GEV 1051-Environmental Science
Aquaponics & Hydroponics
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Aqua(Fo)nics

Are fish really needed in Aquaponics?

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Objective

In this experiment, a pseudo Aquaponics system was orchestrated to determine if fish excrement is needed in an Aquaponic system to yield organic produce. In replacement of the actual fish, fish fertilizer was added to a tank of water to simulate fish waste that contained the necessary nutrients of Nitrogen (N) and Phosphorus (P). In essence, the experiment attempted to reveal the success of fish fertilizer as an alternative.

What is Aquaponics?

Aquaponics is a combination of aquaculture, or the raising of fish, and hydroponics, which is an act of soil-less plant production. Fish excrements provide a nutrient source for the plants while the plants provide a filter for the water being replaced into the fish tank. Overall, a sustainable circuit of nutrients and fresh water is created.

Traditional Aquaponics

Traditional Aquaponics involves using Goldfish and Tilapia as the most ideal fish species due to their durability and waste production. Fishes used in Aquaponics excrete waste that is pumped up and over a garden bed. The wastewater is filtered by gravel and plant roots and it is returned to the tank in purified form.

Advantages

- Fish excrete ammonia
- Fish excrete other nutrients such as P
- Uses 1/10 the water of soil based gardening
- Self-sustaining system
- Yields organic produce

Disadvantages

- Must acquire and care for fish
- Expensive to setup and upkeep
- Power usage
- Does not work with certain crops
- Need permits

Aqua(Fo)nics

Aqua(Fo)nics is similar to a traditional Aquaponic system except it uses fish fertilizer for plant nutrients instead of fish excrement. Instead of harnessing fish waste, fish fertilizer is dissolved into water which is then pumped up and over a plant bed. The fertilizer acts as a nutritious supplement, bearing similar nutrients derived from the fish themselves.

Advantages

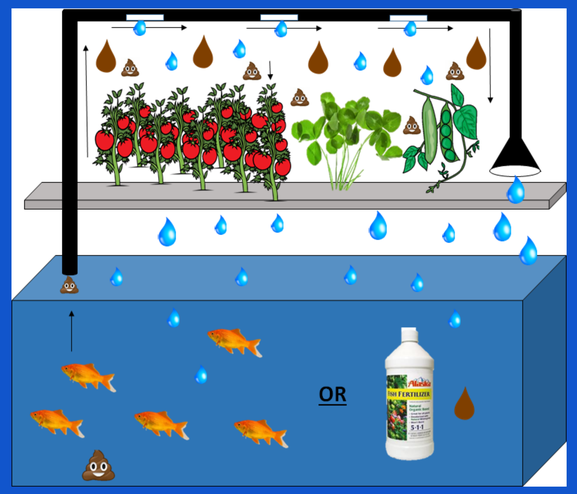
- Cheaper and easier to maintain than traditional aquaponics
- Uses 1/10 water of soil based gardening
- Self-sustaining system
- Yields organic produce

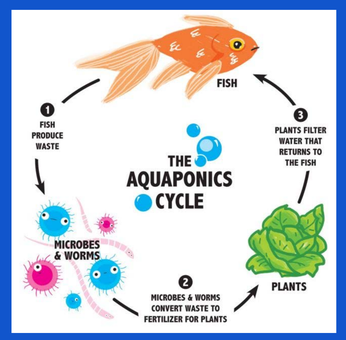
Disadvantages

- Nutrients are not in the same ratio as in traditional Aquaponics
- Displeasing odor
- Power usage
- Does not work with certain crops

References

- "Fish Fertilizer Provides Quality Nitrogen, Among Other Nutrients." *Organic Gardener's Pantry*. The Organic Gardener's Pantry, 2016. Web. 14 Apr. 2016.http://www.gardenerspantry.ca/blog/fish-fertilizer.html
- "What Is Aquaponics." *The Aquaponic Source*. The Aquaponic Source, 2016. Web. 14 Apr. 2016. http://www.theaquaponicsource.com/what-is-aquaponics
- "Disadvantages." *Aquaponics: The Way of the Future*. N.p., 2015. Web. 14 Apr. 2016. http://aquaponicsthewayofthefutureweebly.com/disadvantages.html
- "Aquaponics Fish." *The Aquaponic Source*. N.p., n.d. Web. 14 Apr. 2016.
- "Recommended Plants and Fish in Aquaponics." *Nelson Pade Inc*. N.p., n.d. Web. 14 Apr. 2016.
- "Fish - Backyard Aquaponics." *Backyard Aquaponics*. N.p., 09 June 2012. Web. 14 Apr. 2016.





Methods

To setup the experimental, a 189 L water tank was filled with ~95 L of tap water and was placed underneath a porous, metal table. A plastic container, with the bottom cut out, was placed directly above the tank on top of a wire mesh table. A 500 lph pump was placed in the tank and bendable piping was run from the water tank over the plastic container. Slits were made in the piping to mimic rainfall over the plastic container, which was then filled with gravel, and three each of tomato, snap peas and spinach plants. The pump ran continuously for approximately three weeks and 250 mL of fish fertilizer was added to the 95 L tank each week.

To set up the control design, three tomato, snap peas, and spinach plants were planted in soil that contained no nutrient enhancement. The flowerbed was watered twice daily with tap water.

Results

After three weeks, the experimental design showed little to no growth of the seedlings. Under examination, it was determined the snap peas had minimal growth of approximately 1.25 cm in height. Figure 1 displays the system after the three week duration. The control design, on the other hand, had growth in both the snap peas and spinach plant. The snap peas grew to about 2.5 cmin height and the spinach to approximately 1.25 cm. Figure 2 to the right displays the control system with the respective plant growth.

Figure 1: The experimental design. There are no plants that can be seen.

Figure 2: Control design. The middle plants are snap peas and the plants to the left are spinach

Conclusions

In conclusion, it was determined that fish fertilizer cannot replace live fish in an Aquaponics system. In a traditional Aquaponics system, fish excrete waste and ammonia. Micro-organisms break down the ammonia into nitrate, which are then absorbed by the plants along with other nutrients, such as P, excreted by the fish. The fish fertilizer used in this experiment was simply ground up fish. It contained nutrients needed, such as nitrogen, phosphorous, and potassium; however, the fertilizer used in this experiment was insufficient. The fertilizer used was called an emulsion fish fertilizer. Emulsion fish fertilizer uses "trash fish." They are the most soluble fertilizers, but they also contain high levels of chlorine from water sources used in processing. In addition, oils, amino acids, vitamins, and enzymes are absent in this type of fertilizer. The emulsion fertilizer did not yield any plant growth, whereas the traditional plant bed yielded 2.5 cm tall plants in three weeks. It is not recommended to use emulsion fish fertilizer as a replacement for fish in an Aquaponics system. Hydrolysate and meal fish fertilizers, which were not used in this experiment, are two other types of fertilizer and both contain higher nutrient content. An extension to this experiment would be to test these two fertilizers in the Aquaponics system.