An Introduction to Aquaponics

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Channel Catfish – Ictalurus punctatus

Nitrobacter sp.

Beta vulgaris
A little about me....

- Lead Faculty for the Sciences - Columbia Southern University
- Adjunct Biology Instructor - Mountain View College
- M.A. in Ecology – University of North Texas
- North Texas Master Naturalist
- Gardening since the late 90s – Container, Soil, Hydroponics, Aquaponics
Growing Food Crops

• Soil - “in ground” farming, using the native soil

• Containers/Raised beds – Pots or raised structures using non-native soil medium

• Hydroponics – Water culture: growing plants in oxygenated water + nutrients, largely sterile

• Aquaponics – Water culture: raising fish* and plants together, nitrogenous fish waste fertilizes, dependent on microbes

* May include other organisms
Soil (Outdoors)

Pros

• Relatively inexpensive
• Excellent yields
• Soil is somewhat “forgiving”
• Good water retention
• “Terroir” – if you’re inclined to believe
• Fertilizer options are many

Cons

• Considerable space needed; plants need space
• Greater need for pesticides/herbicides
• At the mercy of the elements, every year is a surprise
• Irrigation/water needs heavy
Containers - Raised Beds

Pros
• Easier to maintain than in ground gardening
• Tend to be neater and more organized
• Weeds often less of an issue

Cons
• Tend to dry out
• Can be difficult to maintain microbial activity (organic gardening)
• Build up of fertilizers salts or other dissolved solids
• Can be overtaken by underground roots (raised beds)
Hydroponics

Pros

• Concentrated production
• Far less space needed than soil
• Outdoor and Indoor
• Variety of techniques
• Excellent yield
• ~70% less water needed than soil

Cons

• Expensive – fertilizers, grow medium, pH buffers
• Maintaining pH can be a problem
• More difficult to maintain outdoors
• Nutrient concentrations must be maintained
• Not practical for some crops
Aquaponics

Pros
- Concentrated production
- Less space needed than soil
- Outdoor and Indoor
- Variety of techniques
- Excellent yield
- ~70% less water needed than soil
- pH problems fewer than hydroponics once system established

Cons
- Somewhat expensive to start
- More difficult to maintain outdoors
- Nutrient concentrations must be maintained
- Not practical for some crops
- System size a factor, depending on climate
Techniques

A Little Background
Hydroponic Techniques

Nutrient Film Technique or “NFT”
Nutrient Film Technique or “NFT”
Hydroponic Techniques

Deep Water Culture or “DWC”
Deep Water Culture or “DWC”
Hydroponic Techniques

Constant Flow / Ebb and Flow
Constant Flow / Ebb and Flow
Constant Flow / Ebb and Flow Grow Media Options

- Gravel – cheap, very heavy, can cause pH problems
- Expanded Clay - “Hydroton” – expensive, light, excellent grow medium!
- Expanded Shale – heavy, relatively cheap and easy to find
- Pumice – volcanic rock, can be used for filler, heavy, cheap
- Grow stone – “puffed” glass – light, excellent grow medium, expensive
Wicking Bed
Aquaponics – How Does It Work?

Nitrifying Bacteria

- *Nitrobacter sp.*
- *Nitroccocus sp.*

Ammonia -> Nitrites -> Nitrates (Fertilizer)
Establishing a “Cycle” – Making Microbes Happy and Abundant

- Dechlorination/Dechloramination – Time, Vitamin C Tablets

With Fish or Fishless

- With Fish – a few fish are introduced to system, may die, dead fish provide ammonia as they decompose
- Fishless – Pure ammonia is added to system before fish are put in
  - Ammonia levels are checked using a testing kit
  - As ammonia levels drop, nitrites are tested
  - Once nitrite levels quickly drop to ‘0’, system is ready for fish
  - May take weeks to establish
  - ‘Slime’ on surfaces coincides with established cycle
It’s Grow Time – What to Raise/Grow?

Animals
• Fish (tilapia, catfish, trout, goldfish, sunfish, bass, carp)
• Crayfish
• Freshwater mussels
• Snails
• Worms (vermiponics)
• Do we need animals at all?

Vegetables
• Will depend on type of system
• Leafy vegetables tend to be the best choice for aquaponics
Crops Successful in MVC Systems

• Basil
• Chard
• Lettuce (all varieties)
• Parsely
• Cucumbers (need pollination)
• Melons (need pollination)
• Okra (HUGE)
• Edible Gourds
• Squash
• Tomatoes (to an extent)
Fish in MVC Systems

• Goldfish
• Catfish
• Plecostomus (algae eaters)
• Tilapia
Challenges

• Fire Ants
• Rodents
• Aphids
• Hairy Crab Weed - *Fatoua villosa*, Basil?
• *Nostoc* – colonial photosynthetic bacteria
• Pumps breaking
• Fish disease
• Mysterious Disappearing Water
• Large Fish Damaging Pipes
Thank You

Are There Any Questions?