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.

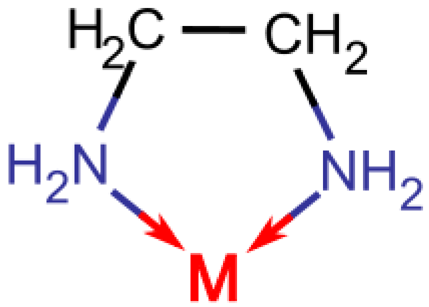
How do you end this problem ? The easiest way to end this problem is to pretreat your media before starting your crop. Place your media in a bucket and then add 1 liter of vinegar for every gallon of water. The media will attempt to neutralize the acetic acid and in doing so it will lose the proton capturing 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 scarse 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 whenver you see this behavior happening within your hydroponic crop.

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 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

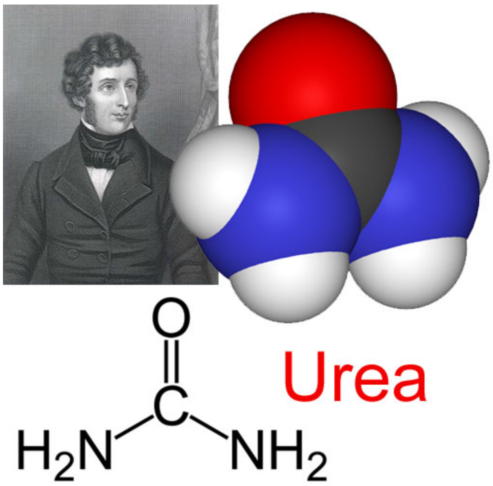
What is exactly a chelate and what are they good for ? A chelate is simply an organic molecule that “wraps” itself around a metal ion and prevents its precipitation, increasing its solubility. Chelates also diminish the amount of available metal ions to plants and therefore they slowly release the quantities 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 standarized formulation based on simple inorganic salts is to add a chelating agent.

The most common of these agents is called Ethylendiamintetraacetic Acid (EDTA), a tetraprotic acid which is able to chelate most metals with a particularly high afinity 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).

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 (NO3-) 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 additonal – 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 baggasse), inorganic (rockwoll 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 unecessary.

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.

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 tomatos, 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 partiular 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 reasearch 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.

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).

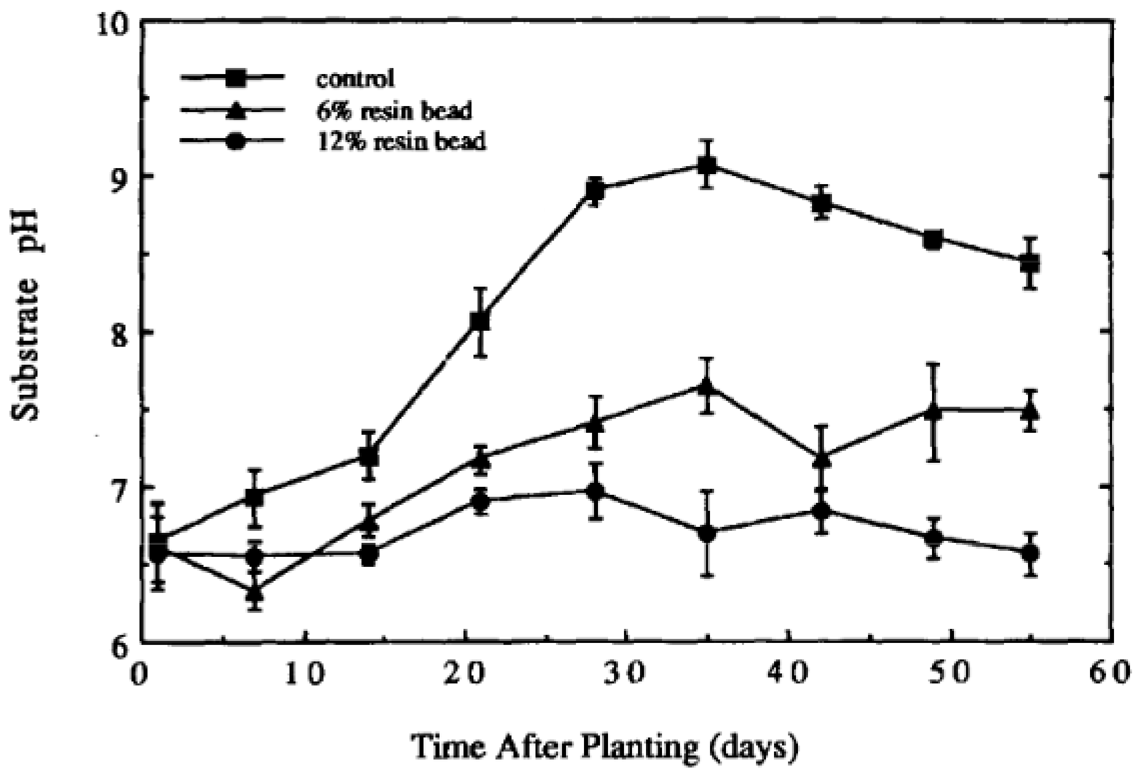

Fig. 2. Effects of cation-exchange resin beads on root-zone pH in solid-matrix hydroponic systems. Vertical bars represent SE of the mean with data combined from two experimental trials.

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!

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 aminoacids. 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 oxigen 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.

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 proffesional 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 was 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.

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

I want to learn more about your new free hydroponic calculator app

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Hydroponic Nutrients… Why Solid is Better than Liquid

One of the most important decisions you can make when buying hydroponic nutrients for your plants is the way in which the nutrients are prepared. Fertilizers for soil-less culture are available both within solid and liquid presentations and it is very likely that you have been buying the liquid once up until now since these are the most well-known and easiest to prepare. However, you may not be realizing that by buying liquid fertilizers you are putting an enormous burdden on your hydroponic growth wallet. The fact is that by buying solid hydroponic nutrients you could be saving 5 to 10 times your hydro-food costs. Within today’s post I will explain to you the difference between solid and liquid fertilizers and why buying solid nutrients is always a better choice for your hydroponic garden.

Liquid fertilizers available for hydroponics are generally prepared by dissolving an array of salts and additives in water. After these additions are done the concentrated solution is prepared and ready to be sold. When you get it the only thing you need to do is to take a given measure of volume from the liquid and poor it into your hydroponic reservoir. What you may not be realizing is that – due to the fact that salts need to be dissolved in water – there is an inherent limitation in the amount of nutrients you are getting and most of what you are buying is actually water. There is also the added cost that in order to make up a concentrated nutrient solution, compatible salts have to be used. This limits the chemicals that can be purchased and makes the cost of the fertilizer higher.

When you purchase a solid hydroponic fertilizer you simply buy a mixture of salts which you then need to weight and dissolve in a given volume of water. Since there is actually no water and the salts don’t need to be predissolved in a concentrated solution, the array of salts that can be used are a lot wider and much cheaper costs can be achieved. Added to that is the fact that packing is a lot simpler and much more efficient since the need to bottle solutions is unecessary. In the end you will see that with 2 pounds of solid nutrients you will be able to prepare more than 300 gallons of nutrient solution while you would probably need much more (about 10-30 gallons of concentrated solution) to prepare the same amount using concentrated liquid fertilizers.

You will definitely see that most hydroponic fertilizer companies are simply charging you a lot for liquid fertilizers when you could as easily be buying bulk solid fertilizers at a fraction of the cost. Premixed solid hydroponic fertilizers are also widely available commercially and easily made up with some basic chemistry concepts (more on this on a later article!). So next time you are planning to buy more hydroponic fertilizers think about cost efficiency and look for some solid premixed hydroponic nutrients which are bound to give you as good – or better – results than your previous liquid mix.

Hydroponic Solutions and Vitamins… NO real proof

It has always surprised me that vendors of hydroponic solutions have always included vitamins and other nutrients as a “boost” and “bonus” of their nutrients. It is not very rare to see a fertilizer containing vitams of the B complex, C, E, etc. When I first learned about this practice to include vitamins – as an avid hydroponic gardner and consultant – I decided to look into this and see if there was actually any positive effect or recorded evidence of the effect of adding vitamins into a nutrient solution. On today’s post I want to talk a little bit to you about my findings on the subject and the real truth behind the addition of vitamins and other “mysterious” additives into nutrient solutions.
What is a vitamin ? In order to understand the problem we first need to understand what a vitam is. These compounds are usually defined as substances which are not synthetized by an organism – usually humans – and needed in milligram or submilligram doses each day for survival. This means that vitamins are vital nutrients which are not synthetized by the human body but – unlike other chemicals – they are only needed in very small amounts. The reason for this is that vitamins are usually used only as means -not as ends – within our body’s biochemistry. So the body uses vitamins as intermediaries for a lot of biochemical processes and only a few vitamin molecules are actually damaged along the way. If a small diary intake is not made to replace the lost soldiers

your body will eventually run out of these “messengers” and you will die.

Why in the world do plants need vitamins ? The truth is that plants don’t need vitamins because they are the organisms which produce them. Consuming vitamins is vital to us – humans – because we cannot make them within our bodies. However, the vitamins we eat come naturally from plants or other organisms who have eaten plants as well. So do plants need vitamins ? No, they don’t. The question now would be : do plants benefit from the addition of vitamins to their roots and/or leaves ?
The fact is that there is simply absolutely NO scientific evidence published in a peer reviewed journal that points this out to be the case. I carried out an extensive search for any scientific literature that evaluated the effect of vitamins on plants and I came up with nothing. No one has studied this and no one has ever claimed that there is any benefit whatsoever gained from adding vitamins to nutrient solutions. Why do sellers do this then ? The fact seems to be that people buy solutions that have vitamins more, just because we have been educated to believe that vitamins are good. So if they are good for us, then maybe for our plants too.

The truth is that whatever benefit is gained from adding vitamins is not documented or accurately studied by an unbiased third party so up until now there is no scientific evidence to prove that vitamins do anything more than add to the price tag of whatever hydroponic nutrient you are getting. The fact is that as many other substances, vitamins may just be used – either by microorganisms within the solution that cannot produce them – or they may simply decompose as oxygen reacts with them. So next time you are going to buy your nutrients you should ask yourself… Is there really any benefit to this additive ?

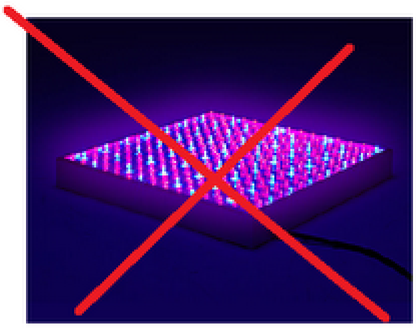
Choosing a LED Grow Light for your Hydroponic Crop

One of the most common problems faced by urban gardeners who want to deal with hydroponic crops is lack of light. Generally plants need very large amounts of light to grow which can only be given by very powerful and expensive lamps which also have the big draw back of consuming large amounts of power. The solution – now readily available – is to buy light emitting diode (LED) lamps to deal with a very efficient yet low consuming light source for your plants. On today's post I want to talk to you about how you can choose your light emitting diode lamp for hydroponic growth and what lamps you should definitely avoid if you don't want your crop not to be a total failure.

So what is so expensive about current lamps and so great about LEDS ? Currently the traditional way to supply artifical light to crops has been the use of full spectrum lamps which can be either tungsten metal halide or high pressure sodium (although sodium lamps have a much narrower spectrum). These lamps are very inefficient – wasting most of the power given to them as heat – and therefore consume great amounts of power. A high pressure sodium lamp (HPS) needs to consume about 400-700W to be able to sustain an average tomato plant. The truth is that most of this energy is wasted as heat and almost none of it (around 20-40W of light) are actually absorbed by the plant.

Here is when LEDS come to save the day. Light emitting diodes are very efficient in generating light from electricity (wasting only a small fraction of the energy as heat) and they also provide light in very narrow ranges which can be tuned to only supply the wavelengths needed by plants. The reason why plants are green is because their main photosensitive pigment is chlorophyll (there are several types by the way), a pigment that absorbs red and blue wavelengths and reflects green. With this in mind – not only are LEDS able to supply your hydroponic plants witha higher efficiency – but they are also able to provide your plant with only the colors of light it needs. Achieving a double gain in efficiency. As a matter of fact, a LED lamp with just 60W is enough to grow a tomato plant.

However, not all LEDS are created equal. Many people think that all LED lamps are the same and they end up buying cheap LED lamps or panels that simply do not provide plants with the energy they need to grow. There are generally two kinds of LEDS available for lamps. The first kind – low power LEDS – are the type of lights used to make your computer and keyboard lights. These lights are weak and they are usually sold in the forms of panels with HUNDREDS to make them appear "useful" for hydroponic growth. The second – high power LEDS – are lights used for traffic lights and high power applications and they ARE the type you need for hydroponic growth.



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In general, when you are looking to replace your TMH or HPS lamps with LEDs you need to look for high power LED lamps in the range of 50-100W for each 400W lamp you want to replace. You also need to look at the red to blue light ratio since different plant varieties need different proportions of light. If you are growing plants that need to have flowers then you will need to aim for a red to blue ratio of about 8:2 while plants that do not produce flowers may grow well with only red lights. This is – of course – a very course guide to the light color ratio but it may guide you well when you are looking for lamps for a certain crop.

With this small guide and knowledge you will be able to eliminate most lamps that do not work and buy high power LED lamps that will deliver and provide you with a much more efficient, cooler and more eco-friendly way to provide your hydroponic crop with artificial light.