Nelson and Pade Workshop

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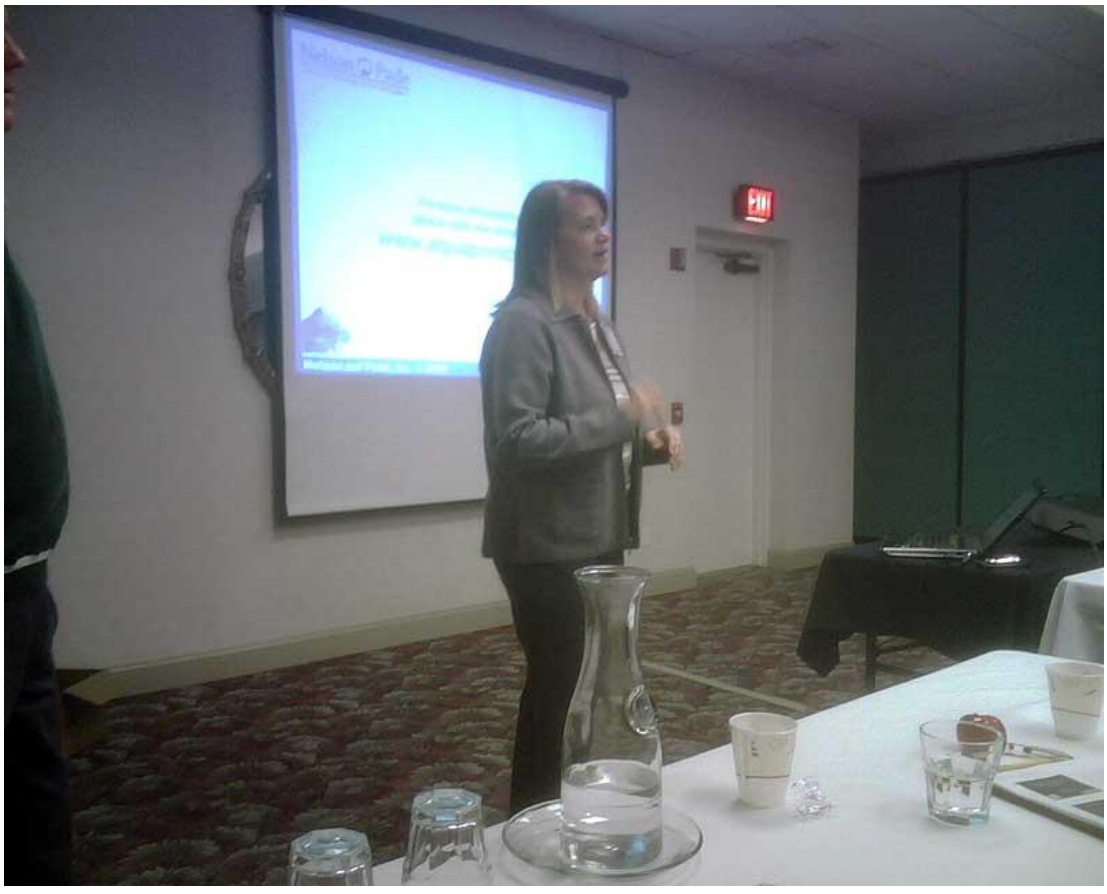
Disclaimer – These notes are my own, they may not reflect what was actually said or intended, nor are they complete as I recorded what I was thinking based on my own experiences. Verify any claims before acting upon them. The workshop is highly recommended, both for those considering aquaponics for the first time, as well as those with established systems. Nelson and Pade have 20+ years in commercial hydroponics construction and operation and almost as much experience in aquaponics research, design, and operation.

Friday, November 13, 2009



Rebecca Nelson – Nelson & Pade

Introduction – Rebecca Nelson

- Aquaponics is not easy, still in the early stage, but it works
- 38% of all food in the U.S. is imported (A large part of the remainder is grown far from where it is consumed and is trucked over long distances)
- Aquaponics is the combination of two highly technical and difficult specialties, Recirculating Aquaculture and Hydroponics. This creates twice the learning curve and twice as many opportunities for failure.
- Most people come to aquaponics without a background in Recirculating Aquaculture or Hydroponics (and as such, lack the training or experience in either)
- Benefits –
    - Locally Grown,
    - All Natural,
    - No Pesticides
    - Organic
    - No Herbicides
    - Fish wastes – Cold Blooded – no e-coli, not harmful to humans.
    - No weeds
    - No Soil born diseases
    - Can be implemented world wide as the single input, fish food, is available worldwide, where as high quality fertilizers and nutrient solutions for hydroponics are not.
    - Efficient conversion ratio (beef 12lbs to 1lb, many fish 1.3-2.0 lbs of feed to 1 lb of fish)
    - Very low water use.
    - Very little discharge.
- General maximum stocking guideline is 1/2lb per gallon in the fish tank (It's the amount of feed that really matters).
- 20 years of testing by Dr. James Rokocy shows that the Recirculating Aquaculture Systems (RAS) is the commercially viable system. Many other methods work, but are not economical enough to be commercially viable.
- Home Systems can operate differently than Commercial Systems as the goals are different. (profit is not necessarily a requirement for home systems)
- Many fish can survive on lower protein inputs as they get larger.

Fish Selection – Jim Held – Aquaculture Extension Agent

Jim runs the Regional Aquaculture Center and has extensive background in RAS operation, and lots and lots of experimentation behind him.

- The number of fish in the system is not critical, the amount of feed fed is!
- Fish can't regulate their body temperature, they stay the temp of the water, and that is why there are such high conversion ratios, they don't spend energy regulating their body temperature.

- We grow 3 things in our systems
    1. Fish
    2. Plants, and
    3. BACTERIA (sometimes we forget this)
- 2 types of Bacteria
    1. Aerobic (need Oxygen (O2) – our nitrifying bacteria are these.)
    2. Anaerobic (don't need O2 – actually changes nitrates back to hydrogen sulfide gas and other toxic products.
- In Aquaponics the money is in the plants, the goal with fish is to break even so they are not a drain on the business.
- Always have 3 levels of redundancy. Ex. Primary Pump, Backup Pump – plumbed in system and ready to go, and On-the-shelf backup. Have auto dialer to notify you when power or systems are out.
- More ventures fail due to single catastrophic events than probably any other cause. (power outage, fish kills, system failure.) Plan for, and prevent those failures. Do the "what if" cases and engineer for them. One example given later in the course, a very large commercial system had big backup generators, lightening took out the power and the transfer switch, generator never got the chance to kick in. Now the power panels are isolated and carefully grounded.
- Story – "Man goes to the Vet with a dead fish, asks the vet if he can save it. Vet says no. Man asks for another opinion, the Vet calls in his black Labrador dog, who smells the fish and walks away. The vet says it's confirmed your fish is dead and can't be saved, the man says I can't believe it, I want another opinion. Vet calls in his Cat. Cat takes one sniff, turns up his noise and says 'meow', Vet says, there you have, absolutely dead. Vet gives man his bill, $500 dollars. The man complains, that's absurd, $500 dollars how come! Vet says $100 for the office visit, $200 for the 'lab' test and $200 for the 'cat' scan.
- 2 rules of aquaculture:
    1. Big fish eat little fish
    2. Related to rule #1, If a fish can fit it into its mouth, it will eat it.
- Disease, nutrition, poor water quality doesn't kill fish, STRESS kills fish. Cortesal is fish adrenalin, long term elevated levels causes problems, weakens fish so disease that is always there gets in. It's not how high the level goes, but how quickly it returns to normal. Some fish when disturbed stay high for days, other return to normal in minutes or hours.
- Jim went through a power point presentation that reviewed the various types of fish and their suitability to RAS and Aquaponics. He rated each for availability, kill-ability, temperature, O2 demand, value of a "(lb)Pound in the Round" (whole dead fish at the ponds edge), concentration(density), social interaction(aggressiveness- ability to live with others and/or other species), nutrition, growth, and potential
    1. Salmonids (Rainbow, Brook, Brown, Coho Salmon)
        - Available, killable, cold water, O2 >8ppm
        - $1-2/lb in the round, High concentration, sociable if well fed
        - Diets readily available, fast growth

- Potential – Poor (O2 needs, to easy to kill)

2. Percids (Yellow Perch (YP), Walleye, Sauger, Hybrid Walleye)
    - YP available, others not
    - YP and hybrid hearty, cool-warm, O2 med,
    - $2-3/lb in round, YP crowd, others not.
    - YP social, others not, Sauger impossible
    - Trout diets work, Growth slow
    - New Hybrid Yellow Perch, fast growing,
    - Potential – YP, Hybrid YP, Hybrid Walleye good, others poor
    - **Hybrid Yellow Perch is the fish to watch, excellent potential**.
    - Trout diets to fat, but work.
3. Esocids (Northern Pike (NP), Muskie, Pickerels)
    - NP available, others not
    - Hearty, cool – warm, med O2, value as pond stockers high. Don't like crowding, socially aggressive, keep well fed.
    - Usually fed cultured minnows, but can be trained.
    - Fast growth, potential poor
4. Centrarchids (Largemouth (LMB) and Smallmouth Bass (SMB), Bluegill (BG), Crappie (C)
    - Readily available, BG and C easy, others touchy
    - Cool to warm temps, O2 med, value LMB, SMB as stockers $2-5 per fish, BG $2-3/lb in round, C has no value
    - BG and C will crowd, others not
    - BG and C social, others not.
    - Feed for trout, or carnivorous diet
    - Potential – BG good, others moderate
    - NOTE: Hybrid Bluegill show great potential
5. Morone (White Bass (WB), Hybrid Striped Bass (HSB)(sunshine or palmetto)
    - Hybrids available, WB not
    - Hybrid hearty but said to have low tolerance for Potassium (I'm proving this wrong, more later), white's killable
    - Cold to warm(40-85 , 72 optimal), O2 med – 4ppm
    - $2-3/lb in the round, can be crowded (WB no value, don't crowd)
    - Not social, will eat trout diet – carnivorous
    - Growth moderate for hybrids, WB not keepable
    - Potential – poor? (see more later, we may be proving false)
6. Cyprinids (Koi, Goldfish, Minnows)
    - Available, hearty, cool-warm, O2 low levels, Value very high
    - Sociable, feed readily available, (although Koi color additives in feed are a problem for plants).
    - Moderate growth, excellent potential, especially to the Asian market and the home pond market.
7. Ictalurids (Catfish, Bullheads)

        - Available, hearty, cool-warm, low O2 demand, bottom dwellers and don't like crowding.
        - Sociable, diets cheap and available, Growth moderate, potential – good
        - Catfish .65/lb, but Smoked Bullhead $$$
    8. Cichlids (Tilapia)
        - Available but may not be legal in many areas
        - Hearty, warm water, low O2 demand,
        - $2-3/lb in the round,$8/lb to Asian market live, can crowd, diets cheep and available
        - Fast growth, potential – Good
    9. Of Note – this was a US based class, many of the Australian fish were not discussed.
- Bottom Line – Fish are a byproduct of the system, availability is more important than profitability, tailor the feed to the rate of gain for the age. Minimize stress.
- He recommends floating feed and hand feeding so you know what your fish are eating.
- When you start, get 3-4" size fish, they are easier to keep alive than fingerlings.

You can "cold bank" (lowing temperatures to slow fish metabolism, growth and egg maturation) your smaller fish at lower temps, lower feeds, no growth, then move them over when they are needed into the main system

NOTE: Regarding Hybrid Stripped Bass (HSB) – often repeated but not documented is the notion that Hybrid Striped Bass may do poorly due to higher Potassium levels in our systems: 1) I have had them in my system for over 6 months and they are growing well. 2) A search of the internet shows lots of studies regarding Potassium Permanganate toxicity, but no studies on potassium hydroxide or plain potassium toxicity. One study mentions that the toxicity may be due to the permanganate, which is caustic, and not the potassium. It appears that the potassium permanganate studies have lead to a belief that has been perpetuated, that HSB will do poorly in systems with elevated potassium, when in my system; they have done well and been a great fish, growing well, with high value and great test and preferring the warm water. They are not as good as Tilapia, but where Tilapia are prohibited, HSB may be a good alternative (except, they only breed once a year, and they are a med. difficult to raise, easier than trout but harder than tilapia) It's hard to beat Tilapia as a fish of choice, they grow fast, like warm waters, breed anywhere, anytime, eat anything and are very tasty. However for a home system, we take what we can get, for me, Bluegill, HSB and Rainbow Trout (in the winter) are my only choices, so that's what I have, all in a single tank.

Recirculating Aquaculture Systems (RAS), Fish and Aquaponics – Sarah Kaatz – UW-Extension Service, UWSP Northern Aquaculture Demonstration Facility.

Overview of RAS components

- Solids Removal
- Ammonia and Nitrite Control
- Dissolved Gas and Aeration
- Disinfection

- Culture Tank

Solids Removal

- Sources
    - Uneaten Food
    - Fish Waste
- Types
    - Settleable (will sink in slow moving water)
    - Suspended (will not sink)
    - Fine or Dissolved Solids

Settleable Solids Removal Methods

- Gravity (from the bottom of the fish tank)
- Sedimentation Tank (Clarifier)
- Or Mechanical Filter
- Or other

Suspended Solids Removal (Will not settle, can irritate the gills of fish)

- Rotating drums
- Mechanical filter
- Screens/netting
- Sand/Pelleted media

Fine or Dissolved Solids Removal (less than 30 micrometers, can increase oxygen demand, cause gill irritation)

- Foam Fractionation (protein skimming)

Ammonia and Nitrite Control

> Ammonia and Nitrite Control handled through biological filtration “bio filter” nitrifying bacteria. Biofilter substrates can be, gravel, sand, plastic beads, rings, plates, and more. The size is based on: number of fish, kind of filter, biomass of the fish, volume of water, and flow rate.

Dissolved Gas and Aeration/Oxygenation

> Aeration or Oxygenation is the process of putting Oxygen from atmosphere into the water. Degassing is the process of aeration with the purpose of removing other gasses. Several types of systems were reviewed (packed columns, pressurized packed columns, downflow bubble contactor) (there are many ways to accomplish this – the most important principle is to expose the water to air, the longer the exposure and the greater the surface area the more O2 that is exchanged. Finer bubbles, deeper are better than big bubbles shallow, but there are

diminishing returns on the pressure needed to create fine bubbles at depth. One method I know of is deep well injection. Basically inject pure O2 down a well at the 100' level and the water comes out fully saturated. We use air stones, lots and lots of them.

Disinfection

Ultraviolet (UV) sterilization or Ozonation.

Culture Tanks

Typically Round tanks, or square tanks with round corners. Lower light and optimal temperatures reduce fish stress (cover or shade your tanks.)

2 Rules to Live by:

1. Keep fish wet
2. Dissolved oxygen runs out first.

Ammonia

Total Ammonia-Nitrogen (TAN), is made up of 2 components: 1) NH3 – Un-ionized, and 2) NH4+ Ionized. Un-ionized is the most toxic and the concentration depends on temperature and PH. TAN is excreted from the gills of fish and is produced when bacteria break down waste solids. The common test kits test for TAN and you must use a chart to convert to Un-ionized. (Aquaticeco has a handy chart at: http://www.aquaticeco.com/pages/full_width/114/Water-Quality-Guide)

Nitrite

Nitrite is produced as Nitrosomonas bacteria convert ammonia to nitrite, not as toxic as Ammonia, but still harmful to fish. It binds with hemoglobin, creating methemoglobin, which cannot bind or transport oxygen. Fish then starve for oxygen – "brown blood disease".

pH and alkalinity

Ph or power of hydrogen is a measure of the hydrogen ion concentration. (Basic or Acidic). Alkalinity is the ability of the water to neutralize acidity. Bicarbonates/carbonates are sources of alkalinity. Higher alkalinity water is able to buffer against pH swings. In some system they use a bicarbonate drip of sodium bicarbonate (Note: this is not recommended in Aquaponics).

Stress

Stress slows growth and increases susceptibility to diseases. Light, movement, water quality changes, handling are all big stressors

Fish Nutrition

Match diet and food size to species and age. Keep feed fresh, store in cool, dry place, use within 3-6 months.

Marketing

Where are you going to sell: Farmers Market, restaurant direct, customer direct, or wholesale?
How are you going to sell: Live, Whole on Ice, or Processed?

Aquaponics

You will have lower fish densities and different components.

Aquaculture Permits and Regulation – Ron Johnson – Aquaculture Extension Agent

This section was specific to Wisconsin.

Next Installment – Afternoon session – introduction to the greenhouse

- Aquaponic Systems and Components
- Plant Growing Systems
- RAS
- Fish and Plant Nurseries