Totally Organic Hydroponics

Perpetually Harvest
Your Favorite Herbs,
Flowers or Any Plant.

GROW THE BEST– YOUR OWN!

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Totally Organic Hydroponics

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Totally Organic Hydroponics

Organiponics, LLC.

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Dedication

This book is dedicated
to my eight children.
May your roots always be
bound to the earth.
May your faces always be
turned toward the light.
May you blossom forever.

Contents

Authors Note

Totally Organic Hydroponics presents the newest, most innovative gardening concept to be applied to hydroponics since hydroponics began. For the first time, you may grow your favorite plants by combining the standard hydroponic methods with the use of organic nutrients. Why grow your hydroponic plants using man-made "chemical" nutrients when you can now grow all your favorite flowers, vegetables, herbs, and medicinal plants using nature's best organic nutrients?

If you desire the purity of natural organic nutrients plus a streamlined method of hydroponics, Totally Organic Hydroponics is for you. I have adapted and refined the standard hydroponics methods, and then combined them with the "forced flowering" process to create a truly unique growing experience. Besides simplifying hydroponics, this unique process of developing dual root systems increases the plant's ability to obtain nutrients and oxygen, therefore increasing its metabolism and photosynthesis processes.

Totally Organic Hydroponics is written especially for the beginning and intermediate gardener, although it also includes some advanced methods and ideas which may be used by both novice and expert gardeners. The book illustrates step-by-step, and day-by-day, all of the fundamentals you need to know to create a bountiful, organic, indoor hydroponics grow area.

The Author

Preface

Basically, hydroponics means growing in a nutrient solution without soil. The word hydroponics comes from two words, "Hydro" which is a reference to water, and "Ponics" which is a reference to working: Doing the work of growing with water. There are a number of different hydroponics methods, most of which incorporate some type of medium, usually an inert substance that retains moisture and serves as a holding strata for the root systems of the plants.

This book demonstrates all processes using the most common and easiest hydroponics technique, the Ebb and Flow method (E&F). In the standard E&F method, the roots of the plants grow through a man-made medium, and, at intervals, are constantly supplied with water. Between the periodic flooding of the roots, the plants are exposed to more oxygen. This increased exposure to oxygen increases the plant's use of the available nutrients, and therefore, promotes faster growth. The E&F method is the fundamental reason why hydroponically grown plants develop at a faster rate than those grown in soil.

Like all living things, plants follow certain cycles. The art of growing lies in manipulating these cycles in order to help you, the grower, gain even more of an advantage with your hydroponics garden. You will create and maintain the most favorable conditions in a precision-controlled environment - which is both exciting and rewarding. If you follow the simple instructions in Totally Organic Hydroponics, you will soon be on your way to becoming a successful hydroponics gardener.

Totally Organic Hydroponics is divided into two sections. The first section provides general information concerning basic indoor hydroponic cultivation. The second section deals specifically with the daily schedule that takes you from seed germination to harvest, and then demonstrates through an organic hydroponic model exactly what you need to do on a daily and weekly basis. Once you have become familiar with the E&F method and my cutting edge "Sea Of Green" process, you will be able to grow healthy plants, flowers, vegetables, and herbs indefinitely!

Totally Organic Hydroponics

Overview

The "forced flowering" process is a specialized technique for growing plants in which the time required to bring your crop to production or harvest is shortened by controlling the light period. All aspects of the plant's life are controlled so that the shortest amount of time is taken to produce the largest amount of product in the least amount of space with a minimal amount of work. I have fashioned the process to be easily accomplished by using common items and equipment.

Numerous garden varieties, such as herbs, tomatoes, strawberries, and potatoes, may be reproduced in abundance using the "Sea Of Green" process. There are thousands of different houseplants - ferns, coleus, palms, and spider plants - that are likewise easily reproduced using this process. For the homeopathic gardener, an endless supply of medicinal plants may be produced.

Very simply, the "Sea Of Green" process begins by cutting a clone from the mother plant, and then placing it in the proper medium. The rooted clones are grown for a desired time, and are then forced to flower or mature to a certain stage by manipulating their photoperiod.

The medium or soil substitute is structured so organic nutrients may be applied directly to them. A dual root system is created by the plant through the use of an upper and lower composition of the medium in the container. No nutrients are placed in the water reservoir.

One of the most exciting aspects of the "Sea Of Green" process is that you determine when you want to harvest or at what stage of maturity you wish to utilize your plants! Once the process starts, it is self-perpetuating: Week after week, wave on wave of your favorite plants will evolve at different stages of maturity.

All aspects of the plant's life are controlled.

Chapter 1 - Botany 101

Environment

Imagine an entire plant world created in an artificial fashion. The sunlight is either fluorescent or HID; the air and wind created by fans. Instead of soil, organic nutrient-filled humus comes from a bottle or bag, and the life-giving moisture is supplied at timed intervals. Simulation of this ideal environment and fine-tuning the results create the perfect indoor conditions for growing almost any plant.

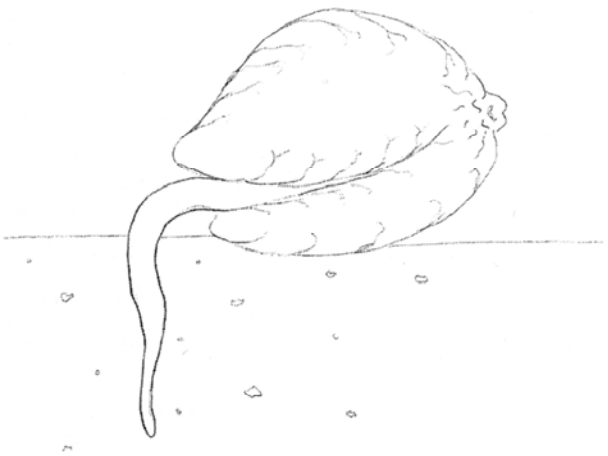
However, mere knowledge of the secrets of environmental control is not sufficient to grow a successful indoor crop. Also required is an understanding of the physical function of the plant itself. It is necessary to know how a plant works and why it works that way. This basic knowledge of botany, along with control of the environment, maximizes the potential for growing a healthy crop of plants.

Germination

In nature, when a seed is cast upon the ground and takes hold in the soil, if all the proper conditions for life are in abundance and proper balance, then the seed will grow. Moisture must first soften the seed shell, and after prolonged exposure to moisture, the embryo within begins to receive some of the moisture. Once this happens, the embryo begins to expand, creating pressure on the shell from the inside. Seeds first show life with the splitting of the shell casing followed by the emergence of a tiny, white, horn- shaped root tip.

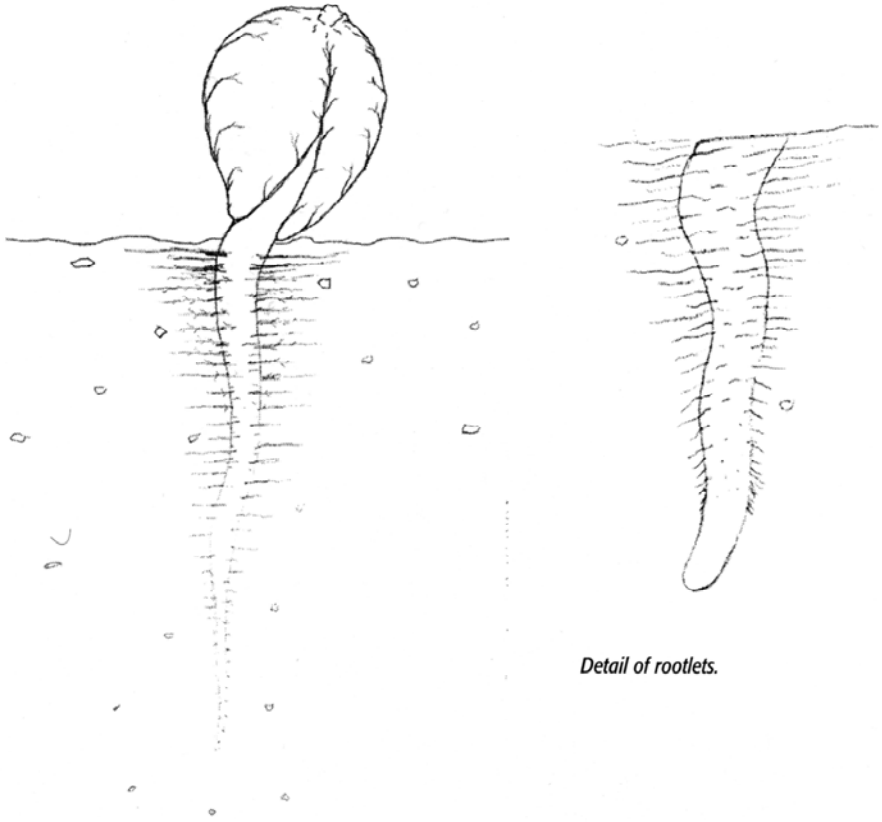
The new root tip grows in a downward direction as it seeks refuge in the soil. It soon elongates into a taproot. As the root grows, it develops small fine hairs and lateral roots. If oxygen is present, these fine root hairs will absorb nutrients and water from the soil or growing medium. As the elongating cells in the tip of the root seek deeper and deeper into the soil, they begin to develop the ability to take on more selective responsibilities and functions. The roots serve as anchors for the plant while storing nutrients and transporting water.

Horn shaped root tip emerges from seed.



Root tip seeks downward direction.

After the seed germinates and sends its root downward, a parallel process of cellular growth affects the embryo. The embryo aims upward in an effort to break the surface of the soil. Once this happens, the expansion of the growing embryo forces open the softened shell and soon casts it off completely. The resulting first two leaves, which come from the seed shell, are the rounded, "cotyledon" leaves. These leaves quickly respond to the light as they immediately begin to grow. These two rounded leaves will soon be joined by the second set of leaves, and then a third set, as the plant grows.



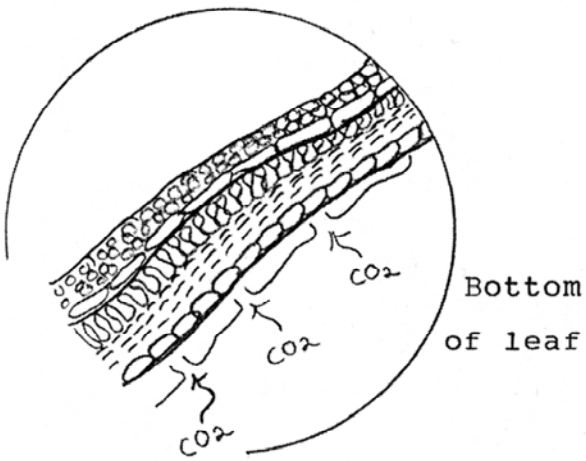
Detail of rootlets.

Lateral rootlets form, from main tap root.

Stems

Between the lower root and the upper leaves is the stem, regulated by certain growth cells which follow predetermined patterns. The stem lengthens as each new set of leaves is created on the tip of the plant; the point of creation is called a node. As growth progresses, growing terminals are created. Between the new set of leaves and the stem of the plant at each new node, a lateral branch will begin to grow. The portions of stem between the nodes are called the inter-nodes. They too will lengthen in a fashion unique to the plant's genetic ability and its environmental conditions.

As the plant matures, more nodes and lateral stems will be produced. The stems have a variety of functions. The stem creates and holds the leaves at proper intervals while it transports water and food to the rest of the plant from bottom to top. When the stem is stressed by the blowing wind, it creates cellulose which makes the stem stronger to resist being blown over.



Stomata allow CO2 to enter the plant.

Leaves

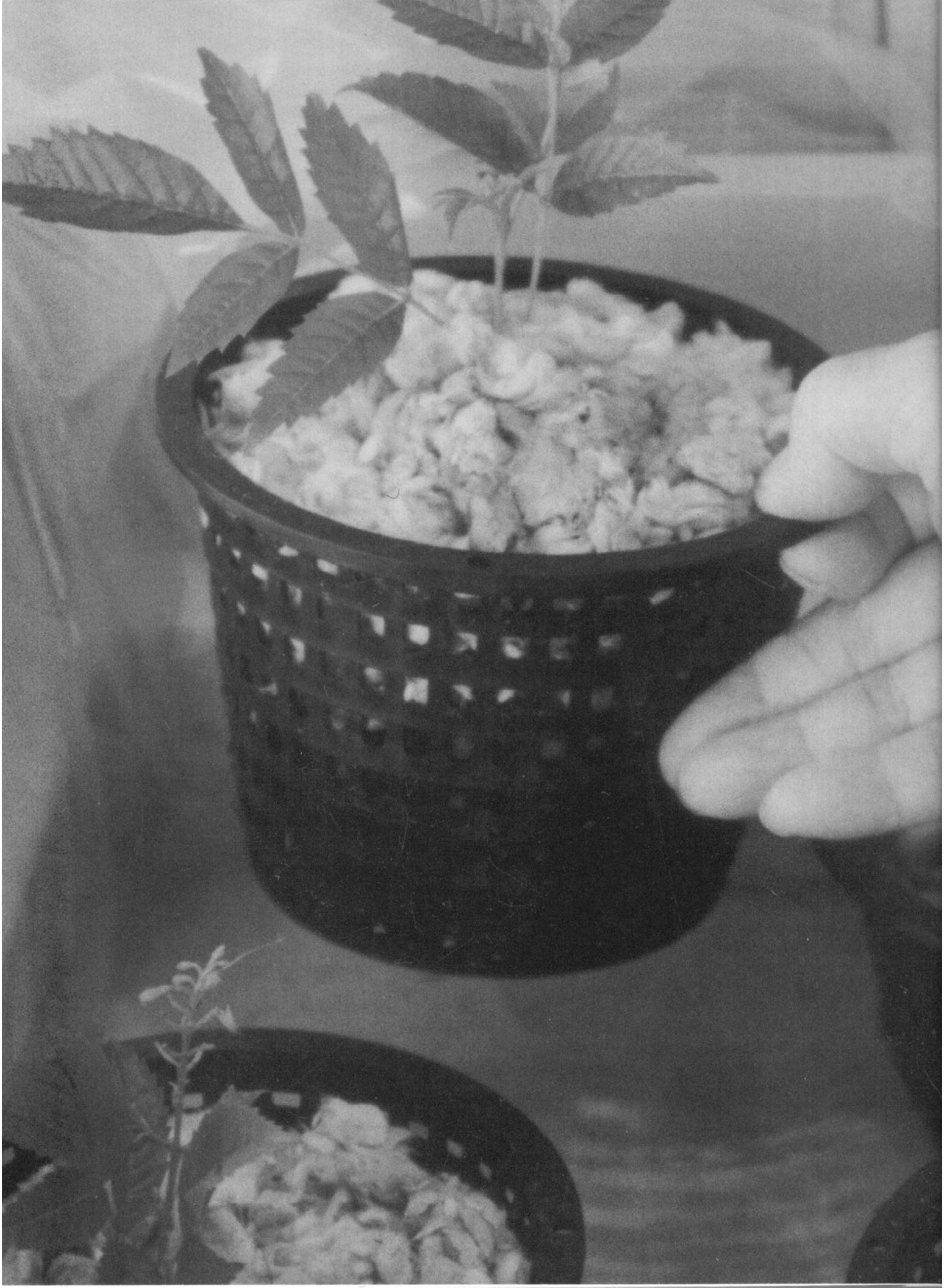
The nutrients and water that move up the stem of the plant are partially consumed as they are transported to different parts of the plant. When the water and nutrients reach the leaves, they combine with carbon dioxide, and with the help of the sunlight and chlorophyll, the leaves create carbohydrates and, as a by-product, oxygen. This miraculous process is called photosynthesis.

In order for the chlorophyll to do its job properly in its "solar powered food factories," the roots and stem must always have an adequate amount of water. The outer and inner parts of the leaves are completely dependent on the water. Once a leaf becomes too dry, it will not be able to function properly and may even die.

The undersides of the plant leaf are covered with small holes called stomata, which serve a variety of functions. They open and close as they evacuate excess moisture, oxygen, and waste products while serving as the portals that allow carbon dioxide to enter the plant. This protects the leaves from drying out.

If the roots, stem, or leaves don't receive all of the essential life-producing elements, there will be a breakdown of all the related processes because the plant functions as a whole. Failure to tend to one primary need may precipitate the breakdown of all the other processes of the plant.

This book explains what requirements are needed for the most suitable conditions for indoor totally organic hydroponics growing. All of the necessary external and internal life processes for all stages of the plant's life must be tended to with care and precision. Therefore, the area for growing which you create must act as the entire world for your garden.



Chapter 2 - The Grow Area

The ideal location for your grow area is known only to you, and is based on the available space in your home and the amount of time you are willing to invest.

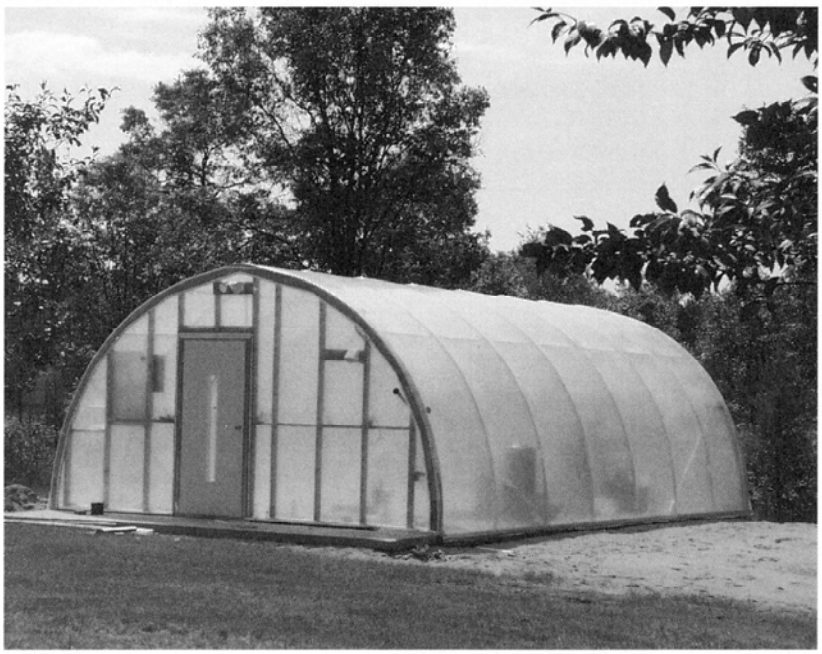
A great beginning place to grow is in a portable camper or small trailer. The entire grow area may be relocated by attaching the "grow room" to a vehicle and simply driving away! However, most indoor growers prefer an outbuilding or an out-of-the-way place in the house. There may be space in a basement, an attic, or a spare room.

Once you have selected the suitable grow area, it must be completely cleaned and cleared of all non-growing items. Carpeting should be removed, and the walls, floor, and ceiling painted with flat white paint. The grow area will also need access to electricity, water, and heating and cooling systems. Then, if at all possible, the area should be enclosed and kept private.

The Garden

Since the Sea of Green process requires two different light schedules, the grow area must be divided into 2 separate areas - one for cloning, and one for blooming. Having these two grow areas adjacent to each other is the most convenient but not absolutely necessary.

The garden model described and pictured in this book is a 12′ long x 8′ wide x 8′ high space set up in a homemade mobile trailer. For describing the hydroponics growing process in this book, the model has the cloning area adjacent to the blooming area.



Small home hydroponic set up distributed by Crop King.

The Cloning Area

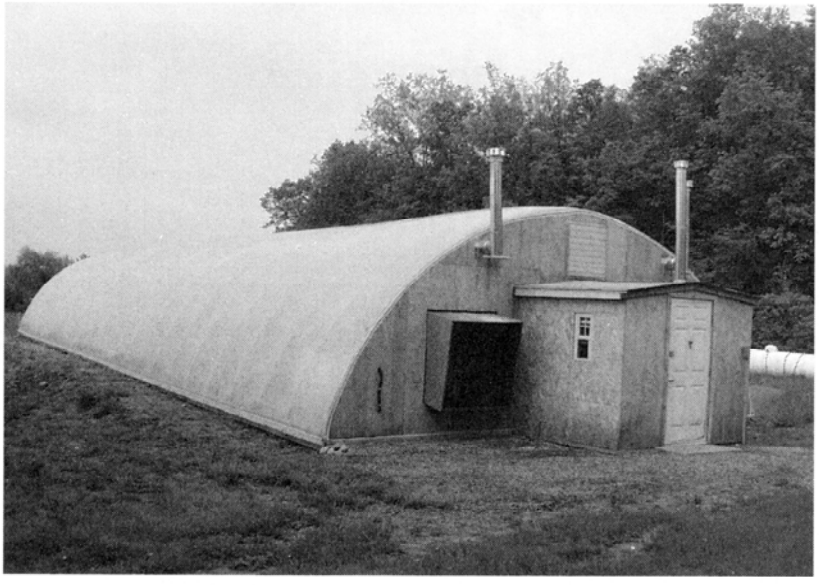
The 8′ x 6′ cloning area contains an oscillating fan, and a fan which exhausts the air from the blooming area adjacent to the cloning room. The cloning room has an 8′ x 3′ table that houses the clones and seedlings to the left, the pre-bloomers in the middle, and the mother plants on the right. A 400 watt metal halide attached to a light moving rail moves over the tops of the pre-bloomers and mother plants with a 4′ fluorescent, two bulb grow light, hanging over the cloning and seedling area. The fluorescent lights are placed about 2″ above the tops of seedlings or clones; their light coverage is about 6″ to either side of the tubes and, of course, the length of the fixtures. A 400 watt metal halide is kept about 2′ above the tops of the pre-bloomers and mother plants. This light is kept on 18 hours a day in order to keep the plants in their vegetative state which is the juvenile plant state characterized by foliage growth and carbohydrate storage.

The light is attached to a moving rail because plants are phototrophic. Photo-mediated degradation of epidermal cell auxin results in decreased elongation on the light-exposed side of the plant and, hence, the plant bends toward the light source. This, in turn, will create cellular growth and stronger stems that support the larger bud and fruiting abilities of the plant.

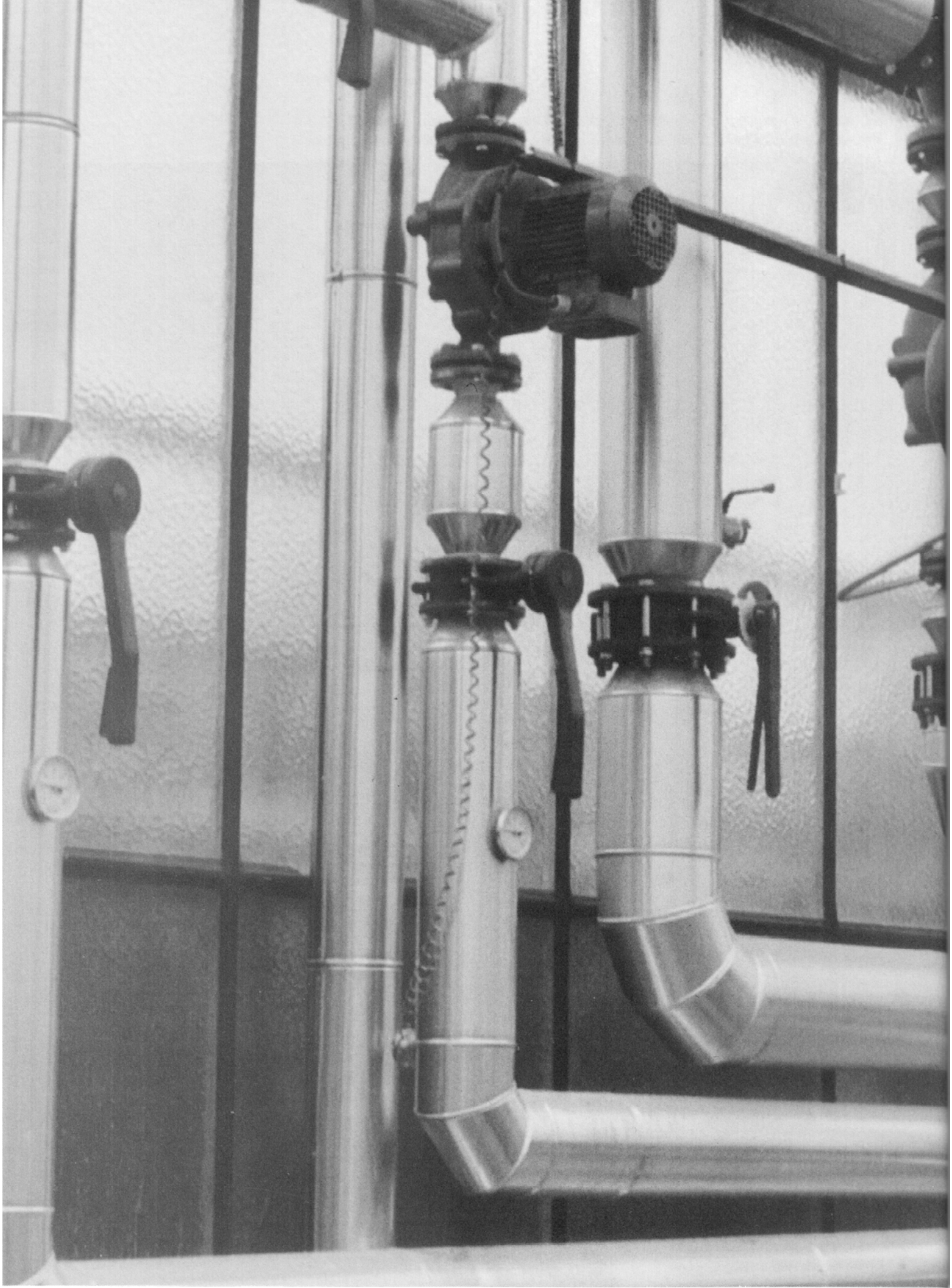
The pre-blooming area and mother plants each have a separate covered grow bed as well as a separate covered reservoir which is placed under the top grow bed. An aquarium air pump with a four-way splitting device sends air to the seedling and cloning tray, as well as the to the pre-blooming reservoir, the mother plants reservoir, and the blooming reservoir.

Blooming Area

The blooming area uses an 8′ x 6′ space in the trailer. An 8′ x 3′ blooming tray runs the width of the trailer. Underneath the blooming tray a reservoir of similar dimension supplies water to the blooming tray above. The reservoir has a large bubbling wand to oxygenate the water and an aquarium pump to send water from the reservoir to the upper blooming bed. The reservoir and blooming bed are covered with a sheet of Styrofoam to keep out light and bugs. An 8′ light moving rail moves the 400 watt (or 600 watt or 1000 watt) High Pressure Sodium (HPS) light, set about 2′ above the plants, back and forth across the tops of the blooming plants for a period of 12 hours during each 24 hour period. This light schedule will induce maturing of the plant. A small exhaust fan ducts air out the top of the room while an oscillating fan imitates nature's breeze across the tops of the blooming plants.



Medium sized home hydroponic set up distributed by Crop King.



Chapter 3 - Air Quality

Overview

Whether adjacent or apart, each of the two grow areas must have an air circulation system because fresh air is integral to growing healthy plants. Each area must have a way for air to enter and exit. Squirrel cage fans are popular with many growers; they are small and quiet, and have the ability to be connected to a standard 6" flexible dryer exhaust hose. The fan can be placed on the ceiling to evacuate the warmest air and, at the same time, conduit out of the floor, roof, or wall using the dryer exhaust hose or similar item.

When setting up the exhaust system, place the exhaust fans so that the air is pulled out of the area. Do not place the fans so that the air is blowing into the area and then out of an exhaust portal. It is dynamically easier to pull the air out of an area than to push air through and out an area.

Air Circulation

In a hydroponics grow area, a fair amount of water evaporates into the air from the water reservoirs, the plants, and the grow beds as the water circulates. If the air is not re-circulated, the air will become stale, and the plants will suffer from the depletion of fresh ingredients, such as CO2. Your grow area will need both exhaust fans and oscillating fans to keep the air healthy for your plants.

Exhaust Fans

Exhaust fans have variable speed controls as well as thermostats. These controls are built into the more expensive models or may be added to any fan. With the addition of these controls, the rate and temperature at which a fan will exhaust air may be regulated. Fans may also be set on timers so they regularly exhaust an area at a certain time and rate.

A fan's ability to exhaust air is measured in Cubic Feet per Minute (CFM). You can determine the cubic feet of a room by multiplying the width by the length by the height. A fan that can completely exhaust an area in about 3 minutes should be used. For example, 12' x 8' x 8' room equals 768 cubic feet, and therefore, requires at least a 250 CFM exhaust fan to effectively exhaust the space in 3 minutes.

It is best to set the exhaust fan speed on "low" so that the air in the room is completely exchanged once every few hours. However, during and directly after spraying insecticides, the exhaust fan should be turned on "high" for a few minutes.

The exhaust fan should also be run on "high" when the temperature or humidity gets too high. The humidity should be 50% or less with a consistent ambient (room) temperature of 76 degrees F.

Fans help exchange and cool the air in this unit.
Photo ©Crop King

Oscillating Fans

Oscillating fans are also essential to the health of your growing plants, and should be placed in the cloning area as well as in the blooming area. Each area will need at least 2 oscillating fans. One fan placed near the ceiling blows the warmer air downward and mixes it with the lower cooler air. The second fan on the floor will mix the cooler air with the upper warmer air. This mixing of air helps you maintain a more consistent air temperature in your grow area. As the air gently blows on the tops of the plant, the plant will be strengthened by creating cellulose within its stems, which gives the plant the ability to support bigger buds, fruit and flowers without falling over.

Large CO2 dispersing unit in commercial setup.
Photo ©Crop King

CO2

CO2 increases the ability of a plant to metabolize the available nutrients and water as it engages in photosynthesis. A plant absorbs CO2 through the tiny stomata on the underside of the leaf. When CO2 levels reach about 1500 PPM (parts per million), the plant uses its food so fast that there is an enormous increase in the plant's metabolism. As the CO2 is increased in a grow area, so must the nutrients be increased. In nature, a plant will receive about 300 PPM to 400 PPM of CO2; this amount is concentrated in the atmosphere at any given time. In your grow area, you should limit the CO2 PPM to about 1900 PPM, the suggested tolerance for people and plants.

Compressed tanks of CO2 have regulators that release a specific amount of CO2 through hoses directly over the tops of the plants. You might also consider a commercial CO2 producer - a machine with safe, simple burners similar to a pilot light encased in a protective device. These are best for winter use since they also create a certain amount of heat. Periodically, you should introduce 900 PPM to 1500 PPM of CO2 into the grow area or maintain a similar constant rate. CO2 is only used during the "lights on" time since photosynthesis does not take place in the dark, and the CO2 would be wasted if used without light.

Temperature

In most geographic locations, winter is cold and summer is hot. Maintaining a perfect 76 degrees F at all times is desirable, but almost impossible in practice. Generally, room temperature should be maintained between 72° F and 80° F.

A 1000 watt High Pressure Sodium lamp can raise the temperature of a small room by as much as 10°. The difference in day and night can bring other temperature changes. An effort should be made to not allow the temperature at night - "lights out time" - to drop more than 15° below the average daily temperature. The temperature should never be allowed to drop below 60° for too long a period of time or rise above 80° F. If CO2 is being utilized, allow the temperature to reach 80° F.

Cooling

Air conditioners are the most common devices utilized for cooling a grow area. They remove moisture from the air and have a built in regulating thermostat. The air from the conditioners should not be allowed to blow directly on the plants, however, especially the clones. When the exhaust is drawn from the ceiling, the hottest air in the room is removed. Burning the lights during the coolest period, usually after the sun has set, will help keep the room cooler during the day when the lights will be off. Some 1000 watt light fixtures may be adapted to a 6" dryer hose and their heat exhausted directly out the room.

Small family run setup, cooled and heated. *Photo ©Crop King*

Heating

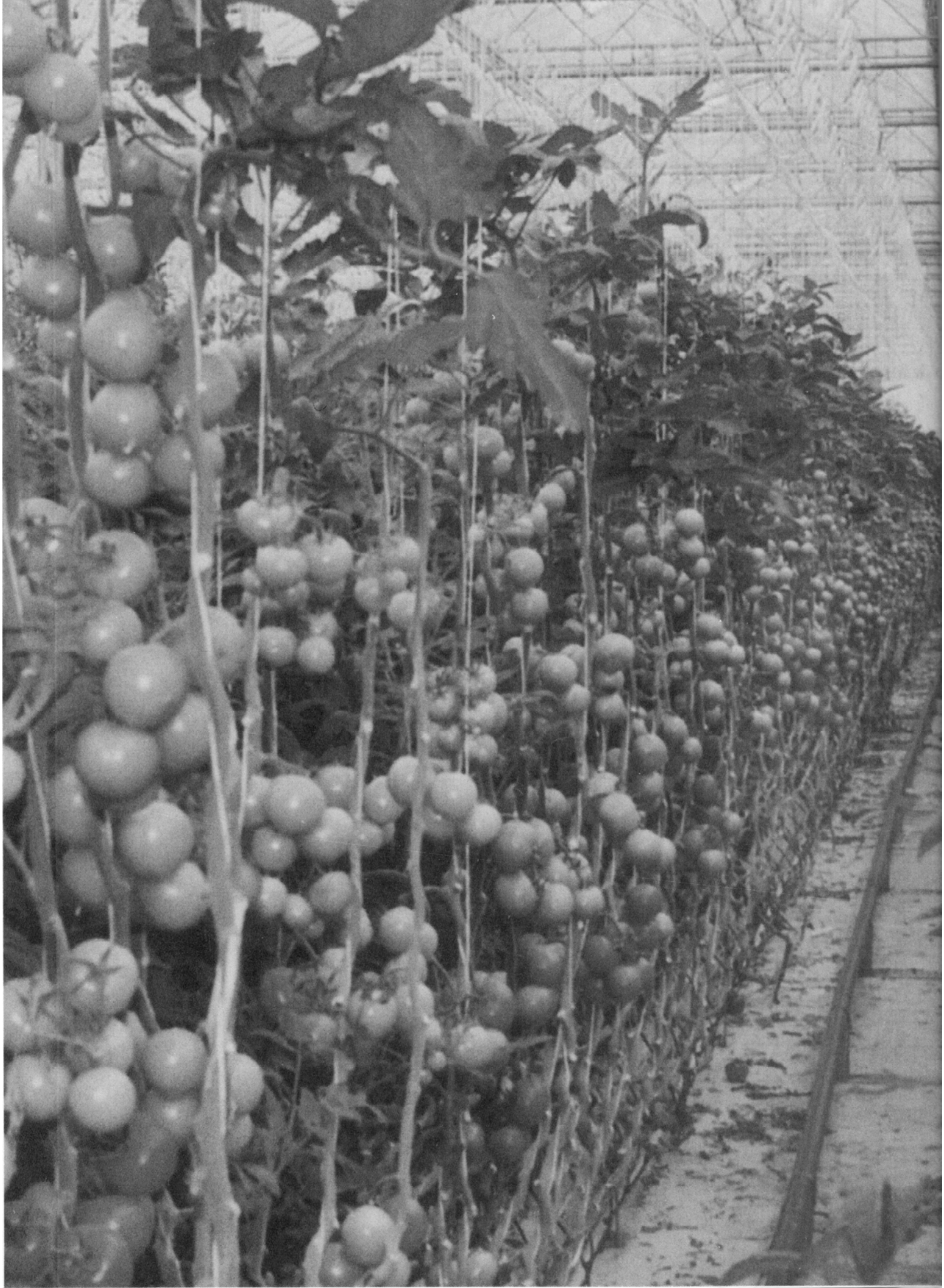
Heating a room poses potential dangers. Never risk a fire in a grow room by using radiant strip heaters.

One of the safest heaters available is the type that has an internal reservoir of oil heated with an internal element. Nothing is exposed. The heat is radiated as the oil heats up. The oil heaters are safest for night use.

Propane heaters may also be used in the winter and will supply daytime heat as well as CO2 for the plants.

Safety Tips

- Always have a large fire extinguisher just outside your grow area.
- Keep a hose handy as a back up.
- Never use a timer or extension cord on a heater.
- All electrical work must be up to code.
- Read a Wiring Simplified book, or hire a professional to do your wiring.
- Test all elements for proper function before any system is operated.



Chapter 4 - Seeds

Only the very best seeds are selected for hydroponic growing. Since genetics play a very important role in the cultivation of plants, seeds from superior plants will produce superior offspring.

Germination

Seeds may be germinated in a variety of ways. I suggest they be germinated in the same medium in which they will be raised. This will allow for the least trauma to the seedlings.

A simple and popular germination method is to place the seeds in a wet washcloth or paper towel. Then enclose the wrapped seed in a small plastic bag to retain moisture, and store in a warm, dark place. The towel or cloth must remain moist until the seeds germinate in usually 3 to 10 days. The germinated seeds may then be transferred to the medium you selected.

Hydroponic Germination

Hydroponic seed germination is quite simple: you need a tray for water and a medium in which to germinate the seeds. A 12" x 24" rooting tray or shallow dish may be used. Fill the tray half full with water. Then place the seeds into one of a variety of hydroponic mediums: hydroponic cups with lava rock, rockwool cubes, or 3" peat moss cups are the most popular of the possible mediums for hydroponic seed germination.

Small 3" hydroponic plastic cups may be placed in the rooting tray and filled to just above the water line with lava rock, a porous kernel used in various hydroponic gardening processes. The seeds are placed on top of the lava rock, out of the water, and then are covered with another layer of lava rocks added to the cup.

Another medium for seed germination is 2" rockwool cubes. The cubes should be placed directly in the tray with half of the cube out of the water. The seeds are then placed about $^1/_2$" into the top of the cube.

The third medium to consider is small 3" peat moss cups filled with a 50/50 combination of coarse grain, horticultural grade perlite and vermiculite. The cup is placed half way out of the water and the seed is placed $^1/_2$" below the top of the non-nutrient medium.

After the seeds are settled into the growing medium, an aquarium pump is turned on and a bubbling wand is placed in the water.

Regardless of which medium you choose, the seeds should never be under the water level in the trays!

Seedlings

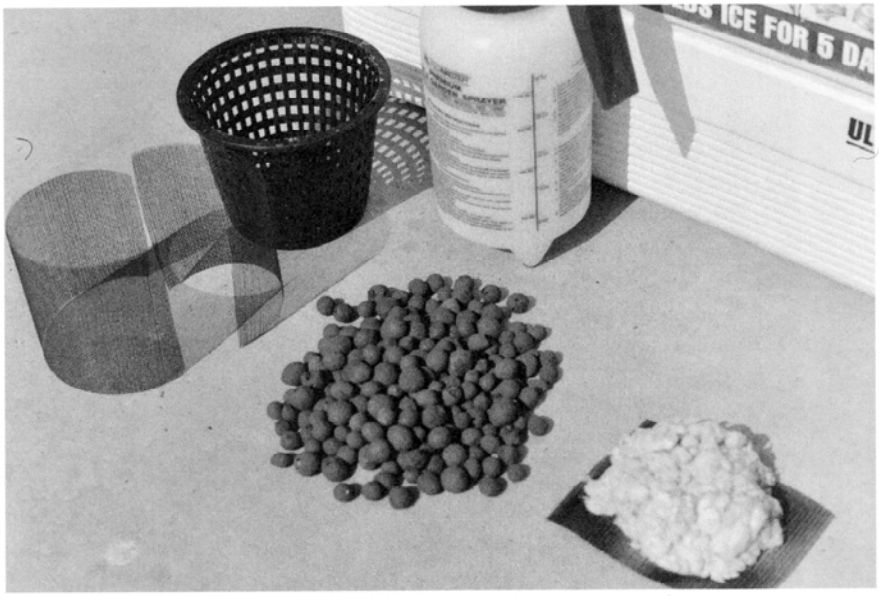
The seeds should be left to germinate in the cloning area with the lights out. Once the seeds germinate, the fluorescent grow lights are turned on. Seedlings will quickly grow to 3" to 4" while developing a longer tap root with several new lateral roots. At this point, the seedlings are ready to be transplanted into larger containers and then moved into the pre-blooming area to allow their feeding times to be increased in response to the ever-increasing growth rate of the plants.

Seedling roots coming out the bottom of Rockwool cube.

During the pre-blooming phase, the standard Ebb and Flow grow bed and reservoir are used. The water is turned on and set to cycle at regular intervals. The seedlings are placed in larger plastic hydroponic grow containers using the standard totally organic hydroponic method.

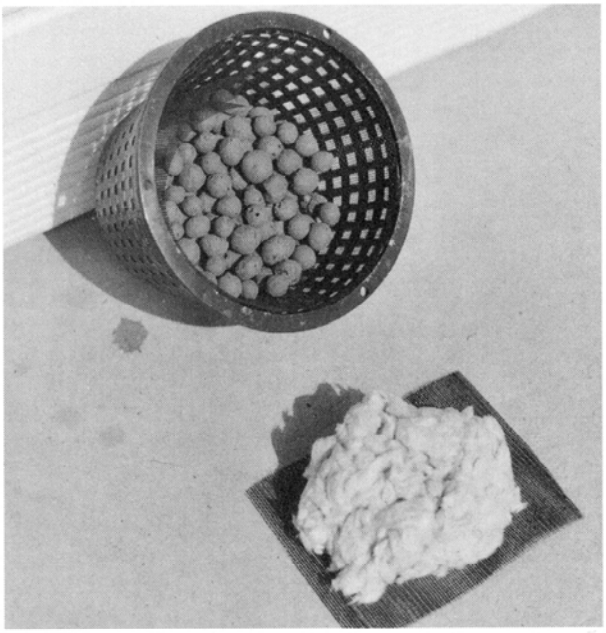
The Totally Organic Method

The secret to totally organic hydroponics is the creation of a hydroponic grow container that allows for organic nutrients to be applied directly to the growing medium rather than into the water reservoir.



Hydroponic container, screen, lava rock, and Rockwool.

The standard grow container is first filled with lava rock half way up from the bottom of the container. The upper remainder of the container houses the medium of choice, such as rockwool or coconut fiber. I prefer to use a simple mixture of $^1/_3$ coarse grade horticulture perlite, $^1/_3$ large-sized, horticulture vermiculite, and $^1/_3$ potting soil. If this soil mixture is used, you should place a thin layer of hydroponic medium, such as rockwool, on top of the lava rock to prevent any of the soil mixture from dropping down into the lava rock. A plastic screen lining fitted on the inside circumference of the entire container, from the bottom up the sides to the top, will further prevent any small particles of the soil mixture from getting into the water. Using a hydroponic container with small holes is helpful also. This layering of mediums best promotes the upper capillary action of the water and prevents any organic nutrients from flowing downward into the bottom of the grow bed.

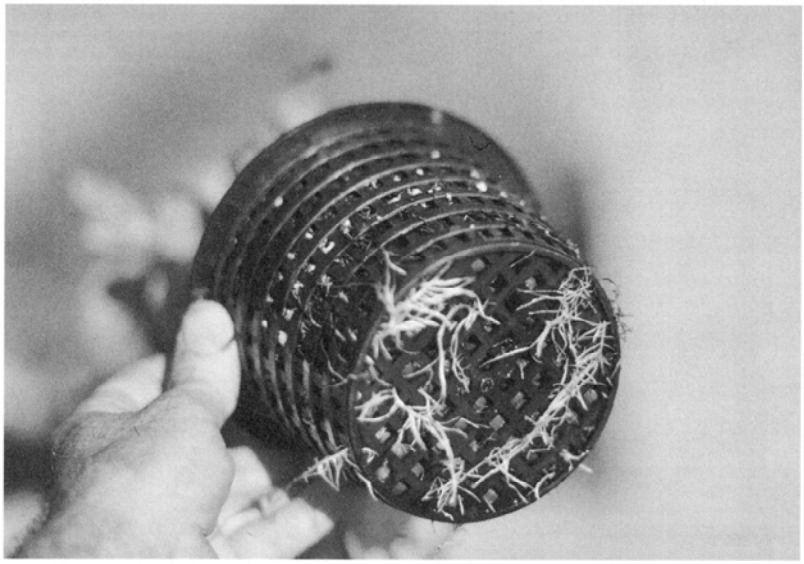


Screen in container, then lava rock, then Rockwool.

The container is then placed in the grow bed with the water level just slightly below the "soil" line. The submerged lava rock will encourage the capillary water flow upward into the soil, thus keeping the soil mixture or medium always moistened.

The soil mixture or medium is where the nutrients may now be placed. The water reservoir is used to periodically moisten the medium, drawing moisture and air into the entire root structure of the plant at frequent intervals. Thus the plant is supplied with more of the vital oxygen and CO2 that enable the plant to metabolize the nutrients much faster.

In nature, the top $^1/_3$ of a plant's roots are specialized for nutrient uptake, while the lower $^2/_3$ of the roots are specialized for water uptake. My "dual root" totally organic growing system enhances the natural specialization of the root systems to maximize their dual nutrient and water uptake abilities.



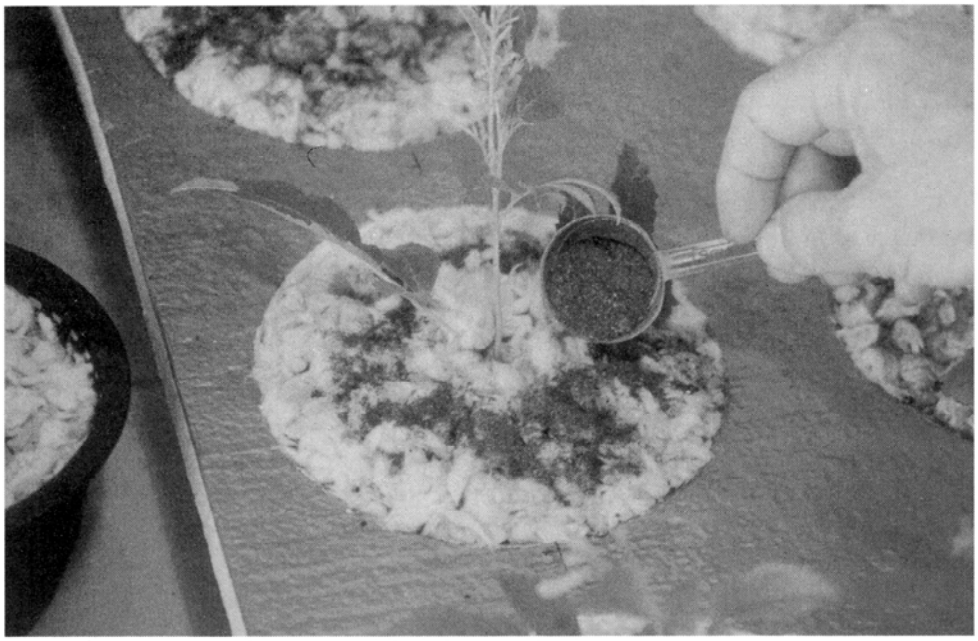
Lower roots get only water.

Since the water reservoir is not used to distribute the nutrients as is done with the "traditional" chemical method, there will be no need to worry about the nutrient PPM of the water. The reservoir will be used for the periodic flooding of the medium only. Using this totally organic method makes hydroponic growing as easy as soil growing by eliminating the need to keep a fine-tuned and chemically balanced water reservoir.

Maintaining this precise nutrient balance causes most novice hydroponic growers to fail. When the PPM is not regulated properly, the plants may be "burned" by the application of too many chemical nutrients or poisoned by unbalanced chemical nutrient content.

The reservoir contains no nutrients.

However, with the totally organic method, all of the organic nutrients are applied directly to the medium, much as they would be applied to any soil. If liquid organic nutrients are used, they are simply mixed to a proper concentration, the same as would be for soil application, and poured on the top of the medium. The secret is to not apply too many nutrients at once.



Nutrients are added to upper medium.

Different mediums will have the capacity to hold water more than others. To find out the capacity of your medium, simply pour a cup of water on top of the hydroponic container filled with medium. If $^1/_4$ cup of water runs out the bottom, you may conclude that the moisture-holding ability of your particular amount of medium is slightly less than $^3/_4$ cup. Next pour $^1/_2$ cup of water into another container of your medium. If no water runs into the lava rock or out the bottom, you will then know that your medium will best retain $^1/_4$ to $^1/_2$ cup of nutrients per feeding. You do not want to feed your plants with more nutrient-filled water than the medium will hold or you will drip nutrients into the lava rock and the bottom of your grow bed where they will then be returned to your reservoir. If during some feeding you notice a bit of nutrient water dripping from your grow container, it is a simple job to just soak it up with a rag. If you notice any nutrients seeping down from the bottom of the upper grow medium into the lava rock, change the lava rock and use less liquid, or no liquid as a delivery system. It is best to feed your plants about an hour before their standard reservoir watering.

I strongly recommend that you grow your plants in my standard medium formula: $^1/_3$ perlite, $^1/_3$ vermiculite and $^1/_3$ potting soil. This combination of ingredients as your hydroponic medium holds the nutrients and facilitates the upward capillary action of the water delivered from the reservoir.

If you wish, you may mix organic nutrients, such as worm castings, directly into the soil mixture. The organic nutrients may also be mixed into a half cup of water and poured evenly across the top of the medium, or you may choose to spread organic nutrients on the top of the medium, followed by a fine misting of water directly on the top of the medium. With any of these application methods, the organic nutrients will enter the soil to be utilized by the plant.

The upper "soil" or "soil alternative" where the nutrients are delivered should be treated just like a soil container. A light spraying once or twice a day to moisten the upper medium will assist the capillary action of the water from the lower hydroponic lava rock.

If a small bit of nutrients drain downward into the reservoir, it is all right. The large volume of water in the reservoir can absorb a small amount of organic nutrients without causing a problem. Standard chemical reservoirs need to have their water reservoir changed every week to two weeks and the same is true with the totally organic process. The reservoir water is changed every 1 to 2 weeks, depending on your ability to keep it clean.

Timers

Timers with a 30 minute on/off capability enable the water pump to be turned on for exactly 30 minutes, the length of time the grow bed should be flooded. The time between watering depends on how long it takes your medium to become almost dry. Anywhere from 4 to 8 hours between watering may be allowed.

Only heavy duty, three-pronged timers should be used for the lights and the fans. Never use more than one light or fan on each timer to avoid overload: One timer, one light; one timer, one fan. Do not use extension cords unless they have their own built in circuit breakers.

CHAPTER 5 - NUTRIENTS

I have created a unique process that allows 100% organic elements to be applied to hydroponic growing, thus creating the finest growing process ever. This process benefits you by utilizing the best concepts of hydroponics and soil growing combined into one unique method.

In earlier times, organic fertilizers consisted of cow or horse manure. Today, organic fertilizers are much more refined. Organic elements such as seaweed, land plants, mineral clays, worm castings, and bat guano are combined to create clean formulas that provide a full range of all the necessary primary, secondary, and trace elements. These organic formulas have opened the door to organic manipulation of the growing process.

You will need basic materials.

In order to be effective, nutrients must be constantly available to the root system of the plants. Since the nutrients are applied directly to the medium when using the totally organic method, they will be continuously available to the plants. The secret to hydroponics is supplying water, nutrients, and air to the root structure at timed intervals. However, it is not necessary for the nutrients to be in the water. As the timers periodically flood the grow bed, they will draw air and water to the roots.The water applied at intervals to any lower medium will capillary upward and steep the nutrients into the upper root structure, which develops in the upper medium.

Use only organic nutrients.

Apply nutrients more evenly.

The organic nutrients are applied to the upper medium of choice the same as if they were being applied to the soil. Read the instructions on any organic nutrients you decide to use. Then apply them as you would to any soil. If the instructions say, "Place 1 Tablespoon fish base fertilizer to 1 gallon of water; then apply to soil," that is what you will do. If the instructions say, "Mix $^1/_4$ cup of powdered worm castings or bat guano on top of the soil, and water in or mix into the top 2" of soil," then that is what you do.

Most fertilizers give instructions for application once every week or two weeks. In order to apply your nutrients precisely, you may speed up their application by simply adding less more often. For example, if a container of organic nutrients directs you to add 2 Tablespoons of nutrients applied with water as a delivery system, once a week, do this instead: Apply one half of that amount - 1 Tablespoon once every three days. This will give your plants a more constant supply of available nutrients.

Feeding is one of the primary factors in producing a superior crop. Mixing nutrient formulas is part of the art of growing hydroponically. It requires an extensive knowledge of standard organic nutrients and a constant awareness of new nutrients that continually find their way to the marketplace.

Special attention is directed towards the different stages of growth. That is because the different stages of growth require different amounts of different nutrients.

Primary Nutrients

If you are interested in growing semi-organic, I suggest an organic formula such as Earth Juice©, Botinacare© or Pure Blend©. They come in two or three part formulas: grow, bloom and macro/micro.

There are three primary nutrients - Nitrogen (N), Phosphorus (P), and Potassium (K) - listed on the front of most fertilizers. The letters "N," "P," and "K" will be followed by a number that represents the designated amount of each primary nutrient in the package. For example, if a container of fertilizer lists "N-2, P-6, K-1," that means the nutrients are proportionally 2% nitrogen, 6% phosphorus, and 1% potassium (or potash).

Nitrogen (N)

In order for the plants to hold the soil together, their roots must grow rapidly as they penetrate deeper into the soil. Nitrogen is the essential nutrient that supports the plant's rapid growth during the vegetative state of growth. Once the nitrogen has been metabolized by the plant, it is then used to make chlorophyll, as well as the leaves, the stems, and the physical "body" of the plant. Nitrogen is also used in the construction of many of the basic molecular "building blocks" of plants, and is a major component of proteins and amino acids.

The plant will find many additional uses for nitrogen; therefore it must be constantly replenished in the proper proportion. Beginning growers soon become accustomed to the nitrogen needs of their plants during the different stages of growth.

Nitrogen is found in blood meal, cottonseed meal, worm castings, bat guano, and seabird guano.

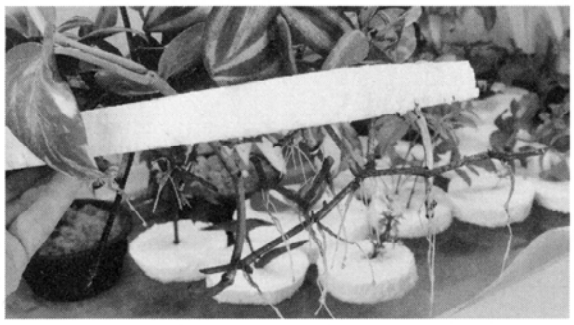
Nitrogen is essential for healthy plant growth.

Phosphorus (P)

Phosphorus is utilized during every stage of the plant's life. It is used for photosynthesis, as well as during seeding and blooming. It is needed by the clones to support the development of roots. Phosphorus also helps the plant with reproduction.

It is the main component of nucleic acids, including energy-transmitting ATP, as well as phosphoproteins and phospholipids.

Phosphorous is found in worm castings, bat guano, seaweed, and bone meal.



Phosphorous helps roots grow.

Potassium (K)

Potassium is also utilized during all stages of plant growth, but is most needed during the critical seedling and blooming stages. It helps the plant manufacture sugars and starches, and is needed for plant metabolism. Potassium helps create strong cellular growth in the roots, stems, and leaves of the plants. It also helps the plants resist disease and assists with the metabolic processes themselves, to include cellular water balance.

Potassium is also found in bat guano, seabird guano, kelp, and sulfate of potash.

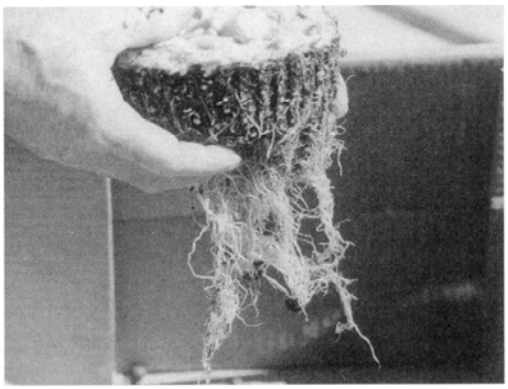
Macro Nutrients

The secondary nutrients, Calcium (Ca), Magnesium (Mg), and Sulfur (S), should be supplied in the hydroponic ingredients in the proper percentages required by plants. Always be attentive to the use of each different formula as the nutrients are mixed.

Calcium

Calcium is used by the plant just prior to cell division - when the cell's chromosomes replicate themselves. Calcium is also used during cell growth. A trace of calcium is found in the tip of each root.

Calcium may be found in gypsum.



Calcium is found in the tip of each root.

Magnesium

Magnesium is essential to chlorophyll production since it is the central atom of the chlorophyll molecules. It helps the plants utilize other nutrients as well as light. It is also necessary for the overall health and vigor of the plants.

Magnesium sulfate is an available source.

Sulfur

Sulfur aids plants in their utilization of nutrients and in the formation of vitamins within the system of the plant. It is found in the nitrogenous organic compounds that are essential components of proteins.

Additional sulfur is found in Epsom salts or magnesium sulfate (Mg SO4).

Micronutrients (Trace Elements)

Although only needed in small amounts, micronutrients, or trace elements, precipitate various essential processes within the plant's systems. Micronutrients are found in kelp meal, seaweed, and bat guano.

Trace Element Supplements

Most standard hydroponic formulas will include a trace element solution, which may be added directly to the medium or be sprayed on as foliage feeding. Additional supplements may be added at $^1/_2$ of the recommended amount, followed by an adjustment period of 2-3 days. This gives you time to determine the extent of effect the extra nutrients have had on the plants before more is added.

B1 or Plant Starter

Both B1 and Plant Starter are useful transplanting aids that lessen the likelihood of transplant shock while they stimulate root growth. They are effective for starting seedlings as well as helping clones develop roots. B1 or Planter Starter may be added to the water in your clones' growing tray or added directly to the medium of larger plants. B1 or Plant Starter is the only nutrient formula needed by the clones, and should be added once during the initial cloning, but not used every time the water is changed (once a week) for that batch of clones.

Overfeeding

Overfeeding initially creates the appearance that your plants are thriving because they look lush and green, and show rapid growth. Growth that is faster than normal, however, should be cause for suspicion, and should be carefully monitored.

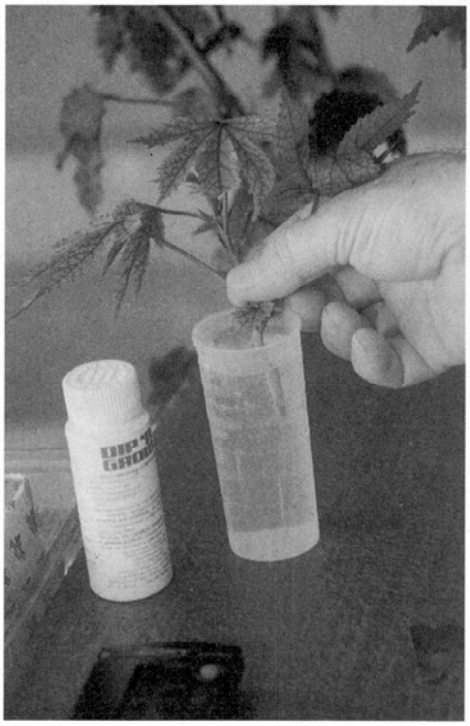
If you suspect you have overfed, simply stop feeding; and in severe cases, flush the medium with an amount of water the same size as the plant's container. The main indication that a plant has absorbed all excessive nutrients is a lighter coloring on the existing leaves, and no signs of burn on the new growth. It usually only takes the plant a few days to recover.

Several signs of overfeeding include the tips of the lush green leaves turning yellow, reddish-yellow or even blackish-green; or, in the case of a severe burn, the tips and edges of the plant's leaves also curl under.

Use root stimulator with clones.

Cloning Solutions

There are many different cloning solutions on the market, available as liquids, powders, and jells. I recommend the liquid Dip-N-Gro: it penetrates the stems of the clones immediately. The clone is placed in the solution as soon as it is cut from the mother plant, left in the solution for up to 30 seconds, and then is immediately placed in the cloning tray. Pure Blend has an organic rooting solution that is also effective.



Dip clone in cloning solution.

Chapter 6 - Healthy Water

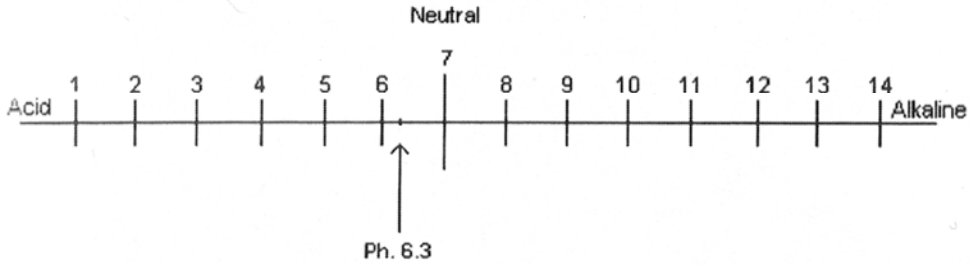
Since the quality of public water varies from region to region, it is important to check your water content before using it in your hydroponics garden. To purify over-chlorinated water, fill a wide-mouthed container with the water and let it sit outside for 24 hours; as the water sits, the chlorine will slowly evaporate into the air. Softened water contains salts that are detrimental to plants. Circumvent the softened water by splicing into the line at a point before the water softener, and drawing your water from that outlet. In other regions, the water may be so alkaline or acidic that it affects the overall pH of the growing process.

If you wish to have a professional test performed on your water, you may send a sample to your city government's water research facility.

pH

pH is the measurement of acidity or alkalinity, and is calculated on a scale of 1 to 14. Number 1 represents the most acidic point on the scale, number 7 the "Neutral" pH position, and number 14 the most alkaline.

Maintaining the proper pH at 6.3 is an important part of creating a successful hydroponic environment. If the water is not pH balanced, then the nutrients in the medium will not have the opportunity to be best utilized by the plant, nor will the food be reduced to a proper configuration which is suitable for assimilation and metabolism by the plant.



The lower the number, the more acidic something is. The higher the number, the more alkaline something is. The pH scale is an indication of the pH value of the measurement of water. The pH of the water in the hydroponic reservoir is maintained, just below the neutral position. The water pH should be maintained at 6.3.

Spend the extra funds to purchase a quality pH tester. A good meter will immediately display a digital read-out of the exact pH of the water. Litmus paper is too crude to give the proper pH and should never be used.

Test the pH of the water as soon as it has been added to the reservoir. Test the pH daily, and at the same time, if possible. If there is a radical change from 6.3 towards acidity or alkalinity, then adjustments to the pH must be made by the addition of chemicals to the reservoir that are specifically designed to raise and lower the pH of water. These chemicals may be purchased with the pH meter. These chemicals are referred to as "pH up" and "pH down." They are sold in pure organic form.

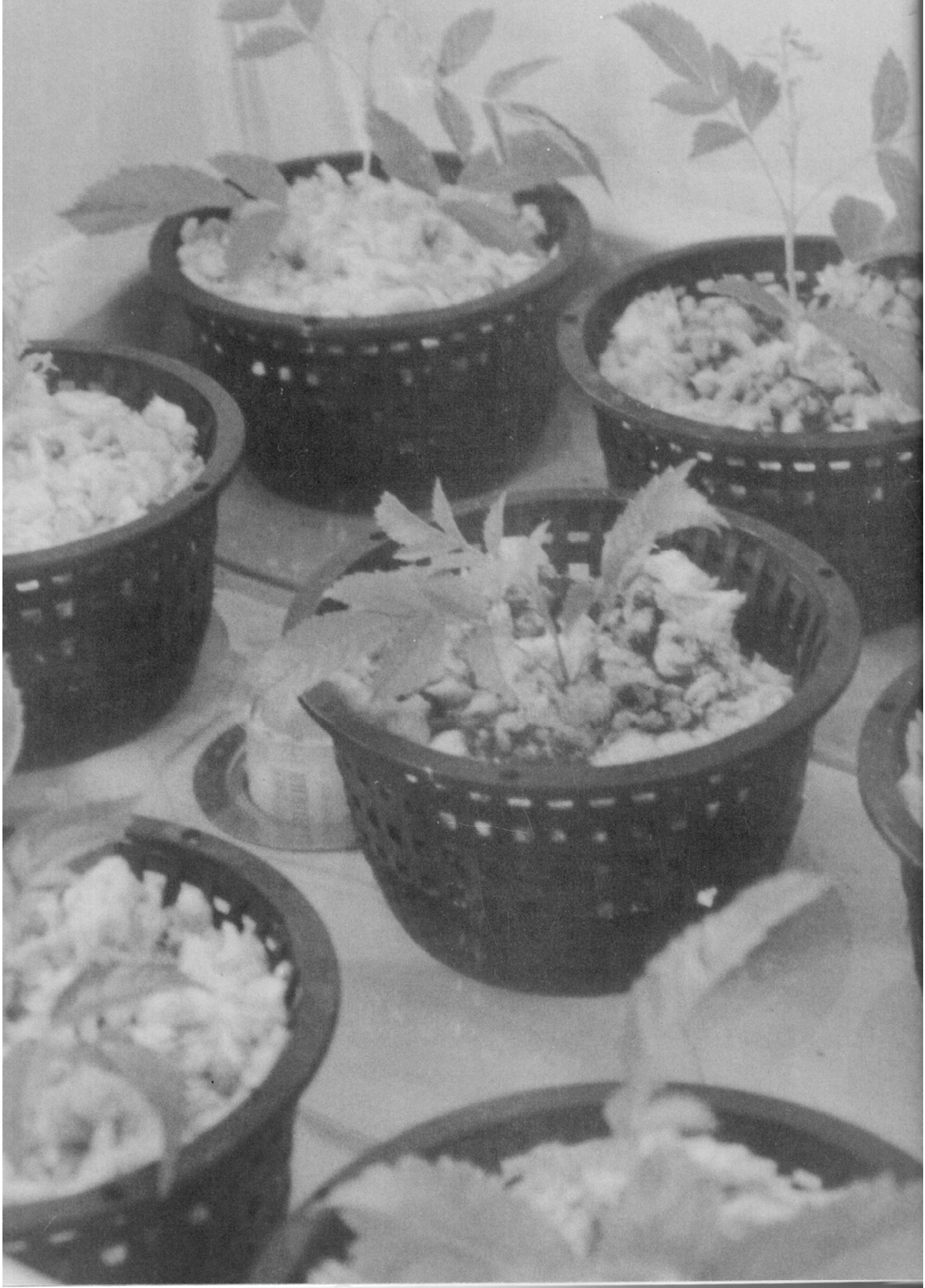
A pH "buffer" solution should be purchased along with the pH meter. This solution will adjust the pH meter to a proper setting just before the pH meter is used. Becoming more familiar with the meter, and the use of "pH up" and "pH down" will fine-tune the pH of the water reservoir. The pH of the water is the only thing being tested in the reservoir. If you do not have a pH meter do not worry. As with any hydroponic system, the water will be changed once every week to two weeks. If you do not have a meter, simply change your water weekly.

Oxygenating the Water

You may want to give your water the additional benefit of oxygenated water with a standard aquarium air pump. To determine the size of air pump you need, simply calculate the capacity of each reservoir. If a pump supplies enough oxygen for a 50 gallon fish tank, then a total of 50 gallons in three reservoirs will be properly supplied and serviced by the same size pump.

Three way or multiple way attachments will allow air to come in one end of the attachment and be sent out the other end to as many reservoirs as needed. Regulators will determine the amount of flow to each reservoir, releasing more air for larger reservoirs. The air is sent through clear plastic tubes, which have bubbling wands attached to their ends. The wands create a myriad of bubbles, oxygenating the water.

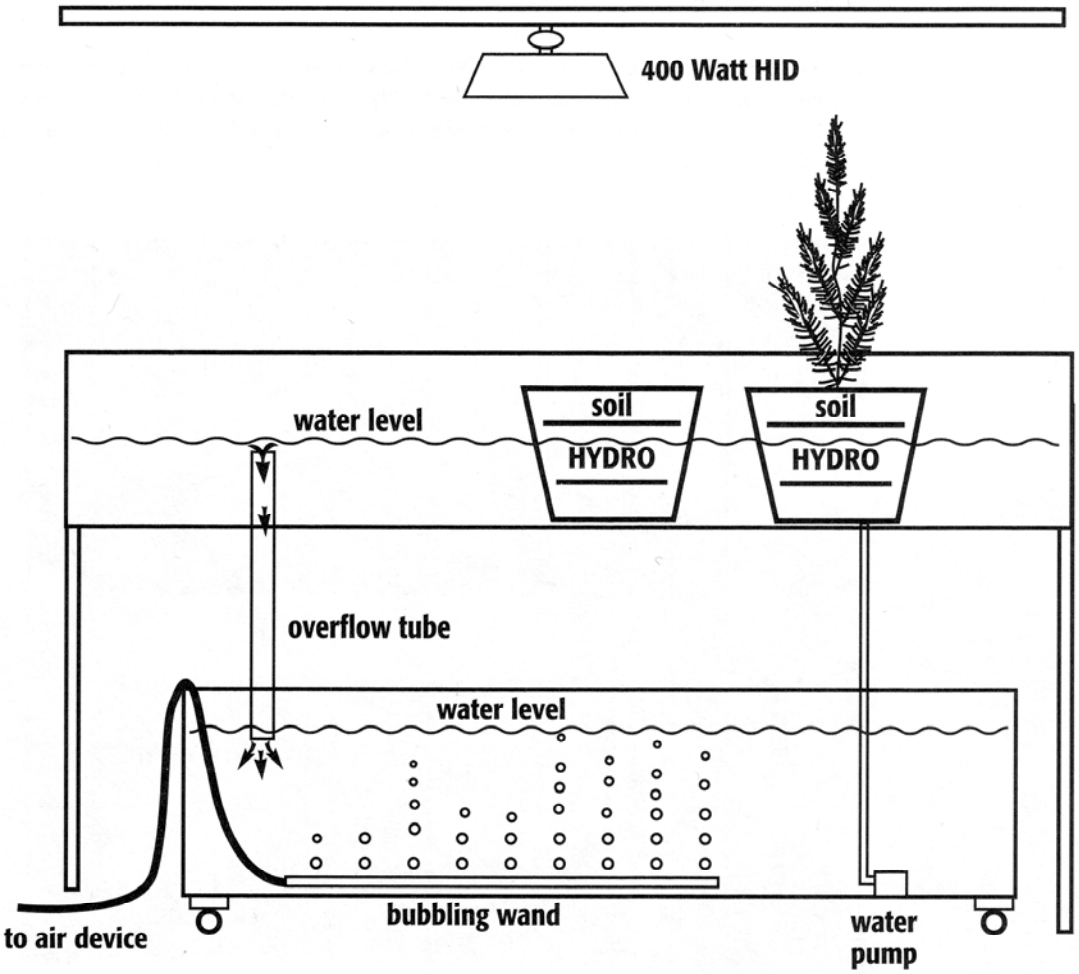
Oxygenate the water.



Chapter 7 - The Ebb and Flow Process (E&F)

The Grow Bed

The E&F grow bed is made so that it has the ability to hold all of the plants plus a standing level of 2" to 6" of water. At the same time, there must be enough water in the lower reservoir to keep the water pump completely submerged as the water circulates from the top of the grow bed to the lower water reservoir. When the water circulation stops, all of the water in the system will back flow down into the lower reservoir. Notice the level of water in the reservoir once all the water has returned to it; that level is the minimum amount of water needed for the system to be working properly. Add a few more inches of water to the reservoir to make up for the day's worth of water use and evaporation. Make sure that the water level never reaches near or below the minimum water level required.



Ebb and Flow setup.
Photo ©Quiet Graphics

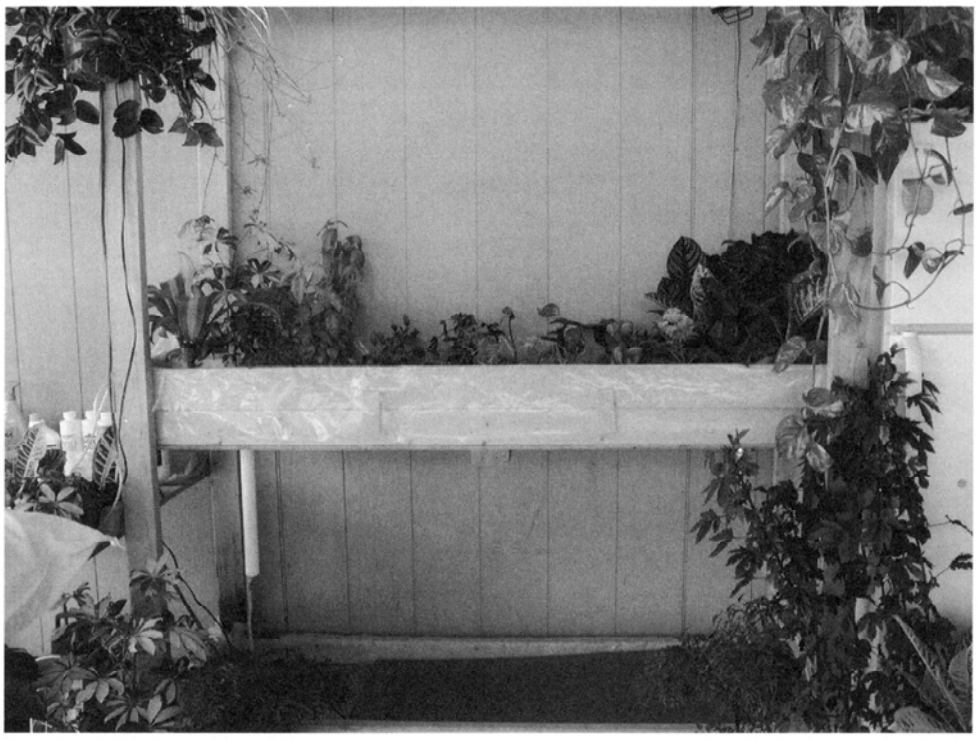
Ebb and Flow Cycle

The E&F set-up requires a lower water reservoir and an upper grow bed. The water "rests" in the lower reservoir until it is needed in the upper grow bed. A small aquarium water pump set on a timed schedule will periodically pump the water from the lower reservoir up to the grow bed. Only purchase and use water pumps that have a "back flow" ability.

The water pump has a clear plastic hose attached to it. The hose enters flush with the bottom of the grow bed, using a standard water fitting, such as would be found in a sink. An overflow tube about an inch in diameter is placed through the grow bed using a standard water fitting, with the top of the tube at the level you wish your water to rise. The water in the grow bed will rise to the level of the overflow tube and then return to the lower reservoir through the overflow tube. The water will flow and circulate in this fashion until the timer on the water pump turns the pump off. The water then back flows down the same hose which pumped the water into the upper reservoir. Placing the hose flush with the bottom of the grow bed will facilitate this.

The water is usually allowed to circulate for 30 minutes. The water is not circulated again until the plants need the water. To determine this time, simply note the time it takes for your plants to begin to wilt after their first watering. If they begin to wilt after 6 hours, then you need to circulate the water every 5 hours. If it takes 8 hours for a plant to begin to wilt, then about 7 hours is needed between watering.

Both the grow bed and the reservoir should be covered to keep out light which will precipitate bacterial growth. A simple, lightweight sheet of Styrofoam (painted black if you wish) will cover the reservoir, and a similar sheet with holes for the plant containers can be used to cover the grow bed.



Ebb and Flow setup.

The Container

The container, lava rock, upper medium soil mixture, and clones.

Place lava rock in the bottom half of the hydroponic grow container. Place a $^1/_4$" layer of loose rockwool on top of the lava rock. Then place the medium of choice in the upper portion of the plant container. Place the container so that only the lava rock is submerged in the water. Make sure the bottom of the upper medium will not be touched by the circulating water. If the circulating water touches the upper medium, it may leach nutrients into the water in the reservoir. As the water circulates around the lower half of lava rock, it will capillary up through the lava rock and into the upper medium.

The plants in the container will then develop two separate root systems. The upper root system will use any hydroponic medium you wish other than lava rock, which is used on the bottom half. I recommend that you use rockwool, coconut fiber, composted bark, Oasis fiber, peat, perlite, and vermiculite, or my standard suggested "soil" formula for the upper medium layer. You may use any organic material, delivered either as a tea, spread on top, or mixed into the strata of the medium, with any of these hydroponic mediums. Different mediums will require different water schedules.

The upper root system will develop a thick web-like structure of fine roots, similar to roots in standard soil, because the medium will not be submerged in the water as will the roots in the lower half of the container. This root web will allow for an enormous uptake of nutrients and create faster and more abundant growth. Plus the hydroponic nature of the upper medium will allow additional oxygen to be exchanged within the medium, replicating a hydroponic environment for the abundant root structure.

In the lower half of the container filled with the lava rock, pumice, georock, gravel, or sand, the secondary system of roots will develop. They will appear as the standard stringy, rope like structures common to hydroponic growing. There will be some fine hair-like roots, but not as abundant as the roots growing in the upper medium. These secondary roots take up water and, between watering cycles, will be constantly exposed to more oxygen, which promotes faster metabolism and plant growth.

The water usually only needs a half hour to moisten the entire medium. If your medium takes longer to become completely moistened, then simply circulate the water at a slightly longer interval until the medium is properly moistened. The upper soil or medium only needs to be moist not soaked.

The development of a dual root structure will create a fast metabolizing growth system for your plants that utilizes the essential processes and benefits of both soil and hydroponic gardening. The end result? Faster and more plentiful plant growth than either standard soil or hydroponics by itself.

Lower hydroponic root system.

Growing Mediums

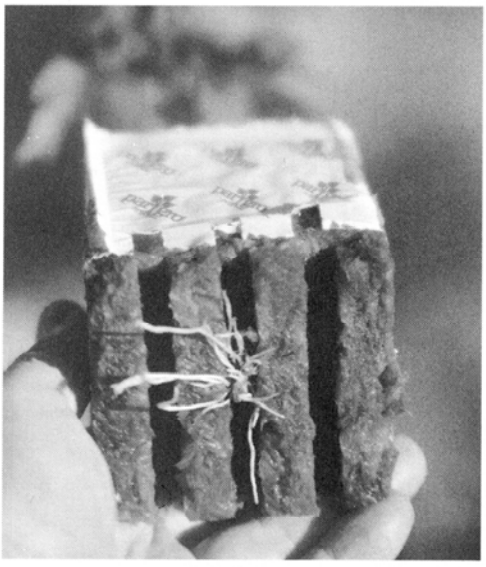
Because the E & F method is medium friendly, a variety of growing mediums may be used during all stages of growth - from clones, to pre-bloomers, to blooming plants. I prefer the standard medium of perlite/vermiculite/potting soil. However, inert media such as rockwool, perlite, or coconut fiber work just as well. The standard medium is more versatile because it is easy to obtain.

Lava rock.

Lava Rock

Lava rock is available in any number of small pea to marble-sized porous hydroponic grow media. These versatile nuggets hold water for long periods of time and assist the upward capillary action of the water. The spaces between the rocks allow for enormous amounts of air to be supplied to the roots - one of the dynamic aspects of hydroponics that create accelerated growth. Lava rock is effective for seedlings, clones, pre-bloomers, and blooming plants.

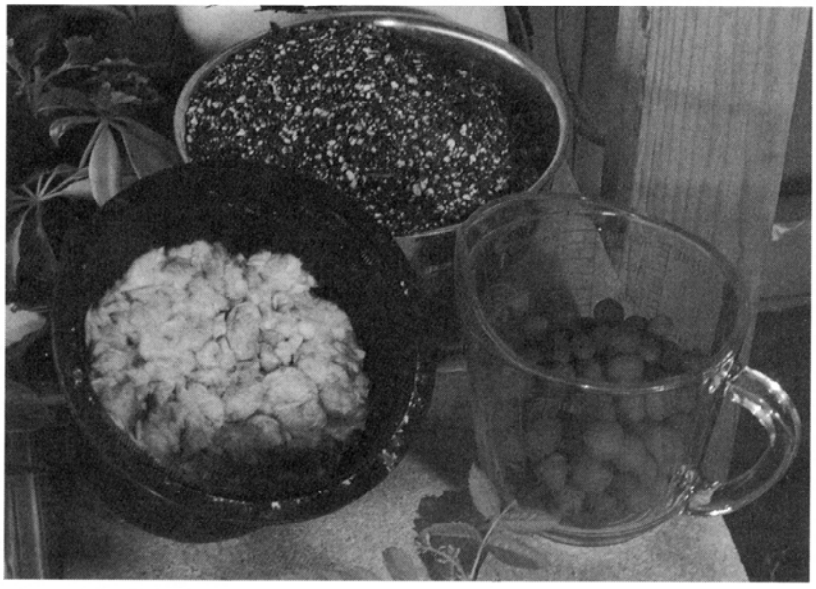
You may also experiment with lava rock. If you take the standard mixture of perlite/vermiculite/potting soil and add an equal amount of lava rock to it, you will have created a medium that has more ability to capillary water through the upper medium to the top of the container. The structure of the lava rock will hold air in the medium and facilitate metabolism. Feel free to experiment with different amounts of lava rock and the standard mixture. The lava rock should be rinsed thoroughly before using the first time.



Roots in rockwool cube.

Rockwool

Rockwool may also be used at all stages of the growing process. Small 2" cubes are perfect for germinating seedlings or clones, and may be placed on top of larger rockwool units for pre-blooming and blooming. Rockwool may be used in slab, cube, or loose form. I prefer the loose form in the upper portion of the hydroponic containers, and cubes for seeds and clones.



Rockwool between lava rock and soil.

Perlite/Vermiculite/Potting Soil

A combination of $^1/_3$ coarse horticultural perlite, $^1/_3$ large grain horticultural vermiculite, and $^1/_3$ potting soil makes an excellent strata. For each 3 gallons of mixture, mix 1 gallon of pasteurized worm castings, or any of the other organic materials you choose. This mixture will add the much-needed nutrients to facilitate future growth.

The medium should be slightly moistened before placing it in the hydroponic containers on top of the lava rock. I also recommend that you place a $^1/_4$" layer of rockwool between the lava rock and the soil mixture. While a small amount of this mixture may fall into the grow bed the first time the water circulates, this is not a problem. The medium may be removed from the grow bed after watering, as well as from the reservoir after the first week when the water in the reservoir is changed. A screen placed along the inner circumference of the container will help prevent this.

Use hydroponic grow containers that have small mesh holes so none of the mixture will escape through the sides. Remember ease, safety, and availability should be considered when determining the best medium to use. Some stores only sell certain items during seasonal times of the year. If this is a problem for you, simply purchase your critical items annually.

Perlite, vermiculite and potting soil upper medium.

The Reservoir

The reservoir requires a Styrofoam cover to keep out light and bugs. If the styrofoam cover is cut into two pieces with the cut made where the overflow pipe passes through it, then it will be easier to remove for access to the water in the reservoir. Using the totally organic process there will be no nutrients added to the reservoir. Remember to check the pH daily, and to note and adjust any changes.

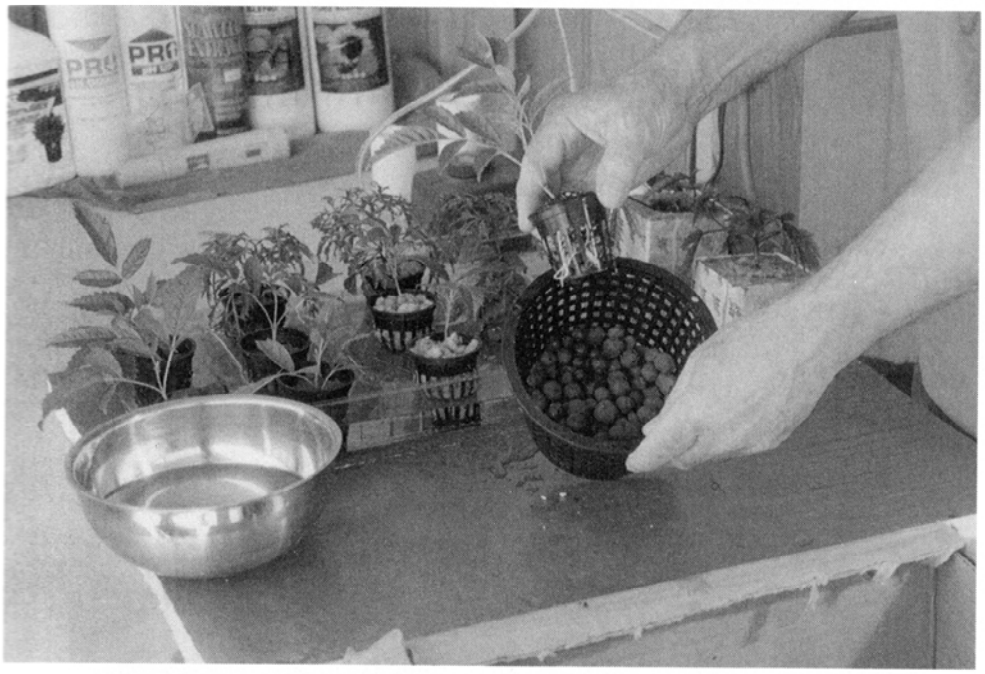
A small submergible aquarium water pump transports the water from the lower reservoir through a clear plastic tube. Water is returned to the reservoir through another plastic tube located at the bottom of the upper grow bed. A large air stone or bubble tube is placed below the water line to aerate the reservoir water.

Chapter 8 - Semi-Organic Growing

If you do not wish to grow totally organic you may grow the next best way: Semi-organic. This means using nutrients that are extracted from organic materials such as bat guano, seabird guano, earthworm castings, fishmeal, sea kelp, raw sugar cane, soybean protein extract, spirulina, and a host of others. These formulas all have the primary, secondary, and micronutrients plants require, and will guarantee a full spectrum fertilizing. In addition to those mentioned above, you may use any other organically derived nutrient you desire. For macro and micronutrients, there are an array of catalyst and essential sprays from which to choose. There are also organic pH up and down solutions, as well as organic rooting solutions.

A PPM meter is needed to test the PPM (parts per million) of nutrients suspended in the water. The PPM meter needs a calibration liquid that is used to set the meter to the proper reading before use. The more plants there are in a grow bed the more nutrients will be used faster by the plants. When only 10 plants are in a grow bed, you may notice the nutrient PPM decreases slowly. Once there are 40 plants in a grow bed, the nutrient PPM will decrease more rapidly, and require additional nutrients more frequently.

This is where most gardeners have trouble with their hydroponics gardens. If too many nutrients are applied to the reservoir, the plants will burn and the entire crop may be ruined. To avoid this, I suggest that you begin by adding half of the nutrient amount suggested in the instructions on the package. For example, if the instructions call for 1 Tablespoon of nutrients to be added to a 50 gallon reservoir, then only add $^1/_2$ Tablespoon of the nutrients. Wait a few hours; then take another PPM reading.



Transplanting into larger container.

At first, the PPM of the reservoir should be kept between 900 to 1,200 PPM. If your first $^1/_2$ Tablespoon of nutrients creates a 600 PPM, then you should raise the PPM by about 300 to meet the minimum 900 PPM. Since a $^1/_2$ Tablespoon of nutrients resulted in 600 PPM, then a $^1/_4$ Tablespoon should raise the PPM level about another 300 PPM, which would give you a 900 PPM. An additional $^1/_4$ Tablespoon added to the 900 PPM reservoir would raise the PPM to the maximum 1,200 PPM.

Semi-organic nutrients.

Always add about half of the nutrients you expect you will need to the reservoir. Give the reservoir a few hours to absorb the new dose of nutrients, and then take a new PPM reading. Once you have mastered the nutrient application, you may increase the PPM of the reservoir from 1,200 PPM to 1,800 PPM. If the PPM exceeds the 1,800 limit immediately drain the reservoir and use only water for a day or so, in case the plants have absorbed too many nutrients. Then again increase the PPM incrementally until the optimum 1,800 PPM level is reached.

Standard hydroponic system.

The water in the reservoir should be exchanged once a week to prevent any build-up of unused nutrients. PPM readings should be taken at approximately the same time every day.

The containers used for the semi-organic grow beds are standard hydroponic grow containers. The medium used is any basic hydroponic medium. You will not use the standard medium of perlite/vermiculite/potting soil that was used with the total organic grow process because the medium will leach into the water. Use only standard hydroponic materials such as lava rock, hydroponic rock, rockwool, perlite, coconut fiber, or coir fiber. Fill the container to the top (as opposed to only $^1/_2$ full as is done with the totally organic method) with any hydroponic medium you prefer.

All other processes of the Ebb and Flow system will be the same. Only the nutrient delivery technique will change. The water is periodically sent to the grow bed at the level even with the tops of the containers and their medium. It returns to the reservoir at scheduled intervals.

If your plants are to be consumed, a separate reservoir may be made which holds only water. Produce and herb plants should be moved to this "water only" reservoir the last 2 weeks before use. During this two-week period, the plants will use up most of their nutrients, resulting in a cleaner final product.

Arizona yellow bell pre-bloomers.

Clones may be taken from mature plants.

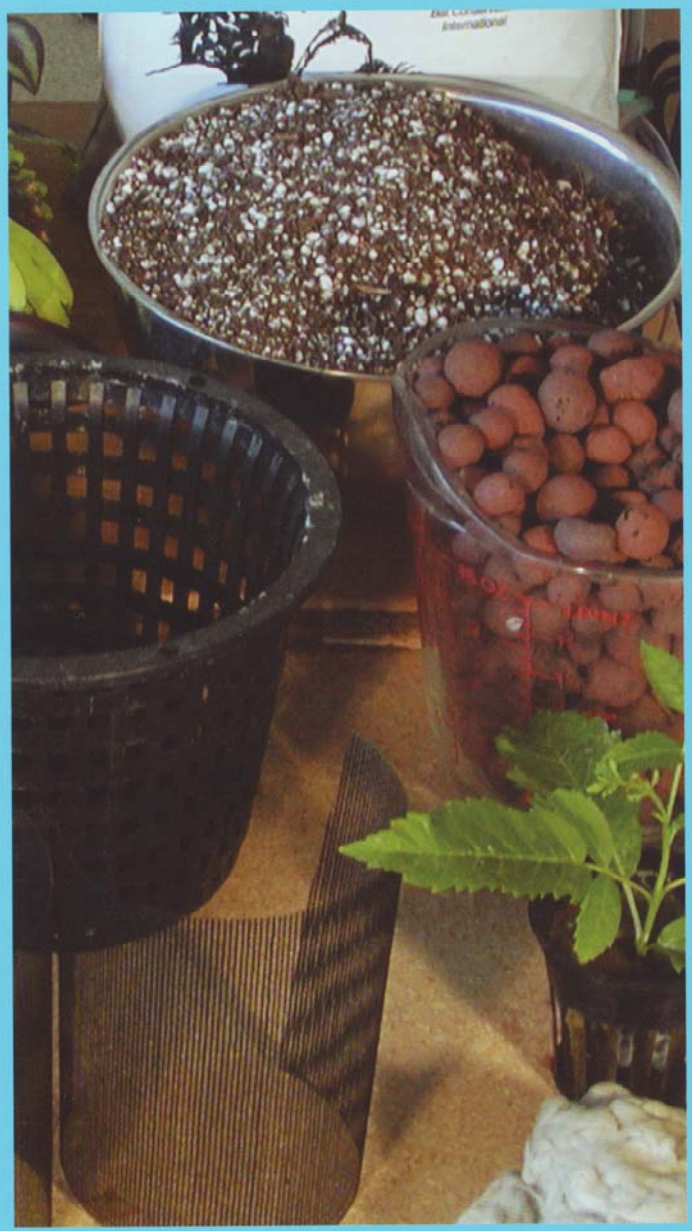
Cloning tray with different mediums

Cloning rack. *Photo ©Crop King*

MAKING CLONES

Rooted clones in Rockwool.

Clone in lava rock and soil.

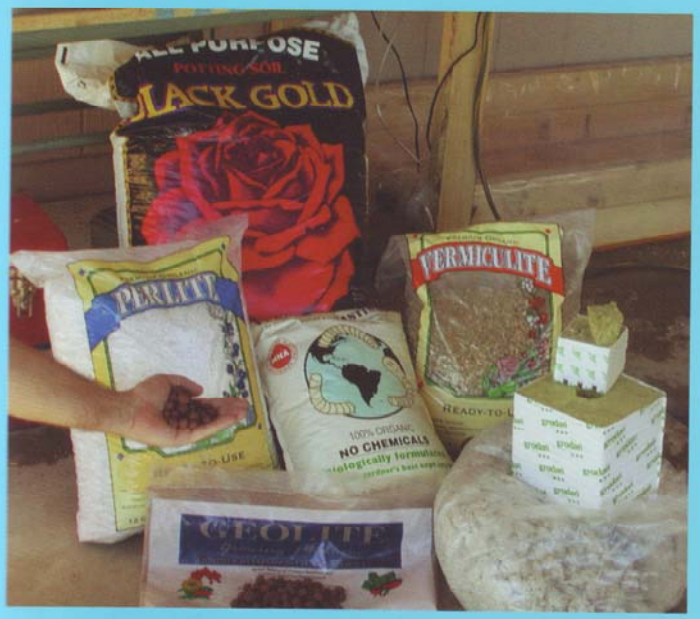


Transplanting materials.

Transplanting into larger container.

Ready to transplant.

TRANSPLANTING



Soil and soil substitutes

Individual grow units
Photo ©Crop King

Additional materials.

Individual small grow unit.
Photo ©Crop King

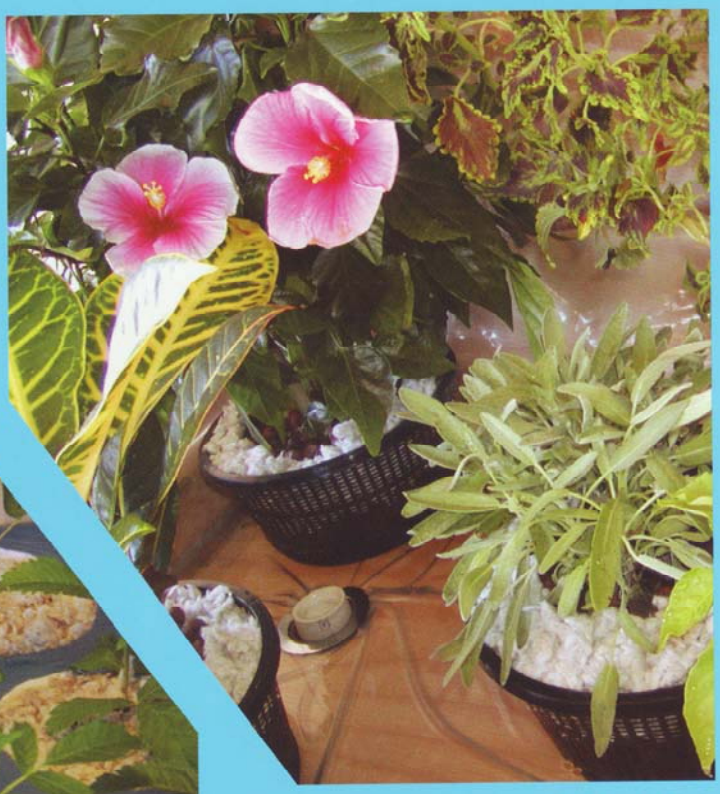
Homemade Ebb and Flow System.

MATERIALS

Clones in lava rock and rockwool.

Water entering grow bed.

Dual root system.



Water exits grow bed through tube in lower left corner.

Grow bed with cover to keep out light, dust, etc.

Rooted clones just placed in pre-blooming area.

Ready to bloom.

Ready to go into the blooming room.

A variety of houseplants fully rooted.

Arizona Yellowbell.

PREBLOOMERS

Plants may be grown to any stage, then sold or used for personal use.

A variety of plants may be bloomed in the same grow bed.

Different stages of growth use different types of fertilizers.

Commercial tomato set-up using Rockwool as a medium and bumblebees to assist pollination.

COMMERCIAL

Photo ©Crop King

This could be you!

Photo ©Crop King

This could be you!

Chapter 9 - Cloning

After the seedlings have been in the pre-blooming area for about 2 weeks, they should have reached a height of 12" to 14", and may be ready to have their gender determined. Determining gender will allow you to decide which seedling you wish to make into a mother plant.

Some species are monoecious which means having both male and female gender on the same plant. For example, tomatoes have the same sex on each flower, and are therefore self-pollinating. These plants do not need to have their gender determined. If you are growing these types of plants, they are simply grown from seed until they reach the size when they may be used for mother plants.

Other plants may be dioecious and have separate male and female plants. If you want to only grow the female plant of a dioecious "short day" species, then you will need to clone the seedlings and determine their gender. The cloning process is quite simple.

Preparation

The first step in cloning is to gather all the proper tools and materials needed for the cloning area:

1. Sharp razor blade, or similar tool
2. A 12" x 24" rooting tray or similar shallow dish
3. Cloning solution, such as Dip N' Gro, or organic rooting compound
4. Plant starter, such as Ortho "Up-Start with Vitamin B1", or organic plant starter
5. Medium of choice, such as rockwool cubes, lava rock, perlite/vermiculite mixture, loose rockwool, or coconut fiber
6. Hydroponic containers or peat moss cups
7. Horticultural heating pad(s), optional

Prior to cutting the clones, the medium should be placed in the cloning tray. The tray should be filled about halfway with distilled water, and the proper amount of B1 starter should be added to the water. The pH should be set at 6.3. Horticultural heating pads may be placed under the cloning trays to further enhance root development; heated water is very conducive to root growth.

The cloning process is quite simple.

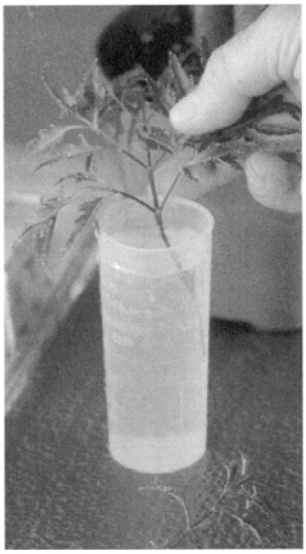
Cutting the Clones

Cutting the clone using a sharp, clean razor blade.

Now you are ready to clone from each 12" to 14" parent seedling. The clones should be cut from the parent's nodes - the place on the plant where the main stem, leaf, and lateral branches come together to form an axis. The spaces between the nodes are called internodes. There will be anywhere from 4 to 8 nodes on the parent seedlings.

Ideally, a clone is about 4" in size. The razor blade is used to make a 45 degree cut about 4" from the top of the plant. Making the cut just above a node will create a clone with a small portion remaining that will act as its stem. Immediately after cutting the clone, place it in the cloning liquid for about 10 to 30 seconds, depending on your desire for penetration of the liquid. The clone is then placed immediately into the rooting tray.

The clone and its parent plant should be identically marked for future identification. The clones are then moved into the blooming area.



The clone is immediately placed in the cloning solution.

Parent Plant Care

Once a clone has been taken from each parent seedling, the parent seedlings are placed back into the hydroponic pre-blooming area under the 400-watt metal halide light on an 18 hour per day light schedule. A light rail over the parent seedlings moves the metal halide to create a phototrophic environment for the plants. The plants will turn in order to follow the light source. When this happens, the movement of the plant causes additional cellular growth in the plant and creates stronger stems that can support larger and more abundant buds, flowers, and fruits.

In the blooming area, the temperature levels of the reservoir should be maintained between 65° F and 76° F. Never allow the water temperature in the reservoir to exceed 80-85° F because this will foster organic growths that consume nutrients and upset the standard pH. When the water in the reservoir is changed remember to add water that is tepid (not below 65° F).

The reservoir holding the parent seedlings will need its pH checked daily, and adjusted, if necessary. The room temperature should be kept at around 76° F - always a few degrees above the temperature of the water in the reservoir to avoid excess evaporation. The water in the reservoir continues to be changed once every week.

The parent seedlings sit in the pre-blooming area for approximately 2 weeks while they increase in size and develop 2 top growing terminals. After a week has passed, pinch the tip of the 2 topmost growing terminals; this will create a 4-headed (4-terminal) plant.

Parent plant care.

Clone Care

Use distilled water in clone reservoir.

The clones in the cloning trays sit in the blooming area and are tended every day on the same schedule as the parent seedling. All environmental systems in the blooming area are in full operation. The pH is checked once a day and adjustments are made to maintain a level of 6.3. The fluorescent light that was used for the seedlings is temporarily placed in the blooming area for these clones, and is set to provide only 12 hours of light each day. The water in the tray is changed weekly. If there is difficulty maintaining the proper pH, then the water should be changed once every 3 days. Spray misting the cloned plants a few times a day with distilled, sodium free, tepid water will invigorate them.

The parent seedlings and the clones continue to grow for about 2 weeks in their respective environments. After about 2 weeks, the clones will have grown a few inches and developed some foliage and tiny root systems. Most important, the tips of the clones will begin to show gender.

If the clones receive 18 hours per day of light like the parent seedlings, the clone will continue to grow in the vegetative state. However, if the light period is lowered to a 12 hour per day light schedule, then the clone will switch to the blooming or flowering state. If your dioecious plants are "short day" photoperiodic, they will leave the vegetative state and enter into the blooming state, which makes gender identification possible.

Assorted clones.

Chapter 10 - Gender Identification

Identifying gender is very important because it is usually the female plant that produces the highly prized buds and flowers. To accomplish this, you must be able to tell the two sexes apart. This is true especially for certain herbs and medicinal plants.

Females

Upon close observation with a hand-held magnifying lens or loop, you will see on some plants - just at the nodes and the tip of the growing terminal - a small, bud-shaped growth. At first glance, these growths all look the same, but upon closer observation, different characteristics may be noticed on certain plants. Some of the small, bud-shaped growths, known as bracts, have a more elongated shape than the others. The more elongated growth has two, sometimes more, tiny white or yellowish hairs, known as pistils, protruding from them. The bracts form in small clusters with their pistils soon becoming the most prominent visual feature. If any of your clones display these characteristics, then you may assume that both the clone, and the parent seedling from which the clone was cut, are female. Label both the clone and its parent as female and as parent-clone.

Female "Pistils".

Males

Under a magnifying glass, some of the clones exhibit growth that do not have the more elongated shape or the tiny little hairs growing out of them. Instead, the clones have more bulbous, nut-shaped growths that cluster in tight groups like grapes growing on small stalks. These characterize male plants. Again, label both the clone and its parent as related-male. If only female plants are desired, the male clone is discarded as well as the parent seedling from which it was cut.

Bulbous nut-shaped growths.

Hermaphrodites

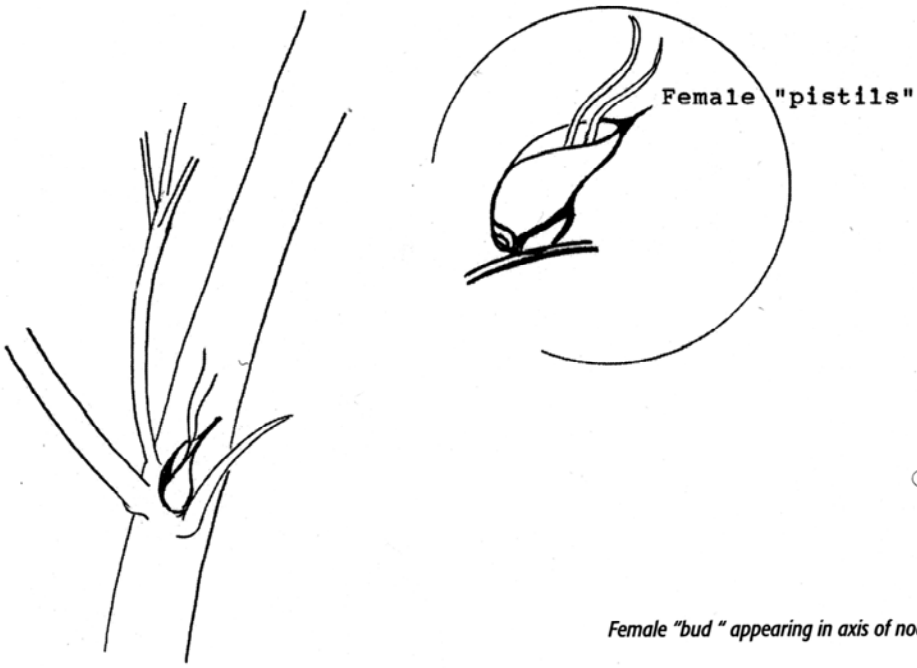
It is sometimes difficult to determine the gender of some dioecious plants because the traits of both sexes are present. If your single sex dioecious plant displays both sexes, the plant and its clones should be immediately removed from the growing area.

Mother Plants

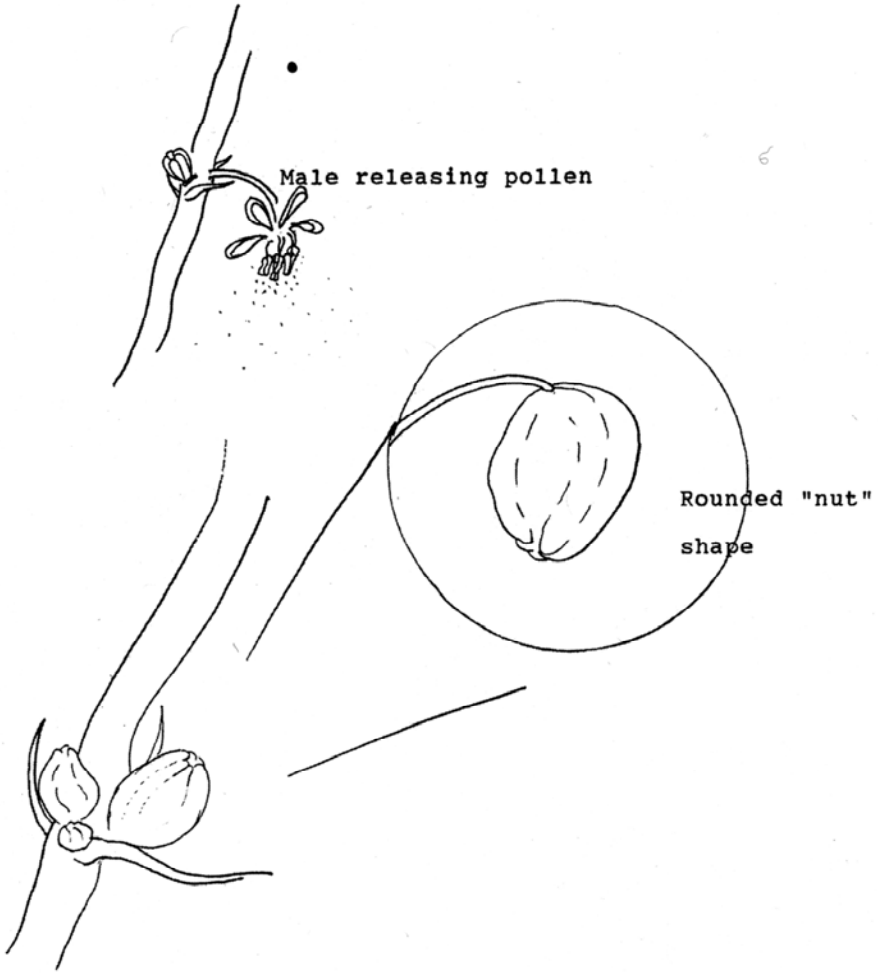
After the gender of all the clones and parents plants has been determined, the production of a never-ending supply of clones, pre-bloomers, matured plants and/or buds may begin. The cloning tray used for determining gender in the blooming area is temporarily dismantled. The light, trays, heating pad, and other tools are returned to the cloning area for future use.

Keep the amount of mother plants for your required amount of clones. The healthiest looking, fastest growing plants that exhibit the characteristics you desire should be selected to be the mother plants. For every 5 to 10 clones desired, one mother plant is kept. All other parent seedling plants must be removed from the pre-blooming area.

Once the mother plants have been selected and have grown to the size where they are able to produce as many clones as you need every 2 weeks, the cloning begins again. In a typical garden, the clones produced by two mother plants fill a full 12" x 24" cloning tray with new clones every 2 weeks, amounting to 5-10 clones from each plant for a total of 10 to 20 clones. Every 2 weeks, the best 15 or so of the clones are then chosen for maturing or pre-blooming. They may be used at this stage of growth for commercial or personal use. If you wish, every 2 weeks after that, the best 10 or so of the pre-bloomers may be placed into the blooming area to be bloomed or matured further.



Female "bud " appearing in axis of node.



Chapter 11 - "Bugs"

As an observant gardener, you should always be on the lookout for signs of bugs on your plant or soil surfaces. There are several visible signs that indicate bugs have found your plants: yellowish "spots" on the underside of the leaves, which are actually bite marks; web, or threadlike substances; yellowish secretions; or the offending insect itself. It is difficult for any bug to be around very long before being spotted if you regularly use your magnifying glass to check your plants from top to bottom.

As a thoughtful grower, you should only use 100% Pyrethrums as a defense against bugs. Pyrethrums are organic, derived from the chrysanthemum plant, and become inert within about 8 hours after use. Therefore, a tomato disinfected with pyrethrums may be eaten the same day it was treated. Follow the directions on the pyrethrum containers for proper dosage, application, and storage. Use the pyrethrum once, then wait 7 days; apply again, then wait another 7 days, and then use a final time.

Please do not use chemical poisons on your plants!

Bumble bees help pollinate tomatoes.

Safety

You should always have a suitable-sized fire extinguisher just outside the grow area. A garden hose within usable reach is also advisable. Never arrange any electrical devices in the grow area which are not up to code; never take a safe, three-pronged electrical cord and cut off one of the prongs which plugs into the outlet; never use extension cords that do not have their own built-in circuit breakers; never overload the circuits; and only use heavy-duty timers. If you are not 100% sure about how to set up the electrical devices used in your grow area, obtain a book on wiring, or consult someone who does. Since there are a lot of electrical components involved in hydroponic growing, you must take into serious consideration the safety of the grow area.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Chapter 12 - Daily Schedule in the Demonstration Garden

As a totally organic hydroponic gardener, you are required to do many things before the actual "fun" part of the process begins: design and build the grow area; learn how to properly use the materials and equipment; and establish a healthy colony of mother plants. From this point on, you will follow a routine that involves a variety of important tasks that must be done on a daily, twice weekly, and weekly basis. Once you have established your routine, the growing operation will become an almost effortless and pleasurable experience!

In an effort to make the first part of the book as understandable as possible, I will lead you through a demonstration garden. Following this simple schedule provides you with a hands-on guide to the entire totally organic hydroponic growing process.

Timing

Whether you are growing clones, small plants, mature budding or fruiting plants, the process is still the same. You are able to set your own harvest schedule, and at what stage of maturity you wish to utilize your products. You will find that once a week, every 2 weeks, or once every 3 weeks are the most common schedules. Let's examine the hypothetical growing schedules of two totally organic hydroponic growers, Erin and Karen.

Erin had a small grow room. Her cloning area was 8′ x 3′. Her blooming area was 8′ x 4′, and could hold a maximum of 40 plants. She had 2 mother plants from which she cut 5 clones every week. After 3 weeks, she had 30 clones with well-developed roots. After the first 10 clones rooted, she transplanted the best 5 into the larger hydroponic containers, and placed them in the pre-blooming grow bed. A week later, she placed 5 more into the pre-blooming area. After 2 weeks the first clones in the pre-blooming grow bed had grown to 12″ to 14″ and were ready to go into the blooming area. Since she cloned every week and transplanted clones every week into the pre-blooming area, she was able to place 5 pre-bloomers into the blooming area once a week. It was not long before the 5 plants that only needed 8 weeks to totally mature were soon harvesting once a week.

Set your own schedule.

Then there was Karen. Her grow areas were exactly the same size as Erin's, but her schedule was different. Her plants also matured in only 8 weeks, however, her plants only needed 2 weeks to develop nice roots. Karen cut about 10 clones from each mother plant every 2 weeks. Then every 2 weeks, she took only the best of the 20 clones and transplanted 10 to 15 of them into the hydroponic pre-blooming area. Every 2 weeks thereafter, she moved 10 of the best 14" pre-bloomers to the hydroponic growing area in her greenhouse. Soon she was producing 10 healthy, genetically identical mega plants once every 14 days that could be sold commercially, or grown to produce fruit, such as tomatoes, for sale or personal use.

What these two hypothetical growing schedules illustrate are the two main factors that determine the number of clones that may be taken and when: 1) The time it takes the clones to root; and 2) The time it takes a certain variety of plant to fully mature or bloom. The exact timing of any individual first crop will have to be flexible to take into consideration these unknown factors. Once the initial crop has been established, and the crop is on perpetual harvest, all the timing factors will be set. Then, and only then, will you be able to establish your particular schedule of cloning, transplanting, and maturing or blooming the harvest.

The demonstration model for the ongoing narrative illustrates a growing schedule that has the clones rooting in 2 weeks, and the variety of plants fully maturing or blooming in 8 weeks after exposure to the reduced rate of 12 hours per day HPS light.

In this model, the grow beds are lined with 4 mm to 6 mm of clear plastic, allowing you to see if there are any leaks in the plastic. The plastic should be occasionally cleaned with a cap of bleach in a gallon of water. If the plastic becomes soiled with any salt build-up, simply change the plastic covering.

If you wish to purchase a hydroponic Ebb and Flow set up, the process will remain the same. There are a number of companies that sell different types and sizes over the Internet or at your local hydroponics store.

Grow any type of plant you wish.

Day 1 - First Set of Clones

Once the mother plants are developed enough to produce the required amount of clones, cut your first set of clones. The clones are placed into the 12" x 24" rooting trays, and the optional heating pads are turned on under the trays. Adjust the aquarium air pump so that a moderate amount of air bubbles are made by the bubbling wand. You may clone into rockwool, lava rock, or my perlite/vermiculite/potting soil medium, or some entirely different medium. You may also float Styrofoam slabs with small holes cut into them through which the clones are placed with the cut bottom of the stem resting in the water of the cloning tray and the top vegetative part of the clone sitting just above the top of the Styrofoam. Distilled water is best for the clone reservoir, but is not required.

When all the clones have been placed in the cloning tray, the condition of the water is set. Add only B1 or Plant Starter as the nutrients to the cloning tray. Take a pH reading, and make adjustments until the optimum 6.3 level is reached. Set and maintain the water temperature between 65° F to 76° F, a few degrees cooler than the ambient temperature. Add water daily as needed. After a while, you will notice any deviation of the clones' normal progressive nature and growth patterns.

When the mother plants are cloned, they should not simply be placed under the light again. The mother plant has experienced some trauma, and will need extra care. Give the stressed mother plant a Nitrogen (vegetative) feeding of any organic nutrient mixed with a $^1/_2$ cup to 1 cup of water as the delivery mechanism. Organic powders, such as bat and seabird guano, and worm castings may be applied to the top of the mother plants' medium, or mixed into the top 2" of the medium. Whether on top of the medium or mixed into the medium, the powdered nutrient should be moistened with a small mister to assist the introduction of the nutrient into the rest of the medium.

After the first week, water the mother plants using the reservoir, and administer weak solutions of low nitrogen feeding to the top of the medium as you would an ordinary plant in soil using water as a delivery system. The mother plant needs the nitrogen to stimulate its vegetative growth just after cloning. Small feedings every 3 days are better than large feedings every week.

For the next 6 days, the mother plants and clones are tended to daily and all environmental conditions are maintained. At this point, the pre-blooming area is empty.

Semi-Organic

If you are using the semi-organic method, do not use the soil mixture for the clones. Instead use any standard hydroponic medium.

Cloning tray pH is kept at 6.3.

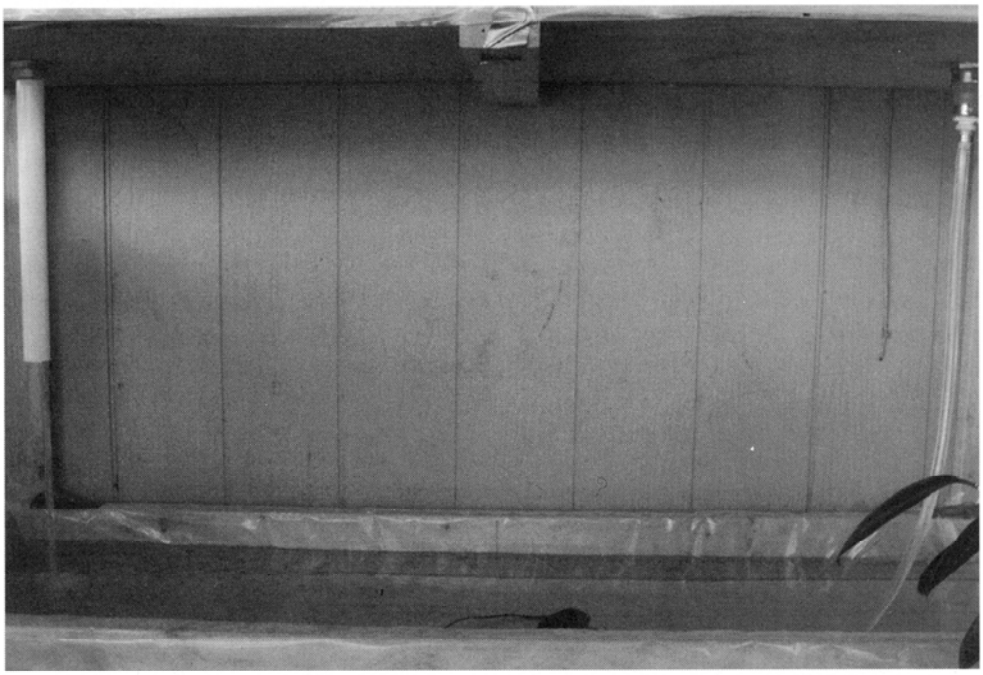
Day 7

After the clones have been in the cloning area for 7 days, it is time to change the cloning water. Remember, the plants should not be shocked with cold water, so maintain the temperature to which the clones are accustomed, between 65-75° F. Exchange the used cloning tray for a new one. The air delivery wand and delivery tube are washed off with a 1% solution of common bleach and water - one capful in a gallon of water. The water temperature gauge is also cleaned. The new water is again chemically balanced to the pH of 6.3.

When the clones are growing under the fluorescent light, it is hung about 1" to 2" above the tops of the plants. When the metal halide is the lighting source, make sure the tops of the clones are at least 4' from the bottom of the halide when it is stationary. If the halide is moving on a rail, it should be kept at least 3' from the clones.

The mother plant is placed on the low nitrogen feeding schedule, and watered from the lower water reservoir in a separate grow bed. The top of the mother plant is kept at least 24" to 36" from the top of the metal halide if it is stationary; if the light is moving, it may be as close as 18" to 24" to the tops of the mother plants. It is better to start a light further away from a plant and every few days move the light a little closer.

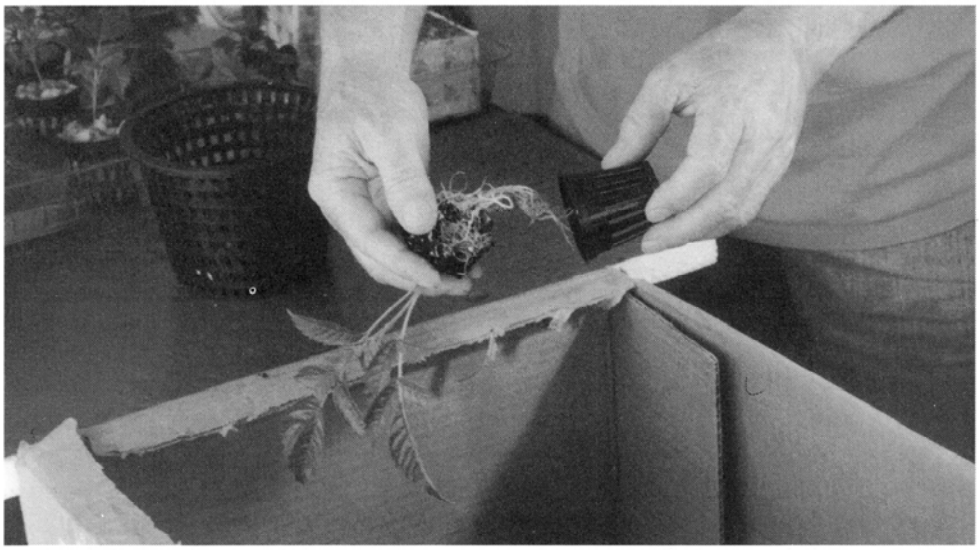
A properly pruned plant looks like a flat-topped hedge with the various tops approximately the same distance from the light source, trimmed as you would a "bonsai."



Reservoir water return pipe (left) and water delivery hose (right).

Day 14

After 14 days, most of your clones have developed healthy, small root systems while growing in the cloning trays. The fresh water in the pre-blooming reservoir is turned on to circulate into the pre-blooming grow bed. The first set of rooted clones is transplanted into the larger hydroponic containers using whatever medium you wish. Remember the container is created to utilize a dual root system with the bottom half of the container filled with the lava rock and the upper portion filled with the medium of choice.



Transplanting clone into larger container.

The water in the pre-blooming grow bed is set to the top of the lava rock in the grow container, and scheduled to cycle once every 4 to 8 hours for a period of 30 minutes. The second controller on the aquarium air pump is adjusted so air is released into the bubbling wand placed at the bottom of the pre-blooming water reservoir.

The pH is checked. If the reservoir needs the pH adjusted, use the correct amount of "pH up" or "pH down" product to adjust the pH to a level of 6.3.

Administer the recommended amount of nutrient food to the plants. Remember to use organic nutrients that have a greater concentration of nitrogen in the ingredients for the pre-bloomers and mother plants.

After the clones are moved to the pre-blooming area, the cloning area is temporarily empty. Each time the rooted clones are transplanted into larger containers and moved to the pre-blooming area, more clones are required to replace them. Therefore, your second task of the day is cloning. Clone each mother plant 10 times, creating 20 new clones. The clones are placed in fresh, clean trays, and the pH is properly adjusted.

Dual root system container.

The mother plants begin their high nitrogen diet, essential for their vegetative growth as they re-grow new clones for the next cloning in 2 weeks. A high nitrogen diet for the next week will create lush new vegetative growth, and should be given in small doses every 3-4 days.

The clones, pre-bloomers, and mother plants are monitored as the week goes by. The pH is determined daily in each reservoir and all environmental requirements are monitored to keep them within their proper parameters. Each plant is observed every day and notes are made. Observation is a key element to success with all beginning crops. Expert gardeners begin by getting a feel for the plants and the process.

The upper grow bed is flooded.

Semi-Organic

If you are using semi-organic nutrients in the reservoir, you should add them after the first 10 plants are placed in the pre-blooming grow bed. Apply only enough nutrients to maintain a 600 PPM level the first few days. Once you are able to maintain that level, then increase the level to 900 PPM for another few days. Then maintain a level of 1700 to 1800 PPM in the reservoir. With only 10 plants in the grow bed, the nutrient level should remain fairly steady.

Hydroponic containers are filled to the top with the hydroponic medium of your choice. The water is raised to the level of the tops of the medium in the hydroponic containers. Flooding the upper grow bed once every 4 to 8 hours will maintain the proper moisture content within the root structure.

The pH is tested after the nutrients have cycled through the plants at least once. It is adjusted to 6.3 just prior to "lights out" time, and again first thing after "lights on" time after nutrient PPM adjustments have been made.

Do not use the soil mixture for the pre-blooming plants if you are using the semi-organic nutrient method. The soil will get into the water.

At this time the 14 day old rooted plants may be used at this time, for personal or commercial use, or continued to mature.

Day 21

Your tasks on the 21st day are not as detailed as the previous week because of the two-week grow schedule. On the 21st day, change the clone water, even if it is adequate. New trays should be filled with fresh water, and the water thermometer and bubble items should be cleaned. The pH level is checked and adjusted if needed.

The same cleaning routine is undertaken in the pre-blooming bed. The water is changed, and the reservoir and grow bed are cleaned, including the water thermometer, bubbling wand, and air hose. Fresh water is placed in the reservoir and circulated. As always, the pH is maintained. If a homemade grow bed and reservoir are being used, the clear plastic lining is employed to allow visual examination of the underside of the plastic for holes; replace if necessary.

The mother plants are once again started on their low nitrogen diet in preparation for another cloning. A spray misting of tepid water several times a day will further refresh the mother plants. They are watered using the lower water reservoir and fed by applying nutrients on top of the medium using water as a delivery system, or by placing the nutrients directly on top of the upper medium. If the nutrients are placed on top of the medium, lightly mist with a garden sprayer to soak the nutrients into the upper medium at a consistent rate.

The nutrients are applied to the top medium as if the plants were in soil. However, the medium encourages the nutrients to be utilized at a much faster rate because the man-made upper medium is more porous than ordinary soil creating a medium with the ability to "breathe." As water evaporates from the porous medium, it draws oxygen into the medium, increasing the plant's metabolism and use of nutrients. The roots in the lower hydroponic part of the container will have an increased oxygen input because they are exposed to a tremendous amount of oxygen between grow bed watering.

Upper medium more porous than ordinary soil.

Between major jobs clean and conduct standard maintenance. Feel the inside liner of your grow and reservoir beds. If the surface feels slimy, change the plastic liner. Keep the floors clean, and have a storage place for all materials used. Rinsing and cleaning your gardening tools will keep bugs and infections from spreading.

The underside of the leaves should be checked for pests. If any plants are infected, remove them from the area and apply pyrethrum. Keep the infected plants away from your other plants until you are sure they are completely clean and free of pests.

Semi-Organic

Check the PPM of the reservoir as soon as the lights are turned on each day. After checking the PPM, check and adjust the pH. Empty the reservoir and replace with clean water if you have any trouble keeping the nutrient level or pH steady. If the PPM is getting too high, change the water but do not apply any nutrients for at least 24 hours. Check your plants daily for nutrient burning; if none is noticed within a few days, start feeding the plants again. Start with a 600 PPM for a few days and work you way back up to the 1700 to 1800 PPM range.

If you have trouble adjusting the pH, it is not as critical as the PPM. Drain the reservoir, refill it, and then apply 600 PPM of nutrients and attempt to maintain the correct pH. Change the nutrient pre-blooming reservoir once a week until you can maintain a constant PPM and pH. Once you can maintain these two factors precisely, you then need to drain the reservoir only once every 10 to 14 days.

The plants may be used at this stage for commercial or personal use, or you may continue to mature them.

Semi-organic hydro setup. *Photo ©Crop King*

Day 28

The first clones, which were placed in the pre-blooming area 2 weeks earlier, are now 12" to 14" high, and are ready to go into the blooming area. Begin all environmental requirements located in or associated with the blooming area: air exhaust, temperature, HPS lighting and the oscillating fans. Fill the water reservoir and turn on the water pump. Check for water leaks. Take only the best 10 plants from the pre-blooming area, and place them in the prime blooming area. Set the water pH to 6.3.

Rooted clones.

Give the blooming plants their first feeding. Spray mist the tops of the upper medium if any dry nutrients are added. This will help to start the capillary action in the container as well as conduct the dry nutrients into the lower part of the upper medium.

It is a good idea to prune the lower, small leaves and branches off of the blooming plants once they enter the blooming area so the plants don't waste energy growing these lower branches.

400 watt lights on moving rails should be placed about 1' above the tops of the blooming plants. Stationary 400 watt lights will need to hang about 2' above the tops of the plants. A 1000 watt light should be kept about 2' above the tops of the plants. Initially place the lights slightly higher than suggested so you do not burn your plants. Lower the lights only a few inches at a time once a day, then watch for any signs of burning. You want your lights as close as possible, but not so close that they burn.

Oscillating fans blowing gently across the tops of the blooming plants will help make them strong. An oscillating fan on the roof of the blooming room, aimed downward, will mix the warmer rising air with the lower cooler air to create a more even room temperature.

The difference in the nutrient solutions is very important so remember to feed the vegetative formula in the cloning area, and the blooming formula in the blooming area.

After the pre-bloomers are moved to the blooming area, the clones that have developed roots are ready to be transplanted into the now empty pre-blooming area. Thoroughly clean the pre-blooming area before transplanting the new clones: the grow bed, the reservoir, and all associated materials and devices. Fresh water is placed in the water reservoir, and the newly rooted clones are transplanted into the clean pre-blooming area. The pH of the water should be set at 6.3.

A new tray is filled with water and receives the new clones cut from the mother plant. The pH is balanced.

Spray mist the tops of the upper clones daily.

Again, the mother plant is placed on the high nitrogen feeding schedule. The plants are tended daily paying special attention to the pH levels as well as the plants' appearance to determine if they are over or underfed. Since the metabolism of the plants is so high, they must be visually monitored for nutrient requirements.

Semi-Organic

Flood the blooming grow bed to the level it will require to moisten the entire medium within a few minutes of beginning the watering. First feed with a 600 PPM solution. Then raise the PPM to 900 after a few days, then again until you finally reach 1700 to 1800 PPM. Check and adjust the PPM first, then adjust the pH to the 6.3 standard. There should not be any reason to make large adjustments in the nutrient levels because with only 10 plants in the blooming area, only a small amount of the nutrients will be utilized by the plants.

Maintain a steady PPM and pH. This is one of the main keys to a successful hydroponics crop when the nutrients are applied to the reservoir. The reservoir water is changed weekly until you gain full control of the PPM and pH levels.

The plants should be a healthy, green color. If you notice the plants turning a darker shade of green, and the PPM is near 1700, do not fertilize again until the PPM drops. Rapid greening of the leaves' tips which then turn downward are the first indicators you have too many nutrients in your reservoir. If this happens, empty the reservoir and refill it with clean, non-nutrient water. Wait a few days until the deep green color of the leaves begins to lighten; then re-apply nutrients starting once again at the 600 PPM level.

The pre-blooming grow bed now has 20 plants in it so the nutrient uptake will be doubled. Attentively monitor the nutrient level and make only one adjustment daily. If there is any indication of burning, replace the water with clean non-nutrient water and watch your plants for a few days before adding more nutrients. Always adjust the pH to 6.3 after the PPM is adjusted.

If you want to use the plants at this stage for commercial or personal use, you may do so or you may mature them some more.

Semi-organic PPM set between 1700 and 1800.

Day 35

By the 35th day, the schedule is routine and consists mostly of watering and maintenance. The grow area and equipment are cleaned, and new water is added to the cloning reservoir. The proper pH of the fresh water is checked.

The water in the pre-blooming reservoir is changed and all associated parts are cleaned. The reservoir is replenished, and the water is re-circulated. The pH is properly adjusted. The plants are fed nutrients on a standard basis until a rich green color is achieved, also an indicator of a healthy, yet accelerated growth rate. Monitor both the color and growth rates and apply nutrients as needed.

The water reservoir is changed and cleaned in the blooming area. The new water is balanced with the proper pH of 6.3. Feed the blooming plants as many nutrients as they will use by monitoring their growth rates and rich green color. This observation will become easier as time goes on and you become familiar with the nutrient requirements of your plants.

The mother plants are placed on the low nitrogen feeding. Remove any excess or crowded stems on the mother plant or pre-bloomers. The mother plant should retain just enough arms and branches to produce a few more clones than you will actually need. Also, the mother plant should be periodically pruned to a shape that is squat, rounded, flat topped and bushy with the non-pruned arms or branches evenly spaced. The mother plants' reservoir needs to be cleaned once every week or two.

Water entry device in upper reservoir.

Here is a trick you may like. Place 3 or 4 lava rocks, or my favorite, plain marbles, under the bottom of each rooting plant container. This will lift the bottom of the containers off the floor of the grow beds allowing additional roots to grow directly out the bottom of the hydroponic containers - increasing their rooting area by 20%!

Semi-Organic

Change the reservoir of the pre-blooming area as well as the blooming area at least once every 10 to 14 days, even if it does not seem to need changing. Look for leaks and change the plastic liner if is has any slimy feel to its sides or bottom. There are also chemicals you may purchase that will help eliminate micro-organisms from growing in the grow beds and reservoirs.

Cover the top of the grow bed with some lightweight material, such as Styrofoam, to keep out light and pests. The lower reservoir may also be covered with Styrofoam, with a hole cut into the top to allow the grow bed return water pipe to fit into it. Another small hole is cut in the top to allow the water pump hose to go through the Styrofoam and up to the grow bed. The less outside light and organisms entering the reservoir and grow bed will make it easier for you maintain the pH and PPM.

If you want to use the plants at this stage of maturity for commercial or personal use, you may, or you may continue to mature them.

Semi-organic commercial bagged nutrients.

Day 42

On this day, the second set of 10 plants is placed in the blooming area. The blooming area will now be holding 20 plants, and will be half full. Before adding the 10 plants, empty the water in the blooming reservoir, and clean the grow bed and the reservoir. Then cycle fresh water through the blooming system, and adjust the pH to 6.3.

Place the plants in the blooming area. A Styrofoam top is then placed on both the upper grow bed and the lower reservoir. Holes are cut in the top of the grow bed's Styrofoam so all the plants may be tended while preventing bugs and light from entering the grow bed.

The emptied pre-blooming area should be purged of the old water. The area is cleaned and new water is cycled into the system. Newly rooted clones are placed in the pre-blooming area in their larger containers. The pH is properly adjusted.

The cloning area is now cleared of plants. Replace the cloning tray with a clean tray filled with fresh water.

The mother plants are cloned and the cloning tray is filled with the fresh cut clones. The water in the cloning tray is set at a pH level of 6.3, and the bubbling wand is turned on. The mother plants are fed a little more nitrogen.

Semi-Organic

Whenever the reservoirs are changed, do not apply all of the nutrients at once to reach the 1800 PPM. Apply only enough nutrients in the water to create a 900 PPM level of nutrients. Once you have reached the 900 PPM level, incrementally increase the PPM to 1800.

Remember to give the pre-bloomers and mother plants their vegetative and micro feeding, and the bloomers their blooming and micro feeding.

If you want to utilize the plants at this stage of maturity, you may do so, or continue to mature them.

Pre-bloomers ready to go into the blooming area.

Day 49

This is the day you change the water in all of the reservoirs and clean the grow areas. If you feel that you have mastered the maintenance of the pH levels in the water reservoir, you may leave the water in all of the reservoirs except the cloning reservoir for one more week. If the plants in any of the grow beds show any adverse effects, such as difficulty in maintaining pH or PPM, then change the water in that reservoir immediately and re-balance the pH.

Change all the reservoirs at least once every 2 weeks without exception. Clean the drain tube at least once a month and replace the water pump tubing at least once every few months. It is not necessary to place nutrients in the cloning water.

Feed the plants in the pre-blooming and blooming grow beds on a schedule of small feedings throughout the week once every 3 to 4 days, rather than once a week or once every two weeks, even though weekly feeding may be the recommended schedule on any package or container of nutrients you may purchase. Small feedings every few days will deliver a more consistent level of nutrients to the plants.

Increase the nutrient applications to the blooming plants the longer they remain in the blooming area. A larger plant blooming for 4 weeks will be using more nutrients than a smaller plant blooming only for a week. Study the small changes in color and growth rate of the plants during the few days after feeding. Observing the plants will provide you with invaluable knowledge: You will soon be able to predict the relative progression of growth factors with each feeding.

Increase the feeding schedule of larger plants with more nutrients. However, you should still distribute the larger amount of nutrients as a few, smaller feedings every 3 to 4 days.

Mentally note whenever the HPS and metal halide lights are in use and you have a water sprayer or hose in your hand. A drop of water hitting a bulb will cause it to explode! If this happens, turn off the lights immediately and leave the room until the air is evacuated. Sheets of heat resistant glass shields are sold with HID lights. They should be cleaned once every few weeks. Never touch a bulb while it is on; a bulb must be cool before it is tended to.

Commercial nutrient mixing and delivery systems.

Semi-Organic

Continuing to grow pre-bloomers for 3 weeks instead of 2 weeks is an option for larger growth. If the pre-bloomers are grown for 3 weeks they will be about 1/3 larger than standard, and may still be bloomed for the same period of time.

Apply nutrients daily as needed to maintain the pre-blooming grow reservoir at the 1800 PPM level. Spraying the leaves with trace element nutrients is one way to provide a full spectrum of trace elements to the plants. Lightly misting the plants a few times daily will help them stay healthy and clean.

Additives, such as Super Thrive©, may be added to the blooming as well as pre-blooming reservoirs to stimulate the growth of the plants. Using a catalyst in the blooming water will add essential enzymes, hormones, amino acids, and vitamins for the plants. Take a look at some of the hydroponic "organic" nutrients and associated chemicals in either your local hydroponics store or on the Internet; then decide which ones best suit your needs.

The plants may be used at this stage of maturity for commercial or personal use, or they may continue to mature.

Three stages of pre-blooming growth.

Day 56

On this day, the water is emptied from the blooming reservoir. The area is cleaned and the water is replaced with pH-balanced water. Cleaning the blooming reservoir is a simple matter of draining it and wiping it down with a bleach solution (one capful to 1 gallon of water), or by replacing the plastic lining. To clean the grow bed, place the plants in the empty reservoir, remove the Styrofoam cover, and wipe or replace the grow bed lining.

The next set of pre-bloomers is moved from the cloning room into the blooming area that now holds 30 plants. It is a good idea to prune the lower, small leaves and branches off of the blooming plants once they enter the blooming area so the plants don't waste energy growing these lower branches. Notice that the first set of plants placed in the blooming area, which are now the largest of the blooming plants, demand more nutrients in order to sustain a deep, healthy green color and their robust growth.

Overflow tube returns water to reservoir.

The pre-blooming area, now void of plants, has its reservoir drained and the entire area cleaned. Fresh water is returned to the reservoir and the pH is balanced to the proper reading. Place the newly rooted clones into the pre-blooming area. Give the new pre-bloomers their first feeding. By now you should know exactly the amounts of each nutrient that constitute a complete feeding for your pre-bloomers. They should receive about 5 small feedings during the 2 weeks they are in the pre-blooming area.

Clean a new clone tray and fill it with fresh water. Test and adjust the pH.

The mother plants are cloned and the newly cut clones are then placed in the cloning tray. Once the mother plants are cloned, their standard feeding is supplemented with a bit more nitrogen, and her reservoir is cleaned. The pH is balanced. Prune the mother plants of any stems growing too close together, as well as the interior stems, to prevent the plant from becoming too dense with foliage.

Heating the grow area in colder months is best accomplished using a propane heater during the "lights on" period, and an internal oil heater for the night or "lights out" time. The propane will supply daily heat as well as beneficial CO2. The internal oil heater is safest for the nighttime when the plants do not utilize CO2.

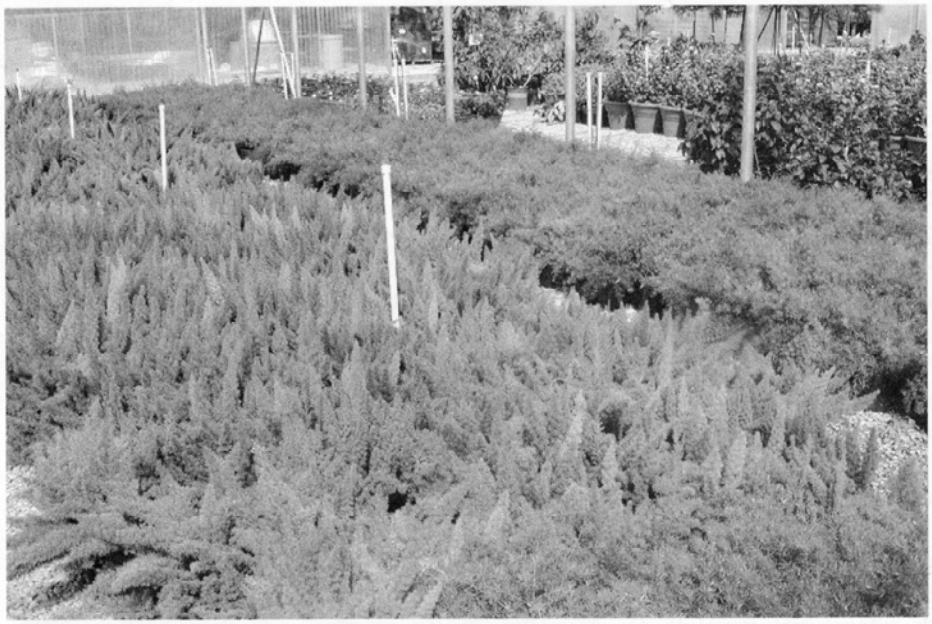
CO2 is used only during lights on time.

Semi-Organic

Check the PPM of the pre-blooming and blooming reservoirs soon after the daily light schedule begins. Adjust the pH after the PPM has been adjusted. Occasionally look at the root structure of the plants in both areas and at each stage of growth. Determine the standard growth of the roots for each separate area and stage.

When chemical semi-organic nutrients are added to the water, their component parts are used at different rates. Therefore, after a while the portions of nutrients not used by the plants will begin to accumulate. Adding more nutrients soon creates an unbalanced nutrient solution in the water. The PPM meter will only tell you how many parts per million of nutrients are in the water; the type of nutrients in the water are not indicated. This is one of the reasons that the reservoir water must be changed once every 2 weeks even if the PPM meter says you have a perfect PPM reading.

You may use the plants at this stage or continue to mature them.



Continue to mature your plants.

Day 63

If you have mastered the pH levels in all of the reservoirs for 2 weeks in a row, then, on this day, you will not need to change the water in them. If you are still changing the water every week in the reservoirs and applying fresh nutrients to the upper mediums, then this is the day you would do all of the tasks associated with the reservoirs.

All tasks should be routine at this point. Clean and tend to all details. I like to give my grow areas a preventative spraying of pyrethrum once a week to help keep bugs from even getting a foothold in the grow areas. Turn on the exhaust fans and start spraying the room nearest the fan, working your way to the exit. Leave the exhaust fan on for a few minutes to evacuate all excess spray.

Use a small, hand-held magnifying glass to help locate bugs or signs of bugs.

Semi Organic

Nutrients are used much faster as the blooming area fills and the blooming plants mature. Close observation of the nutrient uptake is necessary.

If a mother plant gets too large and you wish to replace it, pick your best pre-bloomer and begin trimming it to the shape and size you want it to be. Within another 30 days or so, it will be ready to begin making clones.

You may use the plants at this stage or you can continue to mature them.

Dual line fed watering. *Photo ©Crop King*

Day 70

Your schedule should be well established by now and fairly routine.

This is the day when all reservoirs should be drained and the areas cleaned. Refresh all of the reservoirs with fresh water and balance the pH. More clones will be taken and the mothers fed more nitrogen.

The fourth set of 10 pre-bloomers is placed into the blooming area that is now completely filled. The first plants placed in the blooming area, which have been there for about 6 weeks, are only about 2 weeks from being fully matured or bloomed.

For some plants, such as medicinal herbs, the resinous excretions of trichome glands are indicators of full maturity. Trichomes are specialized epidermal cells that are present in most plants. Trichomes contain volatile oils as well as other plant secretions that protect the plant from ultra violet sun rays and predators, and shelter against drying out. These plants should be matured to their fullest before you harvest the individual buds. For the best harvesting time, you should look for the following signs: a number of the pistils (tiny white hairs) have turned red; the buds are quite bulbous; and the numerous tiny, ball-tipped, stalked resin trichome glands, once translucent and clear, have glossed over and turned opaque. The final 7-14 days before you harvest, the plant should be given only water, and no nutrients, forcing the plant to use up any nutrients that may still be in present in the plant.

Semi-Organic

Blooming plants that will be harvested in 2 weeks should be placed in a separate reservoir without any nutrients for their last 2 weeks before blooming. This will force the plant to use up most of the stored chemicals and will result in a cleaner plant with less chemical content.

The plants may be used at this time or further matured.

Mother plants.

Day 84 - The Harvest

On this day, all standard operations will take place in the cloning area as well as in the blooming area. However, on this day you will be treated to the first harvest resulting from your meticulous care! Plants at this stage of maturity are ready for sale or personal use.

If you are growing herbs for medicinal use, the harvested plants should be hung upside down in a cool, dark, ventilated place. Since dampness may cause molds on drying plants, the drying room should be fairly dry as well. In regions with high humidity, use a fan to blow the moist air out of the drying area and to draw in drier air.

"This could be you." *Photo ©Crop King*

Closing

Hydroponics gardening is rapidly growing in popularity as well as changing in technique, evolving from the Ebb and Flow method to the Nutrient Film/Flow technique and Aeroponics. It was not too long ago that Semi-Organic Hydroponics arrived on the scene. And now, with Totally Organic Hydroponics, you can grow 100% organically!

The evolution to total organic hydroponics brings additional benefits to the entire world of hydroponics. The unique process eliminates the major problem of disposing of the chemically laden water after the water is used in the standard hydroponics system. It eliminates the reliance on the hard-to-dispose of rockwool. And the Totally Organic method permits the use of totally organic materials - from the mediums to the nutrients - throughout the seed to clone to harvest stages.

The organic nutrients placed in the upper soil portion of the container create roots that are allowed to develop microbial activity, while the lower roots intake water as they are specially designed to do. This development of a dual root system creates a hydroponics process that is more similar to the growing processes in Nature than any other hydroponics process thus far.

I hope you will enjoy this wonderful new way of gardening. While growing your plants to a certain stage of maturity for commercial or personal use, follow the simple instructions in Totally Organic Hydroponics, and you will be well on your way to becoming an expert organic hydroponic gardener.

Happy Gardening,
Paul

Growing Schedule

Days 1 - 7 _____

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Day 1 _____

_____

_____

Nutrients: _____

_____

_____

Water: _____

_____

_____

Lights: _____

_____

_____

Cloning and Transplanting: _____

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_____

Day 7 _____

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Nutrients: _____

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Water: _____

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Lights: _____

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Cloning and Transplanting: _____

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Growing Schedule

Days 14 - 21 _____

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Day 14 _____

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Nutrients: _____

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Water: _____

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Lights: _____

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Cloning and Transplanting: _____

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Day 21 _____

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Nutrients: _____

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Water: _____

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Lights: _____

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Cloning and Transplanting: _____

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Growing Schedule

Days 28 - 35 _____

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Day 28 _____

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Nutrients: _____

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Water: _____

_____

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Lights: _____

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Cloning and Transplanting: _____

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Day 35 _____

_____

Nutrients: _____

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Water: _____

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Lights: _____

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Cloning and Transplanting: _____

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Growing Schedule

Days 42 - 49

Day 42

Nutrients:

Water:

Lights:

Cloning and Transplanting:

Day 49

Nutrients:

Water:

Lights:

Cloning and Transplanting:

Growing Schedule

Days 56 - 63 _____

_____

Day 56 _____

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Nutrients: _____

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Water: _____

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Lights: _____

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Cloning and Transplanting: _____

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Day 63 _____

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Nutrients: _____

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Water: _____

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Lights: _____

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Cloning and Transplanting: _____

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Growing Schedule

Days 70 - 84 _____

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Day 70 _____

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Nutrients: _____

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Water: _____

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Lights: _____

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Cloning and Transplanting: _____

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Day 84 _____

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Nutrients: _____

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Water: _____

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Lights: _____

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Cloning and Transplanting: _____

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Equipment List

If you wish to build a small indoor ebb and flow, "sea of green" set up similar to the one pictured in the book, you will need certain materials.

Cloning Area

1. Plywood $^{1}/_{2}$ in. to 1 in. thickness for sides and bottoms of grow beds and reservoirs
2. Straight 2 in. by 4 in. boards for legs and frames of beds and reservoirs
3. Clear plastic sheeting with at least 4 to 8 mm thickness
4. Two standard sink fittings; one for draining the grow bed and one for water delivery to the grow bed
5. Small aquarium water pump, tubing and connectors
6. Overflow tube for draining grow bed
7. Nails, hammer, level, drill, saw, screwdrivers, duct tape and assorted hardware
8. Two bulb, 40 watt, fluorescent light and 400 watt to 600 watt Metal Halide
9. Small bathroom exhaust fan and oscillating fan
10. Rooting trays 12 in. by 24 in.
11. Hydroponic medium such as rockwool, lava rock, etc.
12. Potting soil, perlite, vermiculite, nitrogen abundant organic nutrients such as bat guano, worm castings, sea bird guano, sea weed extract as well as semi-organic nutrients for feeding non consumable plants etc.
13. Hydroponic containers, plastic screen, and all cloning materials mentioned earlier
14. Cloning solution, plant starter or B1 additive, pH meter, rooting tray heating pad, room thermometer and aquarium thermometer
15. Aquarium air pump with hose and bubble wands
16. Timers for regulating water, lights, and all other electrical
17. Hand water sprayer

Equipment List

Blooming Area

1. Plywood and boards to build frame, grow bed and reservoir.
2. Plastic for lining 4 mm to 8 mm thickness
3. Two standard sink fittings; one for draining the grow bed and one for water delivery to the grow bed
4. Small aquarium water pump, tubing and connectors
5. Overflow tube for draining blooming grow bed
6. High Pressure Sodium light fixture 400 watt to 1000 watt with light moving rail
7. Small bathroom exhaust fan and oscillating fan
8. Timers for regulating water, lights, and all other electrical
9. Organic and semi organic nutrients for blooming stages of plant life
10. Standard hydroponic mediums, containers, etc.
11. Heating or cooling capacity
12. Pyrethrum insecticide
13. Hand held magnifying glass
14. Watering can or container
15. Wiring simplified book
16. Only heavy duty extension cords which have their own internal circuit breaker
17. Fire extinguisher

Notes

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GLOSSARY

Acid - the lower part of the pH scale

Air - elemental gaseous particle carrying medium

Alkaline - the upper part of the pH scale

Aphid - small green, red, or black insect

Artificial light - man-made light which simulates the suns frequency

Back flow - the ability of a pump to allow water to flow back through the pump to drain

Bone meal - an organic nutrient foe flowering plants

Bonsai - pruning technique to create properly shaped plants

Branches - the lateral growth terminals at the nodes of plants

Bud - groups of seed bearing pods

Bugs - any number of insect infecting plants

Calcium - a secondary nutrient

Carbohydrate - chemical produced by plants, and needed for growth

Carbon Dioxide - CO 2 an essential ingredient for plants

Capillary - action which draws water upward

Clones - a part of a plant, which once removed from a parent plant is used to make another plant

Chlorophyll - what makes plants look green

Copper - a trace element

Cotolyden - first two rounded leaves which appear on the germinated embryo

Drain - the overflow tube in a grow bed

Dual root system - creation of two root systems on a single plant, one for water and one for nutrients

Ebb and Flow - hydroponic process created by flooding and draining water on the roots of plants

Electricity - energy which must be used with caution in a hydroponic situation

Epson salt - a source of hydrated magnesium and sulfate

Exhaust - to remove or exchange the air from an enclosed area

Female - the micro-pore receiving aspect of a plant

GLOSSARY

Fertilize - to feed nutrients to plants

Fertilizer - chemical or organic nutrients

Film Flow Technique - hydroponic process using a thin film of water

Flooding - filling the grow bed with water in an ebb and flow set up

Flowering - when plants produce flowers

Fluorescent - light source which uses gas as an element

Foliar feeding - mixing certain nutrients with water and applying them directly to a plant as a spray mist

Genetics - the characteristics which are carried from seed to seed or clone to clone

Germination - the coming forth of the plant embryo from the seed.

Guano - droppings from birds, bats, etc.

Harvest - the end product of plant gardening

HID - high intensity discharge lights

Hormones - chemicals which stimulate growth

Humidity - the relative moisture in the atmosphere

Hydroponics - the art of growing plants usually using only water as a medium

Insect - bugs

Iron - a trace element nutrient

Irrigation - flooding the grow bed on a timed schedule

Lava Rock - porous clay type water retaining material

Leaves - the solar factories of a plant

Light rail - device which moves lights in order to distribute it more evenly to plants

Lime - a pH stabilizer

Macro Nutrients - the secondary nutrients calcium, magnesium, and sulfur

Magnesium - a secondary nutrient

Manganese - a trace element

Mealy bugs - $^1/_8$ to $^1/_4$ inch long bugs with a white waxy color

GLOSSARY

Mediums - soil or soil replacements

Metal Halide - HID light used with vegetative growth in the cloning area

Micro-nutrients - the trace elements B, Cu, Fe, Nb, Mn, S, and Zn

Misting - spraying water on plants leaves with a spray mister

Mites - small 1/6th. inch most common of juice sucking pest

Moisture - level of wetness

Molybdenum - a trace element

Mother Plant - the plants which the clones are taken from

Nitrogen - first primary nutrient

NFT - nutrient film flow technique

NPK - three primary nutrient indicators found on the label of most nutrients

Nodes - the axis along the stem where the branches appear

Nutrients - the twelve elements plants utilize as food

Outlets - places to plug in electrical devices

Overflow - tube which regulates the level of water in a reservoir

Oxygen - element which all plants and animals need to sustain life

Passive - technique of capillary action movement of water

Perlite - heated sand with water retaining capacity used as a hydroponic medium or used in potting soil

Pesticides - use only organic non encapsulated pyrethrum

pH - the measure of acid or alkaline

pH tester - meter used for determining the pH of water or material

pH UP and Down - chemicals used to raise or lower the pH of water

Phosphorus - primary nutrient

Photoperiod - the effect light has on a plant to make it bloom or not bloom

Photosynthesis - chemical reaction within a plant between light and the plan.

Pistils - female receptors in a flower

GLOSSARY

Pollen - the male genetic bearing micro-pore

Potassium - primary nutrient

Pre-flower - rooted clones which are maintained in the vegetative stage till an appropriate age is determined when they are then forced to mature by reducing their light period

Propane - gas used as a heat source as well as source of CO 2

Pumps - devices to move water or air in a hydroponic system

Pyrethrum - only organic pesticide I recommend using on your plants

Resin gland - small structures mostly on female reproductive pod which contain medicinal substances

Reservoir - water holding container used in hydroponic growing

Root growth - speed at which roots mature

Roots - the lower part of a plant which is usually grown in water in a hydroponic process

Secondary nutrients - calcium and magnesium

Seed - the combined genetic bearing element of reproduction

Stomata - openings on underside of a plant.

Sulfur - trace element

Tap root - main root of a plant

Timer - device for utilizing electricity on a timed schedule

Transpire - when a plant gives off water into the atmosphere

Transplant - move a plant from one medium or container to another

Vegetative state - initial juvenile phase of plant growth prior to blooming

Ventilation - the exchange of air in a given area

Vermiculite - horticultural substance used as a medium in hydroponic systems or potting soil

Vitamin B1 - additive to prevent transplant shock and stimulate root growth

Whiteflies - winged insect

Wick - used in capillary action

Zinc - a trace element

Organiponics

patent pending

If you are interested in growing plants using the methods described for small personal use gardens that is fine with the author.

If you wish to use the patented processes described in this book for any commercial growing, you may contact us at www.organiponics.com. to acquire proper license.

Totally Organic Hydroponics

SET-UPS

CLONING

DUAL ROOTING

NUTRIENTS

MEDIUMS

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