Hydroponic-Aquaponic Food Production System for the Mars Desert Research Station

Peter B. Merkle, Ph.D., P.E. Associate Professor
Constanza C. Cuneo, BSCE, M. ASCE
Matthew A. Maccarrrone, M. ASCE
Embry-Riddle Aeronautical University
Department of Civil Engineering
Daytona Beach, FL

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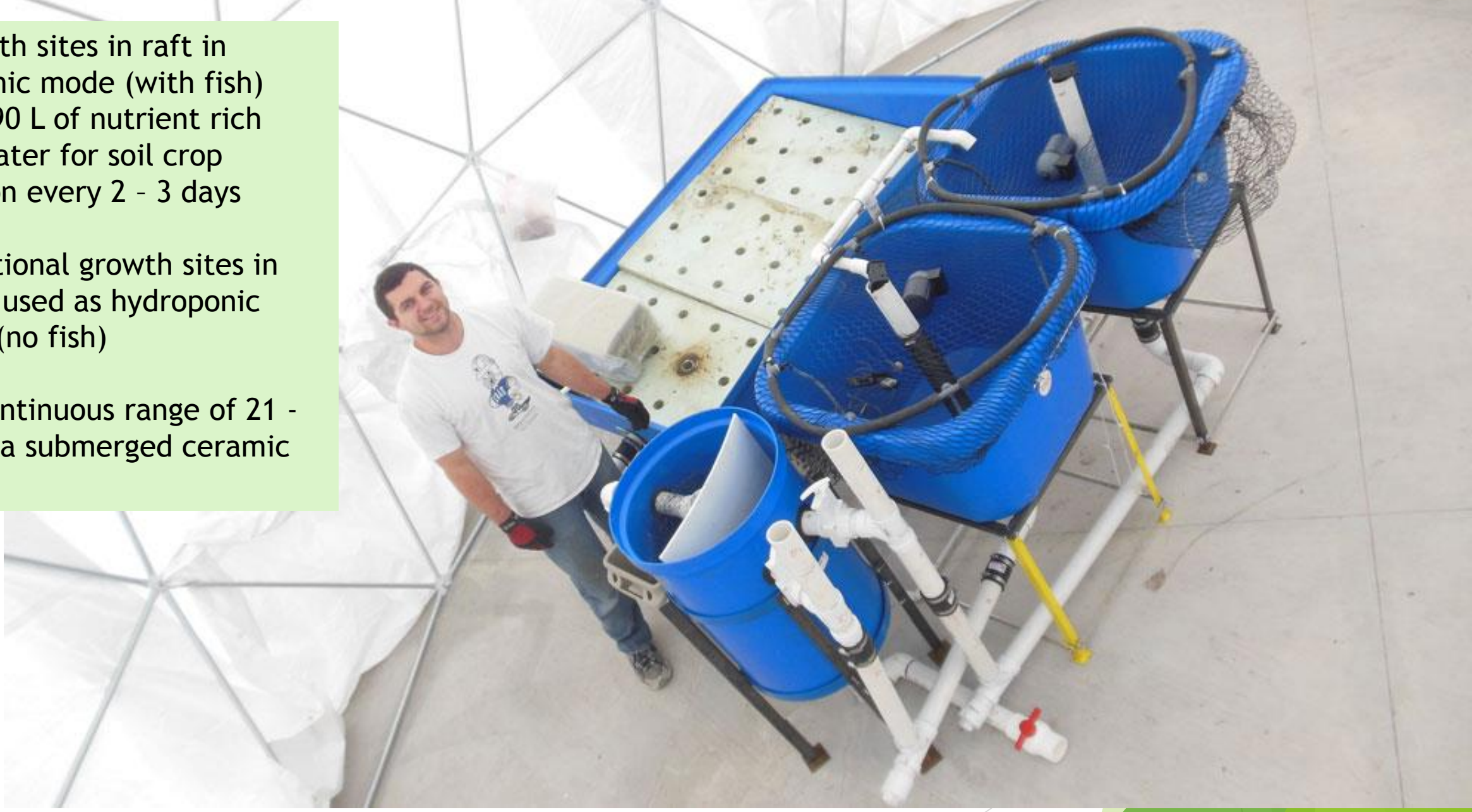
54 growth sites in raft in aquaponic mode (with fish)

- 190 L of nutrient rich wastewater for soil crop irrigation every 2 – 3 days

18 additional growth sites in tanks if used as hydroponic system (no fish)

ideal continuous range of 21 - 24 °C via submerged ceramic heaters



What Are Aquaponics and Hydroponics?

Aquaponics

- Combination of recirculating aquaculture and hydroponic growing method.
- Nutrient-rich water from raising fish provides nutrients for plants.
- Nitrifying aerobic bacteria convert NH_4^+ to NO_3^-

Hydroponics

- Growing plants rooted in a nutrient solution.
- Plants are provided with tailored growth conditions with synthetic nutrient solution

Benefits of an Aquaponics/Hydroponics System

- Fish Tank: 16 to 20 fish per tank
  - Harvest in 30 weeks from fry stage to filet size
- Leafy Vegetable:
  - Harvest between 45 to 55 days (lettuce, kale)
- Nutrient Rich Wastewater
  - Irrigate soil-based crop (tubers, trees)

Aquaponic *Moringa Oleifera*

Hybrid Aquaponics System at ERAU

Hybrid System for the Mars Desert Research Station

- Design Criteria:
  - Design a system that was capable of aquaponics (fish) or hydroponics (no fish) while using as many recycled parts as possible.
  - System must fit within an 8 ft by 8 ft square
    - Ease of assembly and disassembly
  - Minimize energy use
  - Materials used are nonflammable.

Reducing Energy Sources

- The system is suitable for natural sunlight or supplementation by LED plant lights.
- Use one pump to provide aeration and recirculation of water.
- Use ceramic water heaters.

- Frames: Iron and Aluminum
- System parts: Recycled from an existing system.
- Piping: Recycled PVC
- Air pump donated by tag!

The St. Augustine Children's Museum


Fish Tank 3
tag!

Embry-Riddle goes to the Mars Desert Research Station in Hanksville, Utah

Expected Results

- Conduct research on sustainable food production.
- Crews will become familiar with maintaining and harvesting the system.
- Future expansion of system.

Nutrient-Film Technique

Questions?

Thank you!

- One aerated tank of floating rafts has 54 growth sites; two 190 L aerated tanks support fish or plants. A settling tank removes solid fish waste, and two aeration sumps support airlifts for water circulation.
- Submerged ceramic water heaters provide short-term survival for fish and plant under minimum water temperature conditions (13 °C), with an ideal continuous range of 21 - 24 °C.
- In October 2015, the system was designed and fabricated from recycled parts of an existing system, disassembled, shipped, and re-assembled, with supplies for pH testing and initial water conditioning. Utilities were unavailable for system leak test and startup.
- The fish capacity (blue tilapia, *Oreochromis aureus*) is 16-20 fish per tank, with growth from fry stage to 0.7 kg harvest size in 30 weeks from stocking.
- Leafy vegetable harvest time from seed should range from 45 to 55 days for lettuce and kale. The system will provide approximately 190 L of nutrient rich wastewater with settling tank drainage every 48 hours, for use in irrigation of other plants in the greenhouse. If operated as a purely hydroponic system without fish culture, the fish tanks will provide 18 additional growth sites.
- Expansion of the system growing capacity with a vertical nutrient-film technique growing rack may be achieved by airlift from the sump tanks.