

IN SEARCH OF THE ADEQUATE SUBSTRATE

By Noucetta Kehdi

Since the 1950s the greenhouse industry, in search of more efficiency and best results, started to replace soil with “substrates”.

Why replace soil? One of the evident answers is to avoid all soil born pests and diseases. Another is to replace a heavy and sometimes difficult to clean and dispose of medium, with a light, easy to wash and recycle material. And most important: to guarantee a clean, neutral, and well-aerated root environment.

Often hydroponics is understood as a growing technique using only water, with no substrate. This is true for NFT or Aero-hydroponics, which use no media, or just enough to act as a plant support. But growers working with Drip Irrigation, Deep Channel NFT, or Ebb and Flow, will use more or less substrate depending on the growing system they choose.

A very wide array of substrates is offered on the market today, and it may be difficult for beginners to determine the media best adapted to their hydroponic module.

What are we looking for when choosing a substrate?

- Neutrality (no incidence on the nutritive solution's pH level)
- Water retention capacity
- Water to air ratio
- Aeration and drainage
- Cation exchange capacity (buffering action)
- Cleanliness
- Stability of organic matter
- Facility of disposal
- Environmental and health hazards.

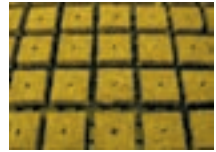
Another essential aspect to keep in mind is the close relationship between the media and the irrigation cycles applied. Substrates like rockwool or oasis cubes will retain much more moisture than coconut fibre and way more than

Substrate as seen in the Merriam-Webster Dictionary is “the base on which an organism lives”. In davidsgarden.com it is a “combination of materials that provide support, water retention, aeration, or nutrient retention for plant growth”.



clay pebbles. With continuously recirculating, deep hydroponic systems like AquaFarms or Flo Gros for instance, you better use clay pebbles as you don't need too high a water retention. If you decided to replace the pellets with rockwool or oasis, then your irrigation cycle must be reduced to irrigate 5 minutes every hour.

1 – Rockwool is made by melting pure basalt at extremely high temperatures (+/- 1500° C). The mass of liquid rock is centrifugally spun to form fibres when cool. This is one of the most wide-spread substrate used until now. It was, and often still is, widely used by the greenhouse industry until it became an environmental hazard, important enough to raise new regulations concerning its use and disposal.



Rockwool is quite a good material and meets most properties of a good substrate. It comes in various forms like cubes of all sizes, slabs and shredded bits, and has several advantages, including neutrality, good aeration, and good water retention capacity.

But rockwool has a strong inconvenience: it is not ecological. It is harmful to your health, especially when dry. The fine particles break off the cubes or slabs, get into the air we breathe, and accumulate into the lung tissues.

Rockwool is harmful for the environment too, creating a serious disposal problem due to the fact that it does not break down easily. After use it gets generally thrown with the garbage in landfill sites and will not decompose, leaving heavy pollution in our soils.

Rockwool is often used with Drip or Ebb and Flow systems, but it is being replaced by cleaner, environmentally friendly substrates like coconut fibre and clay pebbles.

2 – Clay pebbles are these little round pellets you often see in plant containers decorating banks and hotel lobbies. They are clay pellets cooked at high temperature to expand and become porous, providing a sterile and light structure which retains significant oxygen and moisture for healthy roots. The



pellets come in several sizes going from 2 mm up to 24 mm diameters. The smaller sizes have some capillary capability while the larger are most noted for their rapid drainage.

The best combination for deep gully hydroponics is a mix of small and large pellets (4/8 – 8/16) to attain the most adequate root environment.

When chosen from a reliable manufacturer clay pebbles are neutral (pH close to 7.0) in order not affect the pH level of the nutritive solution.

They are easy to clean after the crop. In small quantities they can be boiled in water. In larger quantities they can be



soaked overnight in a strongly acidic solution (4.0) or in Chlorine, and rinsed thoroughly the next day. Of course you can use them over and over again as many times you need.

They are natural and environmentally friendly.

They are totally recyclable: when you are finished using them you can easily discard them in the garden or mix them in your potted plants to lighten the soil.

Clay pellets have little water retention capacity compared to other substrates.

They can't be used with all growing systems but are better suited to deep gully, constantly running growing systems like all "Hydro" Systems.

Some growers will mix them with other substrates to improve drainage and add cation exchange capacity to rockwool or organic mediums like coconut fibre.

3 – Coconut fibre was introduced a few years ago for the greenhouse industry as a substitute to rockwool, when an efficient and cost effective replacement was needed. It is a by-product of the coconut husking process, primarily produced by tropical countries with large coconut plantations.

It comes in 2 configurations:

- The traditional one consists in hard bricks, or chips in plastic bags, which will expand tremendously when watered. This brand has excellent water retention and cation exchange capacities, and is stable enough so as not to decompose too fast.
- The newest brands come in woven cubes and slabs which have hardly any water retention capacity, and should only be used in cases of continuous watering cycles. The counterpart is their perfect drainage and aeration capacities.



There are several parameters to keep in mind when choosing your coconut substrate: sodium content, aeration and drainage capacity, production means.

The quality of coconut fibre is dependent on the conditions in which it has been grown (location) and the processing of the fibre, as it must be separated and is typically leached of salts (from salt water).



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Most coconut substrates come from coastal areas and contain sodium in quantities that may be damaging to plants. Now-a-days the producers will leach the salts and get good enough results.

Another parameter is the drainage faculty of the substrate. As good and well aerated

as your substrate will be, when using shredded fibre, sooner or later your fibre will start compacting, eliminating the aerated space your roots need to

develop. This is why growers will sometimes mix clay pebbles or perlite to their coconut chips.

Coconut fibre is a typical product where fair trade has to be respected. The manufacturing processes in most countries include child labour and/or very poor compensation to the farmers. This is one main issue that we, in rich countries, must start to address as much as possible.

4 – Perlite is derived from sterilized volcanic rock specially graded for horticulture use. It is excellent for increasing aeration, improves drainage and reduces compaction at the root. It is extremely slow to break down and can be used in quantities. In hydroponics perlite will be used for Drip Irrigation and will come in plastic wrapping like rockwool and coconut fibre. Some growers will mix it with another substrate like loose coconut pith for instance, in order to improve drainage and aeration.



5 – Vermiculite is puffed mica heated and expanded. It holds a tremendous amount of moisture and provides capillary action in the root zone. It has excellent cation exchange capacity.

But Vermiculite, like Perlite, is not often used in hydroponics, mainly because of poor aeration. Both substrates are better adapted to germinate seeds or to root cuttings in existing hydroponic propagating units. They can be used mixed together or with other substrates, for better efficiency.



Substrate is a matter of technical choice according to the growing method you use, and it is an ethical one too, when environment and fair trade are concerned.

This is not an exhaustive description of all the substrates available on the hydroponics market today. Rockwool, clay pellets, coconut fibre, perlite and vermiculite are the most widespread. Others, like lava rocks, sphagnum peat moss, and even sand, gravel or tree barks, may be used too. Of course many growers choose to work with no substrate at all, like in Aero-hydroponics or NFT. And in some third world countries, where hydroponic gardeners don't have the same choices or means as we do here, they will use plastic scraps and other inert wastes as medium and obtain excellent crops too, proving that soil is not the only substrate possible when it is replaced with the right material.



Questions and Answers Section

Q1 - Out of the varying hydroponic mediums that can be used can you please enlighten me as to which one is the most environmentally friendly as I like to think of myself as helping the environment?

A1 - When you examine a substrate for its lesser possible impact on the environment, there are 3 factors to consider: How is it manufactured? How do we dispose of it? Is it renewable or in limited supply?

Peat moss is an example of a product with no adverse impact when you use it, but in limited supply and its mining does have an impact on precious marshlands.

Among the safe substrates to use there is Coconut fibre, clay pebbles, pumice rock and a variety of other lava rocks. All of them are relatively equal in terms of environmental impact. Coco is susceptible to contain sodium in large quantity, a problem for recirculating systems. Avoid rockwool or glasswool, since they are serious ecological problems.

Q2 – If you keep a specific plant as a mother to take clones from, how long are you able to keep the mother alive without making the clones you take useless?

A2 – In theory, you can take cuttings from the same mother for a very long time, in real life all depend on how healthy you manage to keep the plant. Each pruning is an opportunity for the plant to catch diseases. The cut stems leave wounds that are entry of pathogens, virus as well as bacteria or fungi. Also, since there is always a balance in a plant between what's above and what's underground, a heavy pruning means death or part of the root mass. The decaying roots are the ground on which thrives Pythium and other root fungi. The proliferation of those organisms make it hard for the healthy roots to survive. The scissors or other tools used for taking the cutting can also be a source of contamination. This covers only what can weaken the plant in her role as a mother. On top of this, there is all the "natural" stress that may occur, such as large variations in humidity, a factor always tricky to control indoor, and many others.

It might be best, once in a while, to choose a healthy cutting to replace the mother plant before she shows signs of abuse. But if you are extremely meticulous and if your plant does not suffer from external causes, you can keep mother plants for many years.

Q3 – How often should I disinfect my indoor grow room? The area in question is 3m by 4m; I'm worried about getting the dreaded spider mites!

A3 – You have to disinfect your room after you have an occurrence of a pathogen in it, and not before. Doing it before does nothing at best and some claim that it is detrimental because killing every organism alive in the room leaves an open ground for diseases to come in. You disinfect in case of mildews of every kind, root rot, a bad case of pythium or fusarium, etc... But disinfecting does little or nothing against spider mites. They will come in once your crop is established through your ventilation, on your clothes, your shoes. Almost everybody and everything can be a carrier for insects or their eggs. To avoid this you can screen your ventilation, restrict visitors to a minimum and do not use the same clothes and shoes you've been wearing outside. It is not a warranty, but it will go a long way toward protecting your crop.

An excellent protection against spider mites is to use their natural predators: *Phytoseiulus persimilis* and *Amblyseius californicus*. If you suspect a spider mite infestation, Integrated Pest Management (IPM) as prevention or treatment against most pests is your best choice.

Please from now on, address your questions directly to: William Texier at williamt@eurohydro.com