Hydroponic Nutrient Availability : What “Pushing Out an Element” Really Means

Plants need a very large variety of elements in order to grow successfully. In hydroponic crops we intend to provide all these elements in their different forms dissolved within our nutrient solutions. However the mechanisms by which plants absorb these elements is complex and there are many different factors that determine which elements are absorbed and which elements are not. On today’s post I will write a little bit about the problem of nutrient availability, what factors determine how ions are absorbed and what does it mean to “push an element out” when talking about a hydroponic system. First we will talk about the nature of the elements dissolved in hydroponics solutions followed by the importance of environmental conditions and nutrient interactions that finally determine the actual availability of nutrients for plant growth.

The first important thing we need to understand is that plants can absorb many different forms of the elements we need to provide and that these elements are not absorbed in their pure state but forming ionic entities dissolved within our solutions. For example nitrogen is absorbed by plants as the NO3(-) ion (nitrate) or as the NH4(+) ion (ammonium), both of these ions supply the plant with nitrogen but their overall effect is different and the ratio of their concentration has an important effect on plant growth and development. The second thing we need to understand is that plants can only absorb things that are dissolved in solution and that plants cannot absorb materials that are above a certain size. Although studies have shown that plants can take large particulate aggregates (such as polyoxometalates) it is true that large bulk solid materials of a few microns in diameter

are already beyond the cellular absorption capacity of most plants. In order for something to get into a plant it needs to be dissolved in water, it needs to form the ionic entities which are assimilable by the plants.

The third and also probably least understood aspect of nutrient absorption is that the chemistry that leads to the entering of a nutrient within the plant cells must be favorable. What this means is that different conditions must be met so that plants can get their nutrients. There are many things that can cause this process to fail which may not be related with the nutrient itself but with the presence or absence of another nutrient. In plants there is an agonist/antagonist relationship between the different ionic species such that the excess or absence of one specie affects the absorption of another. For example iron is absorbed by plants as either Fe(2+) or Fe(3+) while phosphorous is generally absorbed as H2PO4(-) or HPO4(2-), when there is an excess of phosphate species the formation of iron-phosphate crystals can happen within the plant's nutrient transport system causing what seems to appear as an iron deficiency. The problem is not caused by a lack of iron but by an excess of phosphate that hinders the mechanisms of absorption. Increasing iron concentration when this happens merely makes the problem worse as when phosphate concentrations lower an excessive iron concentration – now causing iron toxicity – is present.

The key to have a healthy plant with adequate absorption of nutrients is therefore to make all the necessary above mentioned conditions adequate. The first thing we need to do is guarantee that the nutrients we provide are in the adequate form (ionic species) and the second is that the conditions are adequate so that these species do not change but instead are absorbed. This leads us to the problem of "nutrient push-out" which is mentioned a lot within the hydroponic community.

There are several environmental conditions that can cause the assimilable ionic forms of nutrients to change to something else therefore being “pushed out” of a solution. For example if you have high carbonate ion concentrations within your water the addition of your hydroponic nutrients can cause iron carbonate precipitation. This means that the previously dissolved iron (available as Fe(2+)) now becomes bound to carbonate ions forming a solid (FeCO3). This solid is very stable and hence doesn’t form aqueous ions but instead stays undissolved in the bottom of your nutrient solution. Other things such as an increase in pH (which precipitates metal oxides like Fe(OH)2) can also dramatically affect nutrient availability.

Many people tend to believe that calcium and sulfate precipitate easily but a careful analysis of the solubility behavior of calcium sulfate reveals that you would need a concentration of sulfur as sulfate of more than 400 ppm before any precipitation actually happens. In most cases precipitation can happen if concentrated solutions are mixed too quickly one after another – without adequate dissolution – or if a mix of solid nutrients is added to the reservoir. However this precipitate formed is often later dissolved with time as the aqueous solution reaches equilibrium.

In general when people refer to an element being “pushed out” they talk about the element being made unavailable to the plant through some mechanism generally involving the formation of a stable solid that cannot be used by the plants. The solid “drops out” of the hydroponic solution and therefore the term “pushed out” was born as a way to refer to this phenomena. Nonetheless it is always important to remember that other things can cause elements to become unavailable, such as temperature and the concentration level of other elements. In hydroponics we are dealing with a very complex interaction between ions and plants and our main goal is to keep the different nutrients balanced in such a way that most

interactions are beneficial. Keeping an eye on temperature, pH, nutrient ratios and water quality is vital to achieve this desirable outcome.

Preserving Fertilizers and Additives – How to Keep them from Going Bad

When you prepare your own hydroponic nutrient solutions and you are finally happy with the way in which you have been mixing your nutrients and additives you start to notice that something murky is starting to develop from the top of your container. When you open up your nutrients or additives you then find a very happy fungi colony living in perfect harmony with your nutrients, eating away all the useful things you added and filling your solution with possibly toxic substances that will likely affect your plants later on. When microorganisms develop within nutrient solutions you are done, you need to dump them and start over since the living things that lived within them might have damaged, changed or added substances to your solution that you do not want in your reservoir. How do we prevent this problem ? What magic substances can we add to preserve our nutrients and additives ? On today’s post I will talk about how nutrient solutions and additives (especially those with sugars) are damaged, why this happens and how you can add some little harmless substances to fight these horrible plagues.

Nutrient solutions are made for plants so you could in fact assume that there is nothing that can grow within them that is not a photosynthetic organism. Most of the time you will be

right – especially for solutions with no chelates – since the nutrients are not useful from an energetic standpoint to other organisms such as bacteria and fungi. However one day you open up a concentrated solution and find out a large mass of a gooey substance living within it, what went wrong ? The most common explanation to this problem is that your nutrient solution contains a chelating agent – such as EDDHA, EDTA or DTPA – which are organic molecules that wrap themselves around ions. Since these organic molecules contain carbon-carbon and carbon-hydrogen bonds they are indeed energetically useful for living organisms, especially to some fungi that love to eat chelates and -as a matter of fact – enjoy them better when they are within a soup of highly concentrated iron and other metallic ions.



The second case is even worse which is when you develop an additive that has some very enjoyable food – like some sugar – within it. When you dissolve glucose or other carbohydrates within water you are providing the most useful and delicious meal for any microscopic organism. Fungi, bacteria and protozoa will feed from this solution to the point where it will become filled and vibrant with life. Preparing a sugar additive is like putting a piece of cake next to an ant hill, it would be wishful thinking to believe that it will remain intact. The same thing happens when you develop buffers with organic molecules – such as MES or citric acid – or other types of additives that use amino acids, vitamins, etc. If it has carbon-carbon and carbon-hydrogen bonds some little thing is going to creep inside your bottle and have a feast. Only the air that gets trapped inside the bottle when you prepare the solution already contains a ton of fungi spores, bacteria, etc.

How do we prevent this from happening ? Well thanks to the developments the food industry has had during the past century

we are able to add a little of a few substances that will absolutely prevent the development of any of those nasty things within our solutions. These magic substances that make food remain edible after long periods of time – which can also aid you to save your solutions – are called preservatives and they are cheap and harmless substances when used at the right concentrations. The large majority are approved for their use in the food industry – probably they are contained in everything you eat at the supermarket – and therefore they are perfectly safe to use within your hydroponic crops.

To make things simple you can just add a single substance that will prevent – for a long period of time – the development of nasty organisms within your hydroponic concentrated solutions and additives. This substance is used by most commercial hydroponic solution sellers but it is almost never listed as they are not required to do so by law since the substance is considered generally safe and its disclosure is not necessary when the products used are not intended for human consumption. This substance is called sodium benzoate, a substance derived from benzoic acid which has the magic power to keep nasty organisms away from your hydroponic solutions and additives.

How much do you need to add ? Not that much ! Only 100-300 mg/L of sodium benzoate within your concentrated solutions or additives should keep away most fungi and bacteria, allowing you to use your solutions for more extended periods of time without those nasty organisms having a party with your nutrients. However you need to make sure that your concentration remains below 400 mg/L and that your solution uses a 1:100 or higher concentration rate since the concentration of benzoic acid within the final hydroponic solution must remain below 25*10^-6 M in order to prevent phytotoxic effects. Hopefully with this advice you will now be able to prepare many additives and solutions without having to worry about your liquid preparations going bad a few days after you prepare them :o)

A Step Forward : Moving from AllHydroponics to ScienceinHydroponics.com

Through the past few weeks I have been meditating about the current limitations of the blogger platform and how it makes my writing and customization options smaller and the look of my blog less professional. Due to the fact that I intend to start writing more and expanding this blog it becomes evident that I will need a much more powerful blog hosting platform and blogger seems to be limiting instead of helping my efforts in this regards. For this reason I have taken the decision to move my blog from its current blogspot home to a new self-hosted domain which I will use from now on to post new articles and releases of hydrobuddy.

This new website – scienceinhydroponics.com – will be the new home of my blogging effort in the area of hydroponic crop production and research. I will stop posting new articles on blogger and the old blogger website will start redirecting to the new wordpress based blog today. The idea of this new blog is to allow me to customize my website as much as I want and to be able to exploit the full potential of my web presence through the use of a self-hosted domain. In the future I hope that this move forward will make my content more professional and my efforts more worth-while. Future versions of hydrobuddy will now be released and maintained on the new wordpress blog and the previous blogger implementation will not be maintained anymore.

Of course if you have linked to my old blog the pages will not be deleted but they will cause automatic redirection towards

my new domain. However the RSS feed will stop being updated so feel free to subscribe through my new blog's RSS feed (links available on the top right corner of the blog). There are also now several buttons you can use in the bottom of each page to share the contents of the posts on facebook, twitter, etc and a Printer friendly function that will allow you to easily print my blog's contents without any of the menus, etc. I hope that you will greatly enjoy this new blog which is a milestone achievement for me and the start of a new era for me as a much more professional blogger :o)

Feel free to leave any comments or suggestions ! :o)

Making Isotonic Solutions For Draining : Preparing Your Own – and better – Clearex

When growing hydroponic products it is common in the industry to do a final treatment before picking up the crop in which nutrients are removed from the hydroponic solutions. While in most cases this is achieved by passing RO water through the system it is true that passing water with a very low osmotic pressure can make the plants absorb larger amounts of water than what we would ideally want, disturbing the osmotic equilibrium established by the roots with the nutrient solution. An approach that has been used to solve this problem is the use of isotonic cleaning solutions – such as Clearex – which drain the hydroponic media from nutrients without subjecting the roots to the stress of an hypo-tonic solution (such as RO or distilled water).

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On today's article I will teach you what the Clearex solution is supposed to achieve and how you can make your own (or even

a better) solution to solve this final draining problem. First of all, removing nutrient from a hydroponic solutions is not so hard. Simply by running RO water through your system after draining the original solution you will remove most nutrients since these salts – contrary to what some companies tell you – are readily soluble and easily leave the media and roots when washed with RO water. The small problem when using RO water is that it is hypo-tonic with the roots, meaning that water will go into the roots to attempt to "lower" the concentration of the solutes within the plant's cells.

Depending on what you want to achieve with this final draining solution you may have a problem when using such an hypo-tonic solution. In crops where there is fruit production, using such a solution can cause problems such as the rupture of fruits' skin due to the higher rate of water absorption that takes place when plants are placed in a hypo-tonic media. In order to avoid these problems the best thing is to use an isotonic solution which has an osmotic pressure similar to the original nutrient solution.
Clearex achieves this simply by combining a few sugars to a concentration of about 4-6% in order to get to the point where the osmotic pressure of both solutions is similar. Getting regular table sugar an dissolving it in a ratio of 50g per liter of solution will achieve very similar results as those obtained with Clearex. However using sugars like this can have additional problems since sugars stimulate the development of fungi and bacteria within the root zones of the hydroponic plants.

In my opinion it would be possible to achieve better results by using an isotonic solution with a combination of salts and sugars in such a way that non-nutrient salts are used to provide an ionic content to the draining solution. Using a combination of NaCl, Sucrose and Sodium Hydrogen Carbonate to achieve a more balanced solution may provide better results when doing this type of draining procedures. Of course, this is based purely on my anecdotal evidence and an adequately

controlled study would be needed to say anything conclusive for a particular plant specie.

In the end making these solutions is extremely simple and buying Clearex or such other solutions made for this purpose is an obvious waste of money. If you have obtained good results with solutions like these then you can simply make your own with simple sugars while it is possible that you could obtain results just as good as those by using RO water if your crop is not sensitive to hypo-tonic conditions. If you want to experiment a bit I would recommend using a solution with about 150 mg/L NaCl, 100 mg/L $NaHCO_3$ (sodium bicarbonate) and 10g/L of glucose. Let me know if you get better, worse or similar results :o) **(note that this is NOT a straight solution but a concentrated additive that should be used until the desired EC levels are reached)**

Imitating Commercial Nutrients : A Tutorial Using HydroBuddy (my free Hydroponic Nutrient Calculator)

A few months after the first official release of my free hydroponic nutrient calculator it seems that many people are using it to imitate commercial hydroponic fertilizer formulations. Although the calculator had the capacity to do this from the time when the "salts to formulations" feature was implemented many users apparently did not know how to use this very well and the process seemed to be more extensive

than what would be ideally necessary to get the end ppm concentration values of some commercial fertilizer formulations. In order to make the process far easier I decided to implement a new feature within the calculator that allows anyone to easily input the guaranteed analysis of any commercial fertilizer, the density, the amount of mL or grams added per Liter or gallon and get the end ppm values which can now be used as a recipe in order to come up with a personal formulation that exactly mimics this end result.



This new feature – as shown above- is accessible through a button in the "Desired Formulation" tab. This button is located between the water quality and instrument precision buttons, just below the "preparation type" dialogue box. When this button is clicked a new window pops up in which the user can input the percentage composition of the commercial fertilizer he/she wishes to imitate as well as the manner in which this commercial fertilizer is supposed to be added in order to arrive at the final concentrations intended by the manufacturer.
For liquid fertilizers the maker usually gives you a volume measure to add per gallon or liter which should be expressed as mL per gallon or liter (you can choose if you want to specify the quantity added per gallon or liter using the radio buttons for this purpose). In the case of solid fertilizers the label usually tells you to add a given number of grams or ounces per liter or gallon. You can choose between specifying a given volume and density or a given weight by using the "Addition as weight" or "Addition as volume" radio buttons located at the top right of the new window.

Once you input these parameters you are now ready to get the intended end result for this commercial fertilizer by using the "Calculate Formulation" button. When you click this button the program will automatically calculate the end concentrations which result from adding the amount of the commercial nutrients you specified with the composition you also specified. These values are automatically copied to the

“Desired Final Formulation” column and they can now be used to imitate the commercial formulation. You can now select a given number of salts you have available and use the regular preparation types in order to come up with a direct addition or 1:100 concentrated solution which will match up the end concentration results achieved with the commercial fertilizer you input.



Of course, this will NOT guarantee a perfect copy of the commercial fertilizer since many of the ingredients a commercial fertilizer may contain may not be listed or they can be listed but their actual concentration levels may not be specified. For example you will find that many commercial nutrients contain Boron but their guaranteed analysis does not show it. This is mainly because the law does not require them to include boron in their analysis and therefore they will add it but they will not disclose its actual concentration or sometimes even its presence. Several other additives or nutrients may receive similar treatment so for this reason it is always good to make up A and B concentrated solutions or direct additions which include ALL elements necessary for plant growth.

Do you find this feature useful ? Is there any feature that you would like to see implemented in hydrobuddy ? Feel free to leave a comment with any opinion or suggestion you may have :o)

Bulding a World Without

Hunger : The Massive and Passive Hydroponic System Project

If you have visited my blog within the past few days you have probably realized that I am interested in the further development and use of non-recirculating, totally passive hydroponic systems which are extremely easy to use and require no electricity or high setup costs. These systems are very important due to the fact that if made cheap and reliable enough they could vastly reduce the costs and water usage of agricultural crops around the world, making food cheaper, much more widely available, giving people in third world countries independence over the conditions of their soil allowing the cultivation of a wide variety of crops in areas where it was previously simply not possible.
However the fact is that currently the knowledge we posses about totally passive systems and the reliability of such implementations (and more importantly their robustness) has not been studied widely enough. For this reason I decided to start a project called the Massive and Passive Hydroponic Project or MPHP which is my attempt to use the internet – and most importantly the people who are interested in hydroponic around the world – to research this topic and get experimental results over different parts of the world, with different conditions and with totally different plant species.
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Certainly many people will think that the information obtained in this way will have a ton of variability and therefore little value to further research on this field. On the contrary, I believe that – although such variability does exist – it could bring us very important and relevant information regarding the robustness and implementation easiness of such systems all around the world. Surely if these type of systems are to become good enough to replace a significant part of an agricultural setup they will need to be very robust and adapted against a wide variety of different

conditions. This is what I want to find out with this project. So if you want to help the world, help us gather information and build your own totally passive hydroponic crop, feel free to participate in the MPHP so that you can help us establish the robustness, production and conditions under which totally passive hydroponic systems can be implemented with success. If you want to participate just download the below mentioned document and send me an email to dfernandezp(at)unal.edu.co or leave a comment on this post. By following the instructions within the pdf and gathering information you will help build a better world and you will definitely learn a lot about passive hydroponic gardening :o)

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Completely Passive, Non-Recirculating Hydroponic Systems : Some Tips for Large Plants

On yesterday’s post I talked about the existence of completely passive, non-recirculating hydroponic systems and how they can be successfully used for the growth of almost any hydroponic crop you can imagine. Following on this post’s idea today I want to share with you some tips to use this type of system with larger plants so that you can effectively setup your own hydroponic passive farm with the least amount of effort and chance of failure. On today’s post I will talk about the media and system characteristics for the raising of large plants, particularly plants like tomatoes, cucumbers and bell peppers which require large amounts of oxygen, nutrients and solid media support.

If you read the previous post you might remember that when using large plants -like the ones mentioned above – the best thing is to use a media filled container in which the nutrient solution is first close to the surface and then slowly gets used and evaporates from the nutrient solution. However it is also important here to say that there are some specific requirements for the media and some important changes that can be made to guarantee that success will be much more likely to happen.

The solid media used is better divided in two, the first media is a highly absorbent, capillary efficient media (like rice husk combined with sand 1:1) which is put in a small cup or container while the second media is a non-absorbent very capillary deficient media like gravel which is used to occupy the rest of the available space. Other coarse media can also be used to fill the rest of the container like vermiculite or other types of rocks. The important thing here is that the whole media must NOT be efficient at capillary absorption because this will make the whole media wet all the time and it will drown the roots since the “air space” will be non-existent.



You can follow the diagram above to build a system for a large plant. Note that the container for a large cucumber or tomato plant must be at least 5 gallons and solution needs to be added at a rate of about 1 gallon a month through the crops full life. Note that inserting a small PVC pipe to control volume within the container is always a good idea since you don’t want to put so much solution to drown the roots and make the plant die. Mature tomato plants require a space of at least 50cm of air roots when they are older for their proper development so make sure the container you use is about 70-100 cm tall when you build your system.

Hopefully with this advice you will be able to start your

first passive large-plant hydroponic garden without using any electricity. Also remember that this setup requires absolutely no EC or pH adjustments since once added the solution won't be able to be modified. This however does not cause any problems since the plants adapt to the solution and pH levels acquired. You can also increase the EC or change the nutrient ratios depending on the plant's stage when you perform the monthly nutrient solution additions to your plant's personal reservoir. Please feel free to leave any comments with your experiences with this technique !

Completely Passive, Non-Recirculating Hydroponic Systems : Yes, Its Possible

Generally when we think about growing plants hydroponically we think about complex setups with water pumps, air pumps, artificial lights, environmental control and greenhouses. However, it has been shown through many controlled experiments and experiences that hydroponics can be made in a much less fancy way, so simple in fact that pumps and other such appliances that consume electricity can be effectively and totally eliminated from the growing system without the need to lose a significant amount of crop quality or yield. On today's article I want to discuss some of these extremely simple setups and how you too can effectively and efficiently grow a hydroponic crop with low cost and absolutely no usage of electrical power.

Traditionally hydroponic systems – especially in developed countries – have been extremely dependent on electricity to make them work properly. Water pumps are used to carry fresh nutrient solution towards the plants and air pumps are used to keep the nutrient solution saturated with oxygen. However the

truth is that such complicated setups are actually NOT necessary for successful hydroponic growth if adequate system design is actually made. People in less developed areas of the world such as South America, China and India have been experimenting with completely passive hydroponic setups to replace the more traditional energy intensive hydroponic growth and they have done tremendous progress to achieve this goal.
Many of you are probably already thinking about all the possible problems this might have. You might be thinking that this might work for small plants – like lettuce and some herbs – but never for nutrient hungry plants such as tomatoes, pumpkins, watermelons, etc. The fact is that these entirely passive non-recirculating systems work for ALL of these plants, providing adequate growing conditions and high yields typical of hydroponic systems. Right now it is not a matter of opinion or discussion if it can be done as MANY studies and controlled experiments already show this is a reality. You can see some clear examples here, here and here.

The questions now becomes, how is this possible and how can you do it ? The answers are pretty simple. Passive hydroponics without any electricity can be done for large or small plants given that the following conditions are met :

- Enough space for roots is available
- Enough nutrient solution is available for all the crop's life (or it is replenished)
- Enough oxygen is available for the plant's roots

If this three conditions are met you will be able to build a passive hydroponic growing system that needs NO air or water pumps to give a good yield. How can you make such a system ? The systems that have given the best results up until now are those that follow a very simple design scheme. The plant is put in an absorbent nutrient media and placed to float or stand just above the initial nutrient solution level. The level of nutrient solution slowly falls down in the beginning (due to evaporation) and then quickly as the plants start to

absorb water and nutrients. As the level of nutrient solution lowers the plant roots become exposed to layers of air from which they can absorb oxygen, allowing them to effectively absorb nutrients from the below stagnant solution without those roots dying.
Most people believe that if roots are submerged in an unaearated solution they will die but this is only true if the whole root system is submerged. If a good part of the system is given an “air buffer” from which to absorb oxygen and this space remains humid, the result is a system that can absorb nutrients from the unaerated solution and oxygen from the air buffer zone. This has in fact been shown to work in many cases (you can follow the links mentioned before for some examples).
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For big plants such as cucumbers and tomatoes you would want to use a container filled with solid media to support the whole plant with the initial nutrient level being just a few inches below the surface while for smaller crops a “fixed top” idea might work much better. In the above image you can see both systems and how they evolve as the crops grow. For larger crops you might also want to replenish some solution every month so that the crops can get all the water and minerals they need if the actual container is not large enough to hold all the water the plant would use through its whole life cycle.

Without a doubt passive hydroponic systems like these ones will become extremely important in future world agriculture (especially in developing countries) since they are able to give us many of the wonderful advantages of hydroponics without the problem of complex electronic equipment, water, air pumps or an inherent dependency in the electric grid (which is not available everywhere in rural third world countries). Hopefully this information will also be useful for those looking to establish some passive and effortless hydroponic gardens to have fresh crops year round :o).

Improving Seed Germination : The Science of Seed Priming

When we want to produce large amounts of plants or simply when we want to start our gardens fast and get the most out of our purchases improving seed germination becomes a large priority. One of the largest concerns of world agriculture as well as the home grower is the decrease in germination time and increase in germination percentage since both of these factors can bring great benefits. Some seeds – especially some flowers and herbs – are often quite difficult to germinate and using certain techniques to increase the rate and speed in which they sprout has been the focus of a large amount of scientific research. On today's article I will be discussing the use of priming to decrease germination time, especially what priming is, what types are available and which ones you can use to decrease the germination time of those very difficult seeds.

To understand the concept of priming we first need a good grasp at the general concept of seed germination. A seed is a dormant embryo which carries within it the potential for a new plant's life. The seed is alive, yet has a very slow metabolic rate due to the low mobility of substances within the embryo's cells. This low metabolic rate allows the seed to remain alive, yet survive extremely long periods of time (some seeds can survive even hundreds of years) before actually sprouting into new plants.

Germination – which is the process in which we awaken the embryo – increases seed metabolism and toggles the massive reproduction that causes a new plant to grow. The main mechanism that triggers this process is simply liquid water. When water gets into the embryo and hydrates its cells, it speeds up metabolism and allows the process of cell division and growth to rapidly increase. However it is not always this simple to start this process since several impairments – both chemical and physical – can exist for successful germination.

Priming is simply a process done prior to conventional seed germination which allows the inhibiting mechanism to be broken and the metabolic speed increase to begin. There are several types of priming that can be done. A seed can be submerged in simple water (hydropriming), it can be soaked in a solution of a simple salt (halopriming) or it can be set in a non-ionic solution with high osmotic pressure (osmopriming). It is not entirely well established why one technique might work better than another but certainly some species tend to respond much more efficiently to one or another.



In general, priming offers the opportunity to almost always germinate seeds at much higher speeds without detrimental effects in germination percentages. For example, a two day treatment of parsley seeds with a PEG 6000 (PolyEthyleneGlycol) solution can reduce germination times substantially, from a few weeks to just a few days. Other seeds such as coriander might also benefit from similar treatments with PEG or with treatments with NaCl solutions. In general if you are looking to test priming on some difficult seeds you own you can try three small experiments to know which one works best for your particular seed variety and germination conditions. Do one experiment in which the seeds are simply soaked in water for 24 hours, another in which seeds are placed in a 200mg/L NaCl solution and another one in which the plants are submerged in a PEG 6000 20% solution, then let the seeds air-dry after the treatments. After comparing the results of these experiments with a control with no priming you will be able to see which priming technique is better for you and most effectively increases your seed germination rates.

To sum it up priming your seeds is a very efficient technique to increase the speed of germination without sacrificing germination rates. This methods are not very useful for seeds such as lettuce or tomato – which germinate easily – but they

are invaluable for plants such as parsley, coriander or carrots which are generally much harder to germinate. If you have some seeds that have been giving you a hard time or seem to take ages to germinate then setting up some priming experiments might be the best thing to do.

My Hydroponics Calculator : Features and Objectives

For those of you interested in the preparation of your own hydroponic nutrient solutions, my hydroponic nutrient calculator should prove to be a very useful (hopefully invaluable !) tool to complete this endeavor. Within the following paragraphs I want to talk to you about the main objectives and uses of my calculator as well as some of the confusions that arises when people new to hydroponics and the chemistry of nutrient solutions starts to use it. After reading this you will be able to know precisely what my calculator does, how it can be useful to you and what the calculator simply doesn’t do.

My hydroponics nutrient calculator (hydrobuddy, which you can get here) is a tool designed to aid people to prepare their own hydroponic nutrient solutions in a straightforward and easy manner. The idea of the calculator is to make all the mathematical calculations needed to go from a desired formulation composition to a given weigh of a fertilizer salt much easier than how it usually is with excel spreadsheets or manual calculations. Hydrobuddy therefore allows a person to know exactly how the addition of a given salt affects the concentration of a certain number of elements within a hydroponics solution, allowing the user to select and use the salts that precisely fit his/her desired formulation.

The main function of hydrobuddy is to take a given formulation specifying the concentration of all the giving nutrients as

ppm and translate it into the necessary weights of salts or fertilizers needed to achieve these concentrations. It is however important here to note that these ppm values have NOTHING to do with the ppm values read by your EC meter. The values an EC meter reads as ppm are TDS or salinity measurements that correspond to the concentration of a sodium chloride solution of equivalent conductivity. This measurement has nothing to do with the ppm values used to specify the concentrations of the different nutrients within a solution.

Hydrobuddy also allows you to do some other very interesting things such as the calculation of salt weights for concentrated (1:100) stock solutions and the use of the "straight addition" method that allows you to calculate the weights of salts you need to add directly to a reservoir to arrive at certain concentration levels. Hydrobuddy also contains a "salt to formulation" feature which allows you to input a given weight of a salt or fertilizer and obtain the ppm values you would arrive to within your solution. This should be especially helpful for those of you looking to use hydrobuddy as a way to calculate the concentrations you get when you using specific weights of commercial fertilzers; it is also great if you want to manually tweak your calculation results if the calculator doesn't give you the salt proportions you desire.

The calculator also has a "nutrient log" feature that allows you to keep a record of how your hydroponic solution evolves, warning you when it is time to change solutions in recirculating systems or when pH swings are too wild. Hydrobuddy also allows you to use the "run to waste" option to login the pH and EC in-out measurements of your system to keep a record of how it evolves as a function of time. The nutrient log allows you to plot the evolution of your hydroponics system and quickly realize and correct any problems that might be happening.

If your water is very hard or if you have other problems such as high nitrate concentrations, hydrobuddy allows you to input your water quality parameters by pressing the “water quality” button, letting you take into account the hardness and quality of your water when preparing hydroponic solutions.

As you see my hydroponic calculator allows you to do many things easily which would definitely take a long time to do if done manually or with excel spreadsheets. The calculator allows you to quickly change formulations, used salts, custom fertilizers, etc without having to do a lot of effort. The checklist interface and the ability to save and load formulations makes the program ideal for those of you who do a lot of hydroponic growing with custom solutions but don’t want to go through all the math or spreadsheet changes every time the formulation needs or when some nutrient sources need to be changes.