An Organic, Natural Insecticide for your Garden

Few people have been able to experience the joy of gardening without encountering the nasty problem of insects. Every year, many gardens suffer from the amazing attacks of these small creatures that turn beautiful plant spaces into infested focuses of insect populations.
Up until now, most chemical solutions have acted on insects quiet effectively. In fact, some insecticides are good at removing more than 99.99% of insect populations with a few applications. Chemical insecticides are most of the time harmful for humans but sometimes they can even be safe for us. The main problem with synthetic insecticides is that they affect beneficial insect populations much more dramatically than they do harmful insect populations. The main problem with this is that is effectively diminishes the amount of insects that can predate bad insects and pollinate plants.
Organic (in the sense of natural) insecticides are sometimes good but they are never as effective as available synthetic solutions. In the few studies done about this issue, (mainly dealing with cabbage) all of them have found synthetic solutions much better at controlling insect pests. However, garlic based insecticides have proven effective at controlling insects if not completely removing them from the garden (they also prove almost non fatal to beneficial insect populations).

In order to control your insect populations easily, you can manufacture an insecticide with garlic, vegetable oil and water. Cut 3 cloves of garlic into small pieces and place them in a jar with 200 mL (about a cup) of vegetable oil for two nights (this ensures that the organic non polar molecules present inside garlic are extracted efficiently). Next, mix this with 2/3 of a gallon of water . Agitate strongly before each use. Then your insecticide is ready to be spread on your garden.

Hopefully, if spread adequately over every inch of the plant

(including the underside of leaves), the insecticide should prove efficient against most types of bad insects. It also proves effective in being resistant to rain so your plants should remain protected for a prolonged amount of time. Bear in mind that soap or detergents should not be added to improve surface tension properties because this increases the capacity of rain to remove the insecticide effectively.
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FAQ – controlling, adjusting and knowing pH in Hydroponic Gardening

Even though there has been great effort by many people to show hydroponic growing as something that can be done by anyone with little knowledge, it has come to my attention that many novice and commercial gardeners fail because of their inability to properly interpret the chemical phenomena around them. One of the variables that is primordial in hydroponic culture and that is grossly oversimplified in most literature about hydroponic gardening is the treatment of pH. For this reason, I decided to create this pH FAQ post in order to answer (in a basic but scientific way) the questions most people have (or should have anyway) about the science of hydroponics.

What is pH anyway ?

This is the most basic and important question. In layman terms, pH is a measure that tells you if a solution is acid or basic, with values of pH over 7 being basic, and values below 7 being acid. Going a little bit deeper into detail, pH is just the result of applying the operator “p” over H (which symbolizes the concentration of $H_3O(+)$ ions within a solution).

The operator “p” is just getting the negative decimal logarithm of a number. Since $H_3O(+)$ concentrations appear usually in really small magnitudes, like 0,00000001 M, using the logarithm let’s us express this in more humanly understandable numbers, like 9.

Why is 7 the neutral pH ?

Seven is the neutral pH value because the concentration of $H_3O(+)$ ions in solution is determined by the self dissociation constant of water which is 1x10e-14 and equals the product of $H_3O(+)$ and OH(-) concentrations. If $H_3O(+)$ concentrations are equal to OH(-) concentrations you have that $H_3O(+)$ concentration should equal 1x10e-7 which after applying “p” turns into 7.

Why is pH so important in hydroponics ?

This variable is very important in hydroponic gardening because it determines the form in which nutrients are present inside the solution. In pH values which are too acid or too basic, nutrients assume forms which are different from the ones which plants can assimilate. Therefore, an adequate pH value needs to be maintained in order to ensure that all nutrients are present as the right species.

How do I measure pH correctly ?

First of all, pH meters need to be calibrated prior to each measurement. In order to calibrate any pH instrument, at least two different buffer solutions must be used, one with pH 7.0 and the other with any other known pH value. The measurement should be taken with enough time for the reading on the instrument to stabilize.

How can I correct pH changes ?

Bases or acids can be added to hydroponic solutions in order to increase or decrease the pH value of a solution. Bases and

acids should be added as solutions and the amount added must be recorded in order to know how nutrients are changed. For example, if a potassium hydroxide solution is added to increase the pH of a solution, the amount of solution added needs to be recorded in order to know how much potassium was added to the solution (since this is a nutrient). Common acids to lower nutrient solution pH values are nitric acid, phosphoric acid and citric acid. I would recommend the use of citric acid to reduce pH and potassium carbonate to increase pH.

What is the ideal pH value ?

It depends on the specific plant you are cultivating. Most crops grow very well with pH values between 5.5 and 6.0, although there are some plants which require more basic or slightly more acid pH values.

How can I stop pH from changing ?

Please refer to the article I wrote about controlling the pH of your nutrient solution with buffers in order to effectively prevent pH variations inside your hydroponic nutrient solution.
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A Natural, Organic Fungicide you can easily make!

The nightmare that is fungal disease

Amongst all the problems faced by hydroponic and soil gardeners, fungi related problems remain one of the most challenging. Fungal diseases tend to start rapidly and quickly wipe out entire sections of plants, leaving the grower wondering what happened or if anything could have been done to prevent it.

Sadly, most commercially available fungicides are very toxic to humans and beneficial insects, a reason why their application is detrimental to both the health of the gardener and the environment. For this reason, many people have started to develop natural and more environmentally friendly solutions for fungi-related disease prevention.


The type of fungal disease that ruins any growers day

The issue with most organic fungicide recipes you find online

However, most gardening websites are written by people with limited knowledge about both fungicidal chemistry and biology, they therefore offer simple solutions that may fail to work. These remedies also carry some problems of their own, for example, the use of milk containing solutions over plants is proved to encourage the growth of molds and sometimes even stimulate the gathering of ant or similar insect populations. Using alkaline solutions containing bicarbonate or carbonate ions may prove beneficial for prevention but it’s effects are readily lost due to rain (which inevitably washes away bicarbonate ions).

In the light of this situation, I have decided to publish a

recipe for a fungicide I have been using for sometime, based on US patent No. 6767562. This mix was designed with both the chemistry and biology of fungal diseases in mind, taking into account that most fungi are sensitive to tannic acid and other chemicals naturally present within certain plant species.

How to make the fungicide

This organic, natural fungicide is quiet simple to make. To do so, follow these instructions:

1. Add two thirds of a cup of fresh sage leaves to half a gallon of water
2. Boil the water down to one third of a gallon
3. Add two thirds of a gallon of red wine (the patent says "fermented grape solution" to make it a little bit harder to guess)
4. Let it cool down and bottle it in an airtight container

The solution has been proven to prevent and even cure fungus-related diseases in a variety of crops (as stated in the patent). Note, this information is educational and freely available within the patent. *If you want to commercialize this, you do need to negotiate usage with the patent holder*. I hope you use and enjoy this excellent organic and natural fungicide that will keep your garden free of those nasty, crop ruining fungus pests !

What are Hydroponic nutrients ? The nature of nutrient

salts

When researchers first started to study how plants grow and what plants exactly need to develop, they found out that plant needs are very different from our own. We, as humans, need minerals, vitamins, carbohydrates, proteins and fats amongst other substances. However, plants seemed to require a small assortment of inorganic substances from which they synthesized a very large variety of organic materials.
Many hydroponic growers are confused by the fact that nutrient needs and nutrient solution compositions are provided in the form of elemental concentration. That is, hydroponic solutions are often described in the form “N 200 ppm”, “K 100 ppm”, etc. Compositions are expressed as the amount of milligrams present of a given element per liter of solution. Nonetheless, this does not mean that the element is present as a pure substance. For example, the fact that a hydroponic solution contains 100 ppm of Nitrogen, does not mean that the solution contains nitrogen as elemental nitrogen, that is, N_2 gas. This in fact, does not express the form in which nitrogen is present, it may be present either in the form of $NO_3(-)$, $NH_4(+)$ or other molecules. This has caused some confusion since some people are unaware that hydroponic nutrients are mainly inorganic salts that, when dissolved in water, form ionic substances which are the actual nutrient assimilated by the plant.

It is important then to have a clear mental perspective about the way in which things are expressed and the way in which they really are. For example, you can have a hydroponic solution with 100 ppm of P. That is, a hundred milligrams of phosphorous present per liter of solution but in no way does this express the way in which phosphorous is present within the solution. Phosphorous may actually be located as a large assortment of ions, either $H_2PO_4(-)$, $HPO_4(2-)$ or $PO_4(3-)$.

The reason why nutrient solution concentrations are often expressed as mere element concentrations instead of actual available form concentrations is because it is much simpler to

think about the sum of all the available forms of a nutrient than each nutrient form by itself. In the light of the previous example, it is much easier to say 100 ppm of P than to state a specific concentration of each ion, given that (in this case) all ions are indistinguishable for the plant.

The really important thing about this is that the grower should have a clear understanding of the nature of hydroponic nutrients. Nutrients are really ions, which are formed by the dissolution of salts in water. So when you go out to buy nutrients for your hydroponic solution you should look out for inorganic salts of the desired elements ! (below, an image that graphically shows ion dissolution)
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Keeping the pH of your hydroponic nutrient solution stable

A nightmare for many growers inside the hydroponic industry is the fact that pH adjustments need to be made every now and then to nutrient solutions. In fact, people often adjust the pH of their nutrient solutions several times a week in an effort to keep the values close to those considered ideal. However, most growers are unaware of the basic facts surrounding pH changes and how they can be avoided (please refer to the pH FAQ for more information).
The concentration of H3O(+) ions, which are the ions that determinate pH, changes according to other ions present inside the hydroponic solutions. Since plants take ions (which are charged species), outside of the solution, they cause a charge imbalance which is compensated by the generation of either H3O(+) (if the plant absorbs an ion with positive charge) or

an OH(-) (if the plant absorbs an ion with negative charge). One of the ways in which this pH change can be effectively controlled is by the addition of a specie which balances out this charge and offers reactivity against either OH(-) or H3O(+) species. Such addition of species to a solution in order to offer a chemical equilibrium protection against pH changes is called “buffering”. In hydroponics, solutions are most often “buffered” using ammonia, however, we can carry out simulations to see how this two ions act against “acid” or “base” additions and see how the entire hydroponic system reacts to this.

The simulations are carried out using the Maxima software and all the equation systems are generated according to equilibrium equations, mass balance equations and charge balance equations (this is called systematic study of the chemical equilibrium). Concentrations for all the buffering agents were treated as 0.1 mM.

Long story short, the graph below shows the results for my simulations of “acid” or “base” additions using three different buffer agents. The blue line shows the change when citric acid/citrate is used as a buffering agent, the orange line shows when ammonia is used as a buffering agent and the yellow line shows when carbonate/citric acid is used as a buffering agent.

As it can be seen, citrate provides very good buffering capacity towards acid pH values while it’s buffering potential towards basic pH values becomes lesser. Ammonia provides almost no buffering potential towards acid pH values while it provides almost the same buffering effect towards basic pH values than citric acid. Note that basic pH buffering seems the same for both buffers because here the effect of the phosphate ions inside the solution becomes more prominent.

However, when carbonate/citrtic acid is used as a buffering agent, it suddenly turns the solution’s buffering power towards both acid and basic pH values, extremely high. That said, it should be expected for a solution with this buffering mix to last several times more than a regular solution without needing any pH adjustments. In practice, the preparation of this solution has given me at least three weeks of plant intake without any need for pH adjustment.

Hydroponic Nutrients, Are they Unnatural ?

In today’s world, things seem to have started to shift towards a more “natural” look at things. People are starting to reject synthetic and “artificial” things in favor of the more “natural” and “earthy”. Well, as a scientist, I have to say that most people have some very bad misconceptions about these definitions and their “evilness” or “goodness”. Let us start from the beginning.

What is Natural ?

This is usually defined as something that comes from nature without any fundamental modification caused by humans. Therefore, you could say that blood is natural, algae oil is natural, bones are natural, etc.

What is Unnatural ?

Something unnatural can be defined as not coming or not belonging in nature. You could then say that a bee swimming is unnatural or that a plant growing inside a PVC pipe is unnatural.

What is synthetic ?

Something synthetic can be defined as chemically manufactured by humans from chemically different materials. For example, plastics are synthetic, pure sodium is synthetic, carbon nano tubes are synthetic, etc. Now see that this definition is not exclusive, something can be synthetic but present in nature, like synthetic hormones, synthetic vitamins, etc.

Now which is bad and which is good ?

This is where most people have it wrong. Natural things are good ? Well, that depends, which natural thing. You eat and orange and it’s good, you swallow a scorpion and its bad. Both things are natural. Nature produces things that are toxic and lethal, but nature also produces things that are good for you. You cannot judge something to be good just because it belong inside a group, every category has both good and bad things.

Are unnatural things bad ? That depends. You smell a neurotoxin, you are dead, you use a sulfonamide antibiotic when you have an infection and your cured. It all depends on the specific thing your talking about and the specific use your giving it. There is no sense in judging something as being good or bad for the sake of it.

Now, are hydroponic nutrients unnatural ?

No ! Hydroponic nutrients have the exact same chemical form nutrients have in soil. Plants cannot absorb these nutrients if they don’t have these specific forms so hydroponic nutrients are indeed natural. They are the exact same molecules that are found in soil. Hydroponic gardening is just a form of manipulation in which plants are given an amount of these nutrients that fits their needs optimally. It differs from their natural conditions in that hydroponic growth conditions are better. The plant gets all it’s nutrients in the same form it gets them from the soil without needing to break up organic matter to get them or fighting pathological microorganisms. Indeed, hydroponic gardening has both positive

and negative qualities, just like everything else !

Hydroponic Gardening for Small Spaces

People everywhere enjoy the pleasure of growing plants. Most people use their backyards for this purpose, growing ornamental as well as plants used for eating. However, many people around the world don’t have a backyard because of space limitations, something which is becoming more common everyday with the growth of world population.

For people who want to grow beautiful flowers, healthy vegetables, herbs and spices in reduced spaces, hydroponic gardening becomes an evermore interesting option.

Hydroponic closet for a small space

Hydroponic gardening, which does not use any soil, is ideal for growing many plants. This type of culture has the advantage of not needing any soil and of letting the grower choose the precise composition of the nutrients received by the garden. When this is coupled with a tight space,

hydroponic gardening opens up the possibility to grow plants in much higher densities and in much better quality and uniformity than soil based plants.

With living spaces being more populated everyday and commercial soil based vegetables becoming more polluted and damaged, it is evident that the use of currently unused city spaces (such as rooftops) will become very important for the food provisions of the future.

Small hydroponic systems for people with drastic space limitations can be easy to install. From the inside of a closet to a small patio or a window edge, soilless gardening offers the solution to the problem. Systems known as hydroponic grow closets are becoming more and more popular everyday.

The Hoaglands Solution for Hydroponic Cultivation

This hydroponic nutrient solution was developed by Hoagland and Snyder in 1933 and it’s one of the most popular solution compositions for growing plants (in the scientific world at least !). The Hoagland solution provides every nutrient necessary for plant growth being appropriate for the growth of a large variety of plant species. The solution described by Hoagland in 1933 has been modified several times (mainly to add iron chelates and the like, but you can use the salts you normally use for preparing your solutions as long as you append to the concentrations given for each element) but the original concentrations for each element are shown below.

N 210 ppm

K 235 ppm

Ca 200 ppm

P 31 ppm
S 64 ppm
Mg 48 ppm
B 0.5 ppm
Fe 1 to 5 ppm
Mn 0.5 ppm
Zn 0.05 ppm
Cu 0.02 ppm
Mo 0.01 ppm

As you may notice, the Hoaglands solution has a lot of N and K so it is very well suited for the development of large plants like Tomato and Bell Pepper. However, the solution is very good for the growth of plants with lower nutrient demands such as lettuce and aquatic plants with the further dilution of the preparation to 1/4 or 1/5.

Also remember that the amount of iron you use should be in proportion with the amount of phosphate placed inside the solution, when used at higher strength, there exists the possibility of iron precipitation if non adequate chelates are used. If possible, try using DPTA instead of EDTA (which is not so good a chelating agent for hydroponics).

Indoor Hydroponic gardening, the cheap way !

Hydroponic gardening is a great way in which plants can be grown and cultivated with yields far superior to those of traditional soil based culture. However, the last frontier of hydroponics remains being indoor growing. Light, which we take for granted because of the sun, is a crucial factor for plant growth and becomes dramatically diminished or non existent

inside our house’s or building’s interiors.
The solution, of course, is using artificial lighting to grow our crops. Unfortunately, the amount of light needed by plants (which is measured in Lumens) is quiet high. In order to fulfill a plant’s light needs, high power consuming artificial lights must be used. In fact, most indoor growers use halide lamps which are in the range of 1000 to 2000 watts of power.
The amount of energy consumed by these growing lights is so huge because most of the energy provided to the lights is wasted as heat and little of this energy becomes usable to the plant as light. Other problems also arise because of the excess heat eliminated by this high-powered illumination devices.

The solution for this problem is actually very simple. The use of LEDs (light emitting diodes) for hydroponic growth has become popular because of their low energy consumption (almost 20 times less than regular growing lights). They are simple to install and provide all the necessary wavelengths your plants need for adequate growth. For instance, two tomato plants can be grown with as little as 50 W of growing LEDs while this same tomatoes would consume in excess of 1200 W with traditional lighting. If you are wondering where these lights can be purchased, just search ebay for “growing LED’s” and a bunch of sellers that offer these products will come up.

Hydroponic Floating System for Lettuce Production

Lettuce is one of the most common vegetables produced in hydroponics. It is amongst the first 3 vegetables produced in hydroponic crops around the world with tomato and bell peppers. Most lettuce production systems are designed around two ideas, either the NFT (nutrient flow technique) system or the floating raft system. The later system is of particular interest because it is highly economical and can produce bast volumes of hydroponic lettuce.
One of the main problems with raft systems is that the fact that the nutrient solution is constantly stagnant demands the use of pumps to circulate water and generate significant aeration. Without this precious oxygen reaching the plant's roots, floating raft systems experience high loses of yields in the form of dry weight, nutrients, etc.
Nonetheless, raft systems can be improved dramatically in order to avoid the recirculation of solution and aeration of the roots by mechanical means. This is done in an exceedingly simple way, by placing the raft not directly above the hydroponic solution but a few centimeters above from the solution itself.

The results are incredible. Without any mechanical aeration or movement, this hydroponic system achieves dry weights superior to any floating raft system published in peer reviewed literature. This research was done by horticulturist B. A. Kratky and was published in the year 2005.

So if you are searching for a cheap hydroponic system which can offer you lettuce in high yields with no power usage, this is precisely the way to go. I will publish a post soon showing how this can be done and how you too can enjoy this great system for lettuce cultivation.