CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

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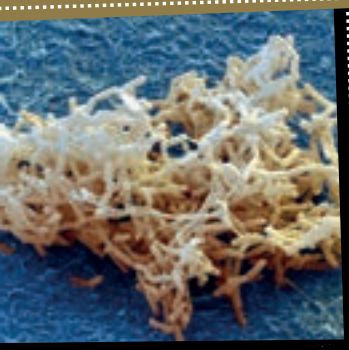
PEST CONTROL

Biological vs. chemical



BEKOTORA TRUCKS

Road rave madness

PUMPKIN

It's a treat!

And more:

HQTalk:

Yes, it's the beginning of December already! We have a month of celebrations ahead of us! A lot of alcohol, good food and unwrapping presents next to the fire place. We like!
Talking about keeping warm, your grow room should be winter-proof already! Have you switched on the heating yet? From experience we have seen that changes in your grow room can cause infestations and diseases. You can read everything you need to know about protecting your crop using pesticides in this issue of the CANNAtalk! CANNA Research will explain what type of plant protection there is on the market and how to control pests and diseases. In the pest and diseases section, we explain everything you need to know about two-spotted spider mite.
Also in this issue, you will find our genetics and breeding section which will be about protecting your genes and Don will tell you about his catastrophic harvest in France! And of course you'll find our regular What's Happening and the Grow It Yourself sections, too. There's certainly enough for you to read again!

We wish you a very merry Christmas with lots of smiles and laughter, and a horticulturally successful 2014!

All the best!

CANNA UK Team

Contents

TYPES OF PLANT PROTECTION PRODUCTS

PLANT PROTECTION PRODUCTS ARE COMPOUNDS THAT ARE USED TO KILL, REPEL AND CONTROL PESTS. THEY CAN BE USED FOR VARIOUS PURPOSES. FOR EXAMPLE, THE AIM CAN BE TO PROTECT A CROP BEFORE AND AFTER HARVESTING, PROMOTE THE DEVELOPMENT OF THE PLANT, STOP WEEDS FROM GROWING OR PRESERVE PLANT PRODUCTS. THESE PRODUCTS MAY BE NATURAL SUCH AS PYRETHRIN, AZADIRACHTIN OR NICOTINE OR THEY MAY BE SYNTHETIC, SUCH AS DDT. By Ignacio García, CANNA Research

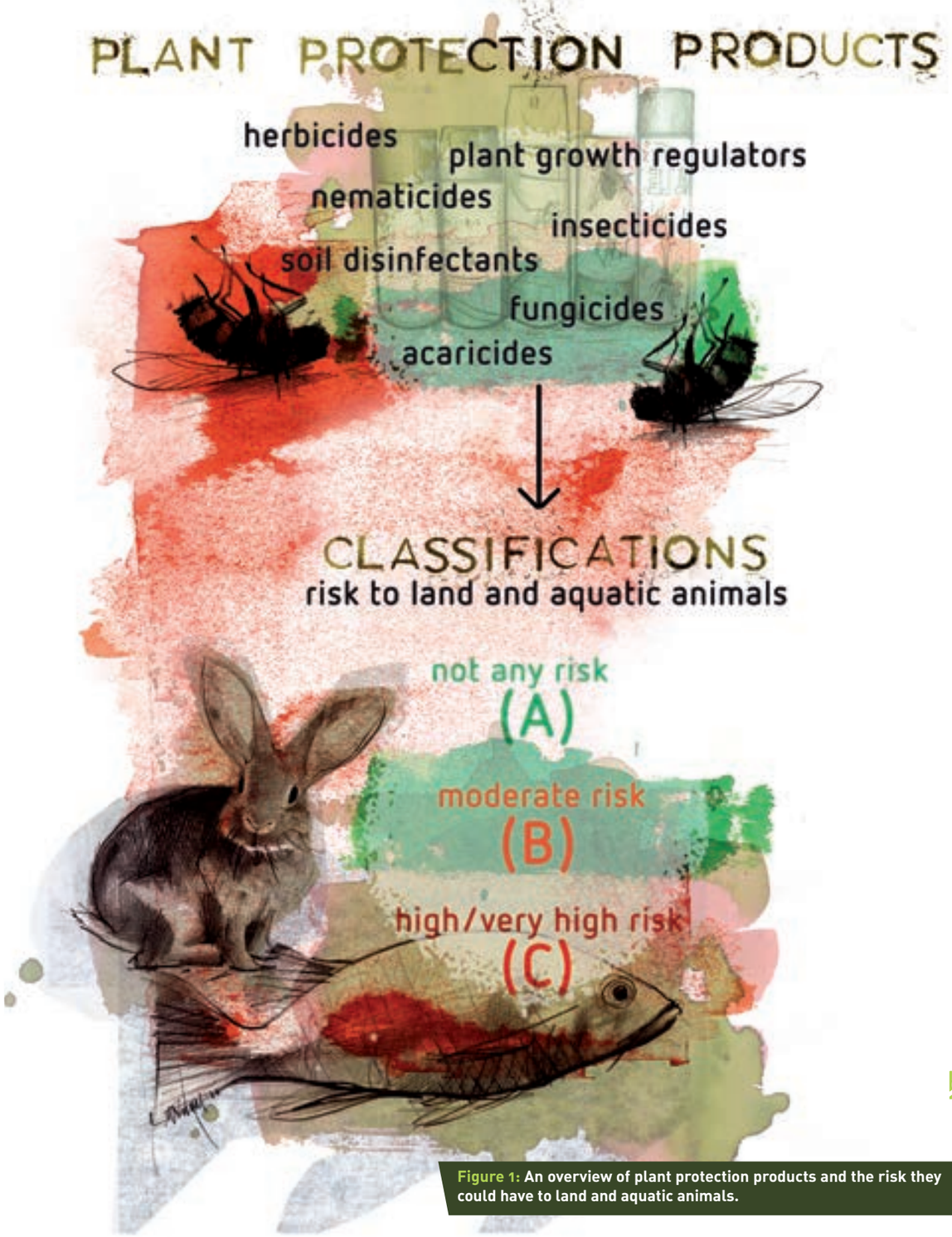


Figure 1: An overview of plant protection products and the risk they could have to land and aquatic animals.

Plant protection products fall into a number of categories – insecticides, acaricides, fungicides, nematicides, soil disinfectants, herbicides or plant growth regulators – depending on their specific function.

A plant protection product does not just contain the active ingredient that has the intended effect on the pest that needs to be controlled, but is a mixture of substances. We therefore refer to plant protection products as formulated solutions or products. In addition to the active ingredient, they contain non-active ingredients such as water, co-assistants that help the active ingredient to have its effect such as humectants, and other additives such as repellent or emetic additives. These additives can include chemicals that give the product an intense or unpleasant smell. These aromas are added to deter people from consuming or touching plants that have been treated with that product. Depending on the formulation, one and the same active ingredient can be sold in various formats. Pesticides can be formulated as a soluble powder (SP), a wettable powder (WP), an emulsifiable concentrate (EC), a suspo-emulsion (SE), a soluble concentrate (SC), a water dispersible granule (WG), an oil miscible flowable concentrate (OF), and so on.

Properties of an insecticide

One of the main properties of an insecticide is its efficacy and this is measured in terms of the effect that it has on

the target pest(s). One of the main factors that determine the efficacy of an insecticide is its effect spectrum. For example, in this context there are insecticides that act on a broad spectrum of pests (also known as multipurpose pesticides). Insecticides that respect useful fauna are termed 'selective', or 'specific' when they act on only one specific pest such as acaricides.

The type of formulation can also influence the effectiveness of the product. The route by which the plant protection product penetrates the plant to be treated is another aspect that will influence its efficacy. In the case of systemic insecticides, the products penetrate the plant and travel through its vascular system. If they are transported by the xylem, the active ingredient will be transported up to the plant's tips where it will do its work. Insecticides for treating pests such as aphids often work through this mechanism. In most crops that have been attacked by aphids, the majority of the aphids are located at the growth tips. When such an infestation occurs, many plants will respond by twisting their leaves, which makes contact between the insecticide and the aphids difficult using a spray, for example. By using systemic insecticides, we can ensure that the pest ingests the toxin without having to spray it onto the affected area. Some products are applied to the leaves and transported by the phloem to the roots such as, for example, the phosethyl aluminium fungicide.

The translaminar route is another way in which an insecticide can penetrate. This occurs when the product can cross the leaf from the topside to the underside and is very useful for pests that establish themselves on the underside of the leaves such as red spider mite. It is always more difficult to reach the underside of leaves in a uniform way, but with these products you can be sure that the product will have its effect on the whole of the plant even if only the topside of the leaves are treated.

To conclude, penetrating insecticides or those that have an internal effect are those products that penetrate the plant tissue but, compared to systemic pesticides, they only cover short distances.

Another property of insecticides relates to the duration of the toxic effect once it has been applied. This is referred to as persistence. Unlike persistent plant protection products, those referred to as "shock products" are those that have an immediate effect after they have been applied but are not persistent. It is very important to be aware of a product's persistence in order to determine the correct interval between treatments if several applications are required to control the pest.

Another issue to bear in mind when choosing an insecticide is whether it will be used as a preventative measure or as a cure. It is very common to use fungicides to prevent the growth of any fungus, while acaricides and insecticides are often used after a pest has taken hold.

Depending on how they exert their toxic effect on the pest, we have plant protection products that work on contact or when ingested or inhaled, and some may have an effect through several of these routes.

TYPES OF **PLANT PROTECTION** PRODUCTS

Classification by means of action

The most common way of action for insecticides is through chemical means, where they have an immediate toxic effect on the target pest. However, others are effective due to their physical effect. These are products that form a layer on the surface of larvae and adults, stopping their development. Their destructive effect on larvae is due to the fact that the product hardens or dissolves the shell, meaning that hydrous or gaseous interchange is impeded, without which the organism cannot survive. Some can penetrate the organism, leading to metabolic imbalances. There are also insecticides that interfere directly with the physiology of the pest, impeding its development. This is the case in the development of inhibitors and the development of insecticides that have an effect through various methods. Development inhibitors may work by, for example, interrupting the moulting process or impeding the formation of a new cuticle. Some of these products are pest-specific hormones that regulate insect growth, metamorphosis and mating. Others work by impeding the formation of chitin, which is a substance that can only be found in arthropods and fungi.

Insecticides can destroy larvae or may repel or sterilise the target organisms, depending on the possible route they take to exert their effect.

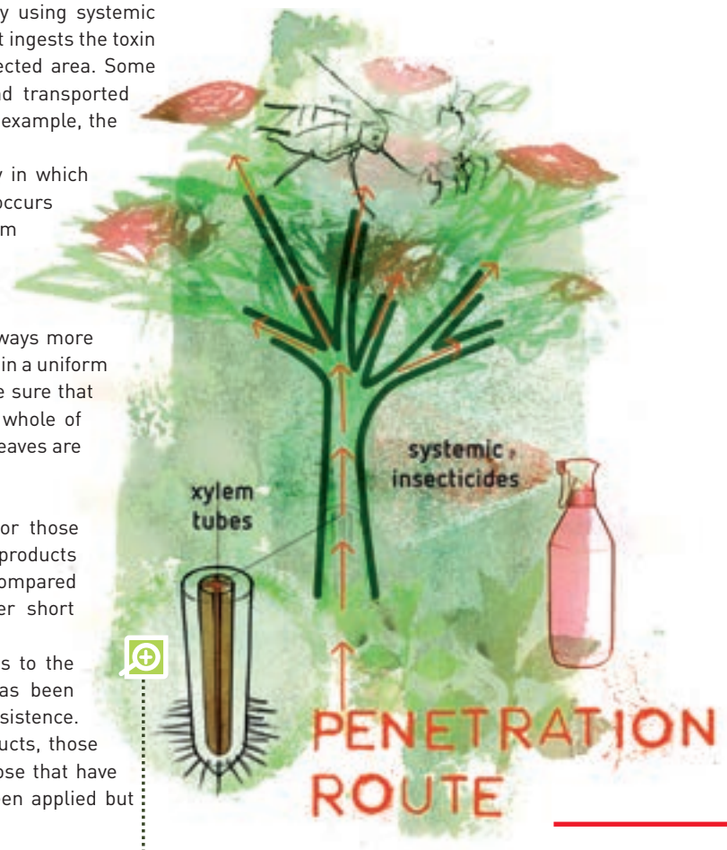


Figure 2: There are several factors that can influence the efficacy of a plant protection product. An example is the route by which the plant is penetrated. In this image you can see systemic insecticides penetrating a plant. The insecticides travel through the plant's vascular system and are transported via the xylem. In this case the active ingredient will be transported up to the tips of the plant...

Are plant protection products hazardous to people?

Some plant protection products are toxic to people, but here we need to distinguish between acute and long-term toxicity. Acute toxicity manifests itself after direct contact with the toxin, whether through ingestion, absorption through skin or inhalation. In this case, the harmful effects occur more or less immediately. This is a risk for people working with pesticides, for example. The use of personal protection equipment is required such as gloves, masks and appropriate clothing when working with plant protection products in order to prevent acute intoxication.

Long-term toxicity occurs as a result of repeated ingestion/contact with the product and is most common among consumers. Possible long-term intoxication is due to residue. Residue is defined as the plant protection substances that remain after treatment at a toxicologically significant level. Residue that is not toxic is referred to as 'remains'.

Metabolites are also considered as residue and are produced as the plant protection product degrades into decomposition or reaction products where these continue to have toxic effects as defined above.

Once plant protection products have been used, they must disappear quickly from the environment to ensure that risks do not occur as a result of their toxic properties. The process of decomposition of the plant protection product after application is referred to as dissipation. An exogenous dissipation may occur because of plant growth or due to mechanical and physical causes such as, for example, rain. There are also chemical aspects that contribute to degradation such as hydrolysis, oxidation and photodecomposition processes (this is not an exhaustive list).

Another route for dissipation is through endogenous causes – that is, due to degradation processes that occur

Figure 3: ...that's why systemic insecticides are very useful when treating aphids.

due to metabolism. In this case, metabolites are produced that may be harmless or toxic depending on the plant protection product that has been used.

The authorities set a maximum residue limit (MRL) that consumer products may result in, so that consumers are not exposed to the risk of toxicity. This parameter is linked to the 'safety period' – the time that elapses between applying the plant protection product and harvesting.

TYPES OF PLANT PROTECTION PRODUCTS

The Lethal Dose 50 (LD50) parameter is used to assess toxicity. This parameter indicates the quantity of the active ingredient that leads to the death of 50% of the organisms on which tests are performed, using the route of ingestion. These tests are performed with laboratory animals such as mice and rats. Within the LD50 parameter, we can make a distinction between acute oral LD50 – where the product is ingested, acute dermal LD50 – where the product is applied to skin or Lethal Concentration 50 (LC50) - where the product is inhaled.

'No effect level' (NEL) parameters are also used to indicate the quantity at which no harmful effects are perceived in organisms, such as problems with reproduction, teratogenesis, carcinogenesis, and so on. Based on the previous parameter, an Acceptable Daily Intake (ADI) level can be determined that indicates the quantity of plant protection product that may be ingested based in terms of body weight per day with no adverse effects on the organism.

The product is classified as category 1 (very toxic), category 2 (toxic) category 3 (harmful) and category 4 (low risk), depending on the product's LD50 or LC50 parameters.

The label must bear a pictogram and a signal word ('danger' or 'warning') indicating the type of hazard involved when handling or using the pesticide. This must also include some hazard and precautionary statements.

Risk to land and aquatic animals

Some insecticides may cause significant harm to animal species near the location in which they are used, but their harmful effect may also extend to places further away due to the contamination of aquifers or because the products are washed into rivers and seas.

Plant protection products are classified as follows, depending on the risk they represent to land and aquatic animals:

Category A: Their use does not represent any risk as long as they are used correctly.

Category B: Moderate risk. These include products that can cause harm to land or aquatic animals if used incorrectly or in a non-controlled manner.

Category C: High or very high risk. These insecticides may cause significant harm if not used correctly and in areas where there is an important presence of fauna. The products that pose a risk to land animals may not be used in grasslands, pasture land, forest areas, humid areas and river networks. Products that entail a risk to aquatic animals are completely prohibited in humid areas and near rivers.•

RISK FOR BEES AND OTHER POLLINATING INSECTS

Figure 4: We are all aware of the task that pollinating insects carry out and especially bees, which also produce valuable honey. Many plant protection products can be harmful to these insects and may, therefore, not be used on flowering crops or during the hours of the day when pollination takes place.

GROWIT YOURSELF

HI THERE PUMPKIN!

VERSATILE. IF YOU COULD USE ONLY ONE WORD TO DESCRIBE THE MIGHTY PUMPKIN, VERSATILE WOULD SURELY BE IT: IN COLOUR, IN TASTE, IN USE, IN SHAPE, IN MYTH AND IN GOODNESS. PUMPKINS MAY WELL BE THE ULTIMATE FOOD AND, THE BEST THING IS – IT'S NOT A TRICK, IT'S A TREAT!

By Marco Barneveld, www.braindrain.nu

A pumpkin is a gourd-like squash of the genus Cucurbita and a member of the Cucurbitaceae family. The word pumpkin comes from the Greek pepõn meaning a large melon. The English called them pumpion or pompion, which later became pumpkin. The plant is a vine and it winds its way across surfaces in a similar way to other members of the cururbitaceae family like cucumbers, squashes and cantaloupe melons. For Native Americans the pumpkin was especially important. Not only did they eat this fruit, they also pounded strips of pumpkin flat, dried them, and wove

Figure 5: **Did you know that pumpkins are a storehouse of vitamins, minerals and other healthy nutrients?**

them into mats for trading. They also used dried pumpkin as food. Modern-day Americans have also embraced the sweet, multi-purpose fruit with all their hearts, and it has become a traditional Thanksgiving food. The early colonists used pumpkin not only as a side dish and dessert, but also in soups and fun-loving girls and boys even made beer from it.

Pumpkins are especially popular at Halloween when they are carved into lanterns. The practice was brought to the United States by Irish immigrants who originally carved turnips into lanterns.

To your very good health!

Known primarily for its role as a Halloween decoration or a pie filling, pumpkins are also packed with nutrition and bring a wide range of health benefits. Pumpkins are a storehouse of vitamins, minerals and other healthy nutrients. Whether it is the pulp or the seeds, pumpkins are great for your health and can offer some incredible benefits.

The pumpkin is one of the lowest-calorie vegetables, providing just 26 calories per 4oz. It contains no saturated fats or cholesterol, but is a rich source of dietary fibre, anti-oxidants, minerals and vitamins. Pumpkin is a storehouse of many anti-oxidant vitamins such as vitamin A, vitamin C and vitamin E. With 0.3oz per four ounces, it will provide about two and a half times your daily recommended dose of Vitamin A, a powerful natural anti-oxidant that is required by body to maintain the integrity of skin and mucus membranes. It is also an essential vitamin for vision. Research studies suggest that natural foods rich in vitamin A also help to protect our bodies against lung and oral cavity cancers. Pumpkin is also rich source of minerals like copper, calcium, potassium and phosphorus.

Pumpkin seeds are good source of dietary fibre and mono-unsaturated fatty acids, which are good for cardiac health.

Grow a giant pumpkin yourself

The fun thing about pumpkins is that they can reach gigantic sizes and that means they are a lot of fun to grow. To grow a real whopper, of course you will need to start with the right kind of pumpkin seed, one that has been selected to produce really big pumpkins, such as 'Prizewinner Hybrid'. Using the right growing methods, it can produce pumpkins in the 150 kilo range.

In general, pumpkins need a lot of sun. Choose the sunniest spot that you have available; remember that pumpkins are sensitive and need shelter from wind and frost. Try to protect pumpkins from the worst of the elements by covering them during heavy rains, putting up some kind of barrier to protect the vines from strong winds, and using shade tents during summer's hottest days.

Pumpkins like and need a lot of water, but don't plant pumpkins in wet or dense soil. They need good, well-drained soil. You can dig the soil by hand. Prepare the ground in early spring, as soon as the ground is warm. Fertilise the patch with a good four inches of manure. Pumpkins will do best in soil that is near neutral or slightly acidic.

If you live in a part of the world where there is still danger of frost in late April or early May, start pumpkin seeds indoors about two weeks before planting. Sow one seed for every four-inch peat pot filled with growing mix. Keep the pots watered and never let them dry out. When the seedlings have developed their fourth or fifth set of leaves, set them outdoors. Protect pumpkin seedlings during the first few weeks with plastic-covered frames.

Fertilising

Pumpkins have two types of flower – male and female, and they appear in early July. The male flowers show up first, followed by the females. Look out for the first female flowers and make sure that the vines are strong and well-established before allowing the female flowers to produce fruit. It could help to break off the first female flower on each vine and wait for the second or third to appear, when the vines are at least 118 inches long. A female flower is easy to recognise – she has a baby pumpkin at the base of each flower.

You will need a large vine to produce a large pumpkin, so in a sense you choose the vine before the pumpkin. When you find a vine that is strong enough and a female flower on the verge of opening, put a cheesecloth bag over it for the night to keep the insects out. The next morning, pick a fresh male bloom, trim off the corolla or outer petals, and rub the pollen-laden stamen in around the centre of the newly opened female bloom.

Growing

This is just the beginning of a summer of hard but rewarding work. What you have started is actually a pumpkin-producing factory. Remember that there are 100 or more leaves on each vine and if you are trying to grow a 300-pound pumpkin, each leaf will be responsible for up to 4 lbs of weight in your pumpkin. Giant pumpkins balloon out from the vine and if precautions are not taken, they will tear themselves off the all-important stem. Vines put out roots at every leaf, so tear out the roots of the vine near to the pumpkin. This will free the vine room to grow away from the pumpkin without being damaged as it swells in size. Gently train the vines away from the fruit to prevent it from crushing them, and give the vines a nudge in the right direction every day.

Softballs

To grow a really big pumpkin, when two or three fruits on each plant have reached the size of softballs, remove all but the most promising fruit and start to prune the pumpkin vine. After the primary vine has reached 20 feet, pinch off the tips and the side shoots so the vines do not divert resources from the fruit. Break off all the other female flowers and a potential prize-winner will be in the making. All the plant's energy must be channelled entirely into this fruit alone.

It is important to remember that all the nutrients needed to increase the size of the fruit come from the vine, and the vine must in turn get enough support from the root system.

To grow really big pumpkins, the most important thing to remember are seeds, soil, sunshine, and water.

By mid-August the plants are pulling in water and nutrients at a great rate. Night-time is when pumpkins do their growing; some will expand five inches in circumference every night.

Tip: Water

Water in the evening, water a lot and water only the base of the plant so that the leaves stay dry. This reduces the risk of disease.•

RECIPE

SWEET AND SOUR GRILLED PUMPKIN

- **2 lbs pumpkin**
- **2 tablespoons olive oil**
- **1 clove garlic, pressed or minced**
- **salt**
- **3 tablespoons wine vinegar (red or white)**
- **3 tablespoons white sugar**
- **chopped fresh mint or parsley**
- **thinly sliced garlic**

Cut the pumpkin in half and scrape out the seeds and membrane. Peel each half and cut into slices. In a bowl whisk together olive oil, one clove of minced garlic, and a generous pinch of salt. Add the pumpkin slices and toss well to coat. Grill the pumpkin slices at a medium heat for a few minutes on each side or until just tender.

In a small saucepan, mix vinegar, sugar, and any garlic oil left in the bowl. Heat until sugar dissolves and the mixture thickens just slightly. Drizzle sweet and sour sauce over the pumpkin on the serving platter. Garnish with fresh chopped mint or parsley and thin slices of raw garlic if desired.

Bon appétit, pumpkin!

We could talk and write almost endlessly about the subject of 'genetics and breeding'. We now come to part four of our series. In previous CANNAtalk editions we have introduced you to the rules of Mendel, explained to you what phenotypes and genotypes are and brought you an article about photoperiodism. Don't miss the upcoming edition to stay on top of this interesting subject!

USING CUTTINGS IS A COMMON WAY TO START A CROP. THIS IS BECAUSE GROWING FROM CUTTINGS HAS CERTAIN ADVANTAGES OVER GROWING FROM SEED. CUTTINGS WHICH COME FROM THE SAME PLANT (COMMONLY CALLED THE STOCK PLANT) ARE GENETICALLY IDENTICAL TO EACH OTHER AS WELL AS TO THE PLANT THEY WERE TAKEN FROM.

By Ignacio García, CANNA Research

PROTECT YOUR GENES

A question which is inevitably often asked about the mother system (the system of taking cuttings from a stock plant) is whether or not changes may arise in the plant which could reduce yield. This series of changes, which normally results in a decrease in the final yield, is produced by what we call 'clonal degeneration'. There are essentially three causes of clonal degeneration: pathogen accumulation, mutations and senescence.

Certain parasites such as fungi, bacteria, viruses and viroids accumulate in plants over their lifetime. This is because over time stock plants are exposed to various pests – some of which will be carriers of viruses. Some of these viruses cause immediate harm to the plant, causing changes to leaf shape, colouring (e.g. the appearance of mosaic-like mottling and staining), dwarfism, and so on. However, there are many other viruses that are not immediately evident, but which can still cause a decrease in the final harvest. Insects that are likely to carry viruses or viroids include aphids, whiteflies and thrips. Another type of infection is manual infection, either via touching plants or spreading via pruning tools, such as scissors or blades. It is precisely for this reason that any scissors or blades should be wiped with alcohol prior to pruning the stock plant or taking cuttings.

The main problem with viruses and viroids is that it is not possible to eliminate them using conventional methods. Any plant affected by these pathogens should therefore be removed from the stock room.

Figure 6: Using cuttings when starting a new crop has many benefits. In this picture, you see where the best place is to take a cutting (left) and what a good length for cuttings is (right). Read CANNAtalk 6 for more information about taking cuttings.

Spontaneous mutations

Mutations may occur more or less frequently depending on various factors such as the species that is being cultivated and the growing conditions. In ornamental landscaping, various mutations (either spontaneous or provoked) have given rise to variegated leaves or flowers with multicolour petals, for example. And in agriculture, many of the different types of fruit we eat come from spontaneous or managed mutations. A good example of this would be the majority of mandarin oranges. A mutation is actually nothing more than a change in the genome of an individual. These mutations can be beneficial (as is the case with fruits), or detrimental. Generally speaking, whenever a mutation appears, more often than not it will be detrimental. In some instances it can be very difficult to visually distinguish between a mutation and a virus, since the latter can cause similar symptoms to the former. For example, some viruses may cause chlorosis. Similarly some mutations to the chloroplast genes mean that cells do not produce as much chlorophyll. This produces plants that do not express pigment – called variegated plants – which have a different genetic make-up (where some leaves can produce chlorophyll whilst others cannot). When two or more cells with a different genetic make-up coexist within the same plant, these plants are called chimeras.

Stock plants that have been infected with certain viruses cannot be used to produce seeds either, since some viruses can be passed on to offspring. For mutations, this will depend on the type of mutation, the type of cells which have mutated, and whether the mutation may appear in seeds. However, it should be noted that mutations will always be passed on from cuttings taken from the mutated plant.

Senescence

Senescence refers to changes at the cellular level which come about as a result of the ageing process. The effects of ageing on phenotypic expression are more than evident. For example, many fruit plants undergo a period which lasts from germination until the production of the first fruit, which is called the juvenile period. During this period (which can last weeks, months or even years), the plant may present distinctive features, such as for example the presence of thorns. Cellular division which causes the growth and development of the plant is known as mitotic division, and is part of the process called mitosis. There are two types of senescence, the first of which occurs in the parts of the plant which have already formed (leaves, stems, stalks, roots, etc.) and whose cells are not dividing any further (postmitotic senescence). The second type occurs in the meristems and other parts of the plant which are still developing (mitotic senescence). Meristems are a group of constantly dividing cells which, depending on the stimuli they are affected by, may form either vegetative or generative structures (leaves, flowers, fruits, etc.).

In time, the older structures of the stock plant will begin to undergo the process of senescence, producing endogenous substances during this period which will affect the meristems. With the passing of time, the new branches sprouting from an old stock plant may present undesired changes in morphology – such as the presenceof flowers – due in part to the stimuli being received from the

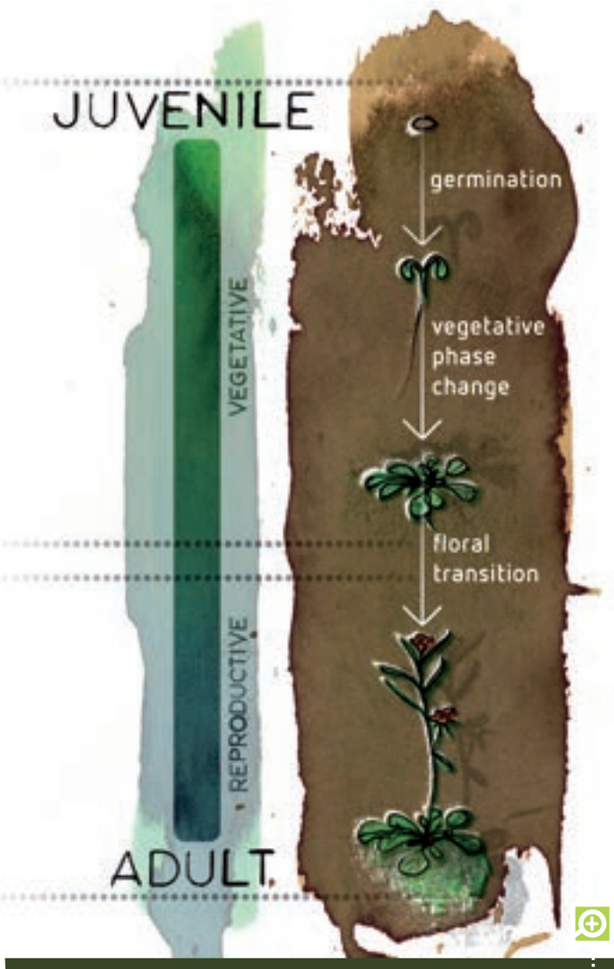


Figure 7: Plants undergo several developmental transitions during their life. The first is the germination phase, and after germination the seedling passes through a juvenile vegetative phase during which it is capable of flowering (the juvenile period can last weeks, months or even years). This phase is followed by a transition to the adult vegetative phase, where a plant can respond to inductive signals. With the transition to flowering, the plant enters the reproductive phase.
During the juvenile phase, a plant may have thorns; a phenotypic expression as an effect of ageing. Good examples are Meyer lemons, grape-fruits and key limes.

Figure 8: It's very important to clean scissors or blades after taking cuttings. This is to prevent manual infection.

Figure 9: Many of the different types of fruit that we eat come from spontaneous or directed mutations. An example is the majority of mandarin oranges.

Figure 10: This is an example of in vitro plants. By using plants grown in vitro, you can eliminate environmental risks which may increase the risk of infection with viruses or viroids.

older parts of the plants. It is precisely for this reason that stock plants should be periodically renewed. The process of senescence is mediated by plant hormones.
Meristematic cells, which are responsible for the indefinite, continuous formation of branches, may also suffer from the process of senescence, which can also manifest itself through the abnormal development of new branches, or by a plant simply ceasing to grow. Senescence may be due to environmental factors and stresses such as extreme temperatures or possibly the effect of certain plant hormones.

Features of the stock room

Generally speaking, stock plants can produce more cuttings than will be needed for a crop. Consequently maintenance pruning is required whenever cuttings are not needed. Pruning should consist of clipping off undesired branches and reducing the height of the stock plants. One pruning technique consists of cutting each branch, but always leaving between 3 and 5 nodes which new branches can sprout from.
To avoid senescence as much as possible, we recommend keeping the room at a moderate temperature (between 21ºC and 24ºC, both day and night), since high temperatures may accelerate the plant's metabolism.
The use of products with vitamins act as antioxidants also helps prevent senescence caused by oxidative stress.

In vitro plants

In vitro plant propagation has always been presented as an option to consider for propagating and maintaining vegetative propagating plants. At their most basic, growing plants in vitro can be defined growing them in aseptic conditions, normally in glass jars or test tubes. The substrate used for the in vitro plant is known as the culture medium, which is usually made up of the mineral nutrients required for sustenance (i.e. fertiliser), growth regulators (plant hormones) and other substances such as sugars which provide the carbon that the plants need (since photosynthesis is inhibited in plants grown in vitro), as well as a gelling agent so that the medium solidifies. Prior to cultivation, the plant material to be micro-propagated is disinfected with alcohol or diluted bleach.
By using a plant grown in vitro, we can eliminate any environmental risks that may increase the risk of infection from viruses or viroids. However, this method does increase the risk of mutations, and thus of phenotypic differences in the micro-propagated clones, known as somaclonal variation.

By using meristems from an in vitro plant, the majority of viruses that a plant may have can be eliminated. This group of constantly dividing cells is not susceptible to attack from viruses; consequently, if we obtain a plant from meristems, the end result is a healthy plant.

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What's HAPPENING

So you think a few fluffy dice dangling from your rear view mirror makes your car look awesome? Think again my friend. Because when you think about decorating your car, you're going to have to set your sites a bit higher. Start thinking BIG... Look at these guys – hug rigs, decked out with neon and ultraviolet lights, colourful murals and shiny chrome and golden exteriors. Welcome to the awe-inspiring world of Dekotora, Japan's wild and whacky truck-decorating subculture.

By Marco Barneveld, www.braindrain.nu

ROAD RAVE MADNESS WITH A SHINE

They are a funny bunch over there in The Land of The Rising Sun. They are total perfectionists, and will not rest until everything is tidy. Except where order is not needed. Then they will go all out on total exuberance, almost as if they were trying to do madness perfectly too. Just think of all the crazy things that have been born in Japan and taken the world by storm - giant mechanical monstrosities, blinking, shiny electronics, Hello Kitty, Transformers and Speed Racer. And if you were somehow to combine all these uniquely Japanese trade marks, you would get Dekotora: tricked-out, spruced-up, super-pimped Japanese trucks.

Optimus Prime meets Lite-Brite

Your average dekotora truck looks like a cross between a locomotive, a fire engine, and a Christmas tree. If you're a 1980s baby, think Transformer overlord Optimus Prime meets the fantastic Hasbro classic Lite-Brite with chrome, welded aluminium embellishments, and LED adornments

ROAD RAVE MADNESS WITH A SHINE

BEWARE: The decorating madness is spreading!

More and more, decorating your commercial vehicle is the thing to do if you are a truck or taxi driver. All over the world, Dekotora-like sub-cultures are popping up with their own names, rules and conventions. Columbia and Ecuador have Chiva Buses, which are decorated passenger carriers. Haiti has its infamous Tap Taps. Jeepneys are Filipino taxis made from US military jeeps left over from World War II, and are the most common type of public transportation in Manila. Pakistan has the king of them all: the Jingle Trucks. Jingle Trucks are some of the most ornate self-propelled devices on the planet. They actually predate Dekotora, but the two practices sprang up independently. Calling all truckers worldwide: let's shine!

– huge numbers of LED adornments. Inspiration comes from a diverse background such as Gundam designs, Cadillac grills, classic Mercedes Benz flares and Samurai armour inspired by traditional Japanese architectural designs. Basically it's all lights, chrome kits and more lights, more lights, then a few more lights. Oh, and we just might need more lights.

Mobile disco on speed

These are working trucks, with the most common examples being delivery trucks and removal trucks, but there has even been a garbage truck or two decorated like this as well. We mean vehicles that carry thousands of pounds of dried squid across the Japanese countryside. Moving from town to town, lit up like some crazy non-denominational Christmas tree, they're like Beyond Thunderdome at the Road Disco on Speed, and they're impossible not to love. Road rage? More like Road Rave. Even though these are not personal vehicles, their owners put a lot of their heart and soul into these modifications. Some of the more intricate designs can take up to 20 years to complete and cost over £100,000 – and that's not including the purchase price of the vehicle. And why do they do it? Because they can! It's considered artistic expression, and the owners of these vehicles are proud and committed to their hobby. Often, Dekotora trucks are even given women's names – ironically in similar fashion to a B-29. Remember Enola Gay?

Truck Guys

Dekotora was started in the 1970s by the Utamaro Kai, a small group of designers and enthusiasts. Their work first came to fruition as design pieces for a movie series called Truck Yaro (Rascals). The Dekotora craze took off after these Japanese low budget B movies about truckers came out in the mid-70s. The first flick was called Truck Guys. The film's main character was an adventure-loving trucker who drove his wildly decorated semi all over Japan, getting into scrapes and chasing tail. Truck Guys was popular enough for ten, yes TEN, more Dekotora flicks to be made (all written and directed by Norifumi Suzuki), and these captured the hearts and minds of lonely truckers across Japan. It's a trend that still persists to this day.

DEKOCHARI: Dekotora for kids

But what if you are not a truck driver? What if you are too young to drive a car? What if you are a kid and you are madly in love with Dekotora? Well luckily there is a little thing called Dekochari, Dekotora for bicycles. Kids were too young to drive a truck so they started modding their bikes in the same way. This is done by attaching a plywood frame to the bicycle frame and then adding the Dekotora chrome and lights to the plywood. Now that's an awesome bike!

Fines

A tiny problem for these truckers-slash-artists is that they go so all-out that they kind of break the law. The drivers have to bend the rules for their art trucks to be roadworthy. Many Dekotora trucks are only legal with all the extra lights turned off. They are considered a road hazard when driven at night with all accessory lights on. But paying hefty fines is part of the lifestyle for a true Dekotora owner; let there be fines, let there be art and let there be lights, lots and lots and lots of lights.•

ANTS

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

- Ants can carry ten times their own weight – and there are even species that can carry fifty or a hundred times their own body weight! That's why these ants are easily holding seed pods from a Mimosa tree.
- Ants are very busy little creatures. They move about fifty tons of soil per year in one square mile, they can build mounds that can reach a height of 16 inches and many species not only collect their food, but actually grow it themselves. Take the parasol ant for example, which cuts small pieces from leaves and transports them to special growing chambers within its nest. Here they cultivate a special mould that the ants use as their food supply.
- But those busy ants also need to rest. Research on the fire ant showed that workers had an average of 253 'sleep episodes' a day with an average length of 1.1 minutes (4.8 hours sleep overall). Fire ant queens, meanwhile, experience 92 sleep episodes with an average of 6 minutes: that makes a generous 9.4 hours of sleep in total.
- There are thousands of different species of ant. In March 2010 the 'antbase' recorded 12,565 species and new species are continually being discovered. Currently there are probably over 20,000 ant species.
- One of these 20,000 ants is the red imported fire ant (RIFA) - a very costly species because it causes approximately £467 million in damage to agricultural assets, including vets bills and losses to livestock as well as crop loss. Bio-control methods keep these pest ants from further invasion.
- There are several ways to get rid of ants. One way is to throw boiling water in the nest. Another option is to use cucumber skin (ants don't like this at all). But don't use these or other methods if you are in Germany, because there it has been prohibited to destroy ant nests since 1880. Red ants eat all kinds of pests such as insect larvae; a large nest can eat about 100,000 larvae daily.

Photo courtesy to Eko Adiyanto

Pests & DISEASES

Spider mites are a pest that affects many crops worldwide. There are about 1200 species of spider mite, of which more than a hundred can be considered as a pest, and about ten of those as major pests. The most well-known and problematic spider mite is Tetranychus urticae (common names include red spider mite and two-spotted spider mite). Their ability to reproduce extremely rapidly enables them to cause enormous damage in a short period of time. Mites are not insects but belong, together with ticks, scorpions and spiders to a class called Arachnida. By CANNA Research

Figure 11: A coloured scanning electron micrograph (SEM) of the head of a spider mite (Tetranychus sp.)

TWO-SPOTTED SPIDER MITE

Adult two-spotted spider mites are tiny, with a maximum length of 0.02 inches, and are just visible to the naked eye when present in large numbers. They are usually found on the lower leaf surface. Despite their common name – red spider mite – during the spring and summer they can vary between light yellow or light green and dark green, red, brown or even almost black. Often the colour of the two-spotted spider mite depends on the plant on which it is feeding. Both males and females have two dark spots on their back, which is why they are referred to as two-spotted spider mite.
Spider mites spin a silk webbing to help protect the colony from predators, which is why they are commonly known as 'spider mites'. They can also use the strands of webbing as a way of moving to other plants.

Life cycle

The speed of development of the two-spotted spider mite depends not just on temperature and humidity, but also on the type of host plant, the age of the plant and even the cultivar. Each female two-spotted spider mite lays 10-20 eggs per day, 80-120 altogether during its life cycle of up to 4 weeks. These are mostly attached to the silk webbing. The six-legged larvae hatch after 3-15 days. Newly hatched larvae are almost colourless and have bright red eyes. They moult three times within 4-5 days, towards protonymph, then deutonymph and at last adult. Both adults and nymphs have 8 legs.
Under favourable conditions (optimum temperature is 30-32°C with a relative humidity of <50%), the life cycle can be completed in about 1-2 weeks, including a pre-oviposition period of 1-2 days. Often a change to hot and dry weather will lead to a very rapid increase in population density. The life cycle (from egg to egg) is about 7 days at 30°C and 17 days at 20°C. Development stops below 12°C.
Only females overwinter as non-feeding adult mites on plants or hide in crevices and structures, or in plant litter or the soil. Indoors the mites become active again during March but may not manifest themselves on outdoor plants until mid- to late summer.

Damage

Spider mites have needle-like sucking mouthparts. They feed by penetrating the plant tissue with their mouthparts. Large populations may cover entire plants with webbing. Like other tetranychid mites that infest plant leaves, the two-spotted spider mites remove photosynthetic tissue. When there is a well-established infestation, the damage will not be restricted to the spongy mesophyll but extend to the palisade parenchyma and the leaf tissue may collapse completely. The function of the stomata will be affected and transpiration will be inhibited. The leaf will turn yellow, wilt, and finally be shed; sometimes complete defoliation occurs and often the entire foliage of infested plants will become tinged yellow or brown.

The loss of photosynthetically active surface area, together with reduced transpiration, leads to reduced yield and the plant may become stunted or, in severe cases, die. The degree of damage depends on the severity of the infestation, the crop affected and other biotic and abiotic stresses. It is estimated that 18 to 22 of plant cells will be destroyed per minute. The first visible symptoms are small yellowish or whitish specks, mainly around the midrib and larger veins. If these spots grow bigger and merge, the empty cells give some areas of the leaf a whitish or silvery-transparent appearance.

Control

Two-spotted spider mite can be difficult to control as they breed rapidly in warm conditions. In addition, some strains of the mite have developed resistance to some pesticides. Biological control is an attractive alternative to using pesticides because this sidesteps the issue of resistance and the risk of spray damage to the plants. Spider mites have several natural enemies that can be used to control the population. The most common and also commercially available is the predatory mite Phytoseiulus persimilis. To minimise the risk and rapid spread of spider mite infestations, try to keep the temperature lower (< 25°C) and the humidity higher (>60%), since this will slow the rate of reproduction. However, higher humidity is needed for the predators of spider mite. Keep your growing areas clean, remove leaf litter. Adequate irrigation is important, because water-stressed plants are more likely to be damaged. Broad-spectrum insecticide treatments for other pests frequently cause spider mite outbreaks, so avoid these pesticides when possible. To control spider mite infestations effectively, it is important to know which species of spider mite you are dealing with, because not all spider mites are susceptible to the same predator or pesticide. •

Photo courtesy to Whitney Cranshaw under CC license by 3.0

Figure 12: Damage caused by spider mites.

Figure 13: A large population of spider mites has covered this entire sweet pepper plant with webbing.

Questions & Answers

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

Question

I'm growing with CANNA COCO nutes and soil. Everything seems fine until half-way into the flowering phase when the topmost leaves start to show Ca and Mg deficiencies. A few days later some of those leaves turn purplish. What is going on?

Answer

Well, provided you are mixing your nutrients correctly, it could be that you are watering your plants a little too late (under-watering). Calcium and magnesium are the elements that are the hardest for plants to transport when they are in a state of hydraulic stress. Also the purple you are noticing is probably an excess of potassium exacerbated by the under-watering. Try watering your plants a little earlier and water them until you get 20% run-off which will help wash away accumulated nutrients that might interfere with uptake of magnesium and calcium.

Question

I was recently travelling and saw that the NPK ratio abroad was different than the products that I buy back home in my country. Have you changed the ratio or your PK?

Answer

Absolutely not. This has to do with regulatory bodies in your country. Some countries ask us to print the NPK value as a volume ratio whereas others will require NPK values to be in a net weight ratio.

Question

Does CANNAZYM kill beneficial bacteria and fungi in coco? I have been adding beneficial bacteria and considering using CANNAZYM full dose at harvest and reusing the coco.

Answer

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

Question

How long can I keep mixed CANNA TERRA product in the water tank?

Answer

You can keep a mineral nutrient like CANNA TERRA (Vega or Flores) for a very long time. Make sure you check the pH before every watering because this can change. But if you use an organic additive like CANNA RHIZOTONIC, CANNAZYM or CANNABOOST in addition to the mineral nutrient, the time of stock will be shortened to a maximum of one week. Organic products break down over time due to the effects of light and air (oxygen), which you can often recognise from the air bubbles at the surface of the water tank.

Question

A friend of mine showed me that I was watering my plants too often. Since then I have corrected this and the plants are looking amazing with no more nutrient deficiencies and extremely fast growth. But now I have to leave them unattended for a period of six weeks and my wife will look after them. Are there any tools available to help her know the right time to water?

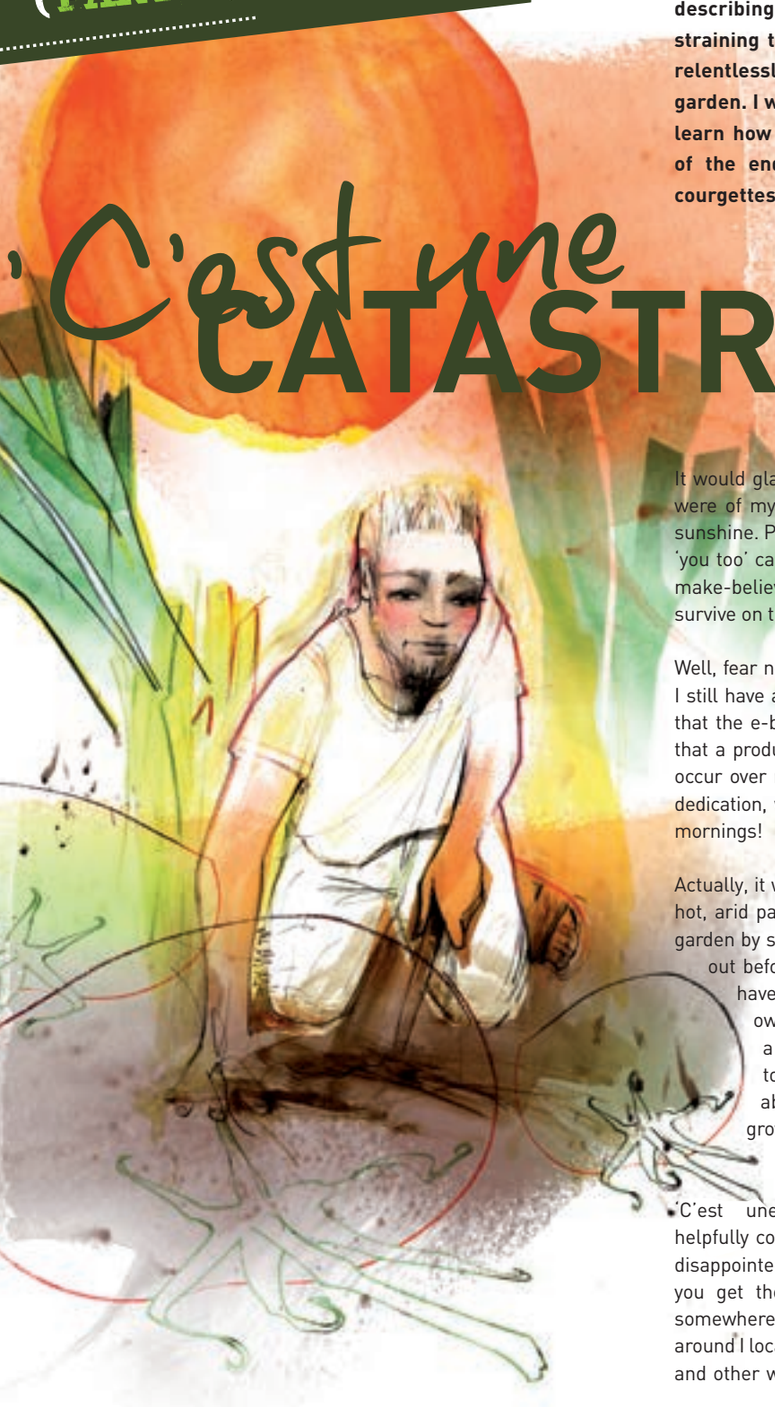
Answer

We wish we had a magic wand in our product range! Unfortunately none of the tools available at nurseries that claim they can tell you when to water are really accurate in their readings. Try teaching your wife to judge the right time to water by feeling the weight of the containers. Go around the garden with her and get her to feel the weight of recently watered containers. These containers should lose about 50% of their wet weight before you water them again. Or you can show her our fourth 'Need to Know' video in the first season at www.canna-uk.com (it's about watering your plants). Good luck!

Don & Nicky

(PART 4)

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.



Okay, so this is the part where I'd dearly love to be describing my wife's homemade wickerwork baskets straining to hold countless kilos of fresh, organic veg relentlessly spewed from my ridiculously productive garden. I want to tell you how we were forced to hastily learn how to can and dehydrate our produce because of the endless gluts of tomatoes, onions, peppers, courgettes, beans, carrots and parsnips.

'C'est une CATASTROPHE!'

It would gladden my heart to know how deeply jealous you were of my blithesome life of freedom here in the French sunshine. Perhaps I could cobble together an e-book on how 'you too' can release yourself from the drudgery of earning make-believe money working a job you hate in order to survive on this beautiful planet?

Well, fear not. Judging from my results in the garden so far, I still have a long, long way to go. You'll be relieved to know that the e-book is on hold for now. Indeed; it would appear that a productive garden (let alone 'self-sufficiency') doesn't occur over night. Neither does it take place without a lot of dedication, work, not a little knowledge and a love for early mornings!

Actually, it was the mornings that really did it for me. In this hot, arid part of the world you absolutely have to be in the garden by sunrise, hoeing, weeding, tending, harvesting and out before the sun gets too hot just a few hours later. I have learnt (the hard, sweaty way) that growing your own food is akin to slavery in itself! That may sound a little harsh but you are certainly bound like a serf to your land. Summer holidays? Forget it! Trips abroad? You must be kidding! Guess what people: growing your own food is really, really hard work!

'C'est une catastrophe!',' one gardening neighbour helpfully commented, shaking her head at me like a deeply disappointed mother. I hadn't just let myself down .... well, you get the picture. Surely the veggies were in there... somewhere? I just had to find them! After some scrabbling around I located carrots in amongst the tall grasses, horsetail and other weeds – oh and some onions too – but the latter had really suffered due to the irrigation channels becoming clogged while I was away on vacation. They had barely formed bulbs. Even my Kelsae 'exhibition sized' onions were the size of...well...normal onions -certainly not warranting any gold medals. I could almost hear Mother Nature cackling from the heavens. It wasn't all bad though. The leeks were doing fine -they were tall, thick and stout and ready for munching. And the parsnips had prevailed too, even if I had nearly given myself a hernia trying to pull them out.

1 Excellent photostock for diseases and pest infestations! This variety of tomatoes just didn't fare well against the intense heat, low humidity and irregular irrigation.

2 Twelve fantastic sweet pepper plants, the result of hard work, regular irrigation and a relatively low-EC nutrient solution.

The tomatoes -you may recall I proudly and somewhat smugly propagated and planted over thirty varieties, ninety-one plants in all.

Well, they managed to yield some excellent photostock for diseases and pest infestations. I learnt why the local growers chose only to grow a handful of varieties. The others -well they just didn't fair well against the intense heat, low humidity and irregular irrigations. My cherry toms did the best, but that's no surprise really. One unexpected triumph was a variety called 'Garden Peach' – an unusual furry-skinned little beast, and 'Pineapple Pig' – a huge, yellow monster of a tom. However, the true beneficiaries of my efforts were hoards of brightly coloured beetles that infested most of the crop.

As if all this wasn't enough, my one outstanding crop – potatoes – was robbed! Yes, two entire rows of my prized Rosabelles were dug up in the middle of the night (presumably). I estimated that was around five large shopping bags' full -quite a haul. Apparently garden theft was common and most fingers pointed towards the migrant workers who came to manage the local vineyards. Whoever the guilty party was, it was an almost fatal finishing move to my now withering ambitions.

However, there is a happier conclusion to this otherwise sorry and tawdry tale. On my small but sunny terrace I discovered that my talents lay in a different arena: container gardening! I set up a modular 12-pot hydroponic flood and drain system and grew twelve fantastic sweet pepper plants! I picked off the early flowers that appeared in June and managed to steer them back towards vegetative growth. The result was larger plants and more sweet bell peppers than I knew what to do with. It looks like I will need to learn how to preserve my produce after all! The peppers loved the shelter of the terrace and were able to withstand the low humidity thanks to regular irrigations of a relatively low-EC nutrient solution.

And the best thing of all about hydroponics? No weeds! Perhaps I've found my true vocation in life after all? •

HOW TO CONTROL PESTS AND DISEASES?

BIOLOGICAL VERSUS CHEMICAL

THERE ARE VARIOUS WAYS OF CONTROLLING PESTS AND DISEASES. THE TWO MOST IMPORTANT AND WIDESPREAD METHODS ARE BIOLOGICAL AND CHEMICAL, BUT THERE ARE MAJOR DIFFERENCES BETWEEN THESE TWO METHODS. THIS ARTICLE WILL EXPLAIN THE BACKGROUND AND PRINCIPLES BEHIND EACH METHOD, AS WELL AS THE DIFFERENCES BETWEEN THEM. By CANNA Research

Chemical control

Chemical pesticides are often used to control diseases, pests or weeds. Chemical control is based on substances that are toxic (poisonous) to the pests involved. When chemical pesticides are applied to protect plants from pests, diseases or overgrowth by weeds, we speak of plant protection products. It is of course important that the plant that needs protection does not itself suffer from the toxic effects of the protection products.
Efforts to protect crops started centuries ago. The Chinese, in around 1200 BC, used lime and wood ash to destroy parasites. The Romans used sulphur and bitumen, a substance derived from crude oil. Substances such as nicotine from tobacco were used from the 16th century on and later copper, lead and mercury as well. After the Second World War the use of true chemical pesticides started and nowadays there are hundreds of chemical pesticides available for use in agriculture and horticulture.

Pesticides are grouped into five main categories depending on the purpose they are usually applied for. The first group are the fungicides, which act against fungi. Then there are herbicides which are used against weeds. Herbicides are taken up by the leaves or the roots of the weed, causing it to die. Insecticides that, as the name suggests, destroy harmful insects, and then there are acaricides which protect plants from mites. Finally there are nematicides to control nematodes that attack the plants.

The advantages and disadvantages of chemical pesticides

The use of chemical pesticides is widespread due to their relatively low cost, the ease with which they can be applied and their effectiveness, availability and stability. Chemical pesticides are generally fast-acting, which limits the damage done to crops.
Chemical pesticides have some major drawbacks, but they are still widely sold and used. We will discuss four of the disadvantages of chemical pesticides here.

First, chemical pesticides are often not just toxic to the organisms for which they were intended, but also to other organisms. Chemical pesticides can be subdivided into two groups: non-selective and selective pesticides. The non-selective products are the most harmful, because they kill all kinds of organisms, including harmless and useful species. For example, there are herbicides that kill both broad-leaf weeds and grasses. This means they are non-selective since they kill nearly all vegetation. Selective pesticides have a more limited range. They only get rid of the target pest, disease or weed and other organisms are not affected. An example is a weed killer that only works on broadleaf weeds. This could be used on lawns, for example, since it does not kill grass. These days, a combination of several products is usually required to control several pests because almost all permitted products are selective and thus only control a limited range of pests.

Another disadvantage of chemical pesticides is resistance. Pesticides are often effective for only a (short) period on a particular organism. Organisms can become immune to a substance, so they no longer have an effect. These

Figure 14: Accumulation, which is illustrated here, is one of the disadvantages of chemical pesticides. Animals or humans at the end of a food chain have a greater chance of damage or dying due to the build-up of pesticides in their system. This drawback is becoming less important, however, because pesticides that do not break down quickly enough are no longer permitted.

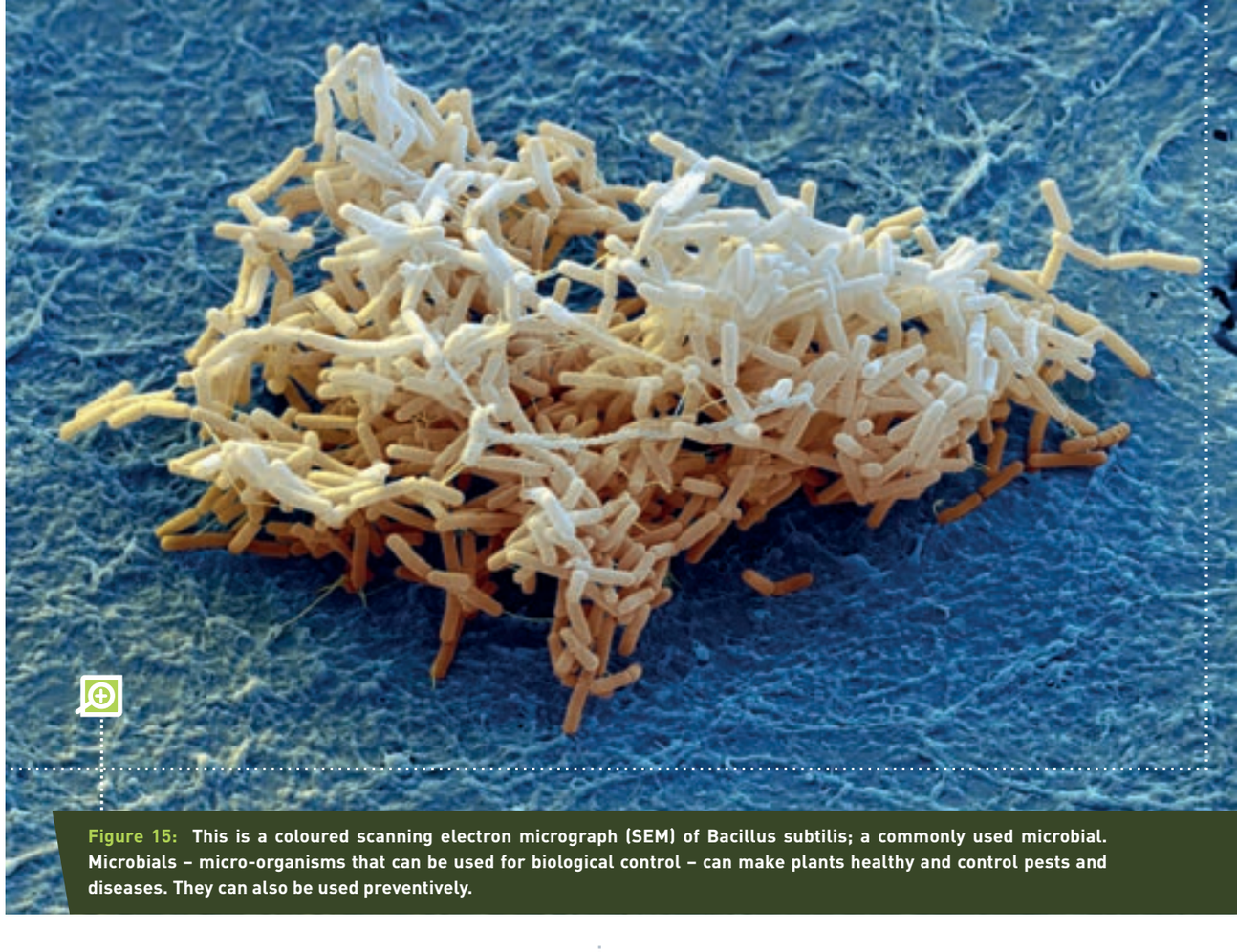


Figure 15: This is a coloured scanning electron micrograph (SEM) of Bacillus subtilis; a commonly used microbial. Microbials – micro-organisms that can be used for biological control – can make plants healthy and control pests and diseases. They can also be used preventively.

BIOLOGICAL VERSUS CHEMICAL

organisms mutate and become resistant. This means that other pesticides need to be used to control them.

A third drawback is accumulation. If sprayed plants are eaten by an organism, and that organism is then eaten by another, the chemicals are can be passed up the food chain. Animals at the top of the food chain, usually predators or humans, have a greater chance of toxicity due to the build-up of pesticides in their system. Gradually, however, this effect is becoming less relevant because pesticides are now required to break down more quickly so that they cannot accumulate. If they do not, they are not permitted for sale.

The last and most significant threat relates to the remains or residues of pesticides which are left behind on the crops. Residue may be consumed on fruit or vegetables, for example, and for this reason crops may not be sprayed close to harvesting. Alternatively, the remains of pesticides may soak into the soil or groundwater and the contaminated water might then be used to spray the crops or be drunk by animals. In short, there are various ways of minimizing the adverse environmental effects of pesticides: use selective pesticides (which do not harm beneficial organisms significantly); choose a pesticide that breaks down quickly; take care when spaying crops so that there is no drift to other crops.

Biological control

Biological controls consist of three different parts;

1 Macrobials
2 Microbials
3 Biochemicals

All three of these will be explained in brief.

Biological control using natural predators or parasites (macrobials)

Biological control is no fad. In China in the fourth century B.C., ants were used as the natural enemy of pest insects, and in South China today ants are still used to control pests in orchards and food stores. The usefulness of parasites was discovered much later. Most parasites are insects, such as parasitic wasps (Encarsia formosa), which during the egg, larva and pupa stages live in or on a host. The complicated life cycle of these insects was first described in the early 18th century by Antonie van Leeuwenhoek. However, it would be many years before their potential use in pest control was discovered. In 1800, Erasmus Darwin, the father of Charles Darwin, wrote an essay on the useful role that parasites and predators may play in combating pests and diseases.

Biological control assumes that natural predators or parasites are able to suppress pests. Initially, therefore, natural enemies were imported to control the pests. These natural predators were released in small numbers, but once they became established they were effective in the long term. This method is also called inoculation. When the natural predator is introduced periodically, it is known as inundation.

There are two groups of beneficial macrobial organisms: predators and parasites. Parasites are organisms that live at the expense of another organism, such as the larvae of parasitic wasps, which live in the larva of whitefly and eat them from the inside. Predators are organisms that simply prey on other organisms for food, such as ladybirds, which eat aphids.

Some examples of commonly used macrobials are; Phytoseiulus persimilis against the red spider mite, Encarsia formosa against whitefly and Neioseiulus cucumeris against thrips.

Biological control using micro-organisms (microbials)

Several beneficial micro-organisms can also be used to improve plant health and control pests and diseases. Bacteria, fungi and other micro-organisms can have these effects because they compete for nutrients or space, they produce antibiotics or they simply eat other harmful micro-organisms.

Microbials can also be used preventively because they can make the plants healthier and stronger. When this happens, plants are not attacked by pests or diseases or are affected less by them. This kind of pest control is not visible.

Some examples of commonly used microbials are; Trichoderma and Bacillus subtilis.

Biological control using resources of natural origin and pheromones (biochemicals)

In addition to macro-organisms and micro-organisms, there are also resources of natural origin and pheromones which can be used to control pests and diseases. This category is very wide, including plant extracts, vitamins and plant hormones. These also work preventively to make plants strong and healthy. The pheromones are used to lure the pest (insects) into a trap. Sex pheromones and aggregating pheromones are the most commonly used types.

The advantages and disadvantages of biological control

Biological control, just like chemical control, has advantages and disadvantages. We will mention three major advantages here, as well as several disadvantages. The first advantage is that the natural enemy can become established and this will produce long-term results. The risk of resistance is also much lower since pests cannot build up resistance to being eaten. Natural pest control is very targeted and therefore an effective way to control particular pests.

The disadvantages of biological control are that natural enemies may move away. In greenhouses this problem can be managed, but not in open fields. Spreading over a larger

Figure 16: **Chewing insects like this brightly coloured caterpillar could be history in the future because our ability to control pests with biotechnological methods is growing rapidly. This technique involves genetically modifying a crop to make it produce an insecticide that makes it unattractive to insects or even kills them. Bt maize is an example of a crop that is resistant to insects.**

BIOLOGICAL VERSUS CHEMICAL

plot also takes time. In the second place, pests are never destroyed completely because the natural enemy needs to stay alive and they will therefore never destroy the entire population. Finally, it is not possible to use them before the pest has occurred and this means that some damage will be done to crops.

Some biological applications are not completely harmless either. Although these are natural products, other organisms than those targeted may be harmed. A natural enemy may also damage the crop, especially when large numbers are needed to control a pest.
The effect of natural enemies is also less pronounced than chemical control. So if the biological method does not work, a higher dosage of chemical pesticides is required, because the pest already is widely spread.

Finally there are no natural methods for the control of viruses others than removing the affected plants.
Just like chemical control, biological control is constantly under development because new pest organisms (insects, fungi, bacteria) appear and organisms mutate. Products that provide biological control through chemicals of natural origin are classified as plant protection products, just as pesticides are, and so they also have to meet strict requirements. This category of 'plant protection products' can also be rather expensive as a result.

Conclusion

Many people oppose the use of chemical plant protection products, but is this realistic? If you find yourself not feeling well, would you take an aspirin?
Horror stories about birds falling dead from the sky after eating sprayed insects are, fortunately, history. There are strict rules about which pesticides may be used on which crops. There are regulations not only about which products are allowed, but also at what dosage, and about how and when to use them. There are also strict checks.
The introduction of bumble bees to pollinate crops has made it necessary to use less pesticide. Most growers use Integrated Pest Management, which is described as follows: "the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimise risks to human health and the environment. Integrated Pest Management emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms."
In both cases the grower should have enough knowledge to control the pests and diseases. Firstly he has to identify the pest. Then he has to know how it spreads and what kind of damage it causes. The next step will be to find out if biological control is possible, which method to use, the amount that should be used and the conditions needed to be effective. Or, alternatively, which pesticide to choose, how to use it and which restrictions apply.

In addition to chemical and biological control, interest has also been growing in recent years in the possibility of controlling pests using biotechnological methods. In that case, no substances or natural enemies are used on the crop, but the crop is genetically altered in such a way that it produces substances that make it unattractive to insects or even toxic to them. The plants thus repel insects themselves. There is pressure from supermarkets and governments to use biological controls instead of chemical pesticides. But the conclusion of this article is that there are no perfect solutions. It depends on the situation, the crop, the knowledge of the growers, even the weather conditions and the stage of development of the crop. There is no perfect solution. There are only advantages and disadvantages. In all cases it is important to use to control the method in the correct way.•

Grower's TIP #23

By F.F.

APPLYING PESTICIDES

The effectiveness of using a pesticide indoors is limited to how well it is applied. This must be done correctly, at the right time and using the correct dose to maximise the effects.

Most insecticides and fungicides are contact products, meaning that in order to kill the insect or fungi, the mixture needs to come into contact with the invader. This means that the spraying has to cover all the plant tissue. Spraying the underside of the leaves is usually harder than spraying the tops. Using a sprayer with an inverted spray nozzle can facilitate spray coverage.
To maximise surface coverage, the sprayer should emit very small droplets of the diluted product within the mist. In some cases, adding a squirt of washing-up liquid to approximately 4 litres of mixture can help 'flatten' the droplets that are deposited, so that they will cover a larger surface area and this ensures more contact with the invaders. But this is also why it is important to follow all the safety precautions on the label, including wearing safety glasses, respiratory protection, and protective clothes: the finer the droplets produced, the more of the product will become suspended in the air during application.
In theory, spraying in the dark would enable the product to work for a longer time on the plant tissue. But in reality, it is impossible to guarantee complete coverage when the worker cannot see the results of the application. It is therefore better to turn off half the lights in the garden and spray the plants beneath those. After a couple of hours, the lights can be changed and the other half of the garden can be sprayed.
Never forget to shake the concentrated product and mixture (diluted product) thoroughly before applying because some pesticides tend to separate when stored. This can seriously inhibit their effectiveness if they are not shaken back into solution before being applied.

Other insecticides and fungicides are systemic products, which means that in order to work they need to be absorbed by the plant or plant roots. To maximise the results, apply these when it is the right time to water the medium. This will ensure that the plant takes up most of the product and reduces losses through percolation and drainage. However, this does not mean you need to apply them to a dry plant, because plants under water stress can suffer serious damage.
In all cases, reading the label on concentrated products is a must. Sometimes manufacturers change the dilution ratios. Never make assumptions about this information because such an error could cause irreparable damage to your plants. Applying these products when infestation levels are high reduces their effectiveness. Scout your garden regularly and spray if you notice even a small population of pests to maintain control over the long term.

Puzzle&WIN

The sudoku puzzles we published in editions #20 and #22 of CANNAtalk were very popular! So this time we thought we'd to put you in for the ultimate sudoku test. Never done this kind of puzzle before? Here's what to do: each row, column and 3 x 3 grid must contain the each of the numbers one to nine once.

WIN A 1 L BOTTLE OF CANNACURE!

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

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 to check) and maybe ...**YOU will be the lucky one who wins a 1 L bottle of CANNACURE!**

WHAT'S NEXT

As a grower, we know that you love your plants and you'll always make sure that they have enough water, light and nutrients. You will do everything for a healthy plant. Of course! But sometimes unexpected things just seem to happen of their own accord: leaves turn yellow, or they get brown spots. Maybe your plant has a deficiency... Want to know what you can do about it and – most importantly – how you can prevent it? You'll read all about this and a whole lot more in the next edition of CANNAtalk. Don't miss it!

CANNAtalk is your magazine, YOUR VOTE COUNTS!

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

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

Request information

- ☐ AQUA Fertilisers (Recirculating systems)
- ☐ HYDRO Fertilisers (Run to waste systems)
- ☐ COCO Fertilisers (Coco Coir)
- ☐ TERRA Fertilisers (potting mix)
- ☐ Additives (Optimizing your yields)
- ☐ List of shops in my area
- ☐ Send me a CANNA Calendar 2014. I've secretly enclosed 10 pounds in this envelope to pay for it.

Solution to the puzzle:

#23

CANNAtalk®

SERIOUS GROWERS

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