Chemical Buffers in Hydroponics : What is the Best, Cheapest Buffer

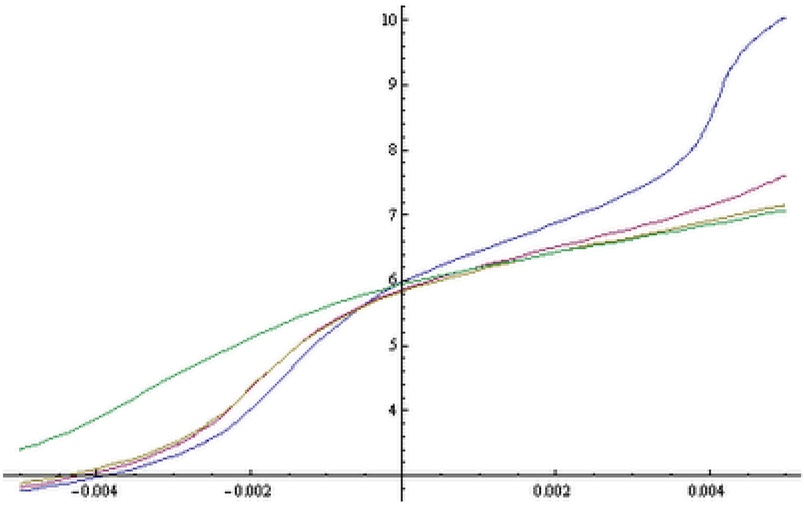
One of the biggest questions people ask when starting to grow hydroponic crops deals with the stabilization of pH and the use of chemical buffers to keep pH levels at acceptable ranges during long periods of time. The question is very relevant since changes in the pH of a nutrient solution can cause a lot of problems related to nutrient availability and having to add large quantities of acids or bases to correct the deviations is also not something plants will enjoy very much. What we need to do then is to keep pH levels within an acceptable range, for a period at least long enough to last a few weeks.

On previous posts I have talked about the way in which I do this using ion exchange resins but these can be too expensive or hard to find for most hydroponic growers out there. More over, chemical buffers are often much easier to use, get and apply although their actual mechanism of action is much less effective and much more aggressive than that of the ion exchange resins. A chemical buffer is mainly a substance which is added into your solution that distributes itself as different ionic species that can react either with acids or with bases at certain pH levels. The buffer however is also available for your plants to absorb and therefore we are limited to chemical buffers which are not phytotoxic (toxic to plants) and which allow us to control pH within the range we want.

From the very large library of chemical buffers available to the modern chemist, only a handful are suitable for their use in hydroponics and – even then – most of these are actually not practical in the sense that they are extremely expensive for the home grower. Certain organic buffers like MES offer extremely good results although they are hard to buy and very expensive, a reason why they are not used widely in hydroponic culture (this buffer is used mainly on hydroponic research where precision – and not cost – is the main determinant factor).

The buffers we are left with are then very simple organic and inorganic substances that have low phytotoxicity and some compatibility with the other ions present in our hydroponic setup. From these ions phosphate species, citrate species and carbonates are the most important ones we can use within our hydroponics setup. However we are limited by the actual concentration values of each we can use and for this reason we cannot have unlimited buffering capacity from these sources.

Which one is best ? We can actually carry out simulations to show us the pH vs acid-base addition for different hydroponic solution constitutions using mathematical equations. Running these simulations requires the solution of highly complex systems of equations which contain all the information relative to the chemical equilibrium of all the different existing ionic species. The below shown simulations were carried out using the Mathematica computer program (all solutions are assumed to be adjusted to an initial pH of 5.8 with a strong acid or base).



The blue curve represents the behavior of a poorly buffered hydroponic solution with only about 0.002M phosphate concentration (about 50 ppm of P). The red and yellow curves represent two solutions with increasing levels of carbonate showing us that if you are battling pH increases, having more carbonate will definitely help you deal with this. However it is also clear that carbonate concentrations at pH 5.8 are restricted to around 100 ppm since values above this are bound to cause toxicity due to the very large presence of the hydrogen carbonate ion. The green curve represents an increase in the amount of phosphate from 0.002 to 0.004M (about 100 ppm) with carbonate, showing us that phosphates are not good at buffering increases towards the upper side but they do increase buffering towards acid territory. Overall I also noticed that citrate concentration increases to the maximum threshold allowed by calcium citrate solubility did not afford a very good buffering effect with only a mild effect that prevented shifts towards the downside.

In the end, the conclusion seems to be that in a regular hydroponics system where pH increases generally happen towards the upside it is better to use carbonate as a buffering agent than to use citrate or phosphate although phosphate at its regular concentration in hydroponic does provide some buffering against pH moves (without phosphate increases are much more dramatic). For this reason I believe that a phosphate/carbonate buffer seems to be the best choice for most hydroponic growers, taking care to keep the concentrations at levels that do not cause precipitation or phytotoxicity problems.

Preparing Your Own Hydroponic Nutrients : A Complete Guide

for Beginners

Chances are that if you are into hydroponic gardening and you live in Europe or in the US you have been buying your nutrient solutions from one of the many hydroponic nutrient sellers available locally. Generally people do not prepare their own nutrients because they consider this task "terribly difficult" and they prefer to keep buying previously made formulations so that they don't have to deal with the technical problem of making their own fertilizers. What most people don't realize is that the profit margin of hydroponic nutrient producing companies is HUGE. You would be surprised to know that each one of those concentrated nutrient gallons you buy costs only a few dollars to make (sometimes even only pennies) and you are probably paying a few times what the whole fertilizer is worth.

Obviously if you are going to be growing plants for a long time or if you simply want to grow a large garden the buying of this commercial nutrient solutions is not an option and starting to make your own formulations – adjusted to your own needs – becomes the main priority. On today's article I will be speaking to you about how to prepare your OWN solutions using my nutrient solution calculator, carefully explaining to you what you need, where to buy it and what you should expect. I will guide you through making your own first A+B solution by YOURSELF getting all the chemicals and utensils you need easily and economically.

So what do you need to make your own nutrients ? The list below shows you the things you will need to start making your own A+B solutions. You will notice that you will need two scales since we are going to have to weight two "nutrient sets" with different precision, micro nutrients (which are used only in small amounts, need to be weight more precisely) and macro nutrients (which are used in larger amounts and therefore need scales with larger capacity).

Note, the links below are amazon affiliate links. This means you help out this blog by buying through these links at no extra cost to you.

- Scale that can weight down to 0.01 g at a +/- 0.01g precision (something like this is perfect) with a max weight >100g.
- Two Empty one gallon containers with caps
- Plastic Spoon
- Plastic small container (to weight salts)
- A source of RO or distilled water (your tap water will NOT work)
- Download my hydroponic nutrient calculator here.

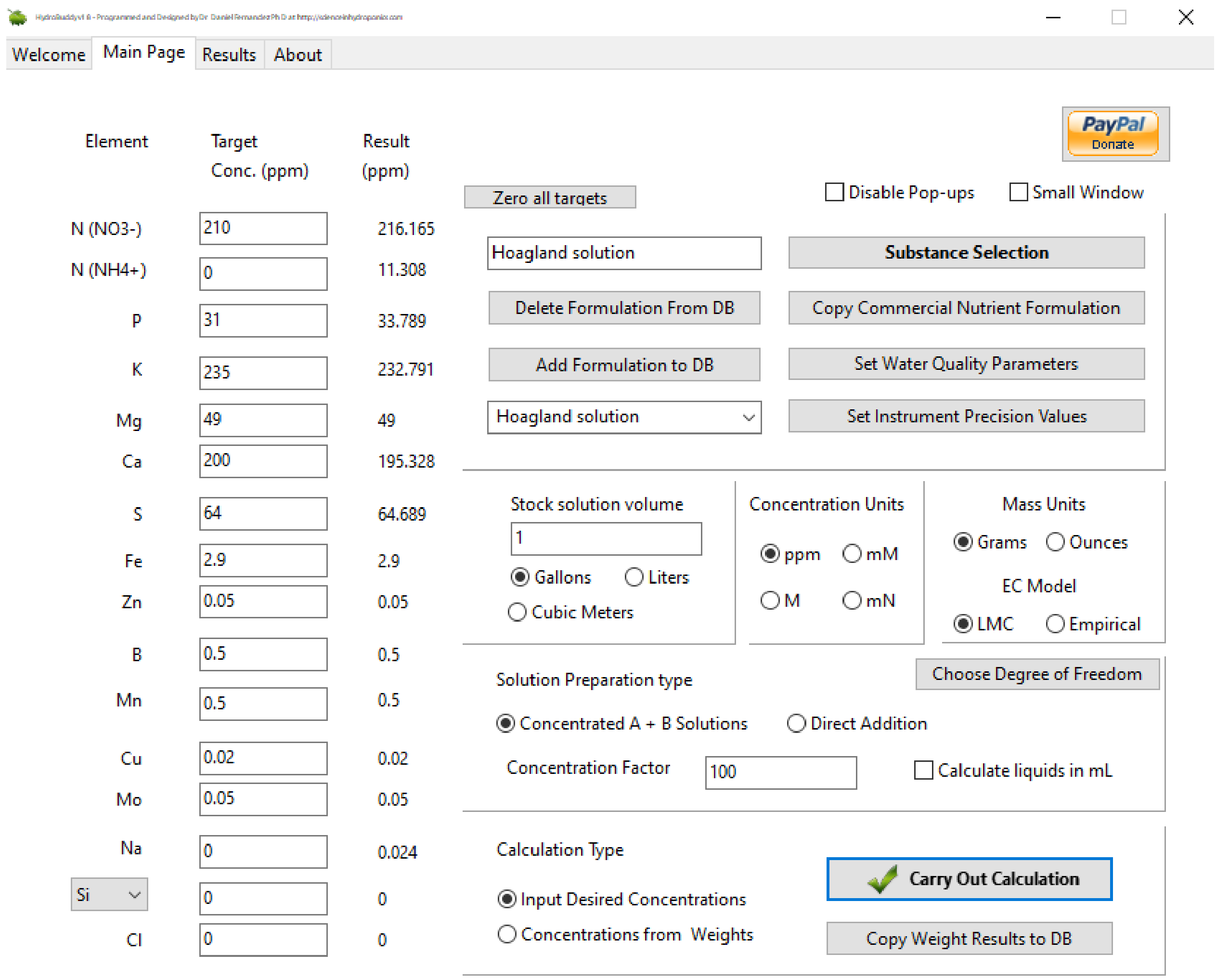
Now these are the chemicals you will need (an online purchase link is included for each one) :

- Calcium Nitrate (here)
- Magnesium Sulfate Heptahydrate (here)
- Potassium Nitrate (here)
- Copper Sulfate Pentahydrate (here)
- Mono potassium phosphate (also known as Potassium Monobasic phosphate) (here)
- Manganese EDTA (here)
- Zinc Sulfate Monohydrate (here)
- Sodium Molybdate (dihydrate) (here)
- Boric Acid (here)
- Iron EDTA (here)

These chemicals can be bought in a variety of places but there is a link next to each one showing you a link where you can actually make the purchase. Often it is also possible to get these chemicals on ebay. The purity may not be as guaranteed as when purchased from a regular supplier but it is good enough for practical purposes in hydroponics.

Of course you may see right now that the initial investment might be significant (from 100 to even more than 500 USD depending on whether you buy 50lb or 1lb quantities of macro nutrients) however after this purchase you will be able to produce more than one hundred gallons of concentrated A+B solutions which would cost you more than 10 times the price you will be paying if you bought them commercially. After doing the math you will see that this is a GREAT way to save money and produce your own solutions ! Hey you could even start selling to the neighbors !

After you buy the chemicals, open my hydroponic calculator and select the “Hoagland Solution”. Then click the “Concentrated A+B Solutions” radio button and make sure you select the “Input Desired Concentrations” option. Set the amount of stock solution volume to 1 and the radio button to “Gallons”. Then click the “Substance Selection” button and make sure you add all the substances that are from the above list into the “Substances Used for Calculations” list. Now click the “Carry Out Calculations”. Your screen should look like the picture shown below .



This is how the calculator should look after you click the “Carry out Calculation” button. Note the selections that are active.

Now that you have calculated the weights needed you should go to the “calculation results” tab where you will be able to find the weights of the different nutrients you need to prepare the solution in the amount you specified. The results of the calculation to prepare 1 gallon of A and 1 gallon of B stock solutions are shown below.

Welcome | Main Page | Results | About

Substance Name [click for url]	Formula	Mass (g) [Edit to fine-tune]	Preparation Cost
B - Copper Sulfate (pentahydrate)	CuSO4.5H2O	0.03	0
A - Iron EDTA	Fe(EDTA)	8.444	0.5
B - Mn EDTA	MnEDTA	1.456	0.1
A - Calcium Nitrate (ag grade)	5Ca(NO3)2.NH4NO3.10H2O	389.156	3.1
B - Zinc Sulfate (Monohydrate)	ZnSO4.H2O	0.052	0
B - Boric Acid	H3BO3	1.083	0
B - Sodium Molybdate (Dihydrate)	Na2MoO4.2H2O	0.048	0
B - Magnesium Sulfate (Heptahydrate)	MgSO4.7H2O	188.119	0.4
B - Potassium Monobasic Phosphate	KH2PO4	56.202	2.5
A - Potassium Nitrate	KNO3	186.121	4.1

Element	Result (ppm)	Gross Error	Instrumental Error
N (NO3-)	216.165	2.9%	+/- 0%
K	232.791	-0.9%	+/- 0%
P	33.789	9%	+/- 0%
Mg	49	0%	+/- 0%
Ca	195.328	-2.3%	+/- 0%
S	64.689	1.1%	+/- 0%
Fe	2.9	0%	+/- 0.1%
Zn	0.05	0%	+/- 19.3%
B	0.5	0%	+/- 1%
Cu	0.02	0%	+/- 33.7%
Mo	0.05	0%	+/- 21%
Na	0.024	0%	+/- 0%
Si	0	0%	+/- 0%
Cl	0	0%	+/- 0%
Mn	0.5	0%	+/- 0.7%
N (NH4+)	11.308	0%	+/- 0%

Total Cost is 10.7

Values calculated for the preparation of 1 gallons of A and 1 gallons of B solution. Please use 10mL of A and B within every Liter of final solution

Predicted EC Value

EC=1.81 mS/cm

Stock Solution Analysis

Nutrient Ratio Analysis

Detailed Per Substance Contribution Analysis

Export To Csv

Amounts of salts to be weighted to prepare 1 gallon of A and 1 gallon of B solution.

You should now follow these steps to prepare the solution:

- Mark one gallon container with an A and the other with a B. One gallon will contain all the A salts, the other all the B salts.
- Fill each one gallon container with half a gallon of RO or distilled water
- Weight one salt on the plastic container you set apart for measuring. Make sure you always DOUBLE check the weights and the appropriate A or B gallon container you need to add the salt to.
- After you measure the salt transfer it to either the A or B gallon container (depending on which one it should go into). Use a little bit of water (RO or distilled) to

transfer any remains that cannot be easily added and dry the container you are using to weight before measuring the next salt.
- Shake the container where you added the salt and make sure it is fully dissolved before measuring and adding the next one.
- Do the same as above for all the salts
- After you are done adding the salts add half a gallon of water (again RO or distilled) to each container
- Then seal the containers and shake them vigorously
- You have just prepared your first batch of self-made nutrient solution !

The above formulation is a general multi-purpose blend – a Hoagland solution – that should allow you to grow a large variety of plants. You simply need to add 10mL of A and 10mL of B for each final LITER of nutrient solution. You should use your pH meter and EC meter to adjust these values as you do with your regular commercial nutrients.

It is very important now to keep your solid chemicals stored in air-tight container in a dark and cool place. Some chemicals like calcium nitrate will absorb moisture and become useless if you leave them in contact with air for prolonged periods of time!

Of course, once you are more comfortable with preparing your own nutrients you can research the available literature for some custom formulations available to grow each one of your plants under its favorite nutrient levels. I hope this tutorial has allowed you to reach a new level in your hydroponic gardening experience, hopefully accompanied by a drastic reduction in your soil-less gardening costs !

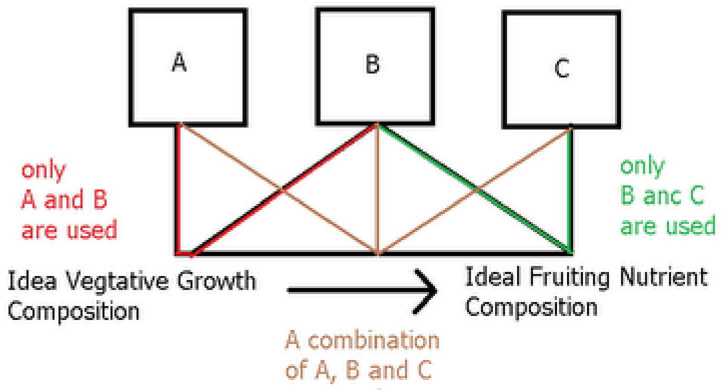
Make sure you also checkout this youtube video for a similar tutorial using a premade chelated micronutrient mix.

Preparing A, B and C (three part) Concentrated Nutrient Solutions, a Tutorial for my Hydroponic Nutrient Calculator

On the last tutorial dealing with my hydroponic nutrient calculator we learned how to prepare A and B concentrated nutrient solutions for any given formulation we would like. We learned about the different incompatibilities that need to be avoided and why this leads to the creation of two separate solutions. After learning how to prepare these solutions many of you may be interested in knowing how to make the three part formulations commonly made available by most hydroponic nutrient sellers. For example, companies like Advanced Nutrients and General Hydroponics offer three part formulas which are meant to be combined to ensure adequate nutrition during a plant's whole growing cycle. Today I am going to explain to you the main objectives of a three part formula, the difference with a two part formula and how you too can prepare your OWN three part nutrients to feed your hydroponic plants through their whole vegetable, flowering and fruiting cycles. As with the past two tutorials you will need to download my hydroponic nutrient calculator available here for free.

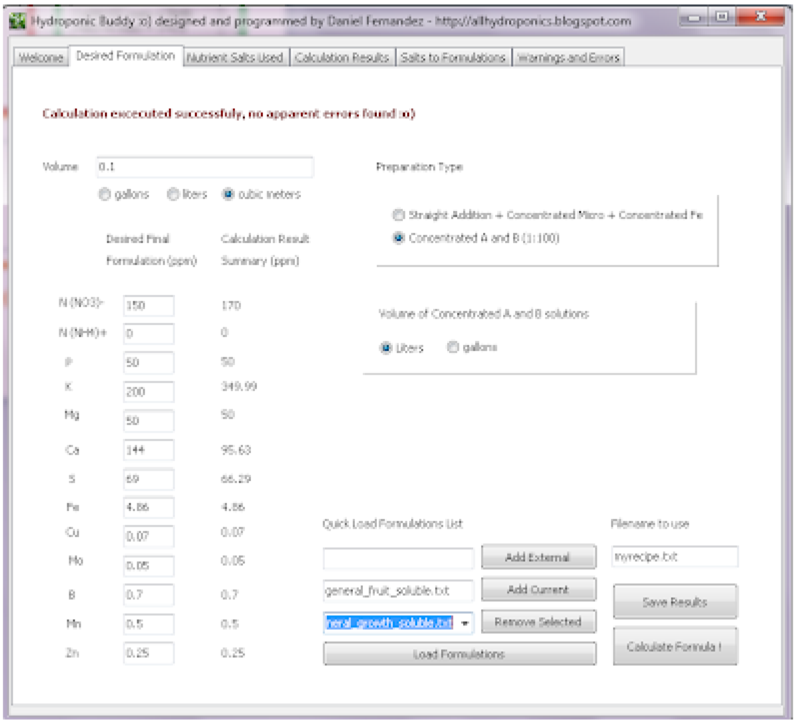
What is the difference between a 2 and a 3 part formulation ?
What we need to understand here is that plants usually have different needs through their whole life cycle and therefore they require different nutrient ratios as they grow older and face different stages of their development. With a two part concentrated nutrient based formulation we can only vary this ratios in a certain way and doing any variations outside this scope will not be possible. With the default approach in my

calculator you can vary nutrient ratios by varying the "desired formulation" every time you prepare your reservoir again (since most nutrients are added directly) but with the A and B concentrated solutions you are bound to "stick" to a certain set of concentration values for each nutrient.

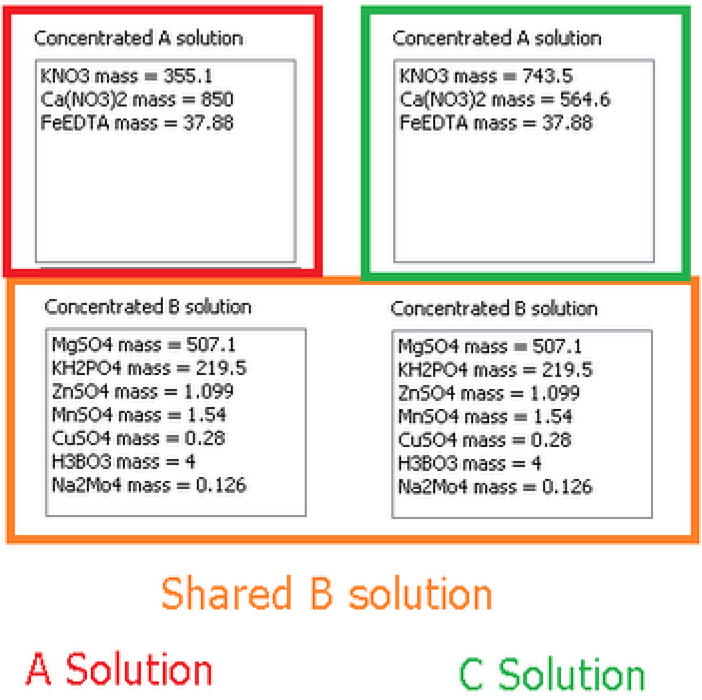


The solution to this problem is quite simple and this is what most commercial fertilizer sellers have come up with. You have two solutions with the same salts but varied nutrient ratios and a third solution that remains constant. What we have then is two possibilities of final compositions A-B and C-B and a whole new possibility for nutrient ratios by combining A-B-C. What is done most of the time is that A-B becomes an ideal formulation for vegetative growth while C-B is an ideal formulation for fruiting. When you start to grow you generally do so with A-B and then you move towards C-B by increasing C and decreasing A as reservoir changes happen.

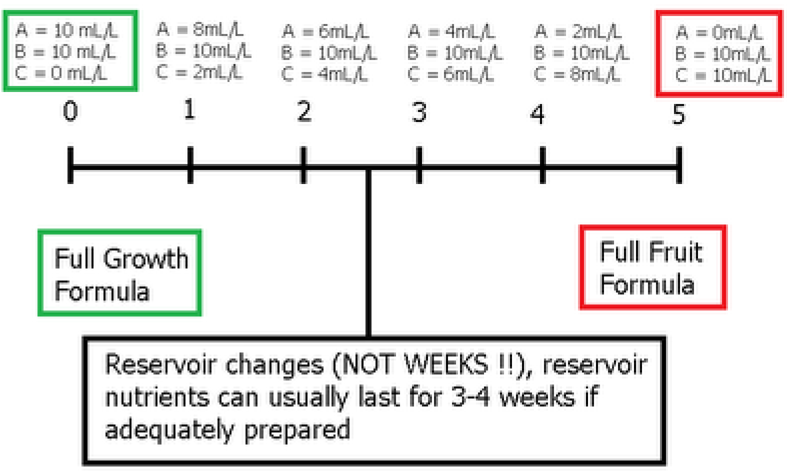
In my program this sort of solution scheme is easily achieved. What you need to do is simply to have two desired formulations, one for ideal growth and one for ideal flowering and then you just need to make two sets of A and B calculations where B is shared amongst the two. To do this we will first load the general_growth_soluble.txt and general_fruit_soluble.txt desired formulations as indicated on the tutorial for the preparation of A and B formulations (you can download them [here]() and [here]()). After loading the general_growth_soluble.txt composition you should have the formulation composition displayed below.



Then follow the same procedure outlined on the “A and B solution tutorial” to arrive to the salt-weight compositions of the A and B formulations (save the results using the “save results” button) . Now load the general_fruit_soluble.txt formulation and repeat the calculation, also saving your results. A summary of the results of both calculations is shown in the image presented below. You will notice that both calculations share the same weights for the B solution (meaning they use the same B solution) while the composition of the A solution changes. What you have now is a basic three part formulation. You could now think about a regime to change from an A-B growth solution to the C-B fruiting solution in the amount it takes your plants to bear fruit.



For example, if your plants took aproximately 5 reservoir changes you would then use different quantities of A and C to go from a 100% A feed to a 100% C feed during that time. A timeline if it takes your plants 5 reservoir changes to get to fruiting is shown below. Note how in the beginning we use 10mL of A per liter and then in the end we use 10mL of C per liter, meaning that we have done a full gradual change from a growth to a fruiting formulation.

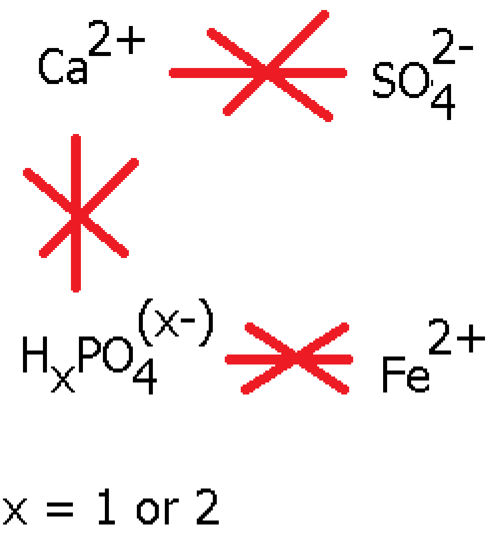


As you see from the above, you can easily use my hydroponic calculator to prepare your own three part concentrated nutrient blends which you can use to build your own nutrient schedule to go from vegeative growth to fruiting. However if you are currently using a fixed composition of a three part commercial nutrient blend then you can easily prepare an A and B solution to replace it, three part nutrients are ONLY needed when you want to do a varying schedule like the one introduced above, using three part nutrients without doing this is simply an overcomplication since a fixed composition can be prepared using just two custom concentrated solutions.

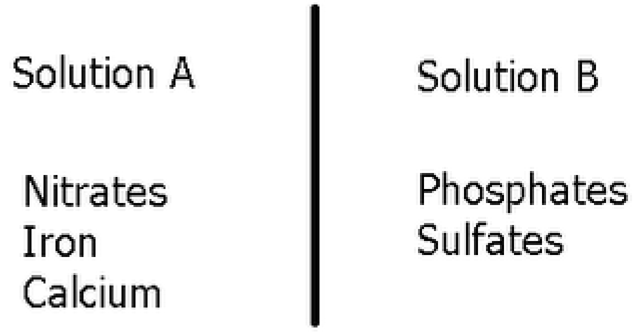
Preparing A and B Solutions Using My Hydroponics Nutrient Calculator

The default way in which solutions are prepared using my hydroponic nutrient calculator involves the direct addition of some component in your nutrient reservoir plus the preparation of some micro nutrient and iron concentrated solutions from which 10 and 100mL are added per batch. This way of preparing solutions is especifically suitable for people with large reservoirs and commercial hydroponic growers since when reservoir levels go above 4 cubic meters all nutrients can be added directly to the reservoir, saving the time and cost of preparating any concentrated solutions. The approach is also good for people with small reservoirs since you can prepare the micro and iron concentrated solutions, dissolve other salts directly and in the end you will have a very accurate amount of micro and macro nutrients prepared with your own custom formulation. However upon the request of several people I implemented an approach that allows people to prepare traditional formulations using an A+B concentrated nutrient solution approach in which two concentrated solutions at a 1:100 ratio are prepared and then simply diluted to prepare the final hydroponic reservoir’s contents. On today’s post I will discuss this approach and how you can use it if you have the appropiate nutrient salts. Please download my hydroponic nutrient calculator here to follow this tutorial.

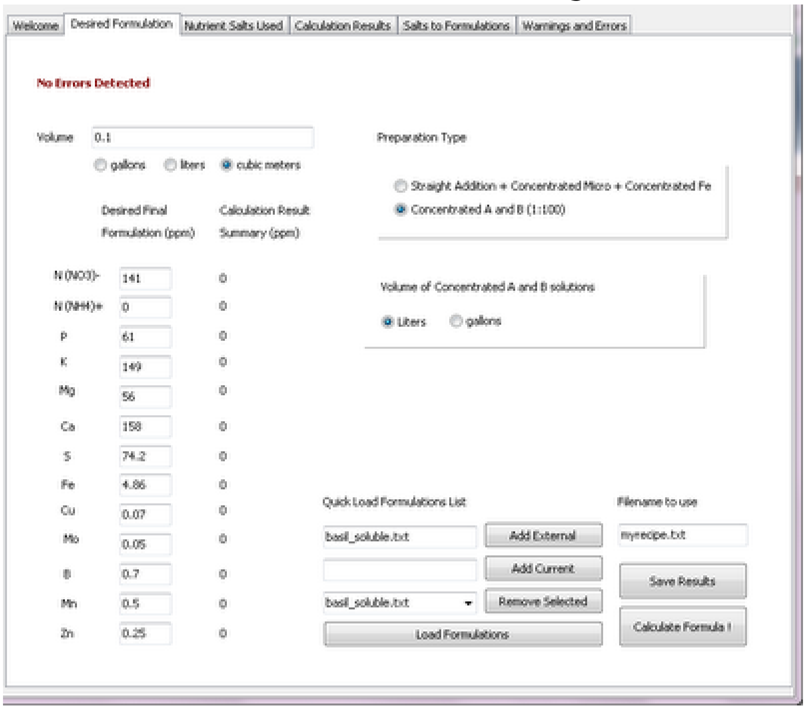
Before we go into the main aspects of the preparation of concentrated solutions we must first understand the incompatibilities that are present within concentrated solutions that restrict the salts that can be used. The program checks for these incompatibilities automatically when using any of the saved salts and for this reason custom salts cannot be used for the A and B custom preparation. The main incompatibilities are shown on the image below. Mainly what we want to ensure is that certain ion pairs that would precipitate insoluble salts are never present together. For this we should avoid putting calcium and sulfate ions together as well as calcium and phosphate species and iron and phosphate species.



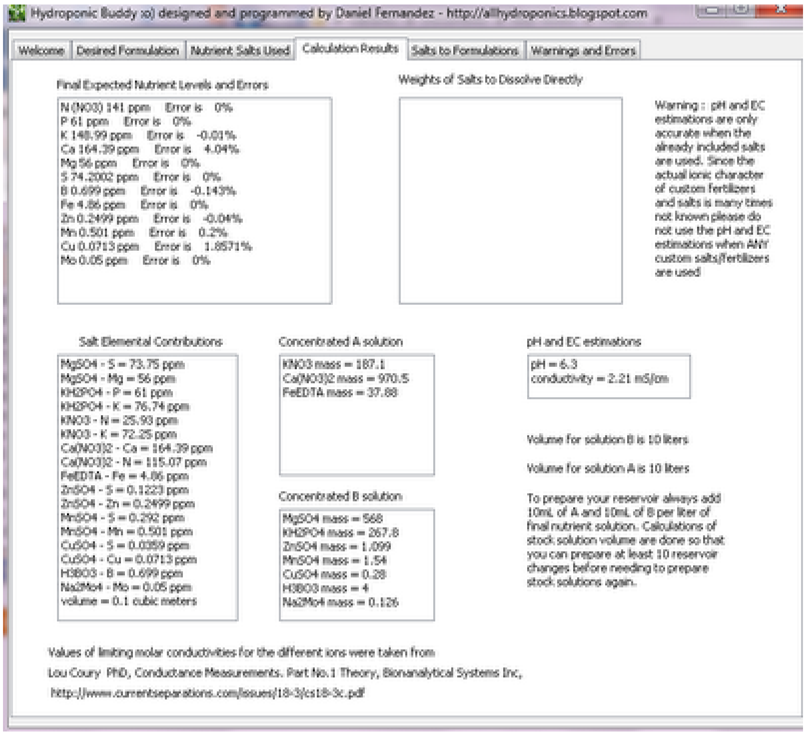
What we have left is the layout shown below that describes the general distribution of ions relevant to solubility of an A and B hydroponics formulation makeup. As you see what we achieve by dividing the concentrated solution into two is to keep away the ions that would precipitate when put together. This of course also restricts our ability to use iron sulfate and a different source of iron, either a chelate (FeEDTA, FeDPTA, etc) or iron nitrate must be used. It also restricts our sources of Calcium to calcium nitrate and therefore our sources of phosphate and sulfate are reduced to potassium salts.



Now let us use our basil_soluble.txt example to calculate the composition of the given A and B solutions needed for this formulation. Unzip the calculator and txt files to any given directory and input basil_soluble.txt under the field next to the “add external” button in the “Desired Formulations” tab, then click the “add external” and “Load Formulations” buttons and select the basil_soluble.txt formulation from the drop down menu. The end result of this process is shown on the image below. Also make sure you check the “Concentrated A and B” option so that the program calculates the results for these solutions instead of the regular method.



After doing this go to the “Nutrient Salts Used” tab and uncheck Calcium Monobasic Phosphate and Iron Sulfate and check Iron EDTA, Potassium Sulfate and Potassium Monobasic Phosphate. Now go back to the “Desired Formulations” tab and click the “Calculate Formula!” button. The program will now calculate the volume of A and B solutions you should prepare so that it will last for 10 reservoir changes of the volume you have input under the “Desired Formulations” tab. So for this case in which we left the input as 100L the final concentrated solution volume is 10L since it will last for 10 changes of the 100L nutrient reservoir, adding 1L per reservoir change. It should also be clear that the concentration ratio of 1:100 cannot be increased due to solubility limitations of salts. The results of the calculation are shown below.

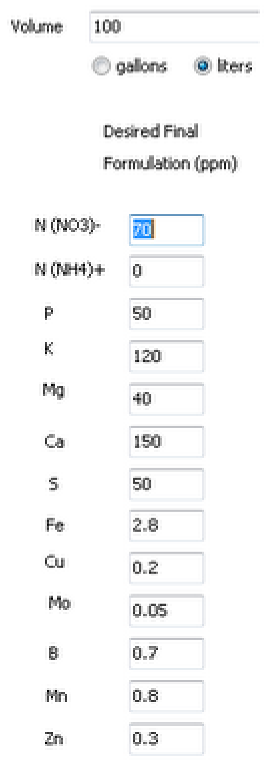


Hopefully with this tutorial you will be able to prepare any A and B solution for any final formulation you would like. It is also clear that this approach has less flexibility than the “default” since it restricts the character and distribution of the salts used, making the use of very cheap fertilizers like calcium monobasic phosphate effectively impossible. However it also provides an “easy way” to make reservoir changes since concentrated A and B solutions only need to be prepared once every 10 times this happens. So it is clear that both approaches have their advantages and with the help of my calculator you’ll be able to choose whichever approach fits you best :o)

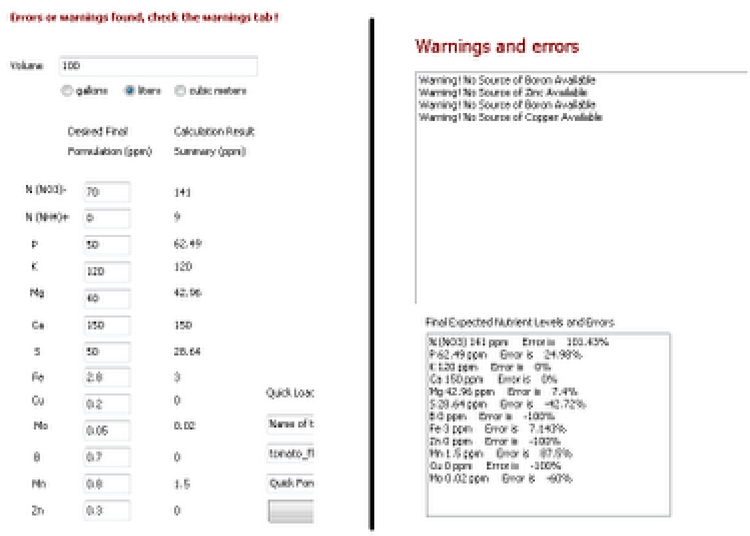
Using my Nutrient Calculator with Commercial Fertilizers : Part No.2

On the last part of this tutorial series I talked about how you could use my hydroponic nutrient calculator to figure out the ppm values of a commercial fertilizer. Today I am going to talk about how you can achieve a given ppm formulation using a commercial preparation figuring out what additional salts you would need to arrive at an adequate composition. I am also going to show how you can figure out the final concentrations of nutrients when using combined commercial fertilizers and salts and how this approach can be used to arrive at full, accurate and complete formulations for your hydroponic reservoir. In the end you will see how my hydroponic calculator (hydroponic buddy) is a great tool for the preparation of your hydroponic nutrients even if you rely solely on commercial formulations. You will need my hydroponic nutrient calculator to follow this tutorial, you can download it here.

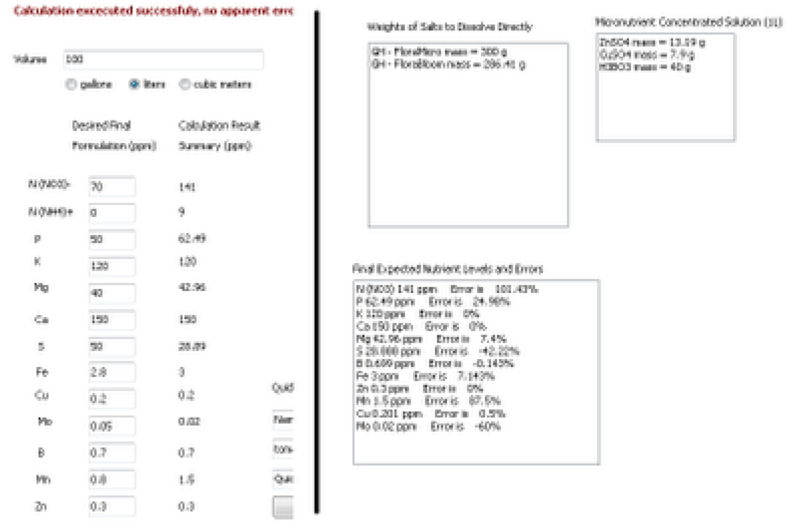
Today we are going to use a few commercial fertilizers from General Hydroponics and Advanced Nutrients as well as a hydroponic formula to grow tomatoes. The formula – applied for tomato growth in Florida for the first cluster growth stage – can be found here. We are going to use the FloraBloom and FloraMicro nutrients from General Hydroponics (labels here and here) . As with yesterday's tutorial the first thing we are going to do is add all the custom fertilizers within the "Nutrients Salts Used" tab by using the "Add New Salt" button by entering the composition percentages found on the label and composition pages of the above mentioned fertilizers. After doing this we input the desired tomato formulation under the "Desired Formulation" tab like it is shown below.



Once we have the formulation we select the custom fertilizers, uncheck all other salts and input a volume of 100 liters. After doing this we press the “Calculate Formula !” button which produces hte results shown below. The software also warns us about errors so we need to go to the “Warnings and Errors” tab where we see that certain nutrients are missing from the formulation. In particular we see that we are missing Zn. B and Cu. You will notice that many combinations of hydroponic fertilizers miss one or several essential nutrients for plant growth (even micro-grow-bloom combinations often miss B, Zn and Cu).



So right now we need to add sources of these elements to have an adequate formulation. Go to the “Nutrient Salts Used” tab and select Zinc Sulfate, Boric Acid and copper sulfate and press the “Calculate Formula !” button again. This now produces the results shown below where all elements are present and the program tells us to prepare an additional 1L concentrated solution of Zinc Sulfate, Copper Sulfate and Boric Acid.



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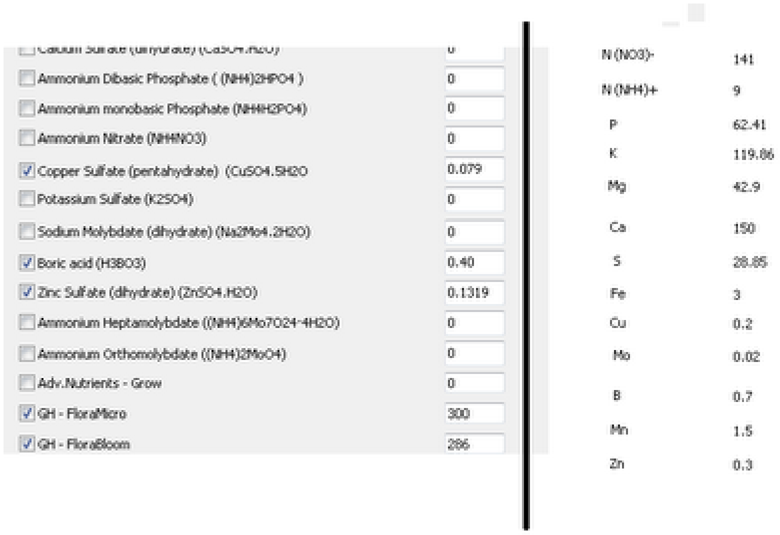
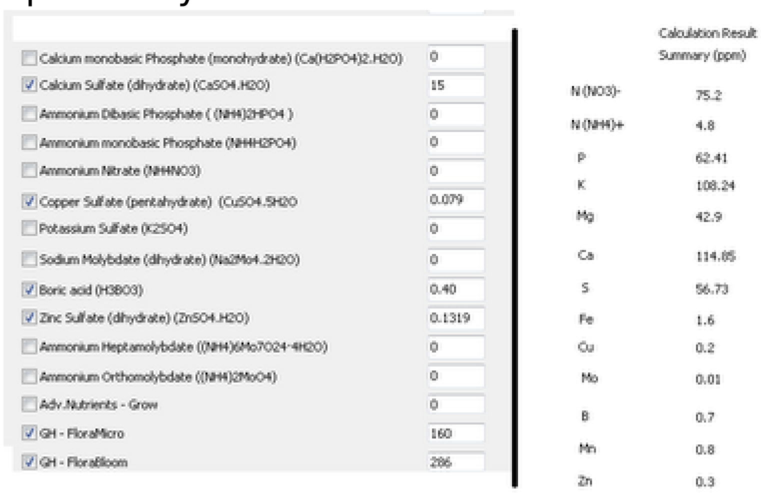
However we see now that the formula is not very well balanced since we have a 100% excess of N and a defect in S so to achieve the desired composition it might be necessary to tweak the results slightly in a manual fashion and use some additional salts like Calcium Nitrate. To do this tweaking you should input the weight values obtained on the “Mass” boxes next to each salt’s name (the mass of Zn, Cu and B salts is the mass of the concentrated solutions divided by 100 since the 1L concentrated solutions are prepared with a 1:100 dilution factor taken into account). The input and the results of the “salts to formulation” calculation are shown below.



Now we need to increase S and decrease N. To decrease N we need to reduce the amount of the most important Nitrogen source (FloraMicro) to about half. Since this reduces the amount of Ca significantly we can now add calcium sulfate to the formulation to make up our now acquired Ca and S deficiencies. Select calcium sulfate and give it a value of 15g. After doing this you will notice that Ca and S concentrations will be much closer to the desired end values given by the original formulations. The final result is shown below. Eventhough the amount of nutrients are not absolutely the same as the ones on the formulation we were able to achieve the same “global ratios” for all important nutrient levels and the solution will now contain ALL the necessary nutrients for adequare plant growth and – in this case – especially for the first cluster development of tomato plants.



I hope that this tutorial allows you to understand better how my hydroponic nutrient calculator can be used for the preparation of a wide array of formulas and the correction of commercial nutrient fertilizers that lack some essential nutrients for plant growth. It also shows you how you can modify the results of the automatic calculator to further correct a formula if you believe that better results and pairings can be achieved. As you see, the calculator gives you tremendous flexibility and makes the preparation of hydroponics nutrients with precise ppm nutrient values a simple exercise.

Using my Nutrient Calculator with Commercial Fertilizers : Part No.1

One of the main reasons why I wanted to develop a nutrient calculator for hydroponics was to allow people to understand the amount of nutrients they are adding to their solutions and to use the calculated amounts to either use common salts to achieve the same nutrient percentages or to understand which salts are needed to adequately compliment the nutrition achieved by their hydroponic nutrients. On these posts I intend to show you how you can use my hydroponic nutrient calculator with your commercial hydroponic nutrient composition, figure out the amount of nutrients given by a certain amount of the fertilizer, adapt your fertilizer to a given formulation you want, supplement your nutrient with other salts and get a similar composition yourself with easily available salts (which are used to make your hydroponic nutrients most of the time). **For this tutorial you will need my hydroponic nutrient calculator available here.**
First of all, lets learn how to add a given nutrient commercial fertilizer to your list of hydroponic salts/nutrients. After you open the program go to the “Nutrient Salts Used” tab and select the “Add New Salt” button. A screen will pop up in which you can input the percentage composition values of your fertilizer. As an

example, let us use the FloraBloom fertilizer from general hydroponics and add it to our fertilizer list. The fertilizer composition given on the product’s label is available here. Below you can see an image of the added percentages on my nutrient calculator, note that the K2O, P2O5 check box is used as the percentage values on the label are given as oxides for K and P. After finishing the addition the “GH – FloraBloom” item becomes available in the bottom of the page.

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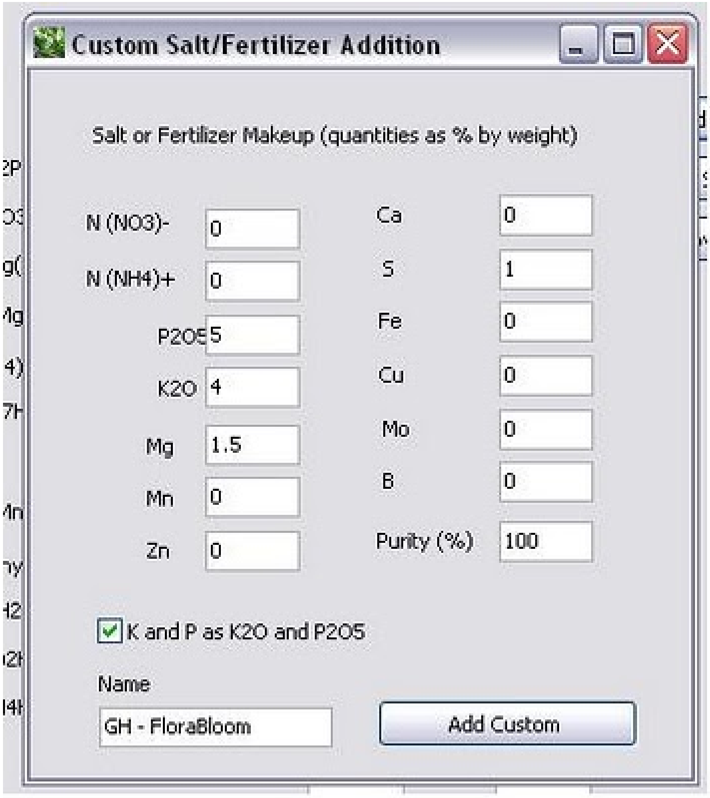

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We are now going to calculate the ppm values for the different nutrients we would get for the recommended addition of 1 tbsp/gallon for regular growth. Since 1 tbsp is 15 mL and we assume the fertilizer density to be 1 g/mL we get an addition of about 15g per gallon of solution. We input 15 in the field next to the fertilizer name, leave the purity at 100% and go to the “Salt to Formulation” tab where we input a volume of 1 gallon. We then get the results shown below. You can see that this preparation would give us around 87 ppm of P, around 131 ppm of K, 60 ppm of Mg and 40 ppm of S. Now that you know how to get these values it becomes easy for you to know the amount of nutrients you are getting for a given amount of any commercial fertilizer simply by using the composition values available on the label.

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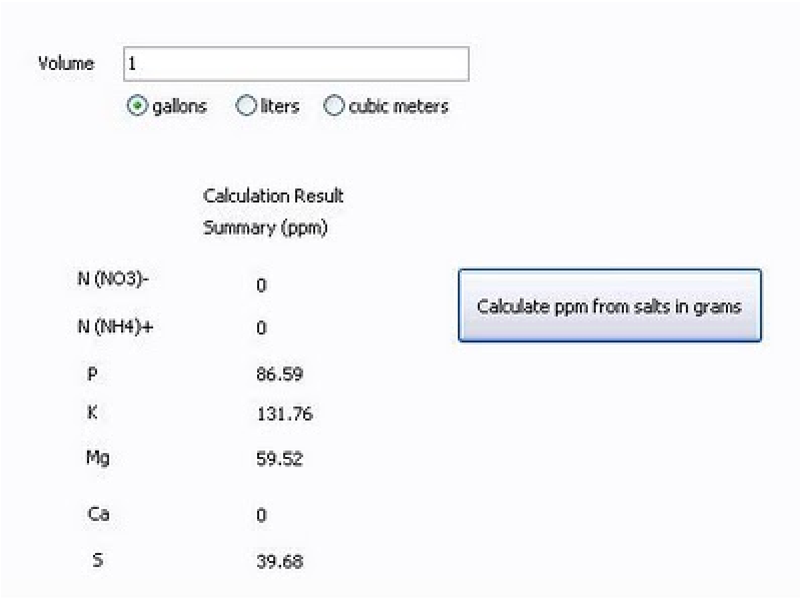


Getting these values is only the first and easiest thing we can do with commercial fertilizers using my calculator but you will see within the next few tutorials that much more powerful things are possible. Right now you can also get the ppm values of different mixes of commercial fertilizers as well as current ppm values you are getting with any custom regime you are using. For example you could upload the whole General Hydroponics series to the calculator and see the different ratios you can achieve with different proportions of their products.

On the next tutorial we are going to use the above mentioned fertilizer as well as a predetermined formula to determine which salts are needed to compliment the above solution and obtain a well-balanced custom formulation. After that we are going to see how we can use the above obtained ppm values to makeup our own copy of this fertilizer as well as how we can improve it. I hope you are enjoying my free hydroponic calculator and that you leave any comments you may have :o)

Possible New Features for my Hydroponics Calculator

A few days after the release of my hydroponic calculator free software implementation I can tell you that I am absolutely happy with the results. The calculator had some resolution problems at first but these problems where easily fixed. After changing to a tabbed interface and by including the ability to save and load nutrient recipes I think that the calculator is on its way to become one of the most important tools for serious hydroponic hobbyists and small business owners. Right now the calculator allows you to get precise weights of different nutrients to prepare your own hydroponics solutions something which no other free software available online does. This allows people to save great amounts of money and achieve very good results around their hydroponic crops, at least when dealing with nutrients. However I believe that there is still a lot to do and for this reason I will be writing today's post about my ideas for the calculator and it will also be great to know what you have in mind :o)

There are several things I want my calculator to be able to do in the future but first of all my focus will be on everything dealing with hydroponic nutrients. The first important additions I am working on mainly deal with the ability to add custom salts to the program and obtain results of ppm concentrations achieved by placing certain amounts of salts within the solutions. Certainly being able to go from a given weight of salt or commercial fertilizer (with known percentage element compositions) to a ppm concentration will allow people to know how adequate their recipe is and – moreover- it will allow people to play with different levels of salts if they feel that the currently "automatic" salt quantity selection is not doing the best possible job. It will also allow people to "reverse engineer" their commercial hydroponic solutions by figuring out their ppm contributions, later using those on the nutrient design tab to obtain salt weights to arrive to those concentrations. By using different sources people will also be able to pinpoint with good accuracy the nutrient sources used by their favorite commercial blend.

The next big feature I am looking forward to add is a "water quality" section which will help people adjust their nutrient solution to their water quality parameters. Things such as hardness, carbonate levels, magnesium, calcium, pH, EC, nitrogen and QOD (chemical oxygen demand) might be important parameters I will take into consideration within this section. A pH and EC prediction module – which is almost finished – will help people calculate an estimate of what their final solution properties for a given formulation might be.

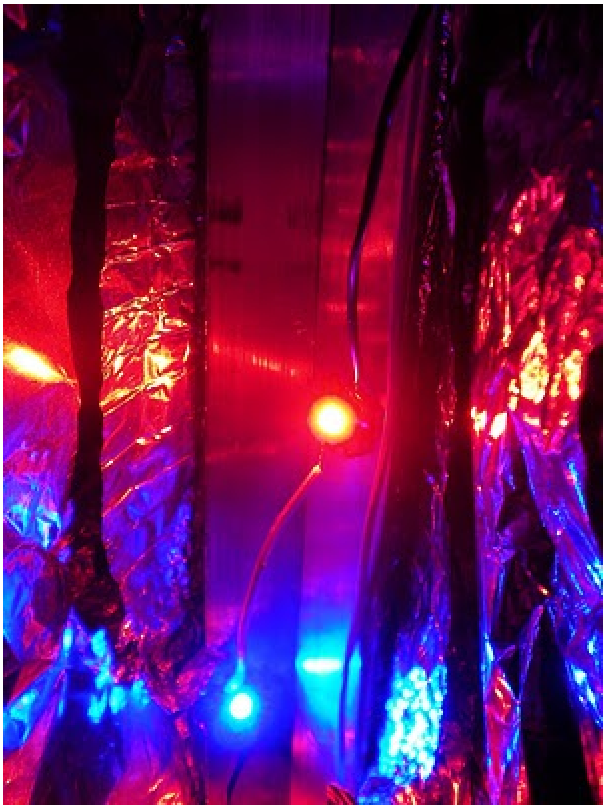
Even though these features are bound to add great flexibility to my calculator, I believe that right now this is only the "tip of the Iceberg" of the potential the software has. After doing this I will attempt to put all my chemical knowledge regarding hydroponics crops into practice by inputting "optional additions" that people will be able to choose when preparing their formulations. For example, you might want to choose the "hydrogen peroxide regime" option and a summary giving you usage instructions as well as detailed explanations of how much peroxide to add and when to your reservoir will be shown. Similar options ranging from "potassium silicate treatment" to "cobalt supplementation" might become available as the calculator progresses.

As you see, there is a lot in storage for this little calculator program which I am hoping to rename to something like "hydroponic buddy" once version 1.0 comes out. Right now I am working on all the features and relearning a lot of Delphi programming which I honestly haven't done extensively for almost 10 years. Do you have any suggestions for my hydroponic nutrient calculator ? Do you have any suggestions about what you would want to do with it ? Please leave any comments, questions or suggestions below ! By the way, you can get the latest version of the calculator here.

Building Your Own High-Power LED Grow Lights for Hydroponics

You will often hear in the world of hydroponic growing that Light emitting diode (LED) lights simply do not work as well as the traditional HPS (high pressure sodium) or Tungsten Halide lamps when growing large plants. The truth is that this belief is centered around the fact that most of the commercially available LED fixtures are built with low-power cascade LEDs that simply do not give your plants enough light intensity to grow properly. The fact that people do not know how to distinguish one from the other, coupled with the problems of getting a genuine, high power LED lamp makes the use of LED fixtures in hydroponics limited and almost never considered a serious option for modern growers. On today's post I want to talk a little bit about how you can build your OWN high power LED lamp and how this way you can get a cheap, low-energy, highly-efficient device to make your plants grow.

The first thing you need to consider here is the amount of LEDs you will be using (the amount you will require for your plants) and the power supply you will need to feed those little hungry fellows. From my experience I can tell you that the lumens measurement of high power LEDs does not give you an accurate estimation of how many you need since LEDs have a highly centered light spectrum that is more accurately measure in micro Einsteins (the appropiate measurement unit for these devices). In this case I advice an empirical measurement of 5, 3W high power LEDs for each plant you wish to grow and 1 blue LED for every 10 red LEDs. (below you can see a picture of one of my LEDs, the LED was dimmed to get a better picture)



The second thing you want to do is buy the LEDs, just google red or blue 3W high power LED on ebay and you will find several chinese or US providers who will sell you these great artifacts for a small price. When you get your LEDs make sure you buy at least 3-5 more than what you will need since these LEDs are sensitive and they will burn easily if you wire them incorrectly. Since the power requirements of these LEDs are also pretty high they will get VERY hot (however much cooler than traditional lamps) and they will need to be mounted on aluminimum rails with at least one 6 inch fan for each 5 LEDs (or a BIG rail than can dissipate all the heat).

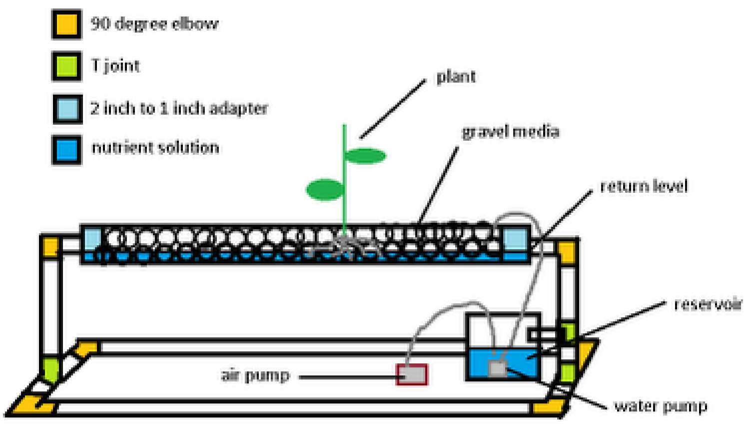
The next part – which is the most difficult – is the building of the power supply and voltage regulator side of the device. You can use a laptop supply to power up some LEDs but you need to calculate their power requirements so that you know how many you can power up for the power supply you will be using. A very good guide I used to create my LED assembly can be found here. Of course you should change the setup and LED number to fit your needs but the tutorial shows you exactly how you can choose the power supply, calculate LED needs and build the voltage regulator with a simple electronic circuit.

Finally, after I finished I hooked the power supply of my LEDs to a regular appliance timer which sets them on and off at certain times of the day. Making sure that my basil plants get enough light for their growth even when I am not at home. It is very worth noting that before I installed this LED fixture my basil plants were extremely leggy, etiolated and just dying. A few days after the LEDs where in place they started to grow like crazy :o) **Do you have any questions, comments or suggestions ? Have you also built your own LED fixture ? Leave a comment below !**

A Simple Home-Made PVC Hydroponic Growing System

When I moved into my new apartment I wanted to build a small hydroponic system I could use to grow basil just next to a window. Since I absolutely love to cook Italian food and fresh basil is a key ingredient this seemed like the best solution to enjoy my cooking to its fullest and practice the building of a new hydroponic system. I finally decided to build a very cheap and simple PVC system which currently hosts 6 beautiful basil plants that give me more than enough basil for all the Italian cooking I could possibly want. On todays post I want to share my system's design and description with you as well as some picture of my basil plants, showing you how they are doing under this great – yet very simple – PVC hydroponic growing system.

The system I built can be classified as a continuous Ebb and Flow system. It basically has a 2 inch PVC pipe with a horizontal cut on top, a reservoir, an air pump, a water pump and a 1 inch PVC framework that also acts as a secondary reservoir for the nutrient solution. The system is filled with river bed gravel as a growing media and it can be used for the growth of almost any type of plant. Of course, any rocky media that easily allows nutrient solution flow can be used and a larger pipe diameter can be used to grow other plants such as tomatoes, cucumbers, etc. For larger plants a 4 inch diameter PVC pipe and a 2 inch frame work would be required. A diagram of the system is shown below (sorry for the poor drawing skills ;o)).



As you can see, the pump constantly sends solution from the reservoir below to the gravel bed inside the 2 inch PVC pipe located above it. The solution recirculates and goes down to reenter the reservoir. Even though the actual passage of the solution may seem "biased" towards once side, the truth is that a small part of the solution actually flows through the whole pipe and ends up draining through the other side as I have not noticed any difference in development between plants in opposite sides of the tube. Since there is a level that has to be filled within the tube before a return of solution is established there is a constant feeding of aerated solution

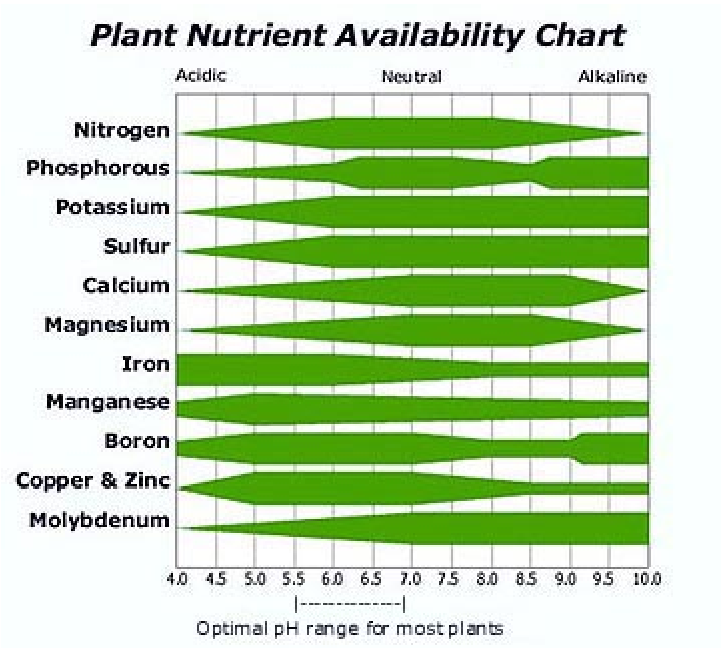
for the plants.
This system is very cheap to build and it can be made with 6 – 90º elbow joints, 3 – T joints, 2- 2′ to 1′ adapters, 5 feet of 2 inch PVC piping and about 10-15 feet of 1 inch PVC piping. You also need a container that can hold enough nutrient solution volume, a water pump and an air pump. The system provides very good growing conditions for plants and the gravel media provides adequate support for a wide host of vegatable varieties. This system is also great for strawberries and similar crops. Several improvement over this design are obviously possible and many will be featured on future blog post articles as I implement and test them.

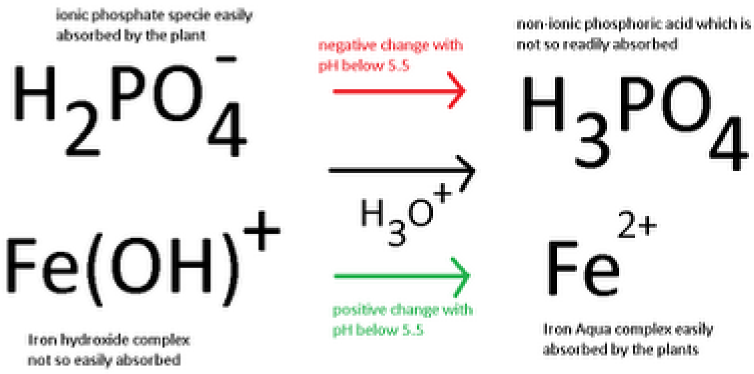
The above picture shows you my setup with the basil plants currently growing vigurously (they are currently about 60 centimeters high). Above the system you can have a small look at the high power LED fixture I built myself to provide these plants enough light (as hardly any light gets through the window). I hope you have enjoyed this article and decide to build your own simple home-made PVC hydroponic growing system. Make sure you leave any comments with questions or suggestions you may have :o).

Understanding pH in Hydroponics – Part No.2

Yesterday – on the first part of this article – we talked about the nature of pH, the origin of pH changes in hydroponics growing and why these changes happen with time within a hydroponic culture, I also talked a little bit about how to prevent pH changes by building a balanced solution with a given percentage of nitrogen given as ammonium. On the second part of this article I am going to talk about the adaptation of plants against pH changes, why certain pH levels are needed and why there is an important over-focus on the importance of pH which does not need to be maintained in ranges as narrow as most growers believe.

What is the ideal range of pH for plant growth ? The fact is that plants can grow ideally from a pH of 5.5 to about 7.0. Above or below these values certain changes start to happen within the chemistry of the solution that makes nutrients less available to the plant. The large importance of adequate – yet not excessive – control of pH values is to maintain an optimum absorption of nutrients for your plants. When we go below a pH of 5.5 certain nutrients like iron become very readily available while nutrients like phosphorous and nitrogen become much less available. This lack of availability has two main causes. The first one is the overall change of chemical species within the solution, with the newly generated species being difficult or impossible to assimilate by the plant while the second one is that species that become extremely available generate a strong antagonic effect against some nutrients. For example, iron is antagonic with phosphorous and with a pH decrease below 5, the absoprtion of iron becomes extremely easy and therefore the aborption of P becomes more difficult, the overall formation of acid phosphate species which are also not so readily available by the plant further reduces P availability. An image shown below gives you a good idea of the availability of nutrients for plant growth as pH changes.





However most growers tend to believe that the pH level of their nutrient solution is the pH level that plants have around their roots, something which is actually not correct in the sense that plants have evolved local pH adaptation mechanisms to survive to changes in soil pH. When you measure the pH of your nutrient solution you are measuring the pH of the “bulk” while the pH of the actual root-zone of your plants might be within the ideal zone for nutrient absoprtion. Therefore growers usually underestimate the actual capacity of their plants to correct pH and spend an enormous amount of time tinkering with pH to make it “ideal”.

The fact here is that plants do not like abrupt pH changes like those that happen when you add pH up/down to continuously adjust your nutrient solution’s pH levels. Plants can deal perfectly with a slow pH increase caused by nutrient absorption from 5.5 to 6.5 but when you – in a matter of seconds – revert the pH back from 6.5 to 5.5 in a matter of seconds you are causing your plants significant levels of stress since they are simply not used within their natural environment to such quick pH changes.

The easiest way I have found to deal with pH is to simply not obsess with it. Most solutions that are well balanced and contain about 10-15% of the nitrogen as ammonium and about 20-40 ppm of phosphorous will adequately contain pH within the 5.5 to 7 pH region from the beginning of your nutrient cycle to the time when the nutrient solution has to be changed. As a matter of fact – beyond the initial adjustment – the changing of pH can be avoided if the nutrient solution is adequately formulated and given in a quantity of at least one gallon per plant. Plants develop well around these pH levels and the improvement you gain from obsessing about perfect pH zone levels will be lost by the stress you put into your plant roots with pH corrections. Of course, there are easy and almost perfect solutions to pH control like the method using ion exchange resins I mentioned in a previous post. A method that mimics the way in which pH is naturally buffered within soil.

Therefore if you want to have a great hydroponic crop with little maintenance and a very good yield I would advice you to prepare your own nutrients taking pH-self balancing and adequate nutrient ratios into account. Certainly this method will give you a lot of control over your composition and a great saving in solution costs.

I hope that after reading these two posts on pH in hydroponics you have now grown a much better understanding of how pH is, how it works and how it evolves in a hydroponic culture. It is very important for you to understand that pH plays a vital role in nutrient absorption but that obsessing with strict pH zones is not beneficial for your plants in the sense that constant additions that cause quick changes in pH values cause stress to their root zone. Adequate nutrient design and a good understanding of how nutrient interact is therefore important for the correct use and low maintenance of a hydroponic crop.