

SUBSTRA Infopaper

**Everything you ever wanted
to know about cultivation
on inert substrates**

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Growing on substrates

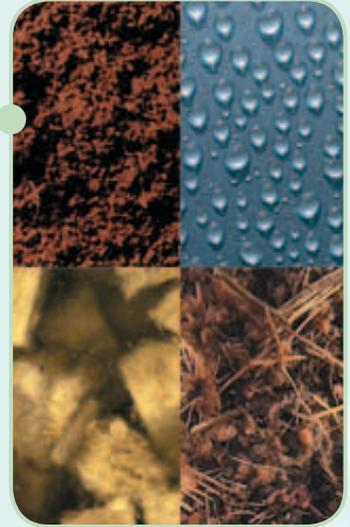
The term growing on substrate is often used incorrectly. A substrate is synonymous with everything that a plant can grow in or on. The substrate, or growing medium, serves to keep the plant in place as well as provide an environment for the root system to function in. Examples of substrate are potting soils, coco and rock wool.

There are basically two methods of cultivating with substrate; run-to-waste and recirculation. In a run-to-waste cultivation system the feed water passes the roots just once and is then disposed. This is in contrast to re-circulating systems, where the drainage water is reused.

In run-to-waste systems we make a distinction between substrate that interact with the plant and substrate that don't. Inter-

acting substrate, such as potting soils, composts or coco, retain nutrients themselves, which influence the extent to which you need to further feed the plant. This holds true with coco's feeding and nutrient retention properties even though they also differ from typically CEC (Cation Exchange Capacity) mediums.

CANNA has developed 4 ranges: CANNA Terra is for cultivating in potting soils and soilless mixes. CANNA COCO for cultivation on coco. CANNA AQUA is for use on inert mediums that the nutrient solution is passed through then returned to the holding tank. AQUA is designed for long term availability in this environment. CANNA SUBSTRA is for substrate that retain or release almost no substances: the so-called inert substrate. SUBSTRA is designed so that the nutrients are available immediately.



Run-to-waste with inert substrates

If you choose to cultivate in a run-to-waste system in combination with an inert substrates, you are choosing a growing method that almost guarantees high yields. However, this is certainly not the easiest growing method, and you will only be able to achieve high yields with the same professional approach that allows for all the variables in growing including temperature, humidity and so on.

The advantage of this growing method is that you know the exact composition of the feed water and so you know exactly what your plants are being fed. The big disadvantage of this method is that the drainage water goes directly into the natural surroundings, so it is very important that the feed you choose is specially designed for this growing method. Only then can you be sure that the minimum possible residue materials will enter the environment (more about this on page 6) while the most is going into the plant. CANNA SUBSTRA has been specially designed for this method of growing.

Advantages and disadvantages of hydro cultivation

The advantages of hydro cultivation include being able to accurately manage the nutrients, the amount of water given and the pH. There are many more advantages. You will hardly experience any problems with soil-related diseases or weeds; the substrate used for hydro cultivation are weed and disease free and are often referred to as sterile. Additionally, measuring the pH and the electrical conductivity (EC) in the growing medium is simple. The electrical conductivity gives an estimate of the total amount of dissolved salts and tells you something about the amount of feed given.

A disadvantage of hydro cultivation is that the substrate used is not always reusable or recyclable. Other disadvantages include the higher initial costs for the substrate themselves, the equipment required, increased required monitoring, and faster response to deficiencies in nutrients.

	Open system (run-to-waste)	Closed systems (recirculating)
Advantages	Plants receive continuously supply of fresh nutrients in the right composition <i>Also suitable for cultivation with 'poor' water quality (EC of 0.75 or higher)</i>	No need to dispose via drainage Plenty of air available to the roots
Disadvantages	More loss of water and nutrients Need to dispose of drainage water	Diseases can spread throughout the system via the feed water pH and EC values in the nutrients have to be monitored more closely
Nutrients	CANNA SUBSTRA	CANNA AQUA

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Substrates

The CANNA SUBSTRA nutrient line is specially formulated to provide the best results possible when used in combination with inert substrate. Rock wool, of all the inert substrate available, is the most common one. It is widely used in general horticulture because it ensures rapid development of good root systems. Additionally, it is easily managed and has good supportive

properties. Plants grown in rock wool remain upright without extra support as long as the medium itself is supported. There are many other inert substrate available to work with besides rock wool. In this section we will discuss some of them, but considering the popularity and suitability of rock wool we will discuss cultivating on this specific substrate in particular.

The origins of growing on substrates

The first farmers of mankind quickly discovered that plants grew better on the remains of other plants and manures; still it took thousands of years before people understood exactly why. Research into plant food began many years ago, long before our time, but only recently, about 150 years ago, researchers found out exactly which substances in the compost actually feed the plants. As a result of these discoveries, the artificial fertilizer industry was born.

Shortly before the dawn of this era, in the Netherlands, Napoleon introduced monoculture, where one crop per field is cultivated. The combination of these new systems increased farming production to new levels. Initially the new developments produced tremendous results, but this success was short lived. No one was familiar with these cultivation methods and all were certainly unaware of the drawbacks. The damage in the cultivation of vegetables was particularly noticeable. Year after year an excess of artificial fertilizers was applied creating problems in the soil structure and in the fertility of the ground. The same crops were grown year in - year out. In turn the monocultures brought on a multitude of plagues. Soil-bound

pathogens were particularly difficult to counteract. A solution was urgently required. Growers began placing the crops in separate compartments and cultivating them on growing medium instead of in the open ground. This was the beginning of growing on non-mineral soil substrate.

Growing on artificial substrate was put into practice for the first time in the first half of the 20th century. As plastic containers became available growing on substrate made considerable progress. Production could be scaled up and automated. As it turned out, growing on these substrate generated up to 25 percent greater yields compared to cultivating in the open ground. This is because nutrients can be adjusted directly to the needs of the plant or crop at any particular time.

When CANNA SUBSTRA was introduced in the 1980s, serious small scale cultivation became possible on inert media and rock wool in particular. This CANNA SUBSTRA formula has been used successfully worldwide for many years and while many have attempted to copy the formula, an equal has yet to be developed.

Clay Pebbles

Clay Pebbles are made by forming clay into pellets and then firing these in a hot kiln. This causes the clay to expand and become porous. Clay Pebbles are available in various shapes and sizes and with two types of surface; smooth and coarse. Clay Pebbles have been used in horticulture since 1936. They have the advantage that they can be reused for up to five years as long as they are well cleaned. The greatest disadvantage of Clay Pebbles is that they absorb almost no moisture,

making them unsuitable as a run-to-waste substrate. However, they are widely used in recirculation systems where the nutrients continually pass through the roots. This is because Clay Pebbles have good supportive properties and are heavier than water and, therefore, do not float. Additionally, Clay Pebbles are used extensively as a drainage layer at the bottom of pots when growing in coco coir, soilless mixes or soil.



Perlite

Perlite is a glassy, volcanic rock that is ground and then baked at high temperature. Perlite is also inert, but due to its poor supportive properties it is relatively vulnerable as a growing medium itself. It does make, however, an excellent soil improver and is used particularly to increase the air ratio in the soil; though, nowadays there are environmentally friendlier methods to do this, such as adding white peat.

Mapito

Mapito is a very light medium with limited water retention capacity. This means that the substrate will dry out faster and needs to be watered more frequently. Mapito is a mixture of Polyurethane (PU), rock wool and sometimes coco or even perlite. Most types of Mapito are not "clean", in that they often have a higher EC and a lower pH than the ideal growing medium; this is the great disadvantage of Mapito. So it is always essential to determine the exact pH and EC values of the Mapito and to rinse it thoroughly before use!

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Soiless Mixes

CANNA SUBSTRA, because of its composition of nutrients, can be used very effectively on organic based mediums that are of reduced quality. In North America, bulk peat based potting soils (soiless mix) are used rather extensively. These mediums are designed to be more of a 'Zero' base medium. They were designed to act as a blank slate with a known quality where all nutrients are available in an equal ratio but at very low levels. The pH of the medium will be somewhere between 5.6 and 6.2 but only develops after watering and after a several days of conversions based on temperature and continued water availability. The pH control in these mixes is designed only for about a 45 day period based on average tests. To this, growers will have to add the correct portions of nutrients so that the ratio

equals what the crop to be grown wants, including the micro nutrients (trace elements). Additional lime or other materials that help regulate the pH are usually added to extend the pH control.

These 'Zero' mixes, if not adjusted to the crop, will maintain giving the wrong ratio of nutrients to the crop. The only real way to get around this requires a harder push on the nutrients needed. CANNA SUBSTRA, since it is designed to be immediately available, accomplishes this. The additional Calcium available will also help the pH situation although that may remain an issue after about 3-5 months.

History of rock wool

Rock wool was discovered in 1840. Nowadays it is manufactured in factories. The volcanic rock is ground and pulverised to grit. This grit is then heated up to 2735 °F, at which temperature it melts. This viscous substance is then poured onto a rapidly rotating sheet. This forms droplets and each droplet is stretched into a long fibre. These fibres are cured in a kiln and then consolidated into slabs of rock wool. Any shape finished product can then be cut to size. In this process 1 m3 of raw material becomes no less than 90 m3 rock wool. Besides the applications for thermal, fire and sound insulation, in the early 1970s it was discovered that rock wool could also be used as a good growing medium for plants.

The rock wool used in construction for thermal and sound insulation is not suitable for cultivating plants. This is because mineral oil is added to make the material water-repellent.

A rock wool variant has been specially developed for horticulture. It has considerable capillary capacity, This type of rock wool can retain up to 80% water and still contain 15% air. The remaining 5% is the rock wool itself.

Because each crop has different requirements, different types of rock wool have been developed. The main differences are in the structure of the fibres, horizontal or vertical, their thickness and density. Rock wool is available in various shapes and sizes; for example small plugs or cubes, for germination and propagation, in which seeds or cuttings can take root. These cubes fit into blocks where the young plants can continue to grow. There are also slabs in all imaginable dimensions. These are also known as slabs on which you can place the blocks with young plants.

Many plants don't like having "wet feet". A rock wool slab that is too soft will retain too much water, and one that is too hard will provide too much resistance to the growing roots. A hard slab means that the plant spends a great deal of its energy developing roots – energy that the plant can better use for growing above ground. Therefore the ideal rock wool slab is not too hard and has a horizontal structure so that there is ample volume available for root growth. The quality of a plant is largely determined under the ground, in fact 50%, so the bigger the root volume, the healthier the plant and the higher the yield.

Hard or soft water?

The fertilizers in the CANNA SUBSTRA range are available in two versions, for hard water and for soft water. If the hardness of your water is 60-80 mg/L available Calcium or more, use the hard water variant. If the hardness of your water is less than this, then the soft water variant is recommended.

Your local water company will be able to tell you the exact hardness of your tap water. In some areas the quality of the water changes regularly, so if you live in one of these areas you would be wise to purchase your own water testing set.

CANNA PRODUCT	SUBSTRATE	SYSTEM	WATERTYPE	WATER QUALITY	PLANT PHASE	PRODUCT
CANNA SUBSTRA	All forms of Rockwool	Run-To-Waste	SOFT	<60-80 mg/L Ca	Grow	CANNA SUBSTRA Vega Soft A&B
					Bloom	CANNA SUBSTRA Flores Soft A&B
	Mapito		NORMAL/HARD	>60-80 mg/L Ca	Grow	CANNA SUBSTRA Vega Hard A&B
					Bloom	CANNA SUBSTRA Flores Hard A&B
Clay Pebbles						
Perlite						
Soiless Mixes						

It is the exact combination of minerals dissolved in water, together with the water's pH and temperature that determines hardness. An exact scale does not adequately describe hardness. Hardness corresponds roughly with ranges of mineral concentrations:

- Soft: 0 - 20 mg/L as calcium
- Slightly hard: 40 - 60 mg/L as calcium
- Hard: 80 - 120 mg/L as calcium
- Moderately soft: 20 - 40 mg/L as calcium
- Moderately hard: 60 - 80 mg/L as calcium
- Very Hard >120 mg/L as calcium

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Soaking rock wool before use

Before you put any plants in your new rock wool slab (or large blocks) you must ensure that it is thoroughly wet, this process is known as pre-soaking. You should soak your rock wool before use for two reasons:

The first reason is to optimise the capillary working of the rock wool. If there are dry patches in the slab or block, these will remain dry during cultivation, and the slab will never reach its theoretical maximum water-retention capacity. Consequently the plants will be less able to absorb sufficient water and nutrients. A chamois works in the same way: when it is bone dry it is difficult to get it properly wet; once it is a little bit wet then it can absorb much more water. Incorrect soaking, or worse still, no pre-soak at all, can have disastrous effects: it might even mean that many of your cuttings die within the first few days.

Secondly because rock wool remains an inert growing medium, it contains nothing to provide a warm welcome for your precious cuttings. By a warm welcome we are referring to the root environment with an EC of about 1.3 and a pH value of 5.6.

If rock wool is soaked with ordinary tap water, depending on your water supply, the EC and the pH will be about 0.5 and 7.5 respectively; not really an ideal start for young plants! If the rock wool has not been 'buffered' or washed thoroughly, the pH can come in well over 7.5 and also proves disastrous to any plant. These types of rock wool must be conditioned prior to use.

We recommend soaking the starting blocks a few days before you soak the slabs; the roots of the plants must have grown through the blocks before you can start with the slabs. So you see, slabs are only used once the root balls of all the plants are sufficiently developed but not overdeveloped.

The initial soaking values for the blocks and slabs are the same; an EC of about 1.3 and a pH of about 5.6. In this example the starting point is tap water that has an EC of about 0.5 and a pH value of about 7.3. These values can be determined with pH and EC meters, which are an indispensable aid to growers cultivating on rock wool.

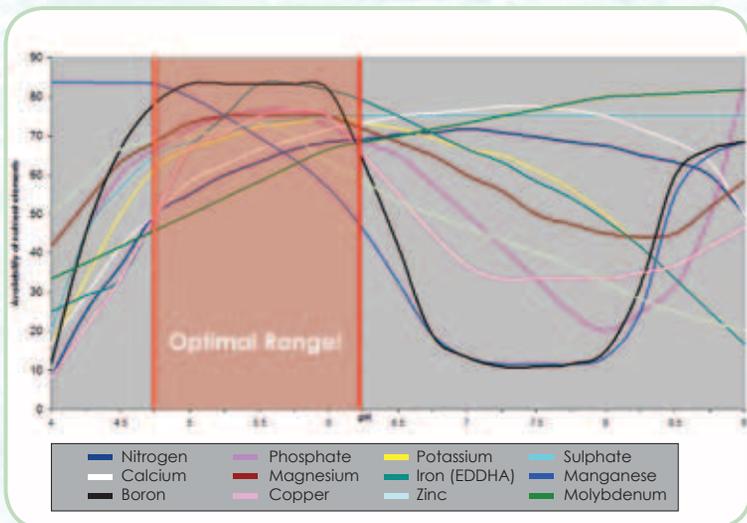
For your pre-soak, you will need to make a solution of water with an EC of 1.3 and a low pH – adjust the pH of your soaking solution to 5.1. NOTE: You will only need to adjust the pH so drastically once! Next, make a hole in the plastic covering the rock wool slab, just large enough to fit a garden hose through. Attach the garden hose to an immersion pump and fill the rock wool slabs with at least 10 litres of this solution. Let the solution stand in the slab for at least 12 hours; preferably 24 to 48 hours.

The EC is fixed, but due to the effect of the water on the rock wool, initially the pH value will drop to about 6.2 only to settle at about 5.8. Rock wool has a continual active influence on the pH value, so it is essential to check it regularly.

Now that the slab has soaked for up to 48 hours it's time to cut a slit in the plastic covering so that the excess water can drain away. Make slits in the bottom of the slab and at the lowest point in the cultivating container.



Tip Make sure the rock wool slabs are horizontal. If they are not truly horizontal the moisture will run to one end of the slab. This could mean that some plants become too dry and others too wet.



Tip 1. Never use raw rock wool! The pH is too high. Always soak rock wool before using it for the first time.

Soak the rock wool with water or with a nutrient mixture with the pH adjusted to 5 and with an EC of about 1.3. As well as correcting the pH and EC, the pre-soak also means that the nutrient solution will distribute itself evenly throughout the slab during cultivation.

2. If you are using CANNA RHIZOTONIC always add this to the feed water before you adjust the pH; CANNA RHIZOTONIC is a natural pH plus product.

Continually changing pH in the slab

Before you mix up a tank of nutrient always check the EC and pH of the slabs. You can do this quite easily by extracting some nutrient from the slab with a measuring syringe. The pH in the slab will change continually, so you need to check this regularly and take corrective measures when necessary. We recommend maintaining the pH in the nutrient tank between 5.2 and 6.2. Once the nutrient in the tank is mixed correctly, you can

start feeding your plants. Water the slab sufficiently so that at least 20% drains away from the bottom, through the slits you made earlier. Check regularly whether sufficient water drains away from the container. If not, increase the amount of water given.



Impact on the environment

One aspect of growing that is often forgotten is the waste feed water that drains into the sewage system or, worse, into the ground water. The drainage water from CANNA SUBSTRA nutrients does not contain any serious pollutants, so the burden on the environment is minimal. Another significant difference between CANNA SUBSTRA nutrients and other products for run-to-waste cultivation is the raw materials used. Because CANNA carefully selects the purest possible raw materials for its products there are considerably fewer heavy metal particles in the drainage water. CANNA SUBSTRA also contains no 'Red Iron', oxides of iron such as ferrous oxide.

The notion that 'red iron' is more easily absorbed by plants is only valid at higher pH values; the pH range maintained in run-to-waste cultivation systems is too low. Large quantities of 'red iron' are added to many products to ensure that there is suffi-

cient iron for the plant to absorb, but much of this iron is not taken up by the plant. So instead of 'red iron', CANNA uses a special yellow variant in its SUBSTRA products. This 'yellow iron' variant is absorbed well by the plant at the pH in the root environment; so considerably less yellow iron is needed than of the widely-used 'red iron'. The idea that run-to-waste systems are more harmful to the environment than recirculation systems is therefore not entirely correct. There is waste water in both systems; a constant trickle in run-to-waste systems and in recirculation systems a relatively large amount from time to time. The amount of waste water depends on the watering system and the dryness of the substrate, a dry substrate requires more feed water than a wet substrate, and thus not on the type of cultivation system.



Watering and feeding plants: fertigation systems

Fertigation systems are systems that irrigate the plant with water containing the necessary nutrients. Fertigation comes from the words irrigation and fertilization, or giving water and fertilizers simultaneously. Irrigation systems are not new; we find narratives of them in the ancient manuscripts. The practice of adding mineral fertilizers to the irrigation water is only about two hundred years old. There are many different ways of fertigating plants. The most common method used with rock wool slabs is run-to-waste via drippers.

Fertigating via drippers

Sometimes one plant looks poorly compared to the rest. There can be many causes for this, but more often than not the problem is related to one of the drippers releasing a widely differing amount of nutrient solution than the others. As a result the plant gets either too much or too little water and the amount of nutrients will vary as well. It is advisable to check regularly for blocked drippers and inspect them carefully every time you start a new crop. A good method is to put each dripper into the neck of an empty bottle and switch on the system. After a while check to see that all bottles have more or less the same amount of liquid; adjust or replace the ones that show a difference greater than 10% more or less. It is also recommended that the drippers are cleaned after each crop. What should you use to clean your drippers? That will depend on the materials they are made of. A simple method to clean your drippers is to add approximately 95 ml pH - (minus) to 1 gallon US of water and to rinse the drippers with this solution.

It is also important to prevent algae from growing in the nutrient tank. Algae will also block the drippers. You can prevent algae from growing by eliminating light from the tank, so use a lid.

Capillary drippers are the least accurate of all drippers; plants seldom get the same amount of water. An excellent solution to this problem is to use drippers that only release water at a certain pressure; pressure compensating and self-closing drippers. In this type of system all drippers start irrigating at the same time and all plants get the same amount of feed water. Another advantage is that a system with pressure compensating drippers does not have to be circular, linear systems work well too. These are the most advanced drippers currently available. Other drippers available include such drippers as spray stakes that disperse the solution across a wider area and are less susceptible to blockage.



Products designed to adjust the pH are concentrated products. It is sometimes difficult to adjust the pH correctly in one go. To make life easier for yourself, dilute one part pH adjuster with ten parts water and use this to adjust the pH in your nutrient tank. When you dilute an acidic product, always add the acid to the water, never add water to the acid, if it splashes it will cause burns on your skin or in your eyes!

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Why CANNA?

There are plenty of good reasons to choose CANNA. CANNA's great reputation stems from its endeavour to be continually leading its field with new developments. After all, CANNA fertilizers are the most commonly used worldwide! The quality of CANNA fertilizers and growing mediums is consistent and these

products meet the highest quality requirements. Growers are guaranteed good results because CANNA monitors the production process from raw materials to finished product: quality proves itself!

CANNA SUBSTRA fertilizers

Since their launch, CANNA Substra Vega and CANNA Substra Flores are used worldwide by satisfied growers throughout. The composition of the products in the CANNA SUBSTRA product range is adapted to the needs of fast growing plants. CANNA Substra Vega and CANNA Substra Flores contain all the elements a plant requires in a form that can be absorbed directly, guaranteeing an optimal uptake as soon as the plant begins to grow. This results in maximum yield and full flavour. When growing in hydro culture the plant is 100% dependent on the nutrients provided in the irrigation water. And because this irrigation water is usually based on tap water CANNA has optimised its products for different types of tap water. The prod-

ucts are designed to prevent salts accumulating which will be damaging to the environment and your plants.

CANNA products basically distinguish between two key phases in the development of the plant. Initially the plant will gain height and grow many leaves in its growth or vegetative phase. CANNA has developed the plant nutrient CANNA Substra Vega especially for this phase. The plant then moves into the flowering or generative phase. As the plant's requirements change it requires different nutrients: CANNA Substra Flores.



You can easily distinguish between CANNA Substra A and B products because the A bottle contents is coloured and the B bottle contents is colorless.

CANNA Substra Vega

CANNA Substra Vega is a complete nutrient for the growth phase, specially developed for cultivation on inert media. Fast and healthy growth is characterised by vigorous shoots and good development of the root system and this forms the basis for achieving top results. CANNA Substra Vega contains all the nutrients a plant needs in this phase. You will need to apply the nutrient solution 1 to 3 times a day. You must also make sure that 10 to 20 percent of the irrigation water with nutrients leaves the slab again! Under normal circumstances you will need 0.8 to 1.32 gallons of nutrient solution per square metre per day.



CANNA Substra Flores

CANNA Substra Flores is specially developed for use during the flowering phase. During the plant's flowering phase all nutrients must be available quickly and in the right quantities and ratio for the plant to absorb directly. When using CANNA Substra Flores, ensure that the drainage is such that about 10 to 20 percent leaves the slab. This usually means applying 1.05 to 1.6 gallons per square metre per day. This will ensure that all elements are directly available to the plant when the plant actually needs them.



1. CANNAZYM extends the lifespan of Clay Pebbles and other growing mediums because it breaks down dead roots.

2. Keep note of the amounts of nutrients and additives you add to each tank of nutrients you mix. You then have a good starting point for the next time!

Switch from Vega to Flores

How do you know when to switch nutrients? Well, during their first two weeks the plants will grow vigorously and then they will need considerably more water. When the first flowers begin to form is the right time to switch from CANNA Substra Vega to CANNA Substra Flores, this is usually 1 to 3 weeks after starting the photoperiod required for flower response. To prevent fertilizers from accumulating, and therefore any excess or shortage of specific elements occurring in the plants, the slabs could be flushed periodically. If it has not been necessary to flush the rock wool slabs prior to this change, then it is advisable to do so in the third week.

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Mixing SUBSTRA nutrients

Half the work is in the preparation. Ensure that you have all the things you will need readily available before you start mixing a tank of nutrient solution. Check you have the right fertilizers ready, Vega or Flores, Hard or Soft and an A and B component. The A and B components have to be mixed in equal volumes.

1. Fill a clean nutrient tank with tap water, preferably at about 68-71.6°F. You can achieve this by running in warm water or by placing a heating element, for example for an aquarium, in the nutrient tank.
2. Then, depending on the EC value of the water, add CANNA SUBSTRA A nutrients to the water; stir the solution thoroughly.
3. Now measure out exactly the same quantity of CANNA SUBSTRA B nutrients and stir thoroughly again.
 - a. Using an EC meter, check whether the solution contains sufficient nutrient salts. If the EC is too low, add more nutrients. If the EC is too high, add more water. Do this carefully and accurately and equally A and B.
 - b. The first time you do this note the quantities used, equal

- amounts of A and B dissolved in tap water. This will make a good starting point for the next time!
4. Then check the pH using a pH meter, the pH must be between 5.5 and 5.8. Adjust by adding a small amount of pH up or down to a container of water. This allows for a slower pH movement which should reduce the chance of 'bouncing' the pH, a condition that gets out of hand quickly.
 5. Finally we also recommend leaving the freshly mixed nutrient tank to rest for about an hour before you start to give it to the plants. This delay allows all substances to dissolve evenly and the solution to stabilize.

As the plant gets bigger, it can absorb more nutrients and thus develop even faster. So it is a good idea to increase the amount of nutrients in the water as the plant gets bigger. How much you can give at which stage of the growth is shown in the grow guide below, remember that these amounts are just a guideline. As you become a more experienced grower you can start experimenting to maximise your yield.



Don't just measure the EC of the feed water and the drainage water regularly, remember to measure the EC of the substrate as well.

CANNA SUBSTRA grow guide



	Cultivation period in weeks	Light / Day In hours	Substra Vega ml/ Gallon	Substra Flores ml/ Gallon	RHIZOTONIC ml/ Gallon	CANNAZYM ml/ Gallon	CANNABOOST ml/ Gallon	PK 13/14 ml/ Gallon	EC + ml/ Gallon	PPM +	
GROWTH	Start / rooting (3-5 days) Make substrate wet	<1	18	4-8	-	15	-	-	0.7-1.1	520-810	
	Vegetative phase I Plants develop in volume	0-3 ¹	18	6-10	-	8	10	-	0.9-1.3	670-960	
	Vegetative phase II - Up to growth stagnation after fructification or appearance of the formation of flowers	2-4 ²	12	8-12	-	8	10	8 ⁵	-	1.2-1.6	890-1180
FLOWERING	Generative Period I - Flowers or fruits develop in length. Growth in height achieved	2-3	12	-	10-13	2	10	8-15	-	1.4-1.8	1040-1330
	Generative period II - Development of the volume (breadth) of flowers or fruit	1	12	-	10-13	2	10	8-15	6	1.5-1.9	1110-1410
	Generative Period III - Development of the mass (weight) of flowers or fruit	2-3	12	-	6-10	2	10	8-15	-	1.0-1.4	740-1040
	Generative Period IV - Flowers or fruit ripening process	1-2	10-12 ³	-	-	-	10-19 ⁴	8-15	-	0.0	0.0

1. This period varies depending on the species and number of plants per m². Mother plants remain in this phase until the end (6-12 months).
2. The changeover from 18 to 12 hours varies depending on the variety. The rule of thumb is to change after 2 weeks.
3. Reduce hours of light if ripening goes too fast. Watch out for increasing Relative Humidity
4. Double CANNAZYM dosage to 19 ml/gallon, if substrate is reused.
5. 8 ml/gallon standard. Increase to a maximum of 15 ml/gallon for extra flowering power

EC: EC+ value is based in mS/cm when EC water = 0.0 by 25°C, pH 6.0
Add the EC of the tap water that is used to the recommended EC!
The EC total in the example is with tap water with an EC of 0.4

pH: Recommended pH is between 5.2 and 6.2
Adding pH- can increase EC.
Use pH- grow in the vegetative phase to lower the pH
Use pH- bloom in the generative phase to lower the pH

PPM: PPM+ value is based on 0.74 conversion factor.

The guidelines in the table aren't an iron law, but can help novice growers to develop a sophisticated fertilization strategy. The optimum fertilization strategy is further determined by factors such as: temperature, humidity, plant species, root volume, moisture percentage in substrate, water dosage strategy, etc.

Make your personal grow schedule at www.canna-hydroponics.com

CANNA, a source of information

If this leaflet has been of use to you, you may also find the other sources of information interesting: CANNA General Brochure and BIOCANNA General Brochure as well as the CANNA product leaflets for CANNA RHIZOTONIC, CANNAZYM, CANNA PK 13/14 and CANNABOOST.