelium, which extends beyond its root system, to gather nutrients lying beyond its reach.
In the case of the endomycorrhizae, the process of colonization involves penetrating the cells. There are various types of endomycorrhizae, but the most important ones from an agricultural point of view are the vesicular-arbuscular mycorrhizae or VAM. They include Glomus, Gigaspora, Acaulospora and Sclerocystis.
In the symbiotic relationship, the plant provides the fungus with sugar from photoassimilates and the mycorrhizae provides nutrients which the plant either cannot assimilate itself or can only produce in very small quantities.
Phytoremediation refers to the use of plants to eliminate toxic substances from the soil. Mycorrhizae fungi have been used to promote these plants' capacity to absorb certain toxic elements or aid its distribution through the plant. It has been shown, for example, that the symbiosis of the Glomus mycorrhizae with the roots of the hemp plant helps in the translocation of toxic metals from the roots to the shoots.

CYANOBACTERIA

Cyanobacteria are photosynthetic bacteria. Some enter into symbiosis with plants; these include the bacteria Anabaena azollae which establishes a symbiotic relationship with the aquatic fern Azolla. These bacteria are atmospheric-nitrogen fixers and provide various stimulants such as phytohormones. The nitrogen fixed by the fern-bacteria symbiosis has been widely used for fertilising paddy fields, with the ferns grown prior to planting the rice. As the rice grows and the ferns die, the accumulated nitrogen is released and can then be used by the rice plants.

RHIZOBACTERIA

Rhizobacteria are bacteria that colonize and develop in or near to the plant root system. They are the most abundant of all the micro-organisms in the rhizosphere. The positive effect of these bacteria on the colonized plants was first observed in ancient times, when growers discovered that crops could be improved by planting them in a field that had previously been used for growing legumes. More recently, various studies have demonstrated various properties of some rhizobacteria. These beneficial bacteria are known as plant growth-promoting rhizobacteria (PGPR).

Nitrogen-fixing

The rhizobium-Leguminosae symbiosis was probably the first to be used by humans to improve crop yields. Growers also noticed that the fastest-growing and best-producing plants had protuberances on their roots, called nodules, which were much less common on other plants.
In 1888, the German researchers Hellriegel and Wilfarth showed that it was in these nodules that nitrogen accumulated. The Dutch scientist Beijirink subsequently isolated the bacteria in the nodules. They belong to the genus Rhizobium, which, through the action of nitrogenase enzymes, convert atmospheric nitrogen – which cannot be used directly by the plant – into ammonium that plants can assimilate easily. This transformation occurs inside the nodules, which contain a characteristic dense pinkish liquid. The relationship between Rhizobium and Leguminosae is said to be endophytic because the bacteria develop inside the host plant. Other endophytic bacteria that are also nitrogen fixers include Azetobactor diazotrophicus, which develops inside the sugar cane plant and spreads throughout its vascular system.
The actinomycete Frankia also forms nodules with nitrogen-fixing capacities in some trees and bushes of the genus Casuarina.
There are other bacteria that fix atmospheric nitrogen, colonizing the roots of non-leguminous plants. Unlike Rhizobium, they do not develop inside the tissues of the host but in the rhizosphere. This is true of bacteria in the genus Azospirillum, for example.
Other nitrogen-fixing bacteria do not develop inside plants or in the rhizosphere and are therefore not considered to be rhizobacteria. These include bacteria in the genus Azotobacter which feed off decomposing organic matter in the soil.

Converting phosphorus and iron into a soluble form

Like Trichoderma, there are rhizobacteria that have the capacity to mobilize inorganic phosphorus and iron found in the soil to form insoluble compounds. They include bacteria of the genera Bacillus, Pseudomonas, Rhizobium and Erwinia.

The production of useful active molecules

Phytohormones and growth stimulators. Many of these bacteria produce plant hormones (also known as phytohormones) such as natural auxins (indoleacetic acid), gibberellins and cytokinins. As a result, their presence or application can improve processes such as germination and rooting. One fungus that produces large quantities of auxins is Azospirillum sp.

Triggering defence responses in the plant

These rhizobacteria do not cause the plant to produce phytoalexins or resistance proteins but they boost its production if the plant is attacked by a phytopathogenic organism.

They promote the symbiosis of the root with other fungi and rhizobacteria.

Although PGPRs produce substances that prevent the development of certain micro-organisms in the soil, they can also sometimes aid their symbiosis. This is the case of the endomycorrhiza Glomus and the PGPR Bacillus subtilis.

They have an inhibiting effect on other pathogenic micro-organisms, and as such can be used as biological control agents

Antibiotic production. The production of antibiotic substances makes these bacteria ideal candidates for preventing root-rotting conditions such as damping-off and even to fight air-borne fungi such as Botritis. Many rhizobacteria produce these kinds of antibiotic, some of which have fungicidal or antiviral properties. The rhizobacteria that produce this type of antibiotic are primarily of the genus Pseudomona and Bacillus. Some antibiotics, such as Mupirocina produced by p. fluorescens are widely used in medicine. •

Puzzle&WIN Great PRIZES

We thought it was time for a change from the same old spot-the-difference-puzzle. So next issue we're going to bring you something new! And maybe even more challenging for you die-hards.

So this might be the last spot -the-difference for a while...

Find the five differences and WIN A BOTTLE OF CANNAZYM

Don't forget to let us know what your answers are!

Winner Puzzle#17

We picked a winner at random from all the correct entries we received, and we would like to congratulate.

Mr. Lorenzo

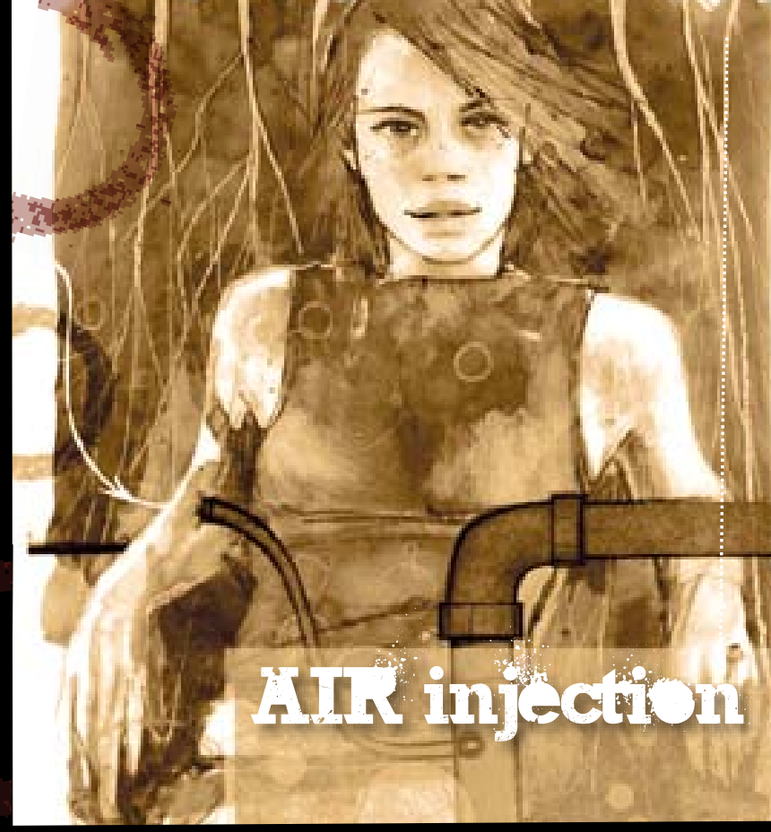
Congratulations with your bottles of CANNA Terra Vega & CANNA Terra Flores. We will contact you as soon as possible to organise the dispatch of your prize.

WHAT'S NEXT

Growers who want to know everything about using air injection in nutrient holding tanks, root-zone temperature and root-zone health should not miss the next issue of CANNAtalk!

There will also be a Grow it Yourself-article about the almost forgotten parsnip (did you know that it's hip to grow parsnips these days?).

You will also find two brand new returning items, Pest and Diseases feature, Questions and Answers and a lot more in the next edition of CANNAtalk!



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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!

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- ☐ Send me a CANNA Calendar 2012. I've secretly enclosed 10 pounds in this envelope to pay for it.

Solution to the puzzle:

#19

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Paylite

Grow better plants with the PowerPlant DayLite ballast!

- Will ignite lamps up to 15m from ballast
- Suitable for both HPS and Halide lamps
- "No Quibbles" new for old guarantee
- Black powder coated enclosure helps dissipate heat. Enclosure designed to aid easy lifting and protect cable glands from any water spillages. Rubber feet eliminate vibration and provide airflow under the ballast.
- Designed in the UK. Every unit is test fired before it leaves the factory!
- The only mainstream ballast to utilise 'super imposed' ignition technology that offers increased component life over traditional impulse ballasts.
- Units are fully assembled – **Just plug into your reflector and grow**

Now with new design of choke and air intakes to aid cooling and lengthen component life.

Sun in a box for year round plant growth

For trade enquires only.
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