

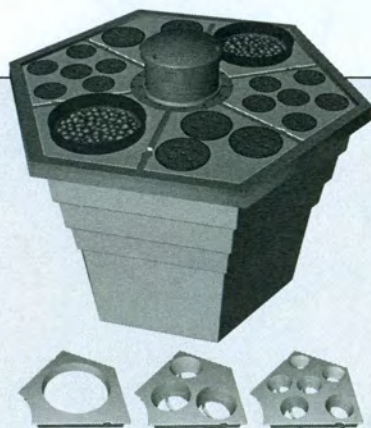


### FLORAKLEEN®

FloraKleen removes fertilizer residues that can accumulate over time in hydroponic systems, growing media, and potting soils. Use FloraKleen monthly to purge your hydroponic system or potted plants of excess salts that can accumulate as a result of regular fertilizer application. FloraKleen is an excellent final flush, and can be used at any time to dissolve mineral and salt buildup. It's high concentration and low price makes FloraKleen the economical choice for maintaining your plants in both hydroponic and soil based environments.

### FLORASHIELD®

Maintain healthy roots without resorting to harsh, toxic chemicals. FloraShield's unique combination of compounds can thoroughly rinse systems and plants during all phases of the life cycle. FloraShield is safe to use on and around actively growing plants at all stages of growth. Growers across the globe have attested to FloraShield's ability to solve root rot problems. FloraShield can also be used to clean system parts and pumps.



### RAINFOREST®

The Rainforest is perfect for propagation or growing plants to full maturity. Our patented Vortex Sprayer provides a super-oxygenated mist for rapidly developing plants. With a compact design and small footprint, the Rainforest is available with 2", 3", and 6" site lid inserts to suit specific growing needs.



PO Box 1576, Sebastopol, CA 95473, USA

707-824-9376 Monday through Friday 9am to 4pm PST

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# GENERAL HYDROPONICS®

# WaterPOWER™ 85/120



water POWER	85	120
Operating Voltage	120V / 60 Hz	120V / 60 Hz
Power Usage	85W	120W
Head	11.2' / 3.4 m	13.8' / 4.2 m
Output	792 gph / 3000 lph	951 gph / 3600 lph
Max Submersion	10' / 3 m	10' / 3 m
AC Cable Length	10' / 3 m	10' / 3 m
Protection type	IP68	IP68

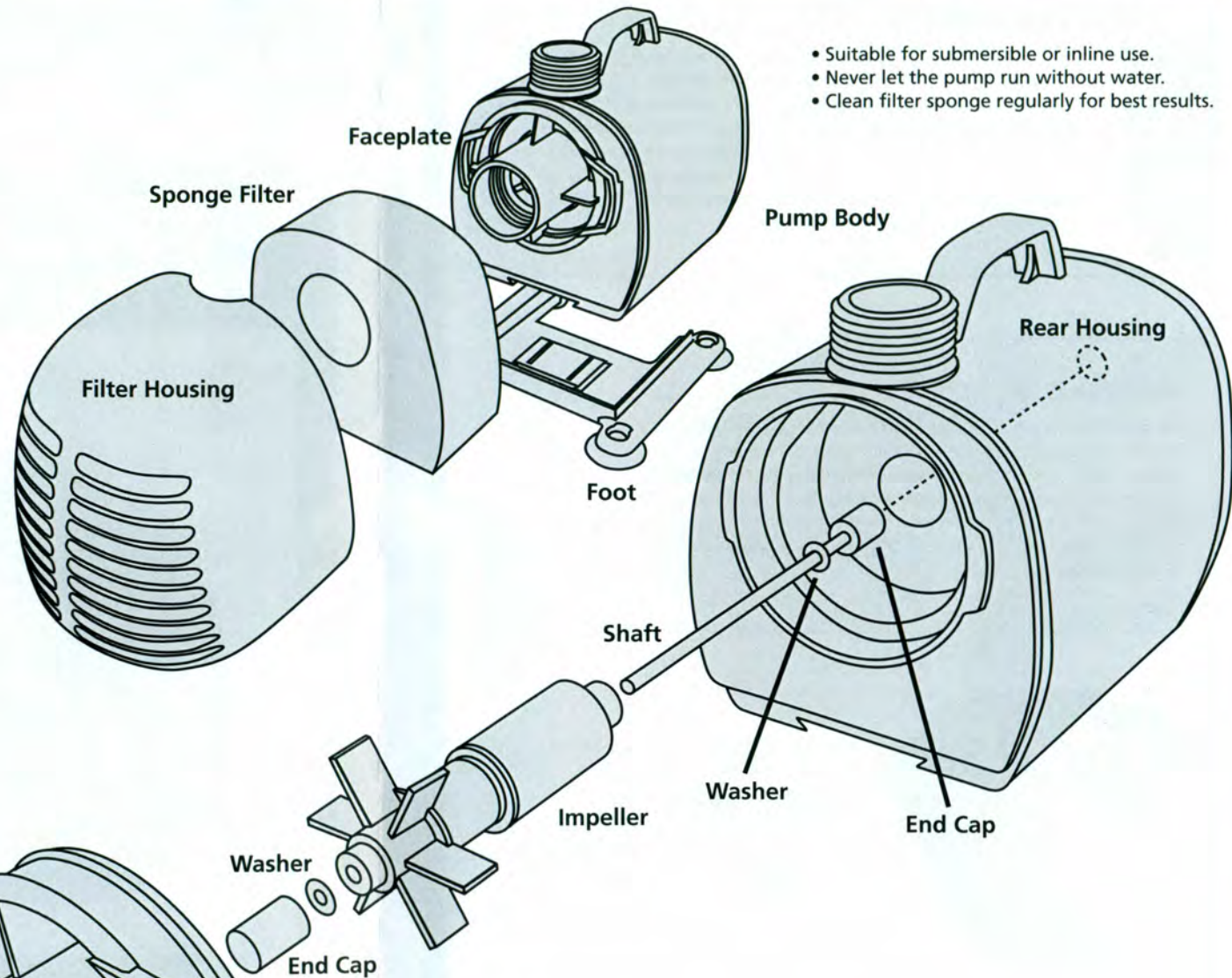
genhydro.com



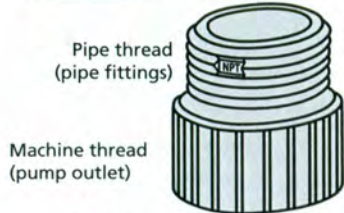
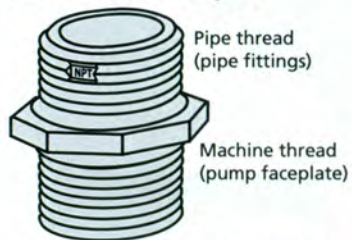
### Replacing Impeller Assembly:

- 1) Remove **filter housing** by tapping or pushing on the underside of the housing.
- 2) Remove the **faceplate** by rotating it counterclockwise and then pulling it out and off.
- 3) Remove old **impeller** by pulling it out. **Make sure not to lose the two small washers.**
- 4) If the bottom **end cap** and **washer** are still in the **rear housing**, remove the **shaft** from the **impeller** and firmly press into the **end cap**. Pump the **shaft** into the **end cap** a few times to build suction and then slowly pull all the parts out.
- 5) Replace the **impeller** assembly by inserting just the **shaft** with the **end cap** and **washer** into the **rear housing**. Carefully slide the **impeller** into place, and then replace the **washer** and **end cap**.
- 6) Replace the **faceplate** by lining up the **end cap** with the **faceplate** and pushing it in. Rotate clockwise until locked into place.
- 7) Wash or replace the **sponge filter** and reattach the **filter housing**.

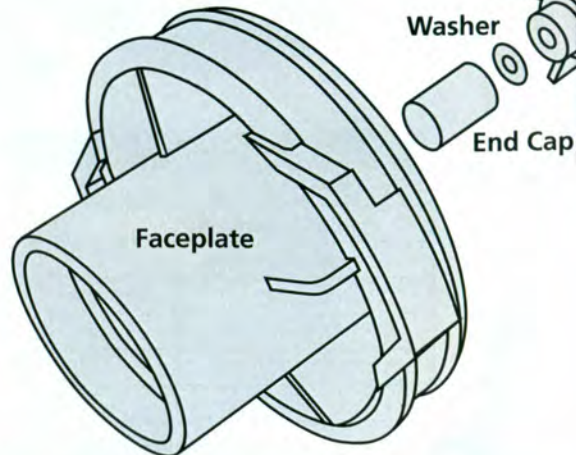
- Suitable for submersible or inline use.
- Never let the pump run without water.
- Clean filter sponge regularly for best results.



### 1" NPT Inlet Adaptor



### 1" NPT Outlet Adaptor



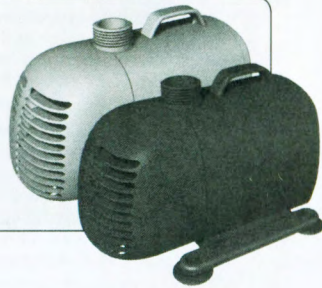
- ⚠ Use only with compatible power sources (120 V / 60 Hz).
- ⚠ Do not operate when cable or housing appear to be defective. Defective cord is not repairable, and cannot be replaced. Do not pull or hang the pump from the power cable. Using the pump in a solution that is excessively chlorinated, acidic, or basic, may damage the power cable.
- ⚠ Only use pump on a grounded circuit with a ground fault interrupt. Do not use pump with ground-lift adaptor (two prong plug) or on an unprotected circuit.
- ⚠ Unplug the pump before adjusting or servicing.





### waterPOWER® 85 & 120

The WaterPOWER magnetic drive pumps offered exclusively by General Hydroponics can be used in line or completely submersible. Used in our popular AeroFlo 18, 30 and 36 units, the WaterPOWER pumps come with 1" fittings and an extra sponge filter and impeller.

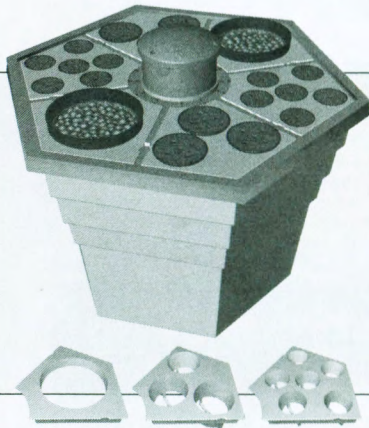


### RAPIDROOTER®

Rapid Rooter's breakthrough technology produces a unique matrix of composted organic materials bonded together with plant-derived polymers. Rapid Rooter plugs are manufactured using a scientifically controlled process that yields large populations of beneficial microbes in the media. These naturally-occurring microbes colonize young roots, helping plants resist disease while maximizing nutrient uptake. Rapid Rooter plugs are fortified with General Hydroponic micronutrients for abundant root growth. The optimal air-to-water ratio within the plug matrix results in early root growth. Use Rapid Rooter for robust early rooting that supports explosive plant growth.

Rapid Rooter plugs are available in the following sizes:

- 50 plug tray
- 50 plug bag
- 98 cell mat



### RAINFOREST®

The Rainforest is the perfect system for propagation or growing plants to full maturity. Our patented Vortex Sprayer provides a super-oxygenated mist for rapidly developing plants. With a compact design and small footprint, the Rainforest is available with 2", 3", and 6" site lid inserts to suit specific growing needs.



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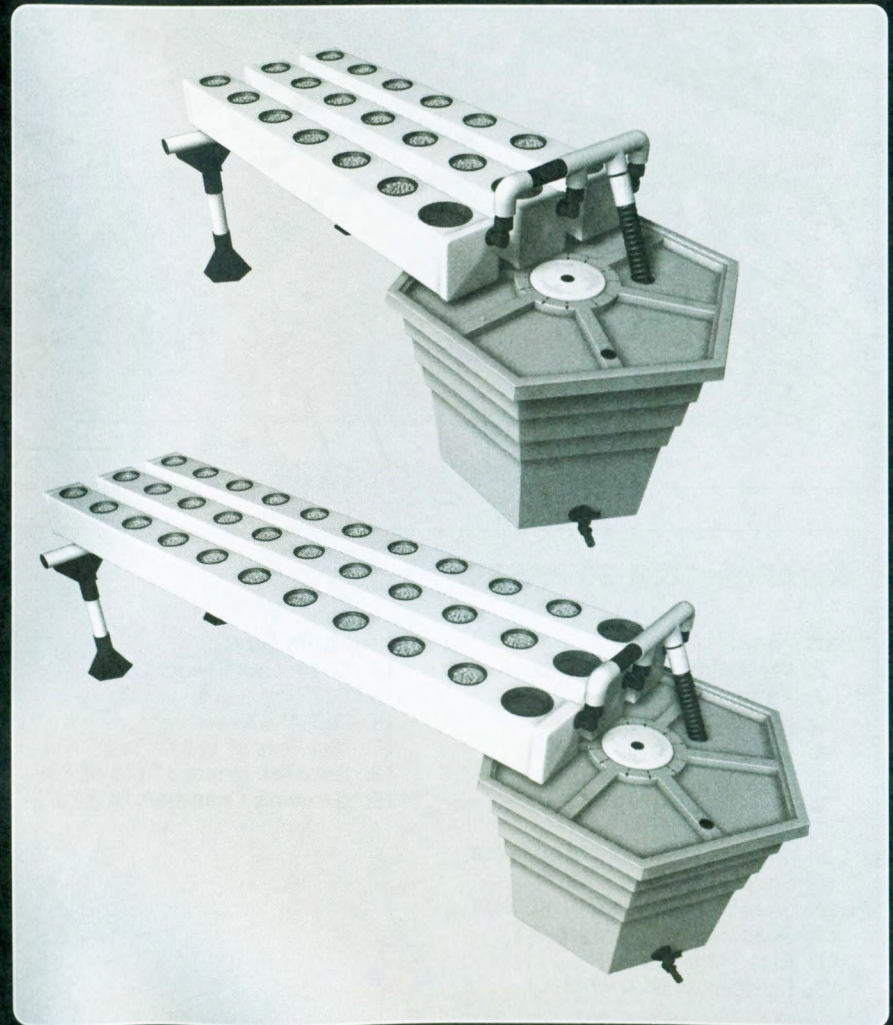
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# GENERAL HYDROPONICS®

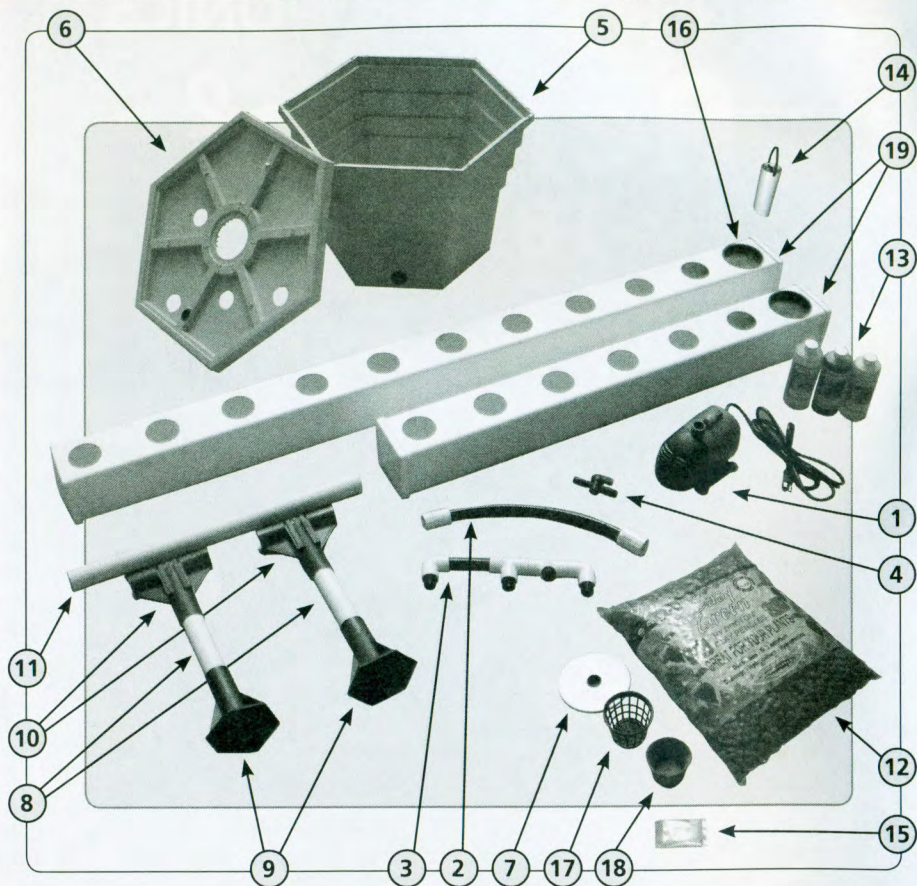
# AeroFlo<sup>2</sup> 18 & 30

## Assembly Guide



genhydro.com





**AeroFlo<sup>2</sup> 18 & 30 PARTS:**

**Parts Box:**

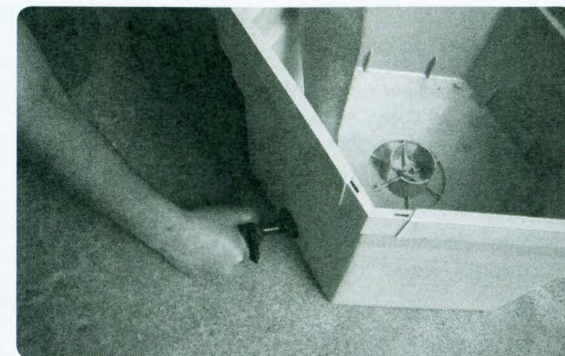
- 1: WaterPower Pump 120
- 2: Pump line
- 3: Manifold
- 4: Drain Valve
- 5: Reservoir 17 gallon
- 6: Reservoir Lid
- 7: Hatch Cover
- 8: SnapStand Support Legs, 2ea
- 9: SnapStand Base, 2ea
- 10: SnapStand Cross Fitting, 2 ea
- 11: SnapStand Cross Support
- 12: Clay Pebbles 9 L
- 13: FloraSeries Nutrients

**Chambers Box:**

- 14: Drain Level Tube (DLT)
- 15: DLT Lubricant
- 16: DLT 4" Covers
- 17: Net Pots 3" (18 or 30)
- 18: CocoTek Liners 3" (18 or 30)
- 19: Growing Chambers (4' or 6')

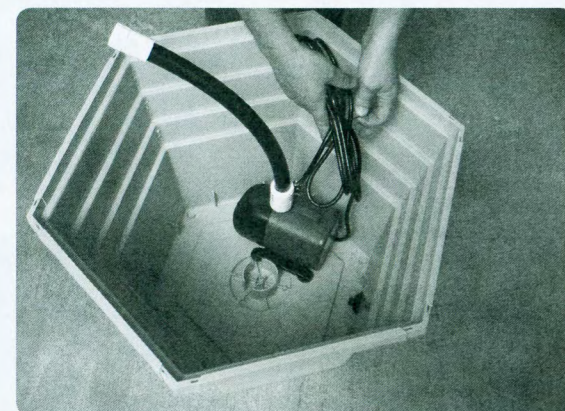
**STEP 1**

Insert the **Drain Valve** into the **Reservoir** grommet while supporting the grommet from the inside.



**STEP 2**

Connect the **Pumpline** to the **Pump** leaving the **Swivel Fitting** to attach to the **Manifold**.



**STEP 3**

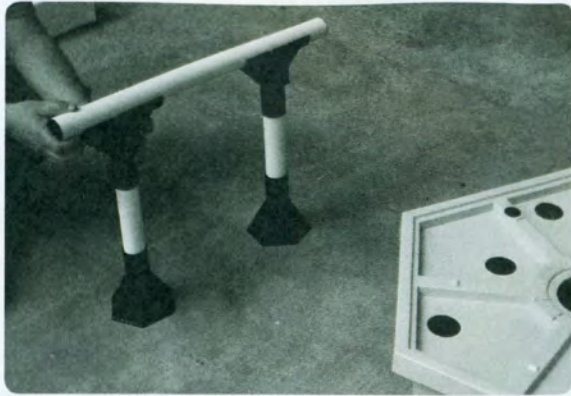
Place the **Pump** assembly into the **Reservoir** so the **Pumpline** emerges through the **Reservoir Lid**.





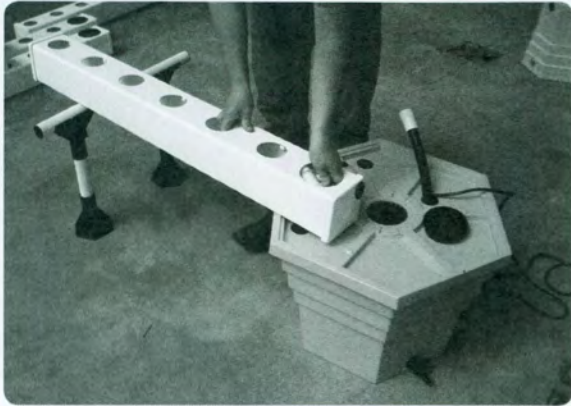
**STEP 4**

Slide the two **Support Legs** into the **SnapStand Bases** and the **Snapstand Cross Fittings**. Snap the **Cross Support** into the **SnapStand Cross Fittings**.



**STEP 5**

Remove the **Sprayline**, **DLT**, **Net Pots** and **CocoTek Liners** from each of the **Growing Chambers** and place the **Growing Chambers** on the **Support Stand** and **Reservoir**.



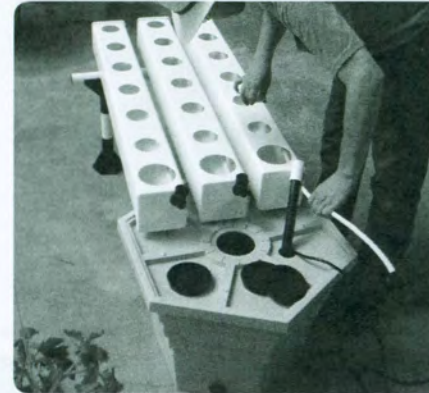
**STEP 6**

Lubricate the end of the **DLT** with the **Lubricant** provided and insert into the **Growing Chamber** drain hole and align with the holes in the **Reservoir Lid** for each **Growing Chamber**. Adjust water level in **Growing Chamber** by raising or lowering the **DLT**.



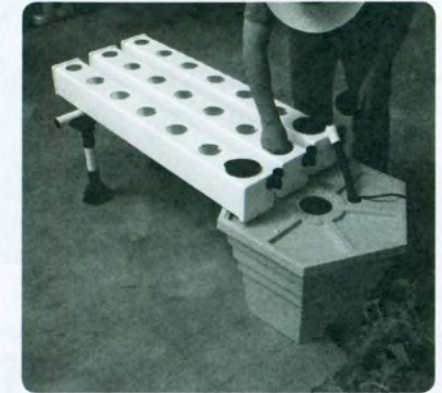
**STEP 7**

Setup the rest of the **Growing Chambers** and install the **Spraylines** by following the directions provided with the **Spraylines**.



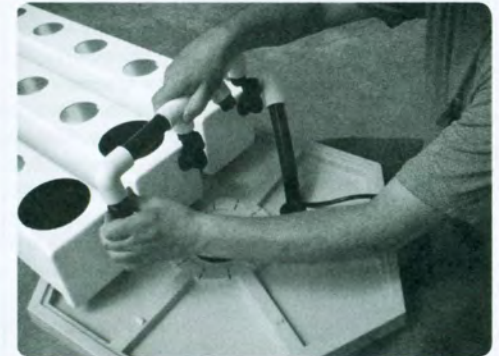
**STEP 8**

The level of the water in the **Growing Chamber** is controlled by the height of the **DLT**. Keep the **DLT** access covered with the **DLT Cover**.



**STEP 9**

Attach each of the **Spraylines** to the **Manifold** and then the **Flexible Pumpline** to the **Manifold**. Make sure there is a rubber gasket in the **Sprayline** fitting and **DO NOT OVER TIGHTEN**. Cover the inspection hole with the **Hatch Cover**





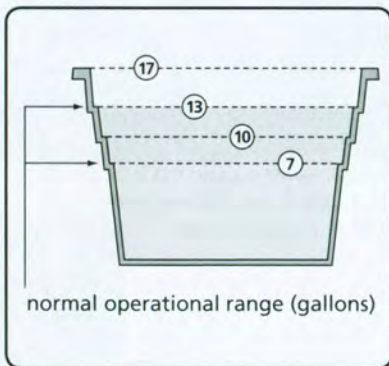
**STEP 10**

Place the **Net Pots** with the **CocoTek Liners** into the growing sites and use the **Clay Pebbles** to support seedling plants. Always rinse the **Clay Pebbles** before use and see the Helpful Guidelines for planting and cleaning the system.



**FILLING**

Before filling your system with water it is essential that you understand the system capacity. The reservoir should be drained first before draining the growing chambers. This will prevent overfilling of the reservoir and possible flooding. See illustration for reservoir capacities at each of the steps. Fill the reservoir with a known volume of water and then start the pump. Adjust the Drain Level Tubes (DLT) to the desired level and start adding water in 1 gallon increments until the Growing Chambers and reservoir are at the desired levels. Record the total gallons to be used for calculating the amount of nutrient to add to the system. See chart for approximate amount of water each system holds at the two operating levels.



**CAUTION:** Never run the water pump without water covering the pump inlet.

AeroFlo <sup>2</sup> system	Reservoir capacity	Each Chamber		Total Water*	
		low level	high level	low level	high level
gallons					
AeroFlo <sup>2</sup> 18	13	0.6	2.4	15	20
AeroFlo <sup>2</sup> 30	13	1.0	4.0	16	25

\* Total amount of water in all chambers and reservoir

**PLANTING**

To prepare a seedling or a plant for transplanting, remove all soil and/or organic material from around the roots. Plants must be sturdy with established roots before transplanting. Choose seedlings because it's more difficult to successfully transplant older plants. If your plant has been growing in soil or peat moss, gently remove the plant from its pot and carefully rinse as much soil as possible from the roots before transplanting. Although this method of transplanting from soil to hydroponics is somewhat risky, (soil may contain diseased organisms that proliferate in the rich hydroponic solution), we have been very successful in implementing, particularly with culinary herbs and encourage you to try it. You can avoid these problems by starting plants from cuttings in one of our RainForest™ Systems or RapidRooters™.

**PLACEMENT**

Abundant light, proper temperature and adequate ventilation are crucial for fast growth, healthy plants and higher yields. Place the AeroFlo<sup>2</sup> system in a warm, well-lit, well-ventilated location, such as an outdoor garden, sunlit window, patio or greenhouse. Keep your AeroFlo<sup>2</sup> away from areas where the inevitable dripping that occurs during filling, draining and pH adjustment could cause water damage.

**NUTRIENTS**

Start by choosing either the most widely recognized, reliable nutrient in the industry, Flora Series® or step into the technological breakthrough of FloraNova® for the accelerated performance of mineral nutrients enriched with the healthy, flavorful characteristics of organics. Please refer to our Feeding Schedule that is provided with the system for nutrient recommendations.

- Keep the nutrient solution temperature below 75° F (24° C).
- Change nutrient solution every 7-10 days.
- Top off with fresh water between nutrient changes.
- Keep nutrient solution aerated for best results.
- If your water is above 200 ppm total or 70 ppm calcium, use Hardwater FloraMicro instead of FloraMicro.

The pH (acidity or alkalinity) of a nutrient solution affects the availability of the elements contained within. Use GH pH adjusters to maintain nutrient pH between 5.5 - 6.5.





### OPERATION

When plants are small and their roots are not well developed, the Drain Level Tubes (DLT) should be at the maximum height to allow nutrient rich water to reach the bottoms of the net cups. Once the roots have grown and are immersed within the flowing stream of nutrient, the DLT's can be pushed down to increase oxygen within the nutrient and growing chamber. The water level in the Growing Chambers should be maintained at a 1" to 2" depth in case the power or the pump fails. Generally it's best for the system to always run. However, many people do put their AeroFlo<sup>2</sup> systems on a timer to save electricity. The AeroFlo<sup>2</sup> stays on during the light cycle and only runs for 10 to 15 minutes every 1 to 2 hours for the night cycle. Cycling the pump keeps the water from stagnating and the roots from drying out and dying.



### PREPARATION FOR REPLANTING

Drain the whole system, brush out the growing chambers and, if necessary, unplug the spray holes in the beige spray lines mounted inside the growing chambers. Sponge off all parts to disinfect. You can use General Hydroponic's FloraShield™ to clean the system and clay pebbles or a disinfectant. Rinse everything thoroughly. Refill it with water and run it for a few hours, then drain again before introducing a new crop. Clean filters frequently. Simply unplug pump and remove reusable filter. Rinse pump filter under hot water to clean. **CAUTION: Do not rinse filter with a strong Bleach (chlorine) solution, it may react with the filter and form an oily residue.**



### TROUBLE SHOOTING

#### *If white salt deposits form on the Clay Pebbles:*

1. Try using a milder nutrient solution and topping off with plain water only.
2. Occasionally drain your system, refill with plain water and run the pump overnight. After the overnight rinse, empty reservoir and refill with fresh nutrient.

#### *If Plants are not growing well and you suspect "hard" water:*

1. Use FloraMicro Hardwater in place of FloraMicro.
2. Try distilled or purified water. You should see a significant improvement in plant health and growth within one week.
3. Collect rainwater for use in your AeroFlo<sup>2</sup>.

#### *If nutrient solution stops flowing from the beige spray lines:*

1. Check to ensure that pump is plugged in and the reservoir is filled with nutrient solution.
2. Check whether emitter holes in the beige spraylines are clogged. Keep pump filter clean and use General Hydroponic's FloraKleen™ to minimize nutrient buildup and crusting.

#### FLORAKLEEN®

- Dissolves accumulated fertilizer salts.
- Reduces plant stress from excess and imbalanced nutrients.
- Releases nutrient bonds between plants and systems, also correcting nutrient lock-out.
- Use FloraKleen as a final flush a few days before harvest to promote maturation and sugaring.
- Safe for all systems and media while plants are growing.

FloraKleen removes fertilizer residue that can accumulate over time in hydroponic systems, growing media, and potting soils. Use FloraKleen monthly to purge your hydroponic system or potted plants of excess salts that can accumulate as a result of regular fertilizer application. FloraKleen can be used at anytime throughout the plant's life and is an excellent final flush to help improve flavor. Its high concentration and low price make FloraKleen the economical choice for maintaining your plants in both hydroponic and soil based environments.



#### FLORASHIELD®

Maintain healthy roots without resorting to harsh toxic chemicals. FloraShield's unique combination of compounds can thoroughly rinse systems and plants during all phases of growth. Growers across the globe have attested to FloraShield's ability to solve root problems.

*Not to be used with SubCulture*





### FLORABLEND®

- Organic nutrient supplement
- Increases and builds healthy root systems
- Increases plant immunity and metabolic rates
- Builds strong plant structure and healthy foliage

FloraBlend is a Vegan Ferment that is made from a proprietary blend of plant materials, seaweed, rock powders and micronized leonardite.

FloraBlend is produced with a diverse mixture of highly bioactive microorganisms that are fed a feast of select food sources in a hyper-oxygenated environment. These beneficial microorganisms multiply rapidly, consuming these food sources and through bioconversion processes new organic compounds are formed. These organic compounds are enzymes, metabolites and organic acids, which energize plant metabolic processes.

These highly soluble organic compounds increase and promote healthy root structures, build plant immune systems and provide carbon building blocks for plant processes responsible for color and flavor of fruits and vegetables.



### FLORALICIOUS PLUS®

Floralicious Plus is a vegan bio-stimulator and nutrient supplement that includes all the benefits of Floralicious but has been formulated to be applied at all stages of plant growth. It is five times more concentrated than Floralicious, so its application rates are much less. It also contains dormant beneficial microbes that activate when introduced to a plant's root structure. This metabolic fuel solution is packed with powerful vitamins, complex plant sugars, protein-building amino acids, seaweed extracts, carbon building blocks and aromatic oils, all in a fulvic acid base.

Floralicious Plus adds quality, flavor and color to all plants, and can be used in all hydroponic applications and soil or soil-less growing environments.



### LIQUID KOOLBLOOM®

Liquid KoolBloom is a flowering nutrient supplement that goes way beyond other bloom boosters. Enriched with stress reducing vitamins and nutrient transporting acids, Liquid KoolBloom provides the essential nutrients needed by plants to initiate explosive flowering and build bigger blooms. Liquid KoolBloom promotes heavy production of essential oils and increases fruit and flower development without damaging delicate root systems often associated with early yellowing of larger foliage.

Start using Liquid KoolBloom during the transitional period between vegetative and regenerative growth to take advantage of its unique characteristics and bloom builders.



### DRY KOOLBLOOM®

KoolBloom is a highly concentrated nutrient supplement that promotes abundant flowering and helps facilitate ripening in annual flowers and herbs. KoolBloom is rich in important nutrients and contains precise amounts of ripening elements. KoolBloom is to be used only at the very end of a plant's life cycle and will help build larger, heavier fruits and flowers.



### FLORANECTAR®

- Organic nutrient supplement
- Influences sweetness and aromas in fruits and flowers
- Helps ensure optimal plant metabolic rates
- Adds additional energy for plants and beneficial microorganisms

Our scientists have formulated FloraNectar to optimize the greatest transference of sweetness and aroma into your fruits and flowers.

FloraNectar contains all natural raw cane sugar, molasses, malt syrup, select plant based esters, L-amino acids, organic acids, vitamins and essential minerals.

This unique blend of ingredients helps your plants regulate enzymes that trigger specific reactions involved in maintaining optimal metabolism. This allows plants to achieve a balance between respiration and photosynthesis in high intensity growing environments where the rate of respiration can sometimes exceed the rate of photosynthesis.

As a result, FloraNectar ensures optimal metabolic rates during flowering and fruiting phase when nitrogen levels have been reduced.

FloraNectar also promotes a sturdier plant structure during the vegetative phase when high levels of nitrogen are present. FloraNectar fulfills the additional energy requirements of your plants throughout all phases of growth and during stressful times of transition.



### pH UP & DOWN

To maximize plant growth, the pH content of your nutrients should be slightly acidic. Experienced growers consider the ideal pH for most crops to fall between 5.5 and 6.5. Users of General Hydroponics nutrient products generally do not experience problems maintaining the proper pH range because our formulas are pH buffered.

#### pH UP

Base formulated using Potassium Hydroxide and Potassium Carbonate. Add a little at a time if your nutrient pH is too low in order to raise the pH to the proper level.

#### pH DOWN

Acid formulated using food grade Phosphoric acid. Just add a little at a time if your nutrient pH is too high in order to lower the pH to the proper level.







# GENERAL HYDROPONICS

## WARRANTY & MERCHANDISE RETURN POLICIES

General Hydroponics, Inc. products are covered by the following warranties and/or return policies. In no instance will General Hydroponics, Inc. become liable for any losses associated with the performance failure of any product. General Hydroponics' liability is limited to issuing a refund (if applicable), or replacement of the product with like kind.

### **LIMITED WARRANTY**

General Hydroponics, Inc. will repair or replace any General Hydroponics, Inc. product found defective within six months of original purchase. To exercise the warranty rights the purchaser must contact General Hydroponics, Inc. at (707) 824-9376 and obtain a "WARRANTY CLAIM NUMBER (WCN)" then return the merchandise with a copy of your proof of purchase (shipping prepaid) to General Hydroponics, Inc. Some components of the hydroponics systems have warranties that supercede or extend that of General Hydroponics, Inc.

### **RETURN POLICY**

Unopened merchandise purchased directly from General Hydroponics, Inc. (excludes custom order merchandise) can be returned within thirty (30) days of purchase. To obtain a refund the customer must contact General Hydroponics, Inc. at (707) 824-9376 and obtain a "RETURN MERCHANDISE NUMBER (RMA)" then return the merchandise with a copy of your proof of purchase (shipping prepaid) to General Hydroponics, Inc. A restocking fee of eight percent (8%) will be deducted from the refund.

**Visit our website at: [www.generalhydroponics.com](http://www.generalhydroponics.com)**



# Advanced Nutrient Management

by Lawrence Brooke

## Check your nutrient IQ

**T**o the skilled hydroponic grower, nutrient management represents an opportunity to enhance plant growth. To the novice, it represents a challenge to be dealt with. The difference is in knowledge, understanding and equipment. Consider the following questions to test your nutrient IQ:

- What temperature is your nutrient solution, what is the range during a day and during a season?
- What is the “dissolved solids” content of the water you use to mix your nutrient and does this content vary greatly from season to season? Does your water supplier provide you with good water from one reservoir at one time of the year and bad water from a different reservoir at another?
- Are there any components in your water that could affect the availability of nutrients to your crop?
- What is the “EC” or strength of your nutrient?
- Do you mix special nutrient blends for different kinds of plants and for each stage of the crop's life-cycle?
- Does the pH of your nutrient stay within a reasonable range?
- Are there any pathogens in your nutrient from a contaminated water supply or from sick plants that may spread disease to the rest of your crop?
- Do you change your nutrient often enough to prevent excesses from salt accumulation or deficiencies from nutrient exhaustion?
- Did you know that an important reason to change your nutrient solution is to eliminate the wastes your plants discard into the nutrient? Did you know that as plants transpire, moisture and nutrient levels drop in your reservoir and the EC or strength of the nutrient can rise to dangerous levels?





Those were just a few basic questions that may help you better realize what you already know, and what you may need to learn to achieve outstanding crops every time. This discussion is especially for the advanced grower who wants to achieve the highest yields and is seriously interested in being at the leading edge of plant growing technology. Hobby growers generally don't have to worry about all of these questions, but don't stop reading just yet. When problems arise and a crop isn't growing as well as it should, the problem can often be traced to nutrient management. Once you know what can go wrong, it's easier to recognize a problem when it happens.

The root environment is what separates hydroponics from soil cultivation. In soil, plants await rainfall or irrigation, and their roots search out essential nutrients. With good, fertile soil and abundant water plants thrive.

In hydroponics, the plant roots are constantly provided with water, oxygen and nutrients- no searching for available nutrients or waiting for the next rain. The challenge for the grower is to keep up with the plants' needs and to avoid damaging plants with excesses or deficiencies of minerals, extremes in pH and temperature, or a lack of oxygen. A few simple tools and techniques can make the difference between success and failure.

### What's in Your Water?

The first question to consider is water quality. With good, soft water it's easy to succeed. Just add the right combinations of nutrients to the water and you're off and growing. If you have very hard water, or water contaminated with sodium, sulfide, or any number of heavy metals, you may have to filter your water using "reverse osmosis."

So, what's in your water anyway? The most complete answer comes from having an analysis of your water done by a lab. If you're on a municipal water system, call your water district and request a copy of their most recent analysis.

Another approach - highly recommended - is to check your water regularly with a dissolved solids meter, also called an electrical conductivity (EC) or parts per million (PPM) meter. These instruments are one of the most important tools for a grower to have and use regularly.

All of these instruments work in essentially the same way. They measure the electrical conductivity of the water. It is the dissolved salts in most water that allows it to conduct electricity. Pure water is a poor conductor since there are none of the conductive salts found in impure water. Purified water will show no, or very low, salt content (conductivity) when tested with a dissolved solids meter.

It is not uncommon to find high levels of salts in well water or municipal water supplies. Calcium and Magnesium carbonates are among the most common ingredients in tap water and in well water. In fact, water "hardness" is defined as a measure of the water's content of calcium and magnesium carbonates.

Since calcium and magnesium are important plant nutrients, water with reasonable levels of these elements can be just fine for hydroponic cultivation. However, even a good thing can become a problem if the levels are too high.

Generally, a calcium content of more than 200 PPM, or 75 PPM for magnesium, are on the verge of excessive for most hydroponic applications. An excess can cause other important elements in the nutrient solution to "lock-out" and become unavailable. For example, excess calcium can bond with phosphorous to make calcium phosphate, which is not very soluble and therefore not available to the crop. The key is to start with decent water and add the right combination of nutrients.

### Too Hot, Too Cold

Water temperature is another important factor. If your solution is too cold, seeds won't germinate, cuttings will not root and plants will grow slowly- or stop growing and die. If it's too hot, the same seeds won't germinate, cuttings won't root, and plants will die from oxygen deficiency or simply from temperature stress. Most plants prefer a root zone temperature range of between 65 degrees (18 C) and 80 degrees (27 C), cooler for winter crops, warmer for tropical crops. When adding water to your reservoir, it is a good idea to allow it to come to the same temperature as the water in the reservoir.

Remember, plant roots have evolved in a soil environment where temperature changes occur slowly, tempered by the thermal mass of the earth. Plants do not like rapid temperature changes, especially in the root zone!



## Water pH

A subject that is often discussed but rarely understood by many growers is nutrient pH. Generally, we worry about pH and its affect on nutrient availability. For example, if pH is too high, iron may become unavailable. Even though your nutrient solution may have an ideal iron content, your plants may not be able to absorb it, resulting in an iron deficiency. The plant's leaves will yellow and weaken.

On the other hand, advanced hydroponic plant foods contain special "chelates" that are designed to assure iron availability at higher pH ranges. The result is that your crop will grow reasonably well, even at higher pH levels. Nonetheless, high pH can damage plants in other ways.

The cause of a high solution pH can be fairly complex. Most city water supplies contain added calcium carbonate to raise the pH of the water and prevent pipes from corroding. As a consequence you are starting with water that has an abnormal pH, typically 8.0 for city water.

The best way to deal with this is to mix fresh nutrient with your water, let it stand for a while to stabilize, then test and adjust the pH. With city water supplies you will often have to add a bit of pH down (usually phosphoric acid) to lower the pH to the range for most plants, between 5.8 and 6.2.

As the plants grow, it is a good idea to occasionally test the pH and adjust it if needed. You can safely allow pH to drift between 5.5 and 7.0 without adjustment. In fact, constantly dumping chemicals into your system to maintain a perfect pH of 5.8 to 6.0 can do a lot of damage. It is common for pH to drift up for a while, then down, and up again. This change is an indication that your plants are absorbing nutrient properly. Adjust pH only if it wanders too far.

A pH below 5.5 or above 7.0 can mean trouble, but don't over-react. An apparently sudden and dramatic shift in pH can be the result of a malfunctioning pH meter. If in doubt, double check with a reagent (color match) pH kit before adjusting your solution. Also remember that all pH measuring methods are temperature dependent. Read and follow all of the instructions that came with your meter or test kit.

## Media Culpa

Another cause of unstable pH is poor quality growing media. Industrial grade rockwool and gravel are notorious for having very high pH levels that cause your nutrient pH rise, often to constantly rise, often to dangerous levels.

A simple way to test a new growing medium is to put some of the medium - rockwool, gravel, soil - into a clean cup, then immerse (soak) the sample in distilled or "de-ionized" (chemically pure) water. Let this sit for a little while and then test the pH of the water, note the pH and continue to let the sample sit. Test the pH occasionally for about a week until it has stabilized. Has the pH risen to 8.0, perhaps 9.0? Construction grade gravel can go as high as 10.0 - torture to roots, death to plants!

Never underestimate growing media as a source of pH problems. This is one of the primary reasons that "water-culture" hydroponic methods are gaining popularity over "media-based" hydroponics. This less media you use, the fewer problems you will encounter with pH instability and salt accumulation. Plus the water-culture systems require less water and nutrient than media-based methods due to higher efficiency and reduced evaporation.

## Time for a change?

How often should you change your nutrient solution? That's one of the most common questions asked, and one of the most difficult to answer. Many people have tried to come up with a simple, easy-to-follow rule - once a week, every two weeks - but they're all wrong! They're wrong because there is no simple answer. It all depends on the species, the number and size of your plants, the capacity of the reservoir, the kind and quality of nutrient you use, water quality, environmental conditions such as temperature and humidity, and the type of hydroponic system used. Instead of a simple answer, what we need is a procedure that takes many of these variables into account and is responsive to changing conditions.

It sounds complicated, but it's actually quite simple. All it takes is a little monitoring and some basic record keeping. Start with a fresh reservoir of nutrient and make note of the date, pH, and EC or PPM of the solution. As you run the system, the level will drop in the reservoir. Note the EC/PPM level, then top-up the reservoir with fresh water. Test again for nutrient concentration. If the nutrient strength has dropped significantly, add a bit of nutrient to bring it back up to spec.

Be sure to record how much water you added to top-up the reservoir. Repeat the procedure every time you top-up the system, carefully recording the amount of water added. When the total amount of water added equals the capacity of your reservoir, it is time to drain and replace all of the nutrient solution.



For example, imagine a hydroponic system in a cool, spring greenhouse with 24 strawberry plants and a nutrient capacity of 20 gallons. Typically, such a system would require about 5 gallons of added water each week. After four weeks the plants will have transpired 20 gallons—the capacity of the reservoir. You need to completely drain and replace the nutrient every four weeks in this example.

## **Nutrient Pathogens**

The problem of pathogens or disease in the nutrient solution can be a serious one. It is not uncommon for this to be a regional and seasonal problem. For example, in Holland during the winter, fungi thrive in the cool and damp environment, the air is full of spores. All kinds of soil-borne diseases become endemic in the Dutch winter and growers have to work hard to avoid infestations. One of the reasons Dutch growers adopted hydroponics so readily was to avoid soil-borne diseases.

Keep your growing area clean. Never allow soil to get into the nutrient stream. If soil is accidentally kicked into the reservoir, the entire crop can be at risk. Some growers will place a sponge-mat, soaked with disinfectant, at the doorway of the greenhouse. Everyone who enters must clean their shoes on this mat before entering. This is an effective and practical way to prevent disease organisms from entering the greenhouse and endangering the crop.

If an infected plant is introduced into a hydroponic system, the disease can race through the entire crop. By the time a problem is noticed, it may be already out of control. Plant diseases are beyond the scope of this article, but the best advice is to avoid problems by working clean, planting only healthy disease free plants, and closely monitoring the crop.

If you see evidence of disease in a single plant, remove and destroy it quickly before the disease spreads. Watch the crop closely and destroy any other plants that show signs of disease. It is better to lose a few sick plants than to risk an entire crop.

If you do encounter disease problems, it is a good idea to completely drain and renew your nutrient after removing the sick plants. If it is possible there is nothing better than to flush the system by running fresh water without nutrient for a day. Then drain and refill with fresh nutrient. Flushing between every three or four nutrient changes can help maintain cleanliness in the root zone and in the hydroponic system. Periodic flushing is especially helpful for gravel systems to remove salt accumulation in the medium.

## **To the Limit**

To some hobby growers, especially those who come to hydroponics from the “U-plant-em-and-pray” school of outdoor gardening, the techniques described above might seem too difficult and time-consuming. Remember, hydroponics offers great control over the health and quality of plants to the grower with the interest and the skill to exercise that control. That’s what this article is all about—pushing it to the limits. Remember, too, that it is possible to produce a hydroponic garden that will out-perform any soil garden by simply following the manufacturers’ instructions on system operation and nutrient changes, and paying attention to the condition of your plants. But even the most casual grower can benefit from an understanding of a few basic concepts.

Quality water is a great advantage, poor water is a challenge. Use only the highest quality plant food—designed specifically for hydroponics. Low grade plant foods and common fertilizers offer your plants poor and incomplete nutrition, cause pH drift, and sometimes contain impurities that can become toxic to hydroponic plants. Only high-quality plant food can grow superior plants. Healthy plants grow faster, generate higher yields and are resistant to disease and insect infestation. When you mix fresh nutrient always measure carefully.

Keep notes on your observations of EC drift, pH drift, total water usage, temperature range, and comments on crop health and progress. Keep an eye on pH, and an especially close watch on nutrient strength (PPM, EC, dissolved solids). Look out for diseases and remove and destroy sick plants immediately.

To control your nutrient temperature, use high quality aquarium heaters to warm nutrient in the winter, and look for “chillers” to cool your nutrient in the summer if high nutrient temperature becomes a problem. The aquaculture or fish farming people have developed excellent chillers. Fish don’t like water that’s too hot or too cold either.

## **Don’t be overwhelmed or intimidated**

Plants can tolerate quite a lot of stress and still produce well. On the other hand, the grower who knows the questions, and how to find answers, is the one who will have consistently good crops. It is far easier to avoid problems through knowledge and proper technique than to fix them after they arise.



**Q: Can I turn my system off at night to conserve energy? Should I run it continuously or cycle it at intervals?**

**A:** All systems can be left off at night once the plant roots are long enough to reach the nutrient level in the reservoir. Longer cycles depend on the type of system you have:

**AeroFlo Systems:** The cycle can be set to run continuously during the day and coming on once or twice during the night for 15 to 30 minute intervals.

**Euro Grower Systems:** Set the timer to come on for 15 to 30 minutes every 90 minutes during the daylight cycle once the plant has a good root system. These systems use cocopeat that holds moisture and nutrients in the root zone.

**WaterFarm & PowerGrower:** Set the timer to come on for 1 hour and then off for 1 hour during the daylight cycle.

**RainForest Systems:** These units are run continuously, especially if you are trying to root cuttings. If you are growing plants, they can be shut off in the evening once the roots have grown into the nutrient solution.

**Q: What pH is best for growing plants hydroponically?**

**A:** The ideal pH range for most hydroponic crops is between 5.5 and 6.5.

**Q: How does pH level affect plant growth?**

**A:** pH is important because it affects availability and absorption of several of the 16 atomic elements needed for plant growth. Maximum absorption of these elements is found at pH readings 5.5 to 6.5. When pH falls below this range many of the macro elements (N, P, K, etc) have less availability, and absorption of the micronutrients can reach toxic levels.

**Q: How do you change the pH?**

**A:** pH is adjusted by using an acid to lower it or an alkali to raise it. General Hydroponics' pH Down and pH Up are designed for this purpose. Many acids and alkalis are extremely corrosive and dangerous, so care should be used if you are not using a product labeled for hydroponic use.

**Q: What is the desired temperature range for the nutrient solution?**

**A:** The optimal temperature of the nutrient solution should be in the range of 65 to 75 degrees Fahrenheit (18 to 24 degrees Celsius). Before adding water to your reservoir, it is a good idea to allow it to come to the same temperature as the water in the reservoir. Plants dislike rapid temperature changes, especially in the root zone.

**Q: How important is fresh air?**

**A:** Ventilation is often overlooked as a problem. Plants absorb nutrients when the water molecules in the leaves transpire. Increased ventilation improves transpiration rate, which correlates with increased nutrient uptake. Remember that ventilation means exchanging the air, not just circulating it around the room.

**Q: Do I ever need to drain the reservoir and refill it with fresh water and nutrient solution?**

**A:** Yes. The reservoir should be drained and rinsed every 7-14 days, depending upon plant size and nutrient usage. It is a good idea to rinse off the growing medium each time the reservoir is cleaned with fresh water for a short period prior to refilling with new nutrient.

**Q: Between cleanings, how often should I check the reservoir level?**

**A:** Fast-growing crops can consume large amounts of nutrients and water so it is important to keep an eye on the reservoir every couple of days. Plants will also use more water under longer light cycles and lower relative humidity.

**Q: When the reservoir level begins to drop, should I top it off with fresh water or nutrient solution?**

**A:** As plants consume nutrients and water, the nutrient strength in the hydroponic reservoir will change. If you drain, clean and remix the nutrients every 7 to 14 days, it's okay to top off with fresh water daily. If the concentration(ppm) in the reservoir decreases 500 ppm, you can add nutrients in the same ratio that were initially used to raise the ppm to the level you started with in the reservoir. Don't do this more than twice between complete nutrient changes to avoid buildup of some elements.

**Q: How do I clean my hydroponic system between crops?**

**A:** The easiest way to clean your system is to drain all the water and remove any accumulated organic matter from the previous crop. Refill the unit with fresh water and add a 1/8 cup bleach per gallon of water and allow the unit to run for several hours. If you have any salt buildup you can start with citric acid or vinegar and warm water to help dissolve accumulated salts. Drain the reservoir and flush with fresh water until the bleach is removed. If you have an AeroFlo unit it is a good idea to remove the plugs at the end of the sprayline to remove any accumulated solids.



## Frequently Asked Questions

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### **Q: Why are there three parts to the General Hydroponics Flora Series Nutrients?**

**A:** The concept behind the Flora-series is simple: Different kinds of plants have significantly different nutrient needs, and these needs change during each plant's growth cycle. By using different combinations of FloraGro, FloraBloom and FloraMicro, the grower is able to fulfill the exact needs of the plant at each stage in the plant's life cycle. As the crop grows, the grower is able to precisely adapt the nutrient formulation to meet the crop's changing requirements.

### **Q: Can you explain the purpose of each component of the Flora Series?**

**A:** In hydroponics, the plant roots are constantly provided with all the water, oxygen and nutrients they need. The challenge for the grower is to keep up with the plants needs, and to avoid damaging it with either excesses or deficiencies of minerals. As a general rule, a plant consumes more nitrogen during the formative or vegetative stage, and more phosphorus, potassium and magnesium as it flowers. Throughout its growth cycle, the plant will also consume calcium, sulfur and micronutrients such as iron, manganese, boron, molybdenum and copper. FloraMicro, the foundation or "building block" of the Flora Series system, provides nitrogen and calcium as well as trace minerals, which are essential for a comprehensive hydroponic plant diet. By adding FloraGro to FloraMicro, the plant will receive additional nitrogen and potassium, which stimulates structural and foliar growth. To stimulate flower and fruit development, FloraBloom is added to provide the necessary phosphorus, potassium, magnesium and sulfur.

### **Q: How do I mix the Flora Series?**

**A:** Always start with a reservoir filled with water, then add the concentrated nutrients one at a time. Never mix the nutrients together in their concentrated form, as this will cause nutrient "lock-out" making some minerals unavailable. It is best to begin by adding FloraMicro, stirring well, and then adding FloraGro and/or FloraBloom one at a time, stirring well before adding the other nutrient.

### **Q: What is a general purpose nutrient recommendation?**

**A:** The proper ratio of each Flora Series nutrient depends on the crop and the stage of growth (see [www.generalhydroponics.com](http://www.generalhydroponics.com) for specific recommendations for different crops).

### **Q: What TDS or EC readings should I expect when combining the Flora Nutrients?**

**A:** Using distilled water for our preparations and adding teaspoon(s) per gallon of each nutrient.

FloraGro:FloraMicro:FloraBloom:

Nutrient	EC (microS/cm)	TDS meter (ppm)
3:2:1	2.6-2.7	1300-1350
2:2:2	2.5-2.6	1250-1300
1:2:3	2.4-2.5	1200-1250

### **Q: Why is conductivity of the nutrient important?**

**A:** Conductivity is a measure of the strength of the nutrient solution. The higher the conductivity, the more dissolved solids there are in the solution. Delicate plants, cuttings, and seedlings can experience fertilizer burn if the conductivity is too high. Once the plants begin growing, they need a stronger nutrient solution, so conductivity must be increased by adding concentrated nutrient. Some plants prefer a milder nutrient strength, while others grow better and produce better quality fruit with a higher concentration. Generally, nutrient strength should run between 500 and 1500 parts per million (ppm). If you want to measure ppm you will need to purchase an EC or TDS meter. Before using your meter, calibrate it with General Hydroponics Standard Reference Solution. If you find that ppm is too high, add water to bring to a safer level. If you find the ppm is too low, add nutrient to increase ppm. When in doubt, remember that it is always better to apply too little nutrient than too much.

### **Q: How does conductivity effect plant growth?**

**A:** Conductivity is really a measure of the nutrients in the solution. Low conductivity implies a low nutrient concentration, which usually results in nutritional deficiencies and slow growth rates of your plants. One can look at the situation as a higher conductivity is more food for your plants. However, be careful of very high levels as this can burn and or kill the plant.

### **Q: How important is water quality?**

**A:** Water containing too much calcium and magnesium (called "total Hardness") may create serious problems. Contact your municipal water supplier who can provide you with an analysis of your water supply. If you are using well water, there are many laboratories that can provide you with an analysis if you send them a sample. If the dissolved salts in your water supply measure 200 PPM or more, we strongly recommend that you obtain a water analysis to determine calcium content. Excessive calcium is the main factor in determining if your water is hard. If an analysis of your water supply reveals that the Calcium content is greater than 70 ppm (mg/liter) you should use Hardwater FloraMicro. Hardwater FloraMicro provides rapidly growing plants with a combination of chelated micronutrients uniquely formulated for hardwater conditions. Other options are to collect rainwater, install a reverse osmosis filtration system, or use purified water. Do not use mineral or "spring" water, which can unbalance the nutrient solution or even be toxic to plants.



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