# Alberta Tilapia Aquaponics



PROUDLY CANADIAN

Tested and tried by our systems

Welcome to our aquaponics workshop, we understand that there is a lot of different ways to run aquaponics and what we present is practices we have tested and used for the past 6 years.

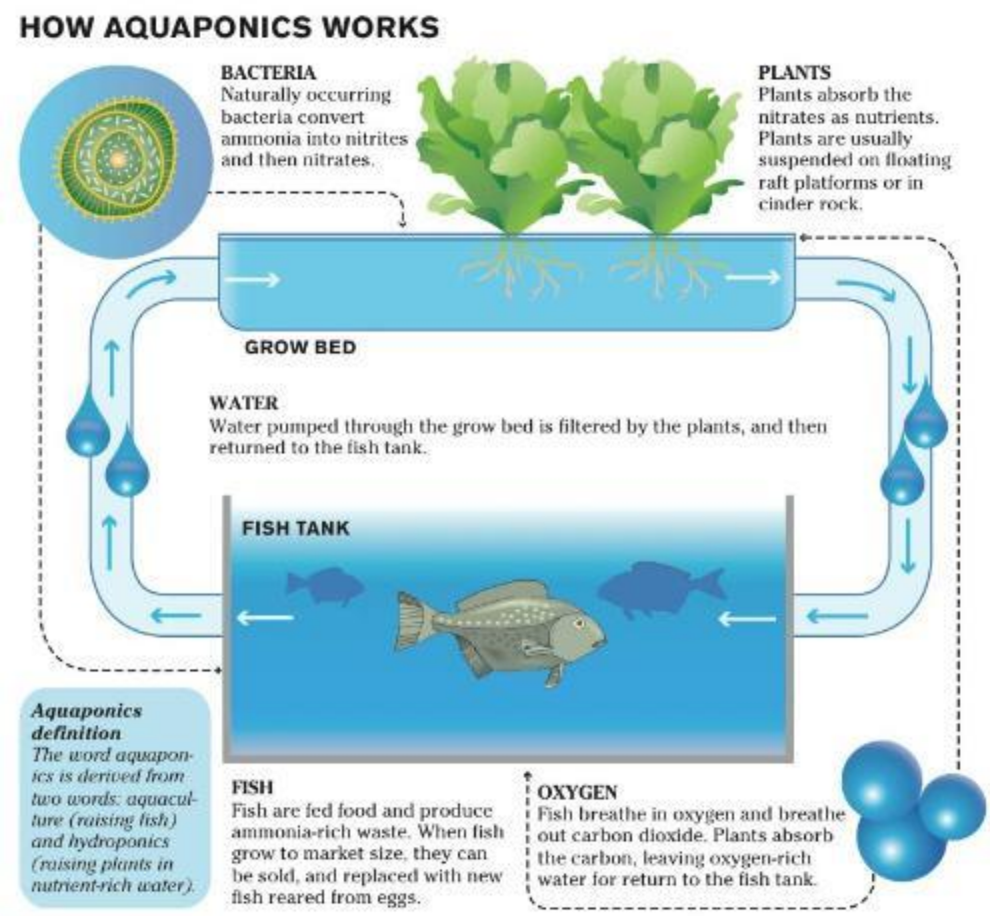
Please feel free to ask questions and ask us to repeat anything if you fall behind or don't understand, you are NOT holding up the class you are only helping everyone understand all the work.

We have a Facebook page at www.facebook.com/albertatilapia

We post new updates here trying to help people putting our practices to work, please not that this is a guideline only.

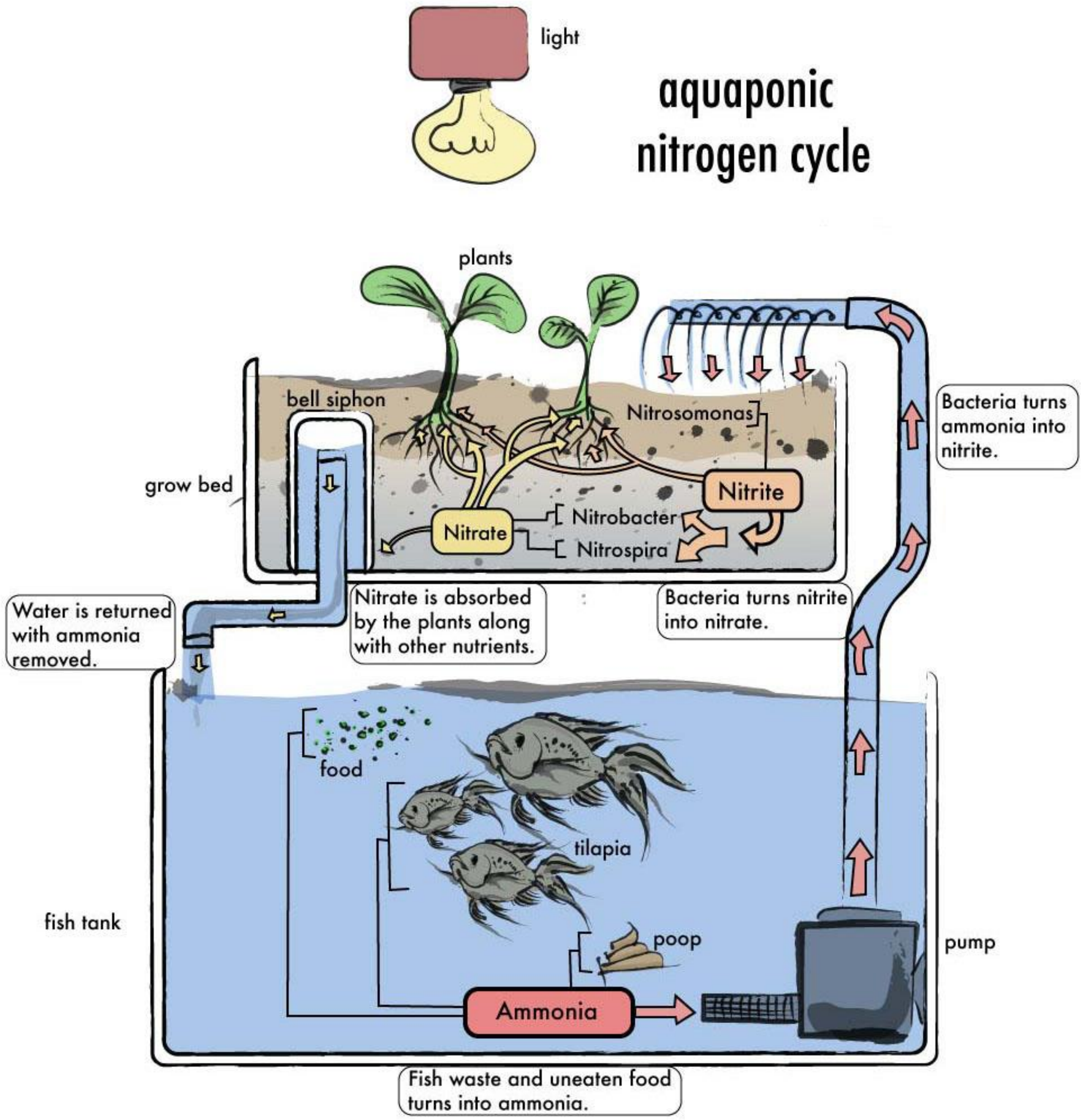
We are very pleased you have come out here today to learn more about aquaponics and tilapia, we hope you enjoy the day and that you leave here a little more excited and prepared for taking on Aquaponics.

At this point we all have a basic idea on what aquaponics is so I am not going to spent a lot of time on it, Aquaponics is using water from a fish tank to grow plants in hydroponic fashion. It works better than hydroponics because it gives you that consistent nutrients that the plants require to grow bigger and better than hydroponics.




This is the basic aquaponics cycle we do however recommend a swirl finter and a bio filter before the water enter the grow bed it keeps solids out of your grow bed and also help with the odor and operation of the system. It starts t change the ammonia over to nitrite as soon as it enters the filter speeding up the process and helping process more ammonia at a time.

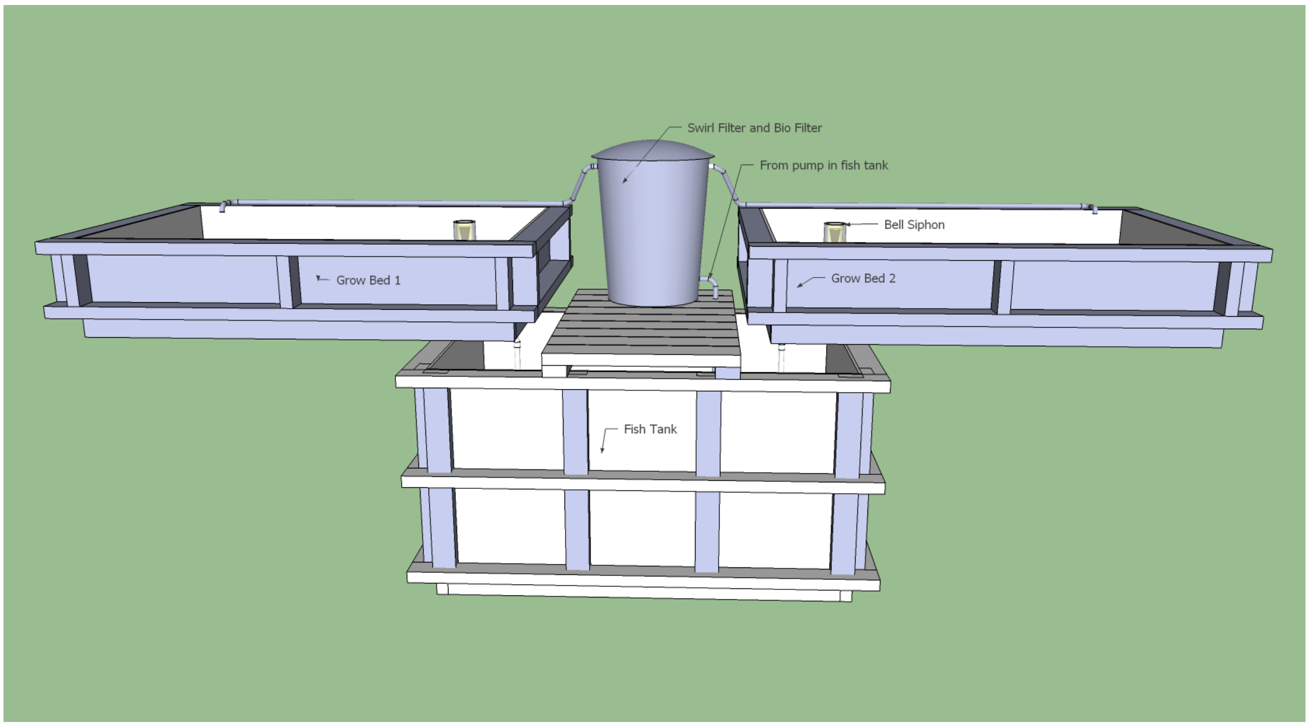
Basic Aquaponic System




As you see in this diagram there is no filters so all of that solids end up in your grow bed making it messy to clean even if you have red wiggler worms in there to help break it up.

We instead recommend systems like these that has filtration on it to help keep your system clean and healthy, adding a bio filter with lava rock is a great additive to any aquaponics system. The swirl filter is an easy way to clean all the solids out and also gives you a little control if you need higher concentrate of nutrients for the plants.

We use Lava rock in our bio filter and here is why it works so well, the lava rock seeps some iron into the water that the plants in turn use to actually absorb the nutrients.



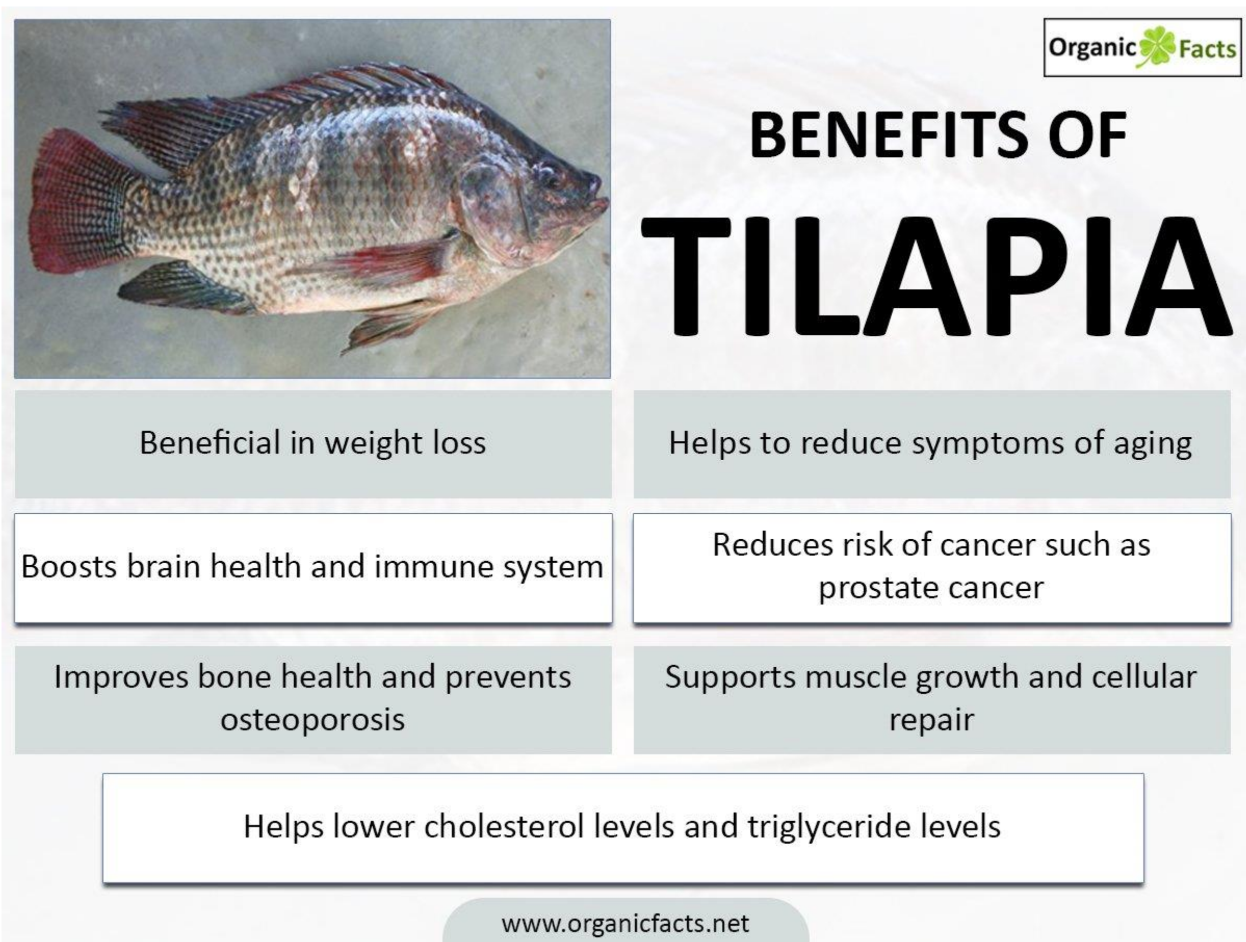

Now that you understand the basic aquaponics system lets move on to what fish you should use in your system. More technical detail about the system its self will be discussed later on in this booklet.

## The Fish

Tilapia are by far the most common species used in small scale aquaculture systems. They're a tropical species, however, and need the water temperature to stay between 70 and 90 degrees to stay healthy and grow quickly. They're used for their tolerance of high stocking densities and less-than-perfect water conditions, plus they have a phenomenal growth rate, reaching a harvestable size of one pound in 6 to 8 months. Thus in a temperate climate, it is possible to stock the tank with fingerlings in May and harvest the 'crop' in October.

Stocking density is recommended for every 2 gallon you grow one fish.

Catfish are also very amenable to high-density recirculating aquaculture systems and have no problem overwintering in all but the coldest climates, though they only put on growth when the water is warm. Yellow perch are the third most common species used in aquaponics systems, and have the advantage of being able to put on growth in cooler waters.



## The Plants

Some food plants are easier to grow in an aquaponics system than others. Basically, anything that is harvested as a leaf—lettuce, kale, arugula, spinach, basil, dill, etc.—responds very well to the nutrients found in fish water and can usually be grown without added nutritional supplements. It is also possible to cultivate species grown for their fruit, such as blueberries, strawberries, raspberries, etc., as well as vegetables like tomatoes, cucumbers and zucchini, but these typically require media systems so that there is enough nutrients in the grow bed for them to fruit.

We have tested these plants in our systems and the results was overwhelming and all of the plants did extremely well.

We took the opportunity to do a side by side test for hydroponics and aquaponics and as you can clearly see the aquaponics did a lot better these plants we planted and transferred on the same day in the same greenhouse so the environment was more or less the same

Hydroponics Aquaponics

## Putting a System Together

You will need a flat, sunny space to set up your aquaponics system. If you're not building it inside a greenhouse, you'll want to get everything together in early spring, so you can stock the fish as soon as the water temperature hits 70 degrees. Stock the fingerlings first and start seedlings in flats of potting soil at the same time. By the time the seedlings are big enough to transplant, the fish should be producing enough waste to support the growth in the grow beds. Incidentally, the vegetables themselves have very little to do with cleaning the water for the fish—this actually occurs in the filter and growing medium, so the water needs to circulate through the grow beds for the sake of the fish, whether there are plants growing in them or not.

We have found using tote tanks for a system is pretty handy and a relative inexpensive start up in this new venture. You can find some on kijiji without much problems.

1. Select a fish tank
2. Build your swirl and bio filter
3. Select a grow bed(fill with media)

Water flow start with pump in fish tank up to your swirl filter then to your bio filter over to your grow bed and back to your fish tank

## Do I use media or not?

When considering aquaponics it's important to choose a growing system that ensures optimal results for what you're trying to produce. There are two main systems that you can choose from. The first of these is the floating raft system. This system is absolutely great for leafy greens that do not bear fruit. If you are going to grow something that bears fruit it needs a strong root system to support the plant. A growing media system is best for such plants. It's important to us that your system work flawlessly, we will work closely with you in determining this and optimizing your growth potential based on the crops you are choosing to grow.

## Flood and Drain?

Using a bell siphon is an effective way to ensure your plant roots get enough oxygen while they are in a media system, giving them the opportunity to grow really healthy in your aquaponics system. This also allow the particles to settle in your grow bed, there they are trapped and keep releasing nutrients into your water.

## Water Quality(The hard part)

### Testing Frequency

Testing frequency will vary depending on the parameter being monitored. However, as a general rule, start-up systems should be tested daily so that adjustments can be made quickly when needed. For example, in response to high ammonia levels, feeding levels can be reduced, aeration can be increased, or water can be diluted. Once nutrient cycles are balanced, weekly testing is usually sufficient. In all cases, it is important to record all of your readings. Keeping good records of your water quality measurements can help greatly in observing trends and diagnosing future problems.

### Dissolved Oxygen

Dissolved oxygen (DO) is one of the most important parameters for growing fish and is also critical to the beneficial nitrifying bacteria that convert fish waste into nutrients plants can use. Warmwater fish (e.g., bass, bluegill, and catfish) require about 5 ppm (ppm or parts per million, which can be used interchangeably with milligrams per liter [mg/L]) and coldwater fish (e.g., trout) require about 6.5 ppm of DO to maintain good health and maximum growth. Tilapia are tolerant of lower levels of DO, but growth rates will be affected. They will come to the surface for oxygen-rich surface water if DO levels go down to 1 ppm. It is recommended that DO levels be maintained at 5 ppm or higher in aquaponics systems. Oxygen levels should be measured frequently in a new system, but once procedures become standardized (e.g., proper fish stocking and feeding rates are determined, sufficient aeration is provided) it will not be necessary to measure DO as often. Low DO levels are not usually a problem with hobby aquaponics growers with low fish stocking rates. The problem tends to arise more in commercial operations with high stocking rates. If DO levels in your system are too low, increase aeration by adding more air stones or switching to a larger pump. There is no risk of adding too much oxygen; when the water becomes saturated, the extra oxygen will simply disperse into the atmosphere. Dissolved oxygen levels are strongly related to temperature: the warmer the water, the less oxygen it can hold.

### Ammonia

Ammonia is the first form of nitrogen released when organic matter decays and is the main nitrogenous waste excreted by most fish and freshwater invertebrates. Ammonia is excreted by fish mainly through the gills and also in trace amounts through urine. Ammonia can exist in two forms: un-ionized ($NH_3$) and ionized ($NH_4^+$), also known as ammonium ion. Un-ionized ammonia is extremely toxic to fish, and ionized ammonia is not, except at extremely high levels. The ratio of $NH_3$ to $NH_4^+$ in water at any given time will depend on the pH of the water and the temperature. At pH 7.0 or below, most ammonia (>95%) will be in the non-toxic form ($NH_4^+$). This proportion of non-toxic to toxic ammonia will increase greatly as pH increases. Water temperature will also affect the ratio of $NH_3$ to $NH_4^+$, with more toxic $NH_3$ present at any given pH in warmer water than in cooler water. For example, at 82°F, the percentage of ammonia that is in the toxic form ($NH_3$) is 2% at pH 7.5, compared to 18% when pH is 8.5. The sum of the gaseous toxic form and the non-toxic ionic form of ammonia is called Total Ammonia Nitrogen (TAN). TAN is what most commercial ammonia test kits measure. It is recommended that TAN in aquaponics systems be maintained at

**The Role of Ammonia in Establishing a Biofilter**

The process of building a bacterial colony during the initial setup of an aquaponics system is known as biofilter establishment, or cycling. Cycling is the essential first step in setting up any aquaponics system. Until a healthy community of nitrifying bacteria has been established, the cycle is not complete and it will not be possible to grow plants. Basically, the process involves the steady, constant introduction of a source of ammonia into the aquaponic unit, which feeds the new bacterial colony and allows it to grow, thereby creating a biofilter. There are two ways to establish a biofilter, either with fish in the system or without fish (known as fishless cycling).

**pH**

One of the most important water quality variables in aquaponics systems is pH. The term pH stands for the power of hydrogen, and refers to the concentration of hydrogen ions in a solution. pH can range from 0 to 14, with values between 0 and 7 being acidic, 7 being neutral, and values between 7 and 14 being basic or alkaline. It is considered a “master variable” because it influences many other parameters, such as the ratio of toxic to non-toxic ammonia in aqueous solutions (see Table 1) and the rate of nitrification on biofilters in aquaponics systems. It is important to maintain pH at levels that are acceptable to both fish and plants. Tilapia, for example, require pH to be in the range of 5.0 to 10.0. Plants, on the other hand, grow best when pH levels are below 6.5. Nitrifying bacteria perform optimally at pH levels greater than 7.5 and basically stop working when pH levels fall below 6. The compromise that is optimal to all three components of an aquaponics system—fish, plants, and nitrifying bacteria—is a pH of 6.8 to 7.0. However, maintaining pH within such a narrow window can be difficult and may lead to unnecessary adjusting and tweaking. As long as the pH is maintained between 6.4 and 7.4 it will be tolerable to all three components of the system. Adjusting pH It is important to measure pH every day because it normally declines daily in response to nitrification processes. If pH levels get too low, nitrification will slow down or stop and ammonia will accumulate to levels that are toxic to the fish. When pH drops below 6.4, a base in the form of calcium hydroxide or potassium hydroxide should be added to the system to bring it back up to 7.0. Additions of the two bases should be alternated because both calcium (Ca) and potassium (K) are essential nutrients that must be supplemented in aquaponics systems. Here is the Southwest, water is alkaline and high in calcium content, so adding extra water rather than calcium hydroxide is often sufficient to raise the pH. Failing to measure pH for several days can lead to drops in pH to levels as low as 4.5. At pH 4.5, nitrification has stopped and TAN concentrations can climb to over 30 ppm. When this happens, it is crucial to add base very slowly over several days. Adding a large amount of base all at once will shift the majority of the TAN into the toxic un-ionized form ($NH_3$ ), and this could kill all the fish. Occasionally a problem can develop in which the pH does not decline over time but instead remains stable or starts rising. This can be due to something in your system causing pH to rise, such as hard water or other sources of minerals, such as net bags of crushed oyster shells that are sometimes added to systems to stabilize pH and add calcium. Rising or stable pH can also be indicative of anaerobic (oxygen-free) zones in your aquaponics system where denitrification is occurring. Denitrification produces alkalinity and stabilizes pH. To remediate this situation, filter tanks should be cleaned twice a week, and all deposits of organic matter accumulated in the hydroponic section should be removed.

**Ammonia Levels Too Low**

If plants are not growing, it could be because not enough ammonia is being produced in the system. Enough ammonia must be produced and converted to nitrate in order for the plants in your system to grow. Low ammonia occurs when there are not enough fish or there is too much water for the number of plants being grown. The solution is to add more fish to your system, feed them more, or use a smaller tank.

**Nitrate Levels Too High**

While nitrate is the essential and desirable nutrient byproduct of biofiltration, excessive levels (greater than 150 ppm) could be an indication that not enough plants are being grown in the grow beds to take up all the nitrates that are being produced by the nitrifying bacteria. To address overly high nitrate levels, more plants could be added to the existing grow beds, more fish could be harvested to reduce the amount of ammonia being produced, or another grow bed could be added to the existing aquaponics system

**Ammonia Levels Too High**

Even after your system is fully cycled, it is a good idea to check ammonia levels on a weekly basis to catch changes early and make adjustments before they become big problems. Higher than desired ammonia levels occur when more ammonia is being produced than can be handled by the biofilters. Possible causes for this include overfeeding of fish, fish densities that are too high for the volume of water (a rule of thumb is 1 lb of fish per 2 gallons of water), or not enough aeration. Pumps and DO levels should be checked, and adjustments in feeding rates or fish density should be made

**Water Temperature**

Water temperature in aquaponics systems will influence not only what type of fish can be reared but also plant growth and the performance of the biofilter. Fish species are temperature-dependent. Warmwater species such as goldfish, bass, catfish, and tilapia prefer temperatures ranging from 65 to 85°F, while cold water species such as trout thrive at temperatures in the range of 55 to 65°F. Tilapia prefer temperatures of 70–85°F (21–29°C) for maximum growth. When water temperature drops below 70°F, growth slows dramatically, reproduction stops, and the incidence of disease increases. Tilapia will die when temperatures drop below 50°F. Vegetables grow best at temperatures ranging from 70 to 75°F, and biofilters (nitrifying bacteria) perform optimally at temperatures ranging from 77 to 86°F. As with other water quality parameters, the key is to find a temperature that falls within the acceptable range for all three components of the aquaponics system.

## Pest Control

Since you can't use pesticides in aquaponics, you need to be vigilant in your pest scouting efforts and quick to react if you see any pest problems. Pest control in aquaponics is really about prevention through good management practices such as writing and following a bio-security program, regularly monitoring and scouting for pest insects, keeping weeds and debris from growing around the outside periment of the greenhouses, installing proper insect screening on greenhouse openings and keeping the greenhouse clean and free of dirt and dead or dying plant material.

I consistently see that the growers who keep their greenhouses clean and crops healthy rarely experience any pest problems. Plant debris and unhealthy plants attract pest insects. Healthy plants repel pest insects.

If you do discover pest insects in the greenhouse, don't panic. There are natural ways to control them. First, though, you need to properly identify the pest and then determine what the biological control is. Most often, this will be another insect that is either a predator or parasite to the pest insect. A predator, like the lacewing shown to above, eats the pest insect. A parasite will disrupt the life cycle of the pest insect.

At the same time you are ordering beneficial insects, physically remove the affected plants along with the pest insects as best you can. When the beneficial insects arrive, distribute as directed by the supplier and let them do their thing. Biological pest control is a fascinating and effective means of controlling pests when you are in a well-constructed, controlled environment greenhouse.

We have found using Diatomaceous earth on the plants also keep some of the pest away giving the plants the chance to grow stronger.

It is best to use any type of spray early in the morning or in the cool of evening, DO NOT spray when the temperatures are above 80'F/27'C. Your plants may "burn" or have a reaction to what you are spraying in hot temperatures also known as "Phototoxicity".

Always perform a small test wait 24 hours to see the reaction and then proceed.

**remember to wear proper PPE when working with chemicals

### Should I have red wigglers worms in my system?

Yes! They are there to remove any of the solid build up from the particles that stay behind in the grow bed and then break it down to a form the plants can once again use. They keep systems cleaner and odor down to nothing.

### How do I know if my fish is healthy?

Tilapia is really active fish they eat like crazy and always on the move, if something is wrong a fish would not eat be slow moving and usually isolate himself from the group best is to grab that one from the tank and place in isolation till he eats and react normally again.

### What food should I feed my fish?

We use a NU-WAY trout ration for our feed, the fish love it and they produce great and have awesome grow rates with it, we find very little wasted food after a feeding and it is very obtainable and affordable. You don't want to spent more money in feed than what the fish themselves is worth.