Aquaponics: The Future Of Farming

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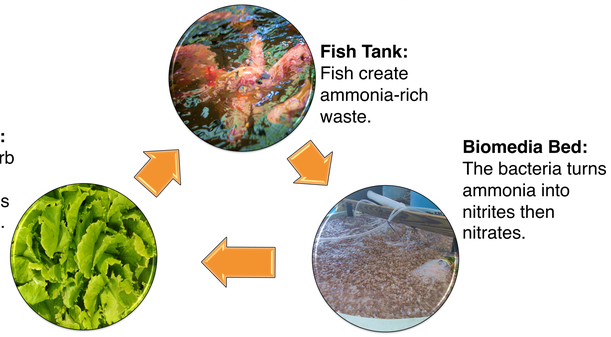
Introduction

As global population continues to grow at an exponential rate, water resources and available arable land are diminishing. Traditional agriculture will not be able to sustain the global population. Alternate methods of agriculture must meet a large, nutritional demand while using land and resources efficiently. (Reid, J et. all).

Aquaponics is part of the Center for Sustainable Development on the Island School campus. The Aquaponics System aims to provide the Island School with lettuce and herbs. The Aquaponics Research Team aims to address local food security issues on the Island School campus and in South Eleuthera, and to inspire sustainable agriculture.

Aquaponics systems can be created anywhere and on any scale. The nature of recirculating systems like the Aquaponics system is such that they require significantly less water than traditional agriculture. Aquaponics systems do not require the use of soil, which means that nearly any type of substrate can be used. At the Island School, cocopete is used. Aquaponics systems provide both a source of healthy food options (animal protein, vegetables, etc..), while using the available land and resources effectively, responsibly and having a minimal impact on the environment.



The Aquaponics Research Team's project this semester is to maintain the Island School's lettuce security throughout the year. There is little agricultural industry in the Bahamas, and the nation is made up of small islands so most of the food is imported. Such import reliance has a large carbon footprint. In addition, land is mostly composed of limestone, making the soil too basic and lacking in nutrients for most crops.

During the summer, temperatures in the Aquaponics system rise dramatically. This heat leads to decreased lettuce production and greater dependency on importation for the Island School kitchen. The Spring's study will decrease the temperature of the Aquaponics system and increase lettuce production in order for Island School to be 100% lettuce secure year-round.
The research question posed is:
How can we cool down the Aquaponics systems in order to maximize lettuce production?

Methods

The *shade cloth* Partial Coverage Plan was implemented to decrease UV exposure from 10:00am-3:00pm (when the sun is directly ahead) by using 90% shade.

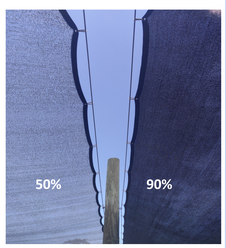


Figure 1: *50% shade is the control for the shade experiment, and 90% shade is used in the Partial Coverage Plan.*

The *misting* was used to decrease ambient temperature. John Reid, a consultant who worked on an Egypt-based Aquaponics system, suggested that for maximum efficiency of the system, it should be set to spray when air temperature reaches 25^{O}C and above.

Figure 2: *Misting system that is set to spray when temperature reaches 25 degree Celsius and above.*

The *chiller* was put in place to keep the water temperature of the grow beds consistently at 26^{O}C year round.

Figure 3: *The chiller keeps the water temperature consistently at 26^{O}C.*

Results

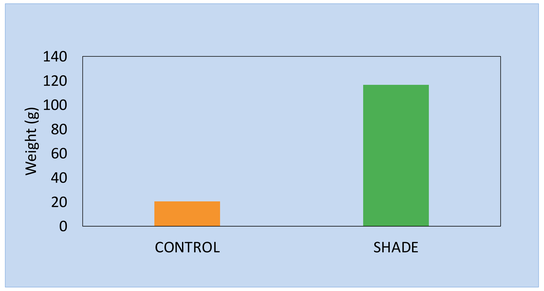


Figure 4: *Average Lettuce Weight After 8 Weeks Growth*

Shade:

Based on figure 5, it can be seen that the partial coverage plan was extremely successful. The average weight of the lettuce in the control group was ~20g whereas the average weight of the lettuce with the partial coverage plan was 115-120g. The experiment was so successful that the partial coverage plan was implemented on all of the other grow beds, and an increase in lettuce has already been seen after just a week.

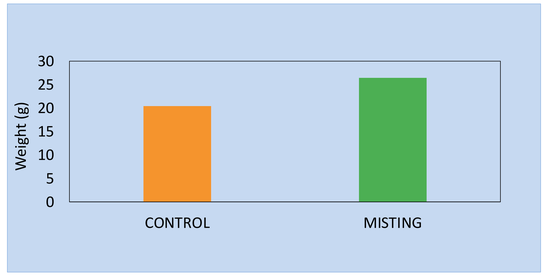


Figure 5: *Average Lettuce Weight After 8 Weeks Growth*

Misting:

According to figure 5, the misting experiment was successful, however that is incorrect. The lettuce weighed more, but it was rotting at the tips, had spotting all throughout, and it was quite pale. All of these are signs of unhealthy lettuce. Therefore, the experiment was stopped early because the aquaponics team needs to consistently provide lettuce for the kitchen. Furthermore, stopping the experiment early is one of the reasons that the data is skewed.

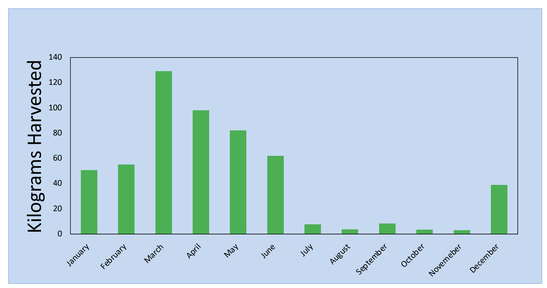


Figure 6: *Lettuce Production 2018*

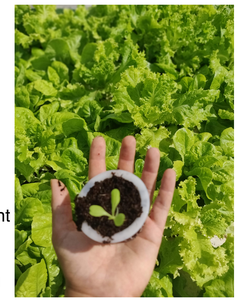
Chiller:

By referencing figure 6, it is evident that in past years, lettuce production has greatly decreased in the summer months due to extreme heat. With the introduction of the chiller, it is hypothesized that the aquaponics system will be able to grow lettuce year round. Furthermore, it is also hypothesized that the chiller will increase lettuce production. The chiller has only recently started working, therefore, only a small amount of data has been collected. More data is required before inferences and conclusions can be made about its impact on the system.

Discussion

Island School Campus:

The chiller and shade experiments have increased Island School lettuce production to the point where the campus is 100% lettuce secure.



The chiller has maintained a consistent temperature of 25 °C. Further data collection will highlight the effect of fish growth and lettuce production.

The shade experiment's lettuce survivability, coloration, and overall health surpassed those of other grow beds. This lettuce was leafier, dark green, and with no browning. To increase lettuce production, the partial coverage plan has been implemented over all five grow beds.

The lettuce under the misting system died in early development stages, displayed signs of rotting (tipburn and browning), and paled in coloration. The misting system was disbanded three weeks into the experiment due to high mortality rates, causing low lettuce production. Although the aquaponics system was acting as research project, its production is crucial to the campus mission of sustainability.

Wider Implications:

Moving forward, the aquaponics team will draw inferences from this experiment's results in order to increase production/food security on a broader spectrum.

Given the educational mission of the Island School aquaponics system, any new information on sustainable farming is of benefit to local farmers and educators. The findings of this experiment have the potential to improve the agricultural industries of Eleuthera, the Bahamas, and other Small Island Developing States. Furthermore, this research can be utilized to increase lettuce production in areas of the world where previously lettuce growth was unfeasible.

Acknowledgements

The Island School aquaponics team is grateful for the Global Aquaculture Alliance's aid in publishing our work. The Island School aquaponics team thanks all groups for aid throughout the course of this experiment.
Specifically, to the Island School facilities team, to Walter Neely, to John Reid, to Tom Stack, and to Iona Hamilton Stubber, and Sam Chronert. The actions and insights of the aforementioned groups were much appreciated.

Works Cited

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