CANNAtalk®

MAGAZINE FOR SERIOUS GROWERS

ISSUE 25 2014

THE EFFECT OF LIGHT

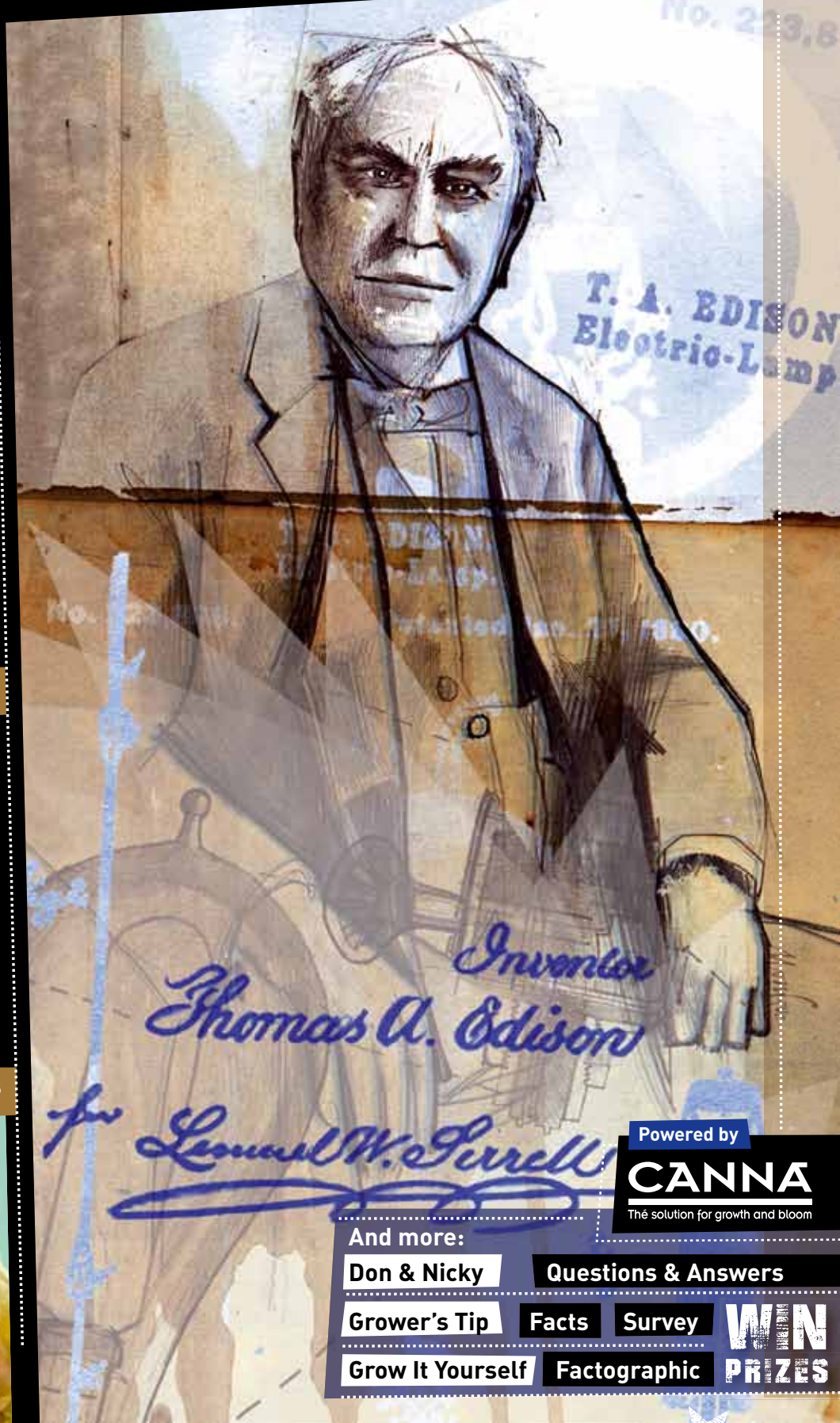
Interaction with plants

WEIRD FOOD

Insect caviar

ROOT APHIDS

Destructive insect pests



HQTalk:

Being as pale as a Twilight vampire, I always take sunblock with me if I go for a day in the sun. In fact, I usually take all the necessary precautions; a cap, shirt, shorts, sunglasses, etc. I am also very aware that I have to re-apply sunscreen regularly. Recently I went to a local festival. Good times! But.... at one point I fell asleep in the grass. I don't know for how long. Although I can tell you: it was long enough to have my aviators make me look like a sunburned panda for the rest of the summer... But that is nothing compared to the pain I suffered for the next week. It was horrible! So, from now on an alarm clock is another thing I add to my list of things to take with me on a sunny day.
Anyways, even though everyone likes the sun and it usually makes us happy, this is just one of many stories that prove what a bad influence light can have on us. And what can be harmful for us human beings also applies for plants...
Read our Grower's Tip on page 27. It will explain to you how the heat from lights can give your plants a (sun) burn. For more in-depth information, check out the article on page 4 about light spectra. There is more on page 22 when we talk about LED lights. And even Don talks about testing several lights in his column on page 14. In short, this edition of CANNAtalk is all about Light.

Enjoy reading,
Jeroen (Twilight vampire disguised as sunburned panda :-)

PS – CHECK OUT PAGE 28...
YOU COULD **WIN** A BUNCH OF CANNA PRODUCTS!

WIN PRIZES

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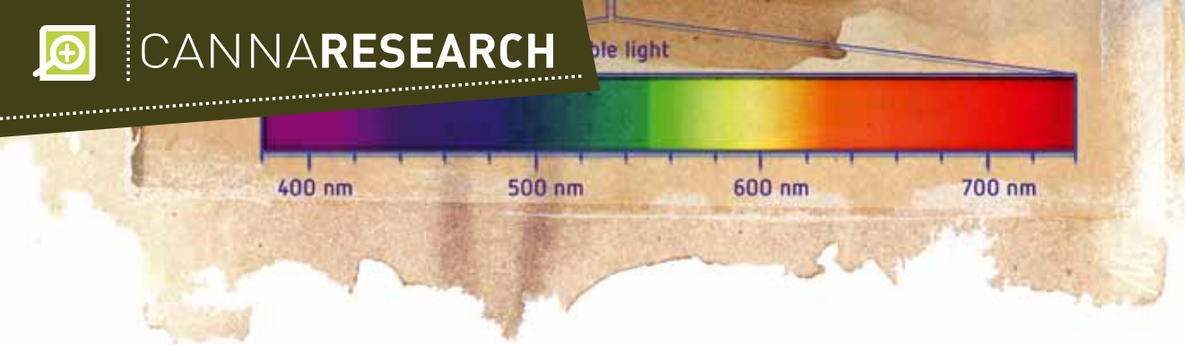


THE EFFECT OF THE LIGHT SPECTRUM ON PLANT DEVELOPMENT

HAVE YOU EVER USED GROW LAMPS FOR YOUR PLANTS? IF SO, THEN YOU'VE PROBABLY BEEN AMAZED BY THE EFFECT OF THE LIGHT ON THE DEVELOPMENT OF YOUR PLANT. THIS ARTICLE WILL TELL YOU MUCH MORE ABOUT THE EFFECTS OF LIGHT ON PLANT DEVELOPMENT. AS WE WILL SEE, PLANT DEVELOPMENT REALLY IS SOMETHING DIFFERENT FROM PLANT GROWTH. WE WILL EXPLAIN THE PRINCIPLES OF LIGHT AND ITS INTERACTION WITH PLANTS, AND ALSO GIVE YOU SOME PRACTICAL TIPS. CHOOSING THE RIGHT LAMP CAN MAKE A HUGE DIFFERENCE TO THE QUALITY AND QUANTITY OF YOUR CROP. By CANNA Research

Everyone knows that a plant needs light to grow by means of photosynthesis, a process that involves energy fixation and sugar production. But in addition to providing energy, light also plays a key role in many other plant processes, such as photomorphogenesis and photoperiodism. All these processes are influenced by the light spectrum, which is the distribution of the light across the electromagnetic spectrum. In order to explain a plant's different responses to light, we first need to think about the phenomenon of light itself.

Principle of light and its spectrum

Light is a form of radiation, which takes the form of electromagnetic waves that pass through air or vacuums. It can therefore be described in terms of three physical properties: intensity (or amplitude), frequency (or wavelength) and direction of vibration (polarization). All possible forms of electromagnetic radiation can be described by placing them in the electromagnetic spectrum, see figure 3.

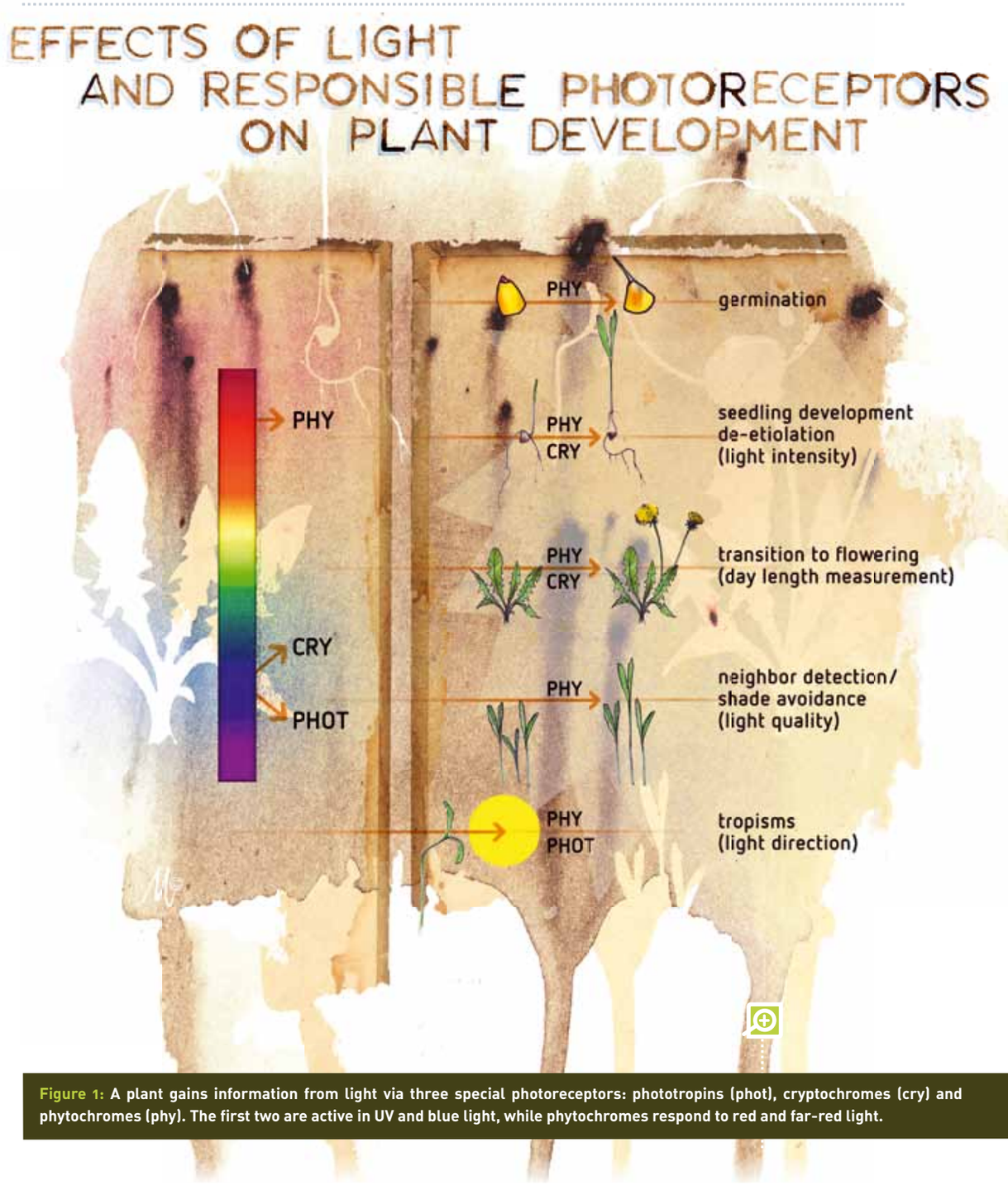


Figure 1: A plant gains information from light via three special photoreceptors: phototropins (phot), cryptochromes (cry) and phytochromes (phy). The first two are active in UV and blue light, while phytochromes respond to red and far-red light.

When we describe the electromagnetic or light spectrum, it's better to talk about wavelength than about color. That's because visible light for humans comprises only a small portion of the light spectrum as a whole – namely the range of wavelengths between 400 and 700 nanometres (nm, which is 10-9 m). As you can see from figure 3, this is a very small range. In fact, it is less than 1 percent of the total spectrum. Photosynthetically active radiation (PAR), or photosynthetic photon flux density (PPFD), is the range of light that can be used by plants to photosynthesise. However, because the PPFD is a summation of all photons in the 400-700nm range, two very different spectral distributions can have the same PPFD. This means that there is no one-to-one relationship between PPFD and spectral distribution. It also means that when we compare light sources, we need to consider spectral distribution data as well as PPFD. PPFD light is expressed as $\mu mol/m^2/s$ and tells us how many light photons will reach a predetermined surface area (m^2) in a specified length of time

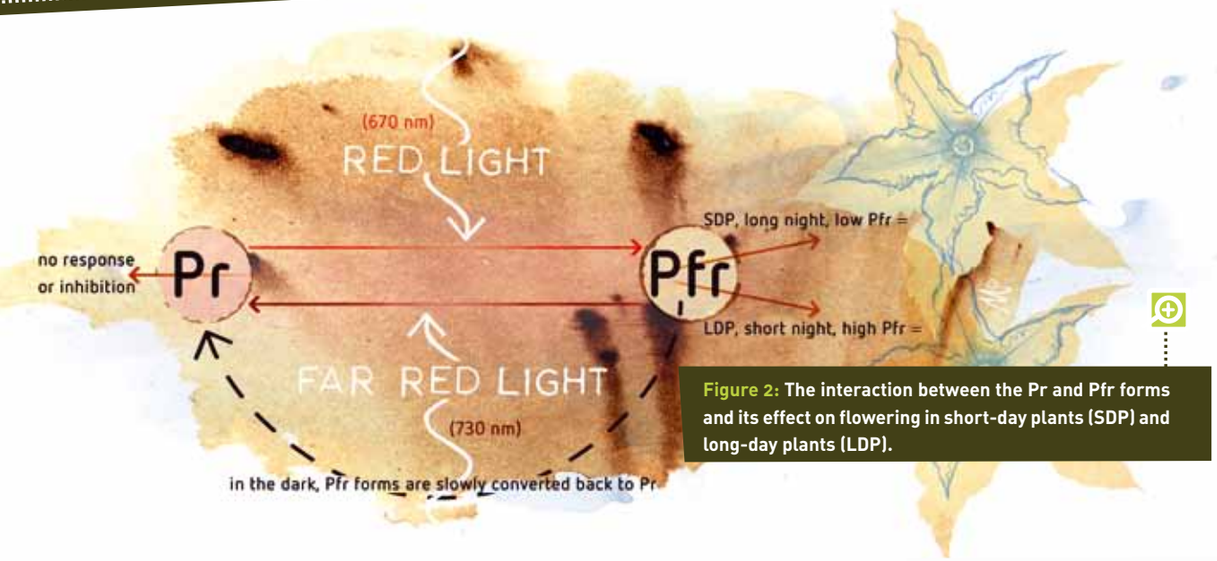


Figure 2: The interaction between the Pr and Pfr forms and its effect on flowering in short-day plants (SDP) and long-day plants (LDP).

LIGHT SPECTRUM

(a second). To illustrate: most plants need a minimum of 30 – 50 µmol/m²/s PPFD to stay alive.

How a plant senses light

As well as providing the energy for photosynthesis, light also acts as an information source for plants. Different light spectra give the plant an indication of its environment and therefore how it should survive, and hopefully thrive and reproduce. In this sense, the composition of the light is as important as the total quantity of light used for photosynthesis. The light spectrum in the range of 300 to 800 nm causes a developmental response in the plant. Additionally, UV and infrared (IR) light are known to play a role in plant morphogenesis.

A plant gains information from the light that reaches it by means of special pigments, called photoreceptors. These photoreceptors are sensitive to different wavelengths of the light spectrum.
There are three groups of photoreceptors, see figure 1:

- Phototropins
- Cryptochromes
- Phytochromes

The first two photoreceptors – phototropins and cryptochromes – are active in the lower range of wavelengths (UV (A) and blue). These two receptors obviously have different functions. Phototropins are responsible for phototropism or plant movement, and the movement of chloroplasts inside the cell in response to the quantity of light. Phototropins are what cause stems to bend towards light and stomata to open.

Cryptochromes are pigments which sense the direction of the light. The inhibition of stem elongation is governed by cryptochromes as well as stomatal functioning, the synthesis of pigments and the tracking of the sun by the plants leaves. The other photoreceptors – phytochromes – are sensitive to red and far red light. There are two forms of phytochrome, Pfr and Pr, which interact. Phytochromes have the biggest influence on photomorphogenesis. Stem elongation, shade avoidance, chlorophyll synthesis and the flowering response are all functions typical controlled by phytochrome. In CANNAtalk 14, you can find an article called 'The effect of red and far-red light on flowering', which will give you much more information about phytochromes.
Now that we have looked at the light spectrum and the photoreceptors responsible for plant development, we come to the next question: how can we apply this knowledge as a grower? What makes a good light spectrum for growing? In order to answer this question, we need to think about the plant's response to different light spectra. Because these fall mainly under visible light, we can speak about 'colors', starting with the most important ones for plant development.

Blue light (400 – 500 nm)

A larger proportion of blue light has an inhibitory effect on cell elongation, which leads to shorter stems and thicker leaves. Conversely, a decrease in the amount of blue light will cause a larger leaf surface area and longer stems.
Too little blue light will negatively affect the development of plants. Many plants need a minimum amount of blue light, which ranges from 5 to 30 µmol/m²/s for lettuce and peppers to 30 µmol/m²/s for soybean.

Interaction between red (600 – 700 nm) and far-red (700 – 800 nm) light

Because red and far-red light have a higher wavelength, they are less energetic than blue light. Combined with the profound influence of the red-induced phytochromes on plant morphogenesis, relatively more red and far-red light is needed for plants to develop.

The two forms of phytochrome, Pfr and Pr, play an important part in this process. Because red and far-red light are both present in sunlight, plants in nature will almost always contain both Pfr and Pr phytochromes. A plant senses its environment by the ratio between those two forms; this is called the phytochrome photostationary state (PSS).
The Pr phytochrome has a light absorption peak at a wavelength of 670 nm. When the Pr absorbs red light, it is converted to the Pfr form. The Pfr form acts the other way around – when it absorbs far red light at a peak of 730 nm, it converts into a Pr form. However, because Pfr molecules can also absorb red light, some of the Pfr molecules are converted back to Pr. Because of this phenomenon, there is not a linear relationship between PSS and the ratio of red to far red. For example, when the ratio of red to far red light exceeds two, there is barely any response in the PSS and thus plant development is not affected. It is therefore better to speak about PSS than the red to far red ratio of the light.

The amount of Pr and Pfr tells a plant which light it is receiving. When there is a lot of Pr present, this means that the plant is receiving more far red light than red light. When there is less red light, the opposite conversion (from Pr to Pfr) is hampered, meaning that there is relatively more Pr.

In environments in which many plants grow close together, all the red light from the sun is used for the photosynthesis process (between 400 and 700 nm) and much of the far red light is reflected by the plants (>700 nm). Most of the plants, especially those in the shade, will receive more far red than red light in this situation. As a consequence, Pr increases, and when this happens, the plant senses that it needs more light for photosynthesis and stem elongation is triggered (see figure 4). The result is taller plants with a bigger distance between the internodes and a thinner stem. This is a clear example of a shade avoidance response, where plants seek to capture more light in order to survive.
Taller plants can absorb more red light which increases the quantity of Pfr forms. This will trigger greater branching, shorter distances between the internodes and less vertical growth in order to maximize the light absorption for the photosynthesis. As a result, plants expend less energy on growing as tall as possible and allocate more resources to producing seeds and expanding their root systems.

Influence of the light spectrum on flowering

Flowering is also influenced by the Pr and Pfr forms. The length of time for which Pfr is the predominant phytochrome is what causes the plant to flower. Basically, the levels of Pfr tell the plant how long the night is (photoperiodism). As the sun sets, the amount of far red light exceeds the amount of red light. During the darkness of the night, the Pfr forms are slowly converted back to Pr. A long night means that there is more time for this conversion to happen. Consequently at the end of the night period, the concentration of Pfr is low and this will trigger short-day plants to flower (see figure 2).

A low red to far-red ratio and consequently a limited amount of red light at the beginning of the night is thus very important for the flowering of short-day plants. Research conducted on

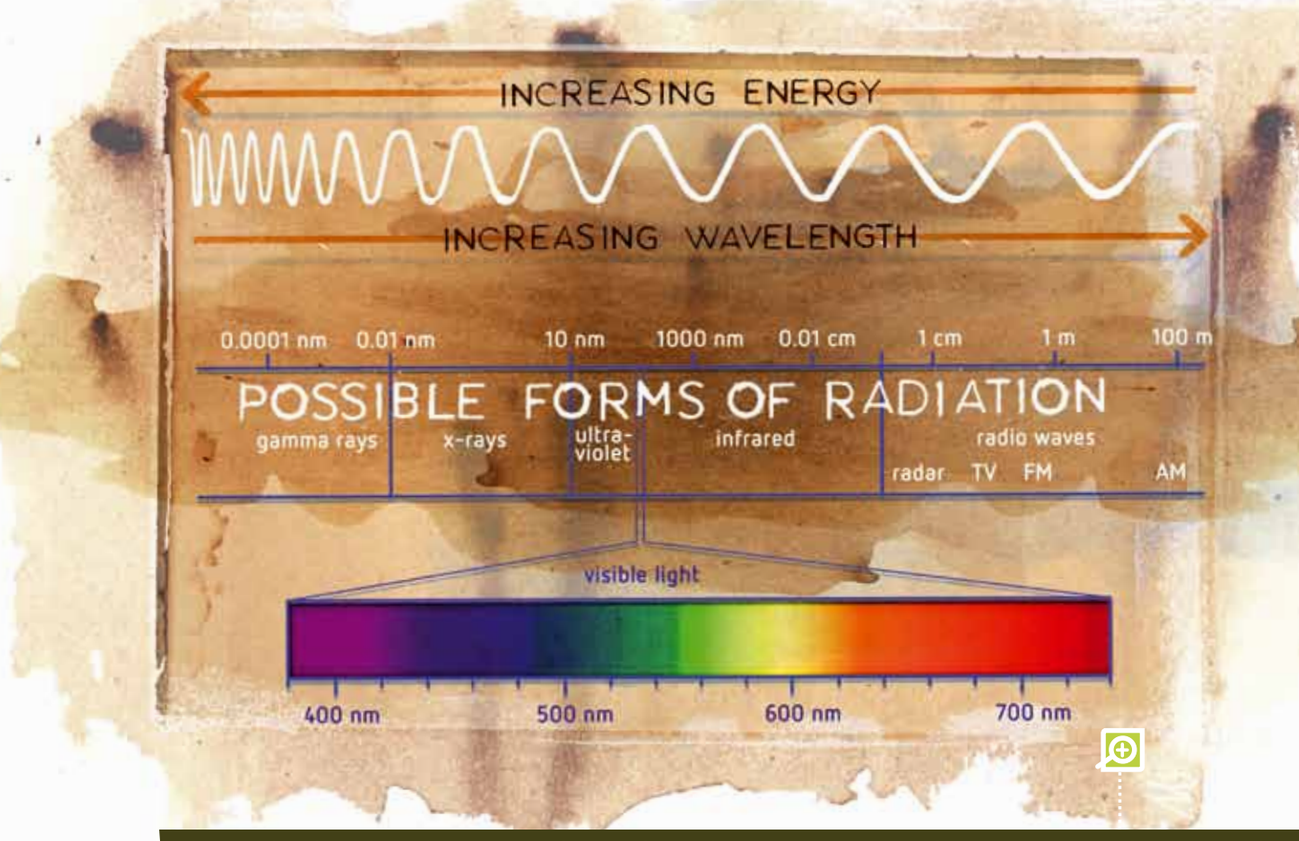


Figure 3: Light, in the form of electromagnetic waves, is described by the electromagnetic spectrum. The most important quality of light for plants is its wavelength or energy content; the shorter the wavelength the higher the energy content.

three short-day plants – chrysanthemum, dahlia and African marigold – shows that when the night is interrupted by a red flash, causing a high red to far-red ratio, flowering decreased dramatically. It was also concluded that far red light alone does not regulate flowering. An equal or higher far-red light portion will improve flowering for short-day plants. These responses are described in more detail in CANNAtalk 14.

Limited effect of green light (500 – 600 nm) on plant development

It's often assumed that only blue and red light help plants to grow and develop but that's not completely true. Although much of the green light is reflected back off the plant's surface (that's why we humans see plants green), green light itself can also be beneficial for a plant. The combination of different light colors can lead to higher photosynthesis than the sum of its parts. Research conducted on lettuce also shows that plant growth and biomass increased when 24% green light was added to a red-blue LED, while maintaining equal PAR levels (150 µmol/m²/s) between the two objects. This indicates that even green light can have a positive influence on plant growth.

Ultraviolet light (300 – 400 nm)

Ultraviolet (UV) light has an effect on plants, too, causing compact growth with short internodes and small, thick leaves. However, too much UV light is harmful for plants, since it negatively affects the DNA and membranes of the plant. Photosynthesis can be hampered by too much UV light. Research shows that this happens at UV-values higher than 4 kJ/m²/day.

Conclusion

This brings us back to the general question of 'what makes a good light spectrum for growing?' It's quite hard to give a general answer to this question, since it depends heavily on the type of plant and the requirements of cultivation. For a 'normal' plant development these specs are recommended:

- Most plants needs a minimal amount of 30 – 50 µmol/m²/s photosynthetic light to stay alive
- A minimum amount of blue light is required, which varies between 5 and 30 µmol/m²/s
- A somewhat larger portion of red and far-red light is required, compared to the blue light
- Balance between red and far-red light: preferably a red to far red light ratio of less than 2
- A limited amount of UV light, less than 4 kJ/m²/day

Also remember that:

- More blue light will lead to shorter stems and thicker leaves
- Too much far-red light or an unequal balance with the red light will result in elongated plants
- A low red to far-red ratio and consequently a limited amount of red light at the beginning of the night is important for the flowering of short-day plants
- Far red light alone does not regulate flowering
- Green light is beneficial for the photosynthesis, although it does not affect the flowering or plant development

The next step is to provide the best light spectrum for your situation. If sunlight is not sufficient, this can be done by selecting a good grow lamp. The emergence of light-emitting diodes (LEDs) in plant production, which you can read more about in our other article, makes it easier than ever before for growers to optimize the light spectrum. •

Figure 4: Since far-red light is mostly reflected by the surface of the leaves, a plant receives (relatively) more of this light when it is crowded in with neighbouring plants. In order to avoid the shade, a plant grows longer stems so that it can catch more light.

THE TOMTATO KETCHUP & FRIES IN ONE PLANT!

Photo courtesy of Thompson & Morgan

DO YOU LIKE TO DIP YOUR FRIES IN KETCHUP? WITH THE TOMTATO YOU CAN PRODUCE ALL THE NECESSARY INGREDIENTS YOURSELF. ALL IN ONE PLANT. MEET VEGETABLE-FRANKENSTEIN.

By Marco Barneveld, www.braindrain.nu

Imagine that you're a horticulturalist with limited land and space to grow. And imagine you are what they call an original thinker, unusually gifted in lateral thinking. Well, one day you're minding your own business, eating your mashed potatoes with a tomato salad on the side, and you get to think... what if you could grow potatoes and tomatoes on one plant? That would give you a double crop and you could produce twice as much food on that small plot of land that you own? If this was a cartoon, a flashing light bulb would appear above your head!

You grow a huge wild beard, and start digging up the bodies of deceased tomatoes and potatoes. You build a giant machine that uses enormous amounts of electricity

and you start to laugh like a maniac as you create your own vegetable-Frankenstein. It might sound crazy, but it is not as unrealistic as it seems. Okay, we can leave out the Frankenstein scene, and actually no genetic modification is necessary either. That's because tomatoes and potatoes are actually related to each other. They are both members of the nightshade family just like sweet peppers, chilli peppers, eggplants, tomatillos, tamarios, pepinos, pimentos, paprika, and cayenne peppers.

Grafting

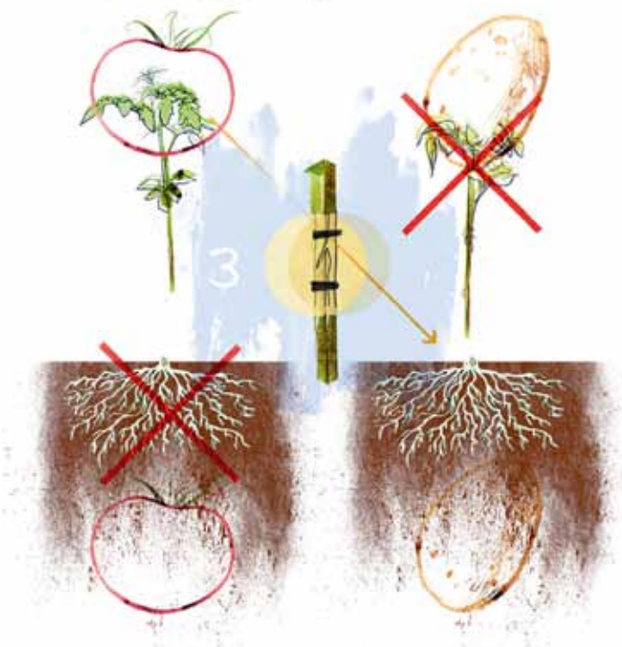
A Dutch horticulture company, Beekenkamp Plants, grafted together the top of a cherry tomato plant and the bottom of a white potato plant at the stem. And voila, the 'TomTato' was born. It is said to produce 500 sweet tomatoes plus a healthy crop of potatoes under the ground.
According to the company, however, the TomTato's fruits have a Brix (sugar content) level higher than that of most supermarket tomatoes, along with 'just the right level of acidity, which only the tastiest tomatoes have'. The potatoes are said to be fine for boiling, mashing or roasting. So there you go. Not crazy at all. Pretty clever actually.
Now these two veggies come in one plant that you can buy online in the UK (www.thompson-morgan.com) and in the US (www.tmseeds.com). The plants cost about $20 each. You can also try grafting yourself, see figure 5. It's as easy as that!

Grow it yourself

When growing a TomTato, it's best to treat it as you would a normal cherry tomato. This means planting it in good soil or growing media in a sunny and sheltered position. The tomatoes of the TomTato will grow fast. It needs to be staked and trained to support a long and prolific crop of delicious, small fruit. The potato roots will, in most cases, send up shoots from alongside the grafted shoot. Let these develop and grow under your staked tomato, as you would a normal potato but don't mound the potatoes, as this will cover the graft.
If you really do have limited space and you only have a balcony or a terrace, you can still grow the TomTato because it will grow happily in a pot. The ideal pot size is 7-15 gallons and a good rich growing media or compost is essential. You'll also need to water regularly, and a sunny sheltered location is essential.

1) Plant a potato plant and a tomato plant together in the ground – they should both be young plants (in two pots next to each other is also possible).

2) Make an incision in a shoot on the tomato plant and the rootstock of the potato plant in opposing directions; the cuts should be about 1 inch long.



3) Slide the stem and the rootstock together. If you keep the two plants together using wire or sticky tape, after about a week you can remove the upper part of the potato plant, and the under part of the tomato plant.

4) Now your TomTato plant has been created.

Figure 5: Growing a TomTato plant.

Full sun

Make sure that it grows in full sunlight for the best results. The maximum sunlight will produce the greatest yield and the tastiest tomatoes. The TomTato should be sheltered from any strong or cold winds and protected from frosts. Water the plants regularly and deeply to encourage good root structure to support the plant in its double harvest.

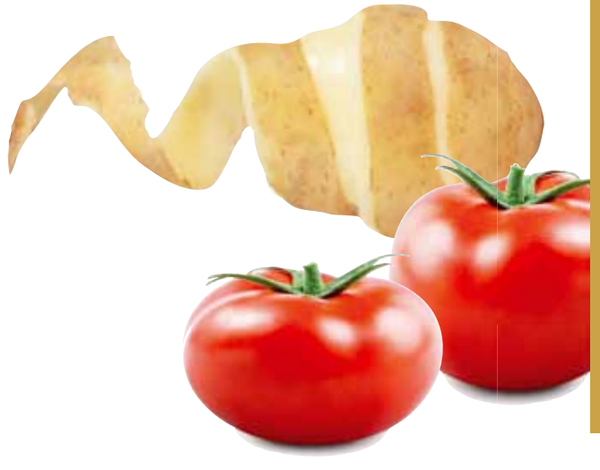
The TomTato is very happy growing in garden soil and it will do best in fertile, free-draining soil with plenty of compost and organic matter. The soil pH should be between 5 and 6. Both tomatoes and potatoes need a lot of feeding, so make sure you fertilize it when you plant it and again after about three months.

Harvesting

TomTato plants can sometimes produce potato foliage from the base of the plants, and this may grow through the tomato foliage. It can be removed by pinching out to ground level without affecting the potato harvest. If, however, you leave this foliage to grow through the tomato foliage, any potato flowers should be removed. Top up the compost in containers every so often to prevent potatoes near the soil surface from becoming green and inedible. The tomatoes can be harvested as they ripen between July and October. To help ripen the green tomatoes, harvest the red tomatoes regularly. If you are growing your TomTato in containers, they can be moved to a frost-free position in the autumn for a prolonged crop of tomatoes. Once the tomatoes have finished cropping, cut back the plants and harvest the potatoes below.

Taste bombs

Tomatoes are packed with antioxidants, which is what gives them their red coloring. Cooking tomatoes releases these antioxidants so that they are easier for our bodies to absorb. They are loaded with vitamins C, B6 and A, as well as calcium and potassium. Eating tomatoes actually protects your skin against the sun from within. You could call them tasty health bombs! Potatoes, meanwhile, are also packed with vitamins and minerals. They are very high in vitamin C with good levels of B6, potassium, manganese, magnesium, phosphorus and iron. They are also full of fibers and contain more potassium than bananas. •



RECIPE

PATATAS BRAVAS (ANGRY POTATOES)

So now that you have your tomatoes and potatoes, what are you going to make with them? You have already tried ketchup and fries so how about something more original. The Spanish have a great little dish called patatas bravas. You will need the vegetables that you have grown on your TomTato plant along with some garlic, hot peppers (to taste), a chopped onion and a pinch of salt. Oh, and white wine!

Preheat your oven to 350°F. Put the potatoes in a baking tray or casserole dish with 3 tablespoons of olive oil and salt well. Arrange them in one layer and roast them until they are brown, for about 50 minutes. While the potatoes are roasting, make the sauce. Heat 2 tablespoons of olive oil in a medium pot set over medium-high heat.
Sauté the chopped onions and hot peppers, stirring occasionally, for 4-5 minutes. Add the garlic and sauté for another 2 minutes. Add the white wine to the pan and turn the heat up to high. Cook the sauce on a high heat until the wine has reduced by half, then add the tomato paste and stir in. Add the crushed tomatoes. Stir well and reduce the heat to a slow simmer. Let the sauce continue to cook slowly while the potatoes roast. If you want, you can use a blender or an immersion blender to purée the sauce until smooth.
When the potatoes are well-browned, toss them with the tomato sauce and return them to the casserole pan. Continue to roast until the tomato sauce begins to caramelize on the potatoes.

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

Can you tell me why week five of flowering is so important to a plant? What happens, what does it need, why does it need it and what should I do? I would just like to understand the plants, hope you can help.

Answer

If the plant goes into generative growth (making flowers), the plant will need more P (phosphorus) and K (potassium). If the plant needs more, we provide more by increasing the dose (the EC level). CANNA puts all these elements into CANNA Flores (although, of course, it contains others too (iron, trace elements, etc).

In week five, the plant stops growing in height and begins to concentrate purely on flower production. That means it needs more P and K. Just increasing the dose won't help any more, because Flores also contains other elements. As the flowers increase in size, we give extra PK on top of the Flores using PK 13/14. This is only temporary because after this period the plant needs fewer nutrients in general. So then we gradually start to lower the dose (EC level) until finally we even start to flush the remaining EC away.

So the extra PK during flowering is needed for the growing 'fruit body' of the flowers; these increase in size and get heavier. We need to warn you, though: if too much PK 13/14 is provided, the plant cannot absorb it and the PK will stay in the substrate. That means the salt level (EC) increases and the plant's leaves will burn. Autumn will arrive early and the plant will stop making flowers.

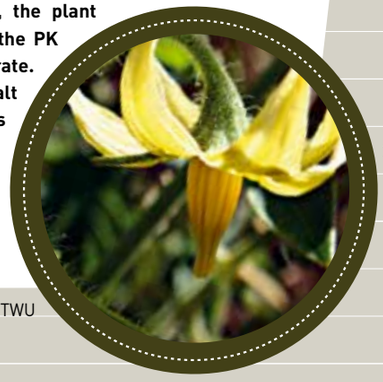


Photo courtesy of Camelia TWU

Question

I am using your CANNA Terra Professional soil with CANNA Terra Vega and Terra Flores nutes and running it at pH 6.2. The run-off is only pH 5. Is this right? My last two plants have not been successful and the leaves are yellowy. Could it be that my pH is too low or am I doing something else wrong?

Answer

It is strange that if you mix at a pH of 6.2 that the run-off from the Terra is 5. If this is true, it is understandable that you're getting poor results.

Here are some ideas about what could have gone wrong.

1. The order in which you made the nutrient solution was not right. Was the pH the last correction before you gave nutrients to the plant?
2. Your measurement of pH 6.2 wasn't accurate, because:
   1. The water was not at the right temperature yet; after adding the nutrients (68°F), the pH can change if the water temperature changes
   2. The pH meter is broken; calibrate the meter
   3. The tank was not stirred right. This often happens if you are in a hurry to make up the tank. Wait one hour after mixing, measure again and if the pH is right, give it to the plant.
3. The Terra is too wet: the soil starts rotting, which can lower the pH. The roots may also be poorly developed with many dead roots.
4. Your water is very soft. Increase the pH of the water to 6.5.
5. You are using additives (of another brand) in addition to our nutrients, which can lower the pH.

I suspect the second option, because you measured the run-off. Although a run-to-waste system is possible, you always have to watch out for high moisture content in the Terra. Check if the pot weighs 25-30% of his volume. A three gallon pot for example should be watered at 6-7 lbs.

Question

I have followed your Substra grow chart from start to finish in my flood and drain system. Does the final 1-2 weeks with just CANNAZYM and CANNABOOST count as flushing or should I then flush with just tap water and if so for how long?

Answer

You should flush with tap water, CANNAZYM and CANNABOOST. Correct the pH (6.0-6.2), and that's it. If the EC (>2.0) gets too high in the reservoir, renew it. You can start 1 to 2 weeks before harvesting.

Question

I'm using CANNA Coco A&B and realized I put CANNA PK 13/14 in a week early although I have not used it yet. Is it safe to let the nutrient sit in the reservoir for a week or should I throw it out?

Answer

PK 13/14 is a mineral nutrient and you can keep mineral nutrients for a long time. But if you add an organic additive to it, like RHIZOTONIC, CANNAZYM or CANNABOOST these products will start to work (ferment) and lose their power. In general, you can hold these products for a maximum of five days in the tank. The shelf life will be shorter if the water temperature in the tank is higher than 68°F.

Question

Can you confirm that your coco has been sterilized and free of gnats? The coco I have bought from other companies is full of gnat larvae... I'm at my wit's end and I want to fix the problem without using chemicals. I have tried Yellow Sticky and Gnat Off, can you recommend a solution?

Answer

Actually, no it is not sterilized as most mediums would be, by steam. But with coco you don't need to worry because it does not originate from the ground and, like peat, the chemical characteristics are not right for most issues. Once it breaks down, and if handled poorly, it will make it a suitable medium for insects and diseases. Moisture control is critical especially for all types of gnats. CANNA Coco is controlled from the husk to the bag and by controlling both this and the age, we achieve a clean mix and every batch is certified as free from weeds and insects, at least up to the point when it is packaged and shipped to the store. After that point, however, contamination with many things, especially Fungus Gnats, is very possible. Gnats are everywhere that plants grow in soil and it is easy for them to get into your bag or container. Gnat larvae typically inhabit all mediums where organic material is available for consumption. This includes fungi, algae, roots, leaves and any decaying materials. They always prefer moist mediums and can be controlled when a medium dries out, as happens with coco between production and packaging. High moisture levels are pretty much a guarantee of a gnat problem, especially when they are active outdoors. They prefer the top 1 to 2 inches (25 – 50 mm) of medium. Females look for these conditions to lay their eggs. Adults do not feed but may take in water, but the larvae (or maggots) will eat anything they can and the higher the population, the more they will eat important things like roots and damage plants.

Given the large populations present in the environment (known as pest pressure), it is, in reality, only ever possible to control the problem, not eliminate it entirely. The key is water in the medium. If you allow the container to dry down to a point the top 1 to 2 inches (25 – 50 mm) are dry, then you will control the gnat problem. Interestingly enough, this is about the point at which the container will have dried out by about 50%, which is exactly what we recommend for peat and coco mediums. Otherwise you can control the gnats with regular applications of Bti (Bacillus thuringiensis subspecies israelensis) in the top 1 to 2 inches of medium. This is normally sold as Gnatrol. There are some natural predators and nematodes such as Steinernema feltiae that can be used. But check the moisture levels first!

Don & Nicky

(PART 6)

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.

Indoor HERB FARM

WITH THREE POTENTIAL LIGHTING SOLUTIONS

I have a confession. I'm addicted to herbs and one in particular: Coriandrum sativum – sent directly from the heavens. You may know it more plainly as coriander, cilantro or even Chinese parsley. Me? I just long for a daily supply of those delightfully pungent, citrusy leaves! They add such a special fragrance to my Asian curries as well as a whole host of Mexican and Chinese dishes. When I have it, I use it lavishly. The problem is, here in the south of France, it's somewhat of a rarity. You won't find it in the main supermarkets and specialist Asian stores, as if sensing its scarcity, opportunistically slap an insulting mark-up on it.

The answer, of course, is to grow copious amounts of it myself – but, as most honest gardeners will tell you, coriander is a tricky beast to tame – especially if you're after a constant, year-round supply of the stuff. When growing coriander for its leaves and roots (rather than for seed) the last thing you want is for it to flower. Once you see flowers and those frilly leaves it's essentially game over. The plant has switched into generative mode and you have to start over.

Although we northerners tend to associate coriander with lazy sunny days dipping cucumber into guacamole and salsa, it's worth noting that it's a cool-season crop. If temperatures rise above 73°F for more than two or three consecutive days most varieties of coriander will start to flower. However, it's also native to southern Europe and northern Africa where sun is in plentiful supply. So here's the $64,000 question: how can I grow coriander indoors using only artificial lighting without spoiling quality and yield with excess heat? I'm sure I'm not the first aspiring indoor gardener to face this quandary!

1 Coriander is a rarity in the south of France and I'm addicted to it!

2 I'm half way through converting my wine cellar into a mini herb factory.

Right now I'm about half way through converting my wine cellar into a mini herb factory. I'm going to trial three very different kinds of grow light and assess the results

The first grow light I'm going to test is a 1000W metal halide. You probably already know that it's rich in the blue part of the light spectrum making it ideal for vegetative growth. However, because of all the heat those watts generate I'm going to house the lamp in an air-cooled reflector and aim to cover around 22 square feet of grow space – this should be more than sufficient for my family's needs. The light will be around 3 feet above my crop. I plan to draw air from an adjacent room to my cellar to cool the lamp and duct the exhaust air directly out of my grow room to my back yard. Hopefully I can simulate a cool, sunny, perpetual spring. I understand that air-cooling a metal halide lamp reduces output by around 6 – 10 percent but I'm not too concerned.

The second grow light will be a T5 high output fluorescent multiple array fixture. It has 2 x 55 watt 6500K (daylight) lamps so uses a fraction of the power of the metal halide but only covers 3 square feet (basically the T5 covers the same amount of floor space as the fixture itself). This might be all I really need for a low-lying, leafy crop however I'm still concerned that the T5s may radiate too much heat as it needs to be positioned much closer to the crop – around 12 inches. Time will tell on this one!

The third grow light is a solid-state, light-emitting plasma. My wife Nicky is still recovering from the shock of its price tag but this really is cutting-edge! Using just 300 watts I can cover 13 square feet when hung 16 inches above the crop. In terms of efficiency, no other light comes close. It also emits more UVA and UVB to promote more essential oil production. I want to really taste and smell my delicious coriander!

As for growing systems, I think I'm going to keep things simple for now and use pots and a 50/50 coco coir/perlite mix. Coriander enjoys light, easy-draining potting mixes. I won't be sowing my seeds in trays as the seedlings become quickly upset if you transplant them. You must sow coriander seeds directly into their growing container.

Successfully growing coriander indoors will certainly set an encouraging precedent! After all, lots of sunshine and cool temperatures isn't the easiest environment to replicate sans air-conditioning but hopefully the subterranean location will help. I love this herb so much that I'll do pretty much anything to secure a regular supply! •

Wish me luck. Full report next time!

PROTOCARNIVOROUS PLANT

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

- The little white balls in this picture aren't the pistils of a flower; they are actually the flowers of the Paepalanthus Bromelioides, a beautiful plant that grows in the Cerrado region of Brazil. The Cerrado is one of the richest of all the tropical savannah regions and is characterized by the enormous diversity of its plant and animal life. It is the richest and most biodiverse savannah ecosystem in the world and houses about 10,000 plant species, 10 endemic bird species and 14 endemic mammal species (species that are unique to that habitat!).
- The Paepalanthus genus has about 485 species in the family Eriocaulaceae. This group of plants is related to the bromeliads, and they have a similar structure to plants in that family that are believed to be carnivorous (its leaves are arranged in a basal rosette around a central cistern).
- Scientists are not sure whether P. Bromelioides is carnivorous or protocarnivorous. Protocarnivorous means that the plant traps and kills insects or other animals, but lacks the ability to digest or absorb nutrients from its prey directly (which is a defining characteristic of fully carnivorous plant).
- Laboratory and field studies in Brazil have suggested that two-thirds of the nitrogen used by P. Bromelioides is derived from termite mounds and there is a clear input from predators and insects via the rosette of the plant. That's why some scientists have concluded that, although most of its nitrogen is absorbed though its roots, P. Bromelioides has all the defining characteristics of a carnivorous plant in the context of digestive mutualism.
- P. Bromelioides belongs to the same family as Brocchinia reducta, a plant whose carnivorous properties have also been questioned because it could not be found to produce any digestive enzymes. However, in 2005 it was shown that the plant produces at least phosphatase and is thus – in strict sense – a carnivorous plant. Additionally, the leaves of the B. reducta are coated with loose, waxy scales. This gives any insects landing on the plants a very poor foothold; the unfortunate creatures slip and slide down into the water-filled cup at the bottom and eventually drown. The slippery scales are also highly reflective of ultraviolet light which acts as an effective lure, since many insects are attracted to ultraviolet. The water in the cup also emits a sweet scent that may serve to attract ants and other insects.

Photo courtesy of Wave Faber

What's HAPPENING

Photo courtesy of Cristiano Oliveira

WEIRD FOOD

PLEASE MUM, CAN I HAVE SOME MORE?

One thing that some people say about traveling is 'When in Rome, do as the Romans do'. But if you insist on following that rule, these ten dishes might prevent you from traveling to certain countries. Or can we tempt you with a frozen, rotting fish head...? By Marco Barneveld, www.braindrain.nu

2.Fried bats, **Indonesia**

Eat this Dracula. In the covered market in Jogjakarta, smoked bats are sold as tasty street food. Kids catch the flying rodents during the day when the creatures are sleeping upside down. Then they are fried alive. They're only about three inches long, like skeletal brown mice with teeth. They are supposed to taste like beef jerky. Is it bad? Nope. It's bat.

1.Escamoles, **Mexico**

Mexicans call this unusual snack 'insect caviar'. We call that a great marketing name for ant larvae that are harvested from the roots of the blue agave, otherwise known as the tequila plant. The consistency is something like cottage cheese and the taste is buttery. Oh, and the larvae won't make you drunk. But maybe a little green around the gills. Rrrrrr.

3.Stinkhead, **Alaska**

This traditional dish of the Yupik Eskimos is made from fermented whitefish heads. The heads and fish innards are stored in a wooden barrel, covered in burlap, and placed in the ground for a month, or even longer. It's then dug up and eaten raw and frozen. This tradition started due to simple poverty. With nothing to eat the hungry Yupik started to dig up their own fishy waste, which they had buried. Then they discovered that it actually did not taste bad at all. There is one problem with Stinkheads tough. They make your head stink.

Photo courtesy of Chris 73 Wikimedia Commons

4.Hákarl, **Iceland**

When in Rome, do as the Romans. In Iceland, this means dining on hákarl – decomposed shark. The shark is buried to ferment in its own rotting fluids for several months. The salty delicacy is then cut into strips and hung up to dry. Oh yeah!

5.Pan-fried spiders, **Cambodia**

Most people would run like a thunderstorm on nitro if they ran into one of these hairy, scary creatures... but not the brave (and hungry) people of Cambodia. Eating tarantulas came into fashion during the reign of the Red Khmer. 21% of the entire population of the country died during this period as a result of torture, murder and famine. The Cambodians, understandably, started to see anything that moved as food. Fried spider is something of an acquired taste. These little chaps are tarantulas, served with a lime and black pepper dip.

6.Ikizukuri, **Japan**

Preparing live fish for sashimi, called ikizukuri, is understandably controversial. The fish used for this kind of sashimi is alive; its meat is sliced away from its body and rearranged on top of it, in a rather macabre fashion. So as you eat the fish's flesh, it watches you while slowly dying. Yes, that's really fresh. It's kind of sick, but it's really fresh.

7.Rocky Mountain oysters, **US**

Thinking of oysters you feel that snotty, salty taste of the sea on you tongue. And although a lot of people might consider oysters as weird food their Rocky Mountain counterpart might be considered worse, especially if you are a bull. See, Rocky Mountain oysters are bull balls deep-fried to a crisp after being peeled, coated in flour, pepper and salt, and sometimes pounded flat. Pounded flat. Ouch.

Photo courtesy of cearensizando.com

8.Witchetty grub, **Australia**

When the Aboriginals in Australia could not get their boomerangs on a kangaroo, they foraged for all kinds of grubs. The top prize is a witchetty grub - what the Australians call the large white larvae of several species of moth. When you bite into one, it will pops open, a bit like a fish egg, oozing an explosion of slimy goo into your mouth. Yummy.

Photo courtesy of Ian Barbour

9.Black Ivory coffee, **Thailand**

Last year, a coffee called Black Ivory became one of the world's most expensive brews, at roughly $ 6,173 per lb. And for that money, you can expect a smooth, slight earthy hint of elephant dung because Black Ivory is made from coffee beans that have been eaten by elephants and then plucked from their poo. The digestion of the coffee beans in the intestines of the elephant adds extra taste to the coffee, making it nutty and sweet. Would you like another cup?

Photo courtesy of LW

10.Sannakji, **Korea**

Sannakji is freshly killed squid; the nerve cells in the tentacles are brought back to life when sodium-rich soy sauce is poured over them. The result is a bit unsettling: a dancing squid tentacle on your plate. And you'll need to watch out as you're swallowing, because the tentacles can stick in your throat, causing a choking hazard. It can be quite a struggle to eat these squirming, worm-like pieces of squid, although the Koreans do it with ease. Most likely, they will be red-faced, taking shots of soju, Korean liquor, at the same time. Delicious.

11.Tong zi dan, **China**

This is perhaps one of the most difficult to understand of all the weird foods that this beautiful world has to offer – the Chinese delicacy of tong zi dan or virgin boy eggs. Every spring in the city of Dongyang, eggs are boiled in the urine of young schoolboys. They actually place special buckets at primary school. Boys who are sick are asked to refrain, to keep the process of boiling eggs in urine as hygienic and healthy as possible.•

Pests & DISEASES

Aphids are a wide and heterogeneous group of insects that live only as parasites on plants. Aphids belong to the family Aphididae and the group includes a number of genera and species. By Ignacio Garcia, CANNA Research

Figure 6: Aphids are small plant-eating insects and members of the superfamily Aphidoidea. Aphids are among the most destructive insect pests of cultivated plants in temperate regions.

ROOT APHIDS

Aphids are small, globular insects that vary in colour from yellow to green, although some may have pink tones. They have a characteristic stylet which they use to suck sap from the phloem of the host plant, and siphons in the rear of the abdomen through which they secrete a sugary substance called honeydew. They are generally found in the aerial parts of the plants they infect (the leaves, stems and buds), although there are aphids which have adapted to soil conditions and feed on plant roots.

Some of the aphid species that specialize in feeding on root sap belong to the genus Pemphigus. Many of these are specific to the crop that they parasitize and are commonly given a name which reflects this, such as the sugar beet root aphid (Pemphigus populivenae) and the lettuce root aphid (Pemphigus bursarius). Other aphid species which attack roots include the rice root aphid (Rhopalosiphum rufiabdominalis) and the rose root aphid (Maculolachnus submacula).

Life cycle of root aphids

Aphids have two methods of reproduction, sexual and asexual (or parthenogenetic, meaning that the females can reproduce without being fertilised). Under the sexual method of reproduction, eggs are formed that can survive through the winter.

Once the aphids are established on a plant host, females generate new viviparous females through parthenogenesis (without laying an egg). When the population grows denser, winged individuals are formed which can fly away and colonize other plants or the aerial part of the affected plant.

Symptoms

The symptoms of an infestation of root aphids can be found in both the aerial part of the crop plant and the roots themselves. These symptoms are a direct consequence of the aphids' feeding: they suck sap from the plant, weakening it. Some symptoms also occur as an indirect consequence of the infestation, such as the inoculation of toxic substances by the aphid while feeding and the transmission of viruses.

The main symptom in the aerial part is generalized chlorosis, similar to a nitrogen deficiency, with leaves looking pale and lacklustre; some leaves may dry up. The plant will also look weak.

The roots of the infested crop will often be surrounded by a dusty halo, similar to a fungal infection. The best way to be sure that a crop is being attacked by a root aphid is to try to see these on the roots, since many symptoms, both aerial and radicular, are similar to those of other diseases such as nutrient deficiencies or attack by soil fungi. Some aphids live close to the surface and are easily visible after irrigation, since they often emerge.

Yellow traps may also be used to monitor the presence of winged aphids on the crop.

Honeydew, which is excreted by aphids, also serves as food for ants and so the presence of many ants in the root zone of the cultivated plant may indicate the presence of root aphids.

Photo courtesy of David K.B. Cheung

Figure 7: The roots of a crop attacked by root aphid are often surrounded by a dusty halo.

Figure 8: The main symptom of a root aphid attack in the aerial part is chlorosis, similar to a nitrogen deficiency.

Treatments

It is essential to begin with a root environment that is free of these parasites and their eggs. For cultivation in pots, it is necessary to use certified substrates which have no insects or weeds. In the field, it is important to rotate crops, since many aphid species are specific to one cultivated species. The use of soil disinfection methods (chemical pesticides or solarization) is necessary in crops which have suffered an infestation of these insects.

Although a small population of aphids do not present a serious problem, it is important that the crop stays free of these parasites due to their potential to transmit a number of viruses to the host. A plant which has been infected by a virus will remain infected until the end of the crop cycle, and a reduction in yield is possible. Biological control methods include the use of insect pathogenic fungi, which parasitize the insects and kill them. The most commonly used species are Verticillium lecanii and Beauveria bassiana. Some insect growth regulators and parasitic wasps have also been used successfully.

LEDS FOR PLANT PRODUCTION

HAVE YOU EVER THOUGHT ABOUT USING LIGHT-EMITTING DIODES (LEDS) IN YOUR CULTIVATION ROOM? IF INDICATOR LIGHTS FOUND IN THE DISPLAY PANELS OF ELECTRONIC EQUIPMENT. NOWADAYS THEY ARE THERE IS LED HOME LIGHTING, AND RECENTLY OF COURSE, LED GROW LIGHTS TOO. By CANNA Research

Some growers believe that it's not a question of if LEDs will become the most common supplementary light source for plants, but when. The major questions for most growers are whether LED grow lights are actually effective, and to what extent they can be used in the same way as traditional grow lights. In order to answer these questions, an understanding of the practical use of LED grow lights is required. This article will give you some insight into the practical aspects of using LEDs and reveal some of the pros and cons. First, however, we will explain the principles of LED lighting so that we can understand how to use it.

What are LEDs?

All LEDs are semi-conductors that produce light by a process called electro-luminescence. LEDs are made out of two types of material, the N-type and P-type. The N-type consists of negatively charged free electrons and the P-type has positively charged gaps ('holes'). When the N-type layer is connected to the negative (-) end of an electrical circuit and the P-type to the positive (+) end of the circuit, the free electrons can move in an electrical flow. The free electrons are attracted to the positive holes in the P-type material. However the hole has less energy than the electrons. In order to 'fit' into the hole the electron has to release some of its energy. In the case of LEDs this energy is emitted in the form of a photon, which is light. The intensity of the light emitted from an LED depends on the energy released by the electrons jumping into the positive hole (figure 9).
The color emitted by the light photons depends on the semi-conductive material in the LED. LEDs can be manufactured in such a way that the photon colors will match the light-absorbance peaks of important plant pigments, such as the red and far-red-absorbing forms of phytochrome, or the red and blue peaks of leaf photosynthetic action spectra. This basically means that LED lighting can save energy by producing only the colors that are essential for plant growth and development.
That's the technical part for now... But how does all this relate to your beloved plants? And how can you choose the right LED grow light?

LEDs for crop production and some practical units

As we already know from the other research article, plants use light for photosynthesis and development. Light for photosynthesis is described by the PAR (photosynthetic active radiation) or PPFD (photosynthetic photon flux density). That is the amount of light, between 400 and 700 nm, used for photosynthesis. For normal cultivation purposes a minimum of 50 to 200 µmol/m2/s is required, but this obviously depends on the type of plants and how much light they require. As a rule of thumb, the more light you provide, the better the plants will grow. However, there is a point beyond which they are unable to make further use of extra light: around 500 µmol/m2/s.

When you are choosing an LED light sources, it is important to keep in mind that plants have different light absorption peaks to the human eye. Photosynthetic light has absorption peaks in the blue and red light spectra, while humans have their light peak in the yellow/green spectra (see figure 10). This means that photosynthetic light is certainly not the same as lux or lumen, which is the 'human measure of brightness'. When you are assessing an LED grow lamp, you will need to know its specification for photosynthetic light production in PAR or PPFD. Unfortunately, these light specifications are not always available for all LED grow lamps.

PAR and lux are different physical quantities, there is not a clear one-to-one relationship between PAR and lux. Basic conversion factors have been formulated for different light sources and corresponding light spectra, so that a different conversion factor will apply for different light sources (table 1).
But what about LED conversion factors? Basically, LEDs are different from other light sources because they can have very different spectral compositions, meaning that an all-purpose conversion factor is not possible.

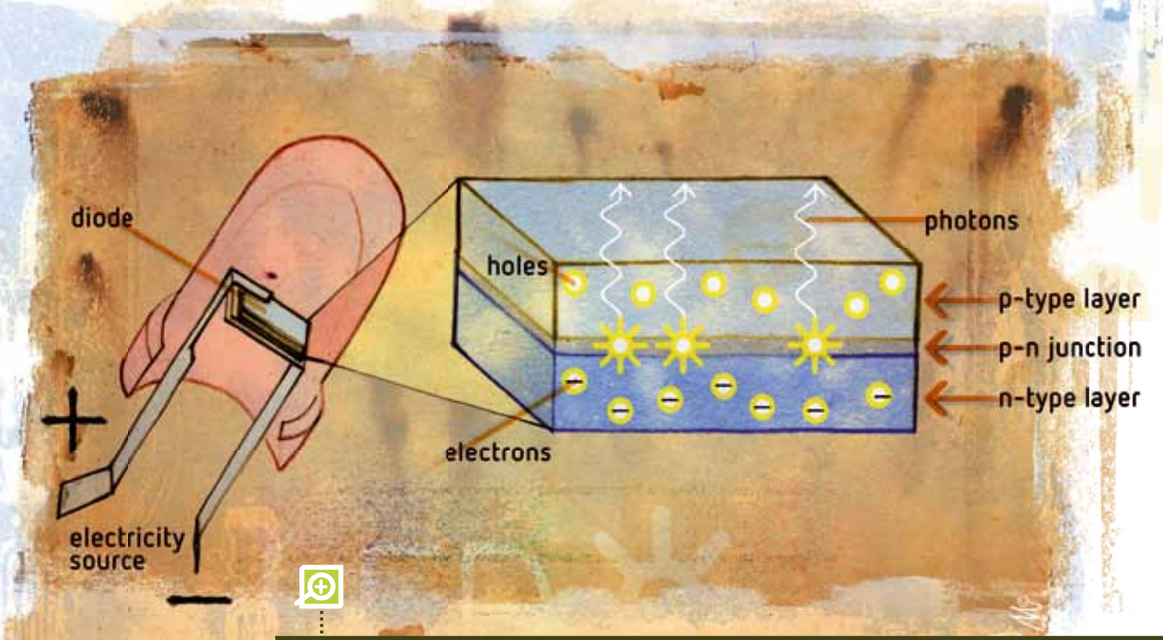


Figure 9: This simplified illustration of an LED demonstrates how extra energy is released in the form of photons when electrons cross the p-n junction to fill holes in the p-type layer.

LIGHT SOURCE	TYPE	400 – 700 nm[1]	400 – 800 nm[2]
Incandescent	3,000K	0.019	0.036
High pressure sodium		0.012	0.013
Mercury	Clear	0.011	0.012
	Phosphor-coated	0.013	0.014
Metal Halide		0.014	0.015
Fluorescent	Cool white	0.013	0.013
	Day light	0.014	0.015
	GRO	0.029	0.030
	GRO/WS	0.019	0.022
	CWX	0.016	0.018
Clear day (sun and sky)	6,000K	0.018	0.024
North skylight	12,000K	0.020	0.024

1 Light spectrum for photosynthesis
2 Photosynthesis and additional far-red light (700 – 800 nm) used for plant development

Table 1: Conversion factors for different light sources from lux (lumen/m2) to PAR (µmol/m²/s)

Evaluating an LED grow lamp

However, it is still possible to determine the quality of an LED grow lamp without profound technical knowledge.
All the LED lighting systems sold on the market as 'grow lights' are made up of different combinations of LEDs. They can consist of up to ten different types of LEDs. Each individual LED should consume at least one watt of power to be effective for plant lighting; below this level, the light emitted will not have enough penetrative power to illuminate the whole plant properly. But there is more to it than that. When evaluating an LED lamp, you should look for high intensity or high brightness 1W LEDs, which measure 10mm and are of the current generation.

In most conventional lamps, the greater the electric power they consume, the higher both the total lumens emitted and the lumens per watt. However, this does not apply to LED lamps. At higher input power levels, each individual LED will certainly be brighter, but they are less efficient (they will emit fewer lumens per watt). There is also no effective difference in penetrative power for horticultural purposes between a 1W LED and a 3W LED. This is a fundamental difference between traditional grow light systems and LED-based systems. A circuit containing 90 x 1W LEDs will be more powerful and more efficient than one containing 30 x 3W LEDs: you cannot simply compare the total wattage in the same way you are used to doing with discharge light systems.

There is another factor to take into account: it is not uncommon that a 3W LED, for example, will be limited to between 2.2W and 2.8W. It is important to study the optimum luminous efficiency, heat loss and life span of each diode. Be aware that LED lamps will also need power to run the LED drivers, fans for cooling and for heat loss. For example, a 135W LED unit will, in reality, only provide about 110 watts of light energy.
Numerous configurations exist for LED grow light systems, such as UFO grow lights, grow light panels and single spot lamps. You should be looking for a system with a minimum power of 90 watts, depending on your specific requirements and situation of course.

A practical difficulty is that (LED) light is governed by the inverse square law: when the distance from a light source is doubled, the amount of light received falls not by 2, but by 2 squared – i.e. by a factor of 4 (figure 11).

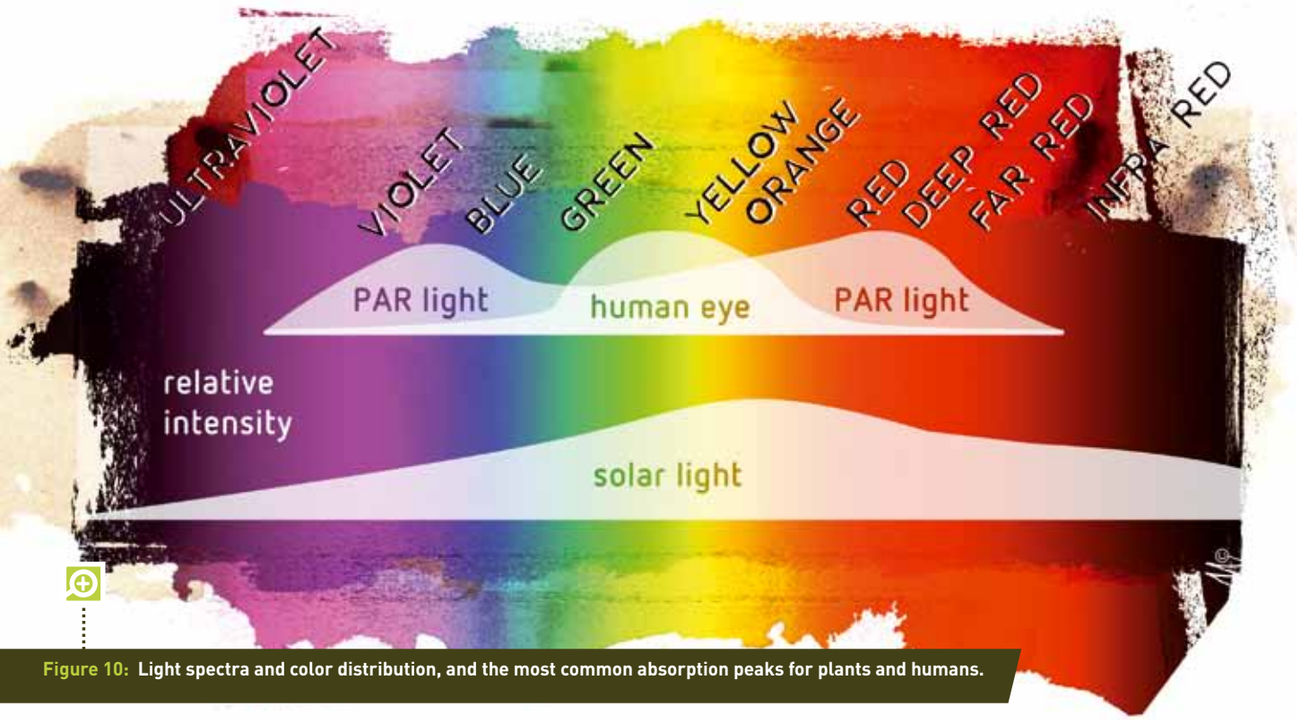


Figure 10: Light spectra and color distribution, and the most common absorption peaks for plants and humans.

The potential of LED grow lamps

One of the most important benefits of LED lights are their energy-efficiency since they produce less unnecessary light photons and heat! The heat produced from incandescent and discharge lights, although it may be beneficial to plants, is not economical. Table 2 shows that LEDs require only 25% of the power of an incandescent lamp to produce the same amount of light (in lumen). This gives LEDs a substantial economic advantage over traditional light bulbs.
When comparing LEDs to the most common source for plant lighting, high-pressure sodium (HPS), it is generally recognized that the newest LEDs are more energy-efficient. High-pressure sodium lamps (HPS) produce 1.8 µmol of light for each Joule of energy input, while the latest LEDs produce 2.3 µmol light per Joule consumed.

Furthermore, LEDs produce less waste heat, so lamps can be placed much closer to crop surfaces without the risk of overheating and heat stress for the plants. By contrast, high-intensity discharge (HID) lamps require considerable a separation between lamps and plants to ensure uniform light distribution as well as to avoid heat stress from the lamps. This means that LED systems can be designed much more flexibly – horizontal, vertical or inter-crop lighting are all possible, for example. LEDs are also more suitable in multi-layer plant systems.

Another major advantage is that LEDs are more robust and long-lived than traditional light sources with filaments, electrodes, or gas-filled, pressurized lamp enclosures. LEDs also have instant restrike capabilities and do not need time to warm up to achieve full brightness.

Still some hurdles...

These advantages make LEDs an interesting alternative to the current lighting systems used to grow plants, such as HPS and metal-halide (MH). LEDs, however, have not yet achieved broad acceptance as a horticultural light source. LED lights require a higher investment at the outset, and LED bulbs often cost more than the fixtures into which they are placed. This expense can make growers hesitate. Luckily, the evolution of the LED has been very favourable: each decade, LED prices have decreased by a factor of 10, while performance has increased by a factor of 20. The future mass production of LED lighting will probably also reduce the cost of building LED lighting and hopefully the selling price.
One important drawback these days is the difficult interaction of LEDs with respect to plant growth. Some growers have experienced reduced production or lack of development in plants grown with LED, compared to traditional light sources. Indeed several studies have highlighted decreased yield or plant development due to LED lighting. A possible misunderstanding and thus miscalculation is the effect of the heat produced. More heat, for example produced by HPS or MH lamps, significantly improves plant growth. When comparing these plants to 'LED plants', which usually lack the additional heat, it is often clear that the HPS or MH plants grow better than LED plants.

LUMENS PRODUCED	WATTS REQUIRED FOR AN INCANDESCENT LAMP	WATTS REQUIRED FOR A COMPACT FLUORESCENT LAMP (CFL)	WATTS REQUIRED FOR AN LED LAMP
400 - 500	40	8 – 12	6 – 9
650 - 900	60	13 – 18	8 – 12.5
1,100 - 1,750	75 – 100	18 – 22	13+
1,800+	100	23 – 30	16 – 20
2,800	150	30 – 55	25 – 28

Table 2: Electrical efficiency of different light sources based on equal light production.

It is important to remember that when it comes to the light spectrum, red or blue/red light combinations only are not good enough. Many first generation LED grow lamps were bi-band (just red and blue) which proved to be inadequate for most plants. Although these two wavelengths would be sufficient for light energy fixation (photosynthesis), most plants still require limited amounts of light from other portions of the spectrum. To ensure that multiple plant

Figure 11: Light distribution according to the Inverse Square Law – in an 'open' situation – as a function of the distance to the plant.

processes are stimulated as effectively as possible, broad photosynthetic light spectra (comparable to the sunlight) are preferable.
Most producers of LED grow lamps consider the exact light spectrum used as a trade secret. They usually cite a more general 'color composition', called the color temperature. Basically a color temperature between 2,700K (2,700 Kelvin, warm white) and 6,500K (cool white) is usable for plant production. Keep in mind that a 'cooler' and more bluish color may have an inhibitory effect on flowering or flower induction! For now, a lot more research and awareness are still needed to determine the optimum light spectra and thus LED lamps for specific plants or cultivation purposes. Since LED systems have not yet been optimized, as HPS or MH lights have been, these remain the best light sources to grow your plants with.

LED grow lights – the verdict

So, are LED grow lights just another fleeting fashion or are they really worth a try? They certainly work for plant cultivation, but you should be critical when evaluating a potential 'LED grow lamp'. If you're considering a new LED lamp, you should look first at its LED components, photosynthetic light, light spectra and power consumption.

Remember that:

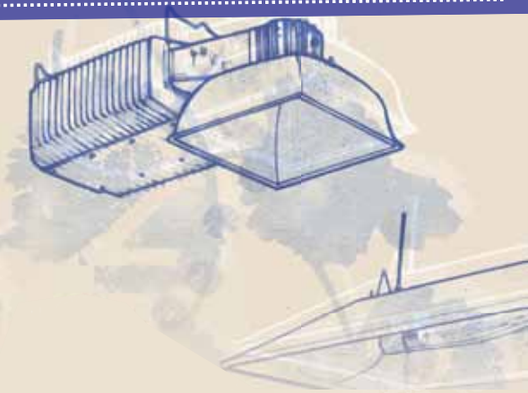
- A minimum of 90W is recommended for plant lighting
- Individual LEDs should at least be 1W or more, preferably 10 mm and the latest generation
- Look for high-intensity or high-brightness LEDs
- Contrary to what you might expect, a higher input power makes an LED less efficient (so 3x 1W is more efficient than 1x 3W)
- Doubling the distance between the lamp and the plant will reduce the light by 4 (22)
- Achieve photosynthetic light illumination from 50 – 200 µmol/m2/s till 500 µmol/m2/s for most plants
- Choose a broad light spectrum (3 or 5 band) with some red and far-red light for flowering
- When plant production specifications are missing, try to aim at a color temperature between 2,700K and 6,500K

The techniques for using LEDs in plant production have not yet been perfected as with existing common forms of plant lighting. Better knowledge of what plants need and how LED lights work will probably lead to the widespread adoption of the LED as a plant lighting source. It certainly seems that the future for LEDs is bright! •

Grower's TIP #25

By your friend SEZ

NEED A LIGHT?



When it comes to choosing a good light source for your garden, before you visit your local indoor specialist, there are many things that you need to consider to make the best decision in relation to your growing objectives.

With so many options on the market, you can face a bewildering array of different types of lights and a range of technology and quality. All this can make this decision more difficult than you might think. Yet it remains a critically one.

The first question to consider is how much power do you really need? Will you really benefit from all the extra power of a 1,000 watt eBallast? If your target is year-round fruiting and bigger, stronger plants, then maybe you will need all the power you can get. But if your main objective is to grow seedlings, propagate cuttings or just get a head start for your outdoor garden, perhaps a less powerful light using a motorized light rail or even high output fluorescents, instead of HID, might be plenty.

Higher light intensity will affect how deeply the light penetrates the canopy and its ability to keep the lower parts of the plants functioning. Obviously, smaller plants do not need as much light energy as taller bushier plants would. Using less power will of course save you energy (and therefore money), and it will also make it easier to control your climate. A better climate will always yield healthier plants. Do not over-power your lighting if you do not need it!

Intense light can be a great thing, but it comes with some drawbacks – the biggest being the extra heat generated. Some of this can be controlled using ambient cooling and ventilation, but radiant heat should not be ignored. No amount of cold air will prevent radiant heat from reaching its target. Only distance can achieve this and there is a balance to be found. If you don't have much height to spare in your grow room, maybe consider replacing that 1,000 watt HPS with several lower-wattage bulbs that you can use closer to canopy.

The rationale behind having the strongest light source possible is that artificial light cannot travel very far before it starts to dissipate. Many gardeners get very anxious after reading in books or on internet forums that 'light loses as much as HALF of its strength every single foot it travels'. That sounds scary! The knee-jerk response of many growers is to place the light source as close as they can to the plants, but it's easy to forget about the harm done by radiant heat. If you place the light too close, the benefits of the extra light will be far outweighed by the damage and stress caused by radiant heat. Heat-stressed plants will produce lower-quality crops, be less healthy and suffer from more troublesome bugs like spider mites. This whole situation can easily be avoided just by raising the lamps a little bit.

There is no magic formula for 'how far' the light source needs to be from your plants. Often we suggest that growers 'put a chair under the lamp and sit there', so that they can see for themselves how long it takes before they get hot and uncomfortable themselves (but if you do this at home, please wear proper eye protection). The distance will of course be affected by the intensity of the light source, but that is not the only factor. The quality of the bulb, technology used to power it, the shape and material of the shades are some of the factors that will affect how much heat is radiated towards your garden. •

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Winner Puzzle#23

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

Mr. J.Wille Congratulations on your 1 L bottle of CANNAZYM. We will contact you as soon as possible to organize the dispatch of your prize.

Facts


Photo courtesy of E.J. Tepe

PLANTS AS A MINI ECOSYSTEM

American scientists have discovered a plant that is home to a total of over forty different species of insects which are completely dependent on that plant. The plant lives in the Ecuadorian and Peruvian Andes mountains. That makes the Piper kelleyi – the Latin name for this wild-growing relation of the black pepper plant – a unique ecosystem in its own right. The scientists say that the plant is home to so many different species of insects because it secretes chemical substances. Many of these are poisonous, which means that many plant-eating animals leave the plant alone. However, some caterpillars are resistant to the toxic effects and now live only on this type of pepper plant. These caterpillars are, in turn, the prey of wasps and flies, and these too have specialized and live exclusively on the caterpillars on this particular pepper plant. This has created a unique ecosystem of organisms that are dependent on one another. Scientists are investigating whether this unique ecosystem also includes birds or bats. They say it is advisable to take good care of this plant – if the species were to die out, over forty species of insect would also perish.

BYE BYE BEES

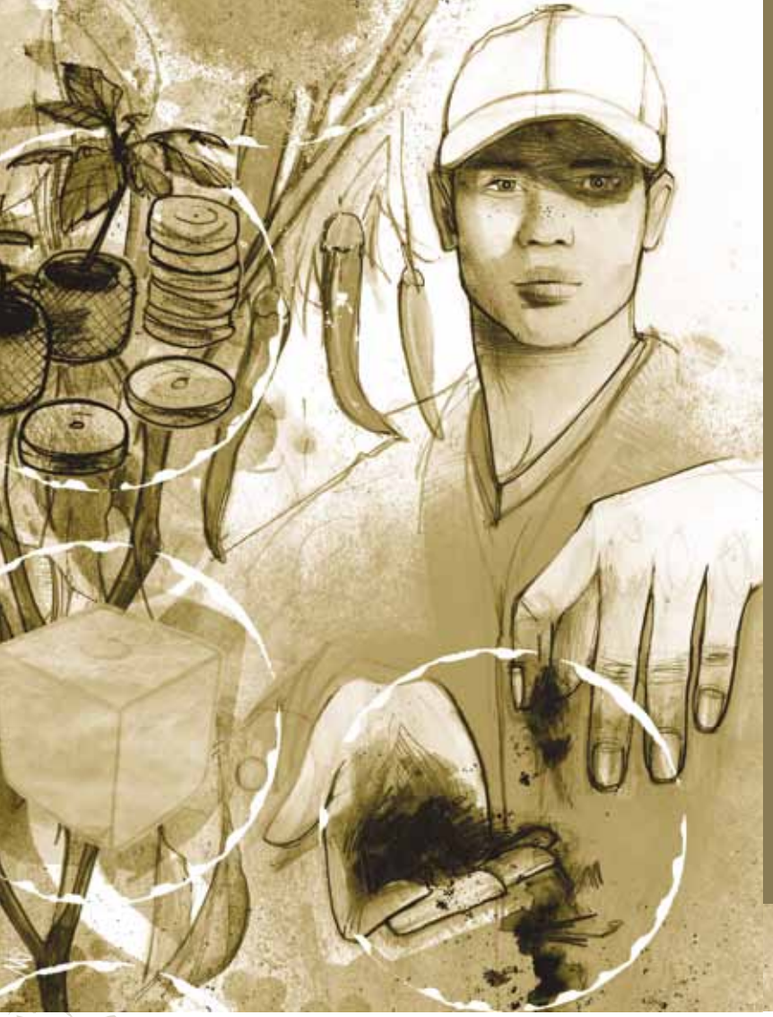
In an article published in the scientific journal Plos One, scientists report that Europe may soon be suffering from a shortage of bees. According to researchers, the number of bees needed to fertilize crops has increased five times faster than the actual number of bees; the bee population has not kept pace with the increase in production. The rise of bio-diesel is seen as one possible cause of the shortage of bees. The product is made from rape seed and soybeans, and many fields of these crops have been planted in Europe in recent years. These crops depend on pollination by bees. To make matters worse, bees have been having a rough time anyway in recent years. Human activities are putting bees under pressure through the use of insecticides and viruses. This is why certain types of toxic substances have been banned for private use.

RECORD-BREAKING TOMATO CROP

A 68-year-old man from Coventry in England has broken the Guinness World Record for 'the highest number of tomatoes harvested from one plant'. He managed to pick over 1,355 tomatoes from one plant! That is almost 900 more than the previous record holder, who collected 488 tomatoes from one seed. The new record holder is very pleased with his record and commented that there was nothing particularly special about the seeds he used: "My daughter bought them in the garden center." His secret? "Lots of care and attention, and I pray next to my plants."

OLDER TREES HAVE MORE LEAVES

New scientific research has shown that trees grow more and absorb more CO_2 as they get older. Researchers explained this finding by the fact that older trees have proportionately more leaves and branches; this means that they convert more sunlight and CO_2 into sugar than younger trees. But how did the researchers arrive at this conclusion? They monitored over 673,461 trees in plantations all over the world – for eighty years in some cases (!) – measuring their height. The conclusion: 97 percent of the 403 types of the trees studied grew more rapidly as they reached a more mature age. Older trees do not become less productive in terms of photosynthesis, but the photosynthetic efficiency of each leaf does decline somewhat. But this decline in efficiency is more than made up for by the increase in the size of the tree's total surface area of leaves.



SOIL AND GROWING MEDIA

WHAT'S NEXT

Can you remember CANNAtalk issue 20, in which our researchers mainly discussed root-zone temperature and root-zone health? This was probably the closest we have got to the subject of our next issue: soil and growing media. Do you have specific issues or do you want to know more about a specific aspect of this subject? Maybe you will find your answer in the next issue! As well as two interesting research articles about soil, the issue also has a new adventure written by Don, a Pests & Diseases article and of course a very useful Grower's Tip. This and much more in CANNAtalk 26!

CANNAtalk:

- Is published four times a year by CANNA Continental, a company dedicated to making the best solutions for growth and bloom.
- Is distributed through CANNA dealers in the USA (find the closest dealer near you through www.canna-hydroponics.com).

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Printed by: Koninklijke Drukkerij E.M. De Jong

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