Indoor Shrimp Farming and KSU

KSU Indoor Shrimp Farming Workshop

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Why Grow Shrimp?

- #1 Most Popular Seafood Item in Many Developed Countries
- Most is Imported
  - Trade Deficit
  - Food Security?
  - Food Safety?
- Hard to Get Fresh Shrimp
  - No Processing with Fresh
- Inconsistent Domestic Supply
- Short Supply – High Demand

Why Marine Shrimp?

- Decades of Selective Breeding
- Fast Growth
- Disease Resistant
- Low Cannibalism = Good at High Density
- Most Popular Shrimp (Familiar Among Consumers)
  - Texture
  - Appearance
  - Flavor

Why Grow Shrimp Indoors?

- Can be Located Anywhere… Warm, Salt Water Animal
  - Markets
  - Away from the Coast
  - Reused Infrastructure
- Control
  - Consistent Conditions = Predict Results
  - Fresh, Never-Frozen
  - Large Shrimp = Higher Sale Price
  - Any Time of the Year

How do I Grow Shrimp Indoors?

- Use Recirculating Aquaculture Systems (RAS)
  - Defined as < 1% Water Exchange per Day... Much Less in Most Cases
  - Must Filter Solids and Nitrogen (Ammonia)
  - Biosecurity
  - Heat Retention

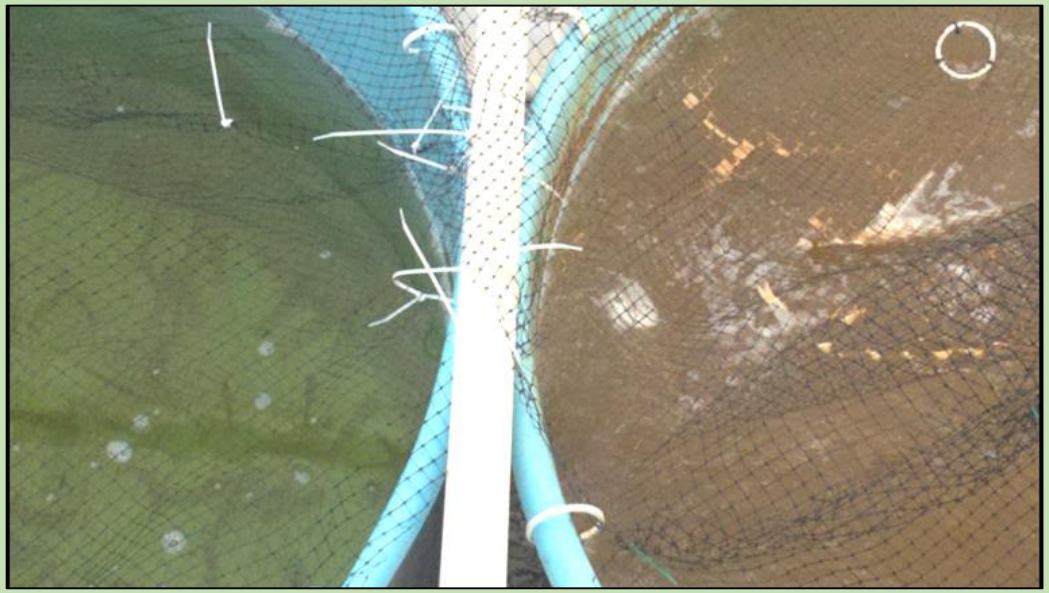
- A Variety of Systems
  - Clear-Water RAS
  - Biofloc
  - Hybrids of These

Clear Water RAS

- More Equipment… Expense
- No Supplemental Food
- Greater Control
- Better Water Quality
- ⬇ Disease Potential?

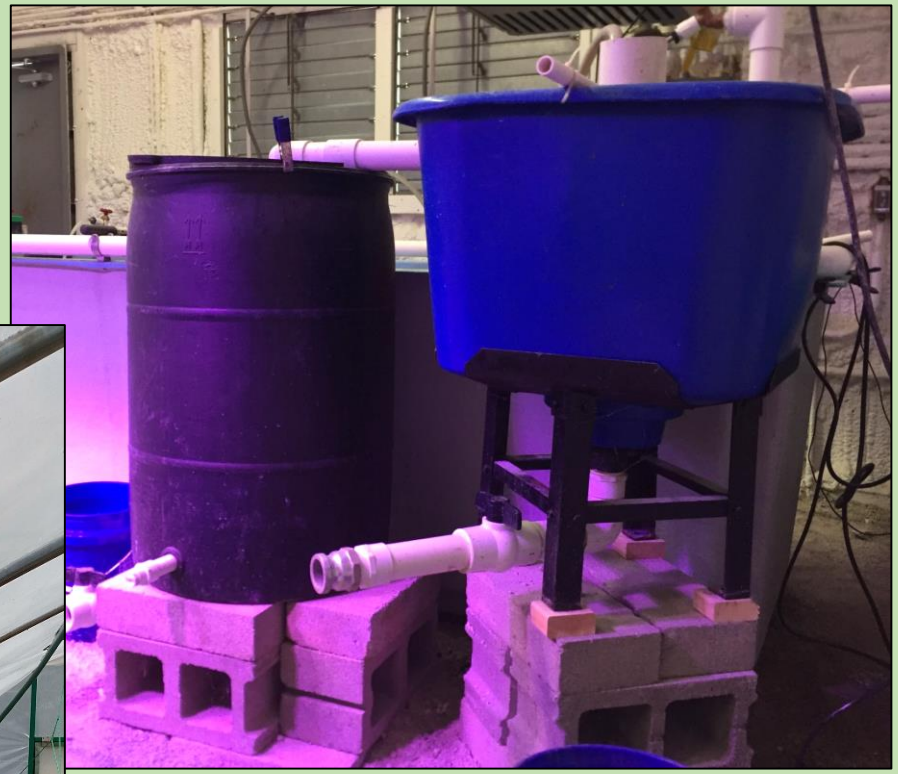
Biofloc

- Less Filtration… Lower Upfront $
- Supplemental Food
- Less Control
- More Attention to Water Quality
- ⬆ Bacterial Abundance



Hybrid Systems

- Not Clear Water
  - Do Not Try to Get All Solids Out
  - Simple Settling Chamber, Possibly a Foam Fractionator
- Add Biofilter
- Potential for Good Water Quality, Along with Some Supplemental Food



Hybrid Systems

- Seem to be a Good Option for Those with Limited Aquaculture Experience
- Home-Made Filters for Small or Large-Scale Farms
- Settling Chambers
  - Large Particles
- Fractionators
  - Small Particles

Insulated Space = Year-Round Production

Greenhouses

- Poorly Insulated Usually
- Extend Growing Season Outdoors
  - Some Supplemental Heat Possible
- Inexpensive
- Combine with an Indoor Nursery
  - Larger Shrimp
- Rotate Crops?
- Couple With Horticulture?

Shrimp in High Tunnels – Solar Powered!!!

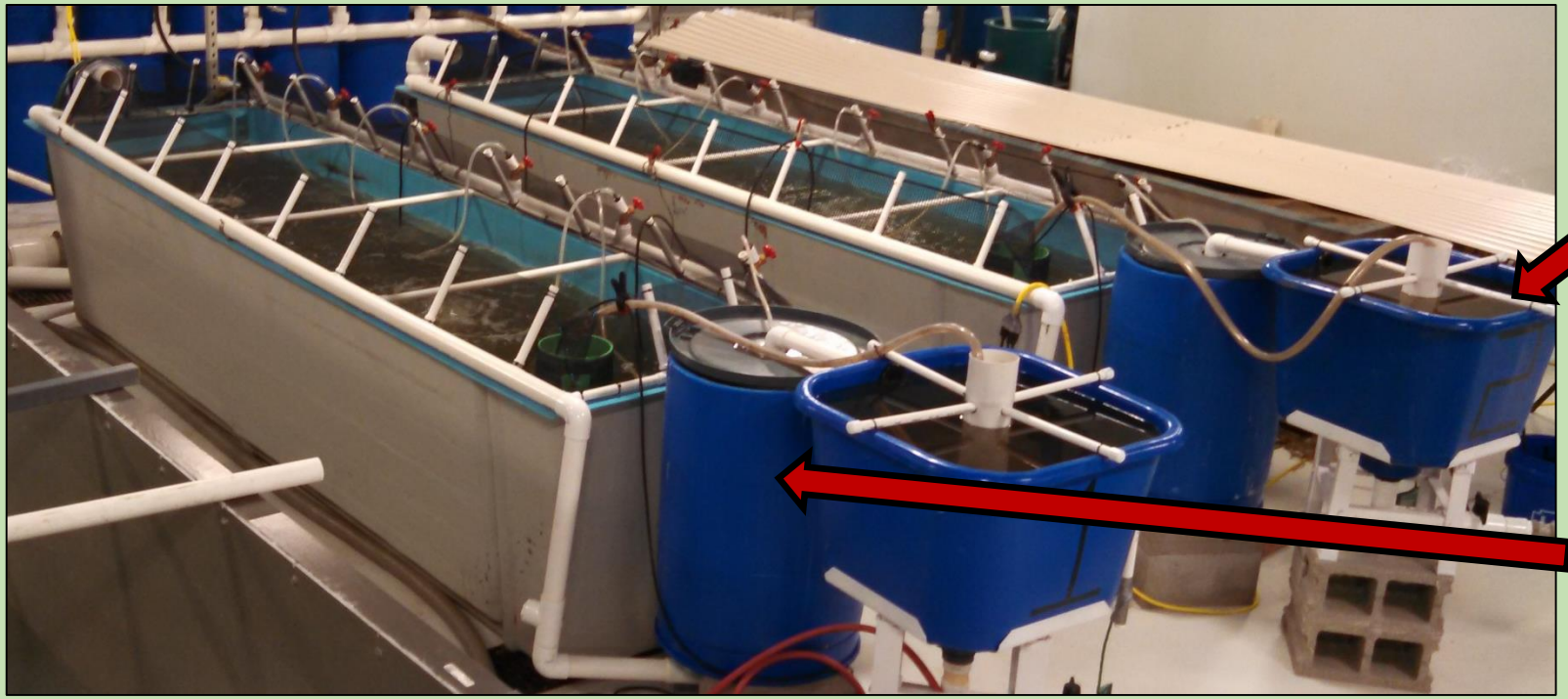
- **~10 kW Photovoltaic Array**
- **~6 kW Aeration Blowers**

Indoor Shrimp Research

- **Aquaculture Production Technologies Lab (APT)**
- **Sustainable Aquaculture Development Lab (SADL)**

Nurseries

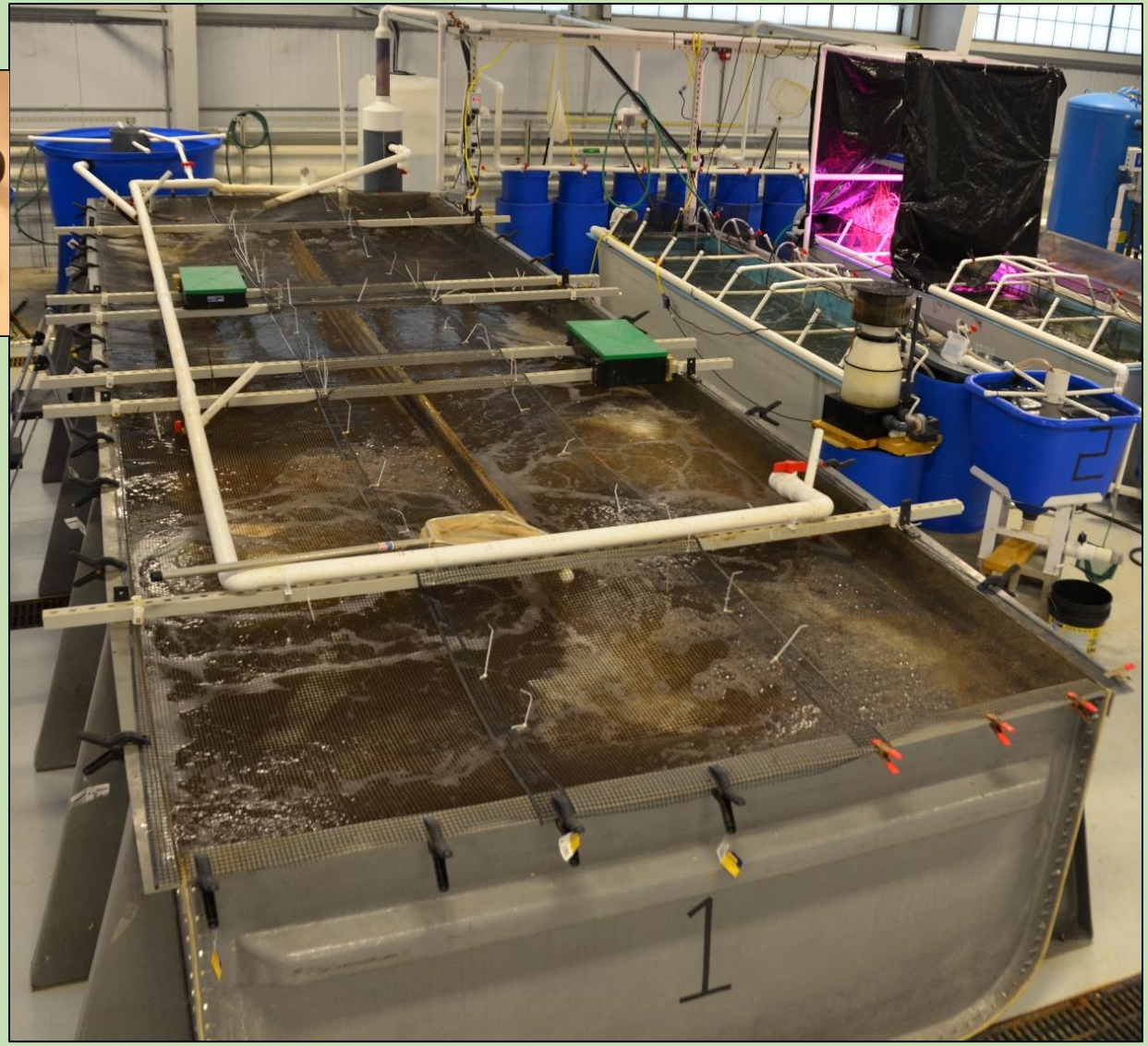
- Biofilters and Settling Chambers… Hybrid Systems
  - Shrimp (~PL 10) from Florida Hatchery
  - 30-45 days
  - Sample Shrimp at the End… Number and Weight



Production System

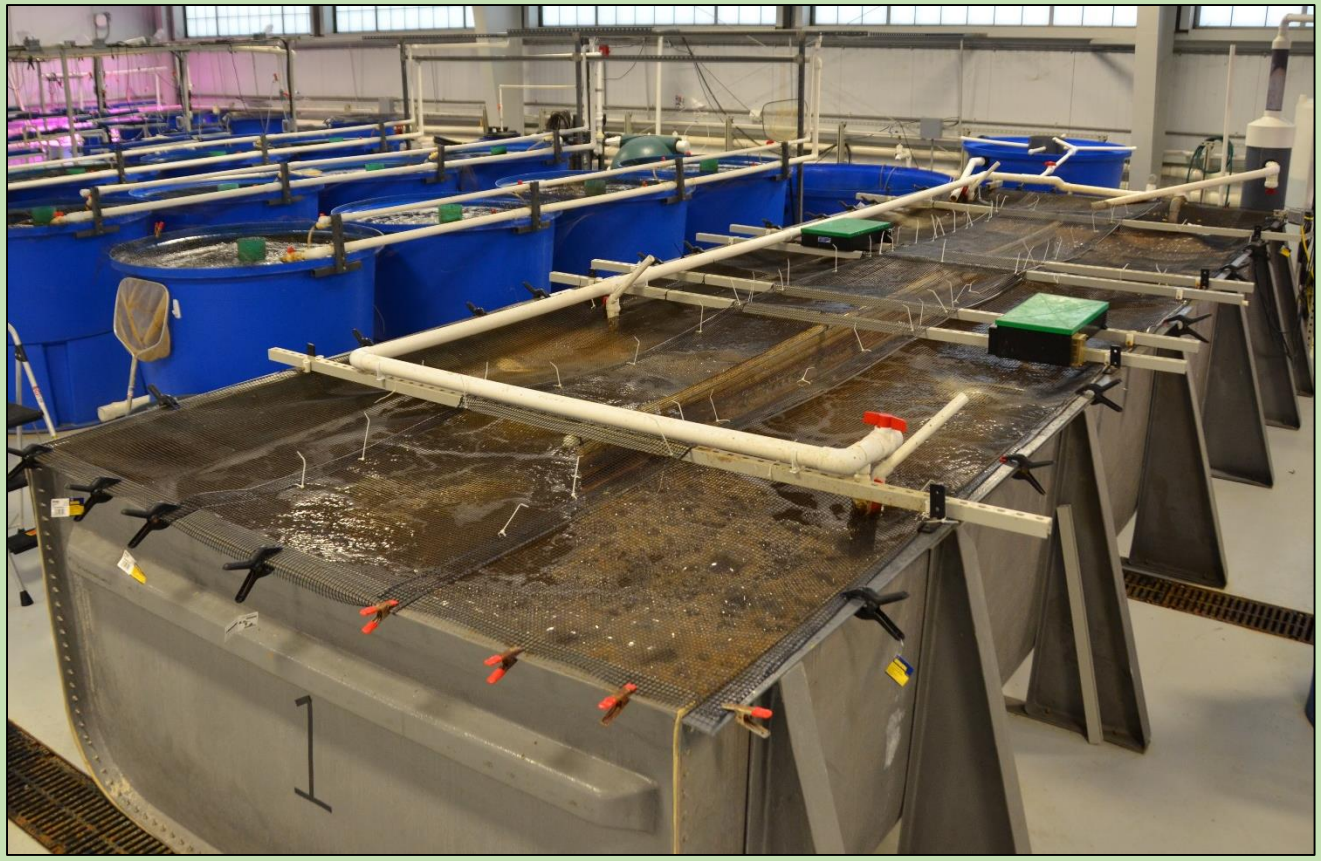
- 20 m^3 Fiberglass Tank
- Scale-Up Research
- 1 HP Pump
  - A3 aeration system
- Dividing Wall in Center
  - Water is Pumped Around This
- Electric heat
  - Is what's available
  - Insulated Building (~74° F)
- 3 hand feedings, feeders at night

  (~30% of Daily Ration)



KSU Production Example

- Shrimp Nursed to 0.55g
- Moved to Production Tank
- Stocked at 250 Shrimp/m^3
- 20 ppt. Salinity
- 98 Days
- Nitrification-Based System
  - No Added Sugar



Production and Marketing

Parameter	Value
Final Weight (g)	24.3
Growth Rate (g/wk.)	1.7
Biomass (kg/m^3)	4.6
FCR	1.3
Survival (%)	69.1

- Produced about 200 Pounds
- Gave them to KY chefs, seafood distributors, and sold 83 pounds at the Franklin County Farmers' Market in 1.5 hours

Farmers Markets

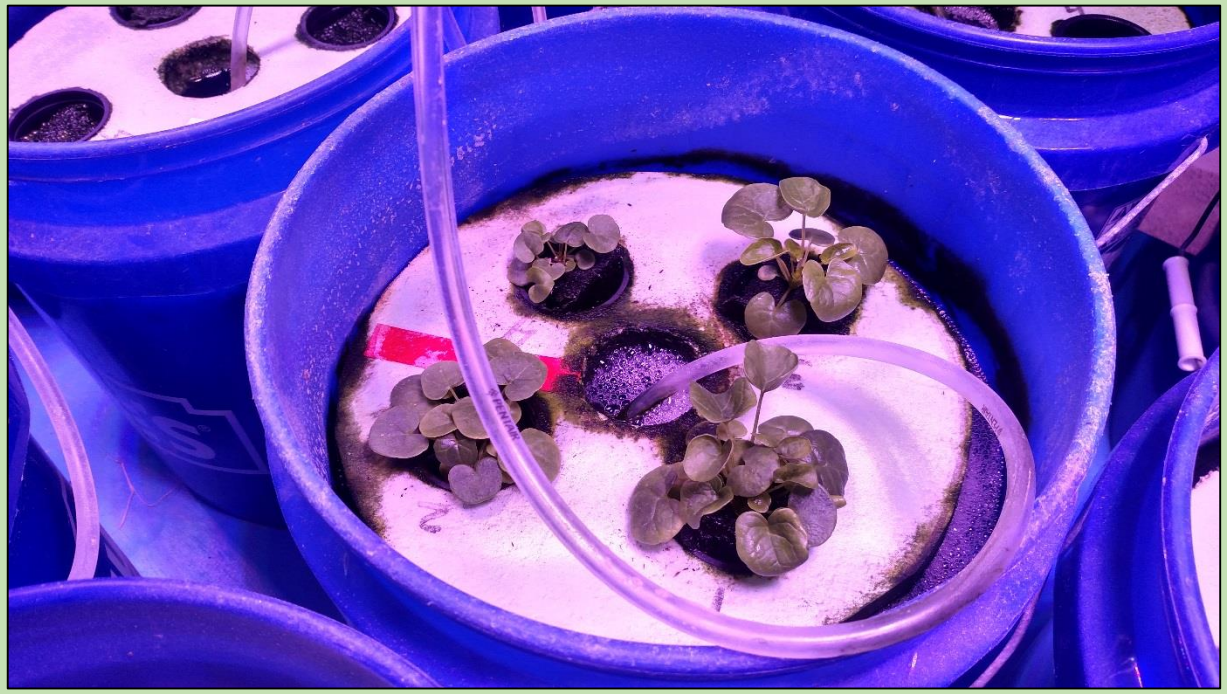
Do People Like the Product? Can $$$ be Made?

- Sold for $12/pound ($26.40/kg)
- Recurring Costs of Production ≈ $5.50/pound ($12.10/kg)
- KSU and Purdue ≈ $6 to $ 9/pound total cost of production

Question (range of options)	**Chefs (n = 5)**	**Consumers (n = 27)**
What is your opinion of the KY-grown shrimp?		
Taste (1-5, where 1 is the best)	2.0 ± 0.0	1.3 ± 0.1
Texture (1-5, where 1 is the best)	2.2 ± 0.5	1.3 ± 0.1
Freshness (1-5, where 1 is the best)	1.0 ± 0.0	1.0 ± 0.0
Size (1-5, where 1 is the best)	2.2 ± 0.2	1.3 ± 0.1
Overall (1-5, where 1 is the best)	2.2 ± 0.2	1.1 ± 0.1
Appearance (1-5, where 1 is the best)	1.8 ± 0.2	1.1 ± 0.1
What would you expect to pay? (open question) - USD/Kg	21.6 ± 2.4	25.9 ± 2.3
What is the maximum you would pay? (set selections) - USD/Kg	26.0 ± 2.5	28.6 ± 1.5

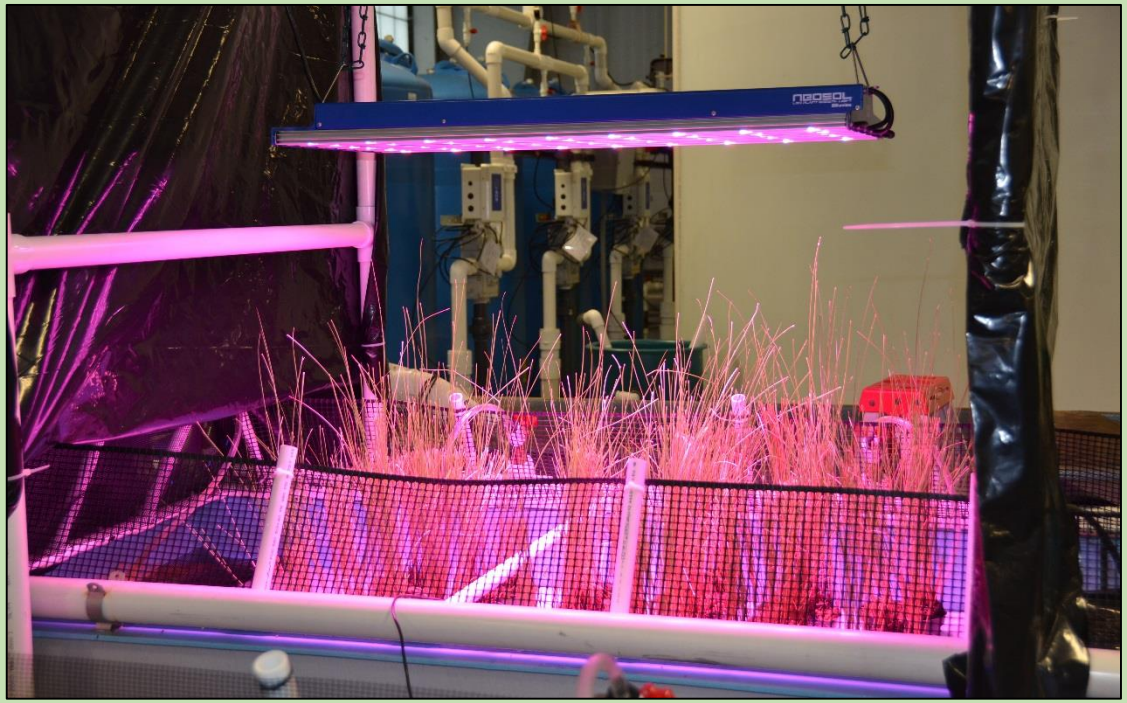
Issue: Nitrate

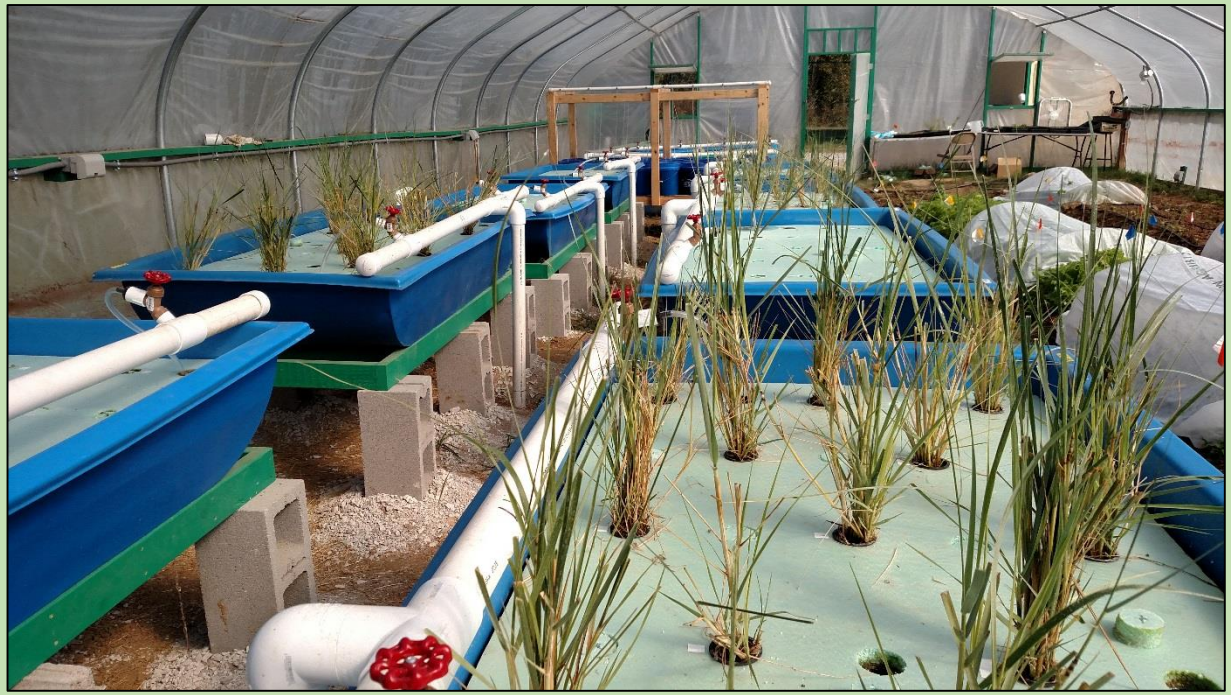
- Problem after 3 or 4 crops
  - ~300 mg/L
- Plants… need to be salt tolerant
  - KSU Exploring Several Species
- Swiss Chard?
- Scurvy Grass?
- Salicornia?
- Marsh Grass?



Issue: Nitrate

- Denitrification
  - Anaerobic Process
  - Nitrification in Reverse
  - PVC Tubes with Substrate
  - Be Careful!
    - Sulfide, Ammonia
- Sequence Batch
  - Aerobic ⇔ Anerobic
- Raise the C:N
  - Internally… Externally
- Inexpensive Salts





How to Learn More

- YouTube Video:
  https://www.youtube.com/watch?v=IwbDqB0C_-Y
- KSU Aquaculture on Facebook:
  https://www.facebook.com/ksuaquaculture/
- KSU Website: http://www.ksuaquaculture.org/
- Contact Me: andrew.ray@kysu.edu
- Recorded Webinars: http://usaquaculture.org/webinars
- SRAC Website… A lot of info on aquaculture

Kentucky State University

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