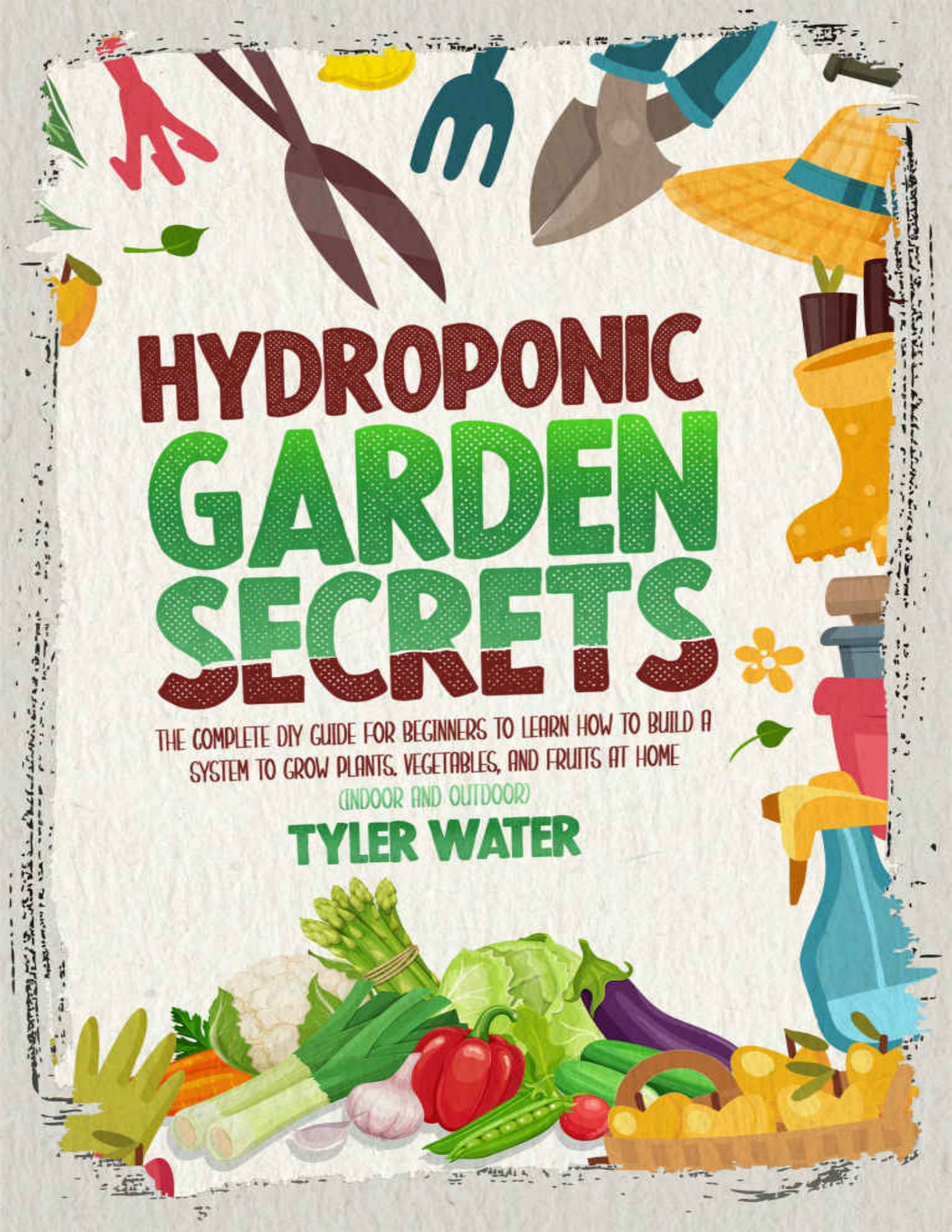
HYDROPONIC GARDEN SECRETS

THE COMPLETE DIY GUIDE FOR BEGINNERS TO LEARN HOW TO BUILD A SYSTEM TO GROW PLANTS, VEGETABLES, AND FRUITS AT HOME (INDOOR AND OUTDOOR)

TYLER WATER



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Tyler Water

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Introduction

Hydroponics is a generic term that embraces different gardening techniques that have as a standard feature the use of water and nutrients to feed plants that are grown “out of the soil” or without using the land.

There are two main methods of hydroponic gardening; the first foresees the use of “inert” materials or supports whose purpose is only to support the root system of the plant, the other is the direct immersion of the roots in the nutrient solution.

The advantages of hydroponic without soil gardening—compared to traditional gardening techniques—lie above all in the possibility of starting one or more hydroponic crops even in less hospitable environments and in conditions not suitable for the birth and growth of plants. For example, it is indicated in all those places characterized by a high drought or where temperatures are particularly rigid or in areas where the soil under excessively sandy, rocky, or arid.

Amount of Water to be Provided for Irrigation

Another essential aspect of hydroponic gardening fundamental for fans and professionals of hydroponic gardening is the quantity of water to be provided for irrigation: in traditional crops on the land, the amount of water necessary to be able to cultivate and make the plants fruit is clearly higher compared to that required by vegetables grown in hydroponics. In fact, it is

calculated that the ratio is 10 (for traditional crops) to 1 (for hydroponic crops).

Hydroponic Culture

The saving of water is reflected both in the economic aspect and on the environmental issue.

In short, hydroponic gardening—also known as hydroponic culture precisely because it affects different economic, social, and even cultural areas—has a decidedly limited ecological footprint compared to traditional gardening techniques.

Use of Fertilizers, Herbicides, and Pesticides

Another critical factor is the use of fertilizers, herbicides, and pesticides used and the relative quantities foreseen in the two types of crops: the volumes of fertilizers used are somewhat limited and always well targeted. Furthermore, there is no dispersion of the soil. Herbicides are not used because they are not necessary, while pesticides are used in small quantities.

Organic Hydroponic Gardening

For those who want to grow organically, it is possible to use organic fertilizers that allow you to have a hydroponic organic culture, respecting health, and the environment.

Why Choose a Hydroponic Gardening Method?

In a Hydroponic system, plants grow out of the ground, in a fully regulated crop context and free from pests and diseases from the soil.

By controlling environmental parameters, such as light, nutrients, temperature, pH, and conductivity, results are obtained much higher than traditional crops, without having to use pesticides that often produce harmful effects on the culture itself.

The hydroponic gardening technique maximizes the yield in terms of quality, quantity, and speed. For this reason, hydroponic crops are becoming increasingly popular and appreciated not only by professionals and large distribution chains (we point out that most of the tomatoes on sale today in supermarkets come from hydroponics) both from small direct growers and —for pleasure or work—they decide to try their hand at crops of this type.

Chapter 1
Equipment

Hydroponics Perfect Equipment

1. It holds an even ratio of air and water.
2. It helps pH changes in the buffer over time.
3. It's flushed quickly and re-wets after being fully dehydrated, as would be the case during transport.
4. It's reusable or biodegradable, so that safe handling is assured.
5. It's cheap, affordable, and easy to get.
6. It should be lightweight and work both indoors and outdoors easily.

In most hydroponic gardens, soil-free growing media are mainly used to start seeds and to root cuttings. The narrower the medium a system requires, the simpler it is to run, and the less it costs. This is an important consideration for those who intend to make a profit out of their hydroponic gardens. Since river gravel and sand were used in early schemes, modern-day soil-free media have come a long way. An ideal medium will accommodate a combination of air and water approximately equal. The plants require oxygen and nutrients to enter their roots, as you have discovered. Every medium's water/air holding potential is determined by the small spaces in between each granule or fiber. Such medium "holes" are known as "interstitial spaces." Coarse gravel, on the other hand, has large interstitial spaces that can hold much of both air and water. Yet, as science would have it, once the interstitial space becomes too big to hold the water

in place for capillary action, you guessed it, the water runs right through. If your body continuously recirculates the nutrient solution, it would be necessary to have a fast-draining medium. But obviously, coarse gravel is not a good medium for a system that does not circulate nutrients to the plants constantly.

Coconut Coir

My favorite growing loose medium is coconut coir, otherwise known as Ultrabeat, Cocopeat, and CocoTek. Coco coir is a major advance in organic soil-free growing mediums. This incorporates Vermiculite water retention with perlite air retention. However, it is a completely organic product made from shredded coconut husks. Unlike peat moss, which is rapidly getting depleted from overuse, coir is a resource that can be completely renewed. There are now several variations of coir available on the market. The most popular format is the compressed briquette, which requires soaking in a gallon of water before use. The coir re-hydrates during soaking, expanding to six times the size of the original briquette, resulting in approximately 1/3 cup of loosed coir ft with consistency and color that closely resembles fresh coffee. Coir isn't soiling your hands, clothes, or carpets as an added benefit. This easily wipes clean without any trace.

Perlite

Perlite was around longer than any other growing soil-free medium. Made from air-puffed glass pellets, perlite has excellent oxygen retention and is almost as light as air. The ability to retain nitrogen is the main reason it's used in soil and fertilizer-free blends as a substitute. Perlite's principal drawback is its lightweight consistency, making it easy to get washed away. This drawback makes perlite an undesirable medium in hydroponic flood—

and flush—type structures, or those that would be prone to strong winds and rains if they were placed outdoors.

Perfect Starts

The latest breakthrough in growing media is the “molded” organic compost starter sponge and a flexible, biodegradable polymer binder. Such creative growing sponges, available in several shapes and sizes, address the main problem encountered by farmers as they choose to use an organic medium in a hydroponic system. Namely, during transplantation, they do not break apart or collapse, which helps to prevent damage to fragile roots. This is a significant advantage because the leading cause of transplant shock is the root damage that occurs during transplantation. The starting sponges exhibit a perfect air-to-water holding ratio, and when used in conjunction with their plastic tray inserts, they will guide the roots to grow directly down rather than spiraling, as is the case with many other types of starting trays. Because the connectors do not crack or fall apart and clog fragile sprayers, Great Starts perform well in all hydroponic systems.

Rockwool

Rockwool is composed of molten rock, which is woven into long fibers like clay.

It retains water promptly and has conventional seepage properties, which is why it is broadly utilized as a beginning media for seeds and as an establishing medium for cuttings. In my opinion, Rockwool’s primary benefit is its sterility from pathogens and just about anything else that might contaminate a hydroponic system.

Hydroponics System

A hydroponic system should be designed to meet plant-specific requirements with the most reliable and efficient nutrient delivery method(s) available. The three main plant-requirements a hydroponic system must meet are:

1. Provide roots with a fresh, well-balanced water and nutrient supply.
2. Maintain an optimal level of gas exchange between the roots and the nutrient solution.
3. In any case of pump failure or power outage, protect against root dehydration and immediate crop failure.

Whether active or passive, hydroponic systems can be. Apart from being more efficient in all spheres, and therefore more productive, how easily they can be implemented in an automated greenhouse is a superb feature of active hydroponic systems. To deliver outstanding results, the automation system does not have to be complicated. Just as a fan can be connected to a thermostat to control temperature, a timer may be connected to a pump to supply the plants with nutrients as needed. If such a device is properly designed, a large reservoir of nutrients may feed the crop for weeks before a refill is required. In this scenario, the garden will continue to thrive indefinitely, as long as the system is reliable, without the need for continuous supervision.

To order for a hydroponic device to be deemed efficient, we need to ensure consistent fulfillment of the three main plant needs. Efficiency is just as critical because it will determine the operating expenses, and can in some situations, avoid the increasing world from being disturbed. By intelligent engineering, the easiest way to build a stable, efficient system is. Combined with hands-on training. Despite the feats of modern engineers, these days

are quite incredible; complex problems are sometimes solved with even more complex solutions.

Experience has proven that simple solutions tend to be the most reliable. So following the old US military dictum, “Keep It Simple Silly” (KISS), the hydroponic gardener can certainly help to achieve consistent, reliable results.

And now that we have a more comprehensive understanding of how a hydroponic system works, let’s look at how some of the active hydroponic techniques currently in use today employ some of the same hundreds and even thousands of years ago garden techniques used. One of the earliest records of people who use hydroponics describes the Mexican Aztec floating gardens. Such parks, complete with water lilies and hyacinths, were designed close to natural ponds. In natural ponds, plants in a bioponic setting derive water and nutrients directly from the dam. Waste products from fish, birds, and other animals provide the bacteria in the sand and mud a rich mix of organic nutrients to grow on. Such microbes’ excrements then provide the plants with the nutrients which they need to survive.

Freshwater, in the form of snow that falls from the sky, replenishes the water that is transpired by the plants and lost to evaporation. In the same way, the falling rain or running water created aeration and drainage in the ancient water field. When the rain stopped coming, or the water was running dry, such plants would stagnate and eventually dry up. Because of this, these early garden builders designed complex irrigation systems composed of troughs that could supply water where it was most needed, and sometimes over great distances.

Sand and Gravel

Although the sand may be successfully used as a growing medium, due to the small interstitial spaces between the grains, it has poor aeration qualities. Remember to look for high water carrying potential combined with good drainage quality when considering a soil-free medium for hydroponics. The mix will mean that your choice of media helps the roots to eat correctly, remove CO2, and absorb oxygen. If proper nutrient and water circulation are met, you would be surprised at the mediums in which plants can be grown. I once grew a plant packing peanuts in Styrofoam, and we've all seen weeds growing out of the holes in the asphalt sidewalks. Recent research has shown that oxygen plays an important role in the root zone. For the plant to conduct respiration, oxygen is required and provides the energy needed to consume water and nutrient ions. These studies have demonstrated that increased oxygen absorption by the roots leads to healthier, larger, and faster-growing crops. As the results of this work are published, new growing methods are being created to extend these findings as well as further increase efficiency.

The Dutch Bucket System

This system is appropriately named because it was first introduced in Holland and is now widely used for roses, tomatoes, and cucumbers by commercial growers there. The Dutch Bucket system allows growers to make use of just about any growing medium, including coconut, perlite, LECA stone, gravel, and even sand.

The Dutch Bucket is essentially a 2, 5-gallon bucket with a special drain fitting and, as a precautionary measure, retains a small nutrient reserve at the bottom. This approach is best suited for long-term large crops like vine tomatoes, cucumbers, and roses. Each bucket is independently fed by a single or double dripper with nutrient solution and drains into a common

drain tube made from a 1.5 inch PVC pipe via the bucket. The reservoir of the device is located below the drain pipe level, and gravity takes the solution back to it. A pump then recirculates the nutrient solution back into the drippers to reset the feeding process. The inset illustration shows how a slight recess on the bottom of each bucket allows it to rest flat on top of a drainpipe. Dutch Buckets can be placed at just about every suitable distance, but growers (and plants!) recommend not less than a 10” interval in the middle.

The Raft System

The raft system provides a fascinating method for raising lettuce and other crops of short stature. To maintain a high level of dissolved oxygen to prevent dehydration, the nutrient solution is pumped and aerated from below. The raft method is a very economical way in which large quantities of lettuce and mixed greens are processed in no time.

Perfect System

1. It has a simple, economical architecture.
2. It’s fully automated and needs the smallest amount of day to day operation.
3. It’s designed to grow your crop choice; for example, the NFT system is perfect for Lettuce but not for Tomatoes.
4. No water and nutrients wastes.
5. It provides exactly the right air-water ratio for your plants to maximize growth.

The AutoPot System

Relatively new to the market is the Autopot here in the US. A special, self-fed planter that has proved to be very effective in commercial plants around

the world. A “SmartValve” resides within each Autopot double tray module, which automatically sub-irrigates plants with a nutrient solution on demand. Since the SmartValve can be fed with gravity, small installations (20 trays or less) do not require pumps and timers. This makes the Autopot suitable for use in unsupervised areas or where there is limited access to electricity.

Vertical Gardening

This is yet another interesting aeroponics application. Verti-Gro invented it, and it represents a great way to save greenhouse space. The system works much in the same way as an aeroponic system except that it shares a drain pipe with as many units as needed. See the cylinders growing underneath the black hoses. Verti-Gro also developed the devices for Disney’s Epcot Center in Florida.

As you can see, designing the hydroponic system represents equal opportunities for challenge and progress. If you can learn the simple plumbing skills that would potentially be required, you can have a lot of fun playing and building on the hydroponic systems currently in use.

Chapter 2
Hydroponic Growing Systems

What is a Hydroponic Growing System?

Hydroponics can be described by simply saying that it is a process of growing plants with water and nutrients without the use of soil. The water is given to the roots of the plants that are being grown. The plant roots may hang in the nutrient solution, misted, enclosed inside of a container, or a trough that is filled with a soil substitute.

There are many different methods of delivering water to the root of the plant. For the growth inside containers, each of the plants will need to be provided with an emitter for the water from an irrigation system. Water can be channeled to a row of plants inside of a trough as the nutrient film technique. A large tray of specific plants can be watered from blow-by filling the tray with water and then allowing it to drain all of the excess water. This is called flood irrigation. Water is then recycled within the nutrient film technique and flood systems. It is harder to recycle using a drip irrigation system, and it requires extra equipment like water sterilizer and fertilizer monitoring, as well as adjustment equipment.

In combination with a greenhouse, hydroponics is a technology and is inexpensive. Hydroponics does not require a lot of knowledge and can be done with the most basic information; however, it can be done on a much larger scale. It will depend on the land you have available and the time. It

will also depend on the purpose. For example, a person only wanting to grow herbs will have much less work than one who wants to grow a year-worth of vegetables for a family of five. Since the regulating of the aerial and the root environment is crucial, hydroponics is usual performed inside of a shelter. The enclosures are used to offer control over air and root temperatures, light, water, nutrition, and the climate.

There are different types of controlled environments. Each component of the environment agriculture, also called CEA, is equally crucial to the process. Not every hydroponic system is cost-effective. If attention is not balanced from the structure to the environment, the system will prove to be less productive than have planned. Therefore, it is extremely important to pay equal attention to every aspect of the hydroponic system.

How the Hydroponic Systems Work

Biological decomposition in the soil breaks down the organic matter into nutrient salts that the plants will feed on. Water dissolves the salts that allow the uptake of all the nutrients by the plant roots. For a plant to receive a well-balanced diet, everything inside the soil or solution must be in perfect balance. The water quality can be an issue due to water that is alkalinity or even have a bad salt content. It will result in an imbalance of the nutrients, and the plant will grow poorly. Softened water will contain amounts of sodium that prove to be harmful to the plant. Water that is high in salts should never be used. Salt that is great than .5 million or 320 parts per million will cause a bad imbalance.

Hydroponic plants will have the perfect balanced diet of food, as well as water that is delivered directly to the plant roots. With the proper exposure to light or sunlight, the plants grow and will develop with much less energy

than it would use a typical growing technique. A soil-free medium like sand, fiber, coco fiber, or more can be used in order to anchor the plant roots. These mediums are porous. This means they hold the water and the air that is necessary for thriving plants. Air circulation around the plant leaves is crucial too. It will prevent plant diseases that are caused by stagnant, moist conditions. Indoor units often will have a small fan in order to circulate the air.

Here is a list of the benefits of hydroponic systems:

- Offer the ability to produce higher yields than soil-based agriculture.
- Allow food to grow anywhere that does not support soil crops.
- Overcome seasonal limitations.
- They are portable.
- Harvesting is extremely easy.
- Eliminate the need for pesticides.
- It’s a learning and fun experience that the whole family can be involved in.
- Hydroponically grown plants like basil, lettuce, and other plants can be packaged and given or sold while they are still alive, which prolongs their shelf life.
- Solution hydroponics does not require any disposal of solids.
- Hydroponics will allow greater control over the plant root zone.

- Hydroponics is often the best way to produce a cropping method in different remote areas that do not have suitable soil.
- Solution hydroponics offers visible roots.
- They are great for teaching, as well as research.
- Solution hydroponics keeps your plants safe from soil-based plant diseases.
- You will not have to deal with weeds.
- The crops are not contaminated by the soil.
- They cost less than soil-based gardens.
- Plants tend to be healthy and grow larger, as well as faster.
- Temperature fluctuations, over or under watering, wind damage, lack of light, and excess sunlight can be controlled.
- Shade cloth is easy to install and removed.
- It is flexible. You can do it as a hobby or professionally.

Seeds and Seedlings

Seedlings that are transferred to a hydroponic system grow inside the channel and can be grown with the roots exposed or even in root cubes. It is the very best way to grow them using a water culture system. Sow your seeds in quartz sand, cellulose fiber, vermiculite, or perlite. These cubes will offer weight and help support your plant. Offer water to your seeds and then cover them with paper towels or cheesecloth that is wet until they germinate. You will then need to remove the covering and thin your plants. Moisten them using a solution that is infused with the right amount of hydrogen peroxide, rather than just water.

Tips for Beginners

Growing plants using hydroponics is a huge step for many individuals and can be a large learning curve. In order to help you, here are signs of deficiencies in order to catch them before your plants cannot recover.

SYMPTOMS	DEFICIENCY
The entire plant is light green. The lower leaves are turning yellow. The growth seems to be stunted.	Nitrogen
The entire plant is almost a bluish, green color. It may develop a red or even purplish cast. The lower leaves might be yellow. They dry to a greenish, brown to black. The growth may be stunted.	Phosphorous
The plant leaves may be a papery appearance. The dead areas are present along the edges of leaves. The growth might be stunted.	Potassium
The lower plant leaves will turn yellow at the tips and the margin between the veins. The lower leaves may be wilting.	Magnesium
The young stems and the new plant leaves die.	Calcium
The leaf tissue between the plant veins is lighter in color. It may be yellowed and papery.	Zinc
The leaf tissue will appear yellow, and the veins will still be green	Iron
The plant’s leaves will be dark green	Copper

or blue around the edges. The leaf edges will curl upward. Young leaves will wilt.	
The young leaves will turn pale green, and the older leaves will stay green. The plant will be stunted.	Sulfur
The growth will be stunted. The lower leaves will have a checkered pattern of green and yellow.	Manganese
The leaves will be stunted, a pale green and they will be malformed.	Molybdenum
The young leaves will be scorched at the ends and the margins.	Boron

Note: In order to fix the deficiency, you will need to mix up a solution in a spritzing bottle. You will need to offer the solution to the plant on a consistent basis until there is a balance. In some cases, it may be best to switch the type of hydroponic fertilizer that you are using. Make sure to watch your plants to catch the deficiencies early so that you can keep them alive and ensure that they thrive.

Chapter 3
Plant Necessities

In order to grow and develop, plants need nutrients, water, sunlight, and of course, air. Although no soil is used, plants still need an anchoring medium that will sustain the weight of the plants through the roots. This is provided by a growing medium, which has the role of only offering physical support. Another function fulfilled is to block sunlight from reaching the roots, which will inhibit their growth.

In a hydroponics system, the water and nutrients are provided as a mix. This can be tweaked so that it fulfills the specific needs of a plant species. Light can be provided naturally or through special growing lights.

Growing Mediums

There is a multitude of different growing mediums as well as numerous mixes, some commercial, some created by the horticulturists themselves. However, all these have to fulfill several basic requirements.

A. **No nutrients or chemicals:** the growing medium should not affect the plant in any way or interfere with the provided nutrient mix. It should be light and soilless.
B. **Porosity:** the medium should contain “holes” or “interstitial spaces” that will facilitate the easy transfer of oxygen and nutrients to the roots. The size of these empty spaces will vary with the size of the growing medium’s particles. Thus, coarse growing mediums such as gravel have large spaces, whereas sand has small spaces.

C. **pH:** although not a requirement, a good growing medium will help to buffer pH changes over time
D. **Safe and reusable:** a growing medium should be reusable and biodegradable in order to ensure safe disposal. It should also be lightweight and easy to work with.
E. **Price:** another important factor that is not completely a requirement is the price. A growing medium should be inexpensive and easy to obtain.

Below you will find a selection of the most commonly used growing mediums together with their advantages and disadvantages.

- **Perlite:** it's a synthetic growing medium that has been used for many years. It is made from heated silica (glass), which expands into small and light pellets.
- **Vermiculite:** similar to perlite in its properties, this growing medium is mined in Brazil, China, Zimbabwe, and South Africa. A naturally occurring crystalline compound, it is expanded by heating in a kiln. During this process, it becomes very light and water retentive.
- **Coconut coir:** it's another popular growing medium that that is natural and a byproduct of the coconut industry. This medium is the hairy out coating that surrounds the coconut shell. It has the role to protect the seed from the sun and salt while floating around the ocean. Sold in blocks, it will swell to between six and eight times its compressed size.
- **LECA:** or light expanded clay aggregate is a growing medium obtained from clay particles. These are lightly heated until they expand to somewhere between six to eighteen millimeters in diameter.

Nutrients

Nutrient solutions are the cornerstone of every hydroponic system. The health of a plant depends on several components that can be visualized in the form of a chain. Oxygen, carbon dioxide, water, light, macronutrients, and micronutrients all represent a vital link in this chain. Thus, it is vital to ensure that all components are in place and in good supply. The nutritional needs of a plant are complex, and creating a balanced solution may seem a daunting task. However, this becomes easier with some basic information.

Vital Elements

There are four chemical elements that are vital for plants: oxygen, hydrogen, nitrogen, and carbon. These are also mostly overlooked when it comes to planting nutrition as they occur naturally. However, depletion of any of these would cause the death of a plant.

- ***(O) Oxygen***

For the plant to conduct respiration, oxygen is required and provides the energy needed to consume water and nutrient ions.

- ***(H) Hydrogen***

Obtained from the water with sunlight as an energy source, hydrogen plays a vital role. Furthermore, it is also essential for the formation of sugars. Water also keeps the plant's structure rigid through what is known as turgor pressure. When a plant is lacking water, it will begin to lose turgor pressure and wilt.

- ***(N) Nitrogen***

Nitrogen is obtained from the soil through the roots as amino acids or different types of ions. It is necessary for the formation of amino acids, co-enzymes, and chlorophyll.

- ***(C) Carbon***

Carbon is obtained during photosynthesis from carbon dioxide. It is the element found in the largest quantities and represents approximately half of a plant's dry weight. It occurs in the cell walls, sugars manufactured by chlorophyll, as well as chlorophyll itself.

Plant Nutrients

A. Macronutrients: Named so because they are required by a plant in large amounts. They play a vital role in the growth and development of plants as they assist in different metabolic processes. Oxygen, nitrogen, hydrogen, carbon all belong here and are four of the nine macronutrients needed by a plant to survive.

The Other Five Macronutrients Are:

- **(P) Phosphorus:** Used to synthesize nucleic acids (DNA, RNA, ATP, etc.), phospholipids, and sugar. It enables food energy to be converted into chemical energy.
- **(K) Potassium:** Helps to regulate the opening and closing of stomata, maintaining a healthy water balance. It is also involved in protein synthesis that requires high potassium levels.
- **(S) Sulfur:** It's part of amino acids such as cysteine and methionine. It is also required in water uptake, protein synthesis, fruiting, and seeding.
- **(Ca) Calcium:** Regulates nutrient transport and supports enzyme functions. It is also required for cell wall formation.
- **(Mg) Magnesium:** Used in the photosynthetic process, chlorophyll production, and enzyme manufacturer.

Nitrogen, phosphate, and potassium are the components always listed on nutrient packets or bottles. Their proportional quantity is always provided

always in the same order N-P-K.

B. Micronutrients: Although required by the plant in small amounts, they are still essential to its survival and are involved in critical functions.

Cations: positively charged and bind to soil particles. Their solubility is greatest under acid conditions.

- **(Cu) Copper:** Activates enzymes and is necessary for photosynthesis as well as respiration.
- **(Fe) Iron:** Involved in chlorophyll formation as well as the respiration of sugars to provide growth.
- **(Mn) Manganese:** It's a catalyst in the growth process and the formation of oxygen in photosynthesis.
- **(Zn) Zinc:** Involved in chlorophyll formation, respiration, and nitrogen metabolism.

Anions: are negatively charged and subject to leaching.

- **(B) Boron:** It's necessary for the formation of cell walls when combined with calcium.
- **(Cl) Chlorine:** It's important for photosynthesis where is part of the opening and closing of stomata. It also helps ensure that the leaves are firm.
- **(Mo) Molybdenum:** It's part of the nitrogen metabolism and fixation.

Water, pH, and Nutrient Concentration

Water lies at the heart of all hydroponic systems. As a result, it is vital that its quality is high and chemical-free. In some regions, tap water may not be suitable due to a high quantity of chlorine. Too much can have adverse effects on the plant's growth. The solution to this problem is fortunately

simple: allow the water to stand in a bucket for twenty-four hours before using it. During this period, the chlorine will break down on its own without requiring additional efforts. However, this method does not help against other pollutants. Alternatively, distilled water can be used, although it is expensive and, in most cases, not necessary. If possible, the best solution is to catch rainwater, which is chlorine-free and also does not cost anything. This may not be possible or recommended if you live in a large city where there is a high amount of pollution.

pH (potential Hydrogen) is another vital component of a hydroponic system. It is a logarithmic scale based on the concentration of hydrogen ions. The value 7 represents a neutral state, where values below show increasing acidity and values above increasing alkalinity. A too high or low pH can have a detrimental effect on nutrient take-up. The ideal value should be between 5.5 and 7. Most commonly, it is affected by the amount of calcium present where too much leads to had water and a high pH. This is another problem that may occur in tap water.

It is thus vital that you measure the pH regularly. Fortunately, today digital pH meters are extremely cheap and easy to find as well as use. Replacing the nutrient solution every 2 weeks is a good safeguard against crop damage.

Nutrient concentration in a solution is a measurement of PPM (Parts Per Million and Total Dissolved Solids). It is also known as EC or Electrical Conductivity, which is the principal at the base of the measurement. Here digital meters can also be easily found. It is good to remember that pH and PPM share an inversely proportional relationship, where if one is high, the other is low and vice versa. A high pH will be a sign of insufficient nutrients, whereas a low pH is a sign of excessive nutrients.

Nutrient Solutions

Today there are many nutrient solutions balanced for the plant types, stages of growth, and growing conditions. These are excellent for beginners as they are easy to find and use. The most important factor is to purchase a mix designed specifically for hydroponics. Supplemental fertilizers should never be used as they are designed for soil-based gardens. Thus, these do not contain trace and micro-nutrients essential to the plant.

Choosing Nutrients

Have your water tested to know what it contains. With "soft" water, you can add any nutrients your plants need for their optimal growing season. With "hard" water, you may need to use reverse osmosis methods to filter out any unwanted heavy metals present in your water.

Both well water and tap water usually contain calcium and magnesium carbonates, which are necessary nutrients for plant growth.

The optimal temperature for water is between 60% and 80%.

Check the right pH balance with a pH meter. The best pH balance would be between 5.5 and 7.0.

How to Mix the Nutrients

Step 1:

Fill your containers with water. Most hydroponic recipes call for 2–4 reservoirs. Make sure your containers are food-grade.

For a smaller nutrient reservoir = 1 gallon (4 liters). For a larger amount = 5 gallons.

If distilled water is unavailable, let your water sit in an open container exposed to air for 24 hours to dissipate the chlorine.

Step 2:

Measure out the nutrients. Fill the other container with a premixed fertilizer or another general nutrient blend.

Measure liquid nutrients.

For a full 1-gallon (20-liter) container of water:

- 5 ml of $CaNO_3$,
- 0.34 ml of K_2SO_4,
- 1.65 ml KNO_3,
- 1.25 ml of KH_2PO_4,
- 3.5 ml $MgSO_4$,
- 0.4 ml trace element compound. (see below)

Step 3:

Rest a funnel into the mouth of the reservoir to avoid spills that could disturb the nutritional balance of the solution. A small plastic funnel will enable you to pour the chemicals into the container more easily without the contact of some nutrients and other additives, which can be irritating or harmful to the skin.

Once you have added the nutrients, check the pH of your water as hydroponics nutrients usually lower the pH balance of neutral water. In that case, you may need to use a pH additive to adjust the balance afterward.

Step 4:

Add the nutrients to the water. Pour the nutrients in one by one. A slight loss of nutrients will not exert any severe effect on your system, but the sooner your plants can adapt to the nutrient supply, the more effective the solution will be.

Step 5:

Cap and shake the container. Shake the container utilizing both hands for 45 to 60 seconds to combine the nutrients.

Shaking is considered the best way to blend the ingredients, but stirring is also effective as long as you do it for a proper length of time.

Lights

Light is the source of energy used by plants. It is what drives the process of photosynthesis that lies at the base of all plant life. In nature, sunlight is converted to sugars to provide fuel for growth. This is made possible by chlorophyll, the green substance found within the leaf cells. It is a wonder of natural engineering as it is capable of trapping light energy and use it to drive metabolic processes.

Both the spectrum of colors contained within the light and its intensity provide its quality. Different plants will require different lengths of light, also known as photoperiod. This affects and controls all the plant's metabolic processes and lifecycles, such as flowering (reproductive cycle). Different light intensities are also required by different species. Generally, photosynthesis happens primarily within the spectrum of visible light, with the wavelength between 400–700 nanometers. In this range, needed most is 650 nanometers (red) 445 nanometers (blue).

White Light

It's a combination of all colors/wavelengths of visible light: Red + Green + Blue (and all colors in between).

Blue Light

At this wavelength, photosynthesis occurs, tips grow toward the light, and hormones trigger growth.

Green Light

Most of this color light is reflected; that is why plants appear green; however, some green light is required for growth.

Red Light

This wavelength, too, triggers photosynthesis. Seed germination is aided, pigments are formed, flowering aided, and dormancy is induced.

Far-Red Light

Speeds up some full sun plants and reverses some red-light effects.

Artificial Light

Besides the lamp itself, artificial lighting requires the usage of a ballast (this is used for igniting and regulating the current to the lamp), a reflector or shade (for directing light to the plants), as well as a timer for controlling when lights go on/off).

Intensity

Light intensity is most often measured in power (watts) per square meter or foot. In order to achieve optimal photosynthesis, a general rule of thumb is 20–40 watts per square foot, with 20 being best for low-light plants and 40 best for light-loving plants.

Duration (Photoperiod)

Most plants grow best when exposed to 16–18 hours of light per day. Further increases in this period have been found to have no additional effect on growth. In order to induce flowering, plants should be exposed to 12–14 hours of light. Total darkness is also required during the darkness cycle for flowers and fruit to form correctly. In order to achieve the desired light durations, a timer is necessary.

Below you will find the three most common lamp types used in hydroponics.

A. **High-Intensity Discharge (HID) Lamps** are usually utilized for the flowering or fruiting and vegetative phases because of the high watt per lumens rating. The HID types listed below are used most often:

- **Metal Halide (MH) Lamps** generate light mainly in the color blue. This is ideal for healthy vegetative growth such as thicker stems and larger leaves as well as a dense and shorter plant that uses light more resourcefully.
- **High-Pressure Sodium (HPS)** generates a higher amount of red color light. It is more appropriate for the fruiting or flowering phase as it encourages flower production and budding.
- Lamps with blended light can be found and are very popular. This is due to the fact that they can be used throughout, avoiding the requirement of an additional lamp kit (lamp holder, lamp, and ballast) for vegetative and flowering phases. These lamps generate a spectrum of blue and red light that is more balanced.

Pros: They can offer a full light spectrum that can be used for both flower and vegetative growth. This type of lamps is extremely powerful.

Cons: Due to high heat and energy output, this type of bulbs wears out quickly, use a high amount of electricity, and require fans.

B. **Fluorescent Lamps:** These generate fewer lumens for each watt when compare with HID lamps. As a result, they are used mainly

for plants that require low to medium light strengths such as seedlings, herbs, clones, orchids, lettuce, etc. They also require less energy as they produce less heat.

Pros: These lamps produce a low amount of heat and thus are more energy-efficient and are inexpensive.

Cons: Not suitable for flowering or fruit-producing plants as they do not offer a full light spectrum, nor are they very powerful.

C. **LED Lights:** These are the latest light-emitting technology and perhaps the most popular as well. These are several areas in which they are superior to the other light systems.

Chapter 4
Best Plants for Hydroponics

Plants Suitable for Hydroculture

First of all, it is necessary to know that cuttings rooted in water are ideal for starting hydroculture because, for them, it is much easier to adapt to the expanded clay substrate since it is mainly composed of water.

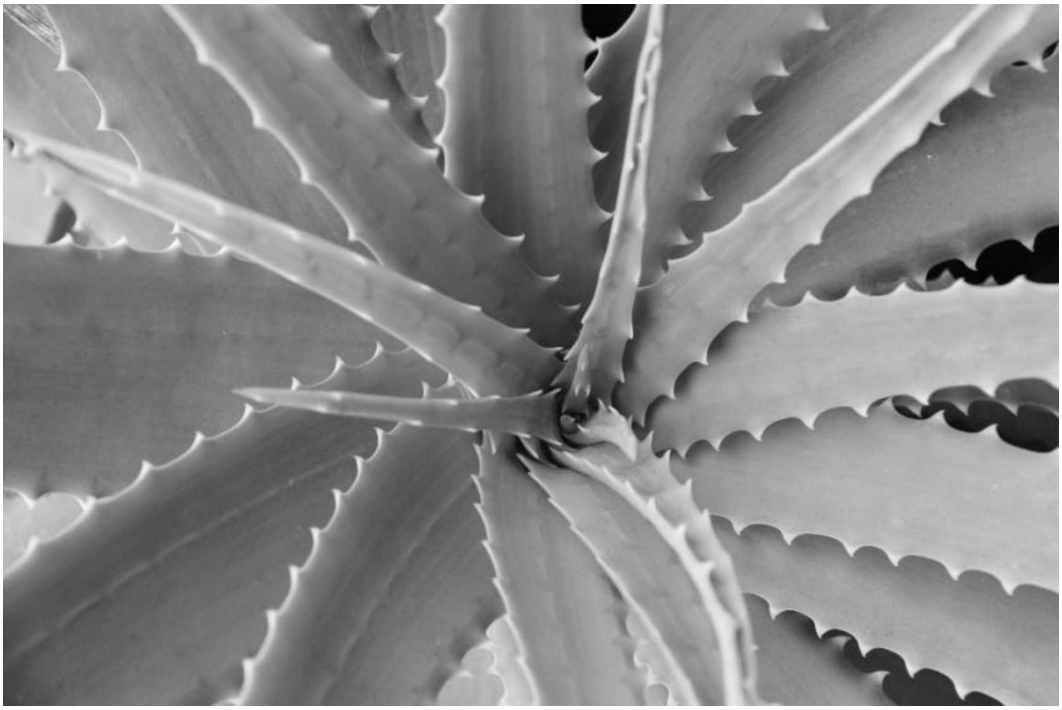
If you want to start with the gardening of hydroculture plants, there is a great variety to choose from. If you are a lover of aromatic herbs, the rosemary plant is perfect for growing in hydroculture if you start from

cutting; otherwise, you can choose other types of ornamental and very decorative plants, such as Ficus, Calathea, Pothos, Dracena, and Philodendron.

All plants characterized by leaves of tropical origin are well suited to hydroculture, such as the orchid and all those species that present a rapid development to the root system.

And what about flowering plants? In these cases, the most recommended species for home hydroculture are Hibiscus, Spathiphyllum, Kalanchoe, Anthurium, or Saintpaulia. Still, nothing prevents you from trying to cultivate other types of plants as well.

What about succulents? Succulents have a more complicated situation since they do not tolerate excess humidity. Therefore the recommended species for hydroculture are aloe, succulent plants, and—as anticipated above—orchids.



1. **Lettuce**

Growing salad in hydroponics is elementary, much more than it might seem, even for those who start from scratch and approach the hydroponics world for the first time.

Once you have identified the variety of salad that best suits your needs and tastes, you must obtain the seeds that you will easily find online. Then you will have to buy rockwool cubes (Rockwool) and net jars, a mini-greenhouse to store them in the warm, in a protected environment and with net pots, designed precisely for the needs of plants that are grown with hydroponic and aeroponic systems. Therefore, a small hydroponic or aeroponic system will be needed.

The salad seeds must be placed inside the moistened rockwool cubes (it is recommended not to insert more than five seeds for each cube) only with water and then placed inside the mini-greenhouse, at a temperature that can oscillate between 73°F (23°C) and 82°F (28°C).

One aspect to check—when using rockwool cubes—is the amount of water they absorb because an excessive amount of liquid could cause the roots to rot and drown them. For this, it is always advisable to check the liquid levels present and possibly wring out the cubes to let out the excess water.

With the right amount of water and the ideal temperature, lettuce seeds will begin to germinate after about 48 hours. When you see the first roots appearing from the rockwool cubes (both from the sides and the base), it means that the time has come to transfer the newly born seedlings to the special mesh pots, which will first be filled with expanded clay and then settled in the hydroponic system you have chosen (or aeroponic). The seedlings inserted in the aeroponic system will then be fed with a special nutrient solution based on water and fertilizers to provide everything they need. It is vital to avoid any fertilizer during the germination phase and then start with a halved dose compared to what is recommended on the package.

Fertilizers for the Gardening of Hydroponic Salad

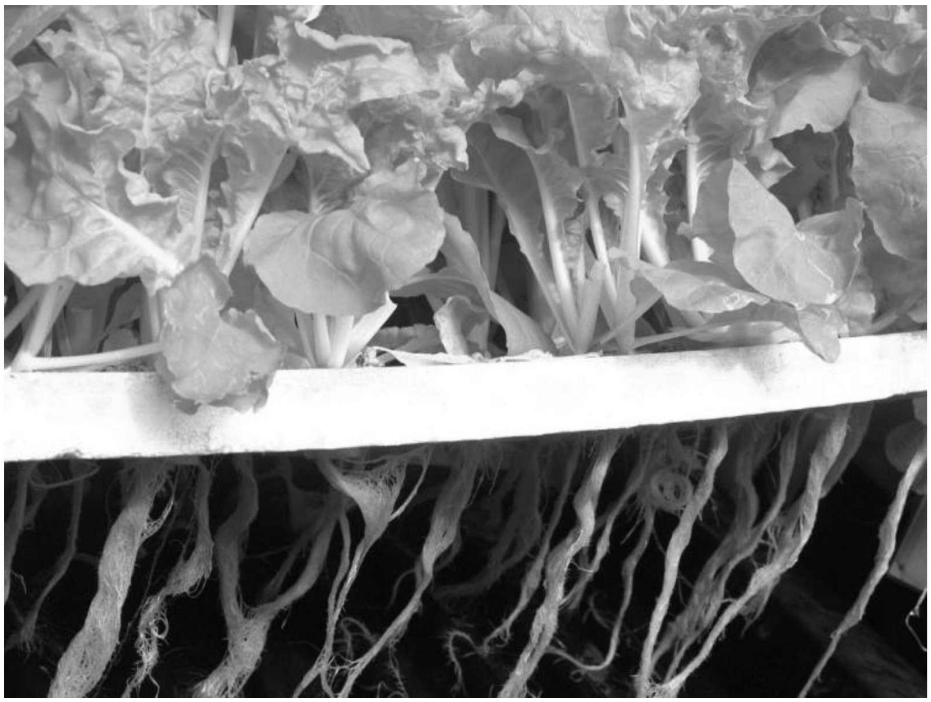
By using suitable fertilizers and in the right dose, the roots of the lettuce seedlings are allowed to develop better and faster than they would use with a traditional gardening system, also because, in this way, the roots can receive and assimilate nutrients faster.

To grow the seedlings in a healthy and fast way, thus strengthening their root system to make it more robust is possible to opt for some special fertilizers, which contain fundamental substances capable of promoting and increasing growth, accelerating absorption nutrients, and keep the most common salad diseases away. Fertilizers play a central role in the life and health of the plant. Since the hydroponic and aeroponic system does not provide for the presence of fertile soil, to ensure that the salad receives all the nutrients, it is essential to use the right fertilizers to be able to grow plants properly. Strengthening the root system of salad plants and preventing pests means growing healthy, strong, and vigorous plants capable of returning a good harvest.

Hydroponic Salad: Parameters to Monitor

At this point, once the gardening has started, it is appropriate to keep under control some fundamental values for the health and growth of each plant, such as the pH, which will determine the ability—by the cultivated plant—to absorb the available nutrients correctly.

In order for salad plants to absorb all nutrients correctly, the pH must be slightly acidic, and to ensure that it is always such, it is advisable to often monitor the situation with manual tests. For example, cheap and easy-to-use paper strips for pH testing can be used.



Tips and Tricks for a Perfect Hydroponic Salad

To create a suitable and protected environment is recommended to repair and check the salad plants inside a grow box to make them grow well, healthily, and faster, without weighing on the cost of the bill.

Among the advantages of using the grow box, there is undoubtedly that of being able to more easily control the temperature than a larger environment and, therefore, less controlled, better manage ventilation, ensure the right

lighting (thanks to the reflective mylar sheet present inside the grow box which allows the light to be effectively propagated).

But When Will You Get Your First Salad Crop?

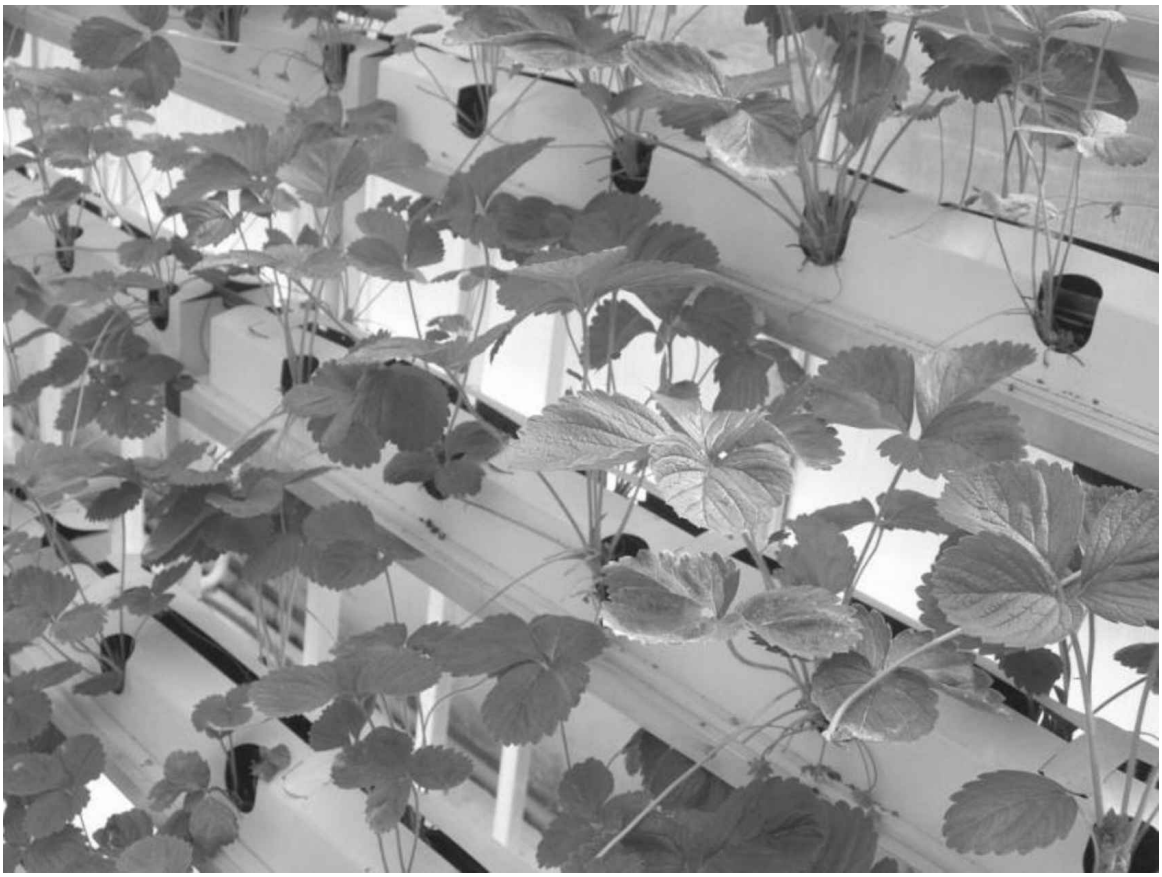
Much depends on the variety chosen and cultivated, but, in general, it is possible to say that the time required varies between 4 weeks and 80 days. By choosing different varieties and managing the aeroponic system, you can have a fresh, tasty, and healthy salad at any time of the year.

To help grow, salad plants should be adequately lit: the best solution is to use HID discharge lamps or LEDs, but a good compromise can also be found by using fluorescent lamps.

To better manage the lighting of the salad plants, it is advisable to activate the lights for 12 hours a day, thus ensuring 12 hours of darkness.

For beginners, it is advisable to purchase a simple lighting set consisting of 4 CFL lamps, sufficient for home gardening.

2. Strawberries



Cross and delight of many professional and amateur growers, the strawberry is a problematic fruit, especially if grown out of season and in unsuitable environments. All difficulties are overcome, especially for those who choose above-ground gardening, better known as hydroponic gardening.

The more than tested technique, especially in strawberry gardening, offers more than exciting advantages:

- Production is standardized;
- There is a considerable saving of energy and water, which is used more rationally;
- Production is better in quality and quantity;
- The problem of diseases, molds, and pests that multiply on contact with the ground is entirely forgotten.

Those who choose the hydroponic technique also have the opportunity to produce strawberries in at least two different periods of the year: from October to December and throughout April and May.

If we also take into consideration that once planted, the plants begin to bear fruit after 45 days. It is well understood why this choice is shared by many growers and lovers of indoor gardening.

Anyone who chooses to switch to this type of technique must first thoroughly wash the roots of their seedlings and insert them in a small pot that contains expanded clay or alchemy of vermiculite and perlite.

It is also essential to have a container that can hold at least 10 liters of water (for each seedling), better if impermeable to the passage of light to avoid the formation of algae and mushrooms.

Among the most popular hydroponic gardening methods for strawberries, there is the one called NFT hydroponics: to make it simple with this system, it is possible to achieve a good circulation of all the nutrients that the roots need. Everything is automated thanks to the use of a timer that alternates between full and dry moments, essential for the roots to have the right oxygenation.

Obviously, it is essential to have the right fertilizer, which in this case, is composed of nitrogen and potassium and water with the correct pH, which should always be adjusted between 5.5 and 5.6. To make the job easier, there are active acidity regulators on the market.

Finally, you must have the right lighting, and in this case, the lamps for indoor gardening will be a potent ally.

Once you start your strawberry gardening, domestic or industrial, it is good to keep in mind that the plant must be regularly pruned: it is wrong not to

cut excess leaves, especially before flowering. These will unnecessarily weaken the plant and could favor the creation of mushrooms that are particularly harmful to the future growth of strawberries.

Also, despite the impatience shared by many growers, it is good that the fruit is harvested only when red and ripe, better still if in times of darkness.

3. **Tomatoes**

Quality and Quantity with Hydroponic Tomato Gardening

Tomato is a genuinely functional vegetable in hydroponic culture. It reacts very well to the so-called “soilless gardening” because it can easily adapt to different types of substrate and does not require demanding agronomic management.

In tomato hydroponics, multiple substrates can be used:

- Rockwool

- Peat
- Perlite
- Coconut fiber
- Compost

And with all, you can achieve magnificent results. The only precaution that must be paid in the hydroponic gardening of tomatoes is the temperature. Indeed, excessive maxims could affect the floral drop and, therefore, the quantity and quality of the product.

4. Kitchen Herbs

The new home dream is to have a thousand and one aromatic herbs on the terrace or the balcony to flavor your dishes with a personal, fresh, and eco-friendly touch. This is why hydroponics has been so successful.

The Greeks already knew it, Francis Bacon spoke about it in 1627, and today, hydroponics (literally the art of growing plants in water) is well appreciated in the industrial and domestic field.

The hydroponic gardening of aromatic herbs has five remarkable qualities:

1. The yield of the product that is developed through indoor gardening is better;
2. Growth is faster;
3. The taste is more intense;
4. The gardening technique is environmentally sustainable;
5. Water expenditure decreases drastically.

With hydroponic gardening at home, it is possible to grow any aromatic plant, whether it is parsley, basil, thyme, rosemary, oregano. Still, you can also choose to grow lettuces, tomatoes, strawberries, and who knows what else.

In short, hydroponics allows at reduced costs and with a disarming simplicity to make your terrace or balcony a garden of wonders, a vertical garden, and an urban oasis.

The roots of our aromatic seedlings will seek support on an inert substrate often made up of expanded clay, pralines, coconut fiber, or other similar materials. Of course, the irrigation that the plant receives must be rich in inorganic compounds that will be able to give it all the nutrients that generally come from the earth. Your gardening of aromatic herbs will surely provide unparalleled satisfaction.

5. Orchids

Orchids lend themselves perfectly to hydroculture. They are, in fact, epiphytic plants (i.e., plants that naturally grow and live on other plants), and humid environments represent their ideal condition for growing well and in health. The plant will develop its roots, which, with the growth and passage of time, will pass through the holes of the pot, to flow directly into the water. Different varieties of orchids can be grown in hydroculture, such as the best-known variety of Phalaenopsis, but also Cattleya, the Dendrobium variety, Paphiopedilum and Oncidium.

One of the main advantages offered by this gardening technique is represented by the opportunity to supply the plant with a constant quantity of water capable of properly hydrating and irrigating the orchid without damaging it with an excess of liquid. All this, combined with correct fertilization, allows the plant to grow at a much faster rate than traditional gardening techniques.

Another advantage of orchids grown in hydroculture is given by the typical characteristics of expanded clay, used in these cases instead of the soil or the mix of materials generally used for orchids, which allows faster, easier, and risk-free repotting to damage the roots.

In this way, orchids quickly develop their root system: in a short time, the roots will grow and pass through the holes of the pot in which they are located and will begin to develop directly in the gardening water.

By doing so, orchid plants will grow faster and healthier, without any disadvantages.

As already mentioned, there are many benefits of using the hydroculture method:

- The plant needs much less maintenance.
- Faster and faster growth.
- A reduction in the risk of pests and diseases.
- Greater oxygenation of the roots.
- Elimination of mold and other allergens.

Plants to Avoid in Hydroponic Gardening

Some plants are not precisely indicated in hydroponic gardening. Here are a few:

Pumpkins

Pumpkins love the sun and well-drained soil with neutral pH.

They are challenging to grow in a hydroponic system as they have large groups of roots that spread rapidly.

Squash

Squash grows at the base of the plant, which means it could rest on damp soils. This will likely encourage mushroom growth.

Also, squash is generally a large plant with minimal yield. There are much better ways to use space in the hydroponic system.

Zucchini

This is a great plant, which means it will need a lot of support. It needs more nutrients than other plants and won't give such a significant yield for space.

It is necessary to keep the temperature around 75°F (24°C), even during the night. It will also dry out very quickly if it does not have enough water and nutrients.

Potatoes

Most root vegetables are not suitable for hydroponic systems. Potatoes are such a case.

The cost of the harvest will be very low compared to the efforts needed to grow it.

Radish

Some plants will grow well, but they are still not a good option. You need the right supports to make them grow hydroponically, and in the end, the cost will probably be higher than buying in a store.

Chapter 5
Pest and Disease

Hydroponics can be a fulfilling and instructive experience. The harvest yields are commonly a lot higher than traditional strategies and require less space. One of the issues with planting, by and large anyway, is managing pests and disease.

Hydroponic nurseries are inclined to disease and mites or pest intrusion simply like traditional cultivating, just with a couple of slight contrasts…

Since hydroponic nurseries are regularly independent and cut off from the outside world, they're in reality far less inclined to getting mites, contagious, or bacterial pests or disease.

The issue, nonetheless, is that on the off chance that one of these living beings discovers its way into the nursery, it does not have the opposition found in nature to keep it in balance. A little pest attack will rapidly dominate and demolish a yield whenever left unchecked in an indoor hydroponic nursery.

Realizing how to manage plant pests and disease is critical in the event that you need to see accomplishment in your indoor nursery.

Basic Insect Pests

Similar bug pests that influence open-air nurseries will influence indoor ones. Thrips, mite parasites, nematodes, aphids, gnats, and mealybugs are largely basic open-air AND indoor nursery pests.

Thrips

Thrips are little, greenish dark bugs that move at lightning pace and will, in general, hop off your plants leaves at whatever point you attempt to search for them, and accordingly, they are once in a while observed. Recognizing thrips depends more on finding the harm they cause than seeing the mites.

Thrips will utilize unique mouthparts to scratch away the outside of the leaves so as to find a workable pace, succulent internal parts. The leaves will look textured and silver. Enormous pervasions will begin to cause development surrenders in the leaves, and more established leaves will start to cease to exist.

Thrips are best managed by closing off the underlying foundations of your plants with plastic. Some portion of their life cycle includes dropping off into the root zone to develop as hatchlings before creeping back up the plant to benefit from the leaves. Closing off this urgent stage in their life cycle is one of the least difficult and best approaches to disposing of thrips from the hydroponic nursery.

Mites

Mite vermin are in the arachnoid family and can really turn networks simply like an insect. These little mites are difficult to see with the unaided eye yet will frame enormous settlements rapidly, which are covered in web structures which they use as interstates to get from leaf to leaf. These

networks shield them from splashes and help to make a little microclimate for their eggs.

Arachnid vermin should be assaulted vivaciously and early. Use bug sprays containing neem, malathion, or pyrethrum for best outcomes and rehash at regular intervals until they are totally proceeded to screen intently for indications of their arrival or reduction.

Mealybugs

Mealybugs are white, fleecy looking mites that join themselves for all time to the leaves or stalks of your plants, where they spend the remainder of their short lives sucking the sugary juices from your plant.

Mealybugs are exceptionally hard to treat in light of the fact that their hard shells shield them from being presented to bug sprays. They recreate rapidly and will benefit from a wide scope of plant species.

The most ideal approach to oversee coarse bugs is to utilize pyrethrum bug sprays to focus on the youngers that do not have the hard defensive shells and to assault grown-ups independently with a cotton swab absorbed liquor. This is dreary; however, one of the best approaches to manage mealybug invasions.

Gnats

Gnats are minor flying mites. Despite the fact that they are not a tremendous threat to your harvest, they increase rapidly and are an irritating pest to have around. They will, in general, collect in the root zone of plants since this is the place they lay their eggs. The eggs bring forth and start benefiting from your plant roots before developing and taking off to lay eggs of their own.

Managing gnats includes closing off the root zone with plastic or a layer of sand and showering intensely invaded plant roots with a blend containing pyrethrum.

Aphids

Aphids are incredible pioneers. At the point when provinces develop sufficiently huge, they start delivering posterity with wings, which they use to travel to different territories looking for new nourishment sources. When they locate another spot (which might be within your hydroponic nursery), they just need a solitary mite to begin a province. Aphids needn't bother with a male and a female to reproduce and are frequently seen pregnant. This makes it simple for them to develop inconceivably huge settlements from a solitary bug.

Aphids have delicate swollen bodies, making them simple to slaughter by either squeezing them with your fingers or through bug spray use. Their quick proliferation and enormous numbers are what makes them hard to kill totally.

The most ideal approach to oversee aphids is to assault them with bug sprays forcefully, catching up with medicines at regular intervals. In any event, when no more aphids can be discovered, it is shrewd to proceed with the treatment for as long as seven days giving unique consideration to the new development on your plants and the undersides of leaves where they will, in general, cover-up.

Common Diseases in Plants

Powdery Mildew

Powdery mildew is a contagious disease influencing the leaves. It's extremely basic in indoor nurseries, particularly regions with poor wind

current and cooler temperatures. You can recognize fine buildup from the dusty, fluffy appearance it leaves on contaminated regions. Powdery mildew won’t develop on anything other than leaves, so in the event that you discover something that fits this portrayal in the dirt, it is something different.

Treating powdery mildew is commonly very simple. Antifungal specialists can be splashed onto the influenced territories and, for the most part, bring about the total end of the organism after only a solitary treatment. Now and then, a subsequent treatment or 2 will be required. Once dispensed with, it can assist with expanding the wind current of your hydroponic nursery by including dissemination fans or changing current ones. With high wind stream, powdery mildew doesn’t have the chance to replicate and develop on your plants.

Pythium

Pythium is one of the most exceedingly terrible regular diseases you will find in your nursery. It is a growth-like creature that contaminates the underlying foundations of your plants. It's both profoundly irresistible and deadly.

The best treatment for this disease is counteraction. Guaranteeing that there are not dead or decaying established in your greenhouse, use proteins or hydrogen peroxide.

Changing the water normally and ensuring it stays in steady movement with air stones and water siphons will go far in forestalling pythium disease in your nursery too.

Recognizing what can contaminate your plants and how to distinguish them make it a lot simpler to discover an answer for the issue. The entirety of the pests and disease talked about right now exceptionally normal, and in any event, one of them is probably going to be looked at by any hydroponic plant specialist regardless of what number of safety measures you take. This is the reason customary examinations of your plants is urgent on the off chance that you need to get these diseases early and manage them well before they become an issue.

Look at our stock of pest control items and consider keeping some close by before the issue happens. Along these lines, you will have the entirety of the apparatuses expected to treat the issue rapidly without heading out to the shop when an episode happens.

We prescribe keeping something with pyrethrum close by and a few chemicals to forestall pythium at all.

Chapter 6
Choosing the Right Place for Your Garden

Humidity

In order to maintain conditions suitable for plant growth, it is necessary to provide a number of parameters, the first of which is humidity. In conditions of high humidity, the leaves of plants grow larger. Their maximum growth is observed at 60–80%. But it is better not to stick to the extreme numbers and set the humidity at 65–75%. Cuttings will need more moisture—up to 90%, and 60% is enough for seed germination. During the late flowering, it is best to use minimal humidity to avoid mold.

Humidity is a relative concept: there is much more water in hot air than in cold air. The used percentage humidity parameter is associated with water, which air is able to hold at a given temperature. This indicator is completely unrelated to the total water content in the air. At ten degrees and 100%, the relative humidity of water in the air will be half as much as at the same humidity, but at 20°C. This means that any increase in temperature in the room will lead to a decrease in humidity.

Accordingly, if the lighting turns off, and the temperature drops, the humidity increases. So, darkening the room for the dark period of the cycle, it is worth running the hood for a few minutes to remove excess moisture. Otherwise, it will settle on the leaves in the form of dew and can serve as an environment in which pathogens multiply. If the lighting is on, the humidity drops, so do not immediately start the hood to keep CO2 produced at night.

If the humidity has dropped below 40%, and the air outside is too dry to raise the humidity, ventilation is indispensable: you will need a household humidifier. The air outside is usually cooler than the one in the room; therefore, once inside, it heats up and loses moisture. So even if the air outside is initially humid, it is not suitable for increasing humidity in the greenhouse.

In cold weather, it is better to cover the ventilation so that the air in the room warms up. Plants produce a lot of moisture, so it is even possible to use a dehumidifier. Plants prefer stability, so sharp changes in humidity are best avoided. If the leaves are bent up, this may be due to a rapid loss of moisture rather than an unbalanced diet, so do not rush to add corrective substances: it may be a matter of humidity.

Ventilation

Ventilation is needed, powerful and reliable, capable of updating all the air in the room in one minute. However, if the fan is too powerful, it will be difficult to ensure constant humidity. You can use an exhaust fan that can replace the air in the room in 4–6 minutes—this is enough, and the atmosphere will be stable in the room.

It is necessary to use different types of ventilation in parallel: an exhaust fan mounted on an outlet in the wall under the ceiling, it will blow air from the room; an outlet with an air intake located on the floor, in the opposite corner to the hood of the room, while the air intake must supply air from the basement or from the north wall of the house, it will not interfere with installing a protective net from dust and insects, if this does not interfere with the passage of air; circulation fans will make the air in the room homogeneous, exclude cold or hot abnormal zones, direct them better

directly to the stems, which will allow air to be removed from under the crown, making the spread of diseases and insects more difficult.

The exhaust fan is calculated simply. The volume of the room in cubic meters is multiplied by 12 (updating every five minutes—12 times per hour). The resulting figure is an indicator of the corresponding fan. But there can be various barriers to the airflow. Thus, a carbon filter significantly reduces fan performance if air from the outside enters through the pipe; each of its elbows is an additional obstacle. Too small air intake will reduce fresh air. All these factors can be taken into account by taking a fan with a performance 25% higher than the calculated one.

Carbon Dioxide

The plant feeds on sunlight while consuming the carbon dioxide needed for photosynthesis, during which the carbohydrate necessary for the plant is formed and oxygen is released. This reaction is a source of energy for metabolism and, ultimately, for all life on earth, since plants are food for all life forms, including humans.

But the plant also breathes, while oxygen is absorbed, which, when combined with a carbohydrate, releases carbon dioxide and energy. The plant breathes day and night, absorbing CO2 for photosynthesis and releasing it when breathing. As a result, more oxygen is released than carbon dioxide, although oxygen is not released at night.

Gas exchange of the plant is carried out through the pores—stomata, which are located on the underside of the leaves. In dry, hot weather, stomata close, and the plant slows down metabolism. But even when they are wide open, water vapor vaporized by the plant interferes with the absorption of CO2. In the hydroponic cultivation method, the root zone has unlimited

water supply, the stomata do not close, and a good supply of carbon dioxide supports the plants in continuous growth mode.

When the first plants appeared millions of years ago, the atmosphere was much more saturated with carbon dioxide than now. Perhaps that is why the mechanism of its absorption is imperfect, and additional doses of CO2 to plants are useful. Increased carbon dioxide helps plants withstand elevated temperatures. Permanent ventilation will ensure the flow of this gas and remove excess moisture.

A piece of rather amusing advice to talk about plants has a practical basis: a person exhales quite a lot of carbon dioxide during a conversation, to which plants respond with active growth. If you want to provide the greenhouse with additional CO2, you can use sugar with yeast or vinegar with baking soda. You can buy ready-made carbon dioxide in a bottle, although the issue of regulating the amount of gas in the room is not so simple. There are sensors that measure CO2 and maintain its level automatically.

Frost-Sensitive Period

Frost can kill a crop or cause serious damage. To some point, severe frosts will even reach the walls of a greenhouse, destroying plants inside. Even plants that are generally frost-tolerant can be severely damaged if the frost occurs at the wrong time of the year: Virtually all fruit or floral buds are susceptible to the frosting.

If frost is likely to occur at a time near the opening of flowering buds, fruit development may be stopped even if the rest of the plant is not affected. Frost consumes some young seedlings. Tender, lush young growth is more frost-sensitive. You need to know when frosts are likely to occur at a

particular site and select crops that do not have a high risk of frost damage for that site.

Day Length

Along with temperature, it is the most important factor for the formation of flower buds and for the development of fruit. For some plants, for you to achieve a good crop, the appropriate sequence of day length must take place. For other species, there must be a minimum or maximum duration of a day before flower buds develop. For example, for flowering to occur, African violets require at least 16 hours of daylight-or artificial light.

Brightness

The quality of light is just as important for some plants as the duration of the light cycle. Where light intensities are too small, many vegetables and herbs do not achieve the same quality or yield amount. Other plants require lower light intensities and prefer shaded environments.

A location obscured by tall trees or surrounding tall buildings will have lower light intensities than one facing off the afternoon sun. A valley site may have lower luminous intensities than one on a hill or flat plain.

Rainfall

There is usually less need to cover hydroponic facilities in low to medium rainfall areas than in heavy rainfall areas, where the runoff will dilute nutrient solutions or leach nutrients out of the system.

The Optimal Temperature in Hydroponics

The temperature of the air is a very important external factor for the hydroponic plant cultivating place. This factor largely controls the speed of

chemical reactions, enzymatic metabolism, and the development of plants (germination, a transformation of vegetative buds into reproductive buds).

The temperature that the farmer must maintain in his fields depends above all on the geographical origin of the cultivated plant. Indeed, these have special requirements in terms of temperature throughout their development: for germination, vegetative growth, floral induction.

It should be noted that metabolism is the set of chemical transformations that take place in cells or living organisms. These reactions can be divided into two:

- **Catabolism:** The process of degradation of molecules followed by the release of energy.
- **Anabolism:** Brings together the synthesis reactions of macromolecules that demand energy consumption.

How to measure the temperature, what are the biological, chemical, physical processes depending on the temperature and then manage this climatic factor for optimal development of the plants?

To know the temperature in his cultivating space, the horticulturist will use a thermometer. Originally, this instrument consists of a glass tube in which expends a quantity of mercury or colored alcohol. These instruments are simple and of sufficient accuracy for horticultural use. However, mercury thermometers can easily break down and spill the toxic metal into the cultivating place. With high temperatures, mercury vaporizes in the air and can be inhaled by people in the growing space.

Reminder: When an accident occurs with a thermometer, mercury must be collected in a cardboard box, put in an airtight plastic bag, and taken to a pharmacist or specialized waste treatment center. Never use a vacuum

cleaner to remove mercury from a broken thermometer. (The heat will vaporize the mercury into the atmosphere, it is not eliminated, but it is transferred from the ground to the air.)

The digital thermometers are less harmful to the environment and more convenient for the farmer. The measurement of the temperature is carried out by means of a junction diode in which circulates a constant electric field. The temperature variation of the cultivating place varies the dynamic resistance of the dipole. The temperature is displayed directly on a screen (LCD), and most of these instruments also indicate the minimum and maximum.

Some models have an external temperature sensor (probe) that allows you to know the temperature outside and inside the shelter.

This is important for heating management: the greater the difference in temperature with the outside, the more it will be necessary to heat to reach the desired temperature (set temperature).

Where to Place the Hydroponic Installation?

The best place to place a hydroponic installation is an enclosed space. A basement or a greenhouse is well suited. Also, the hydroponic system can be placed in a small room without windows or in the courtyard of a private house.

The base for the installation of the structure must be strictly even and stable so that the water and the nutrient components present in it are distributed evenly. When installing the structure outdoors, pay attention to the control of liquid evaporation and ensure reliable protection of the hydroponic installation from the wind. Installing the system on the street as a whole is an extremely inconvenient option. In addition, you will have to constantly

monitor that the hydroponic installation does not cool down and bring it into the room even with slight decreases in air temperature. In the case of assembling the system in the house, you will have to make more efforts to organize additional lighting.

Chapter 7
Maintenance of Your Hydroponic Garden

Hydroponic gardens need to have proper care and maintenance, or they will not produce healthy plants. Not only do they need to be constantly cleaned, but there are various maintenance checks that need to be carried out in order to make sure the system remains functioning correctly.

A faulty drain or a leaky pipe or switch could do serious damage to a hydroponic garden as most of the systems rely on their equipment and parts to work smoothly.

Cleanliness

Keep the growing room as clean as possible in order to stop the build-up of algae, mold, and fungus or to stop attracting pests.

Equipment should be flushed and cleaned at least twice a month to maintain water levels, stop algae growth, and ensure that there are no pests lurking about the system.

In order to stop pests and various fungal growth, growers should always make sure their hands are clean. Hands should be kept washed, especially after handling anything that was dirty or in contact with a harmful substance.

Do not let old fallen leaves, stems, fruit, produce, or growing media or even pots or discarded trays lie around the growing areas. Rather throw out any debris or broken items, and wash and pack away any unused equipment.

Wash all equipment after use and only reuse a growing medium if it can be reused, and it has been thoroughly washed and sterilized. In fact, all growing mediums, whether old or new, should be thoroughly washed before being used as not to contaminate the grow pots, grow trays, and the reservoir.

Keeping the growing area and equipment clean cuts down on the chances of infestation and development of frustrating diseases that are a nuisance to get rid of.

Nutrient Solution

The proper nutrient solution for the plant and system type should be used at the correct ratio of solution to water.

Only use good quality nutrient solutions with an organic base. Advance nutrients are only required should there be a problem that needs to be fixed, such as a nutrient deficiency in a plant.

The nutrient solution balance should be checked on a regular basis, especially if it is a recovery system where the solution is being continuously recycled.

Make sure that the solution is flushed and completely refreshed on a regular basis and that there is no salt buildup since this is very acidic and toxic to the plants.

Watering

Watering is done in many different ways and is delivered to each of the hydroponic systems differently.

Make sure the water is always fresh and checked on a regular basis. Algae is a common problem, as is nutrient build up in the system. An oxygen pump should be installed in order to ensure the water is being well hydrated and to keep the water fresher for longer.

Water solutions can come from the tap, drain systems, or rain collection tanks.

Watering can be on a continuous flow basis or set by a timer that switches on and off at different intervals during the day.

If possible, a person should always have a backup water solution available in case of an emergency, and their primary watering source is unavailable. Some plants are very sensitive to their watering schedule, and even a few minute’s downtimes and a missed watering schedule can cause some damage.

Reservoir Temperature

The water in the reservoir should be around 65ºF to 75ºF, which is basic room temperature. Water that is either too hot or too cold can damage the plant's root systems and their leaves.

The reservoir should be topped off with water in order to keep pH and nutrient levels constant. Change out the water on a regular basis.

Humidity

Different plants and hydroponic systems need the humidity to be on different levels. There are thermometers that can measure the humidity and temperature to ensure that the plants are comfortable. Keeping an optimum level does not encourage the growth of unwanted diseases and fungi.

Make sure plants that love the hotter temperatures get enough humidity by giving them a regular misting spray. This will help to keep the humidity constant for the plants that do not like too much humidity.

Inspect the Equipment

The equipment should be thoroughly inspected on a regular basis.

There are a lot of things that can go wrong in a hydroponic system, especially with the equipment. And the best way to troubleshoot is to try to avoid as many equipment malfunctions as possible.

The best way to inspect equipment is to keep the entire system in mind. When doing the inspection, start at one point and work your way through your system.

Start with the reservoir and all the systems that are dependent on it.

- **Water feeding pipe.**
    - This should be thoroughly checked for crimps that may not be feeding the solution correctly.
    - Nutrients build up in the pipes, so they may need thorough flushing or replacing.
    - Check for any blockages in the pipe.
    - Check for any holes or leaks that could deter the flow of water pressure in the pipe.
    - Check for any algae or mold that may be growing in or around the pipe.
    - Determine if it may be time to replace the hoses.
    - Give them a good cleaning if they are still viable.
- **Nozzles and hoses.**

- Check the nozzles that feed the root systems, sprinklers, or misting systems.
- When last were they changed?
- Check for blockages or leakage.
- Check any joins and washers for leaks.
- Check for sediment build-up, algae, or mold growing in or around these attachments.
- Give them a good cleaning if they are still usable.
- Drain siphons and hoses.
- Check the drain pipes for blockages.
- When last were they replaced?
- Check for leaks.
- Check for algae or mold growing in or around these pipes.
- They may need to have a good cleaning as part of the system maintenance.
- Check the reservoir water pump.
- Test the pump.
- Make sure it is still working correctly and pumping the water at the optimum flow.
- Check that all pump attachments are not leaking air.
- Check the reservoir.
- Check that there is no build-up, algae, or mold growing in the reservoir.

    - Check for any leaks.
    - Make sure the water is at the optimum temperature for the hydroponic system and plants.
    - Check that any air pumps are functioning correctly and adequately oxygenating the tank.
    - Make sure any oxygen stones do not have unwanted algae or mold growth on them.
- **Growing trays.**
- Make sure the growing tray(s) do not have any leaks in them.
- Make sure the growing tray(s) are clean and have not unwanted algae or mold growing on them.
- Clean off any nutrient build-up and make sure the trays are clean.
- For a closed system, the trays must be given thorough flushing out.
- **Growing pots.**
- Check that each of the pots is still intact and not broken.
- Replace any that are not functioning correctly.
- Make sure any growing medium is clean and does not have any unwanted algae or mold growing on them that could upset the plant's natural balance.
- **Lighting equipment.**
- Check that the bulbs are still functioning correctly.
- Check that the lighting is still adequate for the environment.

- Check the timers are working correctly.
- Clean any residue off the lighting system.
- **Temperature.**
- Make sure that any thermostat is working correctly and that room temperature is normal.
- Check that the humidity is correct for the growing environment.
- Check both the temperature and humidity thermometers to ensure that they are still working correctly.
- **Ventilation.**
- Make sure that there is adequate ventilation in the growing room.
- Not enough ventilation can cause mold.
- Check that all fans and cooling systems are working correctly.
- **Support Systems.**
- Check that any hanging supports for the plants are working without causing the plant or system any undue stress.
- Make sure that the environment in which the hydroponic system is housed offers the correct infrastructure for the system to function correctly.
- Make sure the plants are all supported and planted correctly to ensure a successful infrastructure.
- **Tools.**
- Are all the gardening tools in working order?

- Are they cleaned?
- Are there any that may need to be replaced?

Look at Your Plants

Make sure you keep a vigilant check on your growing plants. Measure their growth rate, root growth, and when they are ready to harvest.

This gives a person a good measure of how the next batch should perform and something by which to determine if the growing medium, solution, or systems structure may need to be changed or optimized.

The plants must also be checked to make sure they are getting enough nutrients, they are growing as they should, and there are no pests or other infestations. A lot of growing problems and deficiencies can be caused by various infestations. Some are easy to spot, others may take more of an experienced eye, but as a gardener gets to know their plants, they will come to instinctively know when something is wrong.

Look for the signs in seedlings such as slow growth, looking sad and droopy, white fluffy stuff growing on the leaves, etc.

Take the time to look over the plants; do not just rush through it. If there are a lot of plants to look over, break them, and do a revolving sweep of one on this day.

If there is an outbreak, you will need to go through the entire growing area right away.

Spending time with the plants in a hydroponic environment can also be quite good for the mind and spirit. Plants and running water are rather

therapeutic and can reduce stress, anxiety, and ease tension.

Change One Thing at a Time

If you are wanting to change or expand your system, do not try and do it all at once.

Choose change, switch it around, or upgrade and start with that.

Before rushing out and buying expensive parts, why not try a bit of DIY and try to make it yourself. Or at least look around to see what you have available before rushing off to spend more money on an item you do not really need.

Hydroponic systems are not only flexible and versatile in what they can grow or how they deliver their solutions, but they can also be easily adapted to suit the grower's needs and lifestyle.

There are so many great DIY ideas on how to create the perfect hydroponic garden online these days that it is well worth a try. The money you save building the system yourself can be better spent on plants, growing media, or nutrient solutions.

In order to keep a system simple and working for you, think carefully about an upgrade or addition. Plot it out and then work through one at a time getting that part right before moving on to the next.

Chapter 8
Water Maintenance, Garden Expansion, and More: Tips from the Experts on Hydroponics

Now that you know a bit more about how to plant your garden, it's time to go over some tips. There are a few things of note when it comes to a hydroponic garden, and these are important to learn. Taking care of your garden is what you need to do; it will give you the best tips on how to get the most out of your hydroponic garden so it will be successful.

Water Maintenance

Maintaining water is one of the key factors in a hydroponic garden. You might be starting off and giving your plants the right water, but they're not growing. However, there are a few tips that can help you with this.

If the medium is still wet, don't water. Sometimes, these hydroponic gardens take a bit more time in terms of growth. The plants might not grow as fast as you believe they should because the roots may not be absorbing the water right away. It does not mean you should stop watering or taking care of the plants. Typically, you should make sure that it is getting the right nutrients, and you should make sure that it's not getting overwatered. It is all about the combination of water and nutrients.

Ensure that the humidity is taken care of at all times. Different plants need different humidity levels, so it's important to note that some plants will need more, and others will need less. Do take time to research your plants so that you're not giving them the wrong care.

If you're using chlorinated tap water in a reservoir, you should fill the reservoir or mixing the bin and let the water sit for a day to help get rid of the chlorine. You should try to get rid of as much of it as possible because the chlorine doesn't help with plant growth. It is, in fact, best if you avoid using tap water at all. Tap water has its own mixture of chemicals and purifications to make it safe for us to drink, but that also means it can contain too much of something a plant needs or something that can kill a plant altogether.

You should also look into getting a timer for the water pump. Usually, an all-purpose timer is one of the best for this. You should get a 15-amp timer because they last longer, and it is barely a dollar more for the better timer. Also, purchasing a dial versus a digital timer is better since the digital timer needs electricity to work. You should look for the settings that you need, and you should look to see if there is a 15-minute setting on there to help you. For the best water maintenance, you need a timer attached to the water pump. In this way, you are sure your plants are getting watered at appropriate intervals, and never without water when it needs it.

Temperature also determined the amount you will need to water your plants. Hot, humid days will require more watering than cooler days. Of course, certain plants handle hot temperatures better than others; thus, the finger test into the medium, which allows you to check if the medium is still wet or if more watering is needed. The one thing you do not want to do is let the roots become dry.

Make certain when considering water and temperature that you have like plants in your hydroponic system. In other words, do not put a pineapple and tomato plant on the same hydroponic watering timer because tomatoes need more water than a pineapple plant. Set your garden up so that plants that need to be watered each day, once a week, or a few times a week, are on the appropriate cycle. It is a low maintenance way to ensure your plants are watered, getting proper nutrients, and growing faster than if you were using soil.

Garden Expansion

When it comes to expanding your garden, there are a few things that you should know because they are definitely important to keep in mind before you start to grow in a hydroponic garden.

Lighting

If you are growing a hydroponic garden in a place that has a somewhat outdoor setting, such as a sunroom, you need to ensure that the area is getting light. When you are expanding, do consider the light factors that are necessary for this. Yes, grow lights do work in many cases, and they can be helpful, but you should also have natural light as well to keep the plants thriving. You should work to have at least all of the plants near two corners of the wall and have windows that will allow the plant to absorb the light. Ideally, try to get as many of them near the window as possible, if not grown in a greenhouse. If necessary, add more lights to ensure the proper amount of sunlight; especially, if you notice your plants are struggling to get proper lighting from windows.

Fixtures

There are various fixtures. Some of the pots are good for garden expansion. You should make sure that you get a trellis or a potting system that has

multiple planters so that you can grow more. Ideally, you want to consider all sorts of planter sizes so that some will fit into small areas and others can fit in areas with more space.

Finally, you should make sure that the plants are given enough space. It frequently happens that when you're expanding, you think you can just put more in the location and expect it to be fine. In reality, that's not going to work, and you will end up creating more problems in your garden than you expected. What you should do instead is trying to figure out new places that work for the plant, and also keep in mind the size of it.

You might think you have plenty of space in one planter until you realize that the roots of one single plant have spread out. For example, carrots need to be spaced 6 to 12 inches apart and have plenty of room to grow down. If you have too many seeds in one hole, without trimming back the amount of new growth to one carrot top, there is not enough room for a full-size carrot.

Remember that vegetables need approximately a foot of room for them to grow so that the roots don't crowd, but in contrast, herbs don't need a ton of growing space, which makes it work for many. You should research what plants will work for which spaces and what works for you.

When it comes to space and planting various fruits and vegetables, there are other things to consider, such as plant compatibility. Have you ever planted vegetables in the same large box planter and had one thrive while the other died, yet the year before, you could grow the one that died just fine? It comes down to compatibility. There are certain competitive plants that cannot grow together in the same space. If you use the drip bucket system, you would want to have one bucket for each type of plant, such as one bucket of strawberries, one bucket of tomatoes, one for cucumbers, and

another for a citrus tree. In this way, there is no competition. Of course, you also have to have plants on the same water pump and timer as outlined in water maintenance.

Growing Medium Options

You should make sure you get the correct growing medium as well for every single plant that you're maintaining. Rockwool, expanded clay aggregate, coconut fibers, and even oasis are all different materials that work better as a growing medium than others for various plants. You should take all of these into consideration for every single plant, so you're getting the yield that you want without too many problems.

Ideally, when starting off and when expanding your garden, you should use a high-quality medium to give yourself the best start for any new plant or some expanding plants. Mediums like gravel, sand, peat moss, expanded clay, and composted bark will work for many of the plants.

You should also shy away from using certain vermiculite for your plants, and for a good reason. This is a substance that can be risky for not only the health of the plant but yours as well. This substance might seem harmless, but the fibers do contain asbestos, and these are very dangerous for your respiratory health and your overall health. You should avoid using this at all costs, and do make sure that if it does contain any of this substance, it isn't used. Not all vermiculite is the same; however, if you buy cheap and you do not read the package, you may end up with some that contain asbestos. This is why you should avoid using the product at all, given that you may never be certain whether it contains asbestos or not.

Important Maintenance Tips

Now, when you have a garden, it's important that you make sure that it's maintained correctly. If you're not taking care of the garden, it will suffer. There are a couple of different elements to keep in mind so you can have the best, most successful garden imaginable.

Hydroponic gardens may not contain soil, but this does not mean pests cannot affect your plants. You can still find disease and pests affecting the growth of the plant, the fruit or vegetable, or the overall health of the plant. There are ways to ensure the pests and plant disease do not wreak havoc in your garden.

- **Keep the environment clean:** remove any dust, immediately remove cobwebs, spray around the edges of the room for bugs, but not around the hydroponic system. A clean, well-maintained environment will reduce the risk of pests and disease.
- **The plants and rooms need to be appropriately ventilated.** Diseases occur when ventilation is weak or when air particles are introduced that can harm a plant.
- **Proper temperature can also lessen the issue of the disease.** It will not help with pests, as many also like warm temperatures. However, maintaining a plant's temperature at appropriate levels reduces the risk of certain bacteria or mold growth.
- **Water, you will see this again and again.** The type of water, water maintenance, pH balance, and circulating water all determine whether a plant is healthy. Stagnant water can breed pests and disease, even things like mold. Letting water stand

near the roots can create rot, which creates decay, and leads to plant death. Overwatering can also lead to blight.

You can prevent problems by choosing plants that are hardier. There are certain plants that are harder to kill for any gardener. These plants tend to have low maintenance requirements. Once you succeed with hardy plants, you can move on to the more fragile plant and attempt to grow it in your hydroponic system. As you grow your plants, you will want to monitor leaf health, stalk health, veggie or fruit health, and growth. If at any stage of the plant's development there looks like disease or pests are hurting your plant, then you can handle it accordingly.

Pruning for Plant Maintenance

You should also prune regularly. Vegetables do need it to prevent root tangling and messes, but you should make sure to prune every single plant to help with the growing environment. You should use a pair of clean scissors that are sharp and take them to the chewed leaves or leaves that are looking like they have a disease. This will allow the plants to be fuller, and to use the emery to create more shoots, and allow you to yield more crop in your hydroponic garden. You can also purchase pruning shears. You definitely want something that is sharp, and that will make a quick cut. Tearing the plant leaves or stems with dull shears can lead to plant death.

Tips on Lighting

If you're looking for good lights, do take a look at the various types of them. Typically, metal halide is a red spectrum lighting, which is good for plants that need a red hue wavelength. In contrast, the high-pressure sodium lights are a lighting system that's great for older, more mature plants to help them continue living. LEDs are the third type of lighting that can be helpful

in your hydroponic garden, but they do tend to be slightly more expensive. You will see better growth with LED lights, plus you have the ability to change the power to help control plant growth. These are the three best types of lights available for hydroponic gardens.

Adding Nutrients

When it comes to adding nutrients, there are some that work better than others. For every single plant, nutrients are required in order to get the best growth possible. There are some micronutrients and macro-nutrients that you must keep in mind and apply to your garden in order to have the best possible outcome for your plant.

The essential macro-nutrients are boron, copper, cobalt, iron, and zinc, and you should make sure that the medium has enough of those by using the proper growing measurements. Along with this, you should also take the time to make sure the pH is at the right level for the plants. It all depends on the type of plants that you have been growing.

When it comes to other macro-nutrients, there are also some that should be in trace amounts, especially since these are important for plant growth. These are typically there already, but if it’s not enough, you should implement a means to have them in the nutrient solution.

- For example, nitrogen is used to help with the growth of the foliage and should be there.
- Phosphorus is needed for root growth, and if your plant blooms, it will need that.
- If your plants are prone to getting sick, you should increase the potassium to help fight off the disease and to generate a higher resistance.

- Calcium allows the plant to have new shoots and roots as well to help it grow and expand.
- Magnesium helps increase the chlorophyll for a plant and to make it produce more food. This is good for any plants that need a bit of a boost in their plant food production.

Ideally, you should keep all of these in mind and test your medium frequently so that it has the right nutrients within it. There are two popular solutions you can consider making at home. These nutrient solutions have been around for ages.

Nutrient Formula 1

- 1-ounce ammonium nitrate, calcium sulfate, and potassium sulfate.
- 0.5-ounce magnesium sulfate and diammonium phosphate.
- You would need a 10-gallon reservoir for these amounts.

Nutrient Formula 2

- 1-ounce sodium nitrate, calcium nitrate, potassium sulfate.
- 0.5-ounce magnesium sulfate
- 1.5-ounces single super phosphate
- Again, you would require 10 gallons of water for the mixture.

To add the trace elements, you can use ½ tsp. of manganese chloride and zinc sulfate, 1.25 tsp. boric acid powder, 1/5 tsp. copper sulfate, and 2 tsp. iron chelate and mix it in 1 gallon of water. You would then allow the two mixtures to combine in the reservoir. You can also spray the trace elements over the plants independently.

All of these tips will allow you to grow your plants easily and without too many issues. Growing a hydroponic garden can take work when you first start, but once you read these tips and implement them, you will definitely

grow the plants that you want to, and you'll be able to be successful with your hydroponic garden endeavors no matter what they are.

Chapter 9
Growing Your Plants

Now that we are here, we are sure that you are almost ready for this moment! It's time to use your new knowledge and begin to grow. We will discuss some of the most common cultivars in this segment and learn about their favorite growing environments. We will also learn about seed starts and how to take and root cuttings. Until we continue, however, let's quickly recapture a few more essential plant needs.

Temperature

The rate at which plants grow is influenced by their ambient temperature. Normally, as the temperature rises, so do other facets of the plant's metabolism and, as described below, may or may not be within optimal ranges either for genetic factors or other limiting factors. It is essential to keep your environment within the temperature range your crop needs to avoid stress and excessive ripening in order to achieve the best growth.

Humidity

The relative humidity is defined as the amount of water found in soil. High humidity levels are stopping plants from transpiring water through their leaves, as the air is already full of water. High humidity can also keep plants from cooling down through the same transpiration cycle and can harm by providing the right atmosphere for growing powdery mildew and botrytis.

Light

Not all light is created equal, especially when it comes to plants. Light appearing within the color spectrum that activates photosynthesis is called PAR (Photosynthetically Active Radiation), and it's the only kind that will affect the crop's growth rate. Many light meters do not calculate PAR, which restricts the utility of the meter in calculating how quickly your plants are going to grow. Even if they don't weigh PAR, the majority of meters are useful in determining whether the light is even over your yard. The Moon, HPS, MH, and now the compact fluorescent lamps emit PAR illumination.

CO2

Normal CO2 concentration (325–425 PPM) can be rapidly depleted in enclosed environments, resulting in slow growth due to the lack of photosynthesis. Providing plenty of fresh air or extra CO2 (ranging from 1000–1500 PPM) will sustain steady chlorophyll production, and plants will grow rapidly.

Dissolved Oxygen

Dissolved Oxygen (DO) is the measure of the oxygen available in your solution. Roots require oxygen to breathe and will fail if they are not consistently supplied with the correct amount of oxygen. Stagnant water must be disturbed or oxygenated in lakes and wetlands if plants are to be grown directly in them. A general rule of thumb is to preserve DO in solution, which directly feeds and bathes plant roots between 5 and 25 PPM. If the plant does not have the correct level of DO, anaerobic respiration will occur, which will allow the plants to generate toxic levels of ethanol rapidly.

pH

The pH of a solution is the relative number of hydronium ions contained therein. The pH level varies from 0 to 14, with a pH of 7 being neutral, 0 being highly acidic, and 14 being extremely alkaline (or fundamental). If the pH is zero, the solution produces equal numbers of hydrogen ions (H+) and hydroxide ions (OH-) to even it out. A solution with a pH of 0 to 6.9 has a higher H+ ion concentration, which makes it acidic. In this case, however, a solution with a pH of 7.1 to 14 has a higher concentration of OH-ions, resulting in it being alkaline or basic. The pH in any nutrient solution is highly critical, as it controls the plant's availability of elementary salts. Nutrient deficiencies can occur at pH levels outside the standard due to their non-disponibility to the plant.

Total Dissolved Solids (TDS)

Electrical conductivity (EC) is explained as the measure of the total dissolved solids in a solution. Because nutrients are taken up by a plant, the EC ratio is reduced because the solution contains less salt. Conversely, as water evaporates from an open pool or is absorbed by the plants, the EC of a solution decreases.

Growers Guide to Common Plants

Always use a high-quality hydroponic fertilizer and maintain a healthy growing area, allowing you to enter your plants with plenty of light, air, and moisture. Seed packets will provide more detail about the specific strain that you wish to grow.

IMPORTANT NOTE

The ratios of nutrient solutions shown here (PPM/EC) are only a general rule of thumb. When you work with a commercially available nutrient solution, make sure to follow the instructions of the supplier for use with the crops you choose to grow. This is primarily due to the variation between the materials used in the very different industrial products in the electrical signatures.

Getting Started with Seeds

Most plants rely on the seed as their primary reproductive process. After pollination by the male flower, the seed is produced inside the female flower. All seeds emerge as an egg inside a female floral carpel. When wind or mosquito drops male pollen into the female flower, the egg becomes an embryo and develops a rough covering around itself. The seed is released when the seed production finally stops, and it is taken to its final resting place by wind, rain, moth, or insect. If all conditions are right, it will turn into a new plant and repeat the process of the growth cycle. I simply “tick” the open flowers with a soft artist brush with the peppers and tomatoes to spread the pollen from one flower to other flowers.

I like using a growing area of 10”x 10” or 10”x 20” to give a friendly environment to the seeds and additionally cuttings.

Keep the stickiness high by utilizing a 6” clear vault spread. A little creativity and some Tupperware and clear saran wrap will work as well.

You’ll also need to choose a starting medium and a growing medium. The starting medium is the thing that you will plant your seeds or cuttings in until they develop sufficiently enormous to be “transplanted” into the framework.

Typically, you will be starting your seedlings in a growing medium.

The Perfect Starts ROOT!T sponges are produced using natural fertilizer that is formed into little fittings with an adaptable cover that keeps up there wipe like surface and shape. This permits the hydroponic cultivator to utilize a natural mechanism for seeds and cuttings that can be transplanted legitimately into a framework. The sponges secure the roots and shield the material from obstructing showerheads.

Abstain from utilizing soil to begin your seeds since it isn't sterile and may contain bugs or pathogens that can contaminate your framework. Water your starting medium with a 1/2 quality supplement arrangement before use and keep it soggy yet not drenched while seeds or cuttings root.

If you are utilizing coco coir, it comes in dried out blocks that can be absorbed the 1/2 quality supplement arrangement during the re-hydration process.

On growing modes for more data on re-hydrating. One block, for the most part, makes around two gallons of free coco coir, so you might not have any desire to utilize the whole block immediately except if you have plenty of seeds to begin.

Seed Starting

From my experience working with various methods for starting seeds, I have built up a basic and solid strategy for effective germination.

1. Pre-dampen starting medium w/1/2 quality supplement, pH 6.0.
2. Maintain a temperature of 72–80ºF.
3. Keep the air temp. at 70–78ºF and 70–90% stickiness.
4. Delicate light (20 watts/sq. ft.) until most grow, at that point increment.
5. Feed 1/2 quality supplement until light power is expanded.

6. Dispose of frail growing seedlings.
7. Move seedlings to the production area once leaves begin to sprout.

Making Clones of Your Preferred Plants

Another great technique for starting and restocking your nursery is cloning. While “cloning” may seem like a term for the five o’clock news, nursery workers have been indistinguishable proliferation plants for many years utilizing this basic system. To start, a little “growing tip” is taken from a solid sample and is “planted” so it can develop its own underlying foundations.

This strategy is autonomous of the plant’s regenerative framework, and along these lines, dispenses with any likelihood that its “posterity” will keep on developing. The cloning system brings about plants that are indistinguishable from all angles. Cloning is extremely well known with indoor cultivators wishing to protect the qualities of an, especially most loved strain. With the goal for cuttings to root appropriately, the accompanying must be watched:

1. Root zone temperature 72–80ºF.
2. Air temperature 70–78ºF and 90–100% stickiness.
3. Roundabout, low power light (20-watt fluorescent).
4. Root sustaining 25% quality supplement distribution.
5. Establishing hormones assist cuttings with establishing quicker.
6. Foliar feed weakens 15% quality supplement splash.

Method

1. Select a sound growing tip from a plant you wish to clone. The tip ought to be roughly 3” to 5” long and incorporate close to two

arrangements of leaves (counting the tip). Continuously select new green growing tips for the most advantageous cuttings.

2. Utilizing a clean blade or razor, cut off the tip and quickly place into a room temperature shower of weakening supplement arrangement or a readied cloning arrangement.
3. Make a crisp cut while submerged at a 45º edge simply over the last cut (end). This will guarantee that no air bubbles (embolism) are caught in the stem, which could block the take-up of water and supplements.
4. Plunge the cut end into your decision of cloning gel or powder and rapidly yet tenderly supplement the cutting around 1/2 to 3/4” into your decision of starting attachment or medium.

The cutting is now fit for containment under a soft light source in a clear dome of humidity. Maintain a low temperature of 72–80ºF, 90–100% humidity, and soft light (20-watt fluorescent) until the roots mature within 7–21 days.

After that time, the cuttings can be transplanted to their final destination or to a better lighting intermediate region where they can harden before being exposed to a high-intensity lamp or sun.

Store Your Hydroponic System

Once a root system has been formed by your seedlings or clones and has been “hardened off,” they can be transplanted. If you’ve used Perfect Starts or any other starting medium plug or cube type, this method just involves placing them in your machine and turning it on. If you used a loose starting medium such as perlite or coconut coir, you would need to use a basket liner to prevent the loose material from slipping into your system and clogging it. I played with an aquarium filter cloth and found that a fine layer

of filter cloth seems to fit well between the coconut coir and the net cups. Coir cup liners are now also made from coco fibers. To be transplanted into the hydroponic planter systems, dig a small hole in the LECA, place the new plants in the hole, and fill the LECA gently around the roots. Place your plants in net cups, and try to get the roots as close as possible to the bottom. Fill in with LECA around the roots/sponge/cube to hold it in place.

Give them a few days, say three to four, of lower than normal lighting when you first place the plants in your system, so they can recover from the move and restore their vigorous growth. Keep a close watch on your new plants. When they look a bit wilted, lower the lighting level. It's also a good idea to use the nitrogen solution to cool the plants from above for a few days. This will keep their roots warm as they adjust to their new home. Normally, I keep them in cups outside the garden under soft fluorescent light for about three days and topwater them before carefully placing them in the system and under HID lights. When you grow indoors under a HID light or grow outside in the daylight, it's a good idea to harden your seedlings/rooted cuttings this way by putting them next to a sunny window or by raising your growing lamp up to about twice its usual distance from the plants. Once they have a decreased light for two to four days, you can start increasing their sensitivity slowly. When the nutrient solution is found in their veins, beware! They are going to grow like crazy!

Stages of Growth

The life cycle of a plant starts with germination, which is generally identified by the presence of a rising shoot above ground. As these leaves begin producing milk, the plant is reaching its growing seedling stage. The plant grows its first collection of true leaves during this period, resembling those of the mature plant and starting the primary development of a root

system. The root development occurring at this time is crucial to the rate at which the plant will continue to grow. Providing the correct root climate will ensure your crop has a chance to thrive. The main advantage of hydroponic systems, as I have said before, is how they preserve optimum root protection!

The vegetative stage starts once the root system can sustain more development. Since growth during this time is primarily focused on stem, branch (also referred to as “frame”), and foliage, plants require substantial amounts of nitrogen (N) required for chlorophyll development. The most significant growth over the plant’s lifecycle begins in the vegetative stage and will continue until disrupted by an environmental change or lack of water and nutrients. The reproductive period is the final stage of a plant’s lifecycle.

Because the plant’s goal now is to replicate and thus carry on growth, most of its resources are dedicated to growing flowers, seeds, and berries. At this time, the primary nutritional requirements start shifting from a high-N diet to a low-N, high-P-K diet (remember our debate on macro-nutrients!). This is attributed to a pronounced decrease in vegetative growth during reproduction. This move causes the gardener to transfer the nutrient solution from a vegetative formula to a floral formula or “bloom.”

For precisely that reason, many hydroponic nutrients are now coming in as a two-part device. In some species, a difference in daylight length causes reproduction; this trait is called photoperiodism. When these plants can be planted and harvested as they grow outdoors, it is this feature that dominates. If you are developing indoors, make sure to provide your crop with the right photoperiod, or they may never mature entirely. Increasing the length of daylight artificial will trick the plant into flowering early.

When you intend to grow indoors, you may have to play “bee” by manually pollinating the flowers on your plants as there aren’t the insects that would naturally do that in nature. A delicate touch, probably with a brush on each flower, will actually help the plant pollinate itself to produce fruit for the tomatoes and peppers. There are “rose shakers” available commercially, which vibrate the flowering plants so often to achieve the same result. I’ve found that the breeze from a strong circulating fan is often enough to also cause indoor pollination.

If this appears to be too much work for you, you can select a variety that grows better in a greenhouse as they will usually be of the type of self-pollination and require no outside effort on the grower’s part.

Chapter 10
Hydroponic Nutrients

The first segment deals with the selection of nutrients, and the second deals with the mixing of these nutrients.

You have two options when it comes to providing nutrients for your plants; you can either purchase a premixed ready-to-use nutrient mixture or make one at home by yourself. If you are using premixed nutrients, then you can assure yourself that the plants will be getting all the nutrients that they need for their growth. However, this amount will depend on the amount of water you are adding to the ready-to-use mixture. If you are mixing your nutrients at home, then it gives you total control over the nutrients you feed the plant, and it is quite economical. Also, it enables us to ensure that you are using only organic materials.

Selecting the Nutrients

Before you can jump into selecting the nutrients that you want to use, there are a couple of things that you must do.

The first thing that you need to do is understand the composition of the water you will use. To do this, all that you need to do is send a sample of the water to a lab and get it tested. If the water is soft, then you can add the necessary nutrients to it to make it fit for the plants you want to grow. If the water is hard, then you will need to filter it out and get rid of all heavy metals before you can use it. You need to get the water tested from time to time to ensure that it is fit for growing plants; if not, you will be merely

harming the plants. The common elements present in regular tap water are calcium carbonate and magnesium carbonate, which are desirable in limited quantities. So, if you are aware of their existing levels, you can add or subtract certain nutrients accordingly.

Now you will need to carefully select the micronutrients necessary for the growth of the plant. Micronutrients are also known as trace elements, and they are needed in small quantities for the growth of the plant. They tend to affect the growth and reproductive abilities of the plant. The trace elements that you need to include are iron, copper, boron, zinc, manganese, chlorine, nickel, sodium, cobalt, molybdenum, and silicon. You can add up to 10 micronutrients to the nutrient mixture.

You will need to check the temperature of the water, also. If the water is too hot or frigid, then the seeds will not germinate. Also, if the water isn't of ideal temperature, then it can severely damage the roots of the plant. The ideal temperate must be between 64°F and 80°F. Plants suited for cold climates will grow well even if the water is colder, and vice versa with plants for warmer climates in warmer water. Whenever you are adding fresh water to the reservoir, you must ensure that it is of the right temperature.

The final thing you need to consider is the pH of the water you use. The ideal pH level for the growth of a plant is between 5.5 and 7. So, keep a pH meter handy at all times and check the pH of the water at least once every week. If the pH levels keep fluctuating, then it will hurt the plant's health. It also affects the plant's ability to absorb and synthesize nutrients. Before you go ahead and add any nutrients to the water, you need to check its pH.

Nutrient Mixture

The first thing that you must do is take a couple of containers and fill it up with filtered water or water that has gone through reverse osmosis. If you don't have access to distilled water, then use tap water that has been left in the open for 24 hours to remove traces of any chlorine from it. If you are using tap water, please make sure that you get it tested first.

Now, you will need to measure out all the nutrients you want to use. Use a graduated cylinder or a beaker to measure liquids and a chemical scoop to portion out the fertilizers.

Once you add the nutrients to the water, you must check its overall pH to ensure that it is safe for the plants. Even a slight imbalance in the level of nutrients or the pH level can seriously harm your plants and damage their roots. Also, ensure that there is sufficient nutrient solution in the reservoir so that the pump doesn't start pumping air. Before you add the nutrient mixture to the water in the reservoir, please stir it.

NPK (nitrogen, phosphorus, and potassium) is the most common ratio of macros that a plant needs for its growth. The ratio of NPK shows the concentration of these elements. For instance, an NPK ratio of 10:5:8 means that for every ten molecules of nitrogen, there are 5 and 8 molecules of phosphorus and potassium present, respectively.

When a plant is developing its roots, then it will need a lot of potassium and phosphorus. While it is growing, then it needs more nitrogen and potassium. During the flowering stage, it needs more phosphorus than the other two nutrients. So, you must keep the stage of the plant's development in mind when you are making the nutrient mix. An all-purpose nutrient blend has a 10:10:10 or a 20:20:20 ratio.

Chapter 11
Common Problems and Troubleshooting

Growing plants hydroponically is an art because you do not have the same set up as you would with a traditional garden, you are responsible for providing your plants with the light, water, and nutrients that they need to grow. Sometimes, however, our systems do not allow our plants to flourish as we intended. In these cases, the first step is to check for common problems in the system. Once you locate what is wrong, you will be able to fix your hydroponic system so that it grows larger, better harvests.

Troubleshooting #1: The Lighting

Whether you are using natural or artificial lighting, there are a few things to consider in regards to how well your plants are growing.

Natural Lighting

When it comes to natural lighting, you should ask yourself:

- **Is the plant getting enough natural light?** If you are growing inside, be sure the window that your plant is sitting in gets an adequate amount of light during the day. If you are growing outside, make sure the area your plants are in is not covered by shade too much during the day.
- **Are you growing out of season?** If the daylight is shorter or the shading is different depending on the time of year, you may

want to switch to artificial lighting.

- **Should you switch to artificial lighting to speed up the growth of your plant?** When you use artificial light, you have more control over grow cycles, and you can reap more harvests.

Artificial Lighting

- **Are you using the right kind of lights?** Most fluorescent lights are not compatible with growing plants. You should be using HID lights.
- **How close or far away from the plant is the light?** Your light should be no lower than 1 foot away but no higher than 2 feet. Adjust according to the size of your hydroponics garden. You should also adjust the wattage to a higher number of watts the farther you are from the plant.
- **Are my plants getting too hot to grow?** The simplest way to see if your plants are too hot (your bulb is too close) is to put your hand just above your plants. If it gets hot, then you need to move the light further away.

Troubleshooting #2: The Growing Climate

If the climate is not right, your plants will not be able to grow. Be sure that you take the specific needs of the plant in mind and adjust the moisture level and temperature accordingly.

- **Is the temperature of your growing system between 60º and 90º?** You should also make sure that the temperature drops by 10º at night, as this is important for the night/day rhythm of the growing cycle.

- **Is the air being properly ventilated?** The last thing that you want is to have an excess of stale air around your plants. You should install a vent or even a fan so that the leaves are gently stirred around throughout the day and night.
- **Is the relative humidity of the growing area between 50% and 70%?** This is considered safest for growing because too much humidity can interfere with growing processes and encourage the growth of mold. Between 50 and 60% is the most optimal range of humidity, but as much as 70% is acceptable for certain plants.

Troubleshooting #3: The Nutrient System

In regards to the nutrient system, here is what you should ask:

- **Is there enough solution in the reservoir?** If your pump is sucking any air during the cycles, then it is likely you need to add more nutrient solution to your reservoir.
- **Do you have an adequate ratio of water to nutrients?** If you think that the concentration of your solution is the problem, discard the entire batch and start over.
- **Is the temperature of the reservoir below 85º?** Keeping the temperature under 80º is preferred, but under 85º is adequate.
- **Is the pH of the nutrient system balanced?** Check the pH of your nutrient solution regularly to be sure that your plants are getting what they need. If you need to raise or lower the pH, there are drops that you can buy to do this.

Troubleshooting #4: Pests

It can be hard to pinpoint the reason for pests to show up in your hydroponic garden, especially if you have used sterile buckets and nutrient mixture. However, it does sometimes happen, and when it does, you need to use one of the following three options.

Hand-Pick the Bugs Off

If you catch bugs early on, this is the most effective way to get rid of them. Pick the pests off by hand and put them in a container (you can release them or kill them). Do this for a few days until you notice that no bugs are remaining.

Take Advantage of Natural Predators

If you have a screened-in greenhouse, or if you are growing your hydroponic garden outside, you may be able to use bugs to get rid of your pests. Bugs like lacewings and ladybugs have voracious appetites when it comes to "bad" plant bugs like mealybugs and aphids. This is obviously a method that you do not want to use for your indoor setup, but it is extremely effective (and safe) for biological pest control.

Last Resort-Organic Pesticides

If you are like most people, then one of the reasons you are growing hydroponic fruits, vegetables, and herbs is because you do not want dangerous chemicals and pesticides in your fruit. Unless you want to throw away your entire crop because of a bug infestation; however, it may end up being your only option. The first thing that you must do is identify the bugs that are on your plant. Then, look for organic pesticides that will not leave a harmful residue on your crops. Here are a few tips:

- **Look for non-toxic pesticides.** These are going to be the safest for your plants (and you!).

- **Follow the instructions closely.** Non-toxic pesticides may take several applications before all of the bugs can be exterminated.
- **To prevent the artificial or natural light from harming your plants, spray the pesticides in the evening.** This will allow them to dry, so your plants do not burn.
- **If you do have to use pesticides, be sure to stop spraying at least one week before you harvest the plant.** Also, wash before you eat.

Identifying Critters

There are several things that can indicate an oncoming critter infestation, including icky coatings, discoloration, and more. Here are the most common bug signs and how you can get rid of them.

- **Webs:** If you see the webs on your plants, then spider mites are a likely culprit. Spider mites are red but very small, so unless you are looking for them or you have a large infestation, they are hard to see. In addition to webs, you will probably notice yellowish-white specks on the leaves of your plant. This is caused by the spider mites sucking out the plant fluids. Eventually, this will turn brown unless you take care of the problem. You may also notice the eggs of spider mites, which are small and round. They are also translucent, with a white to amber color.
    - If you catch the infestation early on, you may be able to get rid of mites by raising the humidity and temperature. Because spider mites prefer dry, cool conditions, doing this may send them packing.

    - If that does not work, consider investing in predator mites. These are the natural enemy of spider mites, and you will need to purchase one predator mite for every 100 spider mites that you believe you have.
    - If you must resort to using chemicals, be sure that you are purchasing a blend made with Neem Oil. You can also consider using Neem Oil by itself, though it may not be quite as efficient as the pesticide.
- **Wilted, sickly plants:** If you have noticed that your plants have almost stopped growing or that they are sickly or wilted in appearance, aphids may be to blame. If you do not resolve this problem, the plants will turn brown and curl inward. This is because aphids suck the sap out of the leaves and also have saliva that is toxic to plants and often filled with disease. If you inspect the underside of the plant, you will find dense, yellowish areas. These are softer-bodied bugs that are known as aphids.
    - These are bugs that you can hunt and pick off, especially because they often hang out in such dense colonies. They may be on the undersides of leaves, but also on the tips. Crush them as you pick them off.
    - There are a number of bugs that prey on aphids. Some good choices include green lacewings, ladybugs, and gall midges.
    - Neem Oil is also effective against aphids. Find a pesticide that includes this ingredient.

- **Cotton-like substance in crooks of leaves:** If you have cotton-like substances on your plant, then it is likely mealybugs. Mealybugs have the appearance of cotton, especially when they group together in colonies. Your leaves will become distorted, and your plants can become weak, often dying quickly.
    - This is a bug that is particularly difficult to battle using the pick-and-remove method. You may be able to win if you catch the infestation very early, but you will need a great amount of vigilance.
    - For biological warfare, introduce a couple of ladybugs into the growing environment. Ladybugs find mealybugs to be a tasty treat!
    - Neem Oil can be effective, so look for a pesticide with this ingredient. You will likely need several applications to get rid of this pest.
- **White-yellowish spots with a metallic sheen:** If you have white-yellowish spots appearing on your plants, then thrips may be to blame. These are small wormy-looking creatures with legs. If you do not get the infestation under control, your plants will eventually turn brittle. Here is how to deal with them:
    - In order to locate the thrips, shake the leaves. Then, pick up the bugs and squish them. In the early stages of an infestation, you will be able to kill them by hand.
    - There are a number of bugs that can help with biological warfare, including green lacewings, parasitic wasps, and

predatory mites.

- You will definitely want to treat these with a specific pesticide if they get too severe.

Troubleshooting #5: Gross Coatings (Not from Bugs)

Sometimes, you may notice gross coatings on your plants. The first step to treating the issue is to find out exactly what you are dealing with.

Gray Mold

Gray mold is soot-like in color and can also have tints of white. It may even look like lint or hair. Gray mold is the most common cause of extra humidity. Once this mold gets hold of your plants, it can become fatal very quickly. If you can catch it early, however, you may have a fighting chance. Here's how:

- Begin by taking a soft, dry cloth, and use it to gently remove the mold from the leaves of your plant.
- Look closely at the growing material. If you see any dead debris or matter, remove it. These can become candidates for mold growth.
- To prevent more growth, immediately increase the circulation and ventilation in your growing area and decrease the level of humidity in the room.

Tobacco Mosaic Virus

The tobacco mosaic virus will cause your plants to die. Plants like tomatoes, cucumbers, and peppers are especially susceptible to contracting this disease. The best thing to do in this case is to prevent the tobacco

mosaic virus in the first place because it can be very dangerous to your plants. Here is what to do for prevention:

- Do not smoke in your growing room. Do not let anyone else smoke in your hydroponic growing room, either.
- If at all possible, do not let someone who smokes handle your plants. If you cannot avoid it, be sure that the smoker washes their hands thoroughly using hot water and antibacterial soap. This may not even prevent it, but this is your best bet.

Damping-Off

Damping-off is a disease that affects new seedlings, and there is no cure once it takes hold. After your plant is affected, it will collapse and fall over, dead. Fortunately, you can take the following measure for prevention.

- Make sure that the planting material you choose is sterile and fast draining.
- Routinely apply an all-purpose fungicide to your plant area.

Powdery Mildew

Powdery mildew appears as white spots that cover the tops of leaves early on. As the mildew progresses, it turns into a gray-white powder that covers the entire plant. This will cause the growth of your plant to slow down and eventually die. Fortunately, powdery mildew is one of the less serious diseases. It can be treated using the same measures that you would use for prevention.

- Decrease the amount of humidity that is in your growing environment
- Increase the amount of light intensity (make sure your plants are not getting too hot, though!)

- Increase the ventilation and air circulation
- Regularly apply an all-purpose fungicide

Wilt Diseases

There are two different wilt diseases that can affect your plant—Fusarium Wilt and Verticillium Wilt. These will start as small spots on eggplants, peppers, and tomatoes. Then, the leaves that are on the lower part of the plants are going to wilt, and the plant will die. In order to prevent this (there is no treatment), take the following steps:

- Buy tomatoes that are resistant to wilt. These will be labeled as V or F type.
- Always start with fresh and clean growing medium—never reuse the material from a harvest.
- Make sure you are disinfecting your reservoir, growing chamber, pipes, and any other materials between harvests.

Algae

Algae is one of the safer coatings that you will find on your plants. It appears as a greenish colored guck over the top of your planting media and possibly in your nutrient reservoir. While algae are relatively safe, you should still take its presence as a warning. It shows that conditions like humidity, excessive water and light, and stagnant water may be present, all of which can lead to more serious plant diseases. To treat algae, do the following:

- If your growing medium is porous, put one to two inches of LECA stones on top of your pot. This will create a dry barrier between your plants and the growing medium.
- Scrape any visible algae off.

- Correct the conditions that are causing your algae to prevent the growth of this and other diseases in the future.

Tips for Preventing Gross Coatings

The two primary causes of icky coatings on your hydroponic plants are stale air and humidity. To help stop mold, algae, and other coatings, follow these tips:

- Use an air conditioner to regulate the temperature of your growing room.
- Keep a fan running at all times. Your goal should be to keep your leaves rustling slowly.
- It is important that you do not over-water your plants. This can make the growing material excessively wet and encourage the growth of mold, mildew, and fungus.
- Do not reuse your growing material and nutrient solution. Also, use a solution of ten parts water to one-part bleach to clean your set up between harvests.
- Use opaque coating and tubing so that light is not seeping into your system and encouraging unwanted growths.

Troubleshooting #6: The Leaves

One of the best indicators that there is something wrong with your hydroponic plants or even your growing system is the leaves of your plants. If you know what to look for, you can easily learn of disease, pests, climate issues, and nutrient deficiencies early on—before your plants are not able to be saved.

Integrity of the Leaves

- **Wilted leaves:** Wilting leaves can be an indication of a simple growing problem, such as over-watering, under-watering, or an environment that is too hot or dry.
- **Curled up leaves:** If your leaves are curling up, then aphids or thrips may be to blame. Check for these critters using the tips in the bug infestation.
- **Drooping leaves:** When your leaves start to drop, there are a few problems that may be at hand. The temperature may be too high, or your plant may not be getting enough fluids.

Discoloration

- Yellowing is an indication of a nutrient imbalance or overwatering. It can also be an indication of whiteflies. Plant leaves can also turn yellow when they are at the end of their lifecycle, so know when to uproot the plants and start over.
- **Browning of leaf tips:** If your leaf tips are turning brown, it could be too much nutrient solution. Flush with water for a week before resuming with a new batch of nutrient solution.

Other Troubleshooting

While we have covered some of the main issues you will have so far, keep your eye out for the common problems as well.

Seedling Issues

There are two major issues that happen with seedlings. The first is damping off. The second is spindly growth, which occurs when your seedlings are really thin and tall. This problem is caused by not having enough light.

Chapter 12
Easy DIY Hydroponic Structures That Can be Built in No Time

You really do not need a large garden to grow your fresh produce or many years of experience to create/build your own indoor grow system. This is the beauty of hydroponics.

The entire course is based on flexibility and inventiveness. There are several DIY hydroponics plans all around the World Wide Web.

Below is a collection of the best homemade hydroponics plans you can build. These include plans for beginner, intermediate, and expert level setups.

Aquarium Hydroponics Raft

This is a very cool task to really get your feet wet in the wonderful world of hydroponics. Also, it is a terrific way to make your children connect to the field. As the name suggests, you'll need an aquarium tank to get this to work. This technique may be used to plant small beans or perhaps a single large member of the lettuce family.

Combined with the normal ingredients such as nutritional solution, water, and plants, you'll also need a raft of barge made of foam. The machine can be active or passive, using electric power and pumps.

The Passive Bucket Kratky Method

The Kratky unmistakenly one of the hydroponic methods you can start within a few hours. This system is excellent for anyone who is just getting started with hydroponics.

You can grow greens like lettuces, spinaches at the beginning of fruit plants like tomatoes after you have gathered enough experience.

Framework Hydroponic System

The framework hydroponic strategy is nearly the same as the PVC hydroponic program. It uses the same NFT-based concepts to send nutrients and water to the vegetation.

The difference is actually increased verticality. With the addition of new layers of PVC piping at different levels, you are able to grow even more plants in the same space.

The quantity of tubing needed increases, so will the complexity of the pumping system.

This specific system houses the PVC pipes on the wood rack frame. You are able to grow/develop herbs and vegetation, such as strawberries and tomato vegetables with this technique.

Basic Drip Program with Buckets

This is a little more complex than the solitary bucket program above. It could be cobbled collectively using parts that cost a lower amount than a hundred bucks altogether.

You could change the size of the storage containers and tanks concerning the size of the plants involved. You could use large 4-gallon buckets or

smaller storage containers.

Don’t forget to purchase a big tank in the event that you want to include more plants in the setup later on.

PVC NFT Hydroponics Program

Large 4” (Four inches) PVC pipes. In this course of action, the plants are positioned in cups that are organized in holders drilled into the pipes.

The machine is usually watered utilizing a reservoir and pump. It is a closed system, with water moving between pipes and the tank (or reservoir).

This course of action is usually well suited for planting a large amount of small vegetation within a little area. The basic system may house from 20–40 plants.

This technique could be positioned outdoors or indoors. If inside, grow lamps are obviously essential.

The hydroponics technique used in this plant is named NFT. It really is an excellent system for growing vegetation like tomato plants.

Hydroponic Grow Box

This DO-IT-YOURSELF plan is usually an extremely versatile system that may be moved around. It could be made out of any kind of sized storage space tub or bin. It will have a lid.

The plants are planted in cups filled up with some growth medium. The lid from the box will certainly house the net cups.

Vertical Windows Farm

This hydroponic system is a unique idea that solves the issue of light while also creating a remarkable window screen for the outside world.

The program involves using containers to carry plants within a vertical stand setup. Reused water bottles make ideal containers.

A system of tubes/pipes to take nutrients from your tank towards the plant is essential.

Basic Desktop Hydroponic System

The name says everything. This really is an extremely inexpensive hydroponics program that may be positioned on your table.

The program is usually ideal for small plants, just like a herb or lettuce. This is well suited for newbies who don’t have much space to grow.

The program entails utilizing a half-gallon container or perhaps a coffee can as the primary container. The herb is positioned in a net cup with a growing medium, such as Rockwool.

The most expensive aspect of the set up is a small bubbler.

Simple Bucket Hydroponic System

Here is yet a simple hydroponic setup for individuals that are just starting up.

The system works by utilizing the growing media used in the system to make a capillary action, which moves nutrients up towards the root of the plants.

Dutch Container Hydroponics

Dutch Buckets are known as BATO buckets.

You can simply have a manual sprinkling system to apply the nutrient solution many times each day to the plant. Or you may get a basic

recirculating system using tubes, pumps, and PVC pipes. To create an automated system, all that is required is usually a simple timer.

This grow system may be used for different sizes of plants. The bigger plants may get a complete bucket, even though several smaller sized herbs could be housed in the same bucket.

With regards to the level of the machine, you can develop a dutch container system in the house or outside in greenhouses/patios.

Deep Water Culture Hydroponics

If you wish to grow plants like tomato and member of the lettuce family indoors, this technique is ideal. Farmers usually use opaque plastic storage box as it's suitable for the primary nutritional solution container. With regards to the size of the container, from two to eight vegetation could be produced in this technique.

The only additional components needed are a bubbler plus some air hoses to pump in the air into the nutritional solution.

The plant could be positioned/placed in a net pot, underneath LED grow lamps.

Drip Water Hydroponics

Drip systems could be simple or complicated, based on the needs you have and budget. In a passive system, you can do away with the pumping systems and make use of gravity to bring the nutritional solution to the vegetation. This will demand some creativity in the placement of your garden and tank/reservoir.

Or you may just make use of a submersible pump and a network of thin tubes to provide the nutrient in small amounts to the plant.

A growing medium is usually preferable for drip systems. Well-known options consist of coir and perlite-vermiculite.

Chapter 13
Starting Gardening with Hydroponic Technique

Necessary Tools to Start Hydroponic Gardening

Here are the tools needed in the three germination, growth, and final flowering stages.

For the Germination Phase

Necessary:

- Greenhouse (in which to germinate the seeds)
- Rockwool cubes (at least 1 for each seed to be germinated)
- Root Stimulator

Optional:

- Neon light
- Watertight heating resistance (allows to keep the temperature of the greenhouse stable at the optimal temperature of about 26º)

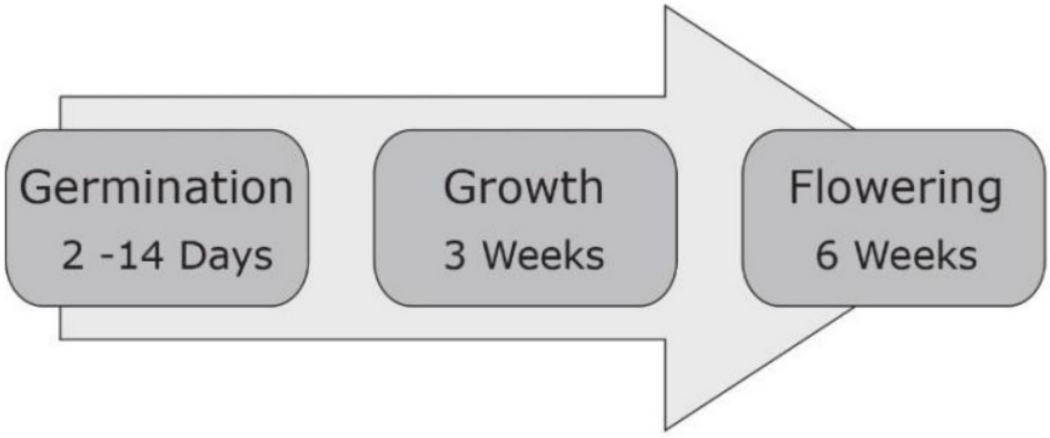
For the Growth and Flowering Phase

Necessary:

- Indoor Lighting Kit (in we will explain how to choose the lighting system)
- Bulb
- Power supply
- Lamp/Reflector Holder
- Hydroponic system
- Expanded clay
- pH Tester
- EC Tester
- pH corrector
- Nourishments for the growth phase
- Nourishments for the flowering phase
- Timer for timing

Optional:

- Thermometer/hygrometer
- Grow box/Grow Room or Mylar tent
- Easy roller
- Humidifier
- Cooling fan



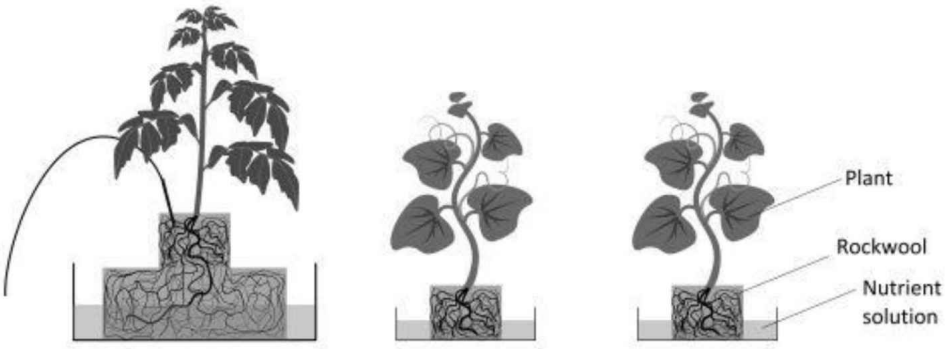
Preparation of the Germination Area

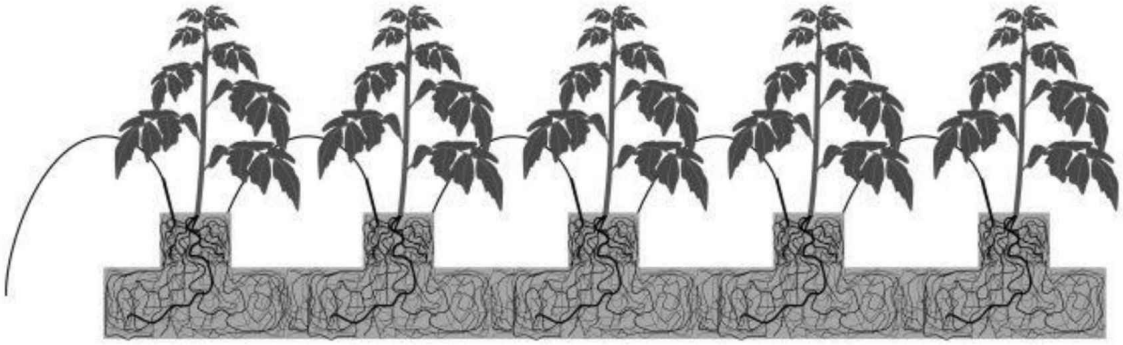
Prepare the Rockwool Cubes for Germination

To prepare the germination area, it is necessary to have Rockwool cubes and the root booster to develop the root system of the plants quickly. Below we illustrate the procedure to start the seed germination phase.

- Prepare a solution with 5 liters of water and 20 ml of root stimulator.

- Take the Rockwool cubes and leave them to soak for about 24 hours in the solution of water and Rootbooster to make the Rockwool cubes less alkaline (their pH tends to 7.0).
- The next day drains the cubes. Rockwool cubes retain a lot of water, so it is useful to drain the Rockwool cube to allow a correct exchange of water and oxygen.
- Insert the seed into the hole of the Rockwool cube at a depth of 1/2 (half) cm.
- Insert the cubes inside the mini-greenhouse and keep the temperature at about 79°F (26°C) with a high humidity rate (about 80%).
- Move the neon lamp closer and keep it on 24 hours a day.





The seed does not initially need light. Once the seedling comes out of the Rockwool cube, however, it is essential to light it with delicate light (preferably neon) or HPS and/or MH lamp (monitoring temperature and humidity).

The roots once crossed the Rockwool cube will tend to come out from the sides and from the bottom of the cube itself.

N.B.: the seed in the germination phase is very delicate and must not be touched.

Installation of the Hydroponic System and Sprout Housing

Once the seed has germinated, it is necessary to plan the preparation of the hydroponic system to plant the Rockwool cube.

But how does the hydroponic system work?

In fact, it is good to specify that there are many hydroponic systems on the market with different characteristics.

In our example, we will use the Atami Wilma Large 4-bowl hydroponic system, which is one of the best-selling with a technology proven by historical results and is now guaranteed.

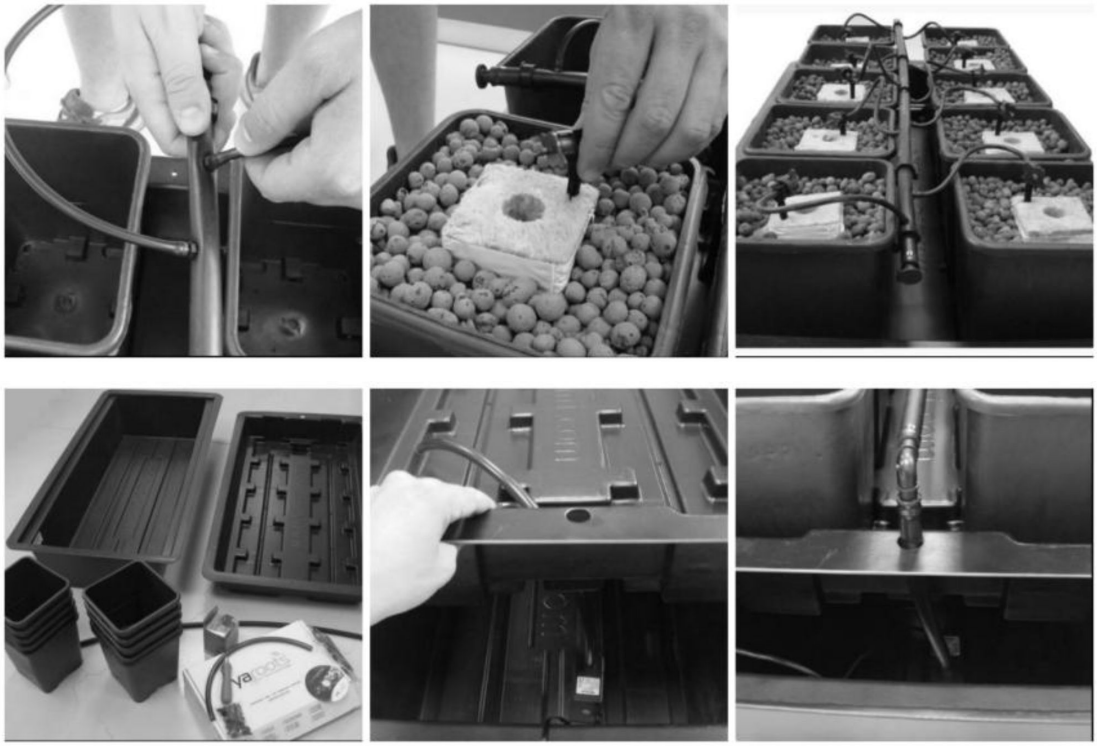
If you decide to use other methods, you should always refer to the instruction manual provided by the manufacturer.

How Does a Hydroponic System Work, and How to Set It Up?

Here is what we must foresee and prepare and how it is appropriate to set up—in detail—the hydroponic system.

- Prepare the lower tank.
- Place the pump in the tank.
- House the upper tank.
- Place the vases on the upper tank.
- Connect the pump to the main fitting.
- Connect the main pipe to the drippers and support rods.
- Fill the expanded clay pots (remember to wash the clay thoroughly to eliminate dust and impurities).
- Connect the pump to the timer and to the power supply (we will deal with the timing of the hydroponic system).

- Fill the tank with water and fertilizers (we will deal in-depth with this topic).
- House the Rockwool cube containing the sprout inside the vase containing the expanded clay and house the drippers so that they supply water directly on the cube.



The lighting system

Once the cubes containing the sprouts have been placed inside the hydroponic system, we must begin to illuminate the seedling (and this applies both to indoor gardening in the ground, both for hydroponic gardening, and obviously for aeroponics). To do this, we must prepare a suitable lighting system capable of making the sprout grow and flourish by simulating the effect of sunlight.

A lighting system for hydroponics and indoors is composed of the following elements:

Power Supply (or Ballast)

It is used to provide a discharge of current sufficient to turn on the lamp. There are two types of power supplies on the market, the iron-magnetic and the electronic ones.

Electronic ballasts have the advantage over ferromagnetic ballasts of:

- Consume less electricity.
- To heat very little.
- To be more stable and therefore increase the life of the bulb.
- Wiring is more straightforward because they have a connection to the electrical network already wired.
- Some models (dimmable) can adjust the watts and, therefore, to manage bulbs of different wattage.

Hydroponic Lamp: What is It?

The lamp that in indoor and hydroponic gardening provides a specific light spectrum to simulate the effect of the sun.

We often speak of a hydroponic lamp, but, in reality, it is more appropriate to speak of a specific bulb for hydroponic gardening, which—thanks to the particular spectrum of light—simulates and reproduces the effects and benefits of sunlight. There are various types of bulbs on the market dedicated to indoor gardening. The difference lies in the kind of technology and the different background of light and colors. For growth, a blue light spectrum is suggested. For the flowering phase, however, an illumination spectrum tending towards orange/red is indicated. Agro lamps are usable during the growth and flowering periods, while MH is usable only during the vegetative phase (when the plant grows), while HPS is for the flowering stage.

Lamp holder/Reflector

It is used to accommodate the bulb and spread the light distribution in the gardening area.

Also, in this case, there are many models on the market and properties. We can say, however, that there are two basic types of reflectors, air-cooled reflectors and those that are not. The latter has the advantage of being designed in such a way as to allow forced air passage from an extractor that can cool the heat emitted by the bulb, effectively preventing the temperature from rising inside the grow room.

Choose the Size of the Indoor and Hydroponic Lighting System

The diagram below helps you to define the size of the lighting system, starting from the available space and the number of plants you wish to grow. The size of the grow box (optional) to be associated with the type of lighting system is also indicated for convenience.

Warning! Always remember that the power supply and the bulb must have the same wattage.

Lighting System Wiring:

	150 watt	250 watt	400 watt	600 watt	1.000 watt
number of plants	1/2	2/4	3/6	4/10	8/18
Square meters	0,5	0,75	1	1,4	1,5
Grow Room Box	32”x32”x72”	36”x36”x72”	39”x39”x80”	48”x48”x80”	96”x48”x80”
	70x70x180 cm	80x80x180 cm	100x100x200 cm	120x120x200 cm	240x120x200 cm

1. **Connect the power supply to the mains.**

There are various types of power supplies on the market. Some are simpler to wire, such as electronic ballasts, because they already have a connection to the electricity grid ready, others like ferromagnetic ones, are more complex.

2. **Connect the power supply to the lamp/reflector holder.**

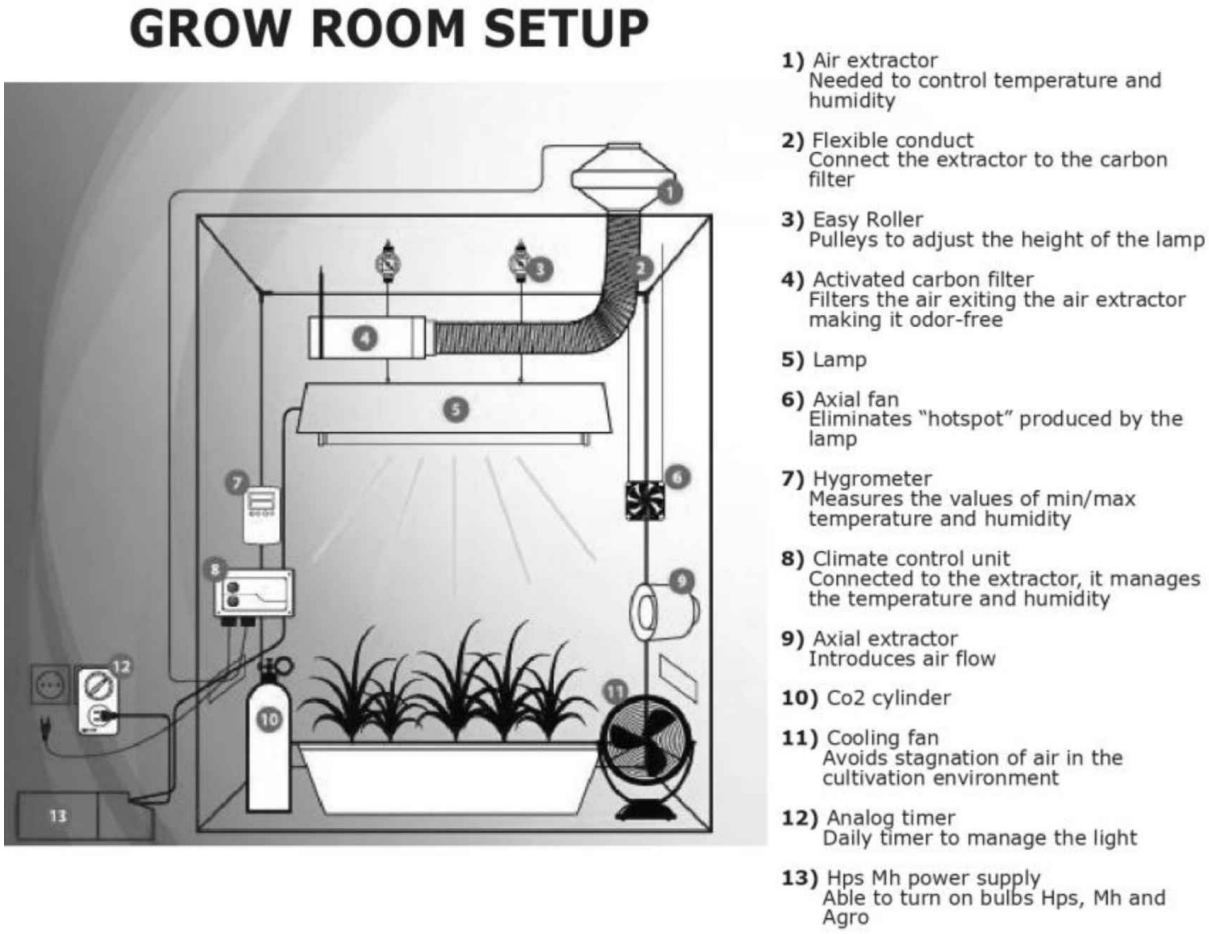
The current from the power supply must be brought and connected to the lamp holder to which the lamp is screwed and then powered. The lamp holder for these types of uses always has a standard attachment called E40.

The lamp/reflector holder: It has the function of reflecting and diffusing the light produced by the lamp. Generally, it is supplied complete with a lamp

holder. There are various shapes and sizes on the market. It is often provided with protective plastics, so it is good to be careful and remove them before putting it into operation.

3. Screw the bulb into the lamp holder.

Once everything is wired, screw the bulb to the lamp holder until it stops. Clean the bulb with a cloth before turning it on.



The Light in the Grow Room

Light in indoor gardening is an essential element. Plants will need to receive the right amount of light from recreating the cycle that naturally provides the sun in outdoor gardening.

In indoor gardening, it is advisable to completely isolate the gardening area, perhaps by purchasing a grow box that prevents access to natural light so that we can artificially control the hours of light and dark.

Light Hours in the Growth and Flowering Stages

During the growth phase, it is necessary to provide the plant with about 18 hours of light per day.

In the third or fourth week of the growth phase, it is possible to reduce the hours of light from 18 to 12. The plant will perceive the arrival of autumn (effect: “shorter days”), then it will begin to bloom before winter arrives.

In any case, it is not recommended to make the plant bloom when it is still too small and weak since it would not be able to support many flowers.

Using the Timer to Control the Switching on and off of the Lights

The timer is handy for regulating the switching on and off of the lights. There are several types on the market; the cheapest ones are the analog timers that provide programming in 24 hours in general in a 15-minute passage.

The digital timers are set to multiple programming and arranged to set up to 20 different programs. Finally, there are timers and multiple channels that lend light to the various power outlets.

Temperature in the Grow Room

The Tools to Control and Regulate the Temperature in Hydroponic Gardening

In all indoor and outdoor gardening, regardless of the type of soil or substrate used and the type of systems used to grow plants, temperature plays a fundamental role in the success of gardening, even in indoor ones with a hydroponic system. For this reason, it is one of the parameters to be monitored continuously and adjusted to make sure that it is always in preset and therefore optimal parameters, which oscillate between 70°F (21°C) and 82°F (28°C) degrees centigrade. If the temperature rises above 82°F (28°C) or drops below 70°F (21°C), it could cause severe damage to your plants.

To prevent this from happening, it is essential to monitor using specific measuring instruments, i.e., thermometers and thermo-hygrometers.

The recommendation is to buy a digital thermometer that allows you to correctly and accurately check the temperature of the grow room or

hydroponic gardening environment, at any time of the day, including monitoring and recording the minimum and maximum temperature reached during an arc of time.

Only in this way can we notice if the temperature has exceeded the recommended parameters and avoid problems that could be more or less serious.

But what should be done if the temperature rises or falls compared to the recommended values? How is it possible to run for cover?

To lower the temperature in the grow room of your hydroponic gardening, it is possible to use an aspirator or air extractor, which sucks in and extracts the hot air, gradually lowering the room temperature. If the temperature rise should occur often, it is possible to provide a thermostat programmed to activate the extractor only during the hot hours, when the indoor lights are on. If the temperature does not drop even with the extractor, an air conditioner can be used to lower it.

Grow Room Moisture

Humidity is another fundamental parameter to be kept under control in the indoor gardening area. The ideal humidity for indoor growing is around 50–60%. The hygrometer is the measuring instrument to monitor the percentage of humidity present in the grow room. When the humidity is too high, it causes molds to arise, which results in the progressive deterioration of the plant.

What to Do If the Humidity is Too High

To decrease the humidity in the grow room, an air extractor is sufficient as for the temperature. The suction of hot and humid air allows a lowering of humidity.

What to Do If the Humidity is Too Low

When the humidity is too low, a humidifier is sufficient for a grow room.

The Ventilation of the Grow Room

Proper ventilation allows our gardening air to avoid humidity accumulation and temperature rise.

The ventilation in the grow room, and in general, the air circulation is a factor of primary importance.

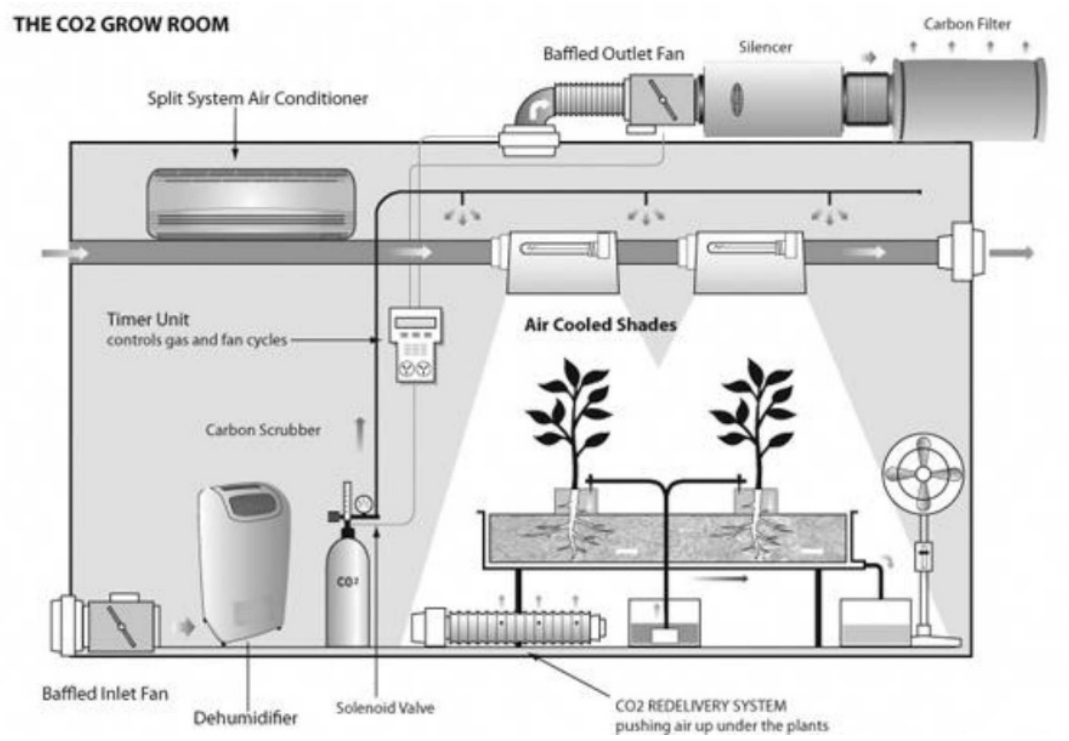
The air extraction process, therefore, becomes an indispensable element whose goal is the extraction of internal air so that all the air is extracted every 4/6 minutes. An extraction system consists of the following items:

1. The extractor to suck the air
2. The duct or extraction hose
3. The fan for the intake of fresh air
4. A fan (optional to improve air recirculation)
5. An activated carbon filter (optional to eliminate odors at the outlet)

Carbon Dioxide (CO2) in the Grow Room

When growing in an enclosed environment, there is a risk that the growing plants consume a lot of carbon dioxide (CO2); if this occurs, the growth of the plant will slow down significantly.

To maintain high levels of CO2, it will be sufficient to let outside air into the grow room through an extractor. Often, however, excessive air circulation causes the temperature to drop excessively. In this case, we can forcefully dispense carbon dioxide through a CO2 bottle dispenser.



Water Quality in Hydroponic: pH, EC, and Temperature

Control, Increase, and Decrease of the Water Values in the Hydroponic System

Hydroponic irrigation of plants is vital because through irrigation—in addition to providing water—all the nutrients the plant needs are also administered.

The Control of pH in Hydroponics: Reference Values

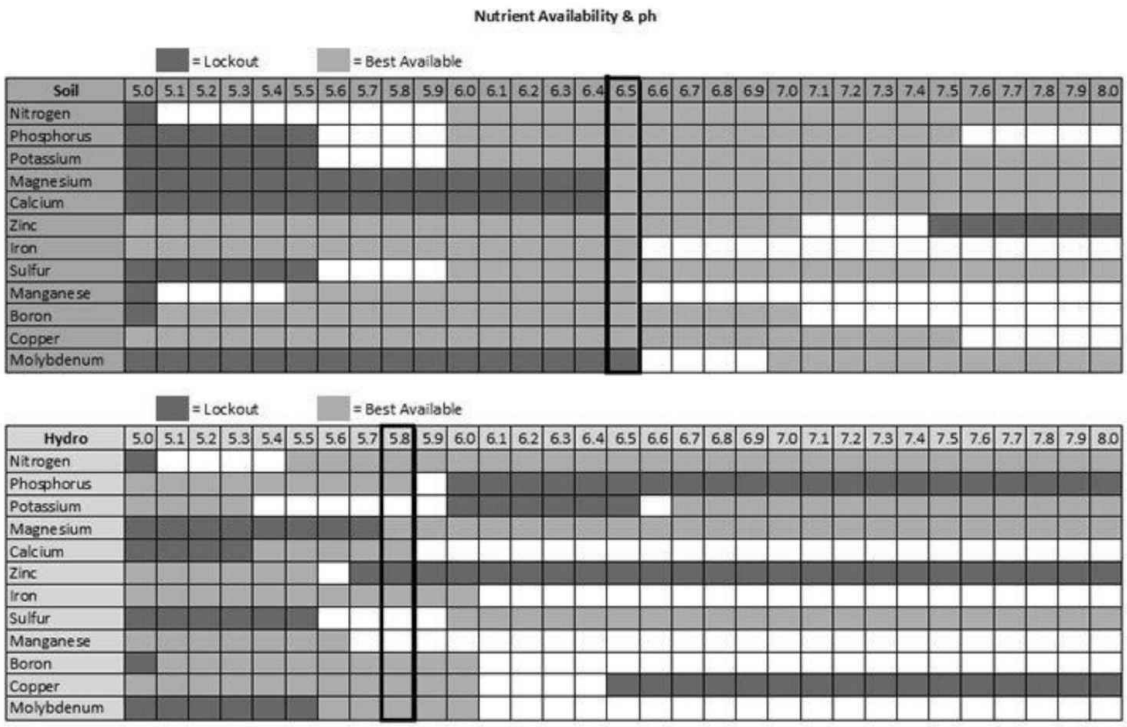
The hydroponic pH must be around 5.8–6.0. Through a pH meter, we can determine if the solution is acidic or basic.

The optimal pH in hydroponics must be around 5.8–6.0.

What to Do if the pH is Too High or Too Low?

If the solution is too acidic, it will be sufficient to correct it by increasing the pH (pH +); if the water is too basic, we will fix it by decreasing the pH (pH-).

pH- contains 30% phosphoric acid to reduce the pH value of the nutrient solution. pH + contains potassium carbonate to increase the PH value during the growth and flowering phase.



Electrical Conductivity Control - EC

Electrical or EC conductivity is measured in mS/sec milli-Siemens per second through a conductivity meter. Measuring the EC is used to establish the quantity of salts dissolved in the water.

The salts naturally present in the water of the water network can vary from area to area, so often, if we are in areas with a high concentration of salts, it is preferable to use osmotic water or water that has been filtered through a reverse osmosis system that leads to values of water conductivity close to zero.

The recommended electrical conductivity—EC—values vary according to the germination and growth/flowering phase

In the germination phase, the EC must be between a minimum of 0.6 and a maximum of 1.0.

In the growth and flowering phases, the EC must be between a minimum of 1.0 and a maximum of 2.0.

In the last flowering phase, it is advisable to drop again between a minimum of 0.6 and a maximum of 1.0.

How to adjust the water EC: what to do if the electrical conductivity EC is too high or too low?

When the EC is too low, it is sufficient to increase the amount of fertilizer, while if it is too high, we must decrease the fertilizer.

The Water Temperature: Reference Values

The water temperature is critical in hydroponics. In hydroponics, the temperature must be between a minimum of 59°F (15°C) and a maximum of 73°F (23°C).

What to Do if the Water Temperature is Too High or Too Low?

When you introduce new water into the system, pay attention to the starting temperature, and if it is too cold, it is essential to wait until it warms up to room temperature. When the water temperature is too low in production, the ambient temperature is probably also too low. And the same principle applies in the case of too high temperatures. Therefore, before proceeding to raise or lower the water temperature directly, act and adjust the temperature of the external environment.

Fertilization of Hydroponics

Fertilizers and Nutrients are for Plants Like Food for Humans

Fertilizers and nutrients are for plants such as food for humans and are, therefore, a fundamental element in indoor gardening. There are many types on the market with different characteristics. Still, it is crucial to make sure the fertilizer used is suitable for the kind of gardening we are carrying out. For example, if we grow in hydroponics, we must use a specific fertilizer for hydroponic gardening, which will be composed of specific elements suitable on inert substrates such as clay or Rockwool.

All fertilizer manufacturers supply the so-called fertigation schemes which are used to synthesize the products and quantities to be administered in the weeks of the plant life cycle. It is advisable to refer to the manufacturer's indications for times and doses of administration.

Chapter 14
Tips and Tricks to Growing Healthy Herbs, Vegetables, and Fruits

Growing Plants on the Walls of Moss

The legendary Babylonian queen Semiramis left a descendant of the seventh wonder of the world—the fabulous "hanging gardens." Today, every amateur flower grower can successfully compete with Semiramis. However, to successfully compete with Semiramis, he must know how to build vertical (in the literal sense of the word) beds. This opportunity is given by the plant culture on the walls of moss.

Walls of moss, possibly the most original way to grow plants without soil, is a variation of the method known as "hanging gardens" widely in the Republic of South Africa and is widely used in this country. According to this method, these plants are grown not in a purely nutrient solution or on an inorganic substrate, but in an organic filler, that is, on suitably prepared plant materials, periodically moistened with a nutrient solution. From South Africa, information about this method reached Switzerland, and here, the method was picked up and developed with great imagination with many successful options by several people. With the help of some simple base (frame), the old horizontal bed is turned into a vertical one. This creates an ideal opportunity for the best use of space to accommodate the cultivated area.

The first attempts to grow useful plants on vertical beds were made in 1941, during difficult times. They wanted to know if it would be possible to grow more fresh vegetables using this method. Basically, all the experiments gave a positive result, and nevertheless, despite these promising results, the culture of plants on the walls of moss until today has not found recognition in industrial vegetable growing, but it has found a greater response to amateur gardeners. An attentive observer every year sees more and more flower walls glistening with colorful paints in gardens, on terraces, balconies, flat roofs, etc. And this is not surprising…

The Basis

Before we start tinkering with something, we should outline the basic principles of the method in a few words.

The thing is to firmly hold, using a suitable base, in a vertical position, a moisture-absorbing organic substrate, which should simultaneously serve as a source of nutrient solution and a medium for the growth of plant roots. The filler in the finished base, or substrate, is periodically moistened with the prepared nutrient solution. Planting or sowing seeds is carried out through the holes in the base on all available vertical and horizontal surfaces.

Common in some places, the so-called strawberry barrel is the simplest suitable base. Any barrel that is unsuitable for anything else is suitable here unless it has been used before to store materials harmful to plants (chemicals, paints, etc.). In the walls of the barrel, drill holes with a diameter of 4–5 cm at a distance of 15–20 cm from one another.

Only at the bottom of the barrel do they leave a belt of 15–20 cm wide intact. Before filling the barrel with a substrate, a small hole is drilled in its

bottom through which excess liquid can flow. For the same purpose, large gravel is used, laid on the bottom of the barrel with a layer 1 cm high.

Now stock up on an empty tin can and a bunch of brushwood or a bunch of twigs. We put the jar (it should be 15–20 cm high) in the middle of the gravel layer and vertically set up a bunch of brushwood or twigs, and fill the rest of the barrel space to the top with a substrate.

Barrels prepared in this way are planted mainly with strawberries, which preserve decorative qualities throughout the growing season and, in addition, continuously produce fruit.

The substrate is poured with a nutrient solution from above, using a watering can, and the brushwood in the center of the barrel ensures a quick and even distribution of the liquid. Finally, a small bar is nailed at an angle above each hole to drain rainwater flowing down from above. The finished barrel can also be painted with oil paint, choosing a color to your liking. After painting, the barrel is completely ready.

Vertical Hydroponics

We now turn to the form that is probably used most often, namely the wall. The materials necessary for the construction of the first small experimental walls can be collected without much labor and almost without cost, especially if you delve into your own pantry. Metal rods, planks, slats, trim boards, a few nails and a bit of wire, and maybe the old wire mesh, you can probably find anytime, anywhere.

A prudent amateur will, first of all, think about the pre-treatment of building material. It is highly advisable to impregnate lumber with a substance that protects them well from moisture in order to protect them from rapid destruction. It is strongly recommended that you carefully paint over all metal parts (nets, wire, rods) with ordinary bitumen paint. This is done not only to protect against rust but also because, as it turned out, metal parts not coated with paint can react with a nutrient solution, as a result of

which substances very toxic to plants can pass into the solution. This, of course, must be prevented. Therefore, you should choose only such means of impregnation and insulation, which certainly do not contain plant poisons (paints, which include the so-called heavy metals, are extremely toxic).

If the proposed structure, for example, for the garden is stationary, then four poles are simply driven into the ground in the right place and, you set them at the same height, connected for greater stability with rails of the appropriate thickness. Then the foundation is ready.

If it is planned to put a flower wall on a terrace, in a garden or elsewhere, then, of course, the portable base must meet these requirements. Therefore, we first build a solid base in the form of a wall about 50 cm long, 50 cm high, and 30 cm wide.

With such dimensions, a wall completely planted with plants will weigh about 65 kg and can still be carried.

As a next step, we will take care of limiting the side surfaces, and here you can go in different ways. It is very advisable to make a crate of narrow vertical rails with a distance between them of 5–7 cm. In this case, with the usually observed subsidence of the substrate mass, plants already planted between the planks will not be damaged. Since the mass of the substrate moistened with the nutrient solution is heavy, it accordingly exerts considerable pressure on the side rails. In order to prevent the strips from bulging out on more or less high walls, a reinforcing horizontal bar should be strengthened every 40 to 50 cm on the side surfaces, which, in addition, is connected by a wire to a similar bar on the opposite wall of the base. If this is done, then you need not worry about the side surfaces.

Another, often chosen and leading to the same goal, is the use of wire mesh. Any nets with mesh sizes from 50 to a maximum of 75 mm are suitable for

this if they are coated with an insulating layer of bitumen paint. The advantage of nets is that after a short time, they become invisible to the eye since a thin wire is immersed in the mass of the substrate or masked by plants. The disadvantage of the grid is that when the mass of the substrate settles, the plants in individual cells are suspended on the grid and are damaged.

However, this can be avoided with a sufficiently careful filling of the mesh with a substrate. Lateral swellings are especially easy to form on wire meshes, so you need to take care of suitable screeds.

Hydroponic “Life Hacks”

Separate barrels or walls are planted with plants from above or from all sides. By this, however, the choice of forms is by no means exhausted. You can easily build planted columns, half columns, cubes, as well as arbitrary shapes like trellises, pyramids, garlands, hanging curtain rods and pots, etc. There is no need to dwell on the manufacture of the basis for all of these forms. Therefore, we confine ourselves to only general provisions for all forms.

When choosing a shape and determining the size of the frame, you can more closely follow personal tastes and adapt to the particularities of the place. However, it is always necessary to reckon with the following: plants must have a sufficient volume of substrate for the roots and have a stock of the solution corresponding to their size and number. The height and length of the structure can be chosen completely arbitrarily, but the width (thickness of the substrate layer) must have the following minimum dimensions: when planting with plants on all sides—at least 30 cm; when planting with plants on one side—at least 18 cm.

If this condition is met, you can be sure that the supply of nutrient solution to the plants is enough for 8 to 10 days.

We have already seen that vertical beds or walls can be stationary or mobile. They can even be put on wheels. In order to use the terrace as a flowering screen in accordance with the position of the sun, an enterprising gardener built several metal frames that could be made together like building blocks and made of the large floral walls. When decorating the stage, stands, and assembly halls, they always successfully replace the slightly treasured greenery of palm trees and evergreen shrubs.

Various vertical walls can also be used to decorate walls and parts of buildings. They can be suspended at any height, and the rear surface adjacent to the walls of the building can be impermeable to moisture (for example, from tin coated with an insulating layer or from the roofing material, roofing felt, or plastic film) so that the walls of the building do not suffer. It is very advisable to put a couple of bars between the back surface of the base and the wall of the building, which will provide better ventilation.

Here, by the way, it should be noted that it is already possible to obtain bases made industrially from asbestos cement or metal. Since they are in good shape and made very reasonably, they certainly deserve attention.

Gardening Tricks

A wall of moss or peat can also be used for internal gardening. However, in this case, it is necessary to provide some kind of receiver to drain a possible excess of nutrient solution. The receiver can be a painted tin can or even a plastic tub installed under the base or suspended from it. With a known dexterity, you should immediately make a device for draining the liquid—it

can be a faucet or just a siphon tube. If all this is provided for, we can be calm for the completely modern conditions for indoor plants that have been created.

Here, in fact, all the most important guidelines that must be observed when building the foundations for growing plants on a substrate of moss or peat. It should only be recalled that when planting young plants, you need to take into account the space required for a fully developed plant. For example, if a fully planted foundation should ultimately have a length of 2 m, then a 2.6 m long frame is sufficient because the height of the plant on the end surfaces will be at least 0.2 m. In conclusion, another indication for the site owner demanding on himself familiar with the craft of a bricklayer: a flower wall can be folded out of brick, or better yet, of uncut stone. To do this, first lay the foundation with a width of about 60 cm and the desired length. The top of the foundation is leveled, and a groove is made in it to drain excess fluid with an inclination to one side.

There is no need for the whole process of work; you should only warn that cement should not be saved. The strength of the structure will increase significantly if you use a solution with a narrow ratio of sand to cement (2:1 or 3:1). When the masonry is finished, you need to hold the brush and cover the inner surface of the masonry and the top of the cement, i.e., all surfaces that will come in contact with the substrate, bitumen paint, to prevent the influence of lime or bricks on the nutrient solution.

A layer of coarse quartz sand with a thickness of 5–8 cm is first poured into the finished base. It will ensure the rapid removal of excess moisture. Then the substrate is stuffed, which should be much moistened to speed up the process of natural subsidence. After this, you can start planting the plants.

Another important point! You can greatly facilitate your work if at the beginning of the masonry, at the end of the wall above the lower end of the gutter, several stones or bricks are fixed so that they can be easily removed. Then, using the poker, you can easily dig out the substrate from the usually inaccessible narrow space. Another detail: curly seams made of white cement give a special decorative effect to a wall made of bright red facing brick.

Using this method, you save the most space and get the most yield from your hydroponic garden!

Conclusion

Hydroponics is an economical, environmentally friendly way to grow plants and produce without soil or pesticides. The plants grow faster and produce bigger yields while being completely GMO-free, making them a lot healthier to eat.

Not only does hydroponics allow for fast, efficient, cost-effective growing environments, but it is a means to grow products where it otherwise was not able to grow. Thanks to innovative irrigation systems and the use of various growing media, places that have inadequate soil composition are able to grow fresh produce.

Hydroponics also provides a growing solution for places that have little to no space for commercial growing lands. It has even been successfully tested in space. Hydroponics is not a new concept but has come a long way since ancient times and keeps moving forward in leaps and bounds with new methods being introduced along the way.

It is not a hard concept to grasp, and some methods are really easy to learn. There are ready-made kits that one can buy and assemble for each type of system. But they are all capable of being homemade with materials found around the home.

Hydroponics is a great way to teach children the joy of gardening without the mess of dirt, and as the plants grow relatively quickly, it holds their attention better than normal gardening does.

There are many exciting growth opportunities to be had with hydroponics, and if done right, you will be rewarded with bountiful, healthy crops.

Another essential aspect, fundamental for fans of hydroponics, is the amount of water to be provided for irrigation: in traditional crops on the land, the amount of water necessary to be able to grow and fruit plants is much higher than that required from vegetables grown in hydroponics. In fact, it is calculated that the ratio is 10 (for traditional crops) to 1 (for hydroponic crops).

This is reflected both in the economic aspect and in the environmental issue. For this reason, hydroponic cultivation is also called hydroponic culture precisely because it affects different economic, social, and even cultural areas and has a decidedly limited ecological footprint.

It will take time, but once you start to grow these plants in your hydroponic garden, you'll be able to get the benefits from hydroponics.

Think about it, with this garden, you can get all of the foods that you love, and you can certainly enjoy these benefits for a lifetime. Plus, maintaining and growing a hydroponic garden is fun, although challenging at times, and it gives you benefits that you might have never expected to achieve until now.

With that being said, the next thing that you should do is get the materials together and plan your hydroponic garden. Do take everything said here in mind before you get started so you have a surefire plan, but once you do get started, everything will fall into place. So do that, work on your garden, and achieve the success you desire.

I hope you were able to find out everything you wanted to know about a hydroponic garden. If you have any questions, feel free to let me know. I

hope your experiences with this amazing and intriguing gardening system, which spans over many different areas, helps you get results from your garden that are better than anything you've expected before.

What Did You Think of ***Hydroponic Garden Secrets***?

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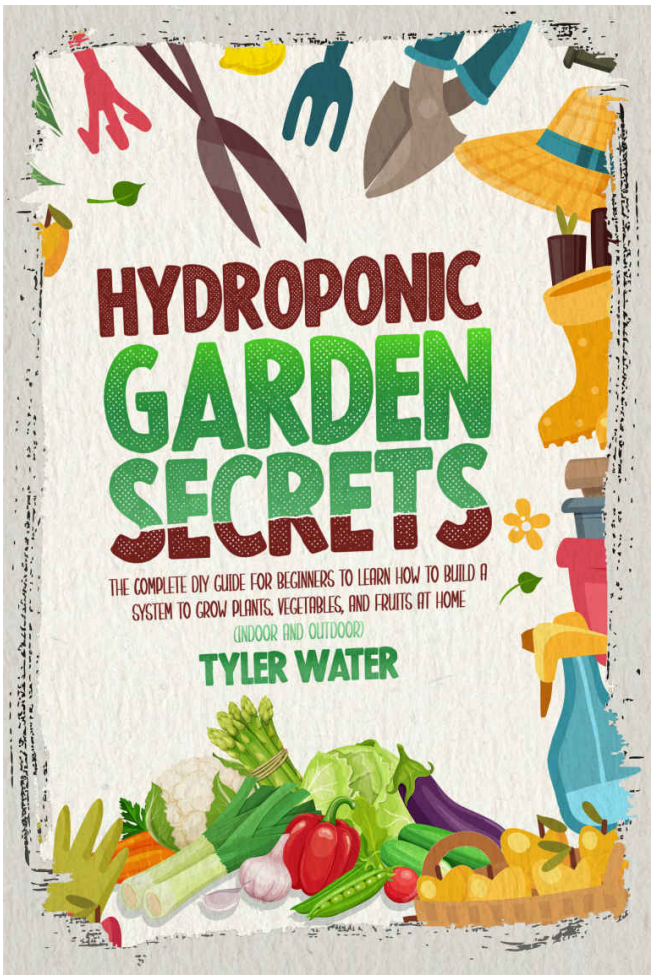
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