

AQUAPONICS

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ABSTRACT

Aquaponics is an eco friendly system for food production utilizing aquaculture and hydroponic system. The ammonia excreted by fish forms Nitrate for the growth of the plants and fish in turn gets fresh water. The solid fish waste obtained can be used for compost preparation.

There are many ways of conducting aquaponics. Out of 3 are prominent according to the available area and budget. They are:

- 1) *Dual loop aquaponic system.*
- 2) *Vertical aquaponics*
- 3) *Mini aquaponics.*

The fish and plants we select for are according to the need of the aquaponic system as far as temperature and PH. As a general rule warm, fresh water fish like sunfish, tilapia, gold fish angel fish, guppies are grown. Plants like lettuce, squash, and basil mint.

KEYWORDS: *Aquaponics, temperature, aquaculture, gardening, symbiotic environment*

INRODUCTION

A system of aquaculture in which the waste produced by farmed fish or other aquatic creatures supplies the nutrients for plants grown hydroponically which in turn purify the water. It combines conventional aquaculture with hydroponics in a symbiotic environment.

In this type of indoor farming you grow substantially more food with less water land and labour than traditional agriculture. The solid fish waste can be turned into vermi compost that acts as food for plants.

How does it work?

Aquaponics re-circulates water from a fish tank through a vegetable grown bed. Nutrients from the fish waste feed the plants and the plants filter the water to keep the fish healthy. The two main components the system are the fish tank and the grow beds with a small pump moving water between the two.

The vegetables clean the water that goes back to the fish. Along with the fish and then waste, microbes play an important route to the nutrition of the plants. These beneficial bacteria grown in the spaces between the roots of the plant and converts the fish waste and the solids into the substances the plants can use to grow. The result is perfect collaboration between aquaculture and gardening.

RECOMMENDED PLANTS AND FISH THE AQUAPONICS

The fish and plants, we select for our aquaponic system should have similar needs as far as temperature and PH. As a general rule warm, fresh water fish and leafy crops as lettuce and herbs will do the best. In a system heavily stocked with fish, you may have luck with fruiting plants such as tomatoes and peppers.

Fish that we raise in aquaponics with good results are:

Tilapia, sunfish, bluegill, goldfish koi and various ornamental fishes like angel fish, guppies, sword fish and mollies. Other fishes are carp, silver perch, cat fishes, golden perch largemouth Bass etc.,

Plants that will do well are any leafy lettuce, basil, mint, water cress bok choy, Kale and common house plants. Plants that have higher nutritional demand will only do well in a heavily stocked, well established aquaponic system. Some examples are tomatoes, peppers, cucumbers, peas, beans, squash, cabbage and cauliflower.

Aquaponics is a big hope for sustainable organic crop production, aquaculture and water consumption. The fish waste is recycled and used for plant growth instead of throwing it into the ocean.



BUILDING OF AQUAPONIC SYSTEM

Building an aquaponic system is very easy once you have a sound design. There are different types of aquaponic systems depending upon your budget. They are

- I. Mini aquaponics
 - II. Duel loop aquaponics systems.
 - III. Vertical aquaponics
1. Construction of Mini aquaponics.
 2. Constructing of duel.

I. Mini aquaponics:

Gravel:

The gravel serves as home for nitrifying bacteria that convert ammonia to nitrite and then nitrate which can be used by plants. The individual pebbles are about 1/8" in size. They should be washed thoroughly.

Pump & tubing:

A water pump is used to pump the water from the fish tank to the grow bed. The gravity feeds back the water to fish tank.

Air pump is used to blow air into the tank water for both fish and plants.

Grow bed:

The bed should be higher to the tank and must be larger than the fish tank. The container that sits on the top of the tank works fine. It should be 3" to 8" deep.

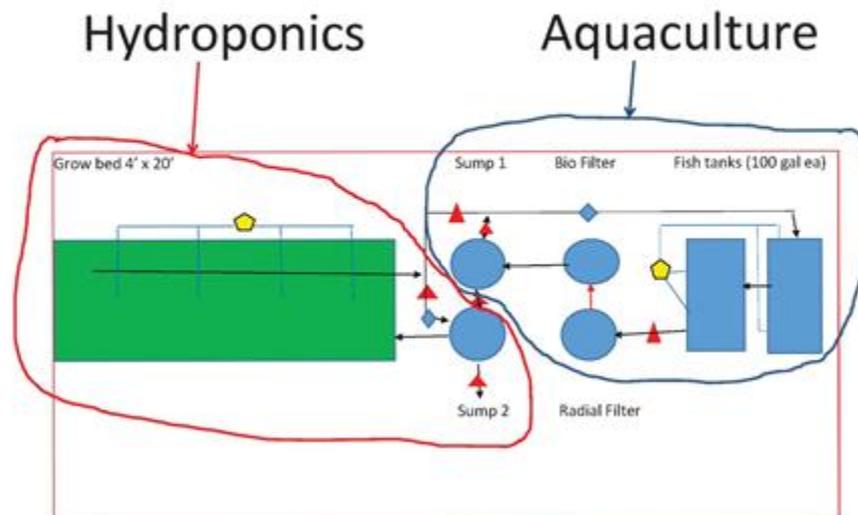
Growing medium:

A growing medium is a porous, chemically inert material that holds the plant roots and maintains moisture. Ex: Perlite, Pebbles, Peat moss, Pea gravel and Coconut coir.

Fish and plants:

In an aquaponic system the fish provide the nutrients and the plants purify the water by consuming those nutrients.

II. Duel loop aquaponics systems



The dual loop system consists of two consists of two stamps. They are hydroponics and aquaculture systems. The dual loop system consists of

- 2 100 gallon fish tanks
- Radial filter
- Bio filter
- two sump tanks
- 2 water pumps
- 2 air pumps with 8 air stones
- 4 ft x 20 ft grow bed.

Fish tanks:

Two food grade 100 gallon rubber made stock water tanks were set up on cinder blocks to be at the highest point of the entire system. Tanks were laid out and area for the grow beds measured to make sure everything is spaced properly and would fit.

The fish tanks are to be covered in order to avoid the growth of algal due to sunlight and to avoid jumping of fish out of the tank. It also avoids the fish from entering into raft system where they will eat the plant roots.

Grow bed (or) trough construction:

The inside dimensions of grow bed are 49.25 inches wide by a little over 20 ft long.

- The floating boards are 4 ft wide.
- The extra 1.25 "with allows for some of boards. Total width outside is 52.25".
- The single trough was constructed using 2 x 12 pressure treated lumber.

Treated lumber is used because the food grade liner used in the trough protects the plants from any chemical teaching from the treated lumber.

Once the lumber is assembled lines is laid down. The lines are ultra scrim only comes in two widths 6.167 ft and 12 ft so that they determine the width of grow beds. The 6.167 ft width is perfect for 4 ft wide beds.

The corners of the liner are folded over one another inside the tank and the corner tips were cut. Bulk head fitting is installed through the liner to facilitate water return pipe through it.

Water return pipe:

The pipe is constructed of two 10 ft long 2 inch schedule 40 PVC pipe, cut to size using a saw 3 all blade and joined together with a 2 inch slip coupling. The intake is at the end of the growing bed and has a bitter to keep solids from re-

circulating. The filter is constructed of hardware net and black pet screen 2" PVC end cap and 2 clamps. The complete return pipe is levelled using a couple of scrap pieces of PVC pipe.

End Filter:

All filters are constructed in the same fashion. Lay down a PVC pipe and an end cap, spaced about 6" apart and roll the hardware net to get the appropriate size and cut it. Do the same with black pet screen. Join the pieces together with clamps. Trim excess net from end.

Radial filter:

This should prevent most solids from exiting the radial filter into the biofilter. This radial filter protects the hole at the bottom. It is cut at the end of the season the drain the fish solid wastes. The solids can be put into worm bins for composting or wicking beds or in vegetable garden.

Biofilter:

Next water flows to the biofilter. It is simply a 30 gallon container with a lid that contains two to three packages of bird netting scrunched upto the container. The purpose of the netting is to provide a large surface area for the bacteria to colorize and transform ammonia which is toxic to fish into nitrite, then nitrate which is nutritious to plants.

You don't need to add anything like bacteria as they are all around us. If you want to speed up the process you spike you biofilter with store bought bacteria.

Sump tanks:

The normal operation, the valve leading to sump # 2 and the pump that feeds it are closed and the valve that leads back to the pump that re-circulates the water to the first fish tank.

Floating rafts:

The final stage of construction is the construction of the floating rafts. A template for hole spacing for the floating rafts is a 2 ft x 4 ft with 2 1/8" holes in it on a pattern with holes 4" apart. This design gives 122 holes with 2 ft x 4 ft template. Another template (2.5 ft x 4 ft) has holes of similar diameter 2 1/8" but on spaced 8" apart and therefore result in 24 holes.

Holes spaced 8" apart are perfect for mature greens (lettuce). The holes spaced 4" apart are perfect for seedling. Both rafts are workable for most people. Some people create an intermediate spacing (6" apart) for plants that are between seeding and full maturity.

III. Vertical aquaponics:



Vertical aquaponics simply refers to an aquaponic system that goes upwards. This can increase the growing space you need for more floor space when there is a limited plate it is a wonderful option. The best part is the crops can grow are above another making use of the entire vertical space, with adequate light.



Putting pipes together:

Now lay out your pipes in the following order are 90° piece, a 1 ft piece, at 'T' junction, 1 ft piece, 'T' junction, 1 ft piece and 90° bit. Do this again to join the whole lot together in the shape of a rectangle.

Add upright pipes. This is really going to gain growing space and room with your vertical aquaponic system. These pipes will slot into 'T' junctions. You need to use your 1 inch hole. Drill 5 holes and see that they are evenly spaced. Turn the pipe 90° and drill 4 holes. Repeat the same until you get the whole pipe with alternating holes.

Positioning the vertical aquaponic system:

Now it's time to decide where your aquaponic system is going to sit. You can use 1 BC tote which is already framed (or) you can use alternative container (or) even 50 gallon drums. The container must be food graded and they should be thoroughly washed before adding fish. Consider your access to the fish tank to check your fish, feed and other issues. Also over the fish tank to avoid the growth of algae.

Vertical garden:

The PVC aquaponic vertical system is placed on the top of your chosen fish tank. If you place the system outside consider the wind factor and clamp the system in position. Now at the aquarium pipe and insert 1 inch drain hole. Aquarium pipe should drop downwards reducing any issue in water flow.

Add cups:

The vertical holes should not need cups but any horizontal ones your plants will be wasted (or) there roots block the pips. To prevent this you need to spike holes into the cups and drop then into the horizontal tubes.

Grow Media:

The plants should get nutrients. To saw the seeds place some rock wood (or) pond filter foam to wedge into the holes so that you can push your seeds into the foam. Before you

Building of vertical aquaponics:

Pipework:— The exact 4 inch pipe you use will determine how large your completed aquaponic towers. You can drill 1 inch hole into one of the long pieces that doesn't have circular holes in it.

insert them hang strips of burlap sacks so that it will absorb water slowing the flow of water in the pipes. The burlap also gives roots so that each plant will secure its position.

The pump sets:

A good quality pump should be used. The pump should be capable of pumping 400 gallons of water per hour. The pump is situated in the fish tank. It should be raised above the bottom so that the fish can swim under it. You need to add adaptor so that water will reach the top of each column. It is a good idea to warm the pipes in hot water before you slide there to join, this will help them to go easier and seal in place.

Fish & Plants:

The water should be de-chlorinated which takes several days. The PH levels, ammonia, nitrates, and temperature should be checked. It is best to add small fish to get the ammonia levels up and encourage, the arrival of bacteria to turn ammonia into nitrates for plants.

Uses of aquaponics:

1. Environmentally friendly with low water usage and low power usage.
2. Primary inputs are fish pond and water.
3. No chemical usage.
4. Plants thrive well in Aquaponic system.
5. Low susceptibility to diseases.

REFERENCE BOOKS

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2. *Aquaponics: An essential step by step guide to beginners* by Seila Brown.
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4. *Aquaponics: A guide to setting up your aquaponic system* by Jim Gears.