2013 CCE Summer Internships

CATEGORY ARCHIVES: APPLIED AQUAPONICS

Weeks 8 & 9: Q1C2 – Q1C1 = Px

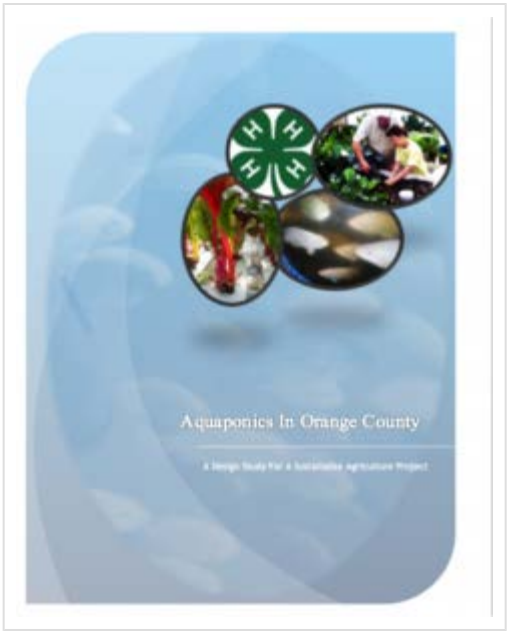
Posted on **August 18, 2013** by **ebc47@cornell.edu**

These past two weeks I focused my efforts mostly on developing and completing a design report for Orange County Cooperative Extension (OCCE).

OCCE is in the process of receiving funding for a new education center and 4-H park that will be established in Mount Hope, NY. They plan for all buildings on the site to be sustainable. Because sustainability is one of their large focuses, I decided that an aquaponics system might be a perfect way for them to demonstrate sustainable agriculture. I talked with Lucy Joyce, Head of CCEOC, who was very excited by the idea.

I designed the system to fit USDA Organic Standards, so both produce and fish can be certified organic. I began by determining the number of plants that would be established in the aquaponic ponds and worked backwards to determine the maximum amount ammonia (produced by the fish) that the plants could sustain.

After formulating a system design, I then generated an economic analysis of the system and predicted returns should cooperative extension wish to generate revenue.



The entire report was a whopping 56 pages. Phew!

Cover of my design report

Posted in **Applied Aquaponics**

Week 7

Posted on **July 29, 2013** by **ebc47@cornell.edu**

We began a second trial of our nitrification experiment this week. We purchased seedlings instead of adult plants. This way, we would be able to observe nitrification rates throughout the lifespan of the lettuce. We created new nutrient solution and stocked each of the tanks.

In addition to starting the second trial, we began discussing the aquaculture component of the system. We primarily discussed our pipe configuration, trying to find a way to most effectively remove solids. Afterwards we generated

some calculations for elevating the tank and creating a stable structure for when loading is applied.

Later in the week we enjoyed a wonderful Dinner at professor Timmons house, in honor of one of our fellow research students who would be leaving for the summer. The dinner was absolutely wonderful! We had tilapia!

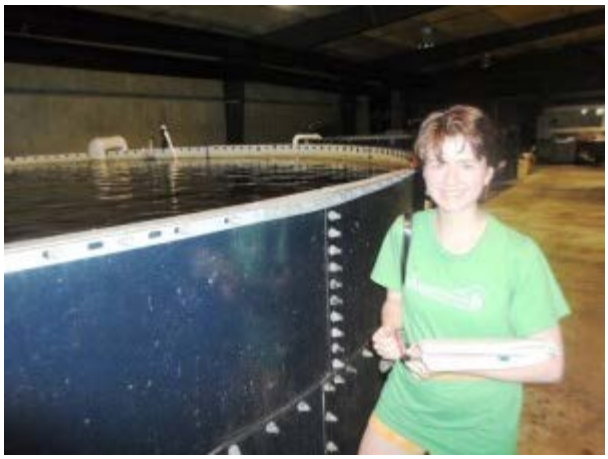
I have been continuing my work with cooperative extension in Orange County. This week, I finished creating a visitor design for their future education center and 4H park. I also have been continuing my work on creating an aquaponics design that they may be able to use in their crop-research area.

Posted in **Applied Aquaponics**

Continental Organics

Posted on **July 29, 2013** by **ebc47@cornell.edu**

My experience at Continental Organics was wonderful! Not only did I have the opportunity to see everything I had learned about aquaculture and hydroponics being applied, but I also had the chance to sit with Dr. Timmons and interact in a consultation meeting.



— I was lucky enough to have the opportuinity to walk through the facility at Continental Organics and look at the mechanics and design of the aquaculture system.

Posted in **Applied Aquaponics**, **_Uncategorized**

Week 6

Posted on **July 21, 2013** by **ebc47@cornell.edu**

On Sunday I drove down with Professor Michael Timmons to Newburgh, New York to assist with the 19th Annual Aquaculture Short Course. It was a very exciting time! During the short course, students learn about an incredible number of system designs and their benefits or downsides. They also learn various calculations for feeding rates, mass balances, nitrification and fluid mechanics. The course then finishes off with design spreadsheets and a discussion of aquaponics.

On Monday the course began with an overview of standard system designs, tank designs, filtration, and some warm-up calculations. After lunch Michael Finnegan, CEO of Continental Organics, visited the short course and discussed his business and experiences starting up a large scale aquaponics facility. Later in the afternoon the class visited Continental Organics and took a tour through both the aquaculture facility and the hydroponic/aquaponic greenhouse.

On Tuesday lecture entailed discussions on fluid dynamics and system plumbing, with some insightful stories from Professor Timmons. Solids management was also briefly discussed. Before dinner JD Sawyer, President of Colorado Aquaponics, gave a presentation of his system and discussed his experiences with installation and funding, product sales, and promotion of education and healthy eating to local communities.

On Wednesday the class began with some detailed discussion on mass balances and growth rate, followed by presentations on biofiltration and denitrification. Later in the day, other students presented the systems they had started, talking about the challenges and successes they endured and providing useful tips for aspiring aquaculturalists.

Thursday covered topics pertaining to heterotrophic systems ways to control the generation of heterotropic flock. Dr. Mike Pietrak, a researcher at The University of Maine, later presented on biosecurity, discussing the common pathogens one encounters when growing fish and standard protocol to prevent the spread of disease. After lecture the students made a second visit to Continental Organics, focusing more on the “nuts and bolts” of the system design and asking questions pertaining more to production and economics.

On Friday, Dr. Timmons presented on the economics of RAS farming and provided numerous “rules of thumb” to be wary of when constructing and regulating a system. Dr. Ebeling, Research Engineer from Toussaint, AZ then discussed
“boutique” system designs and production benefits. Dr. Timmons and Dr. Ebeling then presented design spreadsheets that they made available for the class and provided instruction on how to use them. The class then wrapped up and certificates of completion were provided to students.

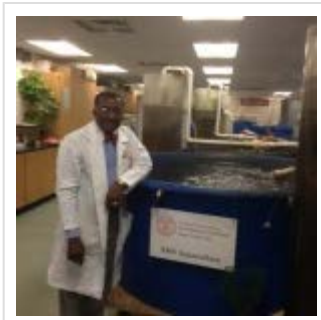
While assisting with the short course, I also spent some time working with Lucy Joyce down at Cooperative Extension in Orange County. I attended a few meetings where Ms. Joyce presented Cooperative Extension’s plans do build an education center and 4-H park in Mount Hope. I will be helping Ms. Joyce with an illustraton of the center and park for visitors.

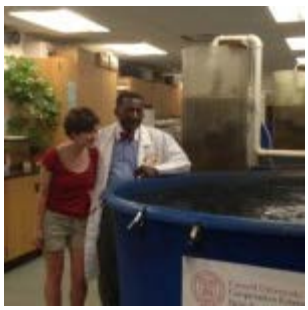
This week I also had the opportunity to join Professor Timmons in an engineering consultation meeting. Dr. Timmons met with Michael Finnegan, CEO of Continental Organics, along with the workers at the facility. He addressed all questions they had pertaining to their system with incredible detail. For me, it was wonderful to have experienced the opportunity of seeing someone provide engineering consultation to a company, as this might be a potential path I may follow in the future.

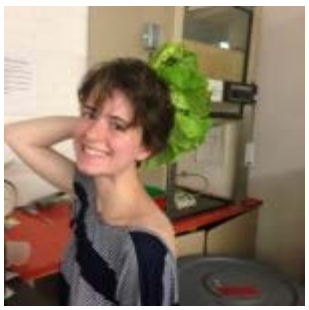
Posted in **Applied Aquaponics**, **_Uncategorized**

Week 5

Posted on **July 16, 2013** by **ebc47@cornell.edu**







This week I visited Orange County Cooperative Extension (CCE OC) headquarters. Lucy Joyce, director off CCE OC, graciously showed me around the facility where I learned about the incredible number of programs, workshops and outreach opportunities available to families and communities throughout the county. I also learned about the subdivisions of CCE OC which include Family and Consumer sciences, Nutrition and Healthy Living, 4-H Youth Development and Agriculture.

In addition to visiting CCE OC headquarters, Ms. Joyce allowed me to shadow her during the day. She informed me of CCE OC's plans for a new Education Center and 4-H park they are working to establish in Mount Hope. Part of my work for CCE OC will entail creating creating an illustration of the park site for visitors, and hopefully some engineering design for a potential future aquaponics system that would be implemented in their facility for crop research.

Later in the week I met with Mr. Philson Warner, who works with CCE in NYC at the Food and Finance High School, to visit his system and see what he was up to. Mr. Warner kindly gave me a tour of his facility where he has established hydroponics, aquaculture and aquaponics laboratories.

In the basement, Mr. Warner has developed a BHS (biologically driven recirculated high speed system) for growing fish. He grows tilapia and feeds them a 57% protein content and grows them to 2 pounds, before using them for consumption, within six to nine months. He maintains an average hydraulic retention time (time taken in order for tanks to have renewed water) of approximately ten minutes in order to maintain clean water. He is also attempting a genetics program of sorts, trying to develop a "pearl" variety of tilapia that he discovered from some accidental breeding.

Mr. Warner is also working on an NDFT (Nutrient film drip technique) for hydroponics. It essentially entails flowing nutrients through growing medium and using gravity for recirculation.

On Sunday I traveled with Professor Timmons down to Newburgh to begin the 19th Annual Aquaculture Short Course!

Posted in **Applied Aquaponics**

Week Four

Posted on **July 6, 2013** by **ebc47@cornell.edu**

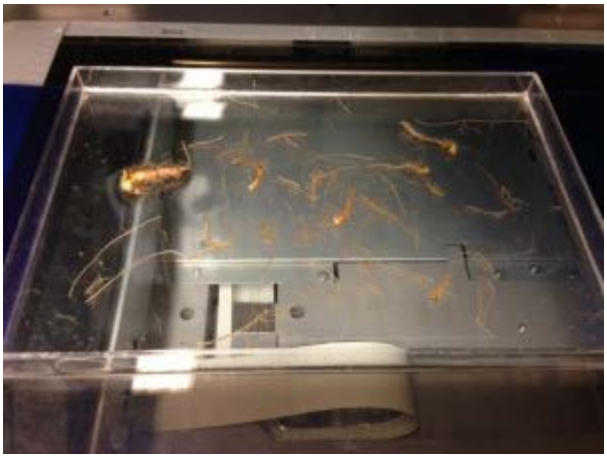
This week entailed mainly scanning roots. From scanning the roots, one can make a relatively accurate estimate of the root surface area and total length of the root structures combined. This places a substantial role in determining the correspondence between root surface area and nitrification/nitrate uptake (via plants and bacteria).

Plants were subdivided into categories based upon size (A being the smallest and D being the largest.) After scanning, the root samples were weighed and placed in an oven for later determining the dry weight.

In addition to scanning roots, I continued my work on regulating the aquaponic system. We currently are experimenting to determine a correlation between root surface area and nitrification (the breakdown of ammonia-nitrate into nitrate and nitrite). We have also begun working on incorporating the aquaculture component of the system.

At first we thought we would purchase tilapia, as tilapia are the standard food-grade fish used in aquaponic systems. We later decided against it—having tilapia would require warm water levels, which are not ideal when slowing the growth of plants like lettuce. Lettuce tends to grow extensively and seed at air temperatures at or above 70 degrees Fahrenheit and warm water would be another factor that could harm our temperature regulations. Addition, natural temperature fluctuations might kill Tilapia. We thus decided that would we would invest in koi fingerlings, as koi can live in a variety of temperatures and are adaptable to fluctuating environments. We would also not need to worry about harvesting koi.

Below are some photos from my scanning endeavors. plants needed to be separated from their growing medium (the green material) and placed in a scanning container with water.



Posted in **Applied Aquaponics**, **_Uncategorized**

Week 3

Posted on **June 23, 2013** by **ebc47@cornell.edu**

This week marked the beginning of experimental research. (The past few weeks have been geared towards reading, programming and construction.) For the next month or so, we (a group of a few students and myself) will be experimenting on nitrate uptake as a factor of both root mass and pH for Bibb lettuce.

On Monday, and Tuesday we continued sampling water from the tanks, analyzing temperature, pH, EC (electrical conductivity) and ammonia. It is essential to measure these values on a daily basis, as fluctuations in one or more of the parameters can indicate the absence of key elements in the system, a lack of growth in nitrifying bacteria, or an unwanted chemical reaction. We then adjusted pH levels by adding .1M sulfuric acid to each of the tanks.

On Wednesday we met with Neil Mattson, Assistant Professor and Floriculture Extension Specialist, to develop a procedure for root scanning. Root scanning essentially entails scanning a plant root system through a specialized scanner. By scanning the root system, one can accurately measure various lengths of individual roots and use these lengths to estimate the total root surface area. Measuring the root surface area will be important when we attempt to determine a particular relation between surface area and nitrate uptake.

On Thursday we added plants to the system. We purchased Bibb lettuce in various stages of growth from Fingerlakes Fresh, a hydroponic facility located approximately 15 minutes away from campus. For four of our tanks we added one small tray of lettuce. We left the other two tanks empty as controls.

In addition to purchasing lettuce to add to the system, we purchased lettuce heads solely for performing root surface area and nutrient analyses. We separated the lettuce heads from the root systems and massed both weights. We then refrigerated the root systems and froze the lettuce heads. We will begin scanning roots this upcoming Monday.

On Friday we continued monitoring the system, measuring pH, EC, temperature and ammonia levels. We also measured nitrate/nitrite levels to see if the plants had taken up any of these compounds, or if more nitrifying bacterial colonies had grown with the addition of available surface area from the plant roots. A lower pH in each tank containing lettuce indicated that the nitrifying bacteria were establishing themselves very well and that the system overall was in a healthy state.








Posted in **Applied Aquaponics**, **_Uncategorized**

Weeks 1 and 2

Posted on **June 23, 2013** by **ebc47@cornell.edu**

Unfortunately my previous two weeks were not published on my page (??) so I have condensed them together.

Weeks one and two entailed primarily system construction. We (a few students and myself) have designed the system in a manner that would enable various experiments to occur at once.

The system consists of six blue hydroponic tanks. Each of the tanks measures approximately 3 feet by 6 feet. The tanks are elevated roughly 4' above the ground. Each tank has a metal frame for reinforcement, and is enclosed by a wooden frame to ensure stability. The tanks have been painted with white oil-based paint, to prevent decomposition of the wooden frames. In addition to a wooden an metal frame, each tank has a pump, two PVC pipes and an aerator to regulate both circulation and aeration.

In each of the tanks we have mixed a standard hydroponic solution for growing a variety of lettuce types. The solution included nitrate, nitrite, and ammonia compounds as well as a mixture of micronutrients (copper, sulfur, iron chelate, etc.).

On a daily basis pH, EC (electrical conductivity), temperature and ammonia levels are measured and adjusted. Water temperature is preferably between 27 and 28 degrees Celsius. We struggled quite a bit with this these past two weeks, due to the evaporative cooling that was occurring in the back two tanks (this yielded a temperature difference of 4 degrees Celsius between the back and front tanks). pH became a slight issue as well, due calcium and phosphorous precipitating out of solution (yielding a sand-like deposit on the bottom of the tanks). Over time, however, the system began to gradually stabilize.

In addition to regulating and developing the system, I have spent a good portion of my time learning to rework a flow simulation using the program SolidWorks. The simulation is designed to be a preview of an MCR (mixed cell raceway), a new and efficient, self-cleaning tank design used in aquaculture systems.

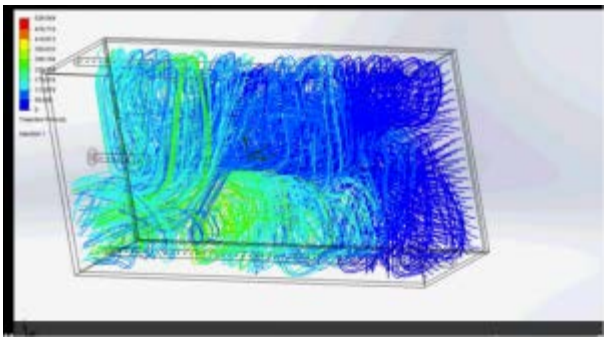


Image 1: SolidWorks Simulation of MCR

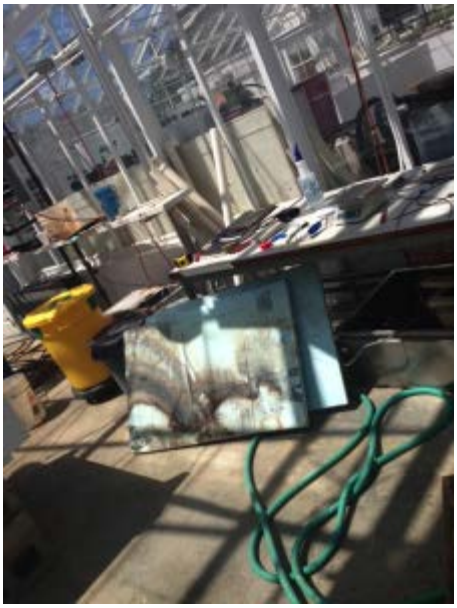


Image 2: Construction of the system in the Ken Post Greenhouse

Image 3: Painted tanks

Posted in **Applied Aquaponics**, **_Uncategorized**

IMAGE

Week 0: Preparation and Overview of Summer Work

My name is Erica (Blaze) Cartusciello and I am working with Professor Michael Timmons this summer on applied aquaponics.

Aquaponics is defined as the marriage of hydroponics (cultivation of crops in a nutrient solution (i.e. without soil)) and aquaculture (the rearing of fish and other marine organisms at high densities)

Aquaponics combines these two agriculture technologies: organic compounds produced by fish and marine organisms are used as nutrient fertilizer for hydroponically grown crops. In turn, the hydroponic component of the system removes compounds that would otherwise accumulate and become toxic to fish.

Our objectives for the summer include constructing a small-scale system prototype here at Cornell and creating a user-friendly interface that can be utilized by farmers and hobbyists. The interface will aid in determining cost outputs and other factors that must be accounted for in greenhouse system design. Experiments from the prototype system will be used in identifying environmental factors that affect crop production and can be used to generate a cleaner, faster-growing product.

Later this summer we will be presenting our results to the the BOD of Continental Organics LLC, an aquaponic facility located in Orange County, NY that has interactions with CCE. We hope to apply our results not only to Continental Organics, but also to other programs of CCE in Orange County.

This week entailed general maintenance and setup. We have just finished cutting and welding frames for grow beds of the hydroponic component. We have also begun clearing space and installing our system at the Ken Post Greenhouse Lab, located on campus.

Photos:

June 3, 2013 by **ebc47@cornell.edu** Posted in **Applied Aquaponics**, **_Uncategorized**