Walking Towards v.1.0 : Why Development of HydroBuddy is Taking Its Time

If you had been following my development of the free HydroBuddy nutrient calculator your probably have wondered why development seems to have “stopped” during the past few months. The truth is that beyond the fact that I have been quite busy – with my other occupations – I have actually decided to implement some very large changes to HydroBuddy before version 1.0 comes out. On today’s post I will take some time to discuss the changes I will be implementing and what these changes will bring when v.1.0 finally comes out, probably in January-February 2011. I will talk about the current problems on the calculator and what solutions I am working on.

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HydroBuddy is currently a stand-alone free hydroponic nutrient calculator which anyone can use. It is a simple tool for the calculation of nutrient weights or the reverse-engineering of commercial nutrient solution allowing users to perform a ton of analysis without too many complications. However the software does have a few problems which I believe need to be solved if HydroBuddy is to become the most complete and BEST hydroponic nutrient calculator online (even when compared amongst commercial ones).

The first big problems that come from HydroBuddy lies within its software implementation. The program was built within Delphi 2010, reason why compatibility with other operating systems is minimal (if available at all). For this reason I have decided to port the whole program into Lazarus, allowing me to get full Linux and Mac versions released from v1.0 onwards without any further problems.

The second – and perhaps the biggest problem – in HydroBuddy, is the way in which the calculations and database were implemented. HydroBuddy doesn't use a formal database but a series of arrays which it uses to calculate/store the solutions to the problems its presented with. The new version will include a proper database engine which will allow us to greatly expand the scope of HydroBuddy, this will also allow me to solve another problem which makes HydroBuddy "miss" some solutions if combinations of certain salts are used. By implementing a proper database and powerful linear equation solvers the new version of HydroBuddy will be much more powerful and good enough to become a standard for not only hobby but many scientific applications.

As you see, the above changes require me to practically reimplement the whole program but certainly they are worth making since they will make HydroBuddy's core much more robust than with its current implementations. With this HydroBuddy will be able to easily store much more data, solve problems much more accurately and become much more "user friendly". It will certainly take me some time – as I only do this development when I have free time – but it will definitely pay off in the end as it will be a free solution for anyone looking for a software package to help them calculate their nutrient solutions.

In the meantime feel free to use the v0.98 of HydroBuddy which already solves many of the problems of nutrient solution making and allows anyone to prepare their own hydroponic solutions without having to perform any manual calculations :o) Thank you very much for all your support and interest !

Instrument Precision : Its Importance in the Preparation of Hydroponic Nutrient Solutions

One of the most overlooked aspects when preparing hydroponic nutrient solutions is the actual precision of the instruments used to measure the salt or liquid reagent additions. People who are not familiarized with the preparation of solutions usually underestimate the importance of this aspect of solution making – both concentrated and final – which is absolutely vital for the accurate and reliable preparation of solutions. On today’s post I will attempt to explain the concept of instrument precision, the errors caused by this fact and how they are calculated by HydroBuddy to give us an idea of how dependent our calculations are upon our instruments. After reading this article you will be able to know if the instruments you are using for your solution preparation needs are adequate or what you need to do in order to ensure that the preparation of your solutions remains reasonably accurate.

What is instrument precision ? This point is best illustrated by a practical example. Imagine that you are using a ruler to measure the length of a simple pencil. A common ruler (in metric units) generally has large divisions (in centimeters) and smaller divisions (in millimeters), when you measure the pencil you will note that the length of the pencil will be between two of the finest divisions – or very close to one – but you will not be able to determine the measurement beyond this accuracy. For example if the measurement of the pencil is between the 2.3cm and the 2.4 cm line you can say that the pencil measures 2.35 +/- 0.05cm this means that we can be absolutely sure that the pencil has a measurement between 2.3 and 2.4 cm but our instrument does not allow us to "see" any further. In this example the three digits of the measurement are called "significant figures" while the last one is called the "measure of uncertainty" since it is a value we can only be certain about within a certain threshold.

When you measure your hydroponic solutions you need to use instruments to weight your salts or liquid fertilizers and you also need to measure the volume of your solutions (either concentrated or final). When you weight your salts your scale will have some uncertainty (usually represented as the point value of the last digit) so for example if your scale displays a weight for a salt of 5.50g the actual measurement is 5.50+/- 0.01g as – in analogy with the pencil example – the scale cannot determine the latest digit beyond a certain threshold. The problem with this is that if your salt's weight is in the vicinity of the scales last digit your uncertainty will be a big magnitude of what you want to weight. For example, if you want to weight 0.05g of a salt with the above scale the uncertainty of instrument will be +/- 0.01g so you will effectively have an instrumental error of +/- 20% of the salt's mass, meaning that your final concentration will probably be VERY deviated from what you intend to measure.

Another important factor is the precision of your volume measuring gear since errors add up as you continue the preparation. If you can measure the volume of your reservoir with a precision of +/- 1L the you need to prepare at least 100L such that the error you get from the measurement of your nutrient solution's volume is not greater than 1%, however if you are preparing a concentrated nutrient solution (for 10L for example) you will need to use a more precise method of measuring volume, an instrument with a precision of at least +/- 0.1L. If you are uncertain of what the precision of your volume instruments are then you need to look at their graduation, the precision of a volume measuring instrument can usually be approximated to half its finest graduation. If you are measuring volume -for a concentrate solution for example – with a cup that has a line every 100mL then your precision is +/- 50mL (or +/- 0.05L).

The above picture shows you where you can change the precision of the instruments used within HydroBuddy so that the program can calculate the error caused by your instruments in your preparation. Some people may have noted that when calculating “direct additions” there is no instrumental error while when calculating concentrated solutions there is, this is associated with the precision in volume since when straight additions are made the amount of volume that needs to be measured is MUCH higher while for concentrated solutions a much more precise volume instrument is required (depending on solution volume) since the volume is lower.

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If you get very large instrumental errors (for the calculations you are doing) then there are several things you can do to correct them. The first is to prepare large amounts of concentrated solutions since the amount of salts weight will be much larger. Preparing 20L of a concentrated solution with a 1:200 concentration factor will allow most people to weight their salts in a scale with a 0.01g precision while other solutions -such as using the direct addition methodology with concentrated micro and Fe solutions – are also possible. In the end you need to take very good care of instrumental errors and take them into account since they will determine the final accuracy of your nutrient solutions. For macro nutrients the errors shouldn’t be above 0.05% while for micro nutrients such as Mo and Cu, errors as high as 20% can be tolerated since higher precision would require the use of much higher purity salts since these elements are also possibly contained as impurities within other salts (meaning that salt purity becomes a higher factor than instrumental error below 20%).

Understanding Reagent Purity and Its Importance in Hydroponics

When making hydroponic nutrient solutions one of the most important concepts we need to understand is "reagent purity" and how this affects the overall quality and composition of our hydroponic nutrient solutions. People who have not been academically trained in science usually do not have a very good understanding of this concept and its implications and how they need to take it into account when doing their hydroponic formula calculations. HydroBuddy – my free hydroponic nutrient calculator – allows the user to specify the purity of all the reagents used in the preparation of nutrient solutions so that accurate and adequate calculations are done. What does purity mean ? How do you determine the purity of the reagents you want to use ? What does a 100% purity mean ? Keep reading the following few paragraphs to find out.

What is reagent purity ? Imagine that you have 80g of a pure substance – table salt for example – and you mix it up with 20g of sand. The original salt – which was pure – was 100% table salt while the new resulting mixture is only 80% table salt. This degree of presence of a given “pure substance” with a defined composition within a mixture is what we call the “purity” of a reagent. The objective of purity is to know how much of what you are buying actually fits the chemical composition of what you intend to buy and how much is “other stuff”. The nature of impurities -what is different than what you intend to buy – is different depending on the fabrication process and intent of the reagent you want to use. The nature and amount of these impurities may sometimes be very important while other times it can simply be neglected.

People who are not familiar with this concept generally get confused when people start to talk about the composition ratios of pure substances. For example iron EDDHA is an iron complex which contains about 7% iron. This does not mean that EDDHA is only 7% “pure” but it means that within this pure substance iron accounts for 7% of the weight. The purity of the reagent does not have ANYTHING to do with the composition of the pure substance you intend to get – the iron EDDHA in the above example – but it refers to other things that might be present with what you intend to buy due to the fabrication process. So for example you can can buy Iron EDDHA 7% with a purity of 98% which means that from every 100g, 98g are iron EDDHA with a 7% iron content while 2g are made up of other substances with undetermined composition.

In hydroponics we want to provide our plants with the correct amount of nutrients and for this reason we must make sure that we provide what our formulation demands as a minimum. For this reason when preparing hydroponic nutrient solutions we must always use salts with purity levels above 95% with levels above 98% being better. Salts that are 98% pure aren’t very expensive while the purer grades – used for the biochemical and fine chemical industries – are generally several orders of magnitude more expensive. While you can get a calcium nitrate ammonium double salt with a purity of 98% for just a few dollars per kilogram a single kilogram of this chemical at a 99.999% purity (which is often considered analytical grade) would cost around one thousand dollars. This difference in cost arises because as a salt becomes purer, eliminating the small impurities becomes harder and harder. Salts for which extremely high purity levels are achievable (such as NaCl which can be purified to almost 100%) are known in chemistry as “primary standards” because their composition is known to an extremely high degree.

When preparing hydroponic solutions we should not be worried that much about getting very expensive reagents as the impurities we get and the errors we have in our composition are not bound to affect our plants significantly, however we should take them into account so that we know exactly how much of what we know is pure is being added. So even though a reagent may have a purity of 98%, taking into account this will allow us to add enough so that we are certain that at least certain concentration levels are achieved. Of course, using a 100% purity for the reagents is not bound to increase tremendous error if the actual value of the purity of the salts is unknown but making sure that the purity is above 95 or better 98% is always something that should be done to ensure that high quality preparations are being done. You should also understand that the impurities within your salts might actually be insoluble so some small fractions of the salts may remain undissolved when concentrated nutrient solutions are prepared.

HydroBuddy's Online Hydroponic Formulation Database

There are certainly thousands of different ways in which a hydroponic nutrient solution can be prepared. You can make a solution schedule to closely follow the environmental and growing conditions of a certain crop – like tomatoes – or you can simply make up a generic formulation to use within all your hydroponic plants. Besides this we also have an incredible amount of commercial formulations you would perhaps like to imitate and a ton of ways in which you can experiment with nutrient ratios to improve things such as the flavor, size and production of your crops. Since there are so many ways in which we can prepare nutrient solutions I have decided to create an Online Nutrient Database we can use to store and easily access all this information.

My hydroponic nutrient calculator – a.k.a HydroBuddy – has the ability to save and load formulations for the creation of almost any hydroponic nutrient solution. Since the calculator has the ability to grab external files and load them into its internal database I saw no reason why we couldn't create an online database in which we could keep a global record of all the formulations we find and develop. The calculator – since v 0.95 – includes a "download online database" button which downloads all the formulations kept within the online database to the grower's HydroBuddy program. This way the user doesn't have to keep on downloading the database manually but simply by pressing a button all the information is automatically re-downloaded and updated. Added to this is the benefit that the users other loaded formulations remain intact as the calculator detects which formulations are downloaded and which ones were created by the local user.

The idea of this online database is to put all the information available about nutrient formulations into one place so that people all around the world can benefit and experiment with different setups. Added to this is the ability to make the imitation of commercial formulations even easier since the formulations can be kept within the online database. So in my mind it is a win-win situation for everyone, we get to have the opportunity to create a unique database filled with information about solutions from both empirical, commercial and academical sources while we retain the flexibility to use them or modify them within HydroBuddy as we please. This also makes the standardization of formulation use much easier since you can easily tell people what HydroBuddy database formulation you are using and they can easily then reproduce what you have or change it slightly to fit the nutrients available in different regions of the world.

How can you contribute to this database ? **In order to add a file to the database you need to send me an email to dfernandezp(at)unal.edu.co** , you need to include the name of the formulation you are adding, its intent and source (what plant or if its an imitation of what commercial fertilizer) and a file created by HydroBuddy with the necessary information. In order to create this file just save the formulation on the “Desired Formulation” tab then send me the file created within HydroBuddy’s directory. After you send me your contribution I will add it to the Online Database so that everybody will be able to download it with the click of a button.**If you want to send many files just put them all within a zip files so that they will be easier to download from my email client, include in the body of the email the necessary descriptions for each file as detailed above.**

So if you have been waiting for an opportunity to contribute to HydroBuddy feel free to share with me any formulations you might have found or created that you would consider useful for someone. If you have spent a lot of time taking the formulations of commercial nutrients and translating them into HydroBuddy you can now share this knowledge with the rest of the world. I will also do my fair share to add new formulations to the online database, particularly regarding academic sources since most people do not have access to the research databases where the articles detailing them can be found.

If you want to contribute and support HydroBuddy but you do not want to send any formulations feel free to donate using the paypal donate button on the left hand sidebar :o)

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 NO_3^{-} ion (nitrate) or as the NH_4^{+} 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 $H_2PO_4^{-}$ or HPO_4^{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.

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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.

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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.

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)