The Affects of Alternative Feed, House Fly Larvae (Musca Domestica) and Duckweed (Lemna minor), On The Growth Rate of Nile Tilapia (Oreochromis niloticus)

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Introduction

Aquaponics combines hydroponics and aquaculture into a sustainable, recirculating system (Figure 8). Aquaculture is the cultivation of water plants and animals for human use. Hydroponics is the system of growing plants using other nutrients sources besides soil. Because aquaponics can recycle nearly 99% of the water it uses, the system is very sustainable and wastes much less than aquaculture or hydroponics (Riche).

Although aquaponics systems can be a very sustainable way of producing fish and plants, the commercial fish feed used negatively impacts the environment by polluting the environment during transportation. Additionally, for every kilogram of fish growth, 1.9 kilograms of ocean fish are killed in order to create commercial feed. (Naylor, Rosamond).

The Cape Eleuthera Institute (CEI) has been working to find an alternative food source to feed the Nile Tilapia (*Oreochromis niloticus*) in their Aquaponics system. In previous experiments conducted in labs outside of CEI, duckweed and maggots produced better results than other feeds, including commercial feed (Yaqub) (Chowdhury, 2008). The aquaponics research team created a study with a hypothesis that stated, when completely supplemented, the duckweed or maggot meal will create growth rates equal to or greater than that of commercial feed.

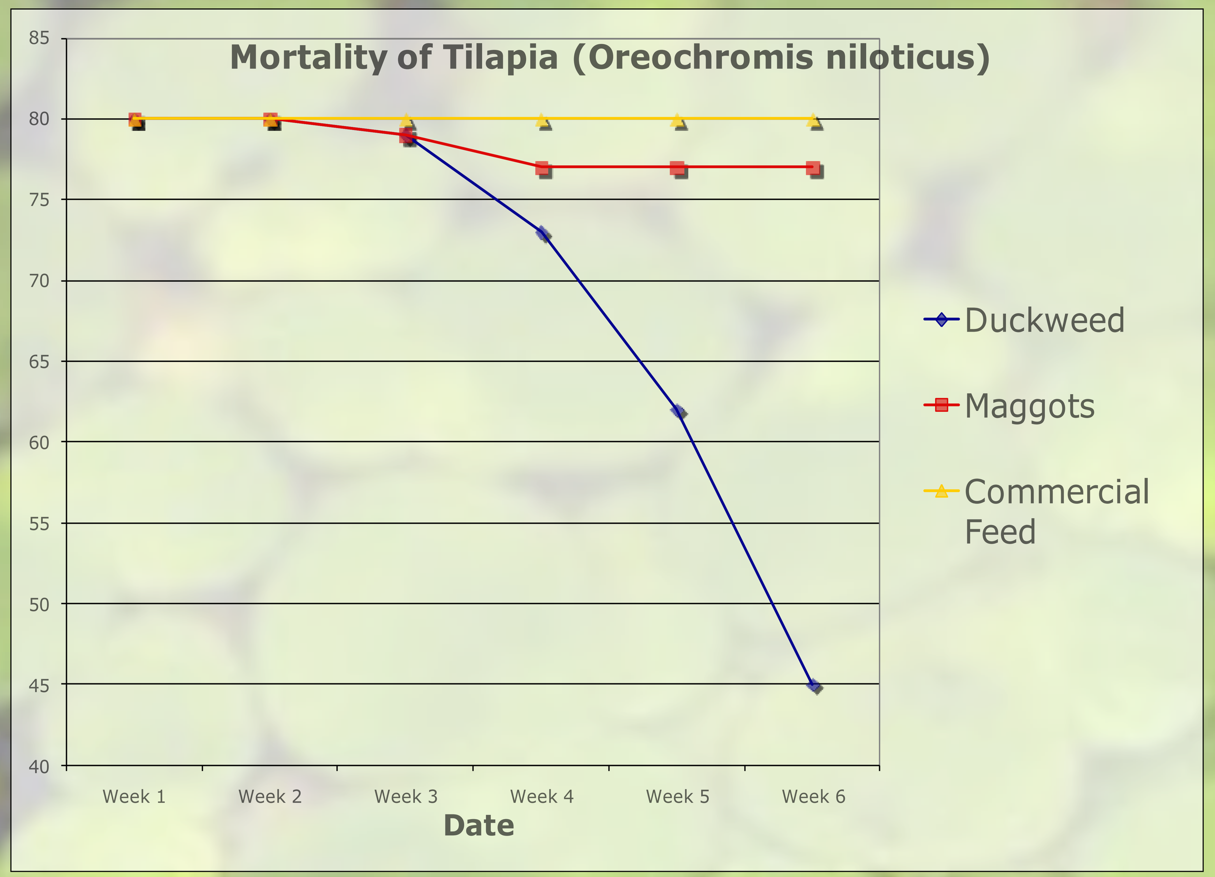

Figure 1: Mortalities of the four different feed sources

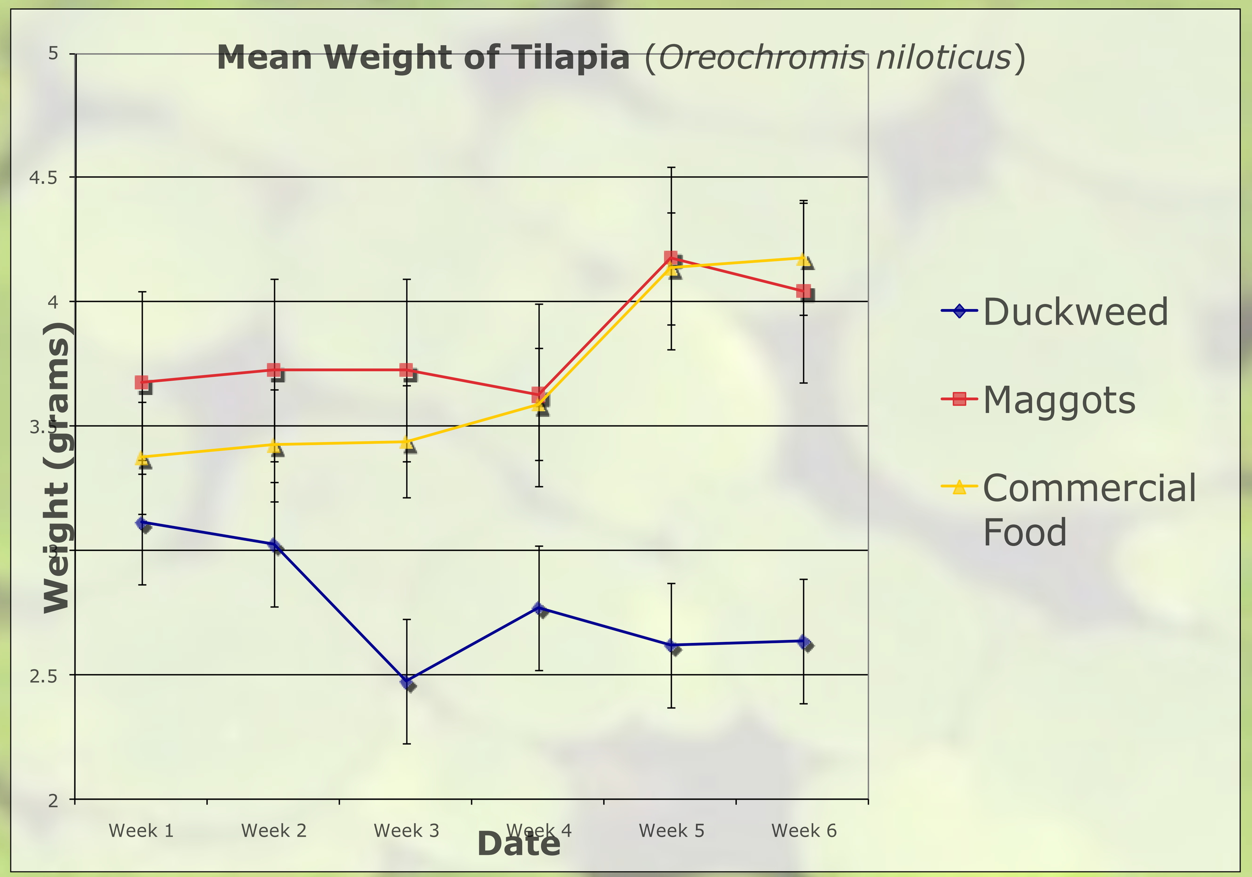

Figure 2: Mean weights of the four different feed sources

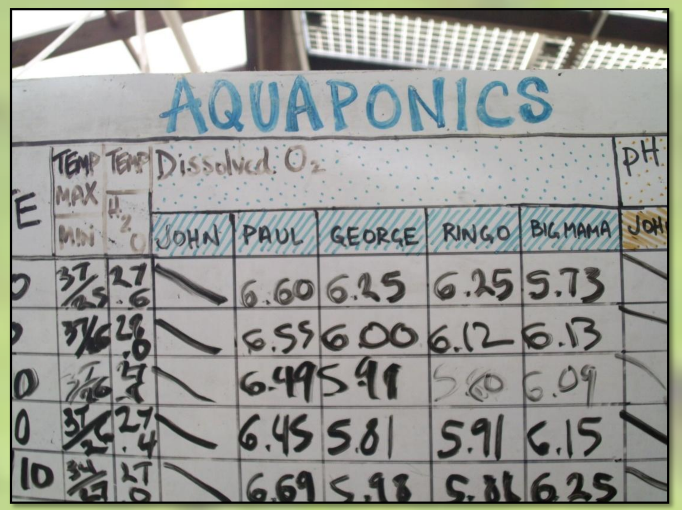

Figure 3::Example of water testing graph

Results

Of the two alternate feeds tested neither of them had growth rates equal to that of the commercial feed. Over the six-week period, the maggot feed had an overall positive growth rate.

The mean weight of the fish in the maggot study grew from 3.675 grams in week one, to 4.044 grams in week six, a growth rate of 10%. The duckweed feed had a negative growth rate. The mean weight of the fish in the duckweed study fell from 3.113 grams in week one to 2.636 grams in week six, a growth rate of negative 15%. Finally, the commercial feed, our control, had a healthy growth rate. The mean weight of the fish in the commercial feed study grew from 3.375 grams in week one, to 4.175 grams in week six, or a growth rate of 24% (Figure 2).

The survival rate for the commercial feed was 100%; all of the fish survived. The maggot feed also had a survival rate of 96.25%, seventy-seven of the eighty lived. The survival rate of the duckweed study was 56.25%, leaving forty-five of the eighty fish living (Figure 1).

Figure 4: Aquaponics team building tank stands

Figure 5: The maggot farm

Methods

Our study included twelve tanks: four were fed maggots, four were fed duckweed and the remaining four were fed commercial feed as a control. The duckweed was grown and collected on site on the surface of 8.5x2.25 foot grow beds. The maggots were spawned from a maggot farm, which consisted of attracting flies with rotted meat creating an optimal breeding ground. Once born, the maggots would migrate up a ramp into a bucket of water, thus drowning them to be easily harvested.

Each fish-rearing tank held 20 juvenile tilapia with an average weight of 84.75 grams per tank. Fish weights were measured by removing the tilapia, patting them dry with paper towels to prevent any error due to water weight, and then placing individual fish on a scale one tank at a time (figure 6). The wet weight of the commercial food was calculated to coincide with the other feeds' wet weights. This was further used to obtain the percentage of food to bio-mass needed for each food type, found to be 5.63%. This percentage, multiplied by each tank's bio-mass, gave the necessary daily feed amount for each tank.

Once harvested, maggots and duckweed are measured into egg cartons to be frozen for storage. Commercial feed is ground into a powder and saturated with water. The feed then follows the same storage procedure as the maggots and duckweed. The fish were fed every morning before 9:15 AM in order to follow the Tilapia's natural daytime feeding schedule. (Riche, Aug 2003). Dissolved Oxygen and pH levels were also measured and recorded daily to ensure that food was the only variable in the study (Rakocy, Nov 2006).

Figure 6: Maggie harvesting Tilapia

Figure 7: Lettuce grow beds used in the Aquaponics system

Discussion

Through further data analysis using a P-value test, it was found that the hypothesis was not supported by the data collected. Therefore it is not suggested to use maggots or duckweed as an alternative feed at this time. The poor results yielded by the duckweed study were unexpected due to evidence of previous successful experiments involving duckweed (Chowdhury et al, 2008). When comparing this study to the previously recorded duckweed study, a key difference in the feeding methods was seen. The successful study dried, grinded and pelletized their feed, while this study involved feeding the duckweed whole, which could have been too large for the juvenile Tilapia to consume. The study also only fed their fish a feed consisting of 60% duckweed and 40% commercial feed, while this study used 100% duckweed (Chowdhury et al, 2008).

Even though maggots had a positive growth rate, they are not suggested as a future feed source due to their difficulty in harvesting. The maggot farm at CEI was unreliable, as shown by the shortage of maggots by week six of our study.

There were a few limitations that may have also affected our results. Human error limited the study as the fish were not fed every day or at a consistent time. This affected our results because Tilapia are day feeders and need to be fed at the same time every day (Riche et al, 2003). A heron was also spotted in our testing area a few times and may have consumed some of the fish, contributing as an outside factor to this study.

Further research is necessary to resolve this global issue. Maggots showed promising results as an alternative feed, but further research needs to be done to develop a more reliable and efficient maggot farm. The possibility of using duckweed and maggots as a supplementary feed as apposed to an alternative feed can also be taken into consideration for a future study. More research needs to be accomplished in order to fix the global affect of the production and use of commercial feed.

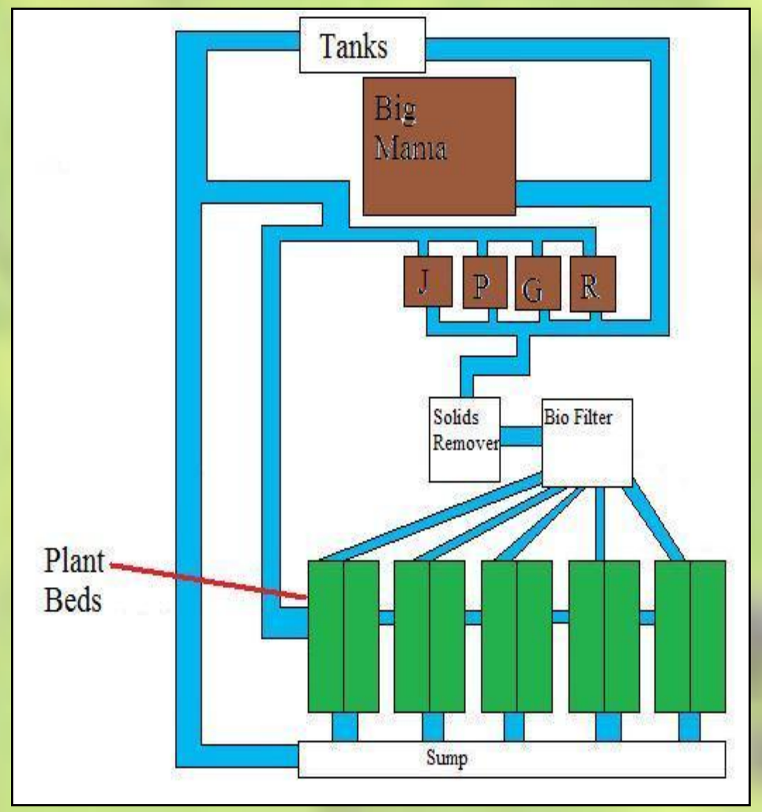

Figure 8: The Aquaponics system

Thank You

Joshua Shultz, Kristen Key, and Andrea Whittle for helping us create and execute the experiment

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