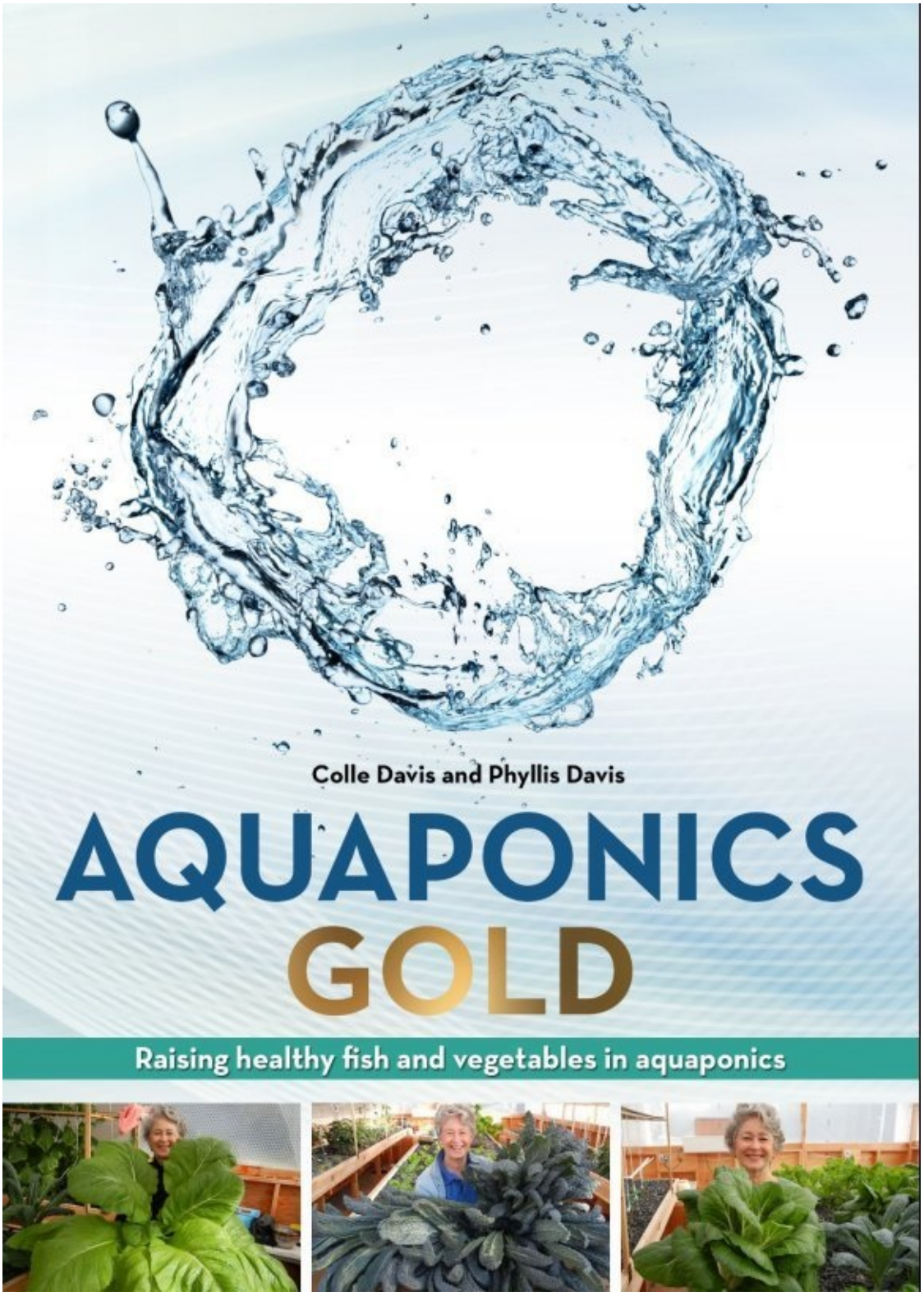
Colle Davis and Phyllis Davis

AQUAPONICS GOLD

Raising healthy fish and vegetables in aquaponics



Aquaponics Gold

- by Colle and Phyllis Davis

Inventors of Portable Farms® Aquaponics Systems (utility patent application filed December 24, 2013)

The inventors of Portable Farms® Aquaponics Syste their TRADE SECRETS for growing delicious food in aquaponics systems for the very first time. Take advantage of our 43 years of refining our own and our customer's aquaponics systems and learn from ALL of our mistakes so you won't have to make the same ones.

Learn how to care for your fish and then harvest and enjoy the fresh fish from your aquaponics system.

Let us show you how to grow healthy, pesticide free table vegetables for your family.

Grow Tables Unplanted

Grow Tables Planted – 40 days later

Portable Farms® Aquaponics Systems – 3 Modules in PFAS LLC's Research and

Development Center in San Diego, California USA

First Edition of this book, ***Aquaponics Gold***

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Written by Colle Davis and Phyllis Davis

http://portablefarms.com

PFAS LLC – Based in the State of Florida, USA, Published by Concept to Licensing LLC

About Us

Colle and Phyllis Davis and their utility patent-pending invention,

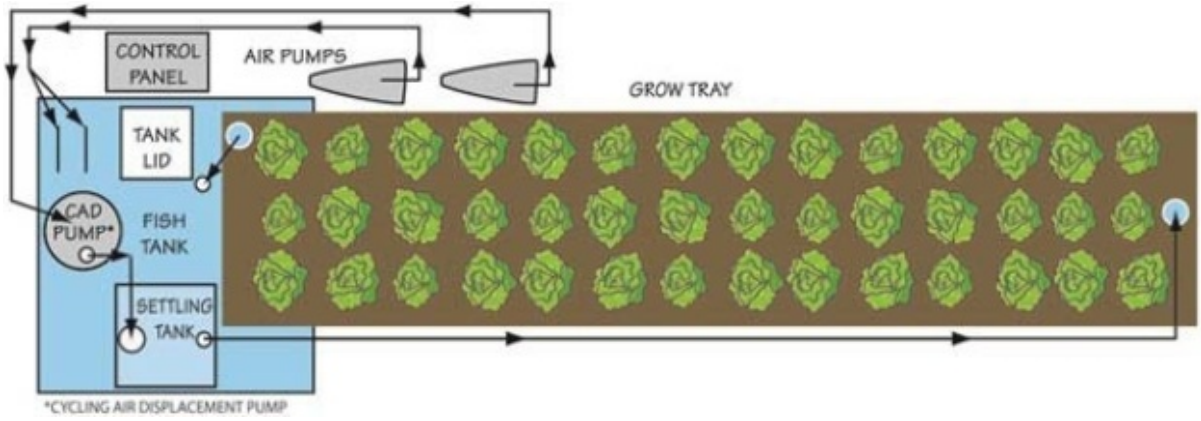
Portable Farms® Aquaponics Systems

Yearly Production from Portable Farms® Aquaponics Systems

A 100′ x 100′ (30m x 30m) unit produces 80,000 vegetables and 23,000 pounds (10,400 kg) of fish

A 24′ x 46′ (7.3m x 14m) unit produces 8,600 vegetables and 1,156 pounds (2,550 kg) of fish

A 10′ x 20 (3m x 6m) unit produces 1,100 vegetables and 400 pounds (180 kg) of fish



Drawing of a Portable Farms® Aquaponics System – 5’ x 40’ Grow Table

We have worked in every aspect of aquaponics from building and constructing backyard greenhouses, installing commercial aquaponics farms to working closely with our global customers to advise them how to grow healthy fish and a wide range of table vegetables.

It is a sad truth that we have inadvertently killed too many plants and fish over the years and as a result of these tragedies, we have learned from our mistakes. This book offers the solutions we have learned for avoiding common mistakes that are often made when working with aquaponics systems, so you can enjoy growing food for your family beginning on the first day you complete the installation of your working aquaponics system.

Phyllis Davis, harvesting bok choy. Average weight of each plant is 12 lbs.

As the inventors of Portable Farms® Aquaponics Systems, we have worked diligently in our Aquaponics Research and Development Centers in both California and Florida to experiment with fish varieties and fish care and seed selections and planting experiments for growing vegetables with simple techniques for maximum production in aquaponics systems. We have also worked closely with our global customers to help them determine seed varieties that are effective in aquaponics systems for their region and market.

As of today, Portable Farms® Aquaponics Systems have been sold in almost all 50 US States, in 10 Canadian Provinces and in 11 countries outside the US. Our customers have installed small aquaponics systems in their garages and basements and in small greenhouses in their backyard. They have also created community farms in greenhouses to feed several families as well as large ¼ acre commercial aquaponics farms for selling food locally to customers who want to buy the healthiest, pesticide food available.

To view the interior of a Portable Farms® Aquaponics System in a 2 minute YouTube Video, **CLICK HERE.**

To view Phyllis Davis' presentation of Portable Farms® Aquaponics Systems at an inventor's contest in Southern California (she was awarded 2nd place) in an 8 minute YouTube Video: **CLICK HERE.**

This book does not provide instructions for building a Portable Farms® Aquaponics System. However, if your goal is to build your own Portable Farm, please visit **Aquaponics University** to view the curriculum for the coursework.

The purpose of this book is to fill in the gap between the burgeoning varieties of technology available today for aquaponics and all the various growing techniques. It is our pleasure to offer many of our own time-tested and effective techniques for raising healthy fish and plants in aquaponics. Read the History of Portable Farms® Aquaponics Systems.

This book is dedicated to our global friends and customers who have grown along with us. Our persistence has been possible because of the generosity and support we have received from Lane McClelland, Laurie Roberts, Phil Estes, Richard Connor, Edgar Sanchez, George Spoerri, Debra Shetka - Attorney at Law, and many others along the way.

Presented by Lead Inventor, Colle Davis, Managing Partner, CEO, PFAS LLC

Presented by, Co-Inventor, Phyllis Davis, Managing Partner, President, PFAS LLC

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Introduction

Colle Davis holding three large India Mustard Greens grown with aquaponics.

This book presents the solutions to problems that we have faced while working in the field of medium-based aquaponics (gravel or substrate based systems) over many decades working with our customers from all over the world.

You will find important information in this book that is occasionally repeated for a better understanding of the materials in various contexts. There is a lot to learn about growing fish and plants in a closed loop aquaponics system and some of this information is not intuitive since aquaponics does not use soil as the growing medium for raising plants.

As various designs for aquaponics systems continue to grow in popularity, more and more attention is being devoted to various methods for raising healthy fish and vegetables. This book offers many suggestions to those interested in growing food in their own aquaponics systems.

The Future of Aquaponics

Aquaponics is trending and today, even city planners are focusing on funding for both hydroponics and aquaponics systems to create higher degrees of food security in large cities to feed their growing urban populations. Their plans include the use of vacant lots for the installation of attractive greenhouses and retrofitting empty warehouses for growing food year round with the addition of grow lights.

The future of food production in urban areas involves growing food in controlled-environments such as greenhouses or modified warehouses so growers are no longer dependent on weather conditions for growing food (drought, high winds, torrential rains, snow, hail, extreme heat or cold weather). Aquaponics farms are able to grow food year round and sell locally to a ready market. Plus, there is no need to use harsh chemicals or pesticides to protect their plants in the controlled environment.

Aquaponics has become a passion for many people. As a result, there are many designs for aquaponics systems available online as ‘open source’ (free) information for those interested in replicating an inventor’s system and installing their own aquaponics systems for growing food.

The population of the world is moving to cities (where the jobs are) and there is an increasing need for fresh healthy food grown locally for urban dwellers. **Aquaponics is**

the future for urban agriculture as well as a reliable food production facility for remote and desert areas and areas susceptible to desertification:

The day of the family-owned farm is changing as we speak because the average age of US farmers is 59 years old.

As Urban Agriculture becomes a key talking point for city leaders, it is because over 50% of the world's population currently lives in cities and healthy food is a vital necessity for its residents.

Currently, the statistics are grim for the topic of Urban Agriculture since only 5% of the world's food is currently grown in cities.

According to UN projections, 2/3 of the world's population will be living in cities by 2030 and Urban Agriculture must become a focus for current funding to install growing systems for its residents.

If growing and transporting food becomes an issue in a large urban area, it will create chaos (think New York City or Los Angeles). Urban Agriculture is at the forefront of discussions for large cities to create food availability for residents. And, as city planning committees consider alternative agricultural technologies, both hydroponics and aquaponics are high on their list of suggestions for funding considerations in the coming years. "Fresh, Locally Grown Food" is also high on the list of chef's options as well as those families who enjoy preparing healthy meals at home.

Aquaponics has been trending (albeit slowly) for about decade, but in light of drought issues in the South and Southwestern US as well as in other countries dealing drought issues, extremely harsh winters and issues related to flooding, investors and city officials are looking at new 'technology' as a way to add to community levels of sustainability by creating community farms as well as micro-farms for growing healthy food. More funding is now available to investors; according to **MicroEntrprise**, "Direct to customer neighborhood meals sales through community sustained farming (CSA), farmers markets and farm stands improved from about $600 million to $1.2 billion from 1997 to 2007. USDA approximates that farm-level worth of local meals sales amounted to concerning $4.8 billion in 2008 (1.7 percent of earnings from all farm manufacturing) and are expected to continue double-digit growth into 2015 as well as past."

In the twenty-first century, the world faces an environmental crisis, issues related to climate change (drought and flooding as well as record-setting heat waves) and an energy crisis. In addition, many parts of the world face severe food shortages. Twentieth century agricultural techniques have harmed the environment and consume an inordinate amount of energy and water. Many countries lack the large amounts of arable land and water needed to sustain growing human populations. Developed nations use large amounts of pesticides and artificial fertilizers to grow their grains, fruits, and vegetables. At the same time, they use huge amounts of gasoline and diesel fuel to power their farm machinery, large amounts of electricity to process their

food, and enormous amounts of fuel to deliver the processed food to grocery stores. The raising of farm animals, particularly cattle and swine, is notoriously inefficient in terms of the amount of land and energy required to raise corn and other animal feed for each pound of protein produced.

UN reports tell us that in 2012, for the 6th time in an eleven-year span, the world will eat more food than it produces. With 7 billion people in the world now and the expanding population growth of the projected 9.3 billion in 2050, there must be a shift towards vegetarianism and the option for farm-raised fish as a protein source for many, and a shift away from meat heavy diets, but this will take time. Growing crops to feed cattle, pigs, lamb or sheep take up more land and emit more greenhouse gases than producing crops for direct human consumption. In the 21st Century, food production accounts for up to 29 percent of man-made greenhouse gasses; twice the amount the United Nations has estimated comes from traditional ‘dirt’ methods of farming.

Many areas of the world, such as California, require elaborate and expensive aqueducts and irrigation systems to deliver potable water to farming regions. A tremendous amount of fresh water evaporates or is otherwise wasted with conventional farming methods. Third world countries often lack the financial resources, arable land and technology to produce sufficient food, and in particular enough protein to maintain the health of their human populations.

There are also health concerns raised by humans consuming pesticide residues on fruits and vegetables and hormones in chicken, pork and beef. Wild birds and animals are adversely affected by pesticide and fertilizer. Local waters (ponds, rivers, and streams) are also polluted by the runoff from the pesticides and fertilizers used for local growing.

Therefore, there is a need to promote a new “green” method of farming around the world for ‘locally grown food’ in any region to produce healthier food that requires far less land and water, and at the same time, is environmentally friendly:

- Eliminates the need or use of artificial chemicals
- Provides sustainability for people locally
- Substantially reduces energy consumption for planting, harvesting and shipping food, and greenhouse gas emissions.
- Also, provides jobs for local people strengthening the local economy.

Phyllis Davis harvesting two larges head of Bok Choy grown in aquaponics.

What IS Aquaponics?

So, let us begin with a simple definition of aquaponics:

Aquaponics is the growing of fish, or other water-based animals, along with land plants in a controlled environment, to maximize the use of the energy and nutrients in the system in order to harvest the greatest amount of vegetables and fish protein from the system.

The word aquaponics comes from words aquaculture, which is the cultivation of fish or other water- based animals, and the word hydroponics, where plants are grown in a sterile medium or completely in water.

By combining the fish, water and plants, aquaponics use an integrated environment to produce vegetables and fish in very small space, with very little water.

Aquaponics has its roots in ancient China and parts of the aquaponics system were developed in other areas of the world where high concentrations of people lived who were observant of the relationships that existed naturally in their environment.

In China, farmers knew that land livestock waste could be added to their fields or ponds to increase production of vegetables and fruit bearing plants. They also noticed that different fish had different tolerances to the level of land-animal waste in their water. For example too much pig or chicken waste caused many fish to die (the modern explanation for this is lack of oxygen) so they were careful about balancing their system for maximum yield and minimum fish loss.

These Chinese farmers were able to refine their systems so they could grow chickens in pens above pigs, (with the waste dropping through along with any spilled food) who were in a pen over a pond with carp in it, and then the water flowed to another pond with other less tolerant fish such as catfish, and perhaps other aquatic animals and certainly other water plants were grown and harvested. These systems were so called flow-through systems, meaning that water was used once through the ponds, and then released to the local paddies, streams, lakes or ocean. The sludge from the bottom of the ponds was used on the fields and some of the water was used in the paddies for fertilizer before it was released.

Aquaponics has been explored for several decades as a possible solution to the foregoing environmental, energy and food shortage problems. In aquaponics, fish and plants are grown together in an integrated closed loop re-circulating system with a very low rate of water usage or water loss due to evaporation. The fish waste (effluent) produced by the fish is delivered from the fish tank to a settling tank to remove the heavy ‘waste’ and then sent to the Grow Tables to provide a food source for growing plants in the gravel and the plants provide a natural filter for the water that keeps the fish healthy. This symbiotic relationship between the fish and the growing plants is the goal of aquaponics by creating a sustainable ecosystem in which both fish and plants can thrive and as a result, produces safe, fresh protein and healthy vegetables.

Aquaponics is simple, elegant and requires very little energy to produce high quantities of locally grown vegetables and healthy fish.

It is our pleasure to share our strategies to you regarding aquaponics.

Chapter One

An Overview of Aquaponics

A 6’ x 16’ Grow Table – Portable Farms® Aquaponics System – growing greens such as kale, Swiss chard and basil

There is a growing movement across the world to secure and eat organic or at least locally- grown foods to increase local economies and reduce the carbon footprint. This movement has become so powerful and wide spread that nearly every major supermarket in the world offers their customers locally grown food. This movement has also pushed seed sales to new heights as people plant soil gardens or install hydroponics or aquaponics systems to grow healthy vegetables for their families so they can control the quality of the food they eat.

Aquaponics is a cutting-edge and water saving technology to increase a family’s level of sustainability and health and by installing their aquaponics system in a greenhouse, families can extend their growing season year round and have complete control of what foods they grow and what they are feeding their family.

Question:

“How is it possible that aquaponics can grow such DELICIOUS and nutrient rich food year round?”

Answers:

In sunlight, plants use photosynthesis to turn CO_2 and water into oxygen and sugar.

In the dark, plants switch to the same system animals use to stay alive, the building and repair of the organism itself.

Added to this phenomena of growth, is the fact that as the temperature increases, chemical activity speeds up.

The closer to the ‘ideal’ temperature in a greenhouse, the better the chance there is

for the plants to grow to maturity. The ideal temperature for plant growth is, interestingly, 73° F at the leaf surface or about the same temperature as humans enjoy.

In a climatically adapted greenhouse, temperatures can be carefully regulated so the minimum and maximum temperatures are adjusted so the plants can comfortably tolerate heat and cold thereby creating the best possible conditions for growth.

Ideal growing conditions are provided in a greenhouse and in an aquaponics system for maximum crop productions:

All of the food (nutrients) for the plants arrives before the plants need it or want it.

The water is always available and is refreshed a couple of times a day

The light levels are always perfect in the structure

The air circulates in a gentle fashion to help with pollination and to help avoid dampness in the structure

The temperature is pleasant and varies a bit so as not to be monotonous

There are no bugs or weeds or poisons or harsh chemicals used to contend with, ever.

As a result of an ideal environment:

The plants grow faster than the seed packets say they will

Food grown in an aquaponics system is much healthier than ‘regularly’ grown plants, and as a result, they are healthier for you, they TASTE BETTER and are higher in nutrition.

The food in an aquaponics system is grown without any chemicals. Think about it; if chemicals were used, they would kill the fish.

The plants mature in less time and require 90 to 95% less water than their dirt-grown friends

The plants stay clean and dry at all times

The plants are harvested when they are at their peak of ripeness and maturation which means their flavor and nutritional content are always at optimal levels

They are simply the best vegetables on the planet.

Let’s begin with a few truisms about raising fish and healthy vegetables in aquaponics so you can begin to understand the process for ‘letting nature take its course.’ After all, we are growing food naturally by offering both the fish and vegetables compatible environments and ideal growing conditions so they will thrive in aquaponics.

Aquaponics requires no harsh chemicals, fertilizers or insecticides in the growing of the food.

A properly installed aquaponics system begins to provide healthy produce approximately forty days after installation.

Tilapia - Oreochromis mossambicus

An aquaponics system using tilapia provides a protein source (fish) within seven to nine months after the system is operational. At that time, they are generally 11” long and weigh 1.25 pounds.

Aquaponics systems use a minimal amount of potable water for food production (the average water requirement is reduced by 90 to 95% compared with conventional ‘dirt’ farming).

Aquaponics is capable of providing fresh locally grown food and food security for families, groups, and cities.

A well designed and properly built aquaponics system can be assembled and operated as a carbon negative installation.

To protect the vegetables from insects, birds and rodents, it is best to install an aquaponics system in a climatically adapted structure such as a greenhouse, enclosed garage or basement (although totally-enclosed structures must rely totally on grow lights since there is no natural sunlight).

We recommend your greenhouse location be positioned in a location with six hours of direct sunlight available.

Phyllis Davis holding one 22-pound head of Bok Choy grown in aquaponics.

In a well-designed aquaponics system with crushed gravel as the medium base, a Grow Table space of 25 to 30 sq. ft. will feed one adult their table vegetables year round – FOREVER.

Use the number of people you want to feed times (x) the 25 sq. ft. required for each person and the resulting figure will be the size of Grow Table space you will need. That's easy.

In the US, check with your State Authorities with the Fish and Wildlife Department and find out if tilapia is legal in your state. Tilapia are the fish of preference in ALL aquaponics systems in the Northern Hemisphere. They are a fresh water/warm water fish and they are very healthy.

Position your farm close to an available source of fresh water. This can be as simple as a garden hose or a waterline buried underground to keep it from freezing. There is very little evaporation inside the greenhouse because the water is not exposed to the air very much, but the plants transpire and literally pump water into the air to bring nutrient up to use. In hot weather, the plants in a Grow Table of 100 sq. feet can 'drink' up to 10 gallons of water per day.

Electricity also needs to be available inside the structure. This can be as simple as running an extension cord from the house or garage to the greenhouse. We strongly suggest that it be either buried or run through conduit underground or at least 8 ft. or more above the ground to prevent accidents with cutting or running over the wire. The best solution is to run the wire inside conduit and place it underground. If you have a friend who is an electrician, have them put in the electrical system for you and include three outlets for the control center, air pumps, exhaust fan and circulating fan and lighting and then when you have a harvest, offer them fresh vegetables in exchange for their services. Solar is an even better solution.

When you're dealing with living aquatic animals, they require daily care, attention and yes, even affection to remain healthy and grow to their full size. **If your fish are 'stressed' for any reason, they won't eat … and if they don't eat, they**

don't poop … and if they don't poop, your plants will not be healthy. So, if you're going to be gone for longer than a day or so, ask a friend or neighbor (that you trust) that will feed your fish.

15 operational aquaponics tasks include the following (many of these tasks will be discussed in depth in various chapters in this book):

1. Maintain adequate levels of water in the fish tank at all times.

2. Feed your fish a high protein fish feed each day (singing to your fish is optional but they do enjoy human contact and they do enjoy the sound of talking and singing).

3. Always wear disposable gloves when preforming tasks in your aquaponics system.

4. Keep the pH balanced in the Fish Tank and clarifier/settling tank under7.2 pH.

5. Stock the appropriate number of fish in the fish tank that is in balance with the area of the Grow Table.

6. 24/7 aeration provided for the fish at all times (bubbles).

7. Carefully control the water temperature range that is properly maintained within a very narrow range in the water in the fish tank – 78 degrees to 80 degrees F.

8. Monitor the movement of adequate water flow throughout the system that is delivered to the plants at various times each day.

9. Consistently plant seeds into starter medium until the seeds become seedlings after a 1 or 2 weeks. Then the seedlings are moved into the Grow Table to grow into healthy plants.

Then tend to the plants in the Grow Table during their growth period.

And harvest the plants when they are at their peak of perfection.

Then, on the day the mature plants in the Grow Table have been harvested (can be tricky and takes practice to plan ahead), plant new seedlings to replace those plants.

10. Harvest plants when the desired state of ripeness/maturity has been reached.

A tomato with Tobacco Mosaic Virus. They rot before they ripen.

11. Make sure that NO ONE is allowed inside the building that smokes (to avoid the dreaded Tobacco Mosaic Virus) or has dirt on their body, shoes or clothes

12. Perform routine maintenance on all mechanical or electrical components on schedule

13. Clean all surfaces in the building to keep the floors, surfaces and working areas clean and dust free. We recommend diluted vinegar water for cleaning surfaces.

14. Occasionally rinse off of the outside of the building if no rain has occurred in the last 60 days.

15. Carefully remove any dead or diseased plants as soon they are noticed.

Chapter Two

Here is a List of 17 Our TRADE SECRETS

This is a short list of Trade Secrets that are key to the success of growing food in Portable Farms® Aquaponics Systems. This list of Trade Secrets is discussed in greater depth in subsequent chapters of this book.

TRADE SECRET #1

The carrying capacity for fish in an aquaponics system is based on an absolute maximum of **1 fish per gallon of water** (1 fish per 3.6 liters), limited by the twice the number of square feet of Grow Table and this is based on the weight of the fish at the time of harvest. We recommend **not** stocking the Fish Tank to its capacity until you learn how to efficiently operate your aquaponics system.

Be very careful when applying this ratio. For best results, it is much better to err on the low side of fish stocking when calculating the number of fish required instead of pushing the system hard with more fish. Once you have a better understanding of how to deal with the higher nutrient loads produced by the excess fish and fish waste in the system, then you can experiment with higher fish loading. For example, if you have a 100 gallon Fish Tank, consider **starting** with only 50 tilapia in your Fish Tank.

TRADE SECRET #2:

To calculate the aquaponics systems' fish capacity for building your system, start by sizing the Grow Table to be built and then multiply the width (usually 5 to 6 feet) by the length (from 5 or 6 feet to 40 feet or even slightly longer) to find out how many square feet of grow space you have in the Grow Table.

TRADE SECRET #3:

To size the Fish Tank correctly, multiply the number of square feet in the Grow Table

times two to calculate the number of gallons needed for the Fish Tank size. The number of fish the system can support is also based on the number of square feet of Grow Table space times two, but this formula is applied more critically. Even though the loading rate for fish appears to be the same as the Fish Tank sizing it is NOT.

TRADE SECRET #4:

No matter how large your Fish Tank is, as long as it holds at least twice the number gallons as there are square feet of the Grow Table it will be the right size.

TRADE SECRET # 5:

The number one cause for stressed or sickly fish or fish problems is OVERFEEDING YOUR FISH. Only feed your fish what they will eat in 15 seconds. It is far better to UNDERFEED your fish than it is to OVERFEED YOUR FISH. By feeding your fish a type of feed that floats, you can monitor their feeding habits.

TRADE SECRET #6:

We feed our fish a high-protein 'catfish chow' that includes soy-meal as a main ingredient from local Feed and Grain Stores to feed to our tilapia. It generally comes in large 50 pound bags. However, for a small aquaponics system, you will not need much food for your fish and you might want to consider a small bag of fish chow by **Purina, Game Fish Chow** (32% protein) or **AquaMax by Purina Mills** (32% to 41% protein). Both are excellent fish feed available at most pet stores and you will raise healthy, happy tilapia.

TRADE SECRET #7:

Only feed the fish during the daylight hours.

TRADE SECRET #8:

We recommend **plastic food grade water troughs** for Fish Tanks. Call around to local feed supply stores and hardware stores in your area to find plastic food-grade water-trough tanks (not galvanized tanks unless you paint them with epoxy paint – the zinc is toxic to both plants and fish, plus they are known to leak). If you are very kind (it never hurts to smile and beg) to the clerks in the feed stores, they'll order you a tank to be delivered to their store so you can pick it up there. They have relationships with tank vendors and catalogues to order from those vendors.

If you can't find what you're looking for, shop online. Here's a good link: http://www.tank-depot.com/productdetails.aspx?part=HCP-AQ-100

TRADE SECTRETS #9:

It is vital you keep your Grow Table full of seedlings and plants at all times because the plants strip the nutrients from the fish waste before the water flows back into the Fish Tanks to keep the fish healthy. If you fail to keep your Grow Table planted to its maximum, your fish will suffer because the plants are not stripping the nutrients from the water. On the opposite end of the spectrum, if you keep your Grow Table full of

seedlings and plants and do not have fish in your Fish Tanks, your plants will suffer from the lack of the nitrogen provided by the nutrient stream (the poop).

TRADE SECRET # 10:

Temperature variances between fish and plants:

The temperature necessary to maintain growth and health for the plants and the fish is slightly different.

The fish prefer a warm water temperature between 78 and 85 degrees F, while the plants prefer 72 to 73 degrees F.

Aquaponics Systems work most effectively when installed inside a greenhouse structure for maintaining temperature and protection from bugs, birds and predators.

The tolerance levels for the fish and vegetables in an aquaponics system are also slightly different:

The fish can be kept in tanks as warm as 92 degrees F, yet they can survive water temperatures as low as the low 50's F. They stop eating when cold. We recommend using aquarium heaters in the Fish Tanks and insulating the Fish Tanks and clarifiers/settling tanks in cold climates.

The plants can stand higher temperatures (104 degrees F), and they simply stop growing at around 50 degrees F. If air temperatures remain below 60 degrees F, blossoms will drop and/or the vegetable will not mature to harvest.

Sudden changes in temperatures are not welcomed by either the fish or the plants.

TRADE SECRET #11:

Our motto: ABP which stands for Always Be Planting! Aquaponics systems are incredibly productive so make sure you are already planting seeds in growing medium to sprout into seedlings before the food in your Grow Table is ready to harvest (generally 10 days to 2 weeks prior to harvesting.) Remember the necessary balance of fish to plant ratio explained in Trade Secret #9.

TRADE SECRET # 12:

Because every inch of the space in the Grow Table is SO VALUEABLE, we recommend the installation of a simple trellis above the Grow Table so your plants (especially blooming plants like tomatoes, beans and cucumbers) will grow skyward and not crowd your Grow Table with vines and leaves. We recommend using 2" or larger plastic coated chicken wire. There are many choices for chicken wire ranging from plastic, wire or PVC coated. Your choice is up to you – just make sure it is has 2" openings so your plants receive enough sun and air. If the holes are smaller, you'll have problems with plants unable to grow through smaller holes. Here is a link to our website for photos and directions for installing a simple trellis.

TRADE SECRET #13:

Grow Lights are optional for use in an aquaponics system but the days are significantly

shorter from November to March (Northern Hemisphere) as if you want to receive the full benefit of your system's maximum production during winter months then the installation of 4 hours of T-8 Grow Lights will provide you a major 'bump' in your production (one light fixture of four T-8 bulbs per 25 sq. ft. of grow space). Add this extra grow time to the late sunlight hours (sunset) when the gravel is the warmest and the plants can derive the most benefit from the extra light. Grow Lights are also mandatory if your system receives less than six hours of 'direct' sunlight, or if it is indoors (warehouse) and receives no sunlight. We recommend a minimum of 10 hours and maximum of 18 hours of Grow Lights for indoor growing (plants and fish needs sleep too).

We repeat: Despite installing grow lights in winter months, if the air temperature inside a greenhouse structure regularly drops below 60 degrees F, most blooming plants (tomatoes, cucumbers, etc.) will not produce abundant blooms that create fruit/vegetables.

TRADE SECRET #14:

In many parts of the world, there simply is not enough year-round sunlight to meet the long-daylight requirements that certain crops require. In greenhouses, where sunlight is the only form of light, the gardener determines what can be grown by:

• Crop Type: Some crops require higher levels of daily light levels than others. This is known as the plants Daily Light Integral or DLI and is measured in Moles per Day.

• Time of Year: The hours of available sunlight or photoperiod, having been reduced in winter months, may not provide adequate DLI that had been at sufficient during summer months.

• Region: **There are well established charts** that show how much sunlight is available based on region and time of year. When choosing crop types for your aquaponics system, it is important to determine if adequate sunlight levels are available in your area for the desired crops you wish to grow and decide at what times of the year those levels are available.

If year-round crop production is desired in areas where adequate sunlight levels are not available to meet these needs, then supplemental lighting systems allow the grower to meet the crops DLI and are a necessary addition to the aquaponics system.

TRADE SECRET #15:

Be sure to install shade cloth (70% - allowing in 70% of sunlight is average strength) above the Grow Tables. Some people install their sun shade on wires so it can be moved over the entire growing area allowing the small plants to be protected and then the larger plants are able to receive full sunlight when they are large enough to cover most of the gravel. It's up to you. Placing the shade cloth on wires allows much more flexibility and is highly recommended.

TRADE SECRET #16:

If your farm water is low in nitrates, you can also adjust the feeding of your fish to adjust water quality in your farm. If your system is low in nitrates, feed your fish MORE food to balance the system. If there is too much ammonia, decrease the feed.

TRADE SECRET #17:

FISH POOP IS NOT ENOUGH for growing healthy blooming plants. FF Mineral Rock Dust provides aquaponics growers the perfect balance of many trace elements not consistently available from just plain ordinary nitrogen-rich fish poop.

Now you can consistently grow blooming plants (year round) with the addition of FF Mineral Rock Dust because your plants will receive 57 nutrient-rich elements along with the fresh available nutrients in your fish poop to grow healthy plants. Now your plants will receive adequate levels of **calcium, iron, magnesium and potassium** which are just four of the vital elements necessary to produce healthy green plants for growing food.

Chapter Three

Growing Healthy Vegetables in Aquaponics

Kohlrabi in aquaponics

Aquaponics is capable of growing most greens (lettuces, bok choy, basil, Swiss chard, kale and other herbs, etc.) and many blooming plants such as tomatoes, cucumbers and beans.

Aquaponics systems that use crushed gravel in their Grow Table as the substrate are not designed to produce starches or grow root vegetables such as potatoes, onions, carrots, beets, radishes, etc. (believe me, we've tried a dozen times). However, we have had some luck with growing kohlrabi (photo above) which creates a large edible bulb above the gravel's surface.

FF Mineral Rock Dust

FF Mineral Rock Dust provides aquaponics growers the perfect balance of many trace elements not consistently available from just plain ordinary nitrogen-rich fish poop.

Please note: PFAS LLC does not ship FF Mineral Rock Dust outside the United States except for a minimum order of 2200 lb. /1000kg tote plus shipping charges (sea freight).

Photo 1: FF Mineral Rock Dust. It looks like chocolate talc. It's very light and powdery.

(FF Mineral Rock Dust spilling out of a salt shaker onto a dinner plate).

After many years of examination, legalities and testing, this mineral rock dust has been *Certified as Organic* by the Department of Agriculture.

This FF Mineral Rock Dust is designed to be FISH FRIENDLY when applied at recommend rates of use.

This FF Mineral Rock Dust contains NO nitrogen which is already being generously supplied by the fish waste from the fish in your Fish Tank so the combination of the freshly produced nitrogen from the fish waste and the many macro and micro mineral elements in the FF Mineral Rock Dust provides the perfect combination for growing healthy plants in aquaponics systems.

The use of FF Mineral Rock Dust keeps you from playing the 'chemical numbers game' and constantly guessing whether you're doing it correctly. By sprinkling FF Mineral Rock Dust on your seedlings prior to planting, you'll never have to ask yourself ANY of these questions:

What nutrients should I use to solve a variety of growing issues in aquaponics including consistently blooming plants?

- How much you should I add to my aquaponics system?
- Is it safe for my fish?
- How often should I be adding chemicals to my aquaponics systems?

The FF Mineral Rock Dust we recommend is an organic amendment or addition to a system that is safe and effective to use in aquaponics systems. This pristine mineral product is used by Certified Organic Growers and is 100% Organic and 100% Natural. FF Mineral Rock Dust is not widely available and is found only in limited quantities drilled deep from a mountain in Europe; it is mined and shipped on as-needed basis. PFAS LLC is very fortunate to have a trusted supplier who oversees all facets of the shipments and legal agricultural grading of this quality product. Each batch that is mined and shipped to the US by shipping tanker must then be tested and overseen by our supplier through the Department of Agriculture. It is a complex and arduous process.

The minerals in FF Mineral Rock Dust are vital to growing both green plants and blooming plants in every stage of growth: Seed planting, root development, plant growth, plant health and plant blossoming. The use of this FF Mineral Rock Dust produces plants that are healthy during every stage of growth and development. This product is also environmentally friendly and does not pollute nor does it 'burn' plants or harm fish (if used as directed).

But please, use as directed to assure fish safety.

After the initial planting of the seedlings that have been sprinkled with FF Mineral Rock Dust, don't be surprised if the water in your fish tank becomes lightly colored like iced tea. This is normal.

One of the expressions we use frequently regarding planting in our Portable Farms® is, "If

a plant has a ‘happy childhood,’ it will grow to be a healthy plant.” And it’s so true. If you take care of every stage of planting your seed, lovingly growing a seedling and placing it into your Grow Table, you have a *far better* chance of growing a healthy plant. If any step of this process during ‘childhood’ is neglected, you will be disappointed with your growing efforts.

The first three weeks a seedling is growing in your Grow Table (especially true of all greens like Lettuces, Swiss chard, Asian greens, etc. which are harvested at around 40 days), the plants LOOK SMALL because the plant is spending all its time and energy growing a strong healthy root system underneath the gravel. Then, during the second three weeks of growth, the plants grows visibly each day (like magic) until they reach their full maturity at 40 or 45 days.

Caveat: All electrical pumps have a finite life span. In technical terms, this is called *Mean Time between Failures*. The FF Mineral Rock Dust, if applied correctly as per instructions will not hasten this process. PFAS LLC recommends the replacement of electrical water pumps in your systems on a regular basis (generally annually).

If you find your own supplier for FF Mineral Rock Dust then please order from them. If not, please visit our website: **CLICK HERE**. Call for more information: 239-14-7092 (Skype).

Plant your seeds **within two weeks of the time** you expect to complete your installation of your aquaponics to be completed which, in most cases will take a few days to build to build your system so PLANT YOUR SEEDS ASAP.

After the seeds have begun to sprout, and after your farm has water running through the Grow Table, you can plant each of the small seedlings into the gravel deeply enough so that the gravel reaches to the top of the shoulders of the cubes.

We strongly suggest you plant in waves so you can enjoy an ongoing harvest.

FIRST ROUND OF PLANTS IN A NEW AQUAPONICS SYSTEM: We recommend the first planting in your new aquaponics system include ALL GREENS (lettuces, basil, Swiss chard, bok choy, kale, etc.) and not to include any blooming plants (tomatoes, cucumbers, peppers, etc.) until after you harvest this first batch of greens.

This 40 or 45 days of growing and harvesting ‘only greens’ allows your system to ‘cure’ and raise the nitrogen level in the fish tanks (with your baby fish’s precious poop) in order to balance the pH in the system for maximum growing. This first round of greens encourages the growth of bacteria in the gravel to change the nitrites to nitrates to protect your plants from nitrite poisoning and enhance plant growth.

ALWAYS BE PLANTING: A.B.P. – Your new mantra

Photo 2: Oasis Horticubes are a Planting Medium Designed for Aquaponics and Hydroponic Growing

Place one seed in each cube. We buy our Oasis Horticubes from Hort Americas.

Photo 3: These rock wool cubes are also commonly used for planting and growing plants in aquaponics and hydroponics systems and available at most hydroponic stores or online. Both wrapped (plastic exterior) and unwrapped rock wool cubes have been used in aquaponics for both seed planting and cloning purposes. We suggest you experiment with both wrapped and unwrapped to see which cube works best for you.

Rock wool is a soilless growing substrate. According to Greentrees Hydroponics, rock wool is made from melted basalt rock and chalk. The materials are combined and heated to a melting point, after which they are spun and compressed into a mat. Rock wool is “chemically and biologically inert” according to the hydroponics products distributor, and one advantage is that it does not “modify or restrict the availability of nutrients to the plants.”

Please note: Oasis Horticubes are not the same Floral Oasis. They are both porous and lightweight but Floral Oasis is made with the addition of toxic chemicals that can harm your fish.

We recommend the 1 inch Oasis Horticubes (Photo 2) which have an extremely porous design and it makes them particularly suited for starting plants by seed. They are completely pH neutral; the cubes have no fertilizer built in them, so organic growers use them for starting seeds.

Oasis Horticubes provide a clean medium for crops requiring high water usage. Frequently used for hydroponic and aquaponics seed germination of vegetables, herbs, and flowers, its unique design allows for drainage of excess water from the base of the seed. These cubes are free of pathogens, providing an environment that reduces disease and insect problems.

Let’s begin with the basic steps for planting seeds which you will ‘transplant’ into the gravel of your Grow Table when your seedlings are 1 ½” to 2” tall.

We have found around 300 seed varieties can be grown in aquaponics (for example, a dozen varieties of basil, a dozen varieties of tomatoes, etc.) but many vegetable plants prefer to be grown in a *drier-sandy-garden soil/dirt.* For example, we’ve never had much luck growing zucchini and squash or melons in aquaponics because they prefer a drier-sandy-garden soil with maximum levels of mid-summer and early fall sunlight. Yes, we **have grown them** in aquaponics, but with less success than we had hoped because of blossom drop, vegetables not forming, or the vegetables form but are stunted and fail to grow to full harvest size.

We don’t recommend growing perennials in aquaponics either. For examples, asparagus, strawberries or blueberries because they only blossom/sprout only once per year and the rest of the year they lay dormant but their roots continue to grow and then those roots begin to rot in the gravel.

In fact, we don’t recommend any plants stay in your Grow Table beyond the time the plant stops growing and reaches maturity or when the plant stops blooming and producing food. For example, tomatoes grow **massive root balls** (that resemble a large flat basketball) between five and six months after they begin producing fruit in the Grow Table and should be removed from the gravel. **Why?** Two reasons:

One, **the root ball has begun to rot** and will (magically) begin to produce ants, aphids and earwigs that begin to eat on the decaying root ball.

And two, because **large root balls impact the flow of water** in the Grow Table and can cause problems for other plants in the Grow Table. If you leave plants in the Grow Table longer than necessary to produce food, you are inviting problems for your entire aquaponics system.

Read the planting distance (between seedlings) on the seed envelope. Some plants need to be planted 4 inches centers and some plants require 10 or 12 inch centers, etc. of spacing so lay out a simple grid on a pad and decide what seeds you’d like to plant in your Grow Table. It’s fun to mix and match and see what you enjoy growing and what you’re family likes to eat. For example, WE LOVE BASIL so I plant a few basil plants year round. We also enjoy growing our own lettuces and of course, tomatoes.

Here is a list of *common* vegetables that are easily grown in aquaponics, but feel free to experiment with different varieties. Remember, aquaponics is not conducive to growing root crops such as potatoes, onions, carrots, or beets in aquaponics because they cannot grow well (to maturity) under the heavy gravel in the Grow Tables.

All varieties of basil; our favorite taste is Genovese

Pac Choi (like Bok Choi)

All varieties of cucumbers but our favorites are Lemon Cucumber and American Slicing Cucumbers

All varieties of lettuce – our favorites are bib/butter, Romaine, and red lettuce.

Leafy Asian Greens of all varieties – EXPERIMENT! We love to grow at least a dozen Asian greens and they're all so rich in taste and high in nutrients. Tokyo Bekana, Red or Summerfest, Komatsuna, Vitamin Green, Shiro, Flamingo.

Kale and our favorite variety is Toscano

Swiss Chard – red or multi-colored

Tomatoes – cherry or large tomatoes (depends on your choices for taste. Here is a short video from Burpee Seed Company explaining the difference between determinate and indeterminate tomatoes. http://www.burpee.com/vegetables/tomatoes/tomatoes-determinate-and-indeterminate-types-article10648.html

We like the taste and longer season of blooming and tomatoes that indeterminate tomatoes provide (instead of determinate), but you must very vigilant about pruning back the vines of the indeterminate plant or they will overtake your farm with foliage so repeat after me, "I promise to prune, prune, prune."

Mustard Plants – Red Mustard, Green Wave Mustard (tastes like wasabi). These plants grow large and luscious and delicious.

Peppers – Green peppers, banana peppers, hot chili and jalapeno peppers. Peppers do **NOT** grow quickly nor do they bloom quickly or produce peppers quickly, so be prepared for them to stay in the Grow Table for several months. They grow faster in the summer months. If you have patience, you'll enjoy growing peppers. If not, plant quickly growing plants like greens.

Green beans - We enjoy all varieties of green beans but don't plant too many because their vines grow 20' to 30' long.

ALWAYS BE PLANTING: A.B.P. – Your new mantra

NOW IS THE TIME TO SPRINKLE YOUR FF MINERAL ROCK DUST ON YOUR OASIS PRIOR TO PLANTING YOUR SEEDS (Photo 3).

Photo 4: Sprinkle the FF- Mineral Rock Dust lightly over the Oasis Growing Medium

Photo 5: After you sprinkle your FF - Mineral Rock Dust on your growing medium, use fish waste water if it's available (if not, slightly warm tap water is fine) to pour over the Oasis.

Photo 6: After you have added water to the Growing Medium, tilt the tray into the Grow Table or a sink and drain out excess water into a sink or the Grow Table before seed planting or your seeds will drown. You only want the growing medium to be very moist but not submerged.

Your Oasis should be placed in a waterproof plastic tray but make sure the Oasis has air on the bottom (underneath it) so it drains well {**Photos 6-11**}. Tiny roots will sprout out of the bottom of the Oasis before you'll see growth out of the top of the Oasis so you want to make sure there is 'air' for the new roots to breathe. If there is water in the bottom of the Table, you're baby plant will literally drown before it has a chance to sprout. This requires the Oasis doesn't sit directly on the bottom of the tray. You have a couple of options (or be creative and develop your own method, please):

Photo 6: Plastic with openings -find at hydroponic stores - Photo 7: Slotted plastic in a tray (Dolly the dog photobombing Photo 7)

Photo 8: Lay Oasis Cubes in tray

Or you can roll foil to elevate the Oasis in the tray or go wild and use the material in Photo 9.

Photo 9: Roll aluminum foil and then ‘flatten roll’ by hand

Photo 10: Place Oasis in Tray.

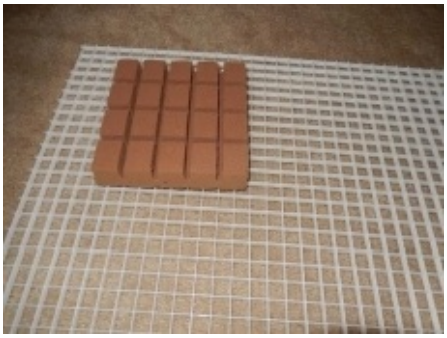


Photo 11: Light diffuser for fluorescent light fixtures

These diffusers can be purchased in lighting sections at hardware stores like Home Depot or Lowes. This is my favorite choice for the oasis and it can be cut to fit the size of the tray you will use to place your Oasis. I use a large tray with handles for moving it easily. I wash it after every use so I can reuse it again when I replant seeds.

Not all seeds that you plant will sprout, so always plant a few more than you think you’ll need. And, since food grows rapidly in aquaponics, it’s vital that you plan ahead for replanting a new seedling that’s 1.5” to 2” tall the instant you harvest a plant from your farm. Harvest. Replace. Harvest. Replace. Harvest. Replace. Etc., as long as you want to grow food.

Also, please check the expiration date on your seeds. If they are past their date for planting then throw them away and buy new seeds. I know, surprise, but seeds do not last forever and generally, a year from the date they’re packaged is all a seller will guarantee them. Even then, the packet will state, “85% guaranteed to spout,” etc. So study the packet and plant accordingly.

After you CAREFULLY drop the seeds into the Oasis, it’s time to shred the edge of the

Oasis so it makes the interior of the Oasis ‘cover’ the seed slightly and makes it ‘dark’ in the center of the Oasis. Just take a small stick and go to each ‘hole’ and slightly shred the edge of each hole so it ‘collapses’ a bit and since the Oasis is damp, it’s very easy to do.

Photo 12 – Shred the Oasis’ top edges to create darkness above the planted seed.

Look closely and you’ll see where we’ve shredded the Oasis a bit around each hole to cover the seed. Not hard. Not time consuming but it requires patience and precision. (Calming music and no coffee are both good ideas during planting.)

Learn to “Think like a Farmer”

If you and your family eat 4 heads of lettuce (for example) per week, you’ll plant five or six seeds one week to get four good seedlings out of the planting. The next week, you’ll plant five or six new seeds. The next week you’ll plant five or six new seeds, etc. until you reach the 7th week and every week thereafter that you’d like fresh lettuce.

As the seeds sprout to 1 ½” tall, you’ll plant four of the new seedling/plants during week one. You’ll plant four the next week. Four the next week etc., until you’ve reached the 7th week, at which time you’ll begin harvesting your lettuce from week one and YOU WILL REPLANT A NEW SEEDLING IN IT’S PLACE. You’ll repeat this process as long as you’d like to eat fresh lettuce from your aquaponics system.

7 weeks in Grow Table

6 weeks in Grow Table

5 weeks in Grow Try

4 weeks in Grow Table

3 weeks in Grow Table

2 weeks in Grow Table

1 week in Grow Table

We use Wooden Deli-Picks as my markers in the Oasis which can be purchased at restaurant supply stores (WEBsurant Store, or Smart & Final on the US-West Coast, etc.). Remember to use waterproof ink (permanent markers) on your wood sticks. You'll throw these sticks away after you harvest your plants and you will NOT reuse them. They'll be very damp from multiple waterings during the plant's lifespan and they are not reusable.

Photo 13 and 14 – Deli Sandwich Picks to use to mark your seeds planted in the Oasis.

Photo 15 – Planted Oasis about a week after planting.

Some are ready to plant now. Some will be ready in a few more days.

Even though you presoaked the Oasis prior to planting the seeds, NOW IS THE TIME to give them a small second watering of warm fish waste water (if you have it, if not, then tepid tap water). Avoid getting the stick wet if possible. I use a pointy-nosed watering pitcher to water the top of the Oasis. Make sure you drain the tray (tip and pour) after this watering so the cubes not standing water in the bottom of your tray.

Photo 16: Narrow Nose Watering Bucket to water only seeds in Oasis and not the Deli Sticks.

Next**, keep your newly planted Oasis in a dark place for 24 hours**. I generally put the seed tray in a black plastic bag and then place it in the bottom of a closet on the carpet, or on a piece of wood or on Styrofoam to keep the Oasis WARM. Do not place your Oasis seedlings on cement, granite counter top, metal or outdoors (regardless of the season).

Keep your Oasis moist and wait for root development. Do not overwater. I LIGHTLY water the Oasis in the 'nursery' about every 2 days (depending on the season – I water more if the weather is hot and dry). Depending on the plant, different seeds take longer to sprout. When the new seedlings are 1 to 2"tall, simply cut the individual cubes with a knife and transplant the entire cube and seedling into the gravel.

For faster seed sprouting in cool temperatures, I also use a thermostatically controlled ‘seed heating pad’ in cool or cold climates. Place pad under the newly planted seeds to maintain their temperatures between 75 degrees F and 80 degrees. There IS a slight trick to remember when using a heating mat (also called propagation mats), so be forewarned that the heat causes the water in the Oasis to evaporate more quickly and you are required to keep a vigilant eye on the plantings to assure they have enough water so you don’t dehydrate and kill (cook) the seeds or the young plants. Lots of stores sell seedling heating mats so do your research to find a simple, affordable one. (Many people use heating pads or electric blankets but please be careful the seeds don’t get above 80 degree F, or you’ll kill your seeds.)

Here is an Amazon link to a ViagrowTM Seed Propagating Seedling Heat Mat, 20.5” X 8.5”:

Product Features:

Warms root zone 10° - 20° above room temperature

Speeds germination and encourages strong root growth

Fits snugly under a standard size seed Table

High quality, water resistant construction

For precise temperature control

To buy Oasis Horticubes in small amounts is not easy because generally, they are sold in large boxes for commercial growing. You can get them in small amounts at a few places so ‘Google search.”

The following companies offer Oasis Horticubes in various size/amounts.

Hort-America

Greenhouse Megastore

Growers Solution

Paradigm Gardens

Or, enter “Oasis Horticubes” in a search engine (Google, Yahoo, Firefox, Opera, etc.) for more selections.

It’s been our experience that we almost force ourselves to *plant too much* to stay up with the demand of harvesting our vegetables, because if we don’t, we find that we must wait several days for new seeds to sprout. So, *think ahead*, choose your seeds and decide how many you want to plant and where you want to plant them in your Grow Table. If you’ll ‘think like a farmer’ you’ll be happier with your unit because it can only do what you tell it to do.

It’s a common mistake for early farmers to wait too long to harvest or plant too much of one vegetable and then they are required to give away the surplus. PLAN AHEAD. Make planting- and-harvesting-calendars so you can maximize your production.

BEFORE you plant your seedlings into the gravel in the Grow Table, WATER THE OASIS WITH TEPID WATER FIRST before you plants them so it's less of a 'shock' to the roots when you place them in the gravel.

Continue to check each plant each day to make sure that the Oasis for each seedling is still damp. I recommend you continue to water your plants with a watering pitcher - by hand if necessary - for the first few days or a full week after they are planted in the gravel in the Grow Table (especially in the summer months and/or dyer climates). It takes the seedlings a few days for their roots to grow deeply enough into the gravel to reach the warm, nutrient rich water that fills the Grow Table. If the water stays in the Grow Table instead of draining after flooding, it will drown your seedlings and they will all die. We flood and drain our Grow Tables twice per day (It takes about 40 minutes to fill a 20' Grow Table and about 2 hours to drain the Grow Table back into the Fish Tank – twice per day). Plus, during summer or warm weather, the gravel is warm and the heat from the gravel can dry out your Oasis quickly. Once the roots are long enough they can grab water and food for themselves; then the Oasis can be dry to the touch and it's okay.

Photo 17 – Horticubes with seedlings

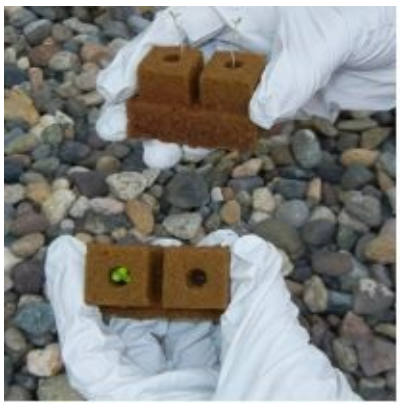


Photo 18 – Separating Horticubes

Photo 19 - Seedlings in Horticubes

Photo 20 – Creating hole for Horticubes seedling

Photo 21 (left): Push the gravel away to make hole Photo 22 (right): -Insert the cube into the gravel and surround it with gravel. In fact, add a few more pieces of gravel around the edge by planting it a bit deeper than I did the one in the photo above.

Please consider proper spacing on your plants when planting seedlings in the gravel. While it may seem like too much space to place your plants 10” to 12” apart (for example), you must follow the directions because if you plant too closely, the air doesn’t circulate well in the Grow Table and your plants will NOT grow well and you’ll find mold on your leaves.

If you place your blooming plants too close together, when they mature, they will not blossom and produce food. Generally, the seed packet will tell you how far apart you should plant because each variety of each plant requires different spacing; some grow wider, shorter, taller, etc. than every other variety, so take your guidance from the seed-packet instructions. While your Grow Table may look sparse after planting, very quickly, it will look full and lush. In fact, plant any plant that BLOSSOMS 10” to 12” apart so they’ll have ample sun, air flow and room to spread out and produce more food.

Remember, even though aquaponics grows a wide variety of food, you still need to keep in mind that some food likes to be grown in cooler *air temperatures* (cooler weather and early spring) and some like to be grown in warmer air temperatures (late spring, summer and early fall). If you have a well-built acclimatized greenhouse that cools in summer and heats in winter in extreme climates, you are less impacted by the seasons if you can use grow lights above your plants from November to March (Northern Hemisphere), you can extend your sunlight for your plants from 4:00 PM to 8:00 PM. But, still, it’s easier to grow vegetables that are relatively seasonal.

Aquaponics systems can easily rely on installing simple **T-8 Fluorescent Lights** hung above their Grow Tables from November to March (Northern Hemisphere) from 4-8 PM. This extended day will give you the ‘bump’ in production equal to about 20%. Here is an example of lights and fixture that we have used successfully and are available at Home Depot. You will need one 4-bulb fixture per 25 sq. ft. above the Grow Table.

Product specs for (link above) light fixture:

Energy efficient T8 fluorescent technology

A detachable wire guard protects the bulbs

12 in. reflector

Pull chain power switch

5 ft. power cord and grounded convenience power outlet (max. 5A)

Heavy duty metal housing in a textured gray finish

Requires four 32 watt T8 fluorescent bulbs (sold separately)

Suspensions mount from ceiling using the included mounting chains

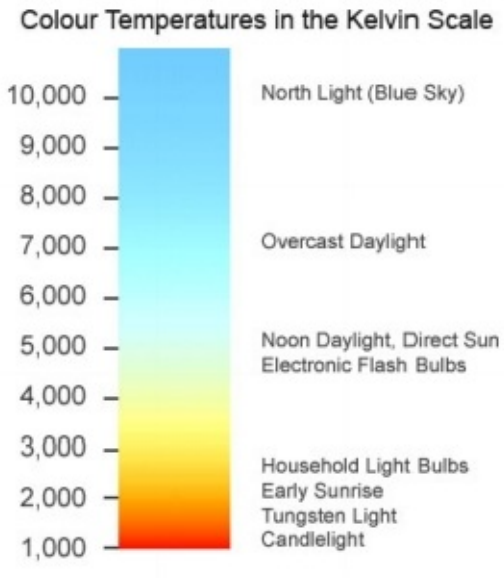
CUL listed to US and Canadian safety standards

Starts reliably down to 0 degrees Fahrenheit

Actual Color Temperature (K) 6500

Assembled Depth (in.)	48.25 in
Assembled Height (in.)	4 in
Assembled Width (in.)	12 in
Certifications and Listings	4-UL Certified, ETL Listed

PLEASE NOTE: Typical fluorescent light bulbs are not as effective for growing blooming plants (tomatoes, peppers, etc.).



The four T8-bulbs REQUIRE a total of 128 watts of power and for best results use the 6500 Kelvin tubes which are labeled as SuperNatural Sunlight for effective growing.

Choose your seeds carefully to grow healthy plants. For example, many varieties of lettuce prefer cooler temperatures and other varieties are far more tolerant to warmer temperatures and the seed packets say, “heat resistant seeds.” Study seed catalogs and study the descriptions carefully when choosing your seeds. This may take some online

study and research as you determine seeds you'd like to grow in your climate, per season.

Consider ordering a seed catalog or visiting websites from seed companies to study the growth time from seed to maturity/harvest, how large a plant grows, etc. We recommend ordering a catalog from Johnny's Seed and visiting the websites of Ferry-Morse Seeds and Burpee seeds. Of course, there are many fine seed companies and we buy from many of them, but these three companies offer many organic (around 400 or more choices for organic seeds) and non-organic seed choices and they're all very helpful on the phone if you need advice when ordering and making your selections.

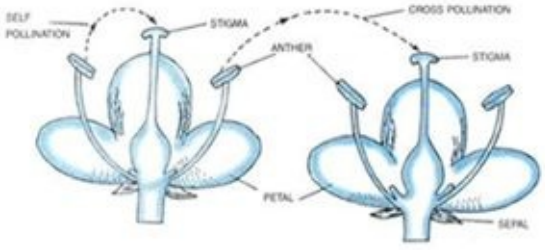
If you are not in the US, find local seeds in your country to purchase since these companies will not ship seeds out of the US due to customs 'issues.'

Experiment with seed varieties before planting too much of any one plant. For example, choose a wide variety of seeds for lettuce, basil, tomatoes, chards, etc. before you plant too many of them. Allow yourself time to learn how to plant and how to harvest.

It takes time to learn how to address issues in your new farm because of many variables:

Watch your pH balance and keep it **under 7.2**. For example, lettuce prefers to be grown best at a low 6.0 to 6.2 pH level.

Important Lesson: SIMPLE Indoor Pollination Techniques



Plant's blossoms open in the morning after the sun is up in mid-sky and then generally close late afternoon. Please note: The majority of blooming plants capable of growing in aquaponics are ALMOST self-pollinating plants such as tomatoes, beans and peppers. But, since we're growing food indoors (greenhouse, garage or basement, etc.), you'll need to give Mother Nature a little support by installing a circulating fan to move the air when the blossoms are opened the widest during the mid-day time of day (10 AM to 2 or 3 PM). Continue to keep the fan moving during these until a few days before harvest. IN FACT, we always recommend you keep a fan air circulating near your farm to discourage mold or mildew on your leaves. After all, the water is the Fish Tank is WARM (78 to 80 degrees F).

We also recommend gently shaking the stalks of the tomato plant, bean or pepper plant to agitate the blossoms for increased pollination during the mid-day when the blossoms are opened the widest.

Cucumbers are not considered self-pollinating but a fan seems to be enough to move the pollination from the stamen to the pistils.

While an electric toothbrush is a fun pollination tool, it's only used in commercial farm operations. Here is a great lesson from this innovative gardener who shows you how to encourage pollination for your self-pollinating plants like tomatoes and peppers with the use of an electric toothbrush. Brilliant. It doesn't disturb the stamens (male) or pistils (female) and provides ample pollination for your plants. BE GENTLE or it over stimulates the blossom. You don't need an electric toothbrush method in your Portable Farms® Aquaponics System. Just shake the branches of your plants mid-day to help pollinate your plants every few days.

Planting and harvesting are an ongoing process and you never actually *catch up*, you simply stay up with an incredibly productive aquaponics system.

Chapter 4

The Fish and the Support of Their Health and Growth

Photo 1: Tilapia

Photo 2: California Hybrid Tilapia

Fish Stressors to AVOID or your fish will not eat or poop consistently:

As we mentioned, temperature changes in the Fish Tank is a fish stressor. We recommend aquarium heaters to help maintain the water temperature of 78 to 80 degrees F.

Depriving your fish of air bubbles in the tanks will stress your fish. Even an HOUR of oxygen deprivation stresses the fish (especially when air temperatures are hot).

Overfeeding your fish or feeding your fish too often will stress your fish. The number one cause for stressed or sickly fish or fish problems is OVERFEEDING YOUR FISH. Only feed your fish what they will eat in 15 seconds. It is far better to UNDERFEED your fish than it is to OVERFEED YOUR FISH. When your fish are small (less than 2” in length) feed them a pinch of food several times per day and no more. For example, if you have 50 fish in a 100 gallon Fish Tank, feed them 1/8th of a teaspoon of a high protein koi fish flake food (available at pet stores) four times per day (always in daylight hours). When they’re 2” long, we’ll grind up catfish chow to feed them one tablespoon three times per day. They’re babies and should be spoiled and fussed over with lots of ooohs-ahhhs and baby talk when you feed them.

Photo 3: Tilapia

Colle Davis balks at allowing us to publish any photos of ‘dead fish’ because we care for our fish and yes, we even love them. We do offer sketches, drawings, renderings, and we publish photos of uncooked tilapia filets and cooked tilapia but we don’t publish pictures of dead fish. But, we convinced him to allow us add this one stock photo (that we purchased) to show you a close-up of a tilapia. At first glance, you will see they’re not the ‘prettiest girl at the dance’ and they don’t have glamorous features or grand coloring, but they are a very happy and healthy fish and a pleasure to work with in aquaponics.

PFAS LLC does NOT breed or sell fish. We buy our 1″ tilapia “fingerlings” from local tilapia breeders.

In the US, contact your State’s Fish and Wildlife Department for local tilapia breeders in your area. For those of you in the US, here is a list of fish breeders by State provided by the Federal **Fish and Wildlife Department**. Of course, these are not the ONLY breeders/hatcheries, but you can begin to make calls and do your own research.

Alabama	Hawaii	Massachusetts	New Mexico	South Dakota
Alaska	Idaho	Michigan	New York	Tennessee
Arizona	Illinois	Minnesota	North Carolina	Texas
Arkansas	Indiana	Mississippi	North Dakota	Utah
California	Iowa	Missouri	Ohio	Vermont
Colorado	Kansas	Montana	Oklahoma	Virginia
Connecticut	Kentucky	Nebraska	Oregon	Washington
Delaware	Louisiana	Nevada	Pennsylvania	West Virginia
Florida	Maine	New Hampshire	Rhode Island	Wisconsin
Georgia	Maryland	New Jersey	South Carolina	Wyoming

See the YouTube Video by Phyllis Davis, Co-Inventor of Portable Farms ® Aquaponics Systems and President of PFAS LLC. She explains tilapia, the fish we use in our Portable Farms. **CLICK HERE** to view.

We recommend Edgar Sanchez (great guy) owns **Tilapia Farming at Home** to buy fingerlings. Edgar also offers breeder colonies to sell and ship to customers east of the Rockies. We've referred him to many satisfied customers over the years who swear by his hardy breeding stock. He is quoted as saying, "A breeder colony consists of 6 females and 1 male. You can easily breed them in a home aquarium! And in my website I'll show you how you can turn your backyard into a Tilapia farm!"

Again, if you are in the US, please check the Fish and Wildlife Department in the county, region or area of the place you intend to place your aquaponics system and make sure tilapia are permitted in your area. Because tilapia can breed so prolifically, some areas restrict the use of tilapia even in closed loop-systems. In Southern Florida, Blue Tilapia are legally certified and we raise Blue Tilapia in our farms here.

Photo 4: (Sketch) Blue Tilapia – The breed of tilapia legal in Southern Florida.

Insulating Your Fish Tank

The Insulated Fish Tank is a multi-part component consisting of a stock watering tank, a lid with a window in it (used to cover an opening in the top of the insulated box). You can insulate a watering trough or an IBC Tote or any other fish tank to maintain temperatures of 78 to 80 degrees F for the health of your fish.

An insulated box (Photo 6 below) is built from plywood or flake board and reinforced in each corner with 2x2's or 2x3's for strength. The top of the Fish Tank insulated container is a very shallow, upside down box, just deep enough to create a lip to hold the insulated top in place. Or, it can simply be a flat cover made the same as one of the sides of the box. After the box is built, the insulation, rigid bead board, 1.5 inches thick is glued in place on the bottom, sides and top. If the aquaponics system is in a high traffic area the corners need to be protected with angle iron or the metal sheetrock corner pieces.

Photo 6: 200 gallon Insulated Fish Tank box with lid/cover

Photos 7 & 8: (above) – A wooden frame cover is used in greenhouse cover (plastic) to contain the heat, reduce the water loss from evaporation and to protect the fish. This transparent lid is easy to keep clean and provides ample sunlight for the fish.

The exact measurements of the insulated Fish Tank box can vary because the stock tanks come in a variety of sizes that vary from the nominal listed size depending on manufacturer.

The insulated boxes and the Grow Table will look much nicer and more finished if they are stained or painted. This staining/painting is a personal preference and helps preserve the wood, plus it looks beautiful but again, it's optional.

The building of the insulated box 'in place' in much easier than building it off site and carrying it to be put in place. The boxes are not heavy, but they are awkward. Building them near where they will be used does require them to be built offset from the Grow Table because the stock tank has to be placed inside before the top is put in place. DO NOT FASTEN THE TOP DOWN YET. Make sure the lid (movable component), not the top, is large enough for a person to have access inside the tank during feeding or harvesting activities. An opening of 18 x 24 inches is usually a sufficient size for the lid.

In order to keep the heat in the Fish Tank place the water trough/tank on a two inch piece of Styrofoam or similar rigid insulation. This prevents the heat from flowing out of the tank and into the ground.

Photo 9: This is an example of installing bead board inside the fish tank to help maintain heat between 78 and 80 degrees year round. The wires go to the heaters.

Photo 10: In cooler/colder climates (areas that night/day temperatures drop under 40 degrees to maintain a constant temperature), you can also add Styrofoam 'packing peanuts' between the insulation on the walls of the insulated boxes and the fish tank.

In addition to the insulated box, you will need to the install into the Fish Tank one or two aquarium heaters into the water in the Fish Tank. We have very successfully used two 150watt aquarium heaters and they are incredibly effective at keeping the water temperature constant at 78 to 80°F, even for 400 gallons of water.

PLEASE NOTE – these heaters need to be replaced about every 6 to 12 months because they grow crud from the fish waste and break.

In hot-to-severely-hot climates, arrangements must be made to cool the Grow Table to protect the plants. The water circulation can be used effectively to moderate the temperature of the water, gravel and air.

Coverings: To keep the fish confined to the Fish Tank, you will need to cover the Fish Tank with something. You can make the covering as simple as a screen or netting (in warm climates) over the entire surface or as elaborate as a complete insulted cover (in cooler climates). Tilapia are very fast and entertaining (clown-like really) and they will jump out of the tank if you're not careful, especially during feeding so keep the tank covered to protect your fish.

Photo 12: This is an early design of a Portable Farms® Aquaponics System installed in a tropical climate and we used a single acrylic sheet over the exposed tank to let the sunlight in the tank and keep the fish from jumping out.

Photo 13 – This plastic frame (greenhouse plastic cover on inside of frame and outside of frame so it's 'double layered) is an ideal Fish Tank cover to maintain the heat in the water and protect the fish. It's also durable and easy to wash (hose off) from time to time. We generally use a rag with diluted vinegar and water to clean the interior of the Fish Tank's lid as an additional cleaner.

Again, the fish need to be confined, because they will jump out if given the opportunity. When they are tiny this is less critical, but install the Fish Tank cover as soon as possible.

Feeding:

Photo 14: Tilapia feeding

In case you were wondering, there are no ORGANIC FISH because the USDA cannot standardize aquaculture regulations. *"What?! Fish Can't Be Organic?" – Published 11-10-2014 – Huffington Post - by* Lisa J. Bunin, Ph.D., organic policy director of Center for Food Safety, "Neither wild fish nor farmed fish can be certified organic because no organic standards exist in the U.S. to regulate them. But that may be about to change — for the worse. Why? The U.S. Department of Agriculture (USDA) is currently proceeding with the development of organic aquaculture regulations that could allow wild fish and ocean-based fish farms to be certified organic." To read article: CLICK HERE.

AGAIN: When the fish are small, they always seem hungry, but the most frequent problem for killing fish is overfeeding them. Feed the fish lightly – only what they can consume in 15 seconds. More feed than the fish can eat quickly and you are providing VERY EXPENSIVE FERTILIZER to your plants.

We feed our fish a high-protein 'catfish chow' that includes soy-meal as a main ingredient from local Feed and Grain Stores to feed to our tilapia. It generally comes in large 50 pound bags. This feed floats and it's easy to access how much the fish will consume in 15 seconds.

However, for a small Portable Farms® Aquaponics System, you will not need much food for your fish and you might want to consider a small bag of fish chow by **Purina, Game Fish Chow** (32% protein) or **AquaMax by Purina Mills** (32% to 41% protein). Both are excellent fish feed available at most pet stores and you will raise healthy, happy tilapia. Please note, it's our experience that the AquaMax feed makes the water in the Fish Tanks slightly cloudy. Plus, we don't like the smell of the feed. The fish love it and that's what is important, but please know that the water in your Fish Tanks will be cloudy and have a strong smell (especially if you overfeed your fish).

Photo 15: FISH FOOD

Here is more information about AquaMax:

GUARANTEED ANALYSIS	
Crude protein (min)	41.0%
Crude fat (min)	12.0%
Crude fiber (max)	4.0%
Calcium (Ca) (min)	1.65%
Calcium (Ca) (max)	2.15%
Phosphorous (min)	1.15%
Sodium (Na) (max)	.40%

Ingredients: Fish meal, dehulled soybean meal, ground corn, poultry by-product fish meal, fish oil, wheat middlings, flash dried blood meal, pyridioxine hydrochloride, menadione dimethylpyrimidinol bisulfite, choline chloride, DL-methio-nine, calcium pantothenate, Lascorbyl-2-polyphosphate (source of vitamin C), thiamin mononitrate, biotin, folic acid, cholecalciferol, riboflavin, nicotinic acid, dl-alpha tocopheryl acetate, vitamin A acetate, ethoxyquin (a preservative), zinc oxide, cyanocobalamin, mangaous oxide, ferrous carbonate, copper sulfate, zinc sulfate, calcium iodate, calcium carbonate, cobalt carbonate.

Tilapia fingerlings can be started on pet store flake food or regular catfish chow. Even koi food from the pet store is high in protein (around 32%) and the fingerlings love it. Begin feeding your fish as soon as they are swimming in their new home. A light feeding several times the first day will get them started.

It's the fish waste that 'fertilizes' your plants so make sure they get enough food but without overfeeding them and making them sick or fouling their water.

Remember the 15 second rule. If there is any feed left after 15 seconds, reduce the amount of feed in the next cycle to match the fingerling's eating requirements. Overfeeding your fish kills them.

If there are more than a few pieces of feed floating after the fish have fed in this short period, it will be cycled into the system as waste and become expensive fertilizer for your plants. This excess feed will can sometimes ***foul the water*** and stink, but not normally because of the cycling the water through the huge treatment system.

Only feed the fish during the daylight hours. It does not harm the fish to be hungry. Overfeeding can be a problem if you have too many small fish in a small tank. By

following the suggestions about stocking rates and feeding advice, there is very little chance you will kill the fish and foul the water by overfeeding them. One of the luxuries you have with a Portable Farms® compared to an aquarium is the HUGE water treatment system running all the time.

Restocking feeding schedule

When restocking your fish tank, you will harvest fish that are 11” long and 1.25 pounds) but, you will have fish that are less than 11” long and 1.25 lbs. that need to remain in the tank to grow full size, and you’ll then introduce new 1” fingerlings in your tank.

Directions below are feeding directions <u>after you restock your fish tank with fingerlings:</u>

Feed the regular fish and the baby fish (fingerlings) their fish chow feed (this feed resembles dog food) and feed both size fish at the same time, but feed them 1/3 of what you would normally feed them – and feed them three times per day. (Reminder, do not feed your fish after dark).

You will use the regular sized fish chow feed along with a handful of ground fish chow (same chow but ground) when you feed the fish.

Grind a large bowl of fish chow by placing it in a bag and using a hammer to make the pieces smaller. Wear gloves so your hands don’t touch the fish chow and introduce the possibility for the spread of bacteria or pathogens.

Again, feed the fish 1/3 the amount you would usually feed them at each feeding.

Continue this split-feed process for a few weeks and then reduce to light twice-a-day feedings.

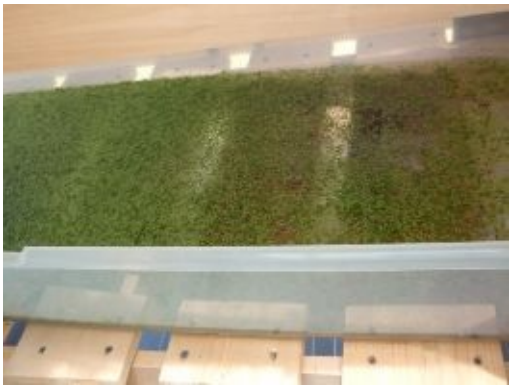


Photo 7: A tub of duckweed to feed your fish

You may decide to attempt growing duckweed in a container near your farm to feed your fish and help add extra protein to your fish’s diet (Photo 7). We use a separate duckweed growing system that provides the duckweed we use for our fish. The protein in duckweed ranges from 15% to 45% under optimal growing conditions.

Duckweed is the smallest flowering plant on earth. (Google search it for more information or visit links at bottom of this section). Under ideal conditions, duckweed doubles in volume every 36 hours.

When we have it available, we feed our fish one small handful of duckweed per fish tank, every day. The next day, when it's time to harvest more duckweed, the duckweed tank or tray is full again. Amazing stuff. It looks like algae, but it is not. Duckweed is very common on ponds, quiet streams and heavily watered areas. Plant nurseries often have duckweed, so call around to find a couple of tablespoons to start your own duckweed system.

Occasionally, add hose water or a very small amount of fish tank water to maintain water depth.

PLEASE NOTE: We **do not** profess to be experts at growing domestic-raised duckweed (and we don't know of any success stories for domestic raised duckweed). In fact, quite the opposite is true. We affectionately refer to ourselves 'duckweed assassins' because we regularly kill entire tanks full of duckweed without ever knowing WHY. We have grown duckweed in containers and open-air tanks off-and-on for many years and we have not always been successful in our efforts to maintain our duckweed farms, but we keep trying and we continue to experiment to find the answers to pass along to you.

Our farm-raised duckweed seems to grow well for days, weeks and sometimes even **months**, and then for some unknown reason, it begins to die off in the grow tanks and then it disappears altogether. We have experimented with different duckweed varieties, as well as experimenting with a variety of methods for sustaining our duckweed crops, and we don't know the 'magic formula' for success.

However, our latest inquiries into growing duckweed suggests putting PVC in the tanks for the duckweed to grow around it (which makes sense) so we're going to try that and we'll keep you posted. (We never give up.)

There is a vast amount of scientific research and available information on the Internet about duckweed.

Duckweed seems to overgrow in places that people do not want it like ponds, rivers and lakes but it's been difficult for us to domesticate and raise it in tubs for more than a few weeks before it dies. If duckweed covers the surface of a body of water, there is an oxygen depletion which kills fish in the ponds, rivers or lakes. (We feed our tilapia only enough for them to eat which accounts for about 20% of their feed. The remnants are picked off over time.)

Photo 8: Duckweed close-up

Fun fact: People asked us for a long time what duckweed tasted like. One day our construction engineer said, "Well, I guess **you** ought to taste it so you can tell them." So I did. It tastes like watercress. Tangy, peppery and very clean tasting." We thought you'd

like to know. - Colle

Also, starch that comes from duckweed can quickly be changed into ethanol, which it can be used instead of corn for ethanol. Farmers from large-scale hog farms, rid their waste through large duckweed “lagoons.” It helps manage their animal wastes through biological treatment and can even ‘clean’ hog-waste water and makes the water potable by running the water through enough duckweed. Interesting, eh?

Here are a few links for you to study duckweed and its benefits and complexities:

http://www.fishfarming.com/duckweed.html

http://www.lrrd.org/lrrd7/1/3.htm

http://en.wikipedia.org/wiki/Lemna

http://www.mobot.org/jwcross/duckweed/Fish.htm

Photo 9: Duckweed in kid’s 8’ swimming pools

Here’s a quick explanation on ehow.com, “How to Plant Duckweed.” **CLICK HERE**.

Here’s a quick explanation on ehow.com about “Using Duckweed in Aquaculture.” **CLICK HERE.**

Read “How to Grow Duckweed.” – **CLICK HERE.**

In fact, here is a link to a technical working paper by researchers for the World Bank, *Duckweed Aquaculture, A New Aquatic Farming System for Developing Countries*, by Paul Skillicorn, William Spira and William Journey - Emena Technical Department, Agricultural Division. http://www.p2pays.org/ref/09/08875.htm#Morphology

Chapter 5

Fish Harvesting and Restocking Fish Tank

Tilapia is a low-fat, white-fleshed fish that is sweet, fine-textured and doesn't taste 'fishy.'

Baked Tilapia - Delicious

Enjoy your Tilapia by baking, broiling, grilling or steaming it. Because Tilapia has a very mild taste, it is the perfect fish to mix with a wide variety of spices and flavors to create subtle or bold dishes to satisfy the most discriminating pallet.

The history of Tilapia as a food can be traced back over 4,500 years to Ancient Egypt with its origins in the Nile River. Tilapia has been called St. Peter's Fish since early Biblical times because it is believed to be the fish that Jesus fed the multitudes in the biblical parable.

The fish used in most aquaponics systems are generally Tilapia. However, you can use catfish, or perhaps several fish depending on availability and your State regulations. We recommend tilapia.

PLEASE NOTE: We do **NOT** recommend growing trout, bass, salmon, and other fish which prefer cold water. The plants in the farms prefer warm water (78 to 80 degrees F) instead of cool (54 degree F water).

Releasing your new baby fish into your Fish Tanks:

Most tilapia are delivered in plastic bags. (Refer to Photo 1 below). Place the bag containing the fingerlings (small fish) in the tank with the top open and one of your air stones in the bag to oxygenate the water. After an hour, place a gallon of fish-tank water in the plastic bag with the fish. After two hours, very carefully remove the air stone and gently release the fish into the fish tank. Hold the bag by the bottom corners and slowly pull the bag up out of the water. You can feed the fish - a very small amount of flakey fish food - right away.

Photo 1 – Fingerlings in plastic bag

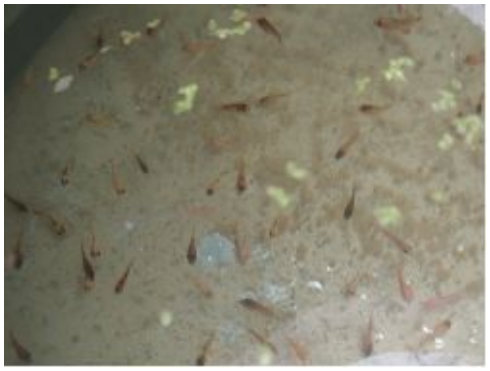


Photo 2 - Fingerlings after being released

Photo 3: Too young to harvest

Photo 4: Harvest size, 11” in length, yields two 4 oz. fillets

When some of the fish reach 11 inches in length, you can begin to harvest them. Because the fish grow at different rates, you will have fish in the Fish Tank that are 11+ inches long, along with their siblings that are only 5 to 6 inches long. Because of this difference, the initial harvesting has to be spread out over about 3 months. After this first round of harvest you will be harvesting on a schedule that works best for you. We have used three different methods of harvesting the fish. Each is described below:

Photo 5 - Fresh Tilapia Fillets

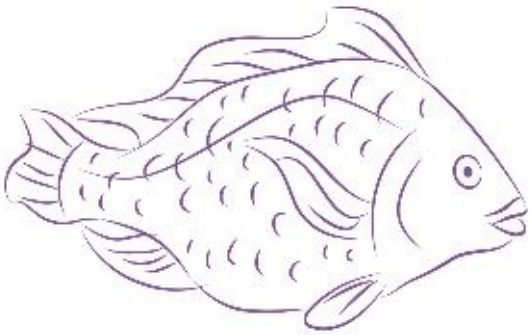


Photo 6 – Tilapia drawing

Method #1

If you only want to harvest one or two fish for dinner, you can actually catch them with a hook and line. Tilapia will grab anything falling into the water so if you simply drop a small hook on the end of a line into the water, they will grab it. Hint, they are REALLY

FAST so be prepared to have them grab the hook the instant it hits the surface. This works especially well if the fish are hungry. We recommend this method for most small installations, when working with small children and to really show off.

However, it doesn't mean that you will 'catch' the largest fish that have grown to harvest size if you have many fish in your tank. Some will be harvest size, and some will not be harvest size. We don't recommend you catch and release more than one fish at a time because it will STRESS THE FISH in the tank and if they're stressed, they won't eat. If they won't eat, they won't poop. If they don't eat/poop, you won't have enough nutrients for your plants in your Grow Table.

Method # 2

Place a hoop type fish net about 8 - 12 inches deep under the surface of the water and then throw some food into the tank above the net. If you're quick enough, you may catch one or two fish on the first try. After that, they will not come to the food. They are not dumb.


Photo 7 and 8: These are very accurate pictures of Tilapia.

They come in a variety of colors ranging from pink/peach to dark gray (most common) to almost black or nearly white.

Method #3

This method makes an interesting assumption; that you are both smarter and faster than a tilapia. We never use this method anymore and discourage its use especially when people are around because we believe we are smarter and faster than the fish, but they manage to show us up all the time, so I no longer use Method #3. Having said that, you need two nets that are at least 14 inches across and have a flat side away from the handle. A pool cleaning net actually works well if you use a short handle.

With one net as close to the bottom of the tank as possible and facing to your left, (right if you insist) and with the other net, herd the fish around to the first net. When there are fish in the first net, lift briskly out of the water and admire your catch. If you thought this was easy, count how many times you have to repeat this process to catch one fish. Remember, the expert here, never uses this method. I have people tell me they are successful at doing this method and I ask for a video. I have never received one, yet. 'Nuff' said.

Method #4

The Commercial Method is the preferred method because it is has been proven over time.

Plus, this method is easy on you, easy on the fish and you can sort the fish as you work.

You will need a second Auxiliary Tank of the same capacity as the Fish Tank to move the majority of the water out of the Fish Tank to facilitate the harvesting of the fish. In most instance a kiddie pool works well, as long as its capacity is the same or larger than the Fish Tank. You will also need a Sump Pump to pump the water out of the Fish Tank and into the Auxiliary Tank and then back into the Fish Tank again when you're finished harvesting. You can use a high capacity fountain pump to move the water also. Then you get to move the sump pump or fountain pump to the auxiliary tank to move the water back. It is up to you how the water is moved.

Make sure the Auxiliary Tank is at least the capacity of the Fish Tank and is placed on a level surface. Check it again. Be careful also that you have some way to keep the sides on the kiddie pool (if this the auxiliary tank of choice) standing up until it has about 6 inches of water in it to support the sides.

Place the Sump Pump into the Fish Tank and place the open end of the hose that is connected to the Sump Pump into the Auxiliary Tank and start the Sump Pump running to reduce the water level in the Fish Tank.

This transfer takes a while so monitor it carefully. The fish will act confused, but they are not terribly stressed. The water will simply become shallower a little at a time, and the fish will tend to congregate along the edges of the fish tank.

Reduce the water level in the Fish Tank down to 1 ½" deep. By reducing the water to this level, it allows you to easily see the fish you want to harvest. It also forces the larger fish to lean over on their side and that slows them down considerably. Only harvest the fish 11 inches long and larger and leave the rest of the fish in the Fish Tank. The most important aspect of this method is that the fish cannot swim away from the net nearly as fast when the water is deeper. Almost any type of net works well for this method as long as the openings in the net are an inch or less is size. Refrain from starting the actual removal of the fish until the water has reached the predetermined depth. This water reduction method also reduces the stress on of the fish and on the people involved in the harvesting.

After removing all of the full-sized fish from the Fish Tank, move the Sump Pump to the Auxiliary Tank, place the open end of the hose into the Fish Tank and pump the water back into the Fish Tank. Again watch this process closely to make sure as much water as possible flows back into the Fish Tank.

Harvesting the fish using this Method normally requires three rounds of harvesting over a period of three months from the same batch of fish. There may still be a few fish that are less than the 11" for harvest size that are left in the Fish Tank after the third harvest. You can simply move them to a different tank (if you have other tanks) of similar sized fish, or leave them in place and add your new fingerlings into the Fish Tank to start the process again.

Restocking:

Introducing new fingerlings into Fish Tank with existing larger fish can be a little scary. When you have completed the second harvest of fish from the tank and still have aggressive tilapia in the Fish Tank and want to introduce more fingerlings, here is the process.

After you feed the larger fish, place the bag (Photo 1) with the new fingerlings to match the total number harvested into the tank to equalize the temperature. After an hour, place some of the water from the Fish Tanks *into the plastic bag* and then very slowly let more water into the bag by submerging it. Then carefully grab the bottom corners in two hands and gently pull the bag out of the fish tank by the bottom. Make sure no fingerlings are trapped in the bag. That's it. (Photo 2)

Tilapia are **NOT** carnivores, however, they will occasionally eat a fingerling, but usually it is a mistake because the fingerling moved too fast. The fingerlings adapt to the Fish Tank very quickly and the larger fish do not bother them. Feed the babies some flake food immediately. The larger fish will eat some of it but it starts the babies off with some food.

Two different size groups of fish the Fish Tank presents a problem at feeding time. The large fish are aggressive and will eat any food available. The babies need to be fed several times each day. Here is the interim solution until the babies are two to three inches long: **Directions (below) are feeding directions AFTER you restock your fish tank with fingerlings:**

Feed the regular fish and the baby fish (fingerlings) their fish chow feed (this feed resembles dog food) and feed both size fish at the same time, but feed them 1/3 of what you would normally feed them – and feed them three times per day. (Reminder, do not feed your fish after dark).

You will use the regular sized fish chow feed along with a handful of ground fish chow (same chow but ground) when you feed the fish.

Grind a large bowl of fish chow by placing it in a bag and using a hammer to make the pieces smaller or by using a grain or nut grinder and set for coarse grinding. Here is an example of a grain grinder. Keep a separate container of ground fish chow feed near your fish tank in a sealed container with its own scoop.

Use a scoop to feed your fish so your hands don't touch the fish chow and introduce the possibility for the spread of bacteria or pathogens.

Again, feed the fish 1/3 the amount you would usually feed them at each feeding.

Continue this split-feed process for a few weeks and then reduce to twice-a-day feedings.

Chapter 6

Fish Processing to Prepare the Fish for Cooking

And as a SPECIAL BONUS for Amazon and Kindle Readers, 10 Tilapia Recipes from Phyllis Davis' cookbook, *Ten Tantalizing Tilapia Recipes to Titillate Your Taste Buds©*

We use the word 'processing the fish' instead of 'killing the fish' out of respect for our aquatic friends.

On to processing the fish:

We suggest you go on YouTube to see lots of ways to 'prepare fish.' Here are a couple of methods we use. Here's a method we agree with and use ourselves on YouTube: **http://www.youtube.com/watch?v=iOTNTN8IFOw**

After the fish is dead, you will need to decide what the finished product will be for each fish.

For example, are you going to fillet it or simply clean and cook the whole fish on a grill or in the oven?

If you are filleting the fish: PLEASE USE A FILLET KNIFE. Scaling the fish is unnecessary if you are filleting it. Make a cut down each side of the back fin from the back above the eyes to the caudal peduncle (area connecting the tail to the body). Make a cut from the top of the back down behind the gills to the area below the gills. Carefully cut the skin off down to the base of the ribs, all the way back to the caudal peduncle. Cut the fillet off the area from the backbone to the middle of the ribs. Voila, fillet. Repeat on the other side.

Here's a YouTube video of a guy who does a great job of filleting a tilapia with an electric knife. This is done after the fish has been killed and gutted. **http://www.youtube.com/watch?v=fO56P4n5A24**

Gutting the fish is done by making an incision from the area where the gills meet on the bottom of the fish, back to the vent. Open the cavity and remove the intestines and wash the cavity thoroughly. This video shows how to fillet a fish (not a Tilapia, but a salt-water fish) but the technique is the same. **http://www.youtube.com/watch?**

v=ZVI9nP2U8gc

Our favorite way to prepare the fish is to scale and gut them and grill them whole. Make sure you scale them well or you will be picking scales out of the meat. Garnish with lemon juice and lay on the grill. Yum.

Bonus Section Added For Amazon And Kindle Readers – 10 Recipies for Tilapia.

10 Tantalizing Tilapia Recipes to Titillate Your Taste Buds©

Recipes created by Phyllis Davis, Co-Inventor, Portable Farms® and Amateur Chef

Two for Baked Tilapia

Two for Grilled Tilapia

Two for Fried Tilapia

Two for Steamed Tilapia

One for Tilapia Tacos

One for Tilapia Ceviche

Tilapia is a low-fat, white-fleshed fish that is sweet, fine-textured and doesn't taste 'fishy'. Enjoy your Tilapia by baking, frying, grilling or steaming it.

Enjoy Tilapia as a Low Calorie, Low Fat, High Protein Alternative to a Skinless Chicken Breast

*** 4 oz Tilapia fillet – 105 calories, 1 gram fat, 23 grams protein**

*** 4 oz skinless chicken breast – - 140 calories, 2 grams fat, 33 grams protein**

All the recipes in this section are QUICK to prepare and QUICK to cook and prepared with fairly common kitchen spices, but you'll need to make a run to your local market for fresh ingredients. These recipes were created for this book because they are all perfect for the busy person to prepare a healthy, nutritious, fresh, tasty meal for a hungry family of all ages.

Because Tilapia has a very mild taste, it is the perfect fish to mix with a wide variety of spices and flavors to create subtle or bold dishes to satisfy the most discriminating pallet.

Garlic and Lemon Baked Tilapia

Ingredients:

4 (4 ounce) Tilapia fillets

5 cloves of finely chopped garlic

5 Tablespoons of olive oil or 5 Tablespoon Italian Dressing

4 Tablespoons lemon juice

¼ Teaspoon salt

¼ Teaspoon pepper

Directions:

1. Preheat oven to 400 degrees. Lay a piece of aluminum foil in the bottom of a medium sized baking pan and conform foil to the inside of pan leaving edges of foil spread out and not tucked under. Grease aluminum foil with cooking spray or olive oil.

2. Place fillets in baking pan. If skin is still on one side of fish, place skin down in pan.

3. In a small skillet, quickly sauté olive oil (or Italian dressing) with garlic, lemon juice, salt and pepper over a medium heat until tender - 2 minutes.

4. Pour hot sautéed mixture over top of fillets in baking pan.

5. Place another piece of aluminum foil over the fish in the baking pan and seal the edges of the upper and lower pieces together until the fish are sealed within the foil.

6. Bake for 20 minutes.

Serve with rice or potatoes, coleslaw, hot garlic bread and chocolate brownies for dessert.

Serves 4

Crunchy Tilapia … and a Secret Chutney That Wow's 'Em Every Time

Ingredients:

4 (4 ounce) Tilapia fillets cut into 2 or 3 inch strips each

1 Cup oat-bran cereal (even cornflakes will work)

1 Teaspoon fresh or dried basil leaves

¼ Teaspoon salt

¼ Teaspoon Pepper

¼ Cup milk (skim or whole)

3 Tablespoons olive oil

Secret Tilapia Chutney that WOW's 'em every time

Ingredients:

1/3 Cup sour cream

1 Teaspoon crushed or creamy horseradish (or more to taste)

3 Tablespoons of freshly chopped cilantro

3 Tablespoons of any mixture of the following choices (use a food processor if you have one): crushed cashew nuts, chopped red or green bell pepper, sliced olives, chopped onion, grated carrots, or chopped broccoli.

(Optional) Lemon or lime juice. If you want to spice it up, add a dash of cayenne pepper or a dash of Tabasco or Cholula Sauce.

Directions:

1. Preheat oven to 400 degrees.

2. Grease or spray a medium sized baking pan.

3. Crush cereal in a small bag with a rolling pin or mix in a food processor.

4. In one mixing bowl, mix cereal, salt, and pepper.

5. Cut Tilapia fillets into 2 to 3 inch strips.

6. In another mixing bowl, pour in milk then dip each of your Tilapia fillets into the milk.

7. Move the moist Tilapia fillets from the milk into the mixing bowl with the cereal, salt and pepper and bread both sides of the fish.

8. Place your breaded Tilapia fillets into the baking pan and drizzle olive oil evenly over the Tilapia strips.

9. Bake uncovered 15 to 17 minutes until the fish flakes easily with a fork.

10. While fish is baking, mix and blend all ingredients for the Secret Tilapia Chutney in a small bowl, and when you serve the fish, serve the chutney on the side of the fish on each plate with a lemon wedge.

Serve your Crunchy Tilapia with pinto beans, boiled new potatoes, Hush Puppies or corn bread, and lemon or coconut meringue pie for dessert.

Serves 4

Grilled Tilapia - Bar-B-Q Style

We all love Bar-B-Qing! Whether you're cooking with hot coals or a gas flame, you'll need to know a 3 secrets before you cook your Tilapia

1) Your grill should be clean with no leftover food particles from previous food to avoid altering the taste of the fish, or having the fish stick to your grill.

2) Spray your clean grill with cooking oil spray prior to placing it on the fire (while the grill is at room temperature).

3) Whether you're cooking with hot coals or gas flames, raise the level of grill as high as possible so your fish doesn't cook too quickly, or stick to the grill and dry out.

4) You can also grill a whole Tilapia (or any fish) in a stainless steel cooking cage placed

on the grill.

California Style Grilled Tilapia Over Hot Coals or a Gas Grill

Ingredients:

2 whole Tilapia or 6 (4-ounce) fillets

Marinade Ingredients:

1 Cup of oil - preferably olive oil but, you can also use vegetable oil or even Italian dressing. Here is a list of healthy cooking oils: olive oil, canola oil flax seed oil, peanut oil, safflower oil, sunflower oil, and corn oil. Avoid vegetable shortenings, butter, and coconut oil because they are loaded with trans fats and saturated fats.

3 Tablespoons lemon or lime juice

1 Tablespoons of Italian Spices or oregano¼ Teaspoon black pepper

¼ Cup red balsamic vinegar, or you also add red or white wine instead of vinegar

½ Cup chopped parsley

2 cloves of finely chopped garlic

(optional) If you'd like to add some spice, add 2 dashes Cholulu Hot Sauce or Tabasco Sauce

The (above) ingredients create an easy marinate for your Tilapia before you fire up your grill. Marinade the fish or about 45 minutes in the refrigerator. By the time the coals are hot, your Tilapia will have marinated in a delicious soup of oil and spices and ready to cook and serve.

Directions:

Elevate your grill as high as you can place it away from the heat source. If your coals are very hot, you'll generally only cook a whole fish about 4 to 5 minutes on each side (depending on the weight of the fish) and cook the fillets about 3 minutes on each side. Avoid overcooking. If you're cooking with a gas grill, keep your flame at a medium temperature during cooking.

Serve with corn on the cob or a baked potato (corn and potato can also be cooked on the grill at a lower heat for a longer time), baked beans, salad, and watermelon for dessert.

Serves 6

Bar-B-Q Tilapia with a Texas Twist

Ingredients:

2 whole Tilapia fish or 6 or 8 (4-ounce) Tilapia Fillets

1 Cup Bar-B-Q sauce of your choice

2 or 3 chopped green onions.

Create an easy marinade before you fire up your grill and let your Tilapia fillets soak. By the time the coals are hot, your Tilapia will have marinated in a delicious bath of Bar-B-Q sauce and it will be ready to cook and serve.

If you're interested in preparing your own Bar-B-Q Sauce from scratch, there are many recipes in cookbooks or on the Internet. And, you can also buy many tasty Bar-B-Q sauces at your local grocery store for this recipe.

For the past 30 years, our family has enjoyed using Original Woody's Cook-In Barbeque Sauce Concentrate for outdoor grilling. Woody's Bar-B-Q Sauce is a unique blend of tomato, mustard and onion. It's not sweet, and it has a Texas kick. It also has a smoky smell, and when we're grilling, our neighbors can smell it's inviting fragrance a block away. You can control the spice by adding less sauce and more olive oil to your marinade. Link for Woody's Cook-In Barbeque Sauce Concentrate: http://www.woodyscookin.com They also have a zip-code search on their website that shows the list of retailers who carry their product in your neighborhood.

Directions:

1) Add the chopped green onions, Bar-B-Q Sauce of your choice, and Tilapia in a dish (large enough to hold marinade and fish) and allow them all to marinade while the coals in the Bar-B-Q pit are heating. You don't need to marinade fish too long. If it's too warm on the back porch where you're grill is 'heating up', put your marinating fish in the refrigerator until you're ready to cook.

2) Elevate grill as high as you can place it, away from the heat source. If your coals are very hot, you'll generally only cook your Tilapia fillets 3 minutes on each side. If you are grilling whole fish, cook 3 - 4 minutes on each side (depending on thickness of fish), with skin side down first, and then turn carefully. Avoid overcooking. If you're cooking with a gas grill, keep your flame at a medium flame during cooking. Avoid overcooking.

Serve with pinto beans, guacamole salad, tortillas (corn or flour) and pecan pralines for dessert.

Serves 6

Fried Tilapia

When frying Tilapia with grease over a hot flame, here are some secrets to assure a successful dish:

1) Here is a list of healthy cooking oils: olive oil, canola oil flax seed oil, peanut oil, safflower oil, sunflower oil, and corn oil. Avoid vegetable shortenings, butter, and coconut oil because they are loaded with trans fats and saturated fats.

2) Heat your grease until it's HOT and then when you put your fish in to cook, lower the heat to medium high. Tilapia fillets are generally not thick, and your fish cooks quickly.

Deep Fried Beer Batter Tilapia

Ingredients:

8 to 10 Tilapia Fillets (4 to 6 ounces each) cut into 2 inch strips

8 Tablespoons of lemon or lime juice (freshly squeezed juice works better than concentrate)

½ Cup chopped parsley

6 Tablespoons olive oil

¼ Teaspoon salt

¼ Teaspoon pepper

1 Cup oil for deep frying.

Beer Batter Ingredients:

3 large egg yolks

½ Cup beer

¾ Cup flour

½ Tablespoon salt

½ Tablespoon baking powder

Directions:

1) Cut Tilapia fillets into 2 inches strips (the more even and uniform they are, the nicer the presentation and the strips will also cook uniformly).

2) Put all the Tilapia strips in a bowl with the lemon or lime juice, parsley, olive oil, and add salt and pepper.

3) In another bowl, mix egg yolks and beer and add flour, salt and baking powder and mix until smooth with no lumps in the batter.

4) Begin to heat oil for deep frying.

5) Dip pieces of fish, individually, into the beer batter, and then lay or drop them into medium hot oil.

6) Again, cook over medium heat. Turn the fish strips over after three minutes or until golden brown all over. Cook 3 minutes on each side. If you make the oil too hot, it will smoke, and your beer batter will cook before your fish cooks.

7) Drain strips well and serve hot.

Serve with French fries or baked potato wedges, corn on the cob, baked beans, garlic bread, tartar sauce, lemon wedges. Serve with cherry or apple pie for dessert.

Serves 6

Southern Fried Tilapia

Ingredients:

4 (4-ounce) Tilapia filets

1 ½ Cups cornmeal

⅓ Cup flour

2 Tablespoons fresh or dried parsley

¼ Teaspoon salt

¼ Teaspoon pepper

¾ Cup healthy cooking oil such as: olive oil, canola oil flax seed oil, peanut oil, safflower oil, sunflower oil, and corn oil. Avoid vegetable shortenings, butter, and coconut.

(optional) Cayenne pepper to taste

Directions:

1. Begin heating ½ cup cooking oil in a skillet/frying pan until it's very hot. Right before you put the Tilapia fillets in the grease, drop one drop of water in it and if it 'pops and sizzles', it's hot enough.

2. Mix the cornmeal, flour, parsley, salt, pepper and cayenne (optional) together in a medium sized mixing bowl by beating mixture with a whisk or fork.

3. Wash the Tilapia fillets one at a time, lay each of the Tilapia fillets in the cornmeal mixture in the mixing bowl and coat both sides of the fillet, and shake off the excess and then IMMEDIATELY, place each of the fillets into the hot grease.

4. Lower the heats in your pan after all 4 fillets are in the grease and cook 3 minutes on each side until golden brown. If filets are thick, add one minute to cooking time.

5. When you take the fillets out of the skillet, place on paper towel to drain the grease.

Serve with black-eyed peas, fresh green beans, sliced tomatoes, tartar sauce and lemon wedges, hot biscuits or dinner rolls and chocolate cake for dessert.

Steamed Tilapia Recipes

Because so many people are in a hurry to prepare meals, and they're calorie conscious, steaming fish is the hot new rage. After all, hot steam cooks quickly and cleanup is fast and easy. You're not limited to a bland tasting fish because you steam cook, in fact, you can add your spices and even quick cooking vegetables and they'll cook right along with your fish to create a fast and delicious dish.

If you don't have a steamer (like the one above), you can create your own fish poacher/steamer by putting a grill in the bottom of a roasting pan or rolling up a foot of aluminum foil into a long curly tube and placing your fish on top it. Or, you can buy a bamboo steamer (left photo) for your fish or placing a stainless steel cooking cage (below)

in roaster. You'll only need an inch or so of water in the bottom of the pan. After all, we want steam from the water to cook your fish. Bamboo steamers are inexpensive (around $15 depending on size) and range from six inches to twelve inches in diameter. They can be purchased at such stores as Sears, Target, Wal-Mart.

You can also steam a whole Tilapia (or any fish) in a stainless steel cooking cage placed inside a large roasting pan (like a turkey roaster) with water in the bottom and placed in an oven, or you can also place on an outdoor grill.

Ginger Tilapia

Ingredients:

1 whole Tilapia fish - 1 ¼ pounds or 4 to 5 (4 ounce) fillets

3 Tablespoons soy sauce

3 Tablespoons olive oil

¼ Teaspoon black pepper

¼ Teaspoon salt

1 inch of grated ginger - chopped or sliced

6 green onions chopped in small bites

4 to 5 tablespoons sesame oil (can also be spicy-hot sesame oil)

Directions:

1. Preheat oven to 400 degrees.

2. If cooking with a whole fish, wash fish, and cut 4 diagonal slices in fish.

3. In a small sauté pan, add olive oil. Heat oil and add salt, pepper, ginger, and onions into the oil and sauté for 2 minutes.

4. Place fish inside steamer.

5. Pour mixture from sauté pan directly over fish, and put lid on pan then put in hot oven.

5. Bake for 18 minutes.

6. When the fish is cooked, take it out; put it on a serving tray.

7. Before serving, heat sesame oil in a skillet until it is very hot (watch so it doesn't get too hot and smoke up your kitchen). After removing fish from oven, pour the hot oil over it. Remember, it's hot oil, and hot oil splatters easily, so go slowly and don't burn yourself!

Serve with edamame, a variety of stir-fried vegetables such as carrots, mushrooms, sweet potatoes, green beans, green peppers. Serve with Jasmine or basmati rice and lemon sorbet for dessert.

Serves 4

Steamed Lemon Tilapia

Ingredients:

4 (4 ounce) Tilapia fillets

Juice of 1 lemon or ¼ Cup of lemon concentrate

¼ Teaspoon black pepper

¼ Teaspoon salt

2 Tablespoons of olive oil

Directions:

1) Preheat oven to 400 degrees.

2) Create a shell out of aluminum foil, spray the interior of the shell with cooking spray.

3) Place the Tilapia fillets in the center of the shell, put the lemon juice on the fish, then the oil, and then add the salt, pepper.

4) Close the foil shell so the edges are loosely held together, but the steam can still get inside the shell to cook the fish.

5) Put a small amount of water in bottom of a big skillet or roasting pan.

6) Place the foil shell in the middle of the big skillet or roasting pan and cover with lid to keep the steam inside the pan.

7) Cook for 20 minutes. If you have more than 4 fillets in shell, cook slightly longer, check to fish to make sure is flaky (with a fork) before removing and serving.

Serve with Brussels sprouts and pearl onions, spaghetti squash, a hot and crispy French baguette and fresh berries for dessert.

Serves 4

Tilapia Ceviche

The citric acid that is in the lime juice used to make Ceviche creates a chemical process called denaturation. The acidic lime juice changes the proteins in the Tilapia, unraveling the molecules and altering their chemical and physical properties and turns the flesh firm and opaque, as if it had been cooked with heat. It doesn’t kill bacteria, but it does ‘cook’ the proteins in the fish and change it

Ingredients:

4 (4 ounce) Tilapia fillets cut in very small squared cubes

5 Freshly squeezed limes (roll the limes before squeezing to produce more juice)

4 Cloves finely chopped garlic

5 Ripe medium to large tomatoes

1 Teaspoon oregano

½ Cup chopped red onion

½ Cup chopped celery

¼ Cup chopped green pepper

½ Cup chopped cilantro

¼ Teaspoon salt

¼ Teaspoon pepper

(optional) 1 Cup chopped avocado

(optional) dash of Cholula Hot Sauce or Tabasco Sauce for spice

(optional) chopped green or black olives

Directions:

Soak the cubed Tilapia squares in ¾ of the lime juice for 3 hours in the refrigerator. Drain off the liquid and discard the rest of the juice. Mix the fish with the garlic, tomatoes, onion, cilantro, oregano, green pepper, and the remaining lime juice.

Serve with hot flour or corn tortillas, or with tortilla chips and guacamole. Can be served as an appetizer or as a main course. Serve tapioca or bread pudding for dessert.

Serves 4

Tilapia Tacos

Ingredients:

1 Pound Tilapia filets cut into small, square, bite-sized cubes

2 Tablespoons taco seasoning (We use Wick Fowler's Taco Mix because it doesn't have sugar in it. It's not always easy to find but we order from the Internet. It's worth the trouble. It's not expensive and great for other recipes. There are many other good taco seasoning mixes at most grocery stores such as Lawry's, French's, Old El Paso, and Ortega Taco Seasonings).

1 Tablespoon fresh squeezed lime juice

1 Tablespoon olive oil

1 Cup green cabbage, chopped

1 Cup red cabbage, chopped

½ Cup freshly chopped cilantro

½ Cup green onions, chopped

¾ Cup nonfat sour cream

1 Cup of your favorite salsa (mild, medium or hot in flavor)

(Optional) Dash of Cholula Hot Sauce or Tabasco Sauce for spice

8 (6-inch) Corn or flour tortillas or you can buy a small box of crispy taco shells

6 Lime wedges

Directions:

1. In a small bowl, mix taco seasoning, fresh lime juice.

2) Add the cubed Tilapia to the bowl and coat each piece of fish.

3) In a medium sized skilled, add cooking oil and heat to a medium heat. Then, add your fish and sauté for about 5 minutes. You don't need to cook long because fish cooks quickly and the pieces are small. When they're cooked, take them out of the grease and put them on a paper towel to drain the grease.

4) In another mixing bowl, mix the 2 cabbages, the fresh cilantro with the green onions.

5) In another mixing bowl, mix the sour cream and your favorite salsa. If you want your Tilapia Taco's spicy, then add hot sauce to your salsa or buy the sauce already seasoned.

6) Put cabbage in bottom on first layer of your Tilapia taco, then a layer of Tilapia fish and then some more cabbage on top. Top it off with up a few tablespoons of the salsa and sour cream mixture and squeeze a wedge of fresh lime on top. Fold it up to hold the ingredients and eat. And enjoy. Top it with more salsa.

Serve with guacamole, fresh salsa, and tortilla chips. Serve flan for dessert.

Serves 4

Chapter 7

Food Safety and Technology On-Farm Food Safety for Aquaponics Systems

Always wear gloves when handling anything in your farm which includes handling food, gravel, fish, fish food or areas around fish tanks. Always. No exceptions.

Never allow anyone who smokes in the farm. The tobacco on their hands or clothes can create Tobacco Virus in your farm and wipe out most (if not all) of your tomatoes and perhaps infect other blooming crops.

Avoiding bringing food into the greenhouse for fear of spreading food-based chemicals that were used in cooking or raising that food.

Avoid tracking in dirt or mud into your farm. The germs and pathogens in the dirt are filled with insects. Some commercial farms may require the use of disposable paper slippers in the farm to avoid their workers from bringing in dirt in the farm.

Consider vacuuming the floors in your greenhouse instead of sweeping the floors in the farm to avoid raising the dust level in the farm.

If you have ‘screens’ on the outside of your farm and you run into problems with insects in your farm and dirt or dust blows consistently inside your greenhouse, consider using an additional breathable dust-proof screen cover on top of the screens the avoid fine dust/dirt from entering the farm. Dust screens are common to protect those with allergies in their homes.

Wash all tools you use to plant and harvest plants after each use with soap and water before reusing. The ideal tools to use are of the hard-plastic variety that do not rust and can be easily washed after each use.

If you see any plant that has bugs, mold or looks weak, remove the entire plant immediately from the farm and replant with a new seedling the same day to avoid ensuing problems from the plants surrounding it in the Grow Table.

Always use drinkable (potable) water in the farms for the Fish Tanks and for any other

uses in the farm.

Check the pH balance in your farm a minimum of once a week to assure that the water level is between 6 and 6.7 (ideally) or as high as 7 but avoid a pH reading of 7.2 or higher or your plants can't absorb nutrients.

Clean areas around the Fish Tank and the exposed PVC every week with a solution of vinegar and water and a clean cotton towel or paper towel. Always wear gloves when cleaning.

If leaves fall on the gravel from blooming plants, pick them up so they do not deteriorate on top of the gravel and build up.

When harvesting plants with large root systems (such as tomatoes) use the trowel to remove excessive roots (detritus) from the gravel in the Grow Table. You don't have to remove it all since it will 'break down' over time, but remove excess and throw away.

Do **NOT** keep a garbage can inside or near your farm because garage attracts insects (ants, etc.) or bacteria in the farm. Even if you have a lid on the garbage can, insects inside the garbage will fly out from the garbage can to your farm.

While keeping ants out of the farm requires a well-sealed greenhouse, ants still appear occasionally in your farm. While a few ants don't look like a problem, remember they can carry aphids with them so find out how those few ants got in the farm, track their source outside the greenhouse if possible and pour boiling water over the anthill to discourage further ants in the farm. You can also add a boric acid and sugar solution in a few strategic

locations inside and outside the farm to kill the ‘queen’ in the ant hill.

Aquaponics systems are an excellent food production system that uses nutrient-rich water from fish culture to irrigate and fertilize plants. After the plants have absorbed the nutrients, the water is re-circulated to the Fish Tanks. This combination of aquaculture and hydroponics recycles both water and nutrients, resulting in an efficient use of resources. However, when food plants are grown in the presence of fish culture effluent, food safety considerations become very important.

We have included this report on *Food Safety and Technology, On Farm Food Safety for Aquaponics Systems* because it provides ‘standards’ for assuring food and fish quality. It also explains a great deal about the need for high levels of cleanliness and sanitary standards for a productive Portable Farms® Aquaponics System. We highly recommend you read this section CAREFULLY and remember to ALWAYS WEAR GLOVES when working in the gravel, working with the plants (planting and harvesting), washing all utensils in soap and potable water after each use, and many more good practices vital to a successful Portable Farms® Aquaponics Systems wherever you live in the world. **READ AND PRACTICE THESE GUIDELINES WITHOUT FAIL.**

This link is directed to a very important report, July 2009 (below) about food safety as it relates to the field of aquaponics. It is VERY IMPORTANT; after all, you are dealing with fish feces and you must learn good practices for working with an aquaponics system. This report teaches practices for harvesting food, how to reduce hazards in your kitchen for any food hazards and many other points related to human sanitation. PLEASE READ IT**.**

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issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, in cooperation with the U.S. Department of Agriculture. Andrew G. Hashimoto, Director/Dean, Cooperative Extension Service/CTAHR, University of Hawai‘i at Mānoa, Honolulu, Hawai‘i 96822. Report by By - Jim Hollyer, Clyde Tamaru, Allen Riggs, RuthEllen Klinger-Bowen, Robert Howerton, Darren Okimoto, Luisa Castro, Tetsuzan ‘Benny’ Ron, B. K. ‘Kai’ Fox, Vanessa Troegner, and Glenn Martinez.

For the link to the entire document that includes graphics: CLICK HERE.

Chapter 8

Growing Healthy Plants and Fish in Your Aquaponics System

Photo 1: Phyllis Davis with 1 head of Bok Choy

Photo 2: Colle Davis with 1 head of lettuce

Photo 3: Phyllis Davis with 1 stalk of Kale

Best advice in this document: ALWAYS BE PLANTING SEEDS. ALWAYS BE HARVESTING PLANTS. You will spend more time on these two tasks than anything else in your aquaponics system.

Please read this document carefully: Do not use any chemicals on your plants that could harm your fish. There are many innovate ways to enhance plant growth, promote healthy plants (free of insects and disease), so please, follow the instructions in this document. If you create problems for your plants in your Grow Tables, you can lose entire crops within your contained structure.

Both macro nutrients and micro nutrients in very small quantities are essential for the plants grown in an aquaponics system. Most of these nutrients come from the fish waste, which has been come directly from the ingredients of the fish food. Plants can still grow with a low level of nutrients, but the food will look and taste less than expected and the fruiting plants will struggle to blossom and produce good fruit and vegetables, and plants will be more likely to suffer from pest and disease problems. You DO NOT want these conditions in your farm, so read this document to learn how to adjust the pH level of your water and the macro and micro nutrient levels necessary to produce health food in your aquaponics system.

Worm Casting Tea – The quick and clean method

There are many vendors who offer organic worm castings throughout the world. But it you can't find organic worm castings in your area, you can order them from us:
http://portfarm.fatcow.com/store/page3.html

The worm castings we supply are pure organic worm castings and not vermin-compost.

Testing proves that there are microorganism properties in the worm casting tea that act as an insect repellent for many insects such as aphids, white fly, spider mites, and other small bugs that eat plant juices. This is due to enzyme released in the worm tea called chitinase which will dissolve chitin which is the exoskeleton of an insect. Although it's optional, we recommend you spray the plants in your aquaponics system **once a week** with worm tea to create healthier plants. There are tremendous benefits from the application of Worm Casting tea:

Safe for your fish (a very big advantage)

It is non-toxic to plants, fish, pets and people

By spraying the worm casting tea on your plants (under the leaves as well as on top) and on your seed garden, you're adding nutrients directly to your growing plant and making them healthier and minimizing any potential problems

Since you're spraying the leaves and fruit/vegetables, pathogens can't attack because you're adding beneficial microbes (very important to healthy plant growth) to the surface

Worm casting tea used as a foliate spray is beneficial as a fungus control as more nitrogen is released.

It can also be used for such problems as black spot, black mildew and tomato blight

Testing proves that there are microorganism properties in the worm tea that act as an INSTANTEOUS insect repellant for many insects such as aphids, white fly, spider mites, and other small bugs that eat plant juices. This is due to enzyme released in the worm tea called chitinase which will dissolve chitin which is the exoskeleton of an insect.

Ants do not like to walk over worm castings or walk over areas sprayed by worm tea. It may not kill ants, but it does repel them.
The 'standard' method of making worm casting tea actually works well. It takes several days to brew, takes more steps and makes great worm casting tea in most cases. If you have twenty-four to forty-eight hours to waste getting your tea ready, use the old standard method, remember, it works well.

The Worm Casting Tea Method makes two assumptions:

You have a Fish Tank or water that has been in an open container for overnight. (Here is a quick and complete way to remove chlorine from water – Vitamin C (just plain water-soluble ascorbic acid with no fancy additives such as Citrus Bioflavonoids or Rose Hips, etc.) at the rate of 1mg per gallon of water. We picked up this trick on curing water from our work on our own aquaponics systems.)

You want to brew the worm tea up and use it the same day.

The standard method works and you can certainly use it to your plant's advantage. We tend to be in a hurry all the time and developed this new method to match our ground speed.

Ingredients and equipment:

1 cup of Organic Worm Castings because they are nearly 100% organic

10 cups of water from your aquarium, fish tank water **or** kitchen tap or water from a garden hose that has been treated with Vitamin C

A bucket to hold 14 cups of water (make sure the bucket has not had chemicals in it prior to use)

Let the blender to do the work

Wire mesh strainer (mesh strainer works better than a spaghetti colander)

Process:

Place four to five cups of water into the blender (this process is tough on blenders, so buy a *cheap one* to use only for this type of work)

Turn on the blender and let it run for about a minute at a relatively high speed to entrain air into the water oxygenating it to the over-saturation level before adding worm castings

Reduce the blender speed to the slowest speed or shut it off and carefully add the one cup of Worm Castings and turn it back on set to low

Replace the top and run the blender at full speed for two minutes

Turn off the blender

Pour the mixture into the bucket with 14 cups of water

Stir the mixture thoroughly into the water

Let the mixture sit for 4 hours – if you are so inclined, you can place an air stone or air wand and run air into the mix from an air pump. This is not actually necessary.

Strain the worm tea mixture through cheesecloth or paper towel placed in a mesh strainer into a separate container – This gets slower and slower so you many want to stop and change filters to speed up the straining

Pour the strained liquid into sprayer – it is VERY black

Spray to your plant’s pleasure.

Note: Use the remaining castings that have settled into the bottom of the bucket or the remainder of what was in the strainer by placing them in your yard at the base of a plant or tree.

Since there are many variables within your structure to consider, there is not a single list of simple solutions to solve all problems because every area has different issues related to water quality, rock/gravel content, crop varieties, wind/weather/humidity issues, season of the year, choice of fish used in the system, and of course, the human element of the operator which is so crucial in the care of your farm. If you run into problems that are not

listed in this document, we recommend you consult with a local botanist or biologist who may be able to shed light on your specific problems.

Tobacco Mosaic Virus

Since you cannot use any type of insecticide in your aquaponics system, you must protect your plants and fish from predators of any kind. NO, NOT EVEN NEEM OIL. We recommend that anyone who touches the gravel or the plants wear clean gloves, every time they enter the farm. We also recommend that **NO SMOKING AND NO SMOKERS AND NO E-CIGERETTE VAPOR SMOKERS EVER** be allowed to handle the gravel or handle the plants for fear of introducing the tobacco mosaic virus into the farm. This NO SMOKING warning goes for those who use smokeless tobacco (chewing tobacco, etc).

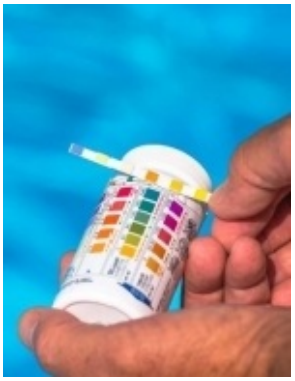
We also recommend all plants are grown from seed because small plants brought in from nurseries hold a high possibility for having been handled by smokers and are susceptible to the Tobacco Mosaic Virus and they may also contain aphids and other pests. GROW FROM SEEDS ONLY. This virus attacks tomatoes, cucumbers and peppers and produces bumps on the leaves, uneven coloring and stunted and distorted fruit.

For more information about the tobacco mosaic virus we recommend further reading:
http://www.extension.umn.edu/distribution/horticulture/dg1168.html

http://www.avrdc.org/pdf/pepper/TMV.pdf

Adjusting pH Levels Aquaponics System

[The letters pH abbreviation for pondus hydrogenii translated as potential hydrogen]



Please monitor the pH level in your lettuce Grow Tables often. If the pH should drop below 5.8 or goes above 8.5, you create a risk of losing (killing) fish and plants.

Lettuce, herbs, and specialty greens (spinach, chives, basil, chard, and watercress) have low-to- medium nutritional requirements. If you do need nutrients while adjusting pH, consider using potassium hydroxide (KOH) and calcium hydroxide (CAOH2) because they do not increase the sodium salts in the system, which are toxic to the plants and can

cause tipburn. These bases provide essential nutrients to the lettuce plants. Potassium and calcium help to ensure healthy plant growth.

Your basic test kit should check pH, ammonia, nitrate and nitrite. When you initially install your fish, the ammonia will naturally increase over time; however, once there is enough ammonia-oxidizing bacteria (AOB) in the water (week to ten days), the ammonia levels should start to decrease. Nitrite levels should now start to increase the nitrite-oxidizing bacteria (NOB) as the AOB starts to convert the ammonia. Nitrite levels should continue to drop to a low level depending on the balance of fish and plants in your farm. pH should decrease as the nitrification process makes the water more acidic. This is important so make sure that the pH balance is as close to 7 as possible for the nitrification process to work properly.

Monitor the pH of the water at the same time of day. Take your water sample from the water flow going into the fish tank from the Grow Table.

After a few months in operation, your aquaponics system may see a drop in pH which means it has become more acidic, now is the time to add some pH UP to bring the pH of your systems back to the mid-to-high 6 pH which is a good place for your fish and plants.

More good suggestions for raising and lowering pH levels in your farm:

Remember that both ammonia and nitrite can be very toxic to fish. Nitrate is not quite as toxic to the fish and the plants use it to produce protein and nucleic acids.

Over time, the nitrification process can cause the water to become more acidic and the pH levels tend to go down. If pH goes low, the water is more acidic and needs to become more alkaline. This can be accomplished by adding pH UP which is contains Calcium Hydroxide (CaOH2). To adjust your pH down you can use pH Down (these are commercial products and rated as organic) Just add a little at a time if your nutrient pH is too high in order to lower the pH to the proper level. We recommend the product pH Down available many places, but we purchase it on Amazon.com.

Start by adding a very small amount of the chemical (lower than directions suggest) into a large bucket of water and then add it slowly, over an entire day to the Clarifier/Settling Tank if you have one or VERY carefully to the Fish Tank WHEN THE PUMP IS RUNNING, so you don’t shock your fish. Be very careful. Add a small amount of the powder to a bucket of water. Then pour it into your settling/clarifying tank over a prolonged period (like a day). Remember, it is very alkaline so do not just dump it all quickly into the system.

The longer a system runs, the pH will tend to stabilize and you will only need to add something like calcium hydroxide or phosphoric acid occasionally.

If your farm water is low in nitrates, you can also adjust the feeding of your fish to adjust water quality in your farm. If your system is low in nitrates, feed your fish MORE food to balance the system. If there is too much ammonia, decrease the feed.

Occasionally your cleaning cycle will be out of sync with the fish harvesting and simply feeding your fish more often helps. If you have very few fish there is a quick method that

will help increase nutrient levels, but you have to follow directions carefully: Turn off the water pump or do this after a pumping cycle has competed. With a board or paddle of some type, stir up the Clarifier/Settling Tank so the waste is swirling about in the water. Let it settle for at least an hour. Run the water pump for an hour or one full trip cycle. Resume the normal cycle. This is a stop gap measure and should not be used very often.

What you are doing is freeing up nutrients in the settling tank for your plants when there are very few fish in the tank. If procuring fish is a problem, go buy 25 to 50 feeder gold fish to get the poop going again.

Chapter 9

Pest Elimination

Organic Solutions for Controlling Any Unwanted Insects in Your Aquaponics System

Photo 1: White Flies

Photo 2: Caterpillar

Photo 4: Aphids

Photo 5: Ants

Photo 6: Butterfly's come in the farm and lay eggs.

Do not use any type of insecticide in your farm because it can kill you your fish. Here are some organic suggestions to help control any problems you may have for coping with insects in your farm. The best solution for the problem of insects and other issues is to keep your farm clean, wear gloves, and keep the door closed to keep insects **OUT.** If a plant looks unhealthy, pluck it out of the gravel and replace it immediately. Don't wait to see if it will get healthy, if it looks sick, get it out of the farm FAST. No exceptions.

Please note: This is important) harvest food the <u>instant it's ready to be harvested and do not leave it in the Grow Table.</u> Many fungal infections occur due to lack of air circulation around the base of plants so keep the foliage at the base of the plant cut back.

Since we provide tours of our farms, we have 'waited' to harvest because of film crews or

important guests coming ‘in a few days,’ and we have **always created problems** for ourselves by waiting to harvest the plants past their harvest peak and then discovering a few insects chewing on the decaying roots when we removed the plants from the Grow Table. **So, here’s an important piece of advice: ALWAYS BE PLANTING. ALWAYS BE HARVESTING. Don’t wait to do either.**

Fish Health:

We are happy to report that we seldom lose fish in our aquaponics system. We have lost a few, but very few over the years. One reason is because we provide them with proper aeration, good food, insulation from cold or excessive heat, adequate sunlight, and we have always done our best to keep our fish from being stressed. When fish become stressed, it lowers their immune system and they can become susceptible to disease. We wear gloves when we feed them to avoid human pathogens from getting in the water. We don’t overcrowd our tanks. We empty the lumpy fish waste regularly with a special design in our Portable Farms® so their water does not foul with ammonia buildups. We don’t use chemicals that could harm them in the system. We add make-up water during times of hot weather by placing the hose in the Grow Tables before it circulates back into their Fish Tank. We even give them occasional treats of chopped cucumber or lettuces grown in the farm.

Solutions to address aphids, whitefly, tropical snails, thrips, caterpillars, red spider mite:

We recommend the use of worm casting tea (above) to treat basic insect problems.

Do not use organic insect sprays in your farm. The majority of them have pyrethrum-based rotenone and ryania, or neem as ingredients, all of which will kill the fish.

For ants, mix a 1 ½ pounds of sugar and 2.5 tablespoons of borax or boric acid into a quart of water and place it near the opening of an ant’s nest on cotton pads placed in old coffee cups (or empty yogurt cup that’s been washed well) and the ants will take it back into the nest and kill the queen. This solution must be replaced <u>every week</u> until ants disappear. If that doesn’t kill the nest, find the source of the ants and pour boiling water down the hole to kill them.
Plant pennyroyal, spearmint or tansy near your farm to discourage ants.

You can also use old-fashioned insect traps by filling a glass beverage bottle (like a Coke bottle), half-full of vinegar hung in your farm. The flies get in, drink the vinegar, but can’t get out and drown.

Use Yellow Sticky Cards or Fly traps outside of vents or door to your greenhouse to deter flying insects.

Insect and pest control is so simple but you must be vigilant to keep the insects out and your farm away from your fish tanks, Grow Table, Clarified and plants to continue to grow healthy food.

DIY Simple Recipe and Directions for Fish Friendly Insect Control Solution™ Concentrated Foliar Solution for Aquaponics Systems and Outdoor Gardening

PFAS LLC – Created by the Inventors of Portable Farms® Aquaponics Systems

This easy-to-make and concentrated Fish Friendly Insect Control Solution uses a mild castile soap to control small, soft-bodied arthropods in aquaponics and can also be used (with a modification in the recipe) for outdoor gardens.

Colle and Phyllis Davis have used this simple technique in Portable Farms® Aquaponics Systems for reducing and eliminating whiteflies, aphids and mealy bugs as well as discouraging ants from the farms. While this solution will not kill ants on contact, it does discourage them from reappearing after repeated use.

“How soaps and detergents kill insects is still poorly understood. In most cases, control results from disruption of the cell membranes of the insect. Soaps and detergents may also remove the protective waxes that cover the insect, causing death through excess loss of water.” - Colorado State University Insect Control: Soaps and Detergents - by W.S. Cranshaw

PFAS LLC RECOMMENDED Directions:

Use 1.5 Tablespoons of Dr. Bronner’s Un-Scented Baby Mild Pure-Castile Liquid Soap per gallon of water. If you do not have access to Dr. Bronner’s Soap, use any pure castile soap that is non-scented.

PFAS LLC recommends less soap in an aquaponics solution than use in outdoor garden mixtures to protect the fish in the tanks. Outdoor garden mixtures may use 2.5 Tablespoons per gallon but that amount may harm or kill the fish in aquaponics systems.

Mix well. Put soap and water into a spray container and spray directly on plants where insects are present as a foliar spray. Create a range from 18” to 24” from the nozzle to the plant. Unless an insect is covered and made wet with the solution, it will have no impact on the insect.

Spray on top and underside of leaves where insects are present.

After spraying solution, let dry for two hours and then spray plants lightly with the mist from a garden hose.

For areas or plants that are infested with insects, repeat spraying/rinsing action again in four to seven days.

Apply solution between 6:00 AM and 10:00 AM.

Do not spray plants if the temperature is above 85 Degrees F as it will cause plant damage.

Encourage plants to dry after each treatment by turning on a fan to promote drying.

WARNING: **KEEP OUT OF REACH OF CHILDREN** – Flush eyes well for 15 minutes

with clean water. If irritation continues, seek professional medical care.

Dr. Bronner's Un-Scented Baby Mild Pure-Castile Liquid Soap is available at many retail outlets such as health food stores and Wal-Mart. It is also available online. Active Ingredients: 95% Coconut oil, potassium hydroxide, olive, hemp and jojoba oils, citric acid, tocopherol.

This product is fish friendly ONLY if used as recommended. If this product is not used as recommended, it will kill fish.

Some plants may not like the soapy solution and the plants can suffer from phytotoxicity so test one plant in an infested area and see if it results in injury from spraying. According to the University of Florida:

PHYTOTOXICITY OF PESTICIDES TO PLANTS

– D.E. Short, Extension Entomologist University of Florida

Plant Damage due to application of pesticides to plants is known as phytotoxicity. Pesticide phytotoxicity appears in several ways on ornamental plants, but probably 5 types of damage most commonly occur.

1). Burn—This type of damage may appear on the tip, the margin, as spots on the leaf or the entire leaf surface may appear burned. The growing tip or bud may also be killed.

2). Necrosis (or death of the plant tissue)—Similar to burn and affecting plants in the same manner.

3). Chlorosis (a yellowing or bleaching effect)—May appear as spots, tip yellowing, or as a general chlorosis of the entire leaf.

4). Leaf distortion—May appear as curling, crinkling, or cupping of the leaf.

5). Stunting or other abnormal growth.