

# GARDENING HYDROPONICS

LEARN THE "AMAZING ART" OF GROWING  
FRUITS, VEGETABLES, & HERBS, WITHOUT SOIL



*Michael I. Rich*

**Gardening: Hydroponics -**  
*Learn the “Amazing Art” of*  
*Growing: Fruits, Vegetables, &*  
*Herbs, without Soil*

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# Introduction

I would like to thank you for choosing this book “Gardening: Hydroponics – Learn the “Amazing Art” of Growing: Fruits, Vegetables, & Herbs, without Soil”

Hydroponics is the method of growing plants without soil, but in different mediums like sand, gravel or even liquid, with additional nutrients. The aim of this book is to provide you with information that will help you pick a method that would work for you. You will learn about the different methods of hydroponics, how to build your own hydroponic system, the type of nutrients you can use, how to plant your own hydroponic garden, how to maintain it and then the common problems and the ways in which you can correct them. Hydroponic gardening let's you enjoy produce at its best, extremely fresh and full of nutrients.

The procedures that are listed in the book you will be able to grow produce of your own at a fraction of the cost that you purchase them for from your local supermarket. This book doesn't have any superfluous scientific information that would only confuse you; this is a beginner's guide to hydroponics, for hobbyists and also those looking to build a hydroponics garden that is commercially viable. So, without further ado let us get started!

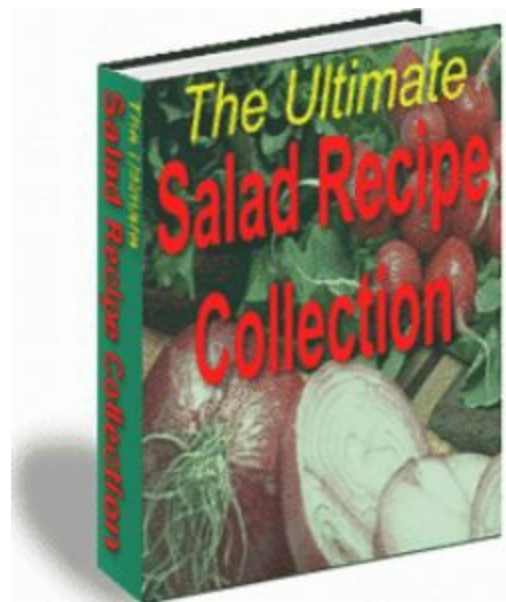
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# **Chapter 1: All About Hydroponics**

The word hydroponics is derived from Latin and it literally means working water. The simplest explanation of hydroponics would be the process of growing plants without planting them in soil.



# History

The art of hydroponics has been around for centuries, it's at least as old as the pyramids! One of the Seven Wonders of the World, The Hanging Gardens of Babylon, made use of a rudimentary form of hydroponics. Rice has been grown around the world by making use of this technique since the ancient times.

In the year 1934, this technique made use of for growing other crops by a professor at the University of California. The result of this experiment was 25 feet long tomato vines that had to be harvested by making use of ladders. This is how modern hydroponics had come into being and it has been developing ever since. During the Second World War, this technique was made use of for growing vegetables, for feeding the Allied soldiers, on the air force and naval bases in the South Pacific region.

Today, hydroponic systems are being made use of for feeding millions of people living in the arid regions of Israel, Lebanon, and Kuwait as well as the islands of Ceylon, Philippines and Canaries. Did you know that more than half of the tomatoes harvested in Vancouver Island and one fifth of the tomato crop in Moscow are produced by making use of hydroponics? There are well-developed hydroponic systems aboard the American nuclear submarines and Russian space stations as well. Even the remotest of regions on this earth make use of this technique for domestic purposes.

Hydroponic installations are being use on large scale by commercial producers as well.

## **Is this meaningful?**

Gardeners are really fond of hydroponics, because they can grow most of the things they would like to without having to put in back breaking physical effort, they don't have to till the ground, don't have to rake or hoe it, no vermin or pests/insects they need to watch out for and they also don't need to pull out weeds or make use of poisonous pesticides and insecticides.

Hydroponics is best suited for hobbyists who don't have time or space for maintaining a fully-fledged soil garden. During spring and summer you can shift the portable hydroponic system onto a porch or a balcony so that they can absorb natural sunlight and in winter the same unit can be placed somewhere inside the house where you can make use of artificial light for growing the plants.

Plants grow better in this technique because their roots need not compete with one another for the nutrients and they don't have to push through layers of soil either. Plants need air to breathe and grow, just like we do, and the porous aggregate that's made use of in hydroponics assist in free circulation of air. This result in a better growth of hydroponic plants, they tend to ripen earlier and provide a better yield as well, when compared to plants grown in soil.

The fruits and vegetables that are grown by making use of this technique are more nutritive and flavorful as well. Hydroponic vegetables usually end up in the gourmet produce section and are sold for higher prices than the ordinary vegetables. The point here is that you can grow the same vegetables in your backyard for a lesser cost.

## **Why choose hydroponics?**

You might have noticed that there is something that's missing in the vegetables purchased from a supermarket. Well, it's the flavor. Like with many other foods, flavor has been bartered for the sake of producer's convenience. In a bid to improve the quantity of the produce, the quality of the produce is being compromised. One of the main reasons for this loss is the seeds that are being developed for this so called agribusiness. These seeds are meant to produce high yields and fast growth.

In the initial years, the lands that were tilled by farmers managed to produce quality yield, but with the passage of time and population growth, these fields turned into the cities that we reside in. Due to space crunch our agricultural lands are disappearing, the costs involved in farming are increasing along with increase in all the other costs related to farming and food distribution. When this happens the food costs are going to increase exponentially. So, it wouldn't be a wrong to say that more and more people in the near future will start making use of hydroponics for harvesting produce that is cheaper than the ones available in the supermarkets and of much better quality as well.

## How do plants grow?

You don't need to get a crash course in biology to get an understanding of hydroponics. A plant can be considered as a natural workshop that helps in building organic matter; roots, stems, leaves, fruits as well as seeds. Around ninety seven percent of the nutrients required for this are provided by air and water, the rest comes from plant nutrients.

Organic substances aren't absorbed by plants; instead they absorb the mineral salts that are inorganic in nature. This means that the vegetable kingdom directly derives its nourishment from the mineral kingdom; this is the reason why there isn't any variance between gardening and hydroponics. The only difference is that in organic gardening it is the soil that the plant is in which is fed with dead animal and plant matter to act as a natural fertilizer, whereas in hydroponics due to the absence of soil, plants are directly fed with the same minerals that are present in healthy soil. A plant wouldn't care where its source of nutrition is coming from, as long as it gets sufficient of it.

There are two fundamental processes that a plant makes use of for its growth and these are osmosis and photosynthesis. Osmosis is the process where minerals and water are absorbed by the roots and photosynthesis is the process where the plant converts water and minerals into plant tissue by making use of light and carbon dioxide.

Hydroponics works really well because it provides the roots with air as well, so that they can breathe, this is possible because of the aggregate; the medium that is used for the growth of the plant is loose and chunky thereby allowing the movement of air.

## **Are chemicals used in hydroponics?**

This question is frequently asked and some might deny this, but the answer is in fact yes.

For hydroponics the most common mixture that is made use of will consist of N<sub>2</sub> and O<sub>2</sub>, that's air and lots of H<sub>2</sub>O, that's water. To this mixture add in small amount of Nitrogen (N), Potassium (K) and Phosphorus (P) along with some amount of balanced trace elements. Before getting worried about this, stop for a minute and consider the fact that the whole world is made of chemicals in one form or the other. So, the one thing that is avoided in hydroponics is the wrongful utilization of chemicals at the wrong place and time.

Most of the produce that is available in the market these days has been grown in a soil that is dumped with all sorts of inorganic fertilizers that would help the farmer to boost his yield. His crops would definitely grow at a much faster pace, but eventually the soil will get seriously damaged in this process. Not just this, these fertilizers are washed away from rains and they drain into various water sources. What this does is result in over fertilization of the water bodies where the algae and other water plants flourish and block the sunlight from reaching the lower regions thereby killing all forms of aquatic life. The same happens when you pour the phosphate rich detergents down the drain. Amidst all this natural degradation, we are presented with hydroponics where water and nutrients are all recycled till they are used up by the plants. Nothing is wasted in this manner and nothing is drained into our rivers and lakes.

## **Year-Round Gardening**

Growing crops in summer is easy, but by making use of hydroponics, you can grow crops in any season. One reason for this is that they don't have to expend a major chunk of their energy reserves for seeking nutrients by sending out their roots and hence they have more energy for growing.

There is another advantage of hydroponics and this is that you needn't tend to your garden every single day. If you have built or purchased a hydroponic system that can water automatically then you can go on a vacation without having to worry about your precious garden. You needn't worry about watering or weeding either.

During winters you can harvest tomatoes, cucumbers, lettuce and other greens that you want, by making use of your hydroponic system. It really is a cheery sight when you can see your vegetables, fruits, herbs and flowering, sitting under the grow light when you have snow billowing outside.

In spring you can move your hydroponic system onto a porch or a balcony or even into the greenhouse so that you can utilize sunlight. You would be able to harvest your ripe tomatoes grown in the hydroponic system at least two months before than those harvested by dirt farmers, because the plants have been able to grow even during the winters.

# Hydroponic Herbs

Not so long ago, herbs were grown in every kitchen garden and they were sold by all the greengrocers, but lately parsley is the only herb that is being used as a garnish.

Whatever happened to good old chives, rosemary, basil, tarragon and sage? Herbs can uplift a simple dish and make it seem like a gourmet dish. But we seem to have forgotten about fresh herbs as we have gotten used to dried herbs, that aren't as flavorful or as fragrant as the fresh herbs.

Hydroponics will once again let you experience the joy of a kitchen garden and you can use fresh herbs throughout the year.

Finally, you need to remember that hydroponics can be an exciting science, don't be afraid to experiment! You will be able to figure out a system that would work best for you but you will need to be patient.

## **What to grow?**

You can grow all types of green. Lettuce grows really well in hydroponic gardens and so do many of the other leafy and green vegetables like spinach, cabbage, chard and any other leafy vegetable that you can think of.

All vines can grow well, so tomatoes, cucumbers and peas would grow really well as long as they have support to lean on. You can grow peppers and other vines. Root crops are a good option as well like potatoes and carrots.

Fruit bearing plants that are small and light can also be grown in a hydroponic system such as a small papaya trees can be grown. Fruit bearing plants like strawberries, raspberries, blackberries, grapes, watermelon, cantaloupe and even blueberries can be grown in a hydroponic garden.

You can even grow lemon and banana trees provided you have the resources for it. Like mentioned earlier, herbs are best suited for hydroponic garden. You can grow tarragon, chives, sage, mint, rosemary, basil, dill, parsley and any other herb that you can possibly think of can thrive in a hydroponic garden.



## **Chapter 2: About Hydroponic Systems**

## Whether to build or buy?

If you enjoy making things with your hands, then building your own hydroponics garden will provide you tremendous satisfaction and the ones who would want to concentrate on the actual growing of crops, then you needn't worry, you can buy a hydroponic system.

One of the brilliant aspects of hydroponics is that the inventiveness that you can put into building or buying your hydroponic system is limitless. You can try anything that you think will work, if it somehow doesn't work, then you can alter the procedure or tweak it a little. You needn't restrict yourself to any one method; you can keep trying different techniques and methods to obtain different results.

Different combinations of nutrients, different hydroponic systems and the amount of light that they can get will all help you produce different varieties of plants.

To sum up the best approach towards hydroponics in one word would be experimentation. If you indeed decide to build your own system, then you will need to keep in mind that hydroponics is more of science than of art. If you really want to get results that are up to your satisfaction then you will need so much more than just a box for holding the plant.

There are four approaches that you can take towards hydroponic gardening. The first one would be to grow crops outdoors like farmers do but by using hydroponic system, the second method is to grow indoors, the third one is to use a combination of outdoor and indoor hydroponic gardening to ensure that you have year round produce and the fourth option that you have is growing in a greenhouse. These methods get more complicated when you start substituting for nature.

When you opt for indoor gardening then you will have to duplicate all the things that are naturally available in the environment by making of artificial techniques. The important aspect that you will have to keep in mind when you are using hydroponics is to recognize the methods and elements that are missing and then replacing them. This is the reason why it is advisable that your year round garden needs to be portable.

If you have decided that you want to confine the crops that you are growing to outdoors, and then you don't require having a lot of knowledge about temperature, lighting, pollination and humidity controls, all that you will need to know about would be the nutrients required. However, if you are considering setting up your hydroponic system indoors, then you will need to have a good understanding of the concepts that are mentioned above. To put it simply, you need to be aware of the environment that your crops are in, if you don't have then you won't have any crops. For instance, when you leave your plants outdoors, then you needn't worry about pollination and cross-pollination because nature takes care of these things. But when you shift your garden indoors, then you will need to take care of these requirements to ensure that your plants are healthy.

Hydroponics is more of a science and you need to possess considerable knowledge for making the best use of it. For these reasons, if you are just starting out with hydroponics for creating a year round garden or decides to stick to only indoors. The reason for this is very simple, if you start out with a hydroponic system that is partially effective, it gets really difficult to ascertain any trouble with the system, the nutrients you are using or the quality of environment, if you start facing any problems.

When you get a manufactured system, then you will know that any problem that you are likely to face would be environmental. In this manner you will be able to focus on learning all that you can about the requirements of the plants. For instance, you might spend around \$30 making your own hydroponic

machine to discover that you will need to keep watering the aggregate a couple of times every day for seven days in a week. This might not be possible for a city dweller with a busy schedule and it could be quite a hassle. So instead it would have been better to purchase a manufactured system, tried experimenting and gained a little biological knowledge to get a hang of it for building a system that would suit your needs.

## Simple Hydroponic Systems

When you want to build your own system, then you will need to keep two simple things in mind. The first one is that you need to be able to build a structure that would provide the necessary support to the root system and the second is that you will need a method that will help you in supplying nutrition as well as aeration to the plants.

Every system needs to have these two elements. Only after that can you move onto a more sophisticated and an automatic method. For the simplest of systems, all that you will need is a container that is waterproof that can be filled with a growing medium or aggregate for providing support to the roots. Into the aggregate that you have chosen you will have to place the young saplings whose roots are washed of all soil and then pour the nutrient solution that you have made over this. This is the basic of hydroponics.

This system isn't much different from the one that was used in the Hanging Gardens of Babylon and there are several problems that you would come across regarding the manner in which they operate.

All these problems and the solutions that are related to them have resulted in the creation of systems that are more sophisticated. The first problem would be regarding the amount of nutrient that you would pour over the aggregate, the second problem would be regarding the number of times you will need to pour the nutrient and the third problem would be the aeration of the roots. For overcoming these problems better methods of hydroponics have been created.

**Aggregates:** aggregates are available in different forms; they could be small stones, broken tiles, Perlite, vermiculite, crushed stone, and lava stones and even expanded oil shale.

The two functions that the aggregate needs to perform are aeration of the roots and provision of support, it would be better if you opt for an aggregate that is light and porous. Perlite is light, it floats and it can also build up heat within it, so this isn't as good as the other materials. Vermiculite can retain moisture and at times this would cause trouble for the plants under certain conditions. Broken tiles can damage the roots due to their sharp edges and crushed stones or gravel might have a lime bases that could disturb the pH balance and they aren't porous. Of all the materials that are listed, haydite is suitable. This is an expanded oil shale and it has been processed specifically for agricultural purposes, just like lava stones haydite is porous and at the same time it is capable of holding onto water. These materials will need to be washed repeatedly to get rid of any accumulated dust and other residues. Haydite is also referred to as herculite.

You will need to make sure that the aggregates you are using are of an ideal size, up to three eighths of an inch, if they are too small then they won't provide sufficient aeration and if they are too big then they won't be able to hold onto any moisture.

***Drainage:*** the potency of the nutrient solution that you are making use of as well as the frequency of its application are really important, but there is one more thing that is equally important and that is the necessity of a drainage mechanism. The plant roots cannot stay submerged in the nutrient solution throughout the day, after a certain amount of time they will need some air if not they will suffocate. The simplest drainage mechanisms would be to pour the solution from the container or by drilling holes in the container to ensure run off of the solution. The method of drainage that you are selecting will also require a considerable amount of attention as well as experimentation.

There are three primary drainage systems, the first one is drip from above system, the second one is flood and drain method and the third one is constant flow method. The third method is generally opted for because the

root system is continually sprayed with the nutrient solution and the solution is also drained out from it immediately. You can achieve constant flow by either making use of an air pump or a submersible pump that can keep on drawing water from a reservoir. The drip from above methods works well but the growing medium will have a very smooth surface and this will result in growth of algae that would diminish any aesthetic appeal and it will also halt the growth of the plant.

Flood and drain method also works well, but the problem with this method is algae growth and also that it might come as a sudden shock to the seeds and the saplings to be immersed in nutrient solution couple of times of the day only to be drained of it suddenly.

Regardless of the system that you are making use of in your hydroponic garden, you will need to consider the type of drainage that you want to use. Not only will this but you also need to take into consideration the aggregate that you are using. Try different combinations of aggregate and drainage systems till you find the particular system that works really well for you.

## **Building your own system**

Building your own hydroponics system can be fun and simple, provided you follow the instructions. The system that is mentioned here would be perfectly suited for water loving plants like lettuce.

The first step is for you to select a particular type of system that you would want to build and your choices can be water culture, ebb and flow and multi flow. Water culture is a very easy option to build and it costs less. This result in your plants or saplings being suspended in water by making use of a platform made out of Styrofoam. The water in this system will be filled with a particular nutrient solution and you can manage to grow up to 5-6 plants by making use of 5 gallons of water.

Multi flow is comparatively difficult and costly when compared to the previous system. This system relies mainly on the operation of gravity for flooding the plat tray with water and nutrient solution. Making use of a timer as well as a float switch would be helpful and you can grow as many plants as you would want to with this method.

The third system that you can easily build is ebb and flow system. In this method, the plant tray would be placed on top of a reservoir and it will be connected to the reservoir by tubes. A water pump would pump the nutrient solution to the plants and the excess liquid would come back into the reservoir for later usage. The second step is that you will need to gather all the things you will need for this project. Go through the following sections to learn more about the things that you will need.



## **Water culture:**

The first thing that you will need for water culture would be a container that you can use as a reservoir; it could be a fish tank, a bin or a bucket. The container needs to be light proof, if not, then paint it black or cover it with a black trash bag. It is important that you don't let any light into the container, because it would promote the growth of algae and this would disrupt the growth of the plant. It really would be a good idea if you can manage to get a container that has the same dimensions from top to bottom.

If it's possible, then you can always make use of a fish tank or any other similar container as the reservoir. Like mentioned earlier, you can spray paint the tank, but before doing so, take some painters tape and apply it from the top edge of the container to the bottom edge, vertically and start painting. When you remove this strip of tape once the paint dries up, you will be able to see how much water is there in the reservoir. It isn't necessary that you do this; you can know the amount of water that's there in the reservoir by simply noticing how far in the Styrofoam floater has sunk in the tank. Adding the tape just provides you with a convenient view. You will need to measure the length as well as the width of the reservoir. Once you do this you will need to cut the Styrofoam quarter of an inch smaller than the measurements that you have taken. The Styrofoam should be a nice fit and there should be sufficient room for it to adjust the changes in the level of water. If the reservoir that you have chosen, tapers off towards the bottom then it would be better that you cut the floater at least 2-4" smaller than the base.

Once you have done this, you will need to cut out holes for the net pots. Put the net pots on the Styrofoam, according to where you would want the plants to be. Now trace out the bottom of the net pots and cut the Styrofoam at such places. Make an air-line by cutting out a small hole on one end of the Styrofoam. The number of plants that you can grow would purely depend upon the size of the garden that you want to build and the kind of crops that you want to grow. There should be sufficient place between the plants so that

they receive sufficient light.

The air pump that you have chosen needs to be strong enough to provide oxygen to all the plants. The air line and the pump need to be connected, this means that the air line should be long enough so that it floats somewhere in the middle if not reaching the bottom of the reservoir, so that the oxygen bubbles can find their way to the roots of the plants. For keeping the track of the amount of water that goes into the reservoir, you can make use of one gallon bottles, but you will need to remember to keep track of the number of bottles that you have made use of.

For setting up the hydroponics systems, you will need to fill the reservoir with the nutrient solution that you have prepared. Now place the Styrofoam floater in the tank. Run the air line through the air hole that you have cut out. The net pots will need to be filled with the growing medium or aggregate that you have chosen and place one plant into each net pot. Put these net pots into the cut outs on the floater. Now, all you need to do is just turn on the pump that you have plugged in and that's it, your homemade hydroponics system is fully functional.

### ***Multi flow:***

The first thing you will need to do for this system would be to place your pots on a surface that is stable. Now, connect all the PVC settings as well as the tubes. The container that you are making use of should have an automatic switch for tuning on and off the power depending upon the levels of water in it. This is a safe method of drainage. Put your plants into the small plant trays and make sure that everything is working.

### ***Ebb and Flow:***

Select a location for your reservoir and put the plant tray on top of the reservoir. If this doesn't fit well then you can set up a support structure for leveling out any imbalances. Now comes the installation of the fill and drain system into the tray. Connect all the tubes to the water pump and place it inside the reservoir. The water needs to go back into the reservoir when it overflows and it shouldn't spill out. Connect the pump timer and place the plants in their pot trays.

### ***Drip system:***

The airlift hydroponic drip system is a really convenient way of watering your plants and it is much cheaper as well as fail-proof when compared to the other methods. This system can be fashioned out of the parts that you can find locally.

The first step would be to gather all the necessary materials. You will need aquatic air pumps. These pumps are referred to as the diaphragm pumps, though they are reliable, they do lose out on performance a few months after their usage has started. You will need PVC pots. These pots are cheap and can hold up to 20 liters. For putting the air line you will need PVC piping that's 22 mm and 5 mm silicon tubing for holding things together and also for stopping the pipe from floating up. Silicon tubing can be purchased from a local aquatic shop and they come in varying sizes. You will need a tube with an inner diameter of about 5 mm. you will need two T piece connectors and these can also be purchased from any aquatic shop. When you are using this method, make sure that you aren't using any of the usual hydro net pots; the standard PVC pots will be sufficient. You will need some airline for connecting the hydroponic air pump with the tubing of the airlift pump.

Keep some black drip line handy, because this will help you make holes through the normal silicon tubing that you are using and you can purchase this from any garden center or the hydroponics store as well. Start out by measuring the inside height of the hydroponic bucket or container that you

are making use of. Measure 30 mm from one end and cut 3 cm off, now place the T piece to the two pieces of tubing that you now have so that you have one piece of tubing that is 3 c, and is attached to the T piece and the other part of the tubing that is attached to the opposite side of the T piece. To the last end of the T piece connector you need to attach the air line. Now that all the four pieces are connected you will have to put the airline and the silicone tubing through the PVC piping that is attached to the T piece.

For building your hydro drip line you will need to measure out the length of the line that you will need if it has to go through the center of every pot and while you are doing so, you should also mark the drip holes on the tubing. Now, heat up the non-drill part of the drill and make use of this for making the drip holes. You can also make a clean hole by using a stove lighter, make use of anything that you want for as long as the hydroponic solution can drop from into constantly.

## **Tips:**

It would be convenient if you can make use of a rectangular reservoir. The top as well as the bottom sides of it should be of the same dimensions so that it would facilitate in the even growth of the plant as well as distribution of nutrients. Make sure that you are protecting your reservoir from light to discourage the growth of algae. Keep a dropper kit with you so that you can keep checking the pH level of the water because plant growth tends to drastically alter the pH level. Whenever you are using a box cutter or a knife to cut Styrofoam, you should be very careful. Depending upon the size of your reservoir you will need to keep on adding the nutrient solution. Also depending upon the crop that you have chosen, you will need to select the method of hydroponics.

## **Thing that you will need:**

You will need an external pump that has a switch system to help with the multi flow system and also for automatically regulating the level of water. Tubing is needed for all the systems, but for an ebb and flow system normal tubing will do whereas for multi flow systems you will need PVC tubing and for water culture an air tube would do. A waterproof bin, bucket or even a used fish tank can be used as a reservoir.

For a multi-flow system it would be better if the reservoir was vertical and it had a controller unit for plugging in the water pump. You will need Styrofoam that's an inch thick would do, if you want to build a water culture hydroponic system. For ebb and flow systems you can make use of plastic nursery pots and for water culture system you can make use of mesh pots. You will need to for water culture you will need to make your own plant trays made out of Styrofoam, multiple plastic trays for multi flow system and either plastic or plastic covered metal trays for the ebb and flow system. Select your growing medium or aggregate and your hydroponic nutrients.

For water culture system you will need air stones and a flow or drain system for ebb and flow hydroponics system. All the pots that you are making use of need to be kept on stable surfaces.

## Chapter 3: Choosing the Right Medium

Instead of making use of soil for growing the plants, in hydroponics you will be making use of a growing medium.

When you are developing your hydroponic system for your hydroponic garden, you will have to take into consideration the kind of medium that you would want to make use, the yield that you want to be able to produce and the easiest way to maintain it as well.

In this chapter we will take a look at some of the most common and popular mediums used for hydroponics, their advantages as well as disadvantages.

**Rockwool** is the most commonly used medium in modern hydroponic systems. This material is made from basalt rock and then it is melted and later on spun so that this material is transformed into strands of fibers that are interconnected.

One of the main advantages of making use of Rockwool is that it tends to hold onto water well and this means that the chances of your plants becoming dehydrated are reduced and even in case of the breakdown of the pump, your plants won't be harmed. It can not only retain water, but it also holds onto a lot of air, this means that your plants won't be over watered and they will be aerated as well.

The disadvantages of making use of this particular medium are that the dust and fibers given off by this medium can be harmful, so you will need to be really careful while you are handling it. The pH level of this medium is high as well, this means that you will need to pay extra attention to the nutrient solution that you are using to ensure that the pH level stays balanced, if not

your crops might just die.

**Coconut fiber** is also referred to as coco and this is obtained from the powdered husks of the coconuts. It is gaining popularity because this is a fully organic medium and it can be used in any of the hydroponics systems. This has the ability to retain lot of water and oxygen; this means that your plants will have a better chance of staying alive even if something does go wrong with the hydroponics system.

However, you need to be careful about where you are getting your coconut fiber from, because the cheaper varieties tend to contain lots of sea salt and this can hurt your crops.

**Perlite** is a form of volcanic glass and it is one of the most affordable mediums that you can get your hands on. This is generally mixed in with other media because of its price as well as the wicking action that it performs. Perlite often is made use of in the wick hydroponic systems.

Perlite cannot retain much water and it can be really harmful when ingested, therefore you will need to wear dust masks while you are handling it.

**Expanded clay pebbles** are created by simply baking the clay in kiln and this creates clay pellets that are filled with air. These clay pellets are comparatively more expensive than the other media that you can use in your hydroponics system.

These expanded clay pebbles are reusable. But they can't retain either oxygen or water well and therefore it is necessary to mix them with other medium for increasing their capacity of retaining water.



**Air** can be used as a medium as well and when you make use of air, as a medium it is referred to as no medium and this method is very cost effective because you don't have to technically buy any medium as such.

Since the roots of the crops will be exposed all the time, you will know that they are getting a constant supply of oxygen. But you will need to ensure that there won't be much room for error when you are making use of air as a growing medium. This means that your roots are at the risk of drying out even if the pump fails for a few minutes and this can cause some serious damage and stoppage of supply of water for a prolonged period of time might kill the entire crop as well.

## **Chapter 4: Mixing Hydroponic Nutrients**

This chapter can be divided into two parts. The first one would be regarding choosing the nutrients and the second one would be regarding the mixing of the nutrients.

For providing nutrients to the plants you can either purchase the premixed nutrients or you can do this on your own at home. Premixed nutrients would ensure that your plants are getting all the nutrients that they need but again the amount of nutrients that the plants would require could vary depending upon the water you make use of as well. Mixing your own nutrients will not only provide you flexibility and variety but it is economical as well.

## Choosing nutrients

For selecting the nutrients that you are making use of there are certain things that you will need to do. The first step would be to understand the composition of your water. So, send a sample of your water to the lab to get it tested. If its soft water then you can add any nutrient that would be good for your crops, but if it is hard water then you will first have to filter out all the heavy metals before using it. Using the dissolved solids meter can help you check your water regularly.

The common ingredients present in tap as well as well water are calcium and magnesium carbonates. These are required by plants but in limited quantities. Knowing the existing level of these in the water will be helpful.

You should familiarize yourself with the macronutrients that are essential for a plant's growth like calcium nitrate, potassium and magnesium sulphate, potassium nitrate, and mono potassium phosphate. When hydrogen and oxygen are combined, water is formed. Sulfur and nitrogen supply amino acids and proteins. Photosynthesis and overall growth require phosphorous. Starches and sugars are created with the help of potassium and magnesium. Calcium helps in the growth of cells and the construction of cell walls, whereas magnesium and nitrogen help in producing chlorophyll that is once again essential for photosynthesis.

Now you will need to select the micronutrients carefully, these are also referred to, as trace elements are required by the plants in small quantities. They affect the growth, reproduction and the manner in which other nutrients would affect the plant. Copper, iron, zinc, boron, manganese, chlorine, nickel, cobalt, sodium, molybdenum and silicon are all trace elements and you can mix at least 10 trace elements in your nutrient mix.

Check your water temperature to make sure that it is of the right temperature and it isn't too hot or cold, if the water isn't of the right temperature then your seeds won't germinate. The ideal temperature of water would be between  $18 \frac{238}{92}$  C and  $27 \frac{238}{92}$  C. Plants that are adapted for colder climates grow well in colder water and vice versa.

Whenever you are adding new water to your reservoir you will need to make sure that it is of the same temperature as the water in the reservoir. You will need to maintain the pH level between 5.5 and 7.0. It would be helpful if you have a pH meter with you. Any imbalance in the pH level will damage the growth of plants. pH levels tend to keep fluctuating when the nutrients are being absorbed by the plant.

The municipal water systems tend to raise the pH level by adding calcium carbonate, so check the level of pH before adding any nutrients to the mix.

## Mixing the nutrients

Start out by filling the containers with distilled water or water that has been run through reverse osmosis. If you don't have any distilled water then you can let the water sit in the open for 24 hours for removing traces of chlorine. If you want to use tap water, then get it tested first. Now measure out all the nutrients that you want to use. A plastic chemical scoop along with sterilized filter paper can be made use of for holding dry chemicals and a beaker or a graduated cylinder can be made use of for measuring liquids.

For mixing the nutrients you don't need a funnel but having one will ensure that you aren't spilling any. It gets easier to pour chemicals when you have a small funnel. Some nutrients can irritate your skin and using a funnel will prevent this. Once you have added the nutrients then you will need to check the pH of the solution. Pour the nutrients into the water slowly, one after the other, avoid any overflows or spills. Even a slight loss in the level of the required nutrients would upset the growth of the plant.

According to the reservoir that is made use of in your hydroponics system, the amount of nutrient solution that you will need to add to the plants would change. There should be enough solution in the reservoir so that the pump doesn't suck in air. Shake the container for about 30 to 60 seconds once you have shut the cap and screwed it in place.

You can stir the mixture if the container is too big to shake. Shaking helps you combine all the ingredients well.

## **Chapter 5: Commercial Hydroponic Enterprise**

Running a commercial hydroponics enterprise would be similar to maintaining a small business venture of your own in the field of horticulture. Like with any other business enterprise, you will need to plan very carefully if you want it to be a success.

In hydroponics the plants are grown without soil and they are fed with water and different nutrients that would facilitate their growth. The hydroponic systems can be recirculating or non-recirculating without any particular growing medium.

Hydroponics is usually pursued as a hobby and taking your hobby one step ahead would mean commercial production. A commercial enterprise should be able to not just give a good produce but should be financial acceptable as well. The rate of failure of setting up small businesses is considerably high during the initial years, it would either be a success, a failure or it may be less profitable than what you have expected it to be.

One of the most common mistakes that lead to failure would be that many tend to underestimate the skill set that is involved not just in horticulture but for marketing as well. This chapter will let you evaluate whether or not you should consider taking your hobby one step ahead and also to give you an idea about the importance of planning.

The first thing that you will need to realize is that hydroponics isn't magic and that you aren't giving up all the control to the plant in hydroponics. It takes skill and experience to just not grow a commercial crop but ensure that it is harvested at the right time and also to ensure that it is of a desired quality. When you are making use of hydroponics you will need certain additional skills for managing the system and you will also need to be able to

sell your produce in the market at a decent price.

You will need to first take a closer look at the reasons why you want to go commercial and you will need to have realistic expectations. You need to remember that hydroponics is just a growing technique.

Hydroponics system is just a form of intensive horticulture and this is just one of the options available for growing a crop. So, you will need to first consider a list of items before you decide that you want to make use of hydroponics for growing crops commercially. You will need to decide on the market, the crop, the growing environment, financial analysis and the management.

Once you have acquired information about any one of the stages, then go back to the previous stage and work through the process again. Continue this till you have managed to select a crop, an environment as well as a growing system that suits your needs. If you feel that it isn't economically viable or that your overall objectives aren't being met then you don't have to proceed with this.

## **Why hydroponics?**

Here are some benefits of using hydroponics for growing crops on a commercial scale.

The crop yields tend to be higher when compared to traditional methods of agriculture. There's a faster turnaround, meaning that you can get a boost in yield and perhaps extend the cropping season into higher priced periods. Produce from this method could have a higher shelf life. Even if the quality of soil is poor or bad, it doesn't matter when you are growing crops hydroponically. Water and fertilizer usage is comparatively low. Under hot conditions the ready availability of water to the roots ensures that there isn't much stress on the plants for finding water and this energy is diverted for their growth.

For crops that are susceptible to soil borne diseases, hydroponics is ideal. The labor costs involved are slashed down drastically and this requires less work for setting up and planting as well. You needn't worry about weeds.



## **The market**

If any small business really wants to prosper, then it should be able to sell its produce in the market at a reasonable price. You will need to decide where you would like to market the crop, the target consumers, the current players in the market and whether or not the market is developing? Consider your competition and decide upon how you can handle it. Don't set any unrealistic expectations regarding your chances against your competitors.

## **The crop**

When you are considering the kind of crop that you would want to grow, you will need to have full knowledge about that particular crop. It takes a lot of skill to ensure that the crop is good, it has been produced on schedule and it is of good quality as well. Experts estimate that it takes about 3 years to learn about producing a good crop.

Hydroponics does not give full control to the crop, it does influence the roots of the plant but the upper part of the plant is influenced by the environment. Light, temperature, day length, genetic makeup etc, all play a major part in the growth of the plant.

You will need to find the environmental disadvantages that a particular variety of plant might be suffering from, the optimum density for planting a crop, the advantages and disadvantages of a particular crop along with the premium time to harvest the crop.

## **The growing environment**

Depending upon the crop that you have chosen, you will need to take into consideration the climate and the requirement of any protective structures. Some of the factors that you should take into consideration when you are comparing protective structures are the ability to perform what it claims, the ease of construction, costs involved, versatility, risks it faces, vulnerabilities it suffers from and maintenance costs. You should also check whether or not the structure that you want to build is subject to any building regulations.

For hydroponics it is really important that there is a constant water supply, so you will also have to check the availability of water. Analyze the water to understand its composition, because depending on this you will be adding in the nutrients and chemicals.

## **Growing system**

You shouldn't overlook the methods of soil growing. You will need to have a good reason if you want to opt for hydroponics. Evaluate all the different methods of hydroponics that are available to you and look at their advantages as well as disadvantages. You will need to consider the systems according to whether or not they would suit the particular crop that you have in mind.

For short term crops like lettuce you can make use of systems like flood and drain making use of gravel channels, whereas for long term crops that are especially vulnerable to root diseases you should opt for non recirculating media based systems.

Some of the factors that you should take into consideration would be the system that would be best suited for your crop, the environment as well as the water quality, the level of expertise that would be needed, the ease with which you can cultivate and harvest the crop, the ability for improving the crop turnaround as well as the installation, replacement, maintenance and operating costs of the system that you have selected.

## **Support systems**

Apart from the basic and the growing structures, you will also need to think about the support systems and equipment that you would need. This would include providing shade, heating and cooling systems for controlling the temperature, equipment needed for harvesting, storage, collection, and water treatment, distribution channels, cleaning and packaging facilities, warehouses and cold storages, transportation facilities as well.

# Management

One really important aspect of planning is to estimate the yield pattern of the particular crop and the time for the annual yield. This is the area where most of the mistakes are made. Calculations need to be made according to the yield per square meter. The yield has three important components. **Yield per sq. meter = # of plants per sq.mtr X avg. yield per plant X # of crops per year.** For most of the crops, there is usually a maximum yield that is obtainable regardless of the number of plants.

It is not just about selecting a crop that has a high yield and then increasing the number of plants that you can grow. This does not guarantee a high yield and this is a rookie mistake. In reality, when the number of plants is increased, then the yield per plant tends to go down. There is usually a loss of product quality as well when the management difficulties, harvesting costs, the risk of diseases as well as the crop size are increased. When the plant density is increased, then this usually results in the outbreak of disease.

When you are planning for short-term crops then you will need to take into account turnaround time and seasonal differences. You will need to take into account different aspects like the quality of the produce, harvesting and packaging costs, transportation and marketing costs as well.

If you have got satisfactory answers for all the items that have been mentioned above, then it means that you are ready to take the step towards creating your own hydroponic commercial venture, if you think you need some more time to process things, then take the time and things think through.

## Conclusion

Now that you have reached the end of this book, you are equipped with the knowledge that you will need for starting your own hydroponics garden. Hydroponics doesn't seem that intimidating now, does it? It really is a simple method; all that you need to do is build or buy your own hydroponics system, choose the plant that you want to grow, prepare a nutrient solution and pick an aggregate. Once you have got all this in place, you can get started.

You can try different combinations till you find one that suits you. When you slowly start gaining confidence, you might as well start your own commercial venture! So, once you get started you will need to take care of your garden and also stay patient. That's it and you will be able to reap the harvest of what you have grown.

I would like to thank you once again for choosing this book. Hopefully it was an informative read.

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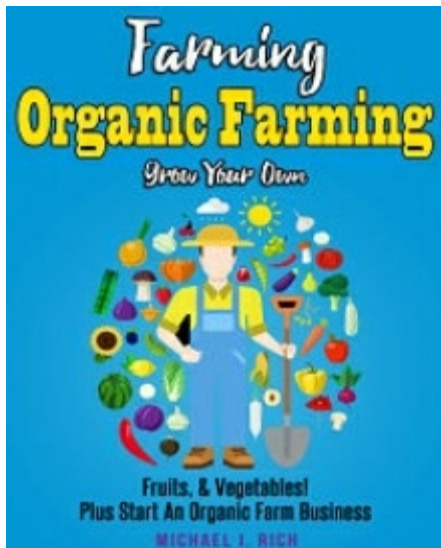
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