SOAP Update on Aquaculture and Aquaponics at CTAHR

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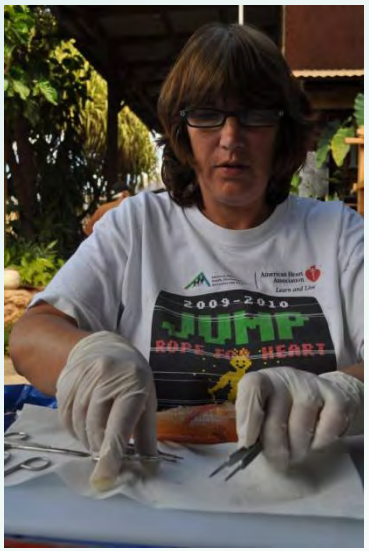
October 21st, 2011

Komohana Research Extension Center, Hilo

Who are we? CTAHR MBBE Faculty

Clyde S. Tamaru, Specialist



RuthEllen Klinger-Bowen, Agent

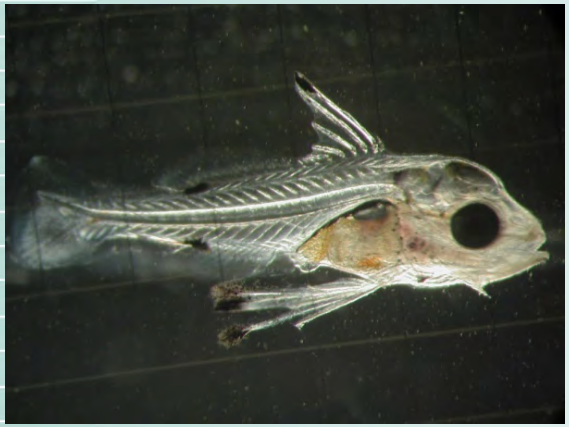
Kathy McGovern-Hopkins, Agent

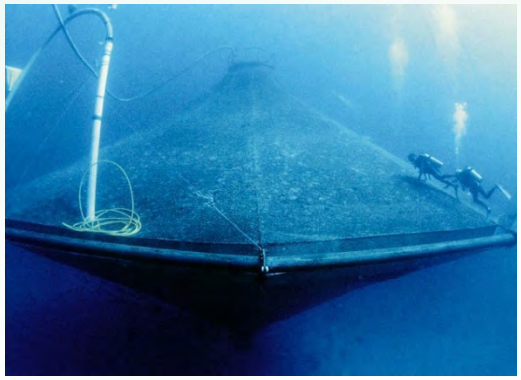
Bradley “Kai” Fox, Specialist

What do we do? CTAHR Aquaculture/Aquaponics

Extension Group: Provide technical assistance to aquaculture stakeholders.

Our group maintains a research and extension portfolio involving three institutions.





College of Tropical Agriculture and Human Resources

University of Hawai'i Windward Community College

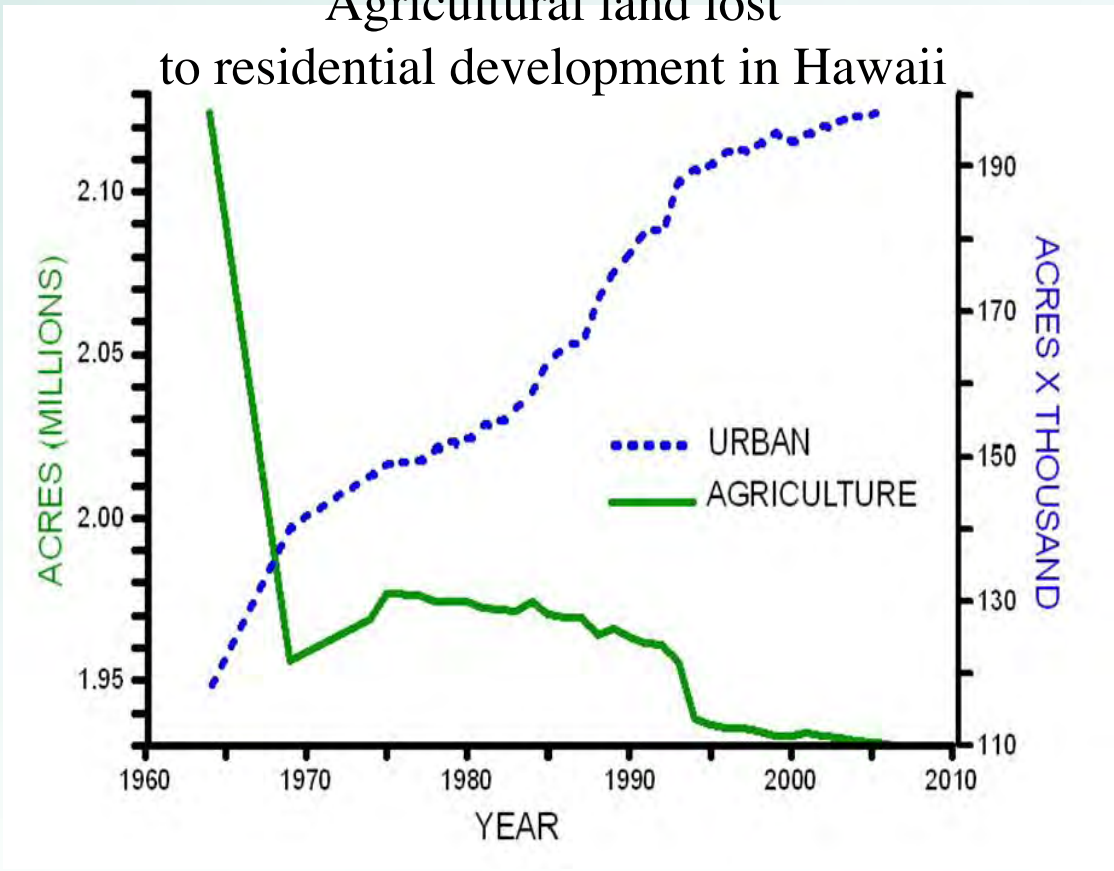
Hawaii Institute of Marine Biology at Coconut Island

Why are we working with aquaponics?

- Addresses several priority actions outlined in Hawai ʻi 2050 Sustainability Plan such as:
  - Increase recycling, reuse and waste reduction strategies.
  - Develop a more diverse and resilient economy
  - Create a sustainability ethic.
  - Increase production and consumption of local foods and products, particularly agriculture.

Justification for focusing on backyard aquaponic systems

Agricultural land lost
to residential development in Hawaii

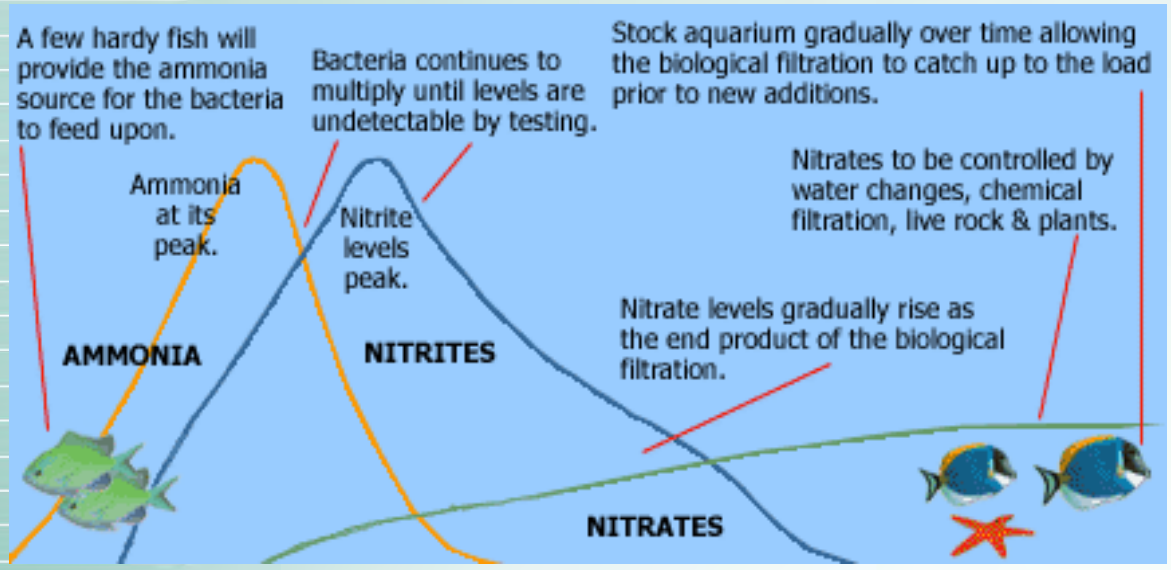


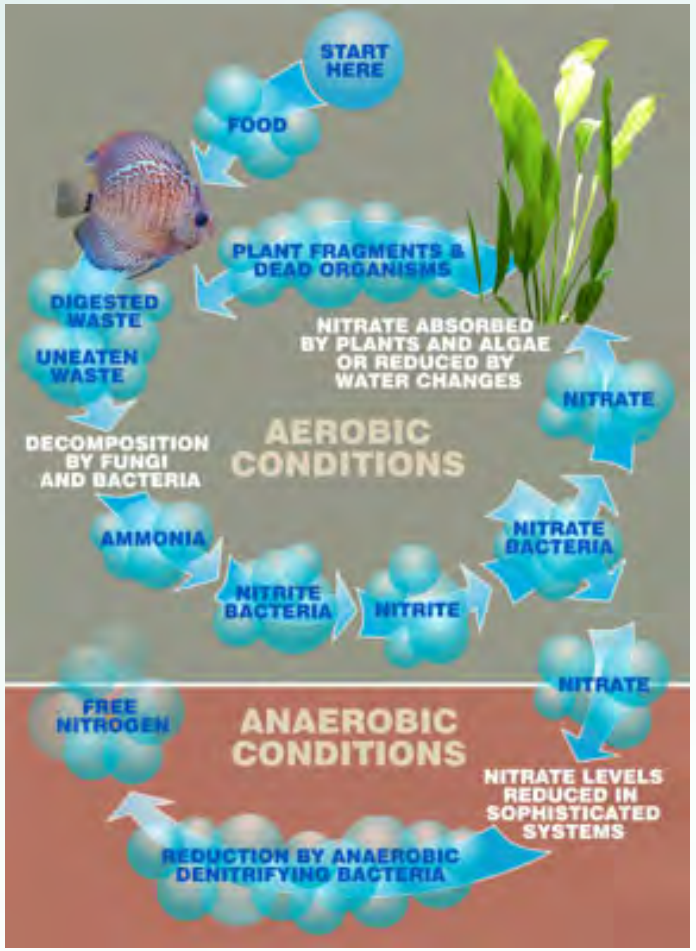
Source: http://hawaii.gov/dbedt/info/economic/databook/Data_Book_time_series/

What is Aquaponics?

- Aquaculture: farming of aquatic organisms under controlled conditions.

Water Quality 101: Nitrogen Cycle in an Aquaculture Setting





Source: http://www.liveaquaria.com/PIC/article.cfm?aid=78

What is Aquaponics?: Hydroponics: Technique of growing plants (without soil) in water containing dissolved nutrients

Static hydroponic cucumbers in a trash can. (Kratky, 2003)

Commercial hydroponic lettuce farm on Maui

Static hydroponic watercress in 5 gallon bucket (Kratky, 2003)

Types of Aquaponic Systems

- Ebb and flow (reciprocating)
  - Hydroponic support media (gravel, clay balls, cinder, etc.)
- Deep water raft aquaponics
  - Polystyrene sheets
- Nutrient Film Technique (NFT)
  - Rain Gutters
  - PVC pipe
- Three Components
  - Rearing tank
  - Biofilter
  - Hydroponic component

Solid support media for ebb and flow systems

Black Cinder

Pea gravel

Expanded Clay Balls

You can grow just about anything in an ebb and flow gravel bed!

The most basic design:

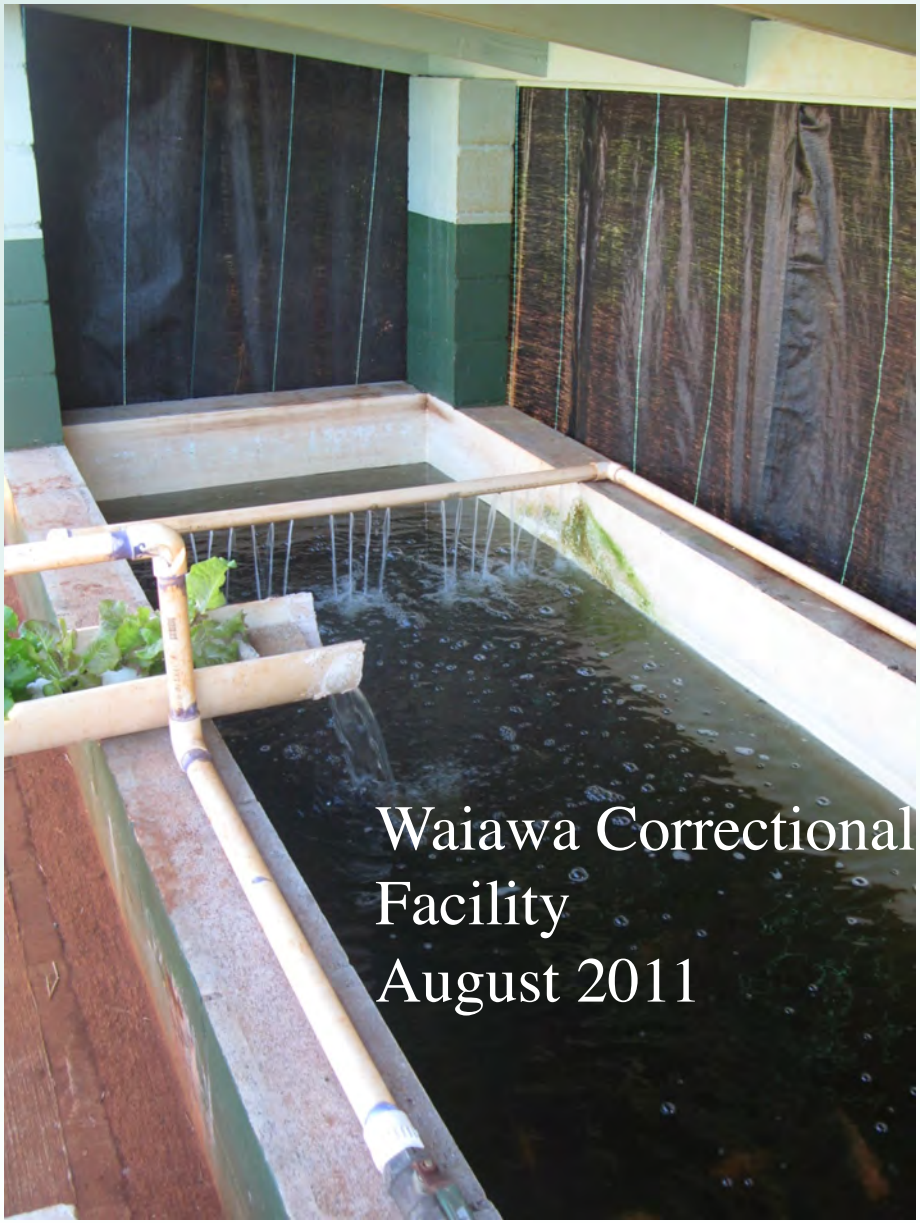
Submersible Pump inside of fish tank

Hawaii State Hospital Module

Rearing Tanks

Biofilter
"Reciprocating
Ebb and Flow"

Hydroponic
Component


Waiawa Correctional
Facility
August 2011

MARI'S GARDENS, LLC

94-415 Makapipipi St Mililani, HI 96789
www.marisgardens.com

What else can I grow besides lettuce?

Blue berries

Cucumber

Beets

Green onion

Chiso

Cilantro

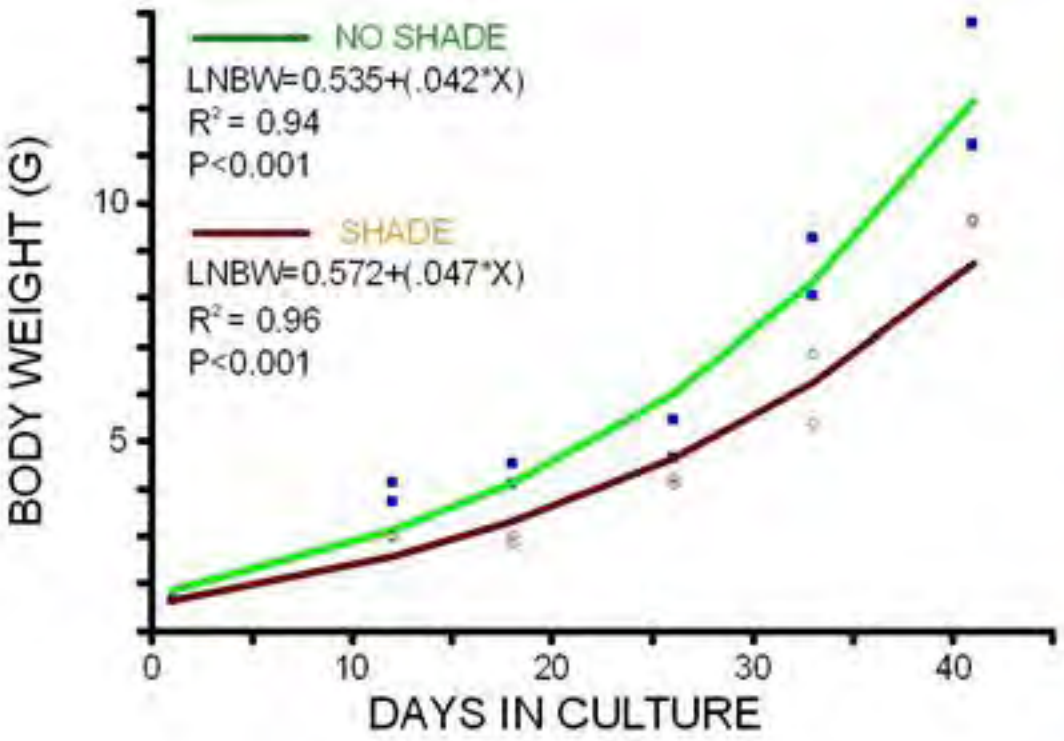
Tomatoes

I never drink water because of the disgusting things that fish do in it.

- W. C. Fields

Plants grown in aquaponic systems taste “Fishy” - Anonymous

Temporal changes in fish growth in covered and uncovered fish tanks



Difference in growth between treatments Is significantly (p<0.001) different, ANCOVA, SYSTAT 1985

No Shade

Shade

Tilapia is the fish used exclusively in aquaponics operations in Hawaii.

- Tolerates low Dissolved Oxygen (DO) levels (e.g., 0.2 ppm)
- Tolerates high Total Nitrate levels (>400 ppm)
- Tolerates high Total Ammonia Nitrogen levels (e.g., >90 ppm) @ pH 6.0
- Tolerates low pH levels (< 5.0)

SmokedTilapia

Alan Wong's RESTAURANTS

Different Feed Treatments

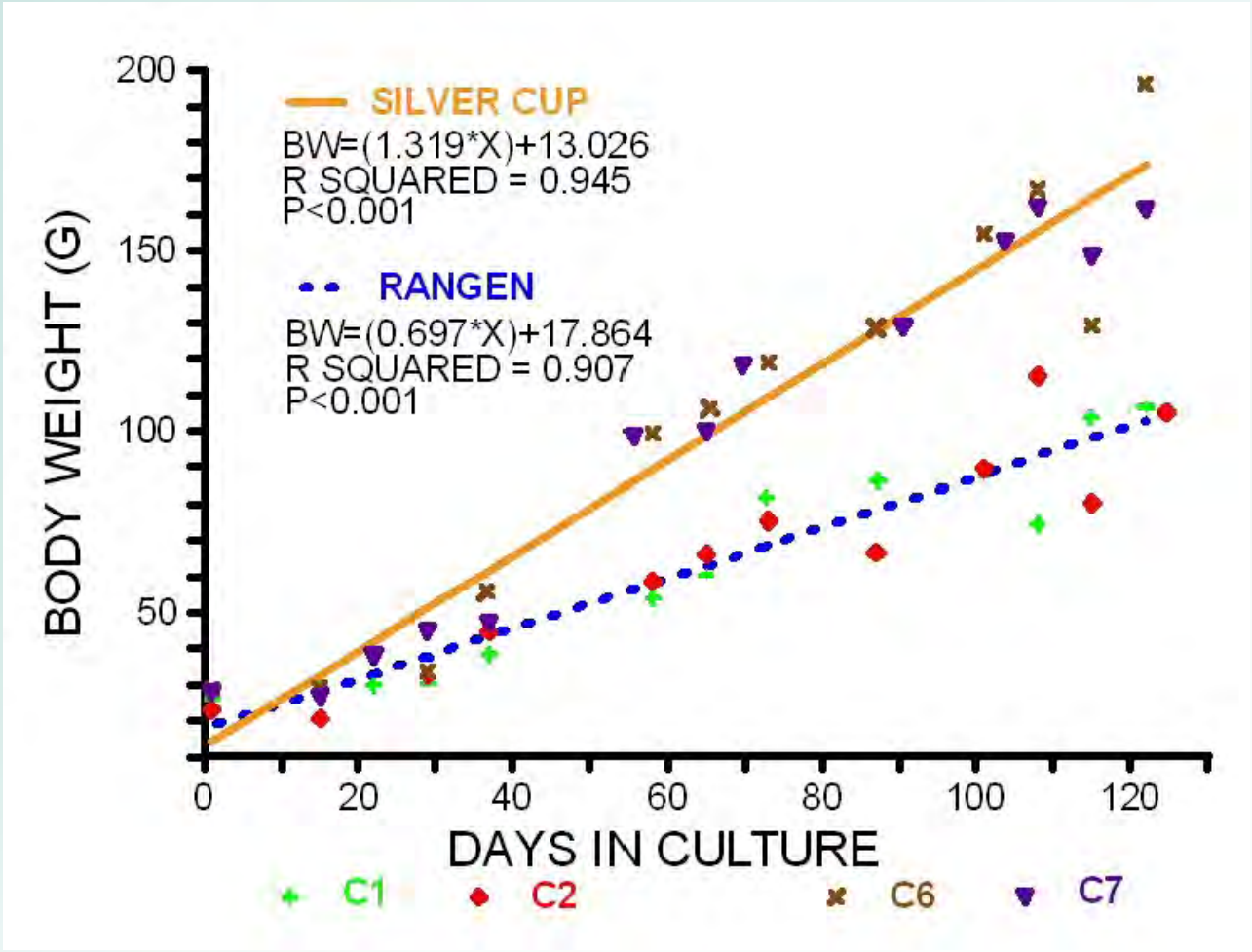
- Rangen 350 Catfish Feed:
  - Crude Protein……35.0%
  - Crude Fat……..……5.0%
  - Crude Fiber…….……..5.0%
  - Ash……...10.0%
  - Phosphorus……..1.0%

Retail Price
$ 0.63/ lb

- Silver Cup Steelhead Feed:
  - Crude Protein…..….45.0%
  - Crude Fat……....16.0%
  - Crude Fiber.……...….3.0%
  - Ash……...12.0%
  - Phosphorus…..……...1.2%

Retail Price
$ 0.77/ lb

Growth of Tilapia Fed Two Different Feeds



Fish being fed the Rangen feed will take an estimated 289 additional days to reach 450g (e.g, 1 lb)

Fish Quality: Significant ($p<0.05$) difference in whole carcass crude fat detected between treatments

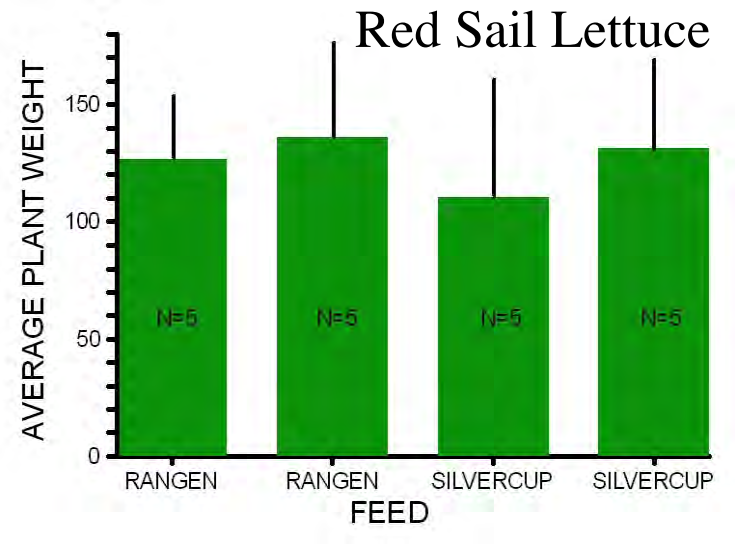
Rangen	Silver Cup
26.1% Fat	33.2% Fat

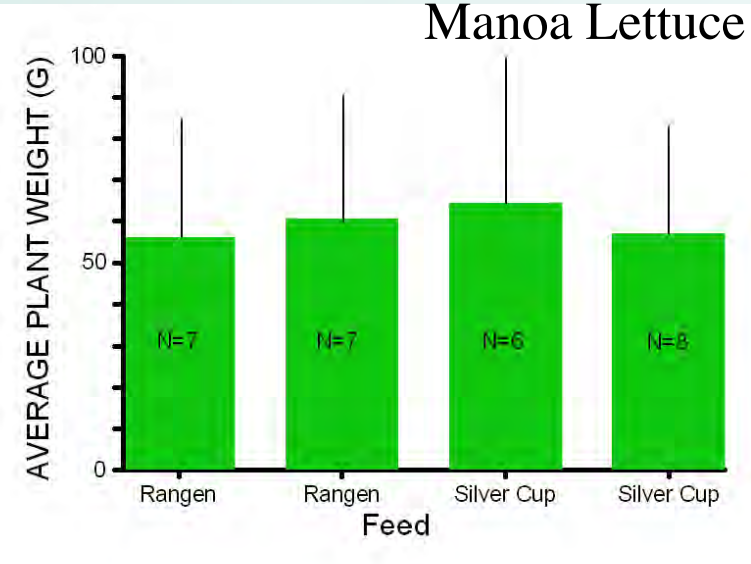

Tilapia Cakes

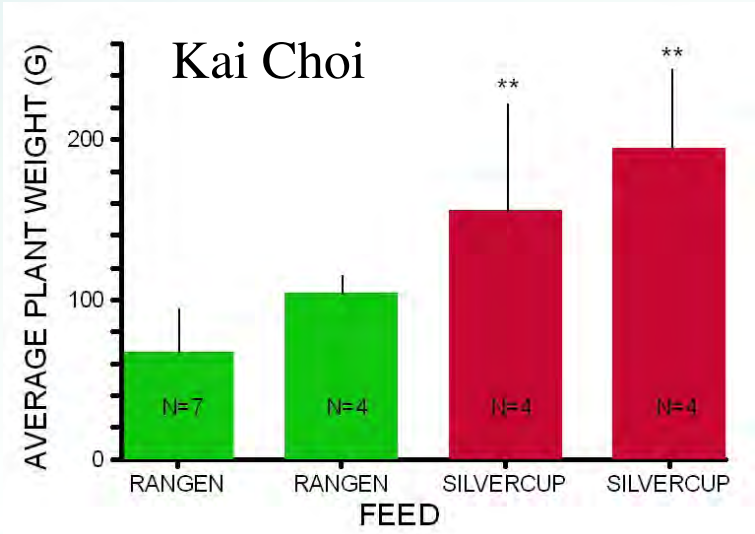

Steamed Tilapia


Baked Tilapia

Growth Of Plants In Response To Two Fish Feeds







Nutrient Profiles of Fish Food, Effluent and Static Hydroponic Recipes

WCC Testing Unit

WCC Static Hydroponic Control

Macro and Micro Nutrients	Fish Food (ppm)	WCC Aquaponic System (ppm)	**Static Hydroponic (ppm)
Nitrogen	686,000,000	38.42	158.00
Phosphorus	124,000,000	2.34	40.00
Potassium	75,000,000	9.26	200.00
Calcium	195,000,000	17.88	200.00
Magnesium	18,000,000	8.97	50.00
Iron (Fe)	282	0.04	3.38
Manganese	38	0.12	0.70
Zinc	124	0.08	0.22
Copper	11	0.03	0.40
Boron	9	0.04	0.62

**Hydroponic recipes from: Jones, Resh, Steiner, Wilcox and Snyder

ADAPTING AQUAPONICS SYSTEMS FOR USE IN THE PACIFIC ISLANDS

CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

CSREES EDUCATION RESEARCH EXTENSION USDA

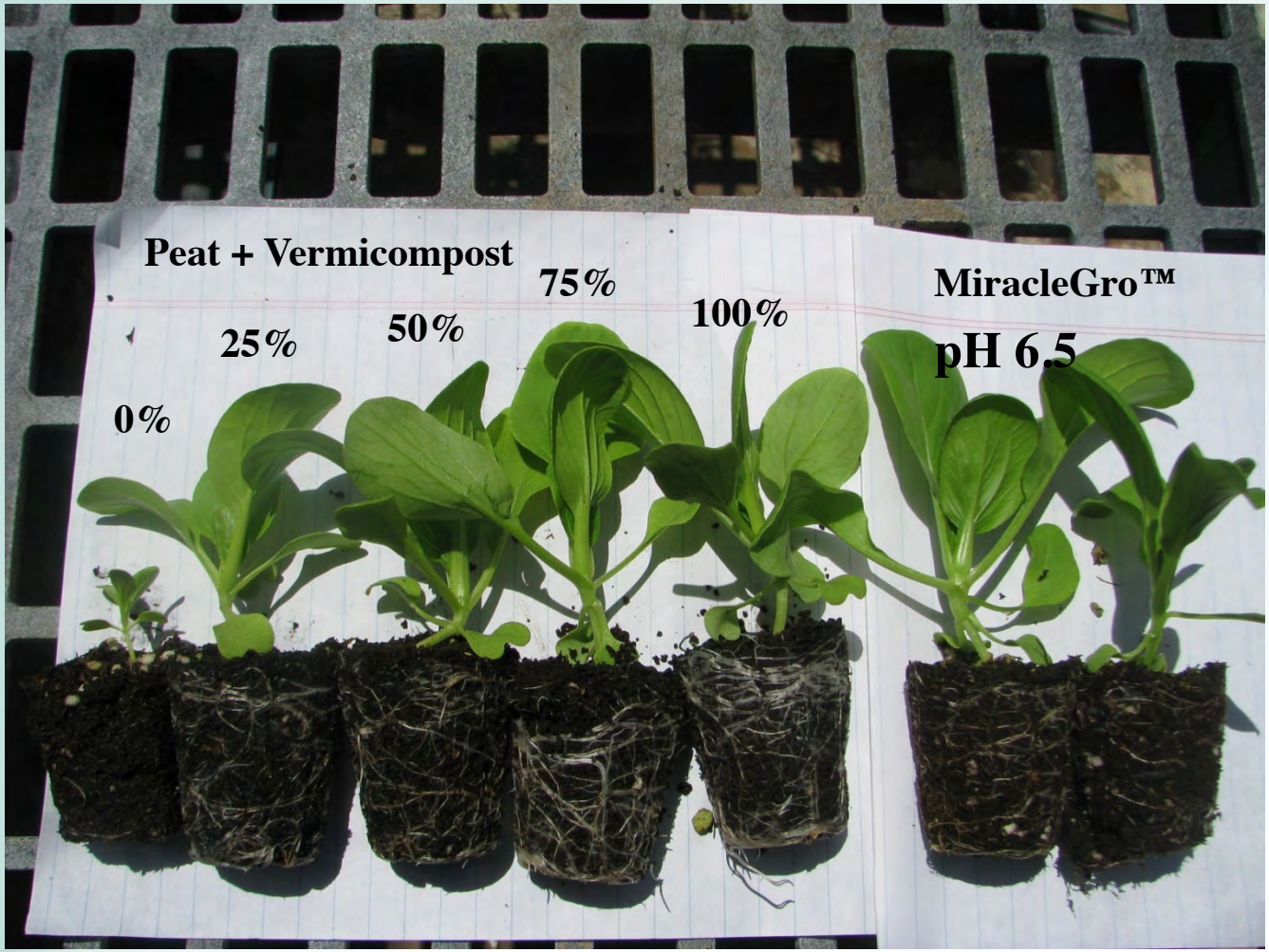
Mass balance of nitrogen. Of total nitrogen input into the system as feed, about 27% is captured as fish flesh, about 43% is captured as lettuce biomass, and a small fraction is lost as nitrogen gas or as solids used to fertilize garden plants.

Tank	Fish biomass (%)	Lettuce biomass (%)	Denitrification or solids (%)
T1	26	40	34
T2	32	41	27
T3	22	49	29
Mean	27	43	30

The amount and sources of denitrification still need to be identified.

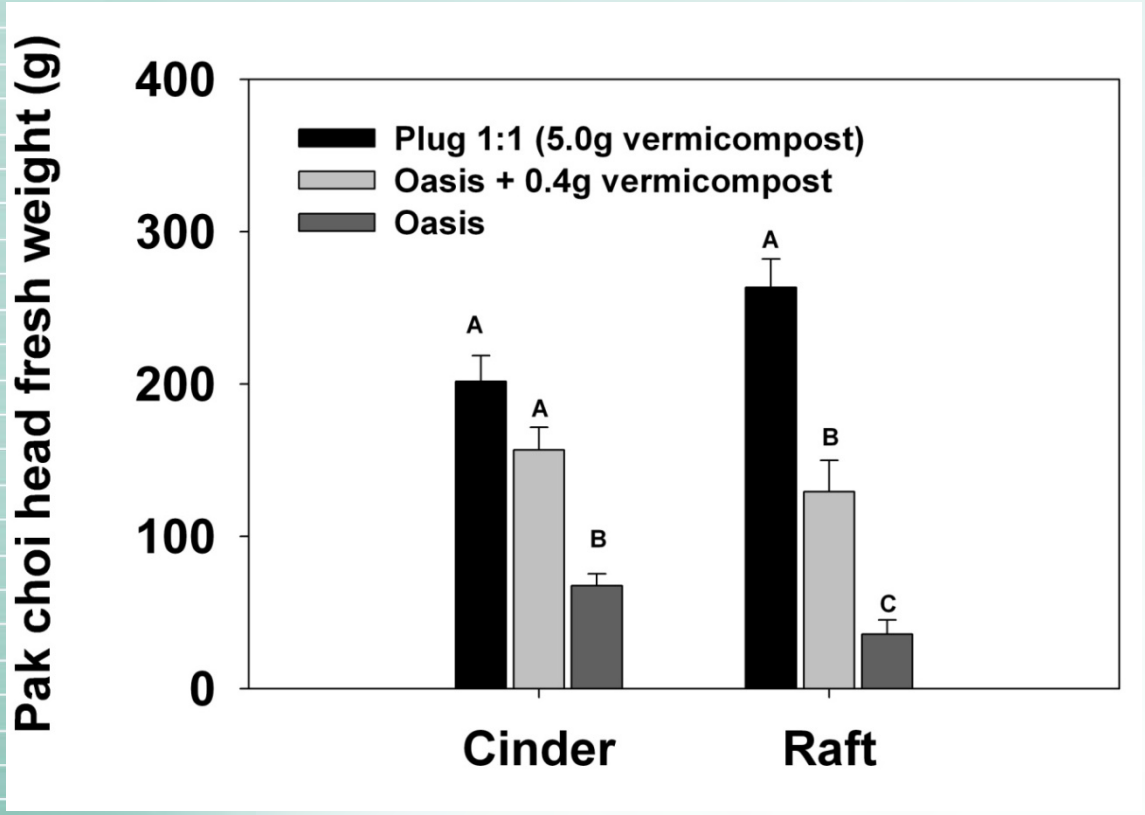
Assessing the utility of vermicast tea for pH remediation and as a source of micronutrients

Seedling Production

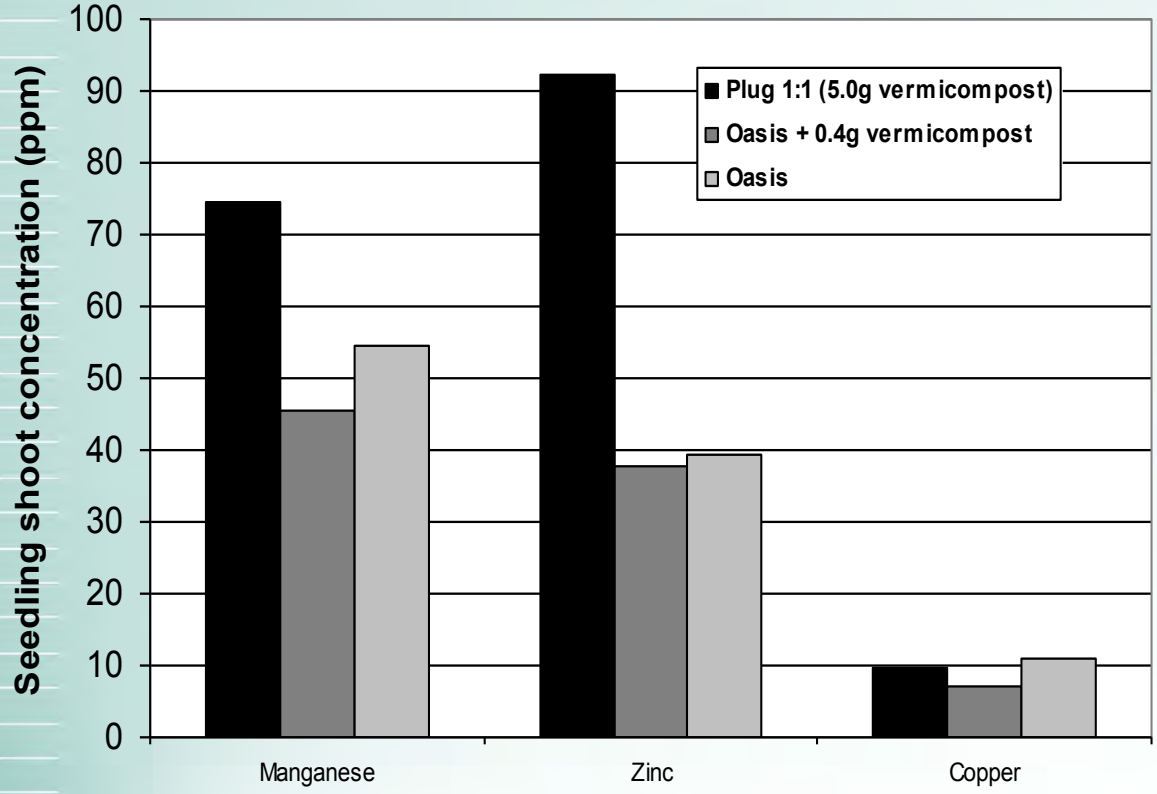


pH 5.0

Impact of seedling media on aquaponic pak choi yield



Are we priming seedlings and avoiding deficiencies?

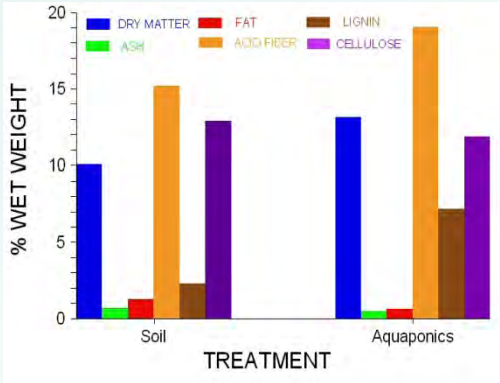


Ongoing observations on-farm

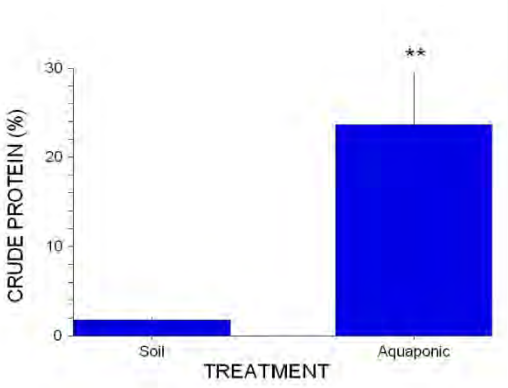
Are there differences in plant performance grown aquaponically versus in soil ?

Bright, L., et.al., 2011. A Hawaiian Herbal Medicine Cabinet Through Aquaponics. 23rd Annual College of Tropical Agriculture and Human Resources & College of Engineering Student Research Symposium. Agricultural Science Building, University of Hawai ʻi at Mānoa. April 8-9, 2011.

Olena in soil



Olena in Aquaponic



Regional Biosecurity: Diagnostic Surveillance for Koi Herpes Virus Disease (KHVD)

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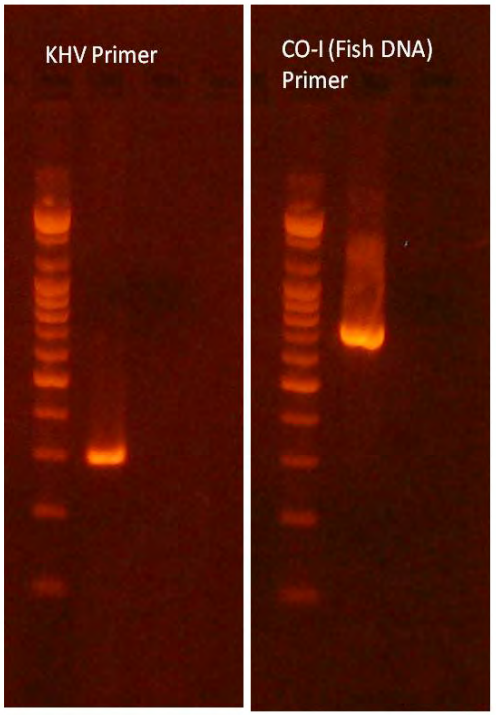

1: Ladder
2: + Gill Tissue
3: Blank

1: Ladder
2: + Gill Tissue
3: Blank

Aquaculture & Livestock Support Services
DEPARTMENT OF AGRICULTURE

MOANA Technologies Inc.

Conduct initial survey of KHV in farmed and feral koi populations statewide

Diversifying Freshwater Aquaculture Products for Hawaii: Two Crossover Species, the Red and Black Pacu (*Piaractus brachypomus* and *Colosomma macropomum)* – Year 1

College of Tropical Agriculture and Human Resources

Sea Grant University of Hawai'i

CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE

COUNTY OF MAUI STATE OF HAWAII

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

USDA

Additional Inputs

- Flow through system that resulted in a daily turnover of approximately 4.4 times per day per tank.
- Ten tanks ≈ 8,360 gallons per day or 31,768 liters per day.
- Estimated water consumed ≈ 944,680 gallons
- Using today's Board of Water Supply rate of $2.79/1,000 gallons the cost in just water is estimated at $2,636.

Objective 2: Compare growth and survival in monoculture and polyculture growout trials:

Aquaponic Format

- March 23, 2011 fish restocked with the following treatments:
  - 20 pacu only
  - 20 pacu + 100 Chinese catfish
  - 50 Chinese catfish only
  - 100 Chinese catfish only
  - 200 Chinese catfish only

  All treatments run in duplicate
- All tanks equipped with two 26 gallon ebb and flow cinder beds with airlifts and run as recirculating aquaponic systems.

Future Directions

- Magoon
- Partnerships?

MAHALO