Comparison of lettuce production by aquaponics systems with different amount and distribution of grow media

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Abstract

Aquaponics is a means of producing food indoors in areas with scarce land availability or to extend the natural growing season. Aquaponics combines aquaculture (raising fish in captivity) with hydroponically grown vegetable crops. These systems mimic natural nutrient cycles by supplying the plants with nutrients from fish waste and using plant uptake of nutrients to manage water quality for the fish. Vegetable grow beds in an aquaponics system require grow media to support plants' root systems and provide surface area for the growth of nitrifying bacteria. Grow media are a significant expense in setting up an aquaponics system. I constructed two aquaponics systems: one with a grow bed filled with clay pebble media and another with the media confined to floating pots. I compared the appearance and mean mass of lettuce plants grown in each system. I predicted that plants in the media-filled grow bed would reach a larger size and be darker in color by the end of a 45-day trial. The results falsified my prediction: the mean mass of plants in the two treatments and their appearance were nearly identical. These results suggest that the floating pot method could reduce the expense of aquaponics systems without compromising vegetable production.

Introduction

There is a growing interest in alternative agricultural systems that prevent pollution of waterways, produce food in or near population centers, and extend the growing season. Aquaponics is a food production system where aquaculture and hydroponics are combined. The plants in an aquaponic system are grown in grow beds with different types and amounts of grow media. Water from fish tanks is pumped into and flows through the grow beds and is then returned to the fish tanks. Grow media support the growth of nitrifying bacteria such as *Nitrosomonas* and *Nitrobacter* that convert fish waste into nitrates (Ako et. All, 2009). Nitrates are an important plant nutrient leading to darker leaf color and greater plant growth.

This study compares two types of grow beds with differing amounts and placement of clay pellet grow media. This study is relevant because grow media for aquaponics and hydroponics is expensive. Using less media makes a system less expensive and more accessible, but it may be less effective at producing food.

My hypothesis is that a grow bed full of media will produce lettuce plants with a higher mean mass and darker color than a grow bed using media only in pots. I predict this because the added media will increase the surface area where the nitrifying bacteria can grow, thereby producing more nitrates for the plants to use, which should result in darker leaves (Yang et. All, 2003).

Materials and Methods

Material	Quantity
30 Gallon Aquarium	2
Aquarium pumps	4
½” PVC Pipes	12 Ft
½” Flexible Tubing	12 Ft
Goldfish	20
Lettuce Seeds	1 Packet
Grow Media	50 Liters
3” PVC Pipe	1 Ft
17” x 24” x 9” Storage Container	2

I established two grow beds to compare the effects of different grow media amounts and placement on lettuce plant production. System A has a grow bed filled with porous clay pellet grow media, and lettuce seedlings are planted directly in the media. In System B, the lettuce seedlings are planted in net pots containing grow media, which float in polystyrene rafts on the water surface.

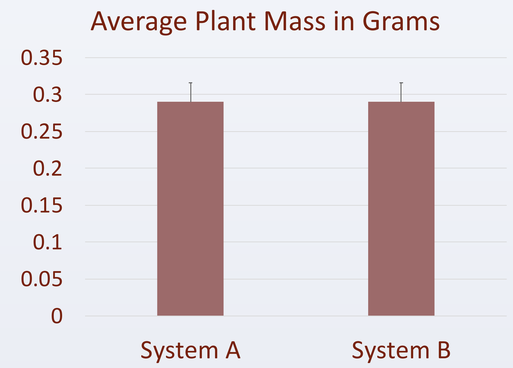
System A

System B

All other variables are controlled. Each grow bed is a 17”x24”x9” plastic container with a water level of 7 inches. The grow beds have the same flow rate: approximately 50 gallons per hour, the standard amount of flow recommended by *Small Scale Aquaponic Food Production*. Each fish tank has a secondary pump to provide circulation. Small goldfish (*Carassius auratus*) were added to each tank over a several week period until a total of 10 fish per system was reached. The water from both grow beds is returned to the tanks through PVC pipes.

I am collecting data from two trials, each lasting at least 45 days, the average time it takes for lettuce to mature (Driver, 2000). Conditions will be kept constant for both trials. Lettuce seeds all come from the same package to ensure similar genetics. I visually compare leaf color in the two treatments while plants are growing. At the end of each trial, I measure the total mass of each plant and compare the average mass of the plants in each system. The first trial is complete, and the second is ongoing.

Results



The data gathered from the first trial shows that the average mass of the lettuce in both systems was 0.29 grams, with a standard error of 0.026 grams in System A, and 0.021 grams in System B. Visual observations of plants in each system showed no noticeable difference in leaf color. There was no significant difference between the average masses or leaf color of the plants in aquaponics systems with differing amounts of growth media.

Conclusions

The data from the first trial falsified my hypothesis. The different amount of grow media in the two systems did not affect lettuce plant production or leaf color. This result is important, because it suggests that the less expensive system could be as effective at producing food plants.

The size of lettuce plants in both treatments was smaller than expected at the end of the first trial. This could be caused by the low fish to plant ratio or the species of fish I used. Additional studies could include monitoring the levels of ammonia and nitrate in each system, or monitoring how fish density affects plant production.

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