



Aquaponics

What You Need to Know

**35th Florida Master Gardener Advanced
Training Conference 2017**

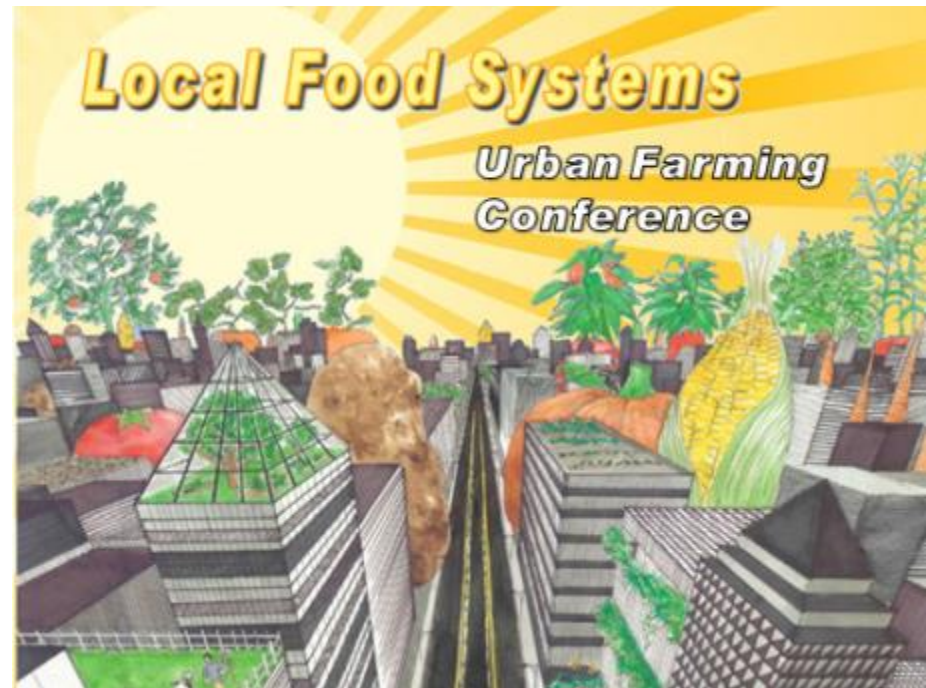
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Local Food Systems

**Socially &
Environmentally
Responsible**

**More Food Safety
Oversight**

**Economic Benefits to
Local Communities**



What You Need to Know

- **If you want to grow plants**
~use hydroponics~

- **If you want to grow fish**
~use aquaculture~

pH Optima for 3 Organisms

**Hydroponic
Plants = 5.5-6.5**

Aquaculture = 6.5-8.5

N. Bacteria = 7.5-9.0

TAN = Total Ammonia Nitrogen



pH Determines Ammonia Equilibrium in Water

pH	6.5	7.5	8.5
NH_3 =	0.2%	↔ 2%	↔ 18%

Nitrifying Bacteria

- Nitrification converts toxic ammonia to nitrate
- $\text{NH}_3 + 1\frac{1}{2} \text{O}_2 \rightarrow \text{NO}_2^- + \text{H}^+ + \text{H}_2\text{O}$
- $\text{NO}_2^- + \frac{1}{2} \text{O}_2 \rightarrow \text{NO}_3^-$

Aquaponics Nitrogen Cycle

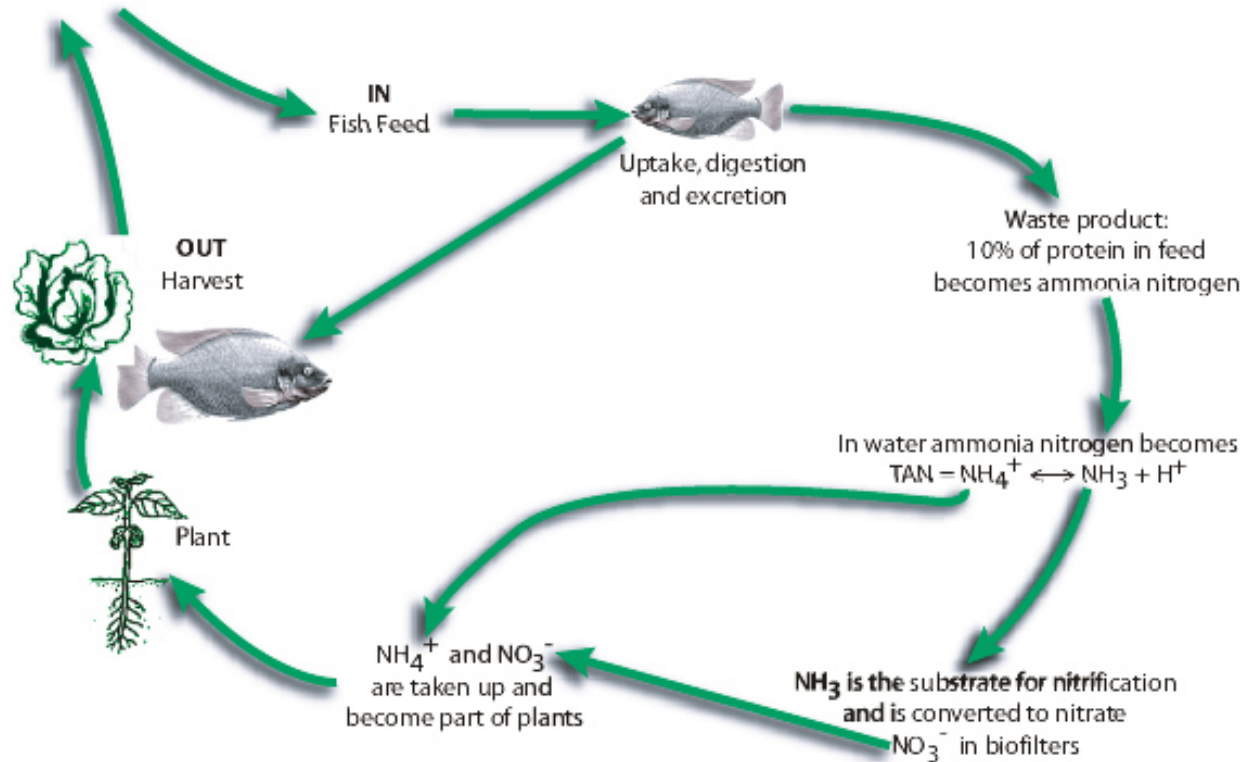


Figure 1. Nitrogen cycle in aquaponics.

What You Need to Know

- **Fish density matters** – range 1/2 lb/gal to 1 lb/10gal
- **1 lb fish / cubic feet (7.5 gallons) or greater**
- **High densities require experienced growers, backup pumps, a generator and 24 hour supervision**
- **Low densities you can go away for the weekend and not worry about the fish dying before you return**

What You Need to Know

- No fish feed provides all the nutrients required by plants – calcium, potassium & iron are low
- Low fish density in home aquaponics will require **supplemental fertilization** with **1/4 strength** hydroponic mix for optimum plant growth

pH Optima for 3 Organisms 6.5-7.0

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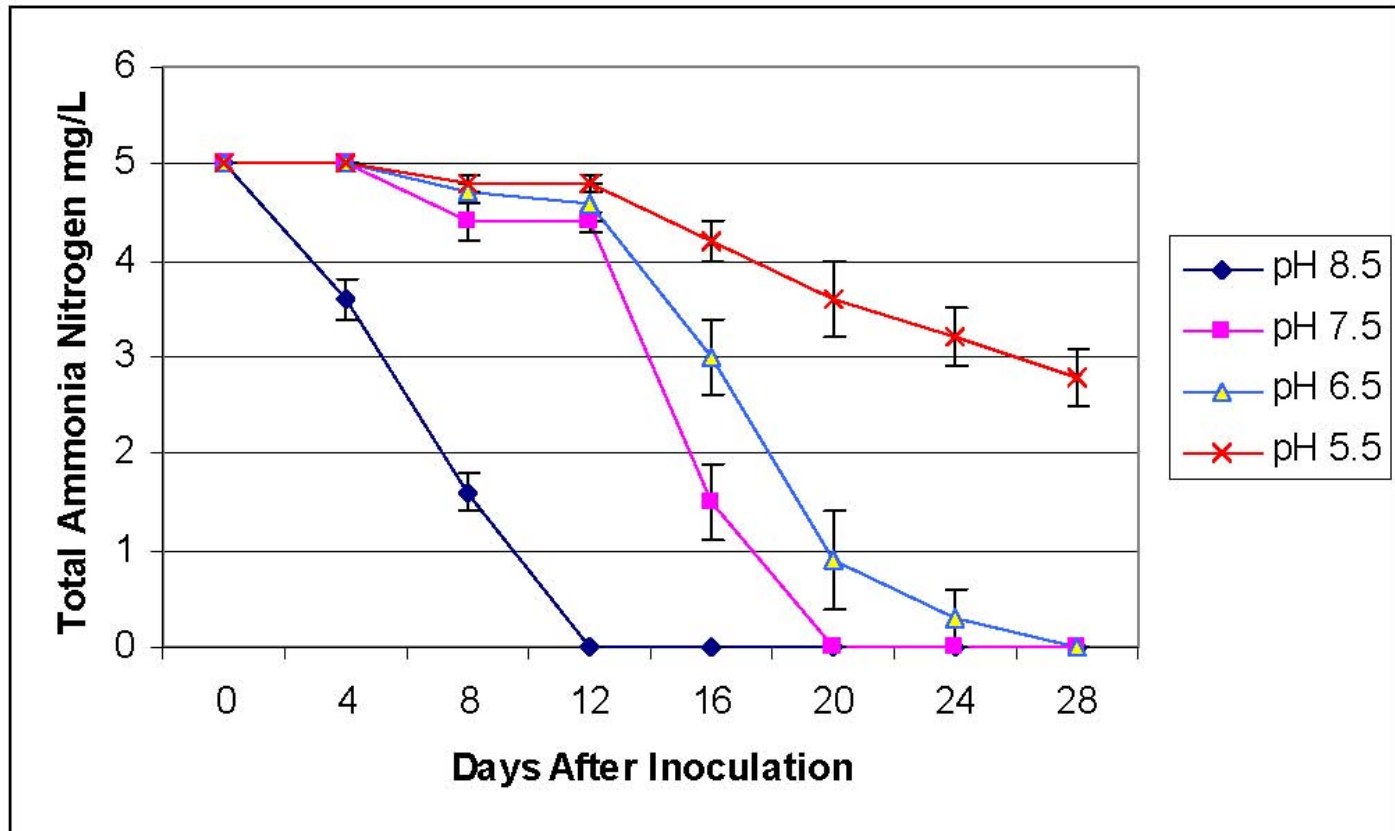
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pH Affect on TAN Loss from Biofilters



Error bars represent \pm SE (n=8).

Aquaponic Systems



NFT



Floating raft



Bench Bed

Hydro - ponics = Water Working

- **Indoor or outdoor systems**
- **Low or high tech systems**
- **Crop sensitive - feasibility considerations**

Water & Nutrient Flow

- **Re-circulating systems**
- **Flood and drain systems**
- **Non-circulating systems**
- **Flow through systems**

Media Systems vs Water Systems

- **Water – Using transplants with net pots or other means of holding plants in place as water flows around roots – water loving vegetables & herbs**
- **Media - perlite, rockwool, coconut coir, peat, vermiculite (or combinations) & clay pebbles – most vegetables & herbs, using transplants**

NFT – Nutrient Flow Technique



Home Made NFT / Aquaculture = Aquaponics

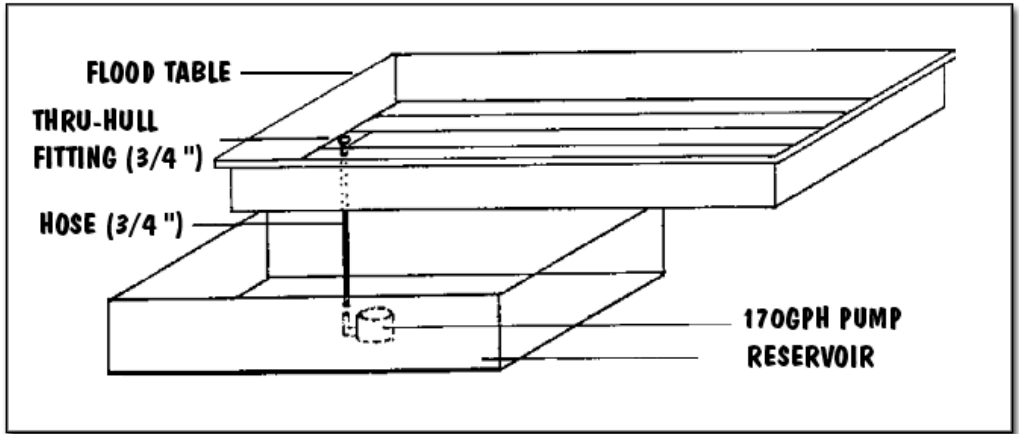


- **Aluminum roof panels, multiple crops, solar powered**

Aquaculture Requirements

- **Keep the water circulating, it provides oxygen to the water and exercise for the fish**
- **Adding pumped oxygen is beneficial**
- **Solids filter and a place for nitrifiers to attach is recommended**

FLOOD AND DRAIN



Floating Raft Leafy Salad Crops & Herbs



Leafy Salad Crops and Herbs

- Bibb
- Boston
- Red leaf
- Green leaf
- Chicory
- Romaine
- Escarole
- Basil
- Watercress
- Mint
- Swiss Chard
- Chinese Leafy Greens

Plant Requirements

- **In general, plants that prefer well drained soils and most fruiting vegetables are best grown in media systems.**
- **Leafy salad crops and most herbs will adapt to either water or media systems.**
- **Choose crop varieties / growing seasons carefully – warm/cool season veggies!**

WATER SOURCES

- **Pond water – nutrients are low - microbial, algae & critter contamination is high**
- **Well and municipal water sources are safest**

FERTILIZER / NUTRITION

- **Using natural and organic materials can be problematic**
- **Water soluble hydroponic fertilizer and Epsom Salts are the easiest to work with using soluble salt meters**
- **10% of the protein in fish feed becomes nitrogen in the water!**
- **Sunlight + Nutrient water = algae**

Water Quality Measurements

- **pH**
- **Soluble Salts**
- **Ammonia**
- **Oxygen**
- **Alkalinity**
- **Nitrate**



So Why Aquaponics ?

- **The Nitrogen Budget!**
- **Fish produce large amounts of harmful ammonia nitrogen as waste.**
- **Nitrifying bacteria change it to beneficial nitrate nitrogen for the plant.**
- **100 lbs of fish will supply enough nitrogen for 4,050 lettuce plants or 540 tomato plants.**

So Why Aquaponics ?

- **The Water Budget!**
- **Plants transpire large amounts of water (1pt - 6 qt/plant/day)**
- **Aquaculture replaces 5 to 10% of tank water/day to maintain quality**
- **Properly designed aquaponic system minimizes water discharges to the environment**

Crop and Fish Choices

- **Leafy salad crops, herbs, tomato, pepper, cucumber and strawberry**
- **Tilapia, catfish, rainbow trout, largemouth bass, yellow perch, bluegill, Barramundi, koi and other ornamental or bait fish**

Summary Need to Know

- **Hydroponics/Aquaculture = Aquaponics**
- **Fish density matters > 1 lb. fish/cubic ft water (7.5 gal)**
- **Low density means supplemental fertilization**

- **Fruiting crops prefer well drained media systems while leafy crops tolerate water systems**
- **Tilapia are the easiest fish to grow but stop feeding at 60F and die at 40F**