

# Is OceanGrown Fertilizer a Scam ? A Scientist's Point of View

In recent days I was contacted by a person who wanted to start selling the OceanGrow fertilizer who asked me to be the head of a research team to do scientific tests to evaluate if there is actually any value behind the OceanGrown fertilizer. After going through its webpage and doing an in-depth review of scientific literature on the subject I have acquired quite a lot of information about this fertilizer and its real potential as an organic solution and replacement for traditional fertilizers. On today's post I want to discuss this fertilizer, which is supposed to be used on either soil or hydroponics, and give you my opinion as a scientist and what the currently available scientific evidence tells us about the effectiveness of this and similar products.

The OceanGrown fertilizer is nothing more than sea water which has been concentrated – probably using reverse osmosis – to give us a fertilizer that is supposed to replenish the minerals lost in soil and provide plants with 90 elements for their adequate and healthy growth. The website has an overall pseudo scientific tone with absolutely no reliable scientific evidence shown and basing all conclusion on “facts” that have not been scientifically proved. For example, the website says that elements in sea water are in “ideal concentrations” when this has no scientific basis, no one has proved that certain nutrient concentrations are ideal and no study has actually been conducted to see if the concentrations of micro nutrients on sea water are ideal for plant growth.

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Besides this, the people at OceanGrown assume that having all elements is “good” when actually even small amounts of mercury, lead, cadmium and other heavy metals can cause chronic effects when eaten continuously. They also show evidence that the elements are absorbed by the plants fed with their product something which is absolutely obvious given the fact that ionic species are absorbed by plants since their absorption mechanisms are not extremely controlled. Does the fact that a plant absorb aluminium or gold prove that the element is essential ? No, plants absorb ionic species without too much selectivity and when you feed a plant with a solution containing non-essential nutrients the plant is bound to absorb some. This effect is widely studied in science to remove heavy metal contamination and other ionic species using plants. There is no scientific evidence that points out that any elements besides C, H, O, N, P, K, Mg, Ca, Fe, Zn, Mn, Cl, Mo, B, S and Cu are essential to plant life or needed for the adequate and healthy development of plants.

The “essays” carried out to test this fertilizer’s efficiency also lack any use of the scientific method and fail to discard very plausible causes of this fertilizer’s sometimes positive effects. For example, increases in conductivity have been found to improve certain crops in hydroponic culture so the effect of this fertilizer might only be of ionic strength increasing which might help certain crops achieve better results. It is also possible that some micro nutrients – which are depleted in soil – might be added by this fertilizer but in the long term the excessive amount of sodium and chloride

ions contained in sea water is bound to cause problems. The evidence that increased sodium concentrations in hydroponic crops causes damage to plants is a well established fact in the scientific community.

The people at OceanGrown seem to be trying to sell a fertilizer with extremely limited and lack of adequately confirmed evidence based on a series of pseudo scientific facts that are not adequately backed up by our current understanding of how plants work. This fertilizer might be able to work to some extent but the reasons why it does or if it causes any long term problems and damage to soil needs to be addressed to confirm the viability of this solution. Right now there is not even one single study published on a peer-reviewed scientific journal that talks about the effectiveness of OceanGrown or true scientific essays done with this solution. It seems evident to me that similar effects as the ones shown by this fertilizer might be achieved by a simple application of an adequately formulated micro-nutrient mix and that positive effects from all the trace elements found in sea water might be limited or undetectable at best.

In conclusion, I think that the OceanGrown fertilizer is a big business based on selling sea water that is currently based in pseudo scientific results. There is no evidence that plants need or benefit from 90 different elements and there is also no evidence that shows that this fertilizer has no long term ill effects due to the excessive sodium enrichment of soil. If this people were truly serious about proving that their fertilizer works in a unique way based on all of its trace elements they would have made adequate scientific trials years ago with reputable scientists from world renowned universities. My advice if you are thinking about using this solution would be to use what we know and have determined works for plants. The application of adequately formulated micro nutrient blends and full fertilizers is a much better solution than a pseudo scientific mess with no adequate

scientific evidence of unique results.

Of course I am a scientist and as soon as there is a peer reviewed publication on a well-respected journal done by an unbiased researcher I will be the first to reexamine my conclusions and use this fertilizer. Meanwhile OceanGrow remains unproved and their claims or at least their explanations, remain pseudo scientific.

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## **Fruit Quality and High EC values in Tomatoes**

You may remember an article I wrote last year about the effect of salt concentration in tomatoes and how several different studies have been done about this matter. On that article I talked about a paper released in 2007 showing that tomatoes raised at an electrical conductivity value of 4.5 dS/m had the best tasting and fruit quality. However, this study was not conclusive in the sense that quality parameters used on the plants were not extensive and adequately analyzed. On today's post I want to talk to you about a previous study done in 2006 which does include fruit quality parameters and a clear explanation about which conductivity levels give you the best tomatoes and why this is the case.

The relationship between high conductivity and high fruit quality clearly depends on how you evaluate fruit quality. In general, the nutritional quality of a fruit is measured by the concentration of important nutrients within it. In the case of tomatoes, important nutrients such as lycopene, vitamin C, carotenoids and phenolics determine most of the tomato's nutritional value. However, fruit quality – from a market perspective – relates to size, shape, uniformity and firmness and market duration.



On a study published on the Journal of Agricultural and Food Chemistry in 2006, Woitke *et al* discussed the effect of electrical conductivity on the yield and quality of tomato crops. Their conclusions after analyzing the concentration of several nutrients at different salinity levels was clear : tomato crops which are raised at higher EC levels have lower overall yield but the concentration of nutrients (vitamin C, lycopene and beta-carotene) was increased by as much as 38% on high conductivity treatments (again at about 4-4.5 dS/m). They also found a nutrient-quality increase as the antioxidative capacity of the phenols and carotenoids increased on the plants with high nutrient treatments.

Another very important fact is that not only nutritional value was increased but total dissolved solids and organic acids – which contribute significantly to the fruit's flavor – also increased significantly. Overall the study concludes that all quality related parameters increased with the increase in salinity pointing out clearly that raising tomatoes at high salinity levels is an excellent way to increase fruit quality. The reduction of yield can be compensated for by the higher inner quality of the fruit allowing it to compete more effectively with other higher-yielding yet lower quality productions within the market.

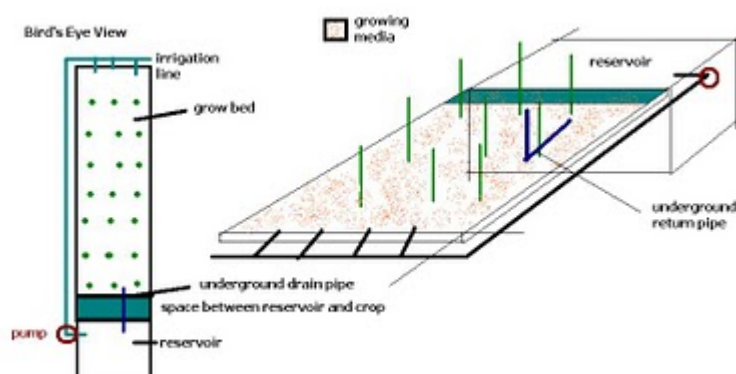
So next time you want to increase the taste and nutritional qualities of your tomatoes just raise your EC levels so that your fruits accumulate the higher levels of nutrients and flavor producing substances that reside within every small tomato. Certainly your tomatoes will be the envy of all other growers with their higher nutrient and flavor levels and increased antioxidative capacity.

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# The Best Outdoor Hydroponic System. A Simple Way to Grow Large Amounts of Food

I have always seen that there is not a lot of information regarding outdoor hydroponics and the building of scalable and cheap systems that may provide large amounts of food without the complexity, trouble and expense of building a greenhouse. For the past several years I have been puzzled by this issue and I have challenged myself to build an outside hydroponics system that is able to deal with environmental conditions successfully, providing adequate conditions for plant growth without significant expenses and without the need for any protective enclosure. Finally, I came up with a system which – I believe – has a lot of promise for the above, giving us the opportunity to build an outdoor hydroponic system which has a low cost and a very high productivity potential. On today's post I will be talking about this system and how it can be easily built with less than 1K USD for each 100 square meters. How do you build a scalable system that can be used on the outdoors with minimal problems due to uncontrolled environmental conditions ? The easiest thing I could think of was a simple continuous flow system which used the ground itself as a place to put the plants. This system uses no NFT channels, no large amounts of PVC pipes and absolutely no complex engineering. The system – shown on the drawing below – is simply a channel which is dug on the ground of about 2 meters wide by 25 cm deep. The nutrient reservoir can be a tank burried in the ground or a reservoir made from bricks and tiles out of another hole dug on the ground depending on the actual volume needs of the crop. The hydroponic system uses a PVC line connected to a pump to irrigate the system at the top and a small decline in the slope of the channel allows the solution to return to the tank through an underground pipe shown in dark blue. The channel is filled with a nutrient media that has adequate drainage and the nutrient solution is

fed continuously through the irrigation system. Of course, when the channel is dug on the ground the soil has to be covered with a polyethylene sheet to prevent the solution to drain into the soil.



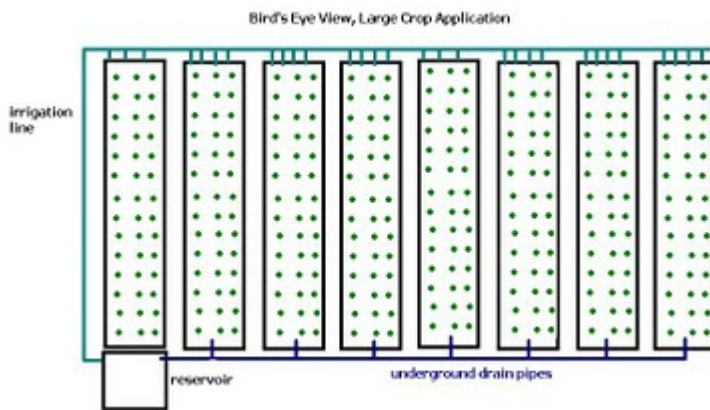
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This system allows you to grow a wide variety of crops, from tomatoes to lettuce heads. The system can be used to grow plants of various sizes and nutritional needs since the media and continuous flow irrigation provides great oxygenation as well as a cheap alternative to more complex systems such as NFT or PVC pipe systems. The system is also absolutely scalable, it can be built from a few square meters to a full plot size commercial cultivation facility without significantly changing the principle of operation. Since the surface area of the system is also large, and all nutrient solution is returned to a central reservoir, rain volume can be accurately determined and nutrients can be added or changed to make up for this effect of external environmental conditions.

The image shown below shows you how the system can be expanded to a full plot system without any modification of the fundamental working principle. The only things that need to be bought to start this system are a tank, a shovel, a polyethylene sheet as large as the channel requires, PVC pipes for the irrigation system and returns pipes, media, nutrients and seed. Since there is no greenhouse, no gutters, no polymer channels and no expensive irrigation equipment, the system is very simple and effective at growing plants at a large or

small scale under outdoor conditions. It is also perfect for people who want to start a small hydroponic business and then expand it as they want to increase their production, since adding channels is easy and requires almost no changes (besides perhaps having larger pumps and increasing reservoir size once this is required).

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In the end I believe that this system summarizes everything that I wanted to achieve with an outdoor hydroponic system. It is able to control and measure the effect and added volume of rain, allows the growth of a large variety of plants and provides us with a cheap and scalable solution to small and large scale commercial growing. Definitely there will be some problems that will probably have to be solved once larger applications start to develop but certainly I can say right now that this idea seems to be the largest, cheapest and most scalable solution for outdoor hydroponic growing available online :o).

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## Crazy pH Swings – How Media



# and Bacteria Affect pH in Hydroponics

I usually get an email from time to time from someone who is experiencing wild pH swings in their hydroponic reservoirs. Growers usually tell me that their pH was around 6.2 one day and then 8.0 by the next morning or some similar story. This situation becomes a little bit frustrating as the grower does a huge effort to keep the solution at a certain pH level only to realize that after a certain time the pH of the solution simply starts to swing wildly between very odd values. In order to help new and experienced growers better understand the nature of these swings, what they mean, and how they can be eliminated for good I decided to write this small article on hydroponic pH swings and how variables different to plant feeding affect pH levels.

Let's suppose you got home from work, prepared a new batch of nutrient solution and set your pH level at a very comfortable level of 5.7. By the next day, when you wake up in the morning to check your plants you find that the pH of your solution is 7.5. You start to argue with your pH meter, recalibrate, readjust your solution and leave for work. When you come back – to your surprise – your pH level is now around 7.3. What ? – you ask yourself – What could be wrong if you set the pH to 5.7 again and it again went up to 7.3 ?



The answer to these wild pH swings comes from an understanding of the chemistry behind everything within your hydroponic system. Generally these swings towards high pH values are caused by media which has surface-active basic sites which act like “buffers” and readjust the pH of your nutrient solution to their own “preset” pH level. This is very much like the mechanism used by soils to naturally control pH, only that this time the minerals are playing against you. Substrates that have been made at high temperatures which have basic potential – such as rockwool – show this kind of behavior.

Other media such as river bed gravel also show strong pH buffering effects due to their natural mineral composition.

How do you end this problem ? The easiest way to end this problem is to pretreat your media before starting your crop. Place your media in a bucket and then add 1 liter of vinegar for every gallon of water. The media will attempt to neutralize the acetic acid and in doing so it will lose the proton capturing ability of its surface basic sites. Using a weak acid like acetic acid is better than using a strong acid – like nitric acid – because this ensures that residual acids within the media won't lead to other extreme pH fluctuations. After the media is soaked in the vinegar solution measure the pH, wait a day and measure it again. If there is no difference between both readings then you can now wash and use the media – if there is – then you need to wait another day and remeasure.

Now basic media is not the only problem around. There are also wild swings to acid values which are usually a consequence of bacterial growth or dying organic matter. When organisms die or when they are being decomposed by bacteria organic acids – which lower pH – are released into your nutrient solution. Wild swings into the 3.5-4.5 region usually mean that the problem is not media but related to root disease. You should do a hydrogen peroxide treatment (check my articles on peroxide for more on this) and wait to see if pH levels stabilize after a while. In extreme cases, physical removal of dead root material may be necessary to correct the problem.

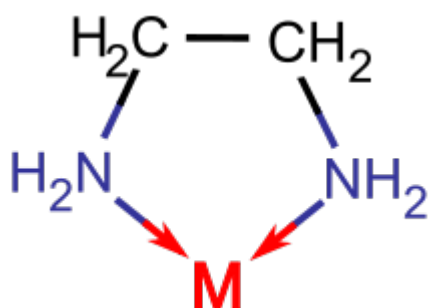
Last but not least, the problem can also be related with plant feeding from a very scarce volume of solution. If you are handling less than 1 gallon per plant of solution in your reservoir then it is likely that plants themselves – through the absorption of nutrients – are causing the swings. This is easily fixed by placing a larger reservoir and ensuring that you are always recirculating at least 1 gallon per plant of nutrient solution. Hopefully with the above guide you will be

able to better understand “wild” pH swings and take corrective action whenever you see this behavior happening within your hydroponic crop.

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## Preparing your Own Chelates – Improving Your Hydroponic Nutrients

If you have already read my free ebook for preparing hydroponic solutions and you have already seen many commercial and other standard formulations you may be asking yourself if you will have problems with iron due to the unavailability of any chelating agents. The truth is that I have used formulations without any chelating agents several times and I haven't had any problems when they are prepared by the ebook. However many of you may be interested in the addition of chelating agents and you may be wondering how you may modify the spreadsheet or what you should add in order to generate the adequate chelates. On this post I want to explain a little bit how you can add chelating agents to your reservoir to chelate the salts mentioned on my ebook and how this can easily generate all the chelated metal complexes you need to avoid any solubility problems.



Simple metal chelate model representation

What is exactly a chelate and what are they good for ? A chelate is simply an organic molecule that “wraps” itself around a metal ion and prevents its precipitation, increasing its solubility. Chelates also diminish the amount of available metal ions to plants and therefore they slowly release the quantities of micro nutrients available for plant growth. There are many available pre-made chelates on the market such as Fe-EDTA. However, the cheapest way to generate chelates once you already have a standardized formulation based on simple inorganic salts is to add a chelating agent.

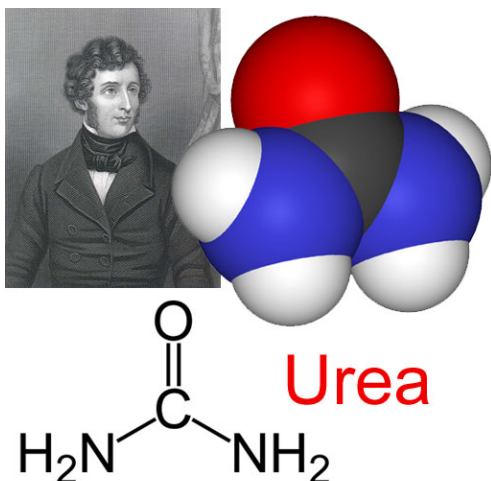
The most common of these agents is called Ethylenediaminetetraacetic Acid (EDTA), a tetraprotic acid which is able to chelate most metals with a particularly high affinity for Fe. However, when you add only chelated iron, the fact that other metals start to compete makes the iron complex destabilize and the chelate is eventually destroyed. However, when we add the chelating agent we can make sure that we add enough to “wrap” Fe and other metals in such a way that the stability of the iron complex is guaranteed.

When we add the chelating agent we do not add EDTA (the acidic form) but we add it as a salt of another element, usually K-EDTA. Once this is added to the solution the EDTA quickly gets rid of K and goes for another metal – such as Fe – for which it has a much higher affinity. The chelating agent quickly forms complexes with all the metals it loves and you end up with a solution that is highly stable and not prone to any micro nutrient related precipitation. How much do you need to add ? Depends on your formulation. The spreadsheet download with the ebook shows the amount of chelating agent (K-EDTA) you need to add to the END solution after all micro nutrient concentrated solution additions have been done (this amount fully complexes Fe, Mn, Zn and Cu).

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# Urea in Hydroponics – Positive or Negative ?

When we supply nitrogen in our hydroponic solutions there are always a several ways in which we can fulfill our plants' needs for this nutrient. The traditional way is to supply nitrogen solely as nitrate (NO<sub>3</sub><sup>-</sup>) salts, something which is well proven to give good results, high yield crops and better than soil growth. However it is always good to ask if a combination or the use of additional nitrogen sources may improve the outcome of our hydroponic experience. Particularly since plants in soil absorb nitrogen as nitrate and ammonia it becomes worth asking if a slow releasing source of ammonia – such as urea – would improve the yields of our hydroponic system. On this post I will write a little bit about the use of urea in hydroponics and the scientific evidence that there is to support or reject its use.



Model of a urea molecule

Urea is an organic molecule which slowly decomposes in water to yield ammonia and carbon dioxide. If the media is slightly acidic, the ammonia released will get protonated to form ammonium, a form of nitrogen which can be readily assimilated

by most plants. Moreover, this form of nitrogen can also be processed by bacteria to yield nitrate, providing us with an additional – slow release- mechanism for nitrate supplementation. Several research groups have asked themselves if urea would bring any significant benefits to hydroponics crops. Of particular interest was [a study published by Oda et al](#), dealing with the effects of Urea and nitrate fertilization in hydroponics crops using both organic (peatmoss and bagasse), inorganic (rockwool and sand) media and pure NFT systems.

After doing a study with several concentrations of Urea and Nitrate -both by themselves and combined – this research group found out that Urea does not improve crop yields in NFT systems and indeed pure nitrate does the best job when no media is in place. When media is introduced, organic media shows a faster Urea to Ammonia conversion but Ammonia to nitrate conversions are faster in inorganic media. However, the effect of Urea remains poor in the sense that nitrate-only crops outperformed almost all crops except for some plants grown with small quantities of Urea which proves to be beneficial in the same way as small additions of ammonia are already known to be.

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So in the end, is it worth to add Urea to a hydroponic

formulation ? The scientific evidence says that Urea does not have any clear beneficial effect that could not be gained by a small addition of ammonium salts, something which has already been confirmed by several studies done on different plant species. If you are planning on starting a new hydroponics crop adding about 5-10% of your total nitrogen as ammonium may prove to be beneficial but any addition of Urea seems completely unnecessary.

Of course, further research on this subject would be needed to know the effect of nitrate/ammonium/urea combinations to know if the beneficial effects are a sole consequence of the presence of small quantities of ammonia or a virtue of the “regulatory” effects introduced by Urea as a slow release ammonium fertilizer.

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## **Hydroponic Tomato Formulations – Nutrients for Every Growth Stage**

One of the most interesting things that can be done once you know how to prepare your own hydroponic nutrients (check out my free ebook on the right hand menu) is to make formulations for the different growth stages of your crops. Certainly the variation of several nutrients along the different stages of a plant’s life will guarantee optimal production with better than average results. In the beginning it certainly isn’t very clear how you should vary nutrients and careful care about the amounts – particularly the ratios between nutrients – have to be taken into account in order to have the best possible results. On today’s post I want to talk a little bit about hydroponic tomatoes and how we can design a very specific “feeding schedule” with small modifications in our nutrient

formulations for the whole growing process of this plant. When you are growing plants, their needs are obviously not the same along all their growing stages. In a similar way as a 5 year old human doesn't need the same nutrients as a 16 or 52 year old, plants that are just germinating and plants that have been flowering or have just begun their fruiting have different nutritional needs. In tomatoes, these differences manifest themselves as different demands for the different nutrients. For example, demand for magnesium, nitrogen and potassium increases as the plant grows older as more nutrients are needed to develop more live material. However some needs – such as those of micronutrients – remain fairly constant as the demand for most of these ions is not increased radically as the plant grows.



Of particular usefulness to understand how to improve your tomato crop by developing a formulation schedule is a study done by the university of Florida by Hochmuth *et al*. The study shows the design and application of a feeding schedule to tomato crops from transplant to fifth cluster development, changing nutritional input as the plant develops. You can access this study [here](#) and look at all the different formulations developed for different stages of tomato growth. By using the ppm values provided on this study you can easily prepare nutrient solutions using the spreadsheet provided with my nutrient preparation ebook (available freely).

When you analyze the nutritional formula given above you can see how some nutrients are increased gradually while some are increased in large steps. You can also see how some ratios – like the N/K and Ca/K relationships – vital to the development of healthy tomato fruits, develop as the plants reach a more mature stage. In the beginning, small quantities of nitrogen (< 70 ppm) are available while in the end this quantity is increased to 150 ppm falling in line with the demand of a much larger fruit-producing plant. Hopefully with the above guidance and research article you will be able to start some



customized nutrient scheduling for your tomato crops to improve their yields, making sure that your plants get the most out of the nutrient formulations they are using.

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# **How to Have a Constant pH in Hydroponics – No More Corrections!**

## **Adjusting pH, the endless chore**

Plants in recirculating systems will change the pH of their solutions through nutrient uptake. This means that the pH of a recirculating hydroponic system will be inherently unstable and will require constant corrections. We usually carry out these corrections through the use of strong acids or bases, such as the commonly used pH up/down solutions we buy at stores. This makes the process of pH adjusting repetitive. Although many people have implemented automated systems for pH correction, these systems have potential for failure, especially due to sensor calibration or failure issues. Ideally, we would want a completely passive solution to maintain the pH of our hydroponic nutrient reservoir.



A weakly acidic ion-exchange resin used for pH control

## Chemical buffers

There are several ways we can tackle the problem of shifting pH. Chemical buffers are a potential alternative. I proposed the use of a citrate/carbonate buffer in a previous post, but this buffer does not work due to the microbial and plant metabolism of citrate ions, which pushes the pH up. Carbonate/phosphate buffers offer a better alternative, but there are inherent limitations in the strength of these buffers due to the limitations in phosphorous and carbonate concentrations that plants can tolerate. This means such buffers are usually restricted 1mM or lower concentrations – not able to compete with plant uptake.

The most popular choice in the research community are MES buffers, which can be used to keep the solutions at stable pH and can be used at concentrations even exceeding 10mM. The problem with these is that they can cause problems in some plant cultures and they can also become extremely expensive for large growing systems.

## Ion exchange resins

How do we keep pH constant without using any chemical buffer?

The solution comes in the form of weakly acidic ion exchange membranes. These substances contain polymer-like matrices which have functional ion attracting groups on their surface that react with acids and bases in solution and provide you with a constant pH level.

These composites are insoluble and the only thing they need to be efficient is to have solution passed around them frequently. It is a matter of putting them in a place where fresh passing solution will be in contact all the time – such as near or connected to a high-flow pump – and that's it, no more pH problems, no more additions to control pH, problem absolutely solved. As the solution passes through the material, it will be able to react with the ion attracting sites in the polymer to stabilize the pH. These compounds have been studied in the literature and given good results ([1](#), [2](#), [3](#)).

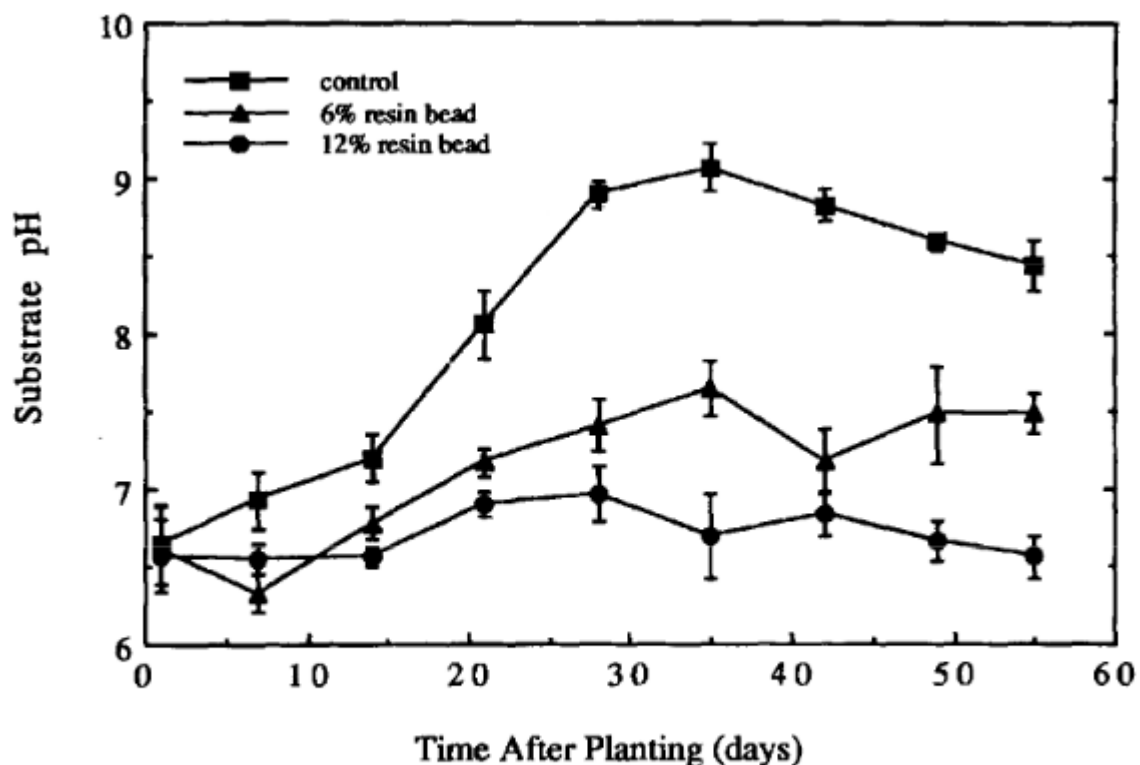


Fig. 2. Effects of cation-exchange resin beads on root-zone pH in solid-matrix hydroponic systems. Vertical bars represent SE of the mean with data combined from two experimental trials.

Taken from [this paper](#). In this research, an ion exchange resin was used as part of the media. You can see how the 12% resin media kept the pH from becoming uncontrollable.

In particular researchers in the 1980s tested weakly acidic ion exchange resins, like Amberlite IRC-50. One of the problems with their use was that these resins can have significantly high affinity for Ca and Mn, which means these cations need to be added in excess or replenished if the plants show problems with their uptake. Note that the Amberlite IRC-50 ion exchange resin is no longer available. For a public list of currently available resins, you can refer to [this link](#).

## My experience

I have tested ion exchange resins extensively in recirculating systems and they can provide you with high pH stability through time, especially when the plants are pushing the pH up. This is the most common steady state of a hydroponic system, as most plants will make solutions more basic through their nitrate uptake. Since the loaded state of the resin is acidic, they have their maximum buffering capacity towards pH increases in this state. As the resin gets used from this state, it gains buffering capacity against the other direction.

Another advantage of the resins is their ability to be regenerated a very large number of times. In weakly acidic ion exchange resins, this is done by soaking the resin for a short time in a strong acid. Normally muriatic acid is the acid of choice, as the chlorides of most cations trapped in the resin will be soluble. While other acids could be used, they might form precipitates with some ions trapped in the resin, especially Ca.

The resins in their charged state are naturally bad at buffering against pH decreases in the nutrient solution as they have only acid to contribute to the solutions. While protection to the downside will be created by the resin with time, you might need to modify the starting state of the resin

if you want this protection from the very start.

## Conclusions

*Weakly acidic ion exchange resins are a great way to provide stability to a recirculating hydroponic system, they are also low cost and can be regenerated easily.* They work best when plants push the pH of the nutrient solution up initially and do require modifications for cases where guards against pH drops are required from the beginning. Depending on the exact chemistry of the resin there might also be some issues with capture of some cations, like Ca/Mg/Mn, reason why it is important for us to monitor the plants closely when these resins are initially used.

**Have you tried any weakly acidic ion exchange resins in your recirculating hydroponic solutions? Is your pH stable? Let us know in the comments below!**

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## The Importance of Oxygen in Hydroponic Systems

It is very common for new hydroponic gardeners to have an over developed focus on the nutrient aspects of their cultures while totally neglecting other very important aspects such as aeration and light. Some of the most common problems that plants face are a direct consequence of a lack of a proper supply of oxygen, issues which could easily be fixed if this factor was taken into account with as much interest as the composition and character of the hydroponic nutrients used. On today's post I want to talk a little bit about the paramount importance of oxygen, why it is so important and what things you can do to ensure that your hydroponics crops are not

starved of this extremely important element.

First of all we need to understand why plants need oxygen. This gas is vital for many living organisms because it performs a very important function within their cells. Oxygen reacts with carbohydrates within any aerobic organism's organelles to produce ATP, which is the primary chemical used to fuel biochemical processes. Plants need this ATP to perform several functions which require energy, like the absorption of nutrients and the production of amino acids. Plants need great amounts of oxygen in their roots in such an extent that one of the limiting factors of growth in hydroponics – after light – is oxygen availability to root cells.



A very important thing that you must take into account is how much oxygen your hydroponic system allows roots to have. Static culture systems, like lettuce floating rafts or any system where roots are permanently soaked in water offer little available oxygen since the solubility of oxygen in water is quite low. Even if you aerate the solution constantly using an airpump, the solubility limitation makes the use of such systems to grow large plants – such as tomatoes – extremely difficult.

Larger plants, which have much larger nutrient and energy requirements generally need systems in which the availability of oxygen is not limited. In this case systems where roots are periodically wet and exposed to air have very good results. For example, ebb & flow and drip irrigation systems in which plants are in contact with nutrient solution and with air in an on/off manner guarantee that the large oxygen requirements of energy demanding plants will be fulfilled. In the end, you will see that plants will perform much better when their oxygen and nutrient availability is optimal. For this reason – aeroponic systems – which supply both requirements in an ideal fashion tend to give the best results for most plant types.

In your hydroponic system, ensuring a good supply of oxygen is absolutely vital. You should ensure that your hydroponic system is adequate for the plant you want to grow and you must also check that your system is always giving its maximum

oxygenation potential. In static systems you always need to check the frequency and quantity of aerators and on dynamic setups checking cultivation media drainage and irrigation frequency is key to get the best possible results. After taking into account all this you will see that paying close attention to oxygenation will eliminate many of the problems you may have, giving you a much healthier and productive hydroponic crop.

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## **Making Your Own Hydroponic Solutions – Download my Free Ebook**

Many of us have always dreamed about making our own hydroponic solutions to stop buying all those expensive solutions from the hydro fertilizer companies. Sadly, most people do not have the necessary knowledge to prepare solutions and coming up with an adequate formulation seems to be extremely difficult for almost everyone out there. As a chemist, I have the fortune of having the knowledge necessary to prepare hydroponic solutions and the initiative to teach you how to do this by yourselves in an understandable way. Through the past 6 years I have worked as a hydroponic consultant, lecturer and avid gardner and I believe this experience allows me to teach all of you how to design your own hydroponic solutions.

How do you make your own final solutions ? The first thing is to get away from the notion that doing this is extremely difficult. Certainly there are a lot of technical aspects that need to be known but I have taken them all and simplified them so that everyone can actually make their own hydroponic fertilizers with little or no practice. Within my ebook – which you can download freely at the end of this post – you will find detailed instructions on how to prepare your own

hydroponic solutions using a spreadsheet I made that makes the preparation of these solutions extremely easy.



My ebook gives you the ability to take any formulation and easily translate it into the real amounts of chemicals you need to weight in order to prepare your final hydroponic nutrient reservoirs. All the chemicals I have included within the ebook are extremely easy to find – as they are very common fertilizers- allowing you to prepare ANY formulation you may want. You can now fulfill your dreams of preparing one solution for each separate growth stage controlling the exact amount of each single nutrient you add into the solution.

What you will find here is a very easy to use solution – made by a professional in chemistry – that will help you prepare fertilizers in the most cost effective yet flexible and satisfying way there is. You will now know exactly what is inside your hydroponic formulations and you will be able to pin-point and solve any nutrient related problems that may arise within your crop. You will also be able to easily discard problems as not being nutrient related since you KNOW the exact quantities of each nutrient you are putting into the solution.

So are you ready to embark yourself in the journey for total



freedom and independence in the world of hydroponic nutrient solutions ? . Please leave any comments with any suggestions, questions or doubts you may have :o) Also if you want to share this ebook with anyone please direct them to my website so that they can download it themselves.

I have also recently made a great move forward by coding my own windows application to calculate hydroponic nutrient formulations. If you would like to learn more about this program and download it absolutely for FREE please follow the link shown below.

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**This EBOOK is NO LONGER AVAILABLE  
as it was replaced by HydroBuddy.**

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calculator app