CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

ISSUE 27 2015

PLANT GROWTH REGULATORS

How they affect plants

HOT ROD GALORE

Soup it up!

KOHLRABI

Space cabbage

HQTalk:

A long time ago, way back when I was still at high school, one of my schoolmates was already 2.09 meters tall, quite an impressive height for the age of 15. Man, I would have given anything for a few of his extra centimeters. But it turned out that he wasn't so happy about being so tall, and he had actually been prescribed hormones to stop him growing any more. This was because if he'd carried on growing as fast as he was, he could easily have ended up at 2.20 meters by the time he was 18. So it seems there is such a thing as too tall...
And just like my schoolmate was taking hormones to stop him from growing, there are also people who are given growth hormones to supplement their own body's hormones so that they can grow an extra few centimeters.
But it's not only people who have hormones that regulate their growth. Plants do too – so-called 'plant growth regulators' (PGRs). These molecules influence the development of the plant and when they occur in the plant in a natural way, they are known as phytohormones or plant hormones. And that is exactly the theme of this edition of CANNAtalk.
Starting on page 4, CANNA Research gives you some background information about the five main plant hormones. And although PGRs can have a number of desirable effects, there are also some drawbacks to using them, both for the grower and for consumers and retailers. In fact, the use of these substances is strictly regulated by the law. It is certainly best to know all about this (starts on page 22) before you start using PGRs.

We hope you enjoy reading!
Jeroen

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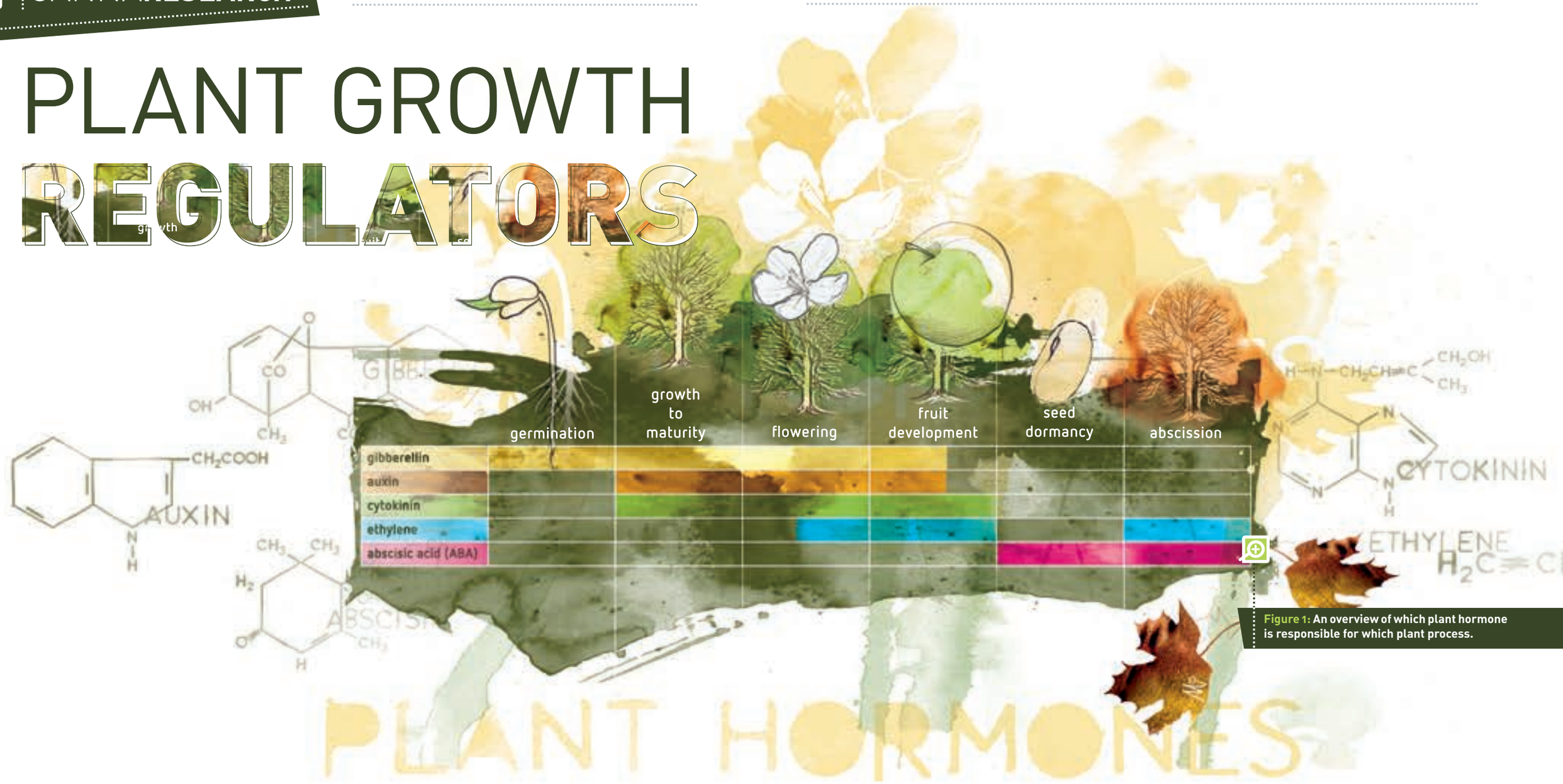

Figure 1: An overview of which plant hormone is responsible for which plant process.

PLANT GROWTH REGULATORS ARE MOLECULES THAT INFLUENCE THE DEVELOPMENT OF PLANTS AND ARE GENERALLY ACTIVE AT VERY LOW CONCENTRATIONS. THERE ARE NATURAL REGULATORS, WHICH ARE PRODUCED BY THE PLANT ITSELF, AND ALSO SYNTHETIC REGULATORS; THOSE FOUND NATURALLY IN PLANTS ARE CALLED PHYTOHORMONES OR PLANT HORMONES. By Ignacio García, CANNA Research

Substances considered phytohormones include auxins, gibberelins, cytokinins, abscisic acid and ethylene, and more recently brassinosteroids, salicylic acid, jasmonates, systemin, polyamines, nitric oxide and signal peptides.

There are differences between plant and animal hormones. For example, animal hormones are synthesized in particular organs or tissues, and by definition they act in different places to where they are produced. This is not necessarily true for phytohormones; some exert their action in exactly the smae place where they are synthesized.

Although all phytohormones have their own specific effects, their combination produces a varied response in plants.

Auxins

The main effect of auxins is to cause cell elongation, mainly due to the alteration of cell wall plasticity. Auxins are synthesized in the apical meristems and to a lesser degree in the roots. The main auxin to be synthesized naturally by plants is indole acetic acid (IAA), although others have been found such as phenylacetic acid, the chlorindoles and, more recently, indole butyric acid (IBA).

The movement of these phytohormones is from the apices to the roots (basipetal) and vice versa (acropetal). However, basipetal movement is much more rapid than acropetal movement.

Some of the effects of auxins in plants include:

Apical dominance. It is well known among growers that when one eliminates the main apical axis (main vertical stem) of a plant, secondary apices will begin to grow and several of these will go on to form main stems. This occurs because the auxins produced by the apical meristem suppresses the growth and development of secondary buds.

Rhizogenesis. Auxins are the main components responsible for the formation of root cells. This property is used by gardeners to produce cuttings: applying auxins to the base of the cut promotes the formation of new roots. This rhizogenesis occurs at very low concentrations of auxins, since higher concentrations of auxins suppress root growth and development. However, it is the presence of other phytohormones that determines whether the new cells become roots or other organs. The balance between auxins and cytokinins plays a very important role in this process.

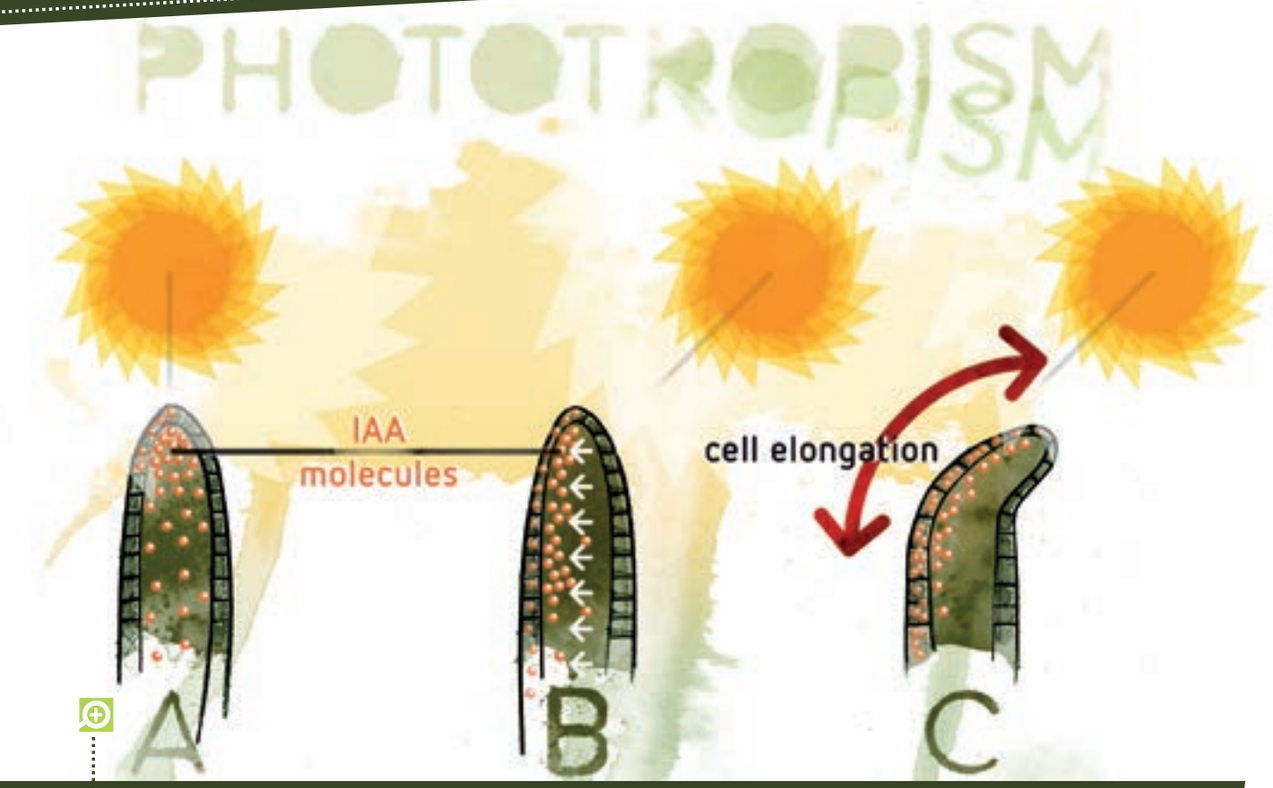

Figure 2: Phototropism is the growth of a plant in response to light. This process is regulated by auxins. A: when sunlight is overhead, the IAA molecules (Indole Acetic Acid; the main auxin to be synthesized naturally by plants) produced by the apical meristem are distributed evenly in the shoot. B: once the sunlight starts to reach the shoot at an angle, the IAA molecules move to the far side and induce elongation of cells on that side. C: cell elongation results in the bending of the shoot toward the light.

Figure 3: This is a close-up of a seed (left) from a spinning top conebush seed head (right). The seed (black) is suspended from a parachute of fine hairs called a pappus. The hairs help the seed to catch the wind when they are released from the seed head. The seeds can be dispersed many kilometers on the wind. Conebushes are indigenous to South Africa. The plants may be either male or female. The male plant has small narrow flowerheads, while the female plant (pictured) has large green cone-shaped flower heads, that later change to a copper color.

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Thus when plant cells are grown in vitro in culture media, if the concentration of auxins is greater than that of cytokinins, new roots will be formed. However, if the concentration of cytokinins is greater than that of auxins, the cells will eventually develop into new buds. When the concentration of the two hormone types is similar, cell growth will occur without differentiation, forming a mass of developing cells called a callus.

Geotropism. Gravity exerts an effect on plant development. When a plant stem is placed in a horizontal position, lateral buds will begin to develop and may form roots in the zone which is in contact with the soil. This is due to the accumulation of auxins due to the effect of gravity. This phenomenon is used to obtain new plants using a technique called layering.

Phototropism. Plants tend to grow towards the light. This process is regulated by auxins, which accumulate in parts that receive less light; this results in the elongation of the cells in this zone and makes the stem curve towards the light.

Regulation of abscission. Abscission is the shedding of some parts of the plant. In many cases the cause is the aging of the plant tissue, called senescence. The exogenous application of auxins will reduce abscission in many species.

Fruit set. When pollination and fecundation occur, the concentration of auxins in the fruit usually increases, possibly as a result of production by the developing seeds. If fecundation does not occur, the fruit are shed instead of developing and maturing. But by applying auxins, the formation and maturation of fruit can occur without pollination or fecundation (and therefore seed formation) being necessary. The development of fruit without fecundation is called parthenocarpy and it is widely used when the formation of seeds is undesirable or when no pollination is possible. This occurs when insect-pollinated plants are grown into greenhouses. When there are no pollinating insects, exogenous auxins are applied to promote fruit set.

Gibberelins

These phytohormones are partly responsible for cell division and the elongation of stems and other tissues. They were discovered by Japanese researchers studying a disease in rice. The disease caused recently germinated seedlings to acquire a yellowish color and the stem to elongate excessively, leading to the death of the plant. The researchers discovered that these symptoms were caused by the Gibberella fujikuroi fungus. This fungus produces a large quantity of these phytohormones which are introduced into the host plant.

Since then, various types of gibberelins have been discovered and isolated. These were given successive numbers as they were discovered; GA1, GA2, GA3, etc. GA3 is gibberellic acid.

Gibberelins are synthesized mainly in meristematic organs and developing tissues.

Functions of gibberelins

Seed germination. In seeds, some of the gibberelins combine with glucosides, and become inactive in this form. During germination, enzymes destroy this combination and the gibberelins are unlocked and activated. This stimulation of germination has been demonstrated in a number of experiments which showed how the application of gibberelins accelerated the germination of lettuce seeds. It was also shown that exposure to light accelerated the germination of lettuce seeds. Later studies showed that light accelerates the transformation of the gibberelins from the inactive conjugated form to the active form.

Sex expression. In species with unisexual flowers - that is, separate male and female flowers, either on the same plant (monoecious) or on different individuals (dioecious) - gibbberelins appear to have a regulatory effect on sex expression. For example, the application of gibberelins in female asparagus plants produces the appearance of male and hermaphrodite flowers. By contrast, gibberellin application in maize plants produces the appearance of female flowers in the tassels (masculine inflorescences).

Influence during the juvenile period. Juvenile plants are different to adult plants - for example, developing fruit trees must mature for several years after seed germination before they are capable of producing flowers and fruits. In some cases they also have different characteristics when adult (for example, the presence of spines or leaves with different shapes). Gibberelins play an important role in the transition from the juvenile period to the adult period. In some plants, such as ivy, the exogenous application of gibberelins produces the expression of branches with juvenile characteristics.

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Fruit set. As with auxins, gibberelins stimulate fruit set in some species.
Induction of flowering. Some plants require long days or cold periods to flower, but the application of gibberelins induces flowering independently of the photoperiod or the temperature.

Cytokinins

The discovery of these phytohormones was due mainly to in vitro cultivation studies. The first observation was that "coconut milk" (the endosperm of the fruit) promoted the growth of several tissues cultivated in vitro.
The first natural cytokinin isolated and identified was named zeatin, since it was isolated from maize (Zea mays) seeds.
The main function of the cytokinins is to produce cell division and retard senescence. As mentioned above, cytokinins in combination with auxins lead to the formation of undifferentiated cell masses called calluses. They also stimulate the development of lateral apices when applied exogenously, breaking apical dominance.

Figure 4: This picture shows a colored freeze-fracture scanning electron micrograph (SEM) of a flower with the top removed, showing a central ovary (pale pink, center) containing ovules (orange). The ovary contains the ovule, which contains the female sex cells. Here, it is surrounded by the filaments of the stamen (pink), at the top of which are the anthers (not seen), the male reproductive parts that produce pollen (male sex cells). The green leaf-like structures are petals.

Ethylene

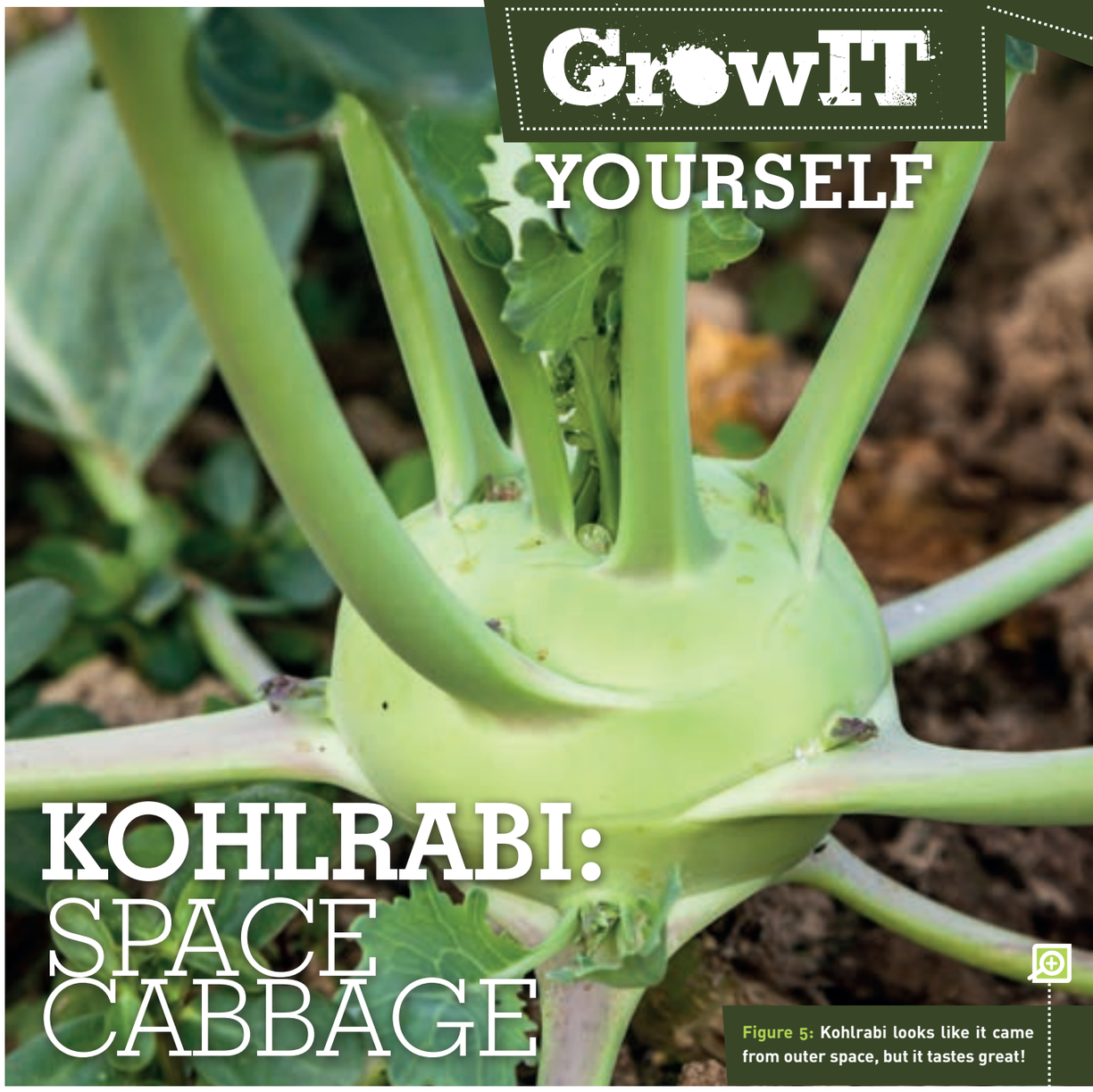
Ethylene is a simple hydrocarbon that is a gas under normal conditions. The effects of ethylene on plants was discovered when streets were illuminated with carbide lamps. The combustion process led to the emission of ethylene and the leaves of trees near these lamps turned yellow and were shed.
The main function of ethylene is on fruit maturation and the senescence of leaves and flowers. In species with climacteric fruit, maturation is induced by an increase in this hormone. It is also responsible for the change in color of some non-climacteric fruits (that is, fruit whose maturation is not affected by ethylene), as occurs in citrus fruit. Ethylene is used to mature fruit that has been collected prematurely. It is applied by burning in closed chambers or with ethephon, a product which decomposes into ethylene when hydrolyzed in the plant.

Another function attributed to both ethylene and gibberelins is the regulation of sexual expression in dioecious plants. The application of ethylene in asparagus induces the appearance of female flowers in male plants.
Ethylene plays an important role along with jasmonic acid in stimulating the production of substances that protect the plant from biotic and abiotic stresses.

Abscisic acid (ABA)

As the name indicates, this hormone is directly implicated in the senescence and abscission of leaves, flowers and fruits. It also affects the latency of some seeds.
As in the case of ethylene, this phytohormone induces the expression of resistance genes for a number of stresses. One effect of ABA is to produce stomatal closure during drought conditions, thus preventing dehydration in the plant.

→ Well, this was a lot of PGR information. If you do like to know more about the benefits and the drawbacks we can highly recommend the article on page 22!



KOHLRABI: SPACE CABBAGE

Figure 5: Kohlrabi looks like it came from outer space, but it tastes great!

IT'S A ROOT. IT'S A CABBAGE. IT'S A SPACE ALIEN TURNED VEGGIE. GET READY FOR A JOURNEY INTO THE UNIVERSE OF THE KOHLRABI WHERE ONE VEGGIE SUDDENLY TURNS INTO TWO. IT MIGHT BE UGLY, BUT UGLY HAS NEVER BEEN THIS COOL.

By Marco Barneveld, www.braindrain.nu

So what exactly is this strange round vegetable with projecting leafy stems? "It looks like a witch turned into a turnip," my son said. True. It's not the most attractive organism. This knobbly bulbous brassica has a peculiar, alien look with its pale green color and strange protruding stems. Although it's sometimes known as a 'space cabbage', kohlrabi really is a very down-to-earth veggie. The name is German for 'cabbage turnip', and kohlrabi is a member of the extensive cabbage family, which also includes broccoli, cauliflower, kale and mustard. It offers the same awesome health benefits just like its vegetable cousins. But kohlrabi is easier to grow than its relatives, and fast to mature, making it ideal for fall or early spring planting.

Two-in-one

Compared to the rest of the cabbage family, kohlrabi is thought to have been developed fairly recently in the 16th century in central or northern Europe from a thick-stemmed plant known as marrow cabbage. The modern kohlrabi actually has

Figure 6: **The coloration in the purple types is only superficial: the edible parts are all pale yellow.**

an enlarged stem that develops into a bulb just above the soil. It has a juicy crispness and a light flavor, which is slightly sweet and milder than both cabbage and turnip. People from Poland even crunch into them raw and unskinned, like an apple. Kohlrabi is also prized in north Indian cuisine, where it is cut into segments and cooked in spicy gravy, with its willowy stems and leaves still attached. Kohlrabi is an important part of the Kashmiri diet and is one of the most commonly cooked foods there. It is prepared with its leaves and served with light gravy and eaten with rice. Several varieties are commonly available, including White Vienna, Purple Vienna, Grand Duke, Gigante (also known under the fantastic name of Superschmelz), Purple Danube, and White Danube. The coloration in the purple types is superficial: the edible parts are all pale yellow.

And yes, this is a two-in-one vegetable because the leaves taste almost as good as the kohlrabi itself. They make a novel substitute for kale or spring greens. Yummm.

Health sputnik

Although it doesn't look too elegant, kohlrabi is amazingly healthy. This sputnik-like veg packs even more vitamin C than oranges, and as we all know vitamin C is a powerful antioxidant and vital for healthy connective tissue, teeth and gums, immune system and it protects against many diseases. Like other brassicas, kohlrabi contains health-promoting phytochemicals that appear to have an anti-cancer and anti-inflammatory effect. Chronic, low-level inflammation can raise your risk of heart disease, stroke, diabetes, Alzheimer's, osteoporosis and other common diseases. Kohlrabi juice also helps to ease skin problems. Drink a glass of carrot and kohlrabi juice every day in the morning with plenty of water throughout the day for good results. And as if that was not enough, kohlrabi is also rich in calcium, potassium, iron, phosphorus, manganese and copper. If you want to sky rocket your health, make this space cabbage part of your weekly diet.

Figure 7: **You can grow kohlrabi in almost any region if you grow it in the spring or autumn. Good timing is key.**

Grow it yourself

Adventurous gardeners and cooks who try kohlrabi quickly become fans, singing the praises of this unique, easy-to-grow veggie. Here's how to bring out the best in this cool crop.

Like other members of the cabbage clan, kohlrabi thrives in cool temperatures. You can grow kohlrabi in almost any region if you grow it in the spring or autumn. Good timing is key. You want to avoid the bulbs forming during hot weather, which can make them woody.

Start the seeds in a greenhouse or in your window. Then transplant the small seedlings to the garden two to three weeks later. Plant them 5 inches apart, with 6 to 7 inches between rows. The bulbs will be ready for harvesting in five to seven weeks, depending on the variety and seasonal conditions. When you start them off in August, you can also leave them in the ground for on-demand harvesting. The mature bulbs are very frost tolerant and hold well in the garden. In mild winters, you can even harvest them in January.

Growing kohlrabi for an autumn harvest has another advantage. A light frost will actually enhance the bulbs' flavor, making them sweeter.

For a spring crop, beat the heat by starting your seeds indoors about six weeks before your last expected frost. You can sow kohlrabi seeds directly in the garden, but you'll have a better chance of avoiding the heat by starting the seeds earlier, indoors. Transplant the seedlings into raised garden beds in mid-April.

Low maintenance

Beyond the need for cool temperatures and full sun, kohlrabi is not especially demanding. Anything you can do to ensure steady, consistent growth will help. Too much stress on the plants such as drought or high temperatures can affect the bulbs, causing them to become spicy like a radish. But with steady temperatures and consistent soil moisture, kohlrabi will stay tender and the flavor will be mild.

The best way to provide those stress-free conditions is to make sure your soil contains plenty of organic matter such as compost, grass clippings or well-rotted manure so that nutrients and moisture are released slowly and steadily.

Kohlrabi is not a heavy feeder. A generous layer of compost mixed into the soil before planting should provide all the necessary nutrients. For an extra boost give a little more compost when you first notice the bulbs beginning to swell. Insect pests and diseases shouldn't be a problem.

Long lasting

Kohlrabi won't keep you waiting long. Within weeks of planting, you'll see the stems begin to swell and form the funny round globes that prompted its nickname. Soon after that, your kohlrabi will be ready to harvest.

If it's spring, don't hesitate to harvest: Kohlrabi is at its most tender and sweet when the bulbs are no more than 1 to 2 inches across. Autumn-grown kohlrabi is less susceptible to warm temperatures and you can harvest at a more leisurely pace.

There are plenty of ways to enjoy your crop. Try our delicious kohlrabi slaw recipe/ But if you find that you just cannot use up all your kohlrabi at harvest time, it's no big deal. Simply trim off the leaves and stems, wrap the bulbs in plastic and you can store them in your refrigerator for several months. Pretty cool for a space cabbage, huh?

Eat it yourself: Kohlrabi slaw

Ok, it's ugly. It looks like it came from outer space. But it tastes great and the bulbs and leaves are extremely versatile. The round bulbs can be steamed, stuffed or stir-fried. You can add them to soups or slice them and roast them in the oven. Raw kohlrabi slices are crisp, sweet and mildly tangy, making them sensational with vegetable dips, or in salads. And don't forget those green leaves: they make a tasty, nutritious addition to salads and stir-fries.

This simple kohlrabi salad recipe with cilantro and lime zest - is dressed with a refreshing citrus vinaigrette made with fresh orange juice. •

RECIPE

Photo courtesy of Feasting at Home.

KOHLRABI **SLAW**

You'll need:

- **½ a kohlrabi**
- **Small bush of cilantro**
- **Two spring onions**
- **One lime**
- **One orange**
- **One red pepper or jalapeño**
- **Olive oil**
- **Salt and pepper**
- **Jack Daniels**

Cut the kohlrabi into small strips, julienne style. Squeeze the lime over the kohlrabi. Cut up the bush of cilantro and mix it up with the kohlrabi. Then cut the spring onions and add to the mixture. Squeeze the orange and mix the juice with a dash of olive oil. Add salt and pepper to taste. Dress the salad with this mixture. Cut the jalapeño or red pepper, or both if you are feeling adventurous, and sprinkle this on top of the slaw. Finish off with just a little orange peel and let it rest for half an hour. And what about the Jack Daniels? Just pour yourself a nice glass and add an ice cube. Sit on the porch in the sun.

Sip. Eat. Enjoy.

Questions & Answers

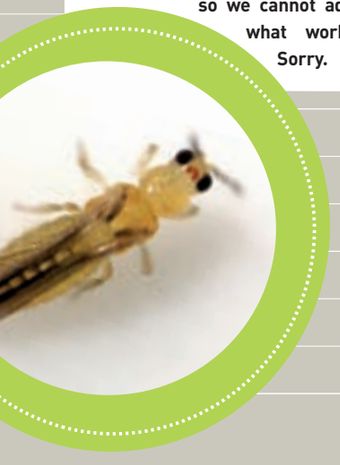
We receive a lot of questions about growing. Of course, our researchers are more than happy to answer them! Just go to the contact page on our website, www.canna-hydroponics.com, to submit your question.

Question

What is a good product to use in an aero set-up for pests such as root aphids and thrips that will not react harshly with CANNA AQUA products?

Answer

It is beyond our scope and legal position to give any advice on the use of chemical or control that fall under Federal FIFRA guidelines. The best source for this information would be 1) the company producing the chemical you are considering using, or 2) though your own trial and error. Even usage rates would vary. We do no tests to see how our product combines with any pesticide so we cannot advise you what works best. Sorry.



Question

My plants seem to start off green and healthy and by the time harvest comes around, the tips of the leaves are brown and most of the large fan leaves are brown and have dried out or been shed entirely, and some of the leaves have yellow edges. I am curious if you had recommendations for feeding? I'm using perlite potting mix in 15-gallon pots, and according to the feed chart I am feeding 2 gallons every 2-3 days with recommended amounts of nutrients in each gallon. The humidity of the room stays between 30 and 40%, temperature runs 85ºF day to 73ºF night, and I use CO^2 from the moment of light change.

Answer

It seems to us that you are having a water issue. What we can see from what you are saying is that you are using a high-porosity medium in very dry conditions with warm temperatures and warm roots. Additionally you are supplementing CO^2 which accelerates the rate at which the plant uses water. Key symptoms are hanging tips at both night and during the day, with the leaves paying the price and drying up. This lack of support for the flowers translates into poor harvests. You state that you are following a chart using 2 gallons of water every 2-3 days. We do not know where this chart is from, but the rule here is always to water when the plant needs it, not just on schedule. Under ideal conditions with twice the humidity, the same temperature and no CO^2 supplementation, the usual amount would be about 7-8 liters per day, which is closer to 2 gallons per day, given the size of your container and plants. While the plant is never denied water, it does suffer long-term drought stress. The tips are always dry and the plant sheds leaves in order to reduce the mass of the plant according to the amount of water that is available. Then it puts on weak flowers which will produce a few seeds and this in the end will satisfy the plant's only real aim in life: to propagate. The solution is to increase the amount of water to provide solution when the plant needs it. When about 50% of the water that the medium will hold when it is wet, is used up. Additionally, increase the humidity levels to a minimum average daily value of about 50% during production, dropping off to about 40% at harvest time. Watch the CO^2 because it will increase water use. As an additional note, please verify that the amount of CO^2 being released into the air is correct and the controls are accurate. Too much of this gas will cause this issue as well and it should be kept below 1600 ppm at all times (and in any case values above 900 ppm will not be of any value). Adding this issue to the lack of water will really hurt your plants. That is what we think.

Question

We have computer-controlled environments. Our environment is perfect, lighting conditions perfect. VPD is between 9-10mb. I have used coco for a while with other products with good success. My start water is 0.0 EC but the pH is variable. But after a lot of research and wanting to simplify my feed schedule, I have decided to use CANNA's full line for the first time.

I have CANNA Coco A and B, CANNA RHIZOTONIC, and CANNAZYM. I also plan to use fulvics and drip clean. So this is where my questions start: CANNA says to mix base nutrients and let it sit for some hours. Is this necessary? I have read it is better to set the pH of 6 in veg to make more nitrogen available and 5.8 in flower? Is this what you would suggest? Our veg cycle is 8 weeks I have heard it is better to run CANNA COGr Vega because it is more suited for long vegetative times? By the way, I use CANNA Coco with 30 perlite mix. Can I use Vega and Flores with regular coco or use Vega in veg and Coco A&B in flower? I have noticed some plants that are light in color, but I have other strains that are good in color. I can't really find a reason for this but that strain may be able to handle heavier feedings?

I also have noticed some plants have drooping leaves during the day, but it goes away, why? I have not seen this before. They are not over or under watered either. I am very meticulous when it comes to EC, pH and feedings and amount of water given. Another question that I have is I usually water when the pot has lost 50 % of its weight. But I have also seen a plant do very well with a feeding everyday no matter if it has lost half its weight. Which is a better way to water with coco? Also interested in what CANNA suggests as optimal substrate pH and EC. There is a lot of misinformation when it comes to this. Anyways I hope I will get some answers soon on these issues. Thanks for your help.

Answer

Well, actually there is no missing information if the grower follows our suggestions and feed charts, just where changes get made or different products get used. Most of your issue comes from the addition of 30% perlite to a medium that already has decent porosity. Because of the increase in air or large pore space, and the size of those pores, and given the refill capacity of coco's small pores to refill the large spaces, there is a slow-down in the available water showing up at the root surface and the requirements of the plant. This is a part of the yellowing and a part of the daytime droop. It is expected to be uneven in its appearance. It is like a carburetor: there has to be the capacity to refill the bowl with gas when the plant starts using it or it will be limited in its power. Lights on, water use ramps up, but there is not enough water is in the system of pores, so what is there gets used up too quickly, then the plant slows, then the medium catches up, then the plant recovers a little. The second issue arises in your use of RO water - or so I assume as you state an EC of 0.0 - and a rather wild pH given the state of the water EC. Add back enough tap water to get an EC value of about 0.2-0.4. Calcium availability is also needed to keep the water moving. In your scheme, the calcium is confused and trying to set up water hardness while being stripped out by the coco. No organic acid is needed in any system that employs coco or peat. Why? Because both these products release large amounts of these acids so, while we try to balance the large amount in the system, some growers want to add more. It is a waste of money and has no additional function in this system. Using anything but a Coco product on coco is a mistake, although with 30% perlite, you are getting close to the point where you can get away with it. Watering coco, unadulterated, is always done (early in the crop before getting a firmly established root system) is always best at 50%. After this point, it is less of a problem but should never go below this mark. Since moisture does not totally penetrate a heavy root system, it may well be necessary to shift to more frequent watering. This remains an option but not something we can advise on except that the grower needs to do his/her job and pay attention. With your long veg cycle, it would be best to use CANNA COGr Vega A and B because the buffered coco is best on a 2-4 week veg cycle. Yes, we do advise this. Substrate pH is impossible for the grower to control with any accuracy. It is also impossible to measure the drainage and know what is going on in the medium. The CANNA COCO Infopaper, available on our website, gives clear instructions on this. Set the pH of the tank solution close to this and the water to 20% drainage and things in the medium should stay fine. Otherwise, your pH parameters are close but not absolute. In true hydro systems with no organic medium, pH is critical at the marks that you mentioned.

In organic mediums, they have their own pH needs and end up being pH higher all around at 6.0 since they will set their own pH quickly in the medium.

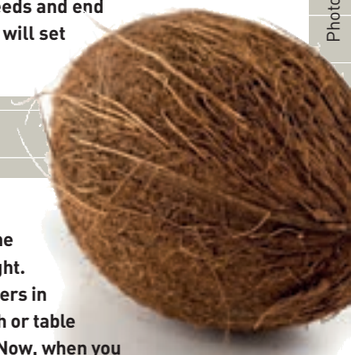


Photo courtesy of Horia Varian

Question

This will be my second batch using coco. The first time was not so good - ppm was about 1190-1260 in root pots (3gal). I used to use rock wool with 20% run off. Is this not right when using coco? I have been using your watering chart. It says 4-6 liters per m^2. I have 9 plants under light. There is no run off (thru pots - is that right? On my first try the plants burned, yellow and purple - also, leaves curled up - waffling - flowers slowed growing and lower ones did better. I tried flushing at the fifth week with 300 ppm - seems to help - but, not much.

Answer

The 4-6 liters/m2 per day figure is how much water the crop will use for a square meter of bench/ bed under light. This is independent of the number of plants or containers in that square meter. It says that a square meter of bench or table top, covered with foliage, will use 4 - 6 liters per day. Now, when you water, always with nutrients on coco, you make 100% sure that you provide a minimum of 20% drainage per container. Otherwise, the salts released by the coco will affect the plants exactly as described. Our advice: mix a batch of nutrients with an EC of about 0.6 and apply 5 times to the containers in rapid succession effectively leaching the medium. Immediately after the last application has been applied, come back and water to 20% drainage with a normal dose of say 1.0 - 1.2 EC nutrients. This will wash away the salts, re-establish the buffer, and start the fix for the plants. After this, water when 50% dry, always water with nutrients until the final flush at the end of the crop, and always provide drainage. Hope this answers your question.

Don & Nicky

(PART 8)

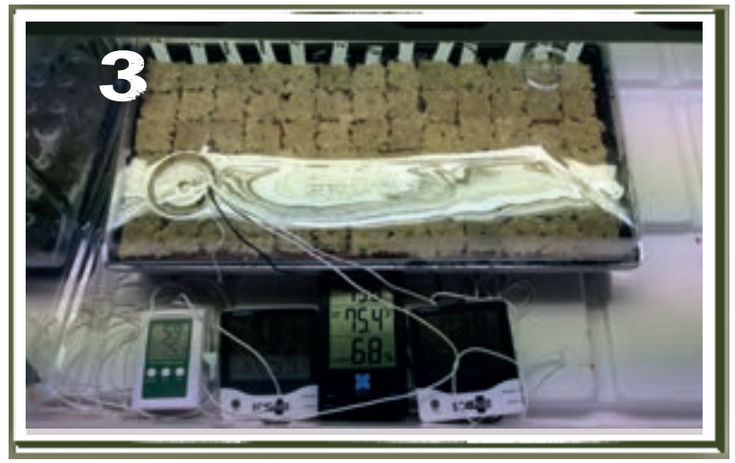
Don and Nicky have moved back from Canada to their home country, the UK. Their search for the good life led them to France and they are now doing exactly what they wanted to do with their lives: growing. Don shares his experiences and will tell you everything about the good life in French Catalonia in this, and forthcoming editions.

Battle WITH THE WASPS

"You'll wonder what you did with your time," an old friend remarked when I told him that Nicky and I were expecting—and boy was the smug old duffer right! Previously I'd have guessed that my wine cellar's transformation into a fully functional indoor garden would take no more than six weeks at the most. Six months down the line and I'm only just at the end of the build process. It's official: my baby is a time vampire!

After laying a plastic, waterproof floor, I was just congratulating myself on the "clean and sterile" laboratory feel of my grow room when the wasps invaded. I certainly didn't have plans to grow any of the fruit crops sometimes targeted by these horrible pests (plums, nectarines, grapes, late strawberries etc). The real worry was the fact that if these relatively large insects could apparently break in so easily, my indoor garden was clearly wide open to hoards of smaller (and far more destructive) foe: thrips, aphids, spider mites, the horror list goes on and on.

1. I knew that temperature and humidity would stabilize as soon as I switched on some grow lights and ventilation fans for my test run.
2. I boarded up the window, made some flanges for my ducting and covered the exits with bug-proof mesh.
3. Fingers crossed these pepper seeds will go pop soon!



I traced the point of break-in to my garden's air exhaust into the yard. I'd simply fixed my ducting near an open window above my outdoor basil plot, leaving my indoor garden susceptible to all sorts of inquisitive pests. A far more defensive design was called for. I boarded up the window, made some flanges for my ducting and covered the exits with a bug-proof mesh. I also methodically sealed every hole in my grow room (e.g. the ones I'd threaded cables through) and taped up every tiny crack. I attached all inflow fans to specially designed intake filters too.

Next I checked the ambient relative humidity in my grow room. My hygrometer was reading over 90 percent and a cool 66 °F however I wasn't too concerned by the high relative humidity as this is pretty normal for cellars and I knew the figure would drop as soon as I switched on some grow lights and ventilation fans for my test run. As expected, temperatures quickly rose five or six degrees and then stabilized at around 75 – 79 °F. Relative humidity dropped to around 65 percent—an ideal environment for vegetative growth—and all this with my ventilation system running at just 50% power thanks to my inline fans' built-in speed controllers. My indoor garden was not just ready to go, it was future-proofed for expansion!

I soaked some rock wool cubes in a super weak nutrient solution at pH 5.5 (for germinating seeds, you really only need to show them the bottle!). The trickier part was getting the distance right between my 2 x 2 ft T5 high output fluorescent light and the top of the propagator lid.

I worked out that about a hand's length was the ideal gap. If that sounds a bit Heath Robinson, fear not, I was also using a thermometer with a remote probe to measure the temperature inside the propagator itself.

When the T5 tubes were just a few inches above temperatures would quickly sore up to 97 °F or more—too hot for seed germination. At around seven inches, the temperature inside the propagator remained close to the rest of the garden.

One last thing: I drank a bottle of red wine to myself the other night and got a little carried away ogling the latest grow gear online. I'd totally forgotten that I'd made any purchase at all until I discovered a confirmation email the next day detailing a transaction of $1,860 for a 300-watt plasma light—on our joint credit card too! Alas, I didn't quite get around to canceling the order so it's only a matter of time before this impulsive purchase reveals itself and I'll have to 'fess up. Hopefully Nicky will understand that growing indoors has become an addictive and all-consuming pastime for me—even though I'm still waiting for my first batch of pepper seeds to actually germinate! Fingers crossed they will pop soon otherwise I'll have an awful lot of explaining to do. Wish me luck on all counts! •

Photo courtesy of Mathilde Guillemot

DEADVLEI

DID YOU KNOW THAT...?

- This impressive picture was taken in Deadvlei, the dried-out, clay-covered riverbed of the River Tsauchab in the Namib-Naukluft National Park in Namibia. The plain is enclosed by giant red sand dunes.
- The dunes that surround the clay plain are, at 984 to 1,312 feet, the highest in the world. The highest is also known as 'Big Daddy' or 'Crazy Dune' called.
- Deadvlei was once formed by rainfall. The rain caused the River Tsauchab to overflow and shallow pools formed where trees grew. When the climate changed, the area was affected by severe drought. Sand dunes surrounded the plain, blocking the flow of water in the river.
- The 'trees' that you see in this photo are the skeletons of acacia trees. The trees seem to be between 700 and 900 years old. The trees are dark brown or black because they have been scorched by the intense sun. Although the trees are not petrified, they are preserved because the plain is so dry.
- Despite the lack of rainfall, some plants still grow in Deadvlei, like salsola (herbaceous plants, half shrubs, bushes and small trees) and inara melon for example. These plants survive on the moisture left by the morning mist, and the tiny amount of precipitation there every year.
- Deadvlei is not a valley. The name literally means 'dead marsh' from the English word 'dead' and the African word 'vlei', which stands for a lake or marsh in a valley between the dunes. In Afrikaans, the plain is called Dooie Vlei.

What's HAPPENING

All around the world, beards are back in fashion, and there are male barbershops that will give you a 1950s-style greased-up hairstyle. It was only a matter of time before the hot rod would rise once more. Soup up your engines. Get ready to turn some heads!

By Marco Barneveld, www.braindrain.nu

Photo courtesy of Mike Foote

HOT ROD GALORE

SOUP IT UP!

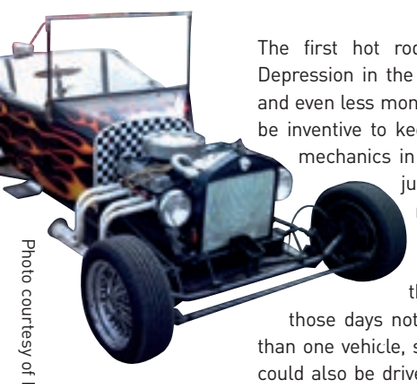


Photo courtesy of Feggy Art

The first hot rods were built during the Great Depression in the late 1920s. There was little work and even less money to go around, so kids needed to be inventive to keep themselves entertained. Young mechanics in Southern California working with junkyard parts, created streamlined, no-nonsense racing cars to compete against each other over straight-line courses laid out on the nearby desert salt flats and in those days not many rodders could afford more than one vehicle, so it was vital that the racing cars could also be driven by road to the sites, as well as back and forth from home to work during the week.

Strip it!

The first hot rods were Ford Model T or Model A roadsters. These cars were cheap and plentiful. The standard procedure was to strip off all non-essential parts such as fenders, running boards, ornaments, even the windshield to achieve maximum weight reduction and aerodynamics.

Large rear tires were installed on all hot rods to raise the gear ratio for high speed, while standard-size or smaller tires left on the front helped lower the car and rake it forward to decrease wind resistance. Rows of slots, called louvers, were cut into the hood, body, and rear deck lid to cool the engine and release trapped air. Sometimes flat aluminum discs were fitted over the wheel hubs for further streamlining. Ford flathead V8 engines were the power plants of choice after they were introduced in 1932. Mass-produced in their millions, they too were cheap and plentiful, and their design permitted relatively easy—and almost limitless—performance enhancements.

Lifestyle

But it was not only about creating a fast car. It was also evidence that you did not need a lot of money to gain automotive status. It had to do with self-reliance, ingenuity and ultimately being independent. You could call building and owning a hot rod a social-emotional statement that says a lot about that period of US history.

The dark side of America

Hot-rodding had a downside. Dangerous and often fatal street racing caught on all across the USA. Hot-rodders became an easy target for public attention, which came to focus on what were increasingly perceived as frightening new national problems: juvenile delinquency and teenage gangs. Along with rock 'n' roll, hot rods and hot-rodding became symbols of the darker side of American youth. And American youth loved that image. The result was a soaring popularity. In 1950, the newly launched Hot Rod magazine boasted a circulation of 300,000.

Many enthusiasts turned to building cars exclusively for drag racing. Others continued to build so-called street rods – hopped-up cars that could be raced at traffic lights, but that usually served chiefly as a stylish way of getting around town. Others broke new ground by modifying cars primarily for their looks rather than their performance. These were called customs. Like early hot rods, they evolved from lower-priced production automobiles.

Fancy paintwork

Customizing did for bodywork what hot-rodding did for engine performance. Favorite techniques involved severe top-chopping, lowering the entire frame to within inches of the ground, filling all seams to smooth them out, and adding streamlined fender panels called skirts to cover the rear wheel openings. Chromed parts were much in abundance, from spare wheel covers to side-mounted exhaust pipes. And of course, no expense was spared on fancy paintwork.

Muscle cars

The 1960s saw the advent of muscle cars, Detroit's bid at performance hot-rodding in the form of plain-looking automobiles stuffed with huge-displacement engines like the Chevy 396, 409 and 427; the Ford 390 and 427; and the Chrysler 440 and 426 hemi, which got its nickname for its racing-engineered hemispherical combustion chambers. Later in the decade came smaller pony cars like Mustangs and Camaros.

But in the early 1970s gas shortages doubled the price of gas. The primacy of the V8 ended and the golden era of traditional hot-rodding and customizing was over. But not gone forever. The hot rod left the collective global memory, but it was kept alive by just a couple enthusiasts.

The hot rod rises again

Two basic groups remained. One had a nostalgic passion for the past. The other charged with the rebellious creativity of youth and independence. In the 1990s the traditional camp in the form of the Los Angeles Roadsters and the Bay Area Roadsters, began a tradition of long-distance cruising along the highways of California in their chromed show cars. Mainly stylized, open-top single-seaters from the 1920s, 1930s and 1940s.

In the other camp were young men from southern California's Chicano culture, whose wanted to refine the craft of customizing to produce probably the most singular of its iterations, the low rider. Initially limited mainly to 1963 and 1964 Chevrolet Impala models, low riders reflected the epitome of ritualized showiness that included meticulous candy paint jobs, delicately air-brushed murals, crushed velvet upholstery, and tiny, thin whitewall tires mounted on deep-dish chrome or gold-plated wire wheel rims.

Hot rods and hot-rodding were enormously popular. In 1950, the newly launched Hot Rod magazine boasted a circulation of 300,000.

Big business

Today, hot-rodding with all its faces and all its different styles is both popular and big business. What began as a way to achieve results without money has become a way of spending it. The National Hot Rod Association has turned drag racing into a nationwide spectator sport that generates millions of dollars annually from events, television coverage, and advertising. Speed and custom parts industries thrive, producing every kind of hot-rodding and customizing every conceivable component, with new products arriving all the time.

These days, it is possible to build complete automobiles using newly made reproduction parts, including frames, body panels and engine blocks. If you are wealthy enough, you can even commission a designer-built, one-of-a-kind hot rod or custom ready to capture first honors at any show or to take you joyriding down your very own boulevard of dreams.

Start your engines

One thing is for sure. Hot rods and customs are an American phenomenon that is loved all over the world. The cars are creative, interesting and just plain cool.

They are a celebration of the last 75 or so years of innovative backyard efforts to create better, faster cars. It takes vision, determination and the skill of a virtuoso metal worker to take on the challenge of making an old car handle, run, ride, and look better.

Although its roots were in the post-war youth, today hot-rodding and custom car building are as strong and vibrant as ever. The reason is probably that we all like to compete and be the best, but also want to stand out and express ourselves. And that will surely never change.

So soup it up!
Start your engines!
Get ready to show off! Go! •

Pests & DISEASES

MILDEWS IN HORTICULTURE CROPS

Mildews are obligate parasites known for causing diseases in plants. They can be seen in the form of a fuzzy growth on the plant's leaves. The most common mildews recognized by horticulturist and gardeners are downy mildew and powdery mildew. Although they have similar names, they are quite different, produce different symptoms and require different control measures. By CANNA Research

Both forms of mildew typically affect the leaves of a plant; however, downy mildew mainly takes the form of a fungal layer on the underside of the leaf while powdery mildew causes white, powdery, fungal growth on the top of the leaf. Another remarkable difference between these mildews is the type of damage they cause in the plant. Downy mildew infections often causes plant death through necrosis of the tissues, while powdery mildew infections can cause indirect plant death by simply overgrowing the leaf surface and preventing photosynthesis and the uptake of nutrients, reducing crop aesthetics and value and increasing production loss.

Downy mildew spreads from plant to plant via airborne spores and the conditions that it prefers include prolonged leaf wetness (relative humidity above 85%) and cool temperatures (50-68 °F). Powdery mildew spores are also spread by wind, but they do not require moist conditions to get established and grow, and they normally do well under warm (68-86 °C) and shady conditions. An accurate diagnosis is crucial in order to manage the mildew successfully, but it is also possible for both types of pathogens to occur at the same time on the same host, making diagnosis more difficult.

Downy mildew

The most important genera of downy mildew are Plasmopara and Peronospora, which are obligate pathogens. Downy mildew can grow locally and systematically in plants, affecting a large range of common plants. Some species of downy mildew are able to survive from one year to the next in plant debris, in the soil, or on weeds, making management and control more difficult.

Colonies of the fungi appear first on the underside of leaves. Discolored yellow spots develop on the upper leaf surface while the colony grows on the underside of the leaf in the form of a white-bluish or grey-purple fluff (depending on the species). The whole period of infection, from when the spores penetrate the leaf to the release of new spores, is usually between 7-10 days.

If colonies grow abundantly on a leaf, they can be confused with Botrytis or powdery mildew. In many cases, downy mildew grows systemically throughout the plant, starting with leaf spots, and followed by the growth of fluffy gray mycelium. At this level of infection, the colonies spread and the affected leaves and branches may die.

Powdery mildew

The genera of powdery mildews that have been classified include Podosphaera, Erysiphe, Leveillula, Golovinomyces and Oidium, the most important in greenhouse production. Powdery mildew is also an obligate pathogen that first appears on the upper surface of the leaves as white powdery spots. They may also form on both the surfaces of leaves, on shoots, and sometimes on flowers and fruit. This fungi normally attacks young developing shoots, foliage, stems and flowers.

Early symptoms vary and can range from subtle irregular chlorosis areas or necrotic lessons, followed by powdery white spots. These spots gradually spread over a large area of the leaves and stems until eventually the leaves turn completely yellow. This fungal disease effects many crops.

Powdery mildew spores can germinate and infect in the absence of free water and humidity. The requirements for germination vary from one host to another. In fact, the spores of some powdery mildew species can be controlled by spraying water on plant surfaces.

Managing mildews

Prevention is the best method of control with mildews. Although powdery and downy mildews are different, a similar cultural and sanitation strategy can be used to prevent both and reduce the chance of reproduction and spreading. Strategies for management include:

Cultural practices:

* Reduce humidity levels through adequate plant spacing and air flow. Open the doors and vents of greenhouse when conditions allow, to encourage air movement.
* Maintain good nutrition levels in the crop, control pH and temperature. However, avoid applying excess fertilizers.
* Avoid situations that favor leaf wetness, especially early in the morning or at night (critical for downy mildew infection times).
* Remove weeds from the production area and the surroundings, reducing the possibility of diseases focus.

Monitoring:

* Scout your crop regularly to detect initial infection in order to avoid the spread of the disease. It is recommended to check at least once a week.
* Look carefully at the middle and lower leaves.
* Remove contaminated leaves or plant material and continue to monitor closely in the following weeks. In the case of downy mildew turn the leaves over to check for sporulation on the undersides of the leaves. It is advisable to check the plants every 2-3 days.

Biological and chemical practices:

The fungal infection process consists of a series of different steps. It starts with inoculation (spores land on the plant surface), which is followed by the adhesion of the spore, the germination of a germ tube, penetration (the germ tube enters the plant) and finally infection (the fungus grows into the plant until it produces spores that are released to start a new cycle of infection).

The use of fungicides (biological or chemical) acts to disrupt the infection cycle.

To reduce risk of resistance, it is important to rotate and combine fungicides from different chemical groups and with different modes of action or properties. The use of biological agents is an alternative practice for controlling mildews. These should be treated as protectant products to be more effective. •

Sanitation practices:

* Use good quality plant and seed material with a history of low disease incidence.
* Inspect your new seedlings and cuttings before planting them. Do not use any type of contaminated plant material. If possible, quarantine new plant materials.
* Prepare production areas by cleaning them of plant debris and do not keep plants between crop cycles.

Photo courtesy of Cornell University

Figure 8: **An example of downy mildew on the underside of a leaf.**

	DOWNY MILDEW	POWDERY MILDEW
SYMPTOMS	• Fungal layer on the underside of the leaf • Yellow spots on top of the leaf	• White powdery fungal growth on top of the leaf • Also form on shoots, flowers and fruit
DAMAGE	• Plant death through necrosis of the tissues	• Indirect plant death by overgrowing the leaf surface • Blocking important plant processes
SPREADS	• Via airborne spores and prolonged leaf wetness • Humidity: >85% • Temperature: 50-68°F • Grows systematically	• Via airborne spores • Shady conditions • No moist or water needed for germination • Temperature: 68-86°F

Figure 9: **Cucurbit downy mildew symptoms on top of a cucumber leaf.**

Photo courtesy of Dr. Lina Quesada, NCSU Vegetable Pathology Lab

Photo courtesy of David Gent, USDA Agricultural Research Service

Figure 10: **Common hop leaves with foliar signs of powdery mildew infection caused by Podosphaera macularis (a plant pathogen).**

TAKING THE GROWING OUT OF GROWING

EVER SINCE THE TALE OF JACK AND THE BEANSTALK, PEOPLE HAVE DREAMED OF MAGIC BEANS AND MASSIVE PRODUCTION FROM THEIR FIELDS. A PLANT THAT WOULD GROW SO BIG, REGARDLESS OF WHETHER YOU BELIEVE THE PART ABOUT THE GIANT, WOULD BE AN ANSWER TO SOME MANY AN EMPTY STOMACH AND PURSE. HUMANS HAVE COMMITTED THEIR LIVES TO THE PRODUCTION OF THE BEST, PRETTIEST, AND MOST PRODUCTIVE PLANTS POSSIBLE THROUGH BREEDING PROGRAMS, RESEARCH, AND AGRICULTURAL ENGINEERING. ONE OF THE THINGS THEY HAVE DISCOVERED IS THAT THERE ARE SOME CLASSES OF CHEMICALS, BOTH INTERNAL AND NATURAL, WHICH CREATE SPECIAL CHANGES IN A PLANT'S GROWTH CHARACTERISTICS THAT WE MAY FIND DESIRABLE. THESE CHEMICALS ARE, COLLECTIVELY, KNOWN AS PLANT GROWTH REGULATORS.

By Geary Coogler, BSc Horticulture, CANNA Research

What are plant growth regulators?

In the simplest terms, plant growth regulators (the entire class), also known as PGRs (again plant growth regulators, non-naturally occurring) and hormones, are chemicals used to alter the growth of a plant or plant part. This is a little confusing but these classes of compounds are divided into classes that are named after, and basically function the same as classes of plant hormones.

The State of Florida, as an example, defines a PGR as "any substance or mixture of substances intended, through physiological action, to accelerate or retard the rate of growth or maturation or for otherwise altering the behavior of ornamental or crop plants or the produce thereof, but not including plant nutrients, trace elements, nutritional chemicals, plant inoculants, or soil amendments." The US Government's EPA has the same view and does not distinguish between natural and man-made growth regulators when these are applied for that purpose. The European Union has similar systems for the control of these materials.

PGRs, like any pesticide or chemical, must be registered and authorized for the use for which it is intended both at the federal and state levels in the US and similarly in the EU at the level of the Union, region and country. For our purposes here, PGRs are what growers apply to the plant, while hormones arise internally and naturally in the plant, even though some PGRs can be identical chemically to a naturally occurring hormone.

The first known use of PGRs in the plant industry was in the 1930s, when acetylene and ethylene gases were used to enhance flower production in pineapple. Later, these same gases began to be used to ripen fruit such as bananas, which are shipped green for both convenience and practicality, and are then gassed in big lockers to ripen as a single batch at your local grocers. There are some chemicals, although not PGRs, such as fungicides, herbicides and pesticides, that can mimic the effects of a PGR, and are listed in some sources as PGRs. Some growers use these PGR-mimicking chemicals to treat supposed issues with their crops when the true intent is to control the plant in some fashion such as fruit thinning on apple trees.

A plant hormone, on the other hand, is a naturally occurring compound that is released by the plant according to its own internal cues. Hormones may facilitate intercellular communication, react with specific proteins, be transported via both the xylem and phloem transport vessels, and two of them - auxin and cytokinine - are essential to plant viability. PGRs, as a broad category, are synthesized outside the plant, are usually chemically different from the hormones that they mimic (although not always), and tend to be plant-specific in their activity.

The American Society of Horticultural Sciences places plant growth regulators into six major classes:

CLASS	FUNCTION(S)	PRACTICAL USES
Auxins	shoot elongation, root stimulation	thin tree fruit; promote rooting and flower formation
Gibberellins	stimulate cell division and elongation	increase stalk length; increase flower and fruit size
Cytokinins	stimulate cell division	prolong storage life of flowers and vegetables; stimulate bud initiation and root growth
Ethylene	ripening	induce uniform ripening in fruits and vegetables
Growth Inhibitors	stop growth	promote flower production by shortening internodes
Growth Retardants	slow growth	retard sucker growth and other

What do PGRs do and why do we need them?

Growth regulators are used for many purposes in the commercial sector such as to even out crop height, shorten plants, increase the number of flowers, make fruit larger, improve color, improve performance, protect crops, improve plant health and increase stress tolerance, shorten crop production schedules and even them out. They can also be used herbicides, to the improve results and timing of rooting new cuttings, and more. In the retail sector, PGRs are used to improve turf health and performance, reduce turf cutting, deal with problem plants such as Ginkgo females, and particularly as herbicides.

Figure 11: **Just like pesticides, most plant growth regulators can also cause (health) problems further up the food chain. In the USA, a pesticide or plant growth regulator can only be sold if it 'will not generally cause unreasonable adverse effects on the environment'.**

These would all be considered benefits, so what are the drawbacks?

PGRs and plant hormones are effective at extremely low concentrations but they produce bad results when too much is applied. The effects of these products are cumulative over time and the over-application of any PGR, whether the concentration is too high or too many applications are given, will likely do great damage to the plant. PGRs are persistent, remaining in the plant and the fruit for the whole season with annuals and into coming years with perennials. However, PGRs are usually applied only once, or maybe twice, and normal plant development will likely resume after a certain time. Nothing lasts forever.

Most growth regulators, for animals or plants, can cause health problems further up the food chain. For instance Paclobutrazol persists in the plant - for more than two years in some plants - after a single application. It is carcinogenic and has a higher primate LD50 (the measure of a lethal dose required to kill 50% of the test subjects expressed in milligrams per kilogram of mass) than that needed to kill the same mass of rats. Knowing the proper stage of plant development is critical for correct results because applying at the wrong time or at the wrong amount can both destroy a crop. Environment, plant development, plant condition, and stressors can all affect the activity of the PGRs, separately or in combination with each other. Plant Growth Regulators will interact with other organic compounds (such as hormones or other PGRs) in the plants, making it increasingly hard to predict results.

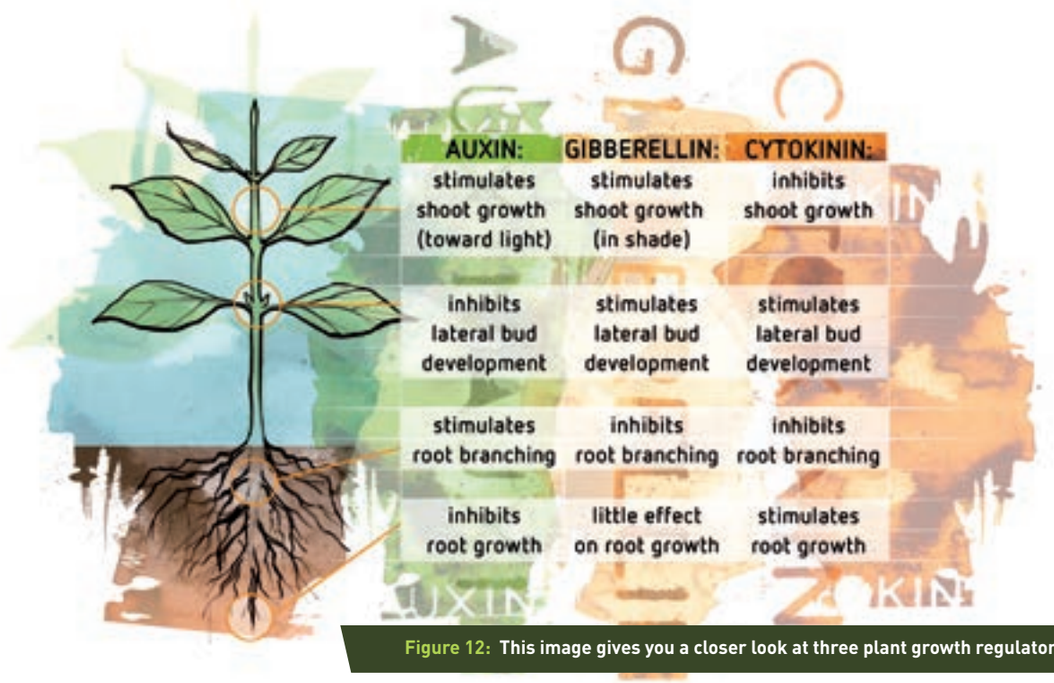


Figure 12: **This image gives you a closer look at three plant growth regulators.**

Hormones, which as we explained are produced inside the plants, are a little different. Plant hormones have traditionally been classified into 5 groups: auxins, cytokinins, gibberellins, ethylene, and abscisic acid. There are over 100 formulations of GA (type of gibberellin) but only a handful are used commercially, GA 3, GA 4, and GA 7. But now a whole new class of hormones is waiting for a general scientific consensus on whether they can be used as PGRs: brassinosteroids, which affect cell elongation, division, gravitropism and others, and at extremely low concentrations. There are other compounds as well, such as jasmonates and polyamines that also demonstrate plant-regulating effects.

These compounds are produced by the plant and have a function within all areas of plant growth and development, not just those targeted by growers. Growers intending to target one side of the functionality of a specific PGR would be wise also to plan for the unintended side-effects of the chemical. These hormones are what synthetic PGRs have been developed to mimic, at least for the desired portion of their function. Almost without exception, these naturally occurring hormones are in harmony with the environment that the plant is in and the physiological state of the plant, and they are present at the correct concentration, except when under the control of an external agent such as a micro-organism or genetic abnormality.

The other side of the coin...

One of the biggest issues facing retailers of these chemicals and the growers who use them is the legal aspect of using these and any other chemicals. No talk on a Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) controlled area would be complete without at least a mention of the regulatory view. Regulatory agencies exist to protect all the people and animals involved and the surrounding environment when a chemical is used.

In the USA, FIFRA, provides for federal regulation of pesticide distribution, sale, and use. All pesticides and chemical plant amendments distributed or sold in the United States must be registered (licensed) by the Environmental Protection Agency (EPA). Before the EPA may register these items under FIFRA, the applicant must show, among other things, that when used according to specifications the product "will not generally cause unreasonable adverse effects on the environment." All pesticides being registered have to be cleared under 5 separate acts as well as the sections of other acts. All must clear (1) FIFRA (2) Federal Food Drug and Cosmetic Acts, FFDCA (3) Toxic Substances Control Act (TSCA) (4) the Pollution Prevention Act (PPA), and (5) the Pesticide Registration Improvement Act (PRIA 2) as well as sections of the Food Quality Protection Act (FQPA), the Endangered Species Act and the Worker Protection and Child Safety Acts.

FIFRA defines the term "unreasonable adverse effects on the environment" as follows:

a) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide, or

b) a human dietary risk from residues that result from a

GROWING

use of a pesticide in or on any food inconsistent with the standard under section 408 of the Federal Food, Drug, and Cosmetic Act'' (FFDCA).
Not all substances need to carry a registration under FIFRA, but most do.
In addition to FIFRA requirements, individual states also have a battery of requirements on a par with FIFRA. State requirements are similar to Federal so most of the data crosses over. The main requirements at state level are geared towards consumer protection. In general, states typically require that tests and data submitted are based on the growing conditions in that state.
In each case, the penalties for violating these regulations, particularly if this is done knowingly, can be very severe. This applies not only goes for the manufacturer and distributors, but equally for the vendor and the end consumer who unknowingly applies these products. In addition to criminal penalties, there is also an opening for civil action l for knowingly distributing an illegal substance. And worse is yet to come if someone suffers an injury from the advice given.
In Canada, the CDFA, Canadian Department of Food and Agriculture and Health Canada's Pest Management Regulatory Agency (PMRA) perform the same function with similar requirements, and both FIFRA and PMRA work together to share data and requirements. In the European Union, a very similar process as North America occurs in 'Dual' system. The first stop is the European Commission Directorate – General for Health and Consumer (DG SANCO) where the active ingredient is approved. Second are the individual member states, where data is supplied intensively based on the final use of the product, location, and targets (among others), and this is submitted for review and approval. In effect, all countries look for the same thing.

Currently, few PGRs have been approved for use on consumed crops

Labels are designed to provide all registration information. These labels will include the rates, the exact crops on which they can be used, the conditions under which they must be used, the worker protection required, harvest intervals, and so on. It is a violation of federal/national laws to use a registered product in violation of the label. It is also a violation of the law for a person that holds themselves in a position of authority to make any recommendation that violates the label. It is compulsory to print the registration numbers on the label, either the federal number, the state/country registration number, or both. All products, whether they end up being regulated by EPA or not, such as an all organic substances with zero issues, must go through the initial process to prove that the substance is indeed what it is claimed to be.
As of now, there is no product registered for use with all crops under all conditions. Every PGR has an exact crop and list of conditions. Likewise, there is no category of plant product called "whatever you want to use it on", or "under whatever conditions and in any location you want". There is only one PGR that is registered for use in North America on most vegetable transplants for size control, and one other that can be used on tomato seedlings only. There are several more that can be used on fruits such as GA on grapes, Carbaryl (an insecticide with PGR attributes) to thin apples and pears, and others. Few can be used close to harvest except some like ethylene or maleic hydrazide (which suppresses sprouting on harvested potatoes). And there are no registrations for crops that are not recognized at the federal level.
So, PGRs, they do work... but is it worth the risks? Using different culture methods can often reduce the need for chemical controls. These range from the simple such as correct trimming at the right time to employing a Temperature Differential (DIF) system to control growth, to correctly timing and fertilizing a crop. Anything you do to crops that are destined for consumption is best done with as few and as little chemicals as possible, if for no other reason than to keep the consumers healthy.

Look at it this way; if the governments of the world, as pressured as they can be by large corporations, insist on strong regulations for this class of products, should we as growers really be so anxious to use them? •

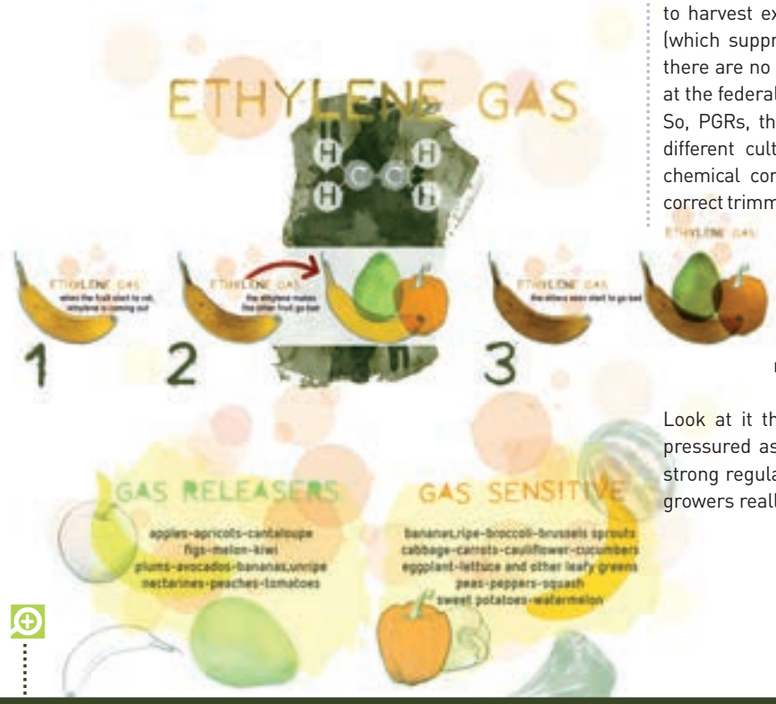


Figure 13: Ethylene gas induces uniform ripening in fruits and vegetables. This image shows you in three steps how this process works. It also gives you an idea which fruits and vegetables are ethylene gas releasers and which fruits and vegetables are sensitive to ethylene gas. A tip for those who want their fruit and vegetables to ripen faster: put it in a closed bag with an ethylene gas releaser!

Grower's TIP #27

By your friend SEZ

'CHEATING' WITH PGRS

Not everything in life shapes up the way we want. This is also true when it comes to growing plants. In order to 'fix' these shape problems, there are options available, of course. You can cheat, but you could also work on being a better grower.

Plant growth regulators (PGRs) are one of these cheats. Like in everything, be aware that cheating may have consequences. With most of these products being designed for ornamental crops, it is obviously not desirable to use them on consumable crops because the chemicals used to trick your plants may not be safe for you or those you share the harvest with. It is your duty to research whether the products you are using contains PGRs, because not every company cares enough to divulge the presence of PGRs on their labels.

The most common use of PGRs is to keep plants short and bulky. While they do succeed in this quite well, there are also some simple cultural practices to obtain the same results without risking a poisoned crop. One of the most common cause of plant stretching is competition within the canopy. Since all plants are selfish and want to have the best spot in the sun for themselves, they can divert a lot of their energy to growing taller than the surrounding ones. This phenomenon is amplified in the early days of the blooming/fruiting phase. You can prevent or limit this stretching phase by keeping the plants away from each other, making sure they are not touching each other and that their leaves are not overlapping. This alone is often enough to prevent the plants wanting to grow taller than their neighbors.

The plant also assesses the climatic conditions to determine its future shape, size, flower pattern and other physical traits. It is especially important to have good control over these parameters in the early blooming/fruiting phase.

When it comes to a lack of flower cluster density or bulkiness, limiting the humidity is very important. If plants 'feel' that it might be a very damp season, they may 'program' their future flower pattern to leave more air space within the blooms. This is the plants way of protecting itself from the rot that can occur in very humid conditions. There are many other gardening practices that can be adopted to shape the flowers in the way you want them without using PGRs.

If however you do decide to cheat... Please follow the instructions for application, do not exceed the recommended dose and be aware that PGRs can be very persistent and special care will need to be taken when it comes to disposing of plant material and the growing medium. Plant matter containing PGRs should not be added to your compost bin. Neither should your used soil be added to your outside garden, as it could ruin the future growth of your garden not to mention contaminate it with possible carcinogenic substances for many years to come. So please be responsible!

Puzzle&WIN

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

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

WIN A CANNA COCO Brick

GREAT PRIZES

So get your brains working out those numbers, and don't forget to let us know what your solution is, before the 4th of April 2015 (sending the middle part of the puzzle to editor@cannatalk.com and mention it regards CANNAtalk #27 is enough) and maybe **you will be the lucky one who wins a CANNA COCO Brick**

CANNAtalk survey#25

We received a lot of responses at http://www.cannagardening.com/cannatalk-survey and would like to thank you for your input, opinions and great suggestions!
A notary picked winners from all the entries we received, and we would like to congratulate these lucky winners and we wish you a lot of fun with your prizes!

Facts

NON-STOP GROWTH

A tomato plant that grows 24 hours a day - it would be music to the ears of growers, no doubt. If it is up to researchers from the University of Wageningen, such a plant may one day exist. They have discovered a gene which makes tomato plants grow and photosynthesise 24 hours a day. This makes it possible to increase crop yields by twenty percent.
At the moment, there is a limit to how much tomato plants can grow. When they are exposed to over sixteen hours of light per day, they develop leaf injuries that can lead to the death of the plant. However, there are some wild species that can cope with continuous daylight. When the gene which is responsible for this (CAB-13) is inserted into modern tomato varieties, these can also cope with constant light. A field trial with this new plant produced plants that could cope with 24 hours of light without leaf injuries and that yielded twenty percent more tomatoes.

Photo courtesy of regan76

RAIN OR SHINE

Photo courtesy of George Thomas

Mild winters and warm springs can disrupt the growth of tulip bulbs to such an extent that the flower bud shrivels. And if the a flower bud dries out, the plant will not flower again the next year. The researchers at Wageningen University thought that was a pity and now they are involved in developing a climate resilient tulip. The research team is aiming to find out which genes play a role in producing flowers. The genetic material from the tulip is compared with that from a model plant. Breeders will then use this knowledge to grow a tulip that is less sensitive to the weather. In this way, tulip growers will soon be able to select not only according to flower type or color, but also according to 'climate sensitivity'.

SMART MUSTARD PLANTS

Researchers have discovered that mustard plants can defend themselves against harmful insects in two ways. When small cabbage white butterflies lay their eggs on the plant, the plant cells under and around the eggs die. As a result, they fall off the plant and no hungry caterpillars will hatch onto it. If this does not work, there is a second way to outwit the bugs. The mustard plant gives off odors that can attract parasitic wasps, and these tiny wasps parasitize the butterfly eggs. These methods mean that up to eighty percent of the butterfly eggs die. But not all the mustard plants in a population make use of these direct defence mechanisms to protect themselves. Future research will aim to find out why this is the case.

Photo courtesy of northbaywanderer

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Looking for the hole difference?

The CANNA COCO quality in a brick

2 x 10 Liter

Washed and buffered

RHP certified

Easy storage and transportation

Expands extremely fast

Re-usable

Multi functional packaging

CANNA COCO

The high quality, buffered coco that CANNA is known for is now available in a brick. One that makes a real difference! It has a specially designed hole which makes it expand faster than you have ever seen before. The packaging functions as a bag in which the brick is designed to be soaked. And its grip handles make it even easier for you. Want to see the hole difference? Check out the CANNA website.

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