UNIVERSITY OF THE VIRGIN ISLANDS

AQUAPONICS AND TILAPIA AQUACULTURE SHORT COURSE

June 17-23, 2007

Program - 7-day course that will provide in-depth knowledge of the principles and practical application of the aquaponic and greenwater tank culture systems that have been developed at the University of the Virgin Islands. Participants will be introduced to a variety of system designs that maintain water quality by various solids removal techniques and by hydroponic plant culture (aquaponics), a suspended growth process (greenwater tank culture) or fixed-film nitrification. Fish production instruction will be conducted using both the Nile tilapia (*Oreochromis niloticus*) and red tilapia. Hydroponic plant production will focus on vegetables, culinary herbs and ornamental flowers.

Instruction - Each day will include a half-day of classroom lecture and a half-day of hands-on field work. Participants will learn the technology through presentation of the theory and practical skill development. Each student will be given a notebook of reference materials. Water quality labs will cover the methods of analysis and the use of water quality test kits. Field work will include fish handling, vegetable production and system operation.

Facilities - UVI is located in the heart of beautiful St. Croix. The Aquaculture Program operates fifteen research-scale systems (six aquaponic and nine greenwater) as well as commercial-scale aquaponic and greenwater systems, a greenwater demonstration system with an associated vegetable garden, a fry sex-reversal system, a recirculating system for fingerling rearing and a purge system. The program annually produces about 20,000 lbs. of tilapia and a variety of vegetables.

Topics

- Aquaponic system
  - System design and management
    - Components
    - Construction techniques
    - Operation
    - Water quality
  - Fish production
    - Stocking rates
    - Feeding, growth and survival
    - Harvesting and processing
  - Plant production
    - Seedling production
    - Transplanting
    - Disease and insect control
    - Harvesting and packaging
- Greenwater tank system
  - Fish production
    - Stocking and growout
    - Water quality management
    - Feed and feeding methods
  - Sludge use for field crops
- Economics
  - Capital budgeting
  - Operations plan
  - Marketing
- Fingerling production
  - Brood stock management
  - Breeding
  - Fry sex reversal
  - Fingerling rearing

Cost - This course will cost $870 for participants registering before May 1 and $970 for registrations received later. Course fee includes instruction, course materials, graduation banquet and a sailing trip to Buck Island National Park for a day of snorkeling amid spectacular coral reefs and a beach barbecue. Daily dorm rooms are $35 (double) or $50 (single) and are available for arrival on Saturday June 16 and departure on Sunday June 24 after the class. Meals cost $10-15 each at the school cafeteria. Airfare to St. Croix, USVI is not included in the registration fee.

Registration - Register by contacting Dr. James Rakocy at the address below. Please provide name, address, telephone and fax numbers and e-mail address Enrollment for the class is limited to 32. A $300 deposit, payable to the University of the Virgin Islands, is necessary by May 1, 2007. No refunds will be made for cancellation after June 1. The balance will be due the first day of class.

Instructional Staff

Dr. James Rakocy - System design/production/water treatment technology
Donald Bailey - Business planning/marketing/operations/construction methods
R. Charlie Shultz - Water quality/pest management/plant production
Jason Danaher – Greenwater systems/tilapia biology/feeding and nutrition

For more information and to register contact Dr. James Rakocy, RR 1, Box 10,000, Kingshill, VI 00850-9781, Phone: 340-692-4020, E-mail: jrakocy@uvi.edu

Visit the Short Course web site for more information. http://rps.uvi.edu/AES/Aquaculture/UVIShortCourse.html

University of the Virgin Islands

Aquaponics and Tilapia Aquaculture Short Course

June 17-23, 2007

Registration Form

Registration fee: Before May 1 $870
After May 1 $970

- A $300 deposit is necessary by **May 1, 2007** to reserve enrollment.
- The balance due will be paid on the first day of class
- We accept personal or business checks, money orders or Western Union.
- We do **NOT** accept credit or debit cards.

Make check payable to the **University of the Virgin Islands**

Enclose this form with payment and mail to:

James E. Rakocy
University of the Virgin Islands
Agriculture Experiment Station
RR 1 Box 10,000
Kingshill, VI 00850-9781

Name: _____

Address: _____

_____

City: _____

State/Province: _____

Zip: _____Country:_____

Phone: _____ Fax: _____

E-mail: _____

Previous aquaponic/fish culture experience:_____

_____

Housing is not included in the registration. Local hotels are available and information will be provided upon request.

University dormitory rooms are available
$35 per person per night (double)
(sharing a double room with another participant is subject to availability.)
$50 per person per night (single).
Payment is made to the Residence Hall Director upon check-in.

Please check the appropriate line.

I plan to stay in a hotel. ____

I plan to stay in the UVI dormitory. ____

I prefer a single room. ____

I prefer a double room. ____

I will share this dorm room with participant _____

UVI Aquaponic System
Agricultural Experiment Station, St. Croix, USVI

AQUAPONICS

An integrated agriculture system combining…

Aquaculture – the production of aquatic animals and
Hydroponics – the production of vegetables without soil

…In a recirculating system

- Fish provide most nutrients required by plants
- Plants use nutrients to produce a valuable by-product
- Hydroponic component serves as a biofilter
- Integrated systems require less water quality monitoring than individual systems
- Hydroponic plants extend water use and reduce discharge to the environment
- Cost savings increase profit potential

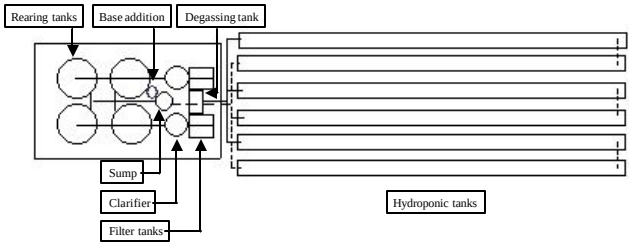
Principles

- Optimum feeding rate, 60-100 g/m^2 plant area/day prevents nutrient accumulation or deficiency
- Slow removal of solids increases mineralization
- Frequency of filter tank cleaning controls nitrate levels through denitrification

Raft Hydroponics

- Advantages: no tank size limitation, no root clogging, maximum exposure of roots to water, sheets shade and cool water, plants not affected when water pump stops, easy to harvest
- Disadvantages: roots vulnerable to damage by zooplankton, snails and other organisms (use tetras to control zooplankton and red ear sunfish to control snails)

System Design



- Four fish rearing tanks, 7.8 m^3 each
- Two cylindro-conical clarifiers, 3.8 m^3 each
- Four filter tanks, 0.7 m^3 each
- One degassing tank, 0.7 m^3
- Six hydroponic tanks, 11.3 m^3 each
- One sump, 0.6 m^3
- One base addition tank, 0.2 m^3
- Two air blowers, 1 hp and 1.5 hp
- One water pump, 1/2 hp
- Total plant growing area, 214 m^2
- Total water volume, 110 m^3
- Land area - 0.05 ha

Wastewater Treatment

Fish feces are settled out of the water and collected 3 times each day from clarifier or removed by filter tanks, which are cleaned once or twice per week.

Mineralization of remaining solids makes nutrients available to plants.

Degassing sparges detrimental gasses produced in anearobic zones.

Plant roots purify the water by taking up nitrogen, excreted by the fish, along with 12 other essential nutrients that are available in their waste.

Tilapia Production

Estimated production:
- 5 mt annually
- 540 kg every 6 weeks

Stocking rate:
- Niles, 77 fish/m^3, 600/tank reared to ≅ 900 g each
- Reds, 154 fish/m^3, 1,200/tank reared to ≅ 450 g each

Vegetable Production

Abundant nitrogen in the system water enhances production of leafy green vegetables like lettuce and collards.

Managing nitrate levels enhances production of fruiting crops like tomatoes and cucumbers.

Future Research

Vegetable varieties
- resistance to *Pythium*
- seasonal/heat resistance
- high value crops
  - medicinal herbs
  - ethnic/cultural crops
  - flowers
- yield data (economic potential)
- spacing
- culture techniques
- pest control

Nutrient management
- all vegetable feed
- net tank cleaning frequency
- supplementation
  - foliar application
  - water application
- nutrient conservation

Solids removal techniques

Ratio studies
(feed to plant growing area)

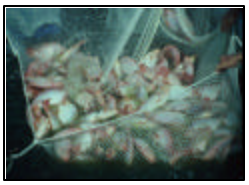
For more information contact Dr. James Rakocy, Aquaculture Program Leader. Phone: 340-692-4020. Email: jrakocy@uvi.edu

UVI Greenwater Fish Culture System
Agricultural Experiment Station, St. Croix, USVI

Greenwater Tank Culture

An integrated agriculture system for the intensive farming of tilapia with water reuse for vegetable crop production.

- Fish production occurs on a small land area
- Waste removed from the fish tank is used to irrigate and fertilize vegetable crops
- Continuous aeration
- Mixing to maintain suspension of bacterial floc
- Biofiltration in water column
- Settleable solid waste removal once daily
- Feed twice daily with floating feed (32% protein)
- Feed ad libitum for 30 – 40 minutes
- Monitor pH daily, maintain pH 7-7.5 with $Ca(OH)_2$
- Add $CaCl_2$ to prevent nitrite toxicity



System Design

- One fish rearing tank, 200 m^3
- 16 m diameter, 1 m mean water depth
- Block wall, 30 mil HDPE liner
- One external cylindro-conical clarifier, 1.4 m^3
- One ¾ HP pump for horizontal circulation
- One to three ¾ HP pumps for vertical aeration
- One solids collection pond
- One water distribution pump
- One bird deflection device
- Land area - 0.02 ha (1/20 acre)

Water Treatment

Aeration
3 vertical lift pumps

Base addition $Ca(OH)_2$
pH 7.5 maintained

Sludge removed daily

Tilapia Production

Stocking:
- Nile tilapia
- 25 fish/m^3 @ 50-g each (5,000/tank)

Harvest:
- ≅ 720 g each 95% survival
- 7,500 lbs per crop, 15,000 lbs annually

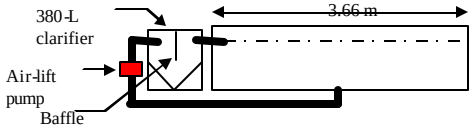
Feeding
with floating pellets to
satiation

Vegetable Production

Marketable yield from crops fertilized and irrigated with fish culture water, sludge, or inorganic fertilizer (mt/ha)

	Culture water	Sludge	Inorganic Fertilizer
Pak choi:	41.0	40.9	35.2
Bell pepper:	3.7	5.0	4.6
Forage grass:	-	12.9	6.4

Fingerling Production



- 11-m^3 rearing tank
- 370 L clarifier
- 9 L/min flow through clarifier
  (1 exchange per day)
- 22 airstones
- 1/2 HP blower

- 4,400 fry (1-g each)
- Reared for 12 weeks
- Harvested at 50-g
- 90% survival
- Fed 4 times each day
  (30 minutes *ad libitum*)

Future Research

Fish production strategies
- staggered stocking and partial harvests
- fingerling rearing in cages
- polyculture

Different fish species

Sludge
- characterization
- application techniques

Water quality management
- denitrification tank for removal of nitrate
  - flow rate for optimal removal
  - flowers for added economic benefits
- aeration methods
  - paddlewheels

Scaling up