iGROW365 Details about "Hydroponics" the word that literally means "water works"

Hydroponics is a method of growing plants in a water/nutrient-rich solution or with a soilless medium. Although in theory any plant could be grown hydroponically, in practice hydroponic gardening is usually reserved for exotic plants and flowers, or for "greenhouse" style vegetables, such as lettuce, tomatoes, peppers, cucumbers, melons and culinary herbs. The detailed information learned from farmers about cultivating with hydroponics has now been adapted specifically to the cultivation of high grade cannabis.

With hydroponics, plants can be grown in a completely controlled environment, free from soil-borne pests and diseases. By carefully monitoring nutrients, light levels and temperature, phenomenal yields of high quality, delicious produce can be obtained, without using dangerous herbicides or pesticides. Therefore, hydroponic gardening is gaining popularity for both commercial and home gardening applications around the world.

Although the hydroponics industry is growing in the United States, the US still lags behind much of the industrialized world in commercial hydroponics technology. In Northern Europe, the majority of greenhouse vegetables are already grown in hydroponics, and in the Netherlands hydroponics and zero run-off greenhouses are the national standard. Australia not only produces vast amounts of hydroponic vegetables, it even grows fodder for animals in 50-foot, hydroponic trailers, each trailer producing a ton of feed a day, every day, 365 days per year. Hydroponics conserves water and natural resources, protects our rivers and ground water from fertilizer run-off, and produces more crops of nutritious fruits and vegetables in a sustainable manner.

Hydroponics also has an important place in the classroom. Experimenting with hydroponics helps students better understand how plants grow. For example, by withholding certain nutrients from the hydroponic solution, students can observe firsthand how plant growth is affected, then take steps to correct the deficiencies. Other experiments can be done with water quality, lighting, temperature and humidity control, and even carbon dioxide levels. In short, a hydroponic garden is a practical way for any school to set up an excellent botany lab in a controlled environment.

Many primary and secondary science and agriculture programs are already experimenting with hydroponics. In some cases, teams of students build, plant and maintain their own systems, and even market the harvests that they produce. Not only are the students becoming intimately acquainted with the science of growing, they are also learning business and accounting skills, and they even produced their own branding! Hydroponics provides a hands-on approach to learning, and many of the life science educational objectives are reinforced.

A few universities teach environmentally controlled agriculture with an emphasis on hydroponics, but there is still a great need for hydroponics education at the post-secondary level especially when it comes to the cultivation of cannabis. So to better understand how hydroponic gardening works, let's first review the basics of plant growth.

Plants are composed of roots and shoots. Water and minerals are absorbed by the root system, but plants can't take up large organic molecules. In soil, minerals and organic matter must first be broken down into very small particles through erosion and the digestive enzymes of microorganisms. The root hair cells, found on the root tips, can then absorb water and minerals into the plant in the form of ions, tiny electrically-charged particles. In hydroponics, water and nutrients are absorbed in exactly the same way, except the minerals are already in their ionic, water-soluble form. Upon demand by the plant, the water and minerals are quickly absorbed into the root xylem, where they are transported upward into the plant.

The shoot system consists of stems and leaves. Xylem in the veins of the plant transports water and minerals to chloroplasts in the leaf cells, where water combines with carbon dioxide from the air in a process called photosynthesis. Chlorophyll (the green pigment in plants) uses light energy from the sun to convert the water and carbon dioxide into simple sugars called photosynthates. The waste products of photosynthesis, oxygen and water vapor, are transpired from the leaves, and the photosynthates are transported throughout the plant by phloem vessels.

Some of the photosynthates are used for plant growth, reproduction and repair, and the rest are stored in the roots, stems and fruit as sugars and starches. It is these stored carbohydrates which, in food crops, are edible. Generally speaking, the more efficient the uptake of water and minerals by the plant, the higher the sugar content in the sap. Sugars in the sap are measured as “brix” %. Higher brix readings generally mean healthier plants with better flavor and nutritional quality.

Hydroponic farming optimizes the nutritional and environmental conditions for plant growth, thus improving the flavor and nutritional value of food and medicinal value of medicine. For example, it is a scientific fact that cannabis grown hydroponically will have 20-30% more essential oils than field grown. Therefore, cannabis grown in water can actually have more cannabinoids and flavor than plants grown in rich, farm soil. Hydroponically grown cannabis, if managed properly, can have higher cannabinoid profile and mineral content, too.

Hydroponic gardening starts at the propagation stage. One of the most popular hydroponic growing mediums is rockwool, a fibrous material with a high air and water holding capacity. Rockwool propagation cubes are first soaked with a slightly acidic nutrient solution, drained, then seeded directly into the medium. The tray can then be covered and put into a propagation station under iGROW Induction lights until the seeds germinate.

Cuttings can also be propagated in rockwool. The cuttings are simply dipped in a protective rooting gel such as Clonex. Special rooting hormones, nutrients and antimicrobial agents in the gel seal the wound and help the root system get started. Simply cut a branch tip with three or four sets of leaves, remove the bottom leaves, dip the cut end into the cloning gel, and stick the cutting into your favorite growing medium just deep enough to support the plant. Then lightly mist the clones with water, cover them with a humidity dome and place them in a propagation station under iGROW Induction lights.

Once the seedlings are well rooted and actively growing, the plants can be transplanted. Simply take the new plant, rooting cube and all, and place it into your favorite growing medium. The small rockwool starter cubes can also be transplanted into larger rockwool growing blocks. The growing block could be eventually be transplanted again onto a three-foot rockwool slab, where it will be fed through a drip line for the entire duration of the crop. Since rockwool provides such excellent drainage and root aeration, it is almost impossible to overwater and kill the young plants.

There are many hydroponic systems available for commercial and home use. Some commercial growers prefer the rockwool medium in a continuous drip, recirculating system. The Rockwool slabs are placed on a flat surface with individual emitters at each site to irrigate each plant. Troughs run underneath the slabs to catch the nutrient solution and return it to the reservoir. A submersible pump in the reservoir continuously re-irrigates the slabs and the recirculation process continues. Another popular system uses an "ebb and flow" style of recirculation. The plants are anchored in a soilless mix, such as expanded clay, perlite or vermiculite. Volcanic perlite is an inexpensive material, with good capillary action and aeration properties. Perlite is often mixed with vermiculite, a spongy material that tends to retain nutrients, while providing excellent aeration for the roots. In an ebb-andflow system, the nutrient solution is contained in a reservoir underneath the grow tray. A timer clicks a pump on, raises the solution to moisten the roots, then recedes back down, pulling fresh oxygen to the roots. The process is repeated three or four times a day.

Aeroponics, a system in which the roots are suspended in air, is another system gaining in popularity. Phenomenal root growth is made possible, with excellent results to the plant. For example lettuce plants can be rooted in web pots and fitted into individual holes. A sprinkler creates a mist chamber, and the roots grow directly in the highly oxygenated nutrient solution. NASA and other research facilities are doing extensive experimentation with such systems.

iGROW365 Fertimix nutrient control is a major advantage with hydroponics over soil-based growing. Some soils have nutrient deficiencies, but once fertilizer salts are added, there is no easy way to change or reduce their concentrations. Hydroponics, on the other hand, makes nutrient manipulation easy. During the vegetative growth stage, a nitrogen-rich Grow Formula is used. At the fruiting and flowering stage, the Grow Formula is drained, and a phosphorous and potassium-rich Bloom Formula is used in its place. The results? Bumper crops of delicious fruits and vegetables every time.

Plants require 17 essential elements to grow and reproduce. The first three are free. Hydrogen, oxygen and carbon come directly from water and air and are essential for photosynthesis and sugar production. These three elements account for more than 95% of a plant's dry weight. The other 14 essential elements are minerals and are provided in the hydroponic nutrient solution Macroelements, those elements used in greatest quantity by the plant, include:

Nitrogen- a critical component of all proteins and enzymes. During the first half of a plant's life, the plant will assimilate more than 80% of the nitrogen needs for its entire life. So nitrogen is particularly important during the vegetative growth stage.

Phosphorous- provides the high-energy phosphate bonds of ATP, an energy molecule essential for life. Phosphorous is used throughout the life of the plant, but is particularly important for root, fruit and flower development.

Potassium- a catalyst in carbohydrate metabolism and an activator of many key enzymes. It is particularly important during the fruiting and flowering stage to maintain fruit quality. During heavy fruit development, a tomato plant can strip most of the potassium from the nutrient formula in a matter of days. Adding a little extra P-K Boost (phosphorous/potassium supplement) during the reproductive stage can help keep fruit quality high.

Calcium- strengthens cell walls and produces strong stems and shoots. A strong vascular system makes it easier for the plant to take up water and all the other essential elements. Calcium must be kept separate from the sulfates and phosphates in concentrated form, or it can react to form lime scale.

Magnesium- the central element in chlorophyll, the green pigment that is essential for photosynthesis. Magnesium also activates the enzymes that release the energy of phosphate bonds. So adequate levels of magnesium are required throughout the entire life cycle of the plant.

Sulfur- present in some amino acids, co-enzymes and vitamins. Sulfur also enhances the flowering process and contributes to some flavors and aromas.

Microelements are also essential for plant growth and reproduction, but they are used in much smaller quantities than the macroelements. Many of the trace elements are metal ions that turn on enzymes in the plant. Without them, the chemistry of life could not function at normal temperatures and the plant would die. In hydroponics, the essential metal ions are usually provided in their "chelated" form. "Chela" means "claw". So chelates are organic molecules that attach to metal ions like a claw, holding them strongly enough to keep them from reacting with other molecules, but weakly enough to release them to the plant on demand.

The microelements include: Iron, Manganese, Copper, Zinc, Boron, Chlorine, Molybdenum, Nickel.

A full-spectrum hydroponic nutrient solution must contain all of the essential macro and microelements. Most commercial nutrient solutions come in a 2-part, A/B concentrated form. Part A is measured and added to the water first. The reservoir is then filled almost to full and Part B is added. A and B mixtures are kept separate in their concentrated forms to prevent chemical reactions that could lock out nutrients and make them unavailable to the plant. Once diluted in water, however, the elements remain in balance. pH Control Just adding plant food to the water isn't enough. The pH levels of the nutrient solution should be monitored daily to insure optimal utilization by the plant. pH is a measurement of the acidity or alkalinity of the nutrient solution. A pH of 7 is neutral, under 7 is acidic and over 7 is alkaline or basic. The ideal pH level for absorbing nutrients by the plant roots in hydroponics is between 5.8 and 6.4, or slightly acidic. If the pH is too high, iron and some of the other metals may become unavailable to the plant. If the pH is too low, the uptake of calcium, magnesium and other macroelements may be hindered.

Adjusting pH is easy in hydroponics. If the pH is too high, adding a little dilute acid such as phosphoric acid will quickly bring it down. If the pH is too low, adding a base such as potassium hydroxide will bring it back up. For most plants, a pH balance of 6.0 is an ideal target. Commercially-prepared pH Lower and pH Raise mixtures are readily available in safe, easy-to-use formulas.

For best results, check the pH daily. Inexpensive pH test kits, specifically designed for hydroponics, are available at most hydroponics retailers, or they can be purchased on line. Simply take a small water sample in a test tube and add a few drops of pH indicator solution. The color of the sample will change and a color chart will tell you the pH. If you are color blind or if you want more accurate readings, pH meters can be used instead. Although in many ways they are easier to use, pH meters require periodic calibration and they are fairly expensive. Most beginning gardeners can do just fine with the inexpensive pH test kits as long as they can keep the pH of their nutrient solution between 5.8 and 6.4.

The EC, or electrical conductivity, of the solution is also important for plant growth. Distilled water has an EC of about zero; it doesn't conduct electricity. But the higher the concentration of mineral ions in the water, the more it conducts electricity. Therefore, EC is a general measurement of mineral content in the water and shows how concentrated or dilute a nutrient solution is.

A conductivity meter can be used to test EC. An EC range of 1.2-3.5 Mho (ohm spelled backwards) is generally desirable. A low EC reading means a slightly dilute concentration. Low to medium levels of EC promote vegetative growth, and should be used in the vegetative growth stage. Medium to high levels of EC restrict vegetative growth, but improve fruit quality. So medium to high EC levels should be used during the fruiting and flowering stage. Generally speaking, use a half-strength nutrient formula for tender clones and seedlings, and use full strength nutrients when the plants are more mature.

If the EC level is too low, simply add more nutrient solution to the water. If the EC gets too high, especially on hot days, add more water to the reservoir. Since plants use different nutrients in varying degrees, the entire nutrient solution should be drained and replaced periodically to insure that the proper mineral balance is maintained. For indoor gardening, replace the nutrient solution every ten days, or so, to prevent nutrient deficiencies from developing.

In a commercial greenhouse setting, it is necessary to install more advanced controllers to compensate for larger fluctuations in temperature, light levels and other variables. The iGROw365 computer controls continuously monitor temperature, humidity, accumulated light levels, wind speed and direction, and even the pH and EC of the nutrient solution. With computerized feedback controls, the entire greenhouse can be automated for optimum quality and yield.

Hydroponics is not as complicated as it seems. In fact, with the right set up it can be even easier than growing in soil. Soil is more forgiving in some ways, but there are many more variables when using soil instead of a soilless medium. Over watering, under watering, over fertilizing and under fertilizing are common problems when working in soil, and minerals can build up to toxic levels over time.

Hydroponics, on the other hand, is like creating the perfect soil. Not only are all of the essential minerals provided in water-soluble form, but the ideal nutrient balance can be achieved for every stage of plant growth. Simply use a good Grow Formula during the vegetative growth stage and a good Bloom Formula during the fruiting and flowering stage.

Hydroponics provides the perfect water, oxygen and mineral balance for optimal plant growth. If you give your plants the right mineral balance, plenty of light and a relatively stress-free environment, abundant harvests of quality flowers and can be used year round.