

The best hydroponic medium you have never heard of

One of the most important choices in a soilless crop is the medium. Ideally, the media in a hydroponic crop should provide no nutrition but just act as support material for the plant. However, common media choices, such as coco coir and peat moss, are far from inert and their usage requires special modifications to the nutrient solutions in order to account for their specific chemical properties. In this post, I am going to talk about a great hydroponic medium choice that is fairly common in South American countries but rarely used in the United States or Canada.



Rice hulls, a key component of my favorite medium for soilless culture

Issues with existing media

The most commonly used hydroponic media types in the US are perlite, peat moss, coco coir, and rockwool. [Peat moss](#) tends to have higher than desirable water retention and acidifies

strongly through time. For this reason, it is usually amended with perlite – to increase aeration – and with dolomite/limestone in order to buffer the constant increase in pH within the root zone. To maximize its potential, you need to account for these amendments and the natural evolution of peat moss through time in your nutrient solution or you will tend to have calcium, magnesium, and nitrogen uptake issues. All of which are commonly observed by peat moss growers.

[Coco coir](#) has other problems. It contains large amounts of chloride, sodium and potassium. It also decomposes through time and, in doing so, exposes cation exchange sites that strongly bind elements like calcium, magnesium and manganese. For this reason, you often need to either pretreat the coir with calcium containing solutions or adjust your nutrient solution chemistry to account for the evolution of the potassium release and calcium capture through the crop cycle. The concentrations and ratios of heavy metals also need to be changed to account for the affinity of the cation exchange sites for these ions.

Rockwool has better chemical and physical stability but the environmental impact of its production is high ([1](#)). It is also hard to reuse and its physical properties are hard to tune since it is hard to mix with other media effectively. Perlite, another rocky medium, is easy to reuse and has low environmental impact, but it dries back too quickly, which increases the need for energy for irrigation and dramatically increases the amount of waste generated in open (drain-to-waste) hydroponic systems.

Rice hulls, the first component of a better medium

Over the past 40 years, rice hull – also known as rice husk – has become a medium of choice in many countries due to its wide availability as an agricultural waste product. It is made

primarily of silica structures supported by organic material, decomposes very slowly through time, and has very benign chemical properties. Rice hulls will not change pH through time, will slowly release bio-available silicon, and can be reused several times before they degrade. However, they usually contain insects and some rice, reason why sterilization of the media with hot water is usually required in order to avoid pest propagation and seedling death due to seed fermentation.

Another issue of rice hulls is their incredibly weak moisture retention. Rice husks are even worse than perlite at retaining water, reason why rice husks are commonly used as an amendment to increase aeration. A hydroponic crop using only rice husks as a medium is possible, provided that the crop is constantly irrigated to compensate for the very fast dry back period of the medium. This constant irrigation is achieved through drip systems.

Washed river sand, the perfect compliment

Given that rice hull is primarily made of silica and has excessively fast dry back, it would be ideally paired with a medium with similar chemical properties but opposite physical properties. River sand, which has exactly opposite physical properties and is also made primarily of silica, perfectly fits the bill. River sand has a very slow dry back. It is therefore hard to use on its own in hydroponics due to its tendency to cause waterlogging. However, when used in combination with rice husks, a medium with exceedingly tunable physical properties and very benign chemical properties appears.



River sand is chemically inert and provides a perfect complement to rice hulls poor water retention properties

To prepare this media, mix 50% rice hulls by volume with 50% river sand. Rice hulls can be purchased for a very low cost, [a 20 USD bag](#) will be enough to prepare 400L of the medium. River sand is even cheaper and can be bought at around 50 USD per ton retail but can be bought wholesale at much lower prices. The density of river sand is around 1587 kg/m³, meaning that it will take around 317 kg to get 200L of sand. This means that the cost per 400L of final medium will be around 16 USD, taking the total cost of 400L of medium to 46 USD. This can be more cost effective than either peat moss, perlite, rockwool, or coco coir. Especially if you take into account that the media can be reused across several crop cycles.

Treating the medium before use

This medium needs to be treated before use, as rice hulls can contain some amount of rice that can be detrimental to seedlings. To treat it, water it with tap or RO water 3 days

before use. This will ferment any of the remaining rice and the increase in temperature caused by this process will help get rid of insects and any pathogens present within the mix. Note that rice hulls are often parboiled, which means they have already been heated in boiling water, which will reduce the issue of pests.

Once this treatment is complete, you are ready to use the medium. You can also adjust the percentage of rice hulls and river sand in order to fit the particular dry back conditions you desire. More river sand will make the medium dry back slower, while more rice hulls will make the media dry back faster. This is similar to what happens when you mix perlite and coco or peat moss, with the advantage that river sand and rice hulls are much more chemically inert than these commonly used media types.

Conclusion

While not common in the US, mixes of rice hulls and river sand have been successfully used in hydroponic settings during the past 50 years in a wide variety of countries, especially South American ones. I have personally used them in both small and commercial-scale projects to grow from leafy greens to large flowering plants, with amazing results. This medium is chemically inert, very easy to tune, and has a low price point.

Had you heard of a mix of rice hulls and river sand as medium? Would this be cheaper than your current media choice? Let us know in the comments below!

What is the ideal amount of media per plant in hydroponics?

When designing a hydroponic crop, the amount of media is a crucial variable to consider as it will determine a lot of the capital costs involved as well as play a key role in determining how irrigation is setup and how big the plants can get. However, how can we figure out what the ideal amount of media in a crop actually is? In today's post I am going to talk about the amount of media per plant in hydroponics, which factors play into deciding what size to use and what different choices will affect other aspects of your crop, such as irrigation frequencies and plant densities.

The first question we need to ask ourselves is, why do we need the media? The function of the media is to provide the root system with structural support and environmental protection. Plant roots cannot generally survive in the open air, so the media provides a cozy home where the roots can prosper and give the plant the water and nutrients it requires. The volume of media you provide will determine the size of this "safe space" and the actual media choice will determine how "safe" the space actually is. Plants require media to allow for enough air – because nutrient uptake requires oxygen – but it also requires the media to allow for some water retention in order for water and nutrient uptake to actually take place. How optimum this oxygen/water/nutrient relationship is for a given media choice, will determine how big the media needs to be in order to sustain the plant.



Plants that are large also require a lot more water/nutrients, so the media and root system will need to provide enough absorption. A small amount of media will demand more from the root system – every cubic inch of root will need to work more efficiently – and it will also demand more from the irrigation scheduling, because ideal conditions will need to be more closely monitored since the root system will affect them quicker. You can sometimes see huge plants grown in 6' x 6' x 6' rockwool cubes, these offer a small amount of volume (0.9 gallons), so to support a big plant, ideal media conditions need to be maintained all the time, which means very judicious monitoring of water content and frequent irrigation periods. As the cubes are irrigated the plant quickly uptakes water/nutrients, so the cube needs to be irrigated again. However, irrigate too frequently and oxygen content will drop and the plant will start to suffer as the root system won't be able to cope to maintain the plant's needs.

An evaluation of the media volume therefore requires an evaluation of other growing conditions. Consider when irrigation cycles will happen, how is monitoring going to be done and how does the media need to be managed to reach ideal conditions. *More media, means bigger costs but more forgiving root zone conditions, so less experienced growers can often do better with larger amounts of media.* Novice growers will often fail when attempting to grow plants using less media, because they lack the experience to maintain the conditions needed for this to happen. *When growing larger plants, media volume per*

plant in the order of at least 5 gallons is recommended for people who don't have a lot of experience or for conditions where close monitoring of the plants and automated irrigation is not going to be a choice.

Take [this study](#) on tomatoes grown using different volumes of media, the authors were able to achieve the same results with either 10L or 15L containers, but they got lower yields when moving to smaller container sizes. Someone starting out under these conditions would be better off erring on the higher side – using more media than less – in order to avoid reducing their yields due to insufficient volume being present for the irrigation conditions used. This might mean a higher expense, but a successful crop is always preferred to a crop with lower yields/failure. It's easier to plan for more media and then reduce it than the opposite.

If you are already growing and you want to lower the amount used per plant, you need to consider whether your media will allow for this or not. Only media that allows for significantly high water retention will allow for this to happen under intermittent irrigation, while media that do not retain water very well will only be able to do this under basically constant drip irrigation. If you're already doing 10+ irrigation cycles per day in intermittent irrigation with adequate dry-back between periods, then the media might already be reaching its limits in terms of what the root system can do in that volume. *Watching how the water content changes as a function of time will help you assess whether your media can be pushed harder or not.* If run-off EC/pH values are getting too extreme, this might also be a sign that you're reaching extreme regions in your media.

Remember that plants need to uptake the same amount of water/nutrient per unit of time to sustain growth. This means that a plant that requires 3 gallons of nutrient solution per day will still require this amount, regardless of whether the volume of the root zone is 1 gallon or 5 gallons. If you go

from 5 gallons to 1 gallon then the drybacks will be significantly faster, so you need to adapt in terms of irrigation frequency.

In summary, media volume is a complex topic and requires a careful examination of different factors. Think about what ideal conditions are like for the media you chose and whether the irrigation system can provide enough oxygen/water/nutrients for the root zone in a given volume to fulfill the plants needs per day. *When in doubt, use more media.* If media reductions are being considered, remember that this will mean quicker dry back periods and therefore more frequent irrigation required. This means much higher stress for plants if irrigation cycles are missed or if problems in the root zone arise (for example problems with solution pH). Less media used means a more technical approach with more judicious monitoring will be required.

The media exchange solution test: A better measurement of media effects in hydroponics

In the traditional hydroponic paradigm we want media to be as chemically inert as possible. The ideal media in this view would absorb no nutrients, give off no nutrients and would not decompose or react with the nutrient solution in any way. However none of the commonly available media sources comply with these properties, reason why we must be vigilant and properly adjust the media we use to fit the needs of our hydroponic setup. In this article I am going to talk about the idea of using a direct comparison test of the nutrient

solution against the media, to understand the effect the media will have when exposed to the target nutrients and how this can help us adjust our solutions to better play with the selected growing medium.



Different types of growing media

First, let us understand how the media interacts with a hydroponic solution. The media can do all of the following things:

- **Dissolve into the solution** (this is what happens if your media is something like sand or limestone). In this case the media is chemically reacting with the nutrient solution, therefore media is being irreversibly lost in the process. This can happen very fast, with something like limestone, or very slowly, with something like sand.
- **React and take something away from the solution.** In this case the media can use ions within the solution to perform reactions that create new substances that are insoluble. For example if you have media containing large amounts of rock phosphate this phosphate can cause the precipitation of heavy metal phosphates.
- **Release ions in exchangeable locations into the media.** This is different than dissolving because the media is

not getting destroyed in the process but it is emptying “storage sites” that contain some ions that prefer the solution instead of these sites. This process is fundamentally reversible and – under the proper conditions – these sites could be replenished with the same or different ions.

- **Take ions into exchangeable locations in the media.** This is the opposite of the process above. In this case the media will receive some ions into “storage sites” because these ions prefer the media to the hydroponic solution. The solution will therefore be depleted of these ions because they are being stored within the media.

Of most interest to us are the third and fourth points above, this is generally understood as the “exchange capacity” of the media. This determines how many and which nutrients the media can store. Different media can have storage sites with different affinities and in hydroponic setups we generally want to aim for the minimum energy state of these storage sites as they relate to our nutrient solution. Media that is already in equilibrium with the nutrient solution will tend not to change it while media that is far away from equilibrium with the solution will change it strongly towards the equilibrium point.

Think about coco coir, a commonly used media in hydroponics that can have a wide variety of different ion exchange capacity values and a lot of different ions initially in its “storage sites” due to the differences in sourcing materials and treatments done by different companies. Coco coir initially contains high amounts of potassium and sodium ions, but some companies treat it with Ca nitrate, which changes all these “storage sites” to contain Ca instead. These two sources of coco would interact very differently with our nutrient solution. In the first case the coir would exchange a lot of its potassium for Ca and Mg ions in solution – because these

ions have higher affinity for the “storage sites” – while in the second case a little Ca would be exchanged for other ions (because all ions are in equilibrium with all the storage sites). The changes to the solution are very different and totally different approaches in nutrient composition changes are required.

Traditional soil tests could provide some answer to us, they would definitely show the ions that could be exchanged to be different in both cases. But they tell us little about the equilibrium position of the media against our target nutrient solution. To make things more realistic we can actually do a test where we pass our actual nutrient solution through a column of media that is exactly what we’re going to run it through in real life (with no plants of course). We then collect the input and output solution and run lab analysis of both of these solutions. **We can then compare the results and see how much the media is actually changing the composition of our input solution and we can then make some decision to adjust.** Such a test would proceed as follows:

1. Prepare the strongest final solution that will be used in the growing process. (for example the solution that is used at the peak of fruit generation in a tomato crop)
2. Take a sample of this starting solution to send for chemical analysis.
3. Pack a burette with a column of media as high as the containers the plants will be in.
4. Fill the burette with the nutrient solution.
5. Run as much solution as required to collect a sample of equal volume to the first one.
6. Send both samples for analysis.

The difference in nutrients between both solution will show us what we should initially be doing to maintain a consistent composition of the nutrient solution, given the interaction with the media. If the interaction is too strong it can also

tell us that we shouldn't be using this media without previously treating it to ensure the imbalances do not happen. For example media like biochar can have an extremely high affinity for metal chelates and nitrogen compounds, if we ran our solution through the media and it turns out that it soaked up almost all of our iron and ammonium, we wouldn't want to just add more nitrate and heavy metals but we would like to pretreat the media with a concentrated solution and then repeat the test to ensure that the media is at a level of activity that we can correct for.

A given media source that is acceptable should not strongly affect the nutrient solution. Any media that does this in the media exchange test requires correction so that the ability to take elements from the nutrient solution is reduced. The test will tell you exactly what the media is finding most appetizing and the treatment options will then be substantially easier to plan. A coco coir that shows it soaks up almost all the Ca will need to be treated with a Ca nitrate solution and a biochar that absorbs a lot of ammonium will need to be treated with an ammonium sulfate solution. These are some cheap pretreatments that will save a lot of heartache within a hydroponic setup and will make the ongoing growing process substantially easier to manage.

This is one of the simplest and cheapest tests that can be done to address media effects. However it is by no means comprehensive in that it does not show us other important media properties that might be crucial for selection. It is important to consider that this test gives us only a glimpse of the chemical properties and the interactions with the actual nutrient solution we intend to use. Other media specific analysis and more complicated media run-off tests can be necessary to address the full extent of the interactions through an entire crop cycle.

Managing a Run To Waste (RTW) hydroponic crop from a nutritional perspective

Today it's very common to create hydroponic crops using techniques where nutrient solution is not recycled. This type of crop, commonly called drain-to-waste (DTW) or run-to-waste (RTW) offers the advantage of having a very cheap setup – since no recirculation is used – with the big disadvantage that nutrient control becomes harder as there is no constant feedback of how the plants are affecting the nutrient solution. Today I want to talk about the main differences between a RTW crop and a recirculating crop and how nutrient management needs to be done in order to be effective in RTW setups.

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One of the most important difference between both crop types is the substrate. In a RTW crop you want the substrate to have a much higher capacity for water retention since you want to

irrigate less frequently and ensure the plants are in contact with nutrient solution as much as possible without having aeration problems and a lot of run-off. Having a lot of run-off means wasting more nutrients in a RTW setup so you want to have a media that can minimize this. This means having a media like peat moss or coco coir where water retention can be very substantial.

The problem with the above is of course salt accumulation within the media. If you irrigate the plants with a full strength nutrient solution and you irrigate when the level of moisture descends then this is both because the plants have absorbed water and the solution has evaporated to some extent. This means that the next time you irrigate your total amount of salts will be the amount from your current irrigation plus the amount accumulated in the media. This can quickly turn into a very problematic situation where the plants are subjected to extremely high conductivity levels.

This is why run-off monitoring is key in RTW setups. You usually want to water your plants enough to allow for some run-off – usually 10-20% of the plant container's volume – so that you can perform measurements of pH and EC over that run-off. This is why it's so important to have the plants over trays where run-off can be collected as measuring the run-off is very important to ensure that your plants are receiving adequate nutrition. Measuring the run-off of every plant is impractical so collecting the solution from many plants in a single tray and then measuring that output is a lot easier. Alternatively – if you cannot place the plants on trays – you can use a [suction lysimeter](#) to take out solution from a few plants after watering to monitor conditions around their root zone.

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In a RTW setup your run-off will always tend to be more concentrated than your input – this is normal – but you want to have conductivities in your run-off no more than 30% greater than your input concentration. If this is the case you should do plain water irrigation until your run-off has at least the same conductivity as your originally desired input. When you water with plain water also make sure you adjust the pH of the water to the value you desire. One of the lead causes of bad results in RTW setups is to have salinity build-ups that cause nutrient lock out simply due to a general lack of run-off monitoring. In general if watering using conductivities close to or above 2 mS/cm plain waterings should be done once for around each 1 or 2 nutrient solution feedings.

The pH is also very important. Depending on your media your pH can change substantially between your input and your run-off but in general you want your output pH to be as close to the desired pH as possible. You can compensate a bit by changing the pH of your input solution – for example if your run-off pH drops you can increase the pH of your input solution – but never increase your input pH above 6.5 or below 5.5. Some media like peat can acidify solutions a lot with time, in these cases it's very important to pretreat the media to avoid these problems with output pH. A strongly buffered input solution can also help in these cases. *Before starting your crop always test the run-off pH/EC of the media without plants to ensure you can make any needed treatments before you actually start your crop.*

The key to successful RTW setups from a nutritional perspective is run-off monitoring. Once you start monitoring your outputs you will see how your plants respond to your input solution and you'll be able to better control the plants' root zone environment. Of course these issues are all eliminated by recirculating setups since in that case the

nutrient solution returns to the tank and there is a constant feedback of how the plants are affecting the solution. This can make recirculating setups much better at giving higher yields.

Using coco coir in hydroponics

Side by side with peat moss, coco coir is one of the most commonly used media in hydroponic culture. Its excellent root propagation and aeration properties, coupled with its adequate water retention, make it an ideal medium for hydroponic culture. Nonetheless, there are several issues that can arise when using coco coir, particularly due to its chemistry and variability. Today we are going to talk about using coco coir in hydroponics, what the main problems with coco can be and how these problems can be avoided.

TABLE 11.7 Levels of pH and EC in Coir

pH	EC (mS cm ⁻¹)	Reference
4.9–6.4	0.17–2.32	Noguera et al. (2003b)
5.6–6.9	0.13–1.26	Evans et al. (1996)
4.8–6.8	0.32–0.97	Meerow (1994)
5.5–5.7	0.80–1.90	Handreck (1993)
5.0–5.7	0.12–1.51	Prasad (1997b)
4.9–6.6	0.32–0.41	Smith (1995)
6.0–6.7	0.2–0.4	Kipp et al. (2000) (coir dust)
5.9–6.1	0.2–0.9	Kipp et al. (2000) (coir chips)

Values of Noguera et al. (2003b), Evans et al. (1996), Meerow (1994) are based on saturated media extract, Smith (1995) on 1:5 water extract, and the others on 1:1.5 water extract. EC values have been converted to 1:1.5 water extract (see text).

EC and pH values for different coco coir sources

Coco coir is basically ground up dried palm tree husks. Although it is organic, it is much more fibrous than peat moss and for this reason, it does not suffer from some of the pH and decomposition issues commonly found with peat. Although

coco is biodegradable, its decomposition can take more than 20 years, reason why it is a suitable media for hydroponics. It can even be used several times within a hydroponic crop in order to save production costs, as long as plant material is removed and the media is properly treated between crops.

Since coco coir comes from large plants grown across a variety of different conditions, the actual chemical makeup of the coco can change very substantially. The table above shows the pH and EC of different coco coir sources. As you can see, we have everything from an EC of 0.1 mS/cm to an EC of 0.9 msS/cm, with pH values that cover anything from 4.9 to 6.8. This is mainly due to the big variations in the ions contained within the coco and how these ions interact with the plant material.

Coco coir also has a high cation exchange capacity, meaning that it can retain large amounts of ions. These are only taken out if they are replaced by others with stronger affinity for the media or when strong interactions with chelating agents are possible. This is generally why coco is treated with calcium nitrate solutions, to remove many of these ions from the media structure and allow the media to be as neutral as possible when used in hydroponic culture. However, many coco producers do not treat the media at all – or simply wash it with plain water – leaving a lot of potassium and sodium within the coco that needs to be accounted for. A lot of micro nutrients that are tightly bonded to cation exchange sites are often also often present inside the coir.

TABLE 11.9 Chemical Properties of Coir (CaCl₂/DTPA Extractable Macronutrients) (mgL⁻¹)

P	K	Ca	Mg	Na	Reference
-	183-222	100-172	36-58	85-92	Kipp et al. (2000) (coir dust)
-	47-98	56-60	31-79	30-78	Kipp et al. (2000) (coir chips)
8-17	304-720	6-15	8-28	110-114	Handreck (1993)
	69-128				Prasad (1997b)

TABLE 11.11 Chemical Properties of Coir (CaCl₂/DTPA Extractable Micronutrients) (µg L⁻¹)

Fe	Mn	B	Zn	Cu	Reference
	1100-1500	120-180	700-1300	170-2200	Handreck (1993)
79-157	814-1540	66-77	429-527	0-6	Kipp et al. (2000) coir dust
45-140	484-561	66-154	364-552	240-448	Kipp et al. (2000) coir chips
4100-7700	900-5000	200-400	500-1100	100-300	Prasad and Maher*

*Prasad and Maher unpublished data.

Some of the chemical properties of different coco coir sources. If you want to ensure your coco is as neutral as possible in terms of nutrients, you can extract it with a 1 g/L solution of calcium nitrate and then with 2g/L of tetrasodium EDTA. This will extract both macronutrients that are exchangeable for Calcium, and micro nutrients that can be extracted when using EDTA. The EDTA step is important, as coco can hold a large amount of micro nutrients within it, that can be exchanged and used by the plant. If you want your nutrients to all come from solution you will need to remove these contributions from the media. After this, you will then want to run plain water to remove any excess Ca and EDTA and then run your full strength nutrient solution for a few days. This will strip the coco from excess ions and equilibrate the cation exchange sites with your nutrient solution's composition.

Note that these steps aren't necessary to grow successfully with coco, but they can give the grower more control over the nutrients received by the plants. You can alternatively run nutrient solution through the coco and then perform an analysis of the output, so that you can compensate for the nutrients that are given by the coco through the growth cycle. This of course means that you need to spend money doing solution analysis through the crop's life to ensure that you're adequately compensating for the coco's contributions through the entire growing period.

When properly treated, coco can be a very good media for growing hydroponic crops. The larger aeration, better chemical stability and fibrous structure makes it better for root

growth than most peat moss sources. Yields for several plants are also often larger or just as good in coco when compared with peat moss. The lack of important decomposition during growth cycles is also a big advantage over peat, as important drops in pH due to media decomposition can be avoided and the media can be more readily recycled.

Using Peat Moss in Hydroponic Culture

There are several different types of media available for hydroponic culture and from these peat moss is one of the most popular due to its low cost and high availability in some countries. This media is made up of decaying mosses and is used mainly in drop irrigation systems of both a recirculating and non-recirculating nature. However the organic nature of the media provides several important challenges to the hydroponic grower which – when not controlled – can lead to important problems associated with nutrient availability, inhibiting plant growth. Today we are going to talk about the characteristics of peat moss as well as how we can amend this media to make it suitable for hydroponic cultivation.

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TABLE 11.2 The von Post Scale for Assessing Degree of Decomposition of Peat (von Post, 1922)

Degree of decomposition (H)	Quality of water exuded	Proportion of peat exuded
1	Clear, colourless	None
2	Almost clear, yellow brown	None
3	Slightly turbid, brown	None
4	Turbid brown	None
5	Very turbid, contains a little peat in suspension	Very little
6	Muddy, much peat in suspension	One-third
7	Very muddy	One-half
8	Thick mud, little free water	Two-thirds
9	No free water	Almost all
10	No free water	All

Peat's main characteristic is its organic nature. Since it is made up of decaying organic matter this means that the chemical nature of the media will change depending on the degree of decomposition of the media and also depending on the particular moss species that were used to produce the peat moss. You can know the degree of decomposition of a peat moss sample by using a simple procedure. Place a handful of wet peat in your hand and then squeeze it, the result – how the exuded water looks and whether peat is squeezed between your fingers – will tell you all about your peat. The von Post scale – developed in the 1920s – will then allow you to tell how decomposed your media is in a scale from H1 to H10.

Highly decomposed peat will tend to remain more chemically stable as the organic decomposition process has already been carried out. For this reason you want to buy what is commonly known as “black peat” (H7-H10) where microbial activity has already dialed down and the peat moss more closely approaches what we would call an “inert media”. This however does not mean that Peat moss is chemically inert at this point as it does contain as a significant amount of substances that can affect your nutrient solution.

One main characteristic of peat is that it's acidic. This means that the pH of untreated peat will usually be between 3 and 4.5, too low for use in hydroponic applications. Peat is

generally amended with calcium carbonate (lime) to make its pH go up and remain there but this process can be ineffective if the peat can still decompose very significantly (if you buy peat with decomposition < H7). This also contributes high amounts of Ca into the media which might lead to nutritional problems if Ca is also applied normally in solution. To alleviate these issues peat is also sometimes treated with lime/dolomite mixtures so that the counter-ions are both Mg and Ca. Alternatively – but more expensively – this problem can be solved by using phosphate buffer solutions that are run through the peat for a significant period of time. A potassium monobasic/dibasic phosphate buffer at a pH of 6.5 with a 100 mM concentration can buffer the peat moss. For this the buffer needs to be applied until the run-off pH out of the peat comes out unchanged. Then tap water should be applied to remove the K/P from the media. Note that this will only work for black peat that's already gone through most of the decomposition process as lighter peats will simply decompose further and acidify the media again.

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TABLE 11.3 Cation Exchange Capacities of Different Peat Types
(Puustjarvi and Robertson, 1975)

Species or peat type	Cation exchange capacity (CEC)	
	cmol kg ⁻¹	meq L ⁻¹
Undecomposed sphagnum moss peat	130	80
Sphagnum sedge peat	110	60
Sedge peat	80	40
Highly decomposed black peat	160	240

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However if all you can get is already treated peat moss then you should run nutrient solution through your peat for a while before putting your plants in to ensure that the peat's cation exchange capacity has already balanced with your nutrient solution's composition, this will also help remove nutrients applied to the peat that deviate the nutrient concentrations

from what we want within the media. Peat can have a significant cation exchange capacity as showed in the table above – even more so for black peat – so a commercial source of peat may exchange a significant amount of nutrients with your solution. Peat is also not very good at retaining anions so the media will be unable to supply any N or P which will be leached very easily from the media. This inability to retain anions basically means that they will only be available when the plant is watered, reason why you should take care to correctly [monitor moisture](#) in your media to maximize your productivity.

For hydroponics it is therefore best to find untreated black peat and treat it yourself. If this is not possible then try to find unfertilized black peat – which has had only lime but no other nutrients added to it – and then use that. A great characteristic of peat moss for hydroponics is that its nutritional content is low – allowing great control over the nutrients added through the composition of the nutrient solution – but this advantage is eliminated when the peat moss is filled up with fertilizers by companies that produce it for non-hydroponic purposes.

If you're using black peat also make sure to check how the peat behaves when watered, if the peat compacts too much you might want to add some perlite to your peat to increase the aeration of the media and prevent excessive compacting from happening. Add perlite until you get the desired balance between aeration and moisture retention. This is not necessary with all black peat sources but it can often be required.