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.

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 mimick 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 one week 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 125 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 mm in height and the spinach to approximately 125 cm. Figure 2 to the right displays the control system with the respective plant growth.

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 insufficent. 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.

References
* "Aqua-Fo:nics is similar to a traditional Aquaponics 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
- 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

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.

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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

Conclusion
Overall, a sustainable circuit of nutrients and fresh water is created.

Yield organic produce

● Self-sustaining system

● Power usage

● Cheaper and easier to maintain than traditional aquaponics

● Uses 1/10 water of soil based gardening

● Yields organic produce

● Nutrients are not in the same ratio as in traditional Aquaponics

● Displeasing odor

● Power usage

● Does not work with certain crops

● Allowing for self-sustaining system

● Power usage

● Cheaper and easier to maintain than traditional aquaponics

● Uses 1/10 water of soil based gardening

● Yields organic produce

● Nutrients are not in the same ratio as in traditional Aquaponics

● Displeasing odor

● Power usage

● Does not work with certain crops

● Amazing!