Design4Practice (D4P) Program
To: Dr. Trevas
From: Yanchu Du
Due: 7/18/2020
Re: Individual Analytical Analysis Report

Aquaponic Nutrient System Report

Introduction:

My research is about the nutritional system of aquaponic. In this study, I need to understand the knowledge or the problems that need to be solved for the team as follows. For example, what are the nutrients in the aquaponic system and how to get them, the optimal growth environment of fish and plants in common ways, and the possible nutritional loss and protective measures in the operation of the system.

1. What are the nutrients in the aquaponic system:

The nutrients in aquaponic system are shown below.

Mobile Nutrients	Immobile Nutrients
Nitrogen	Iron
Phosphorus	Calcium
Magnesium	Copper
Potassium	Zinc
Chloride	Sulfur
Molybdenum	Manganese
	Boron

Figure 1: Nutrients

The mobility of nutrients here refers to whether nutrients can move within plants after being absorbed by plants. And it should be noted that Iron, Zinc and Manganese are three of the few nutrients that aren't adequately supplied to system through fish food. If these nutrients are lacking, they need to be supplemented in other ways like adding iron chelate. Most nutrients can be supplied by fish food or tap water like copper and boron. The classical fish feed consists of 6 – 8 macro components and contains 6 – 8% organic nitrogen, 1.2% organic phosphorus and 40 – 45% organic carbon.

2. **Ideal environment in general and how to reach it:**

There are many environmental factors that affect fish, plants and microorganisms in the system. Of course, theses factors also affect the nutrients transform deeply. In an ideal environment, fish and plants can grow efficiently and nutrients also work perfect and there will be no negative effect on the system like nitrogen toxicity. Air temperature, relative humidity and photosynthetic active radiation (PAR), water temperature, pH, electrical conductivity, and dissolved oxygen need to be detected and controlled. However, because the target users of our scheme are individuals who are interested in planting. Because their economy and energy are limited, it is unrealistic for users to accurately master so many factors. However, in the above factors, pH and temperature can be measured and controlled by our users.

PH needs to be kept at a certain value, because fish are the most sensitive to pH and can keep bacteria healthy. Fish in the system prefer neutral pH, so it is important to monitor the pH of water and maintain it at a near neutral level. To achieve optimal levels, the pH value of fish should be between 6.5 and 8.0, while that of plants should be between 5.0 and 7.0 (the specific data of fish and plants will be posted at the end of this part). The optimal range is 7.8 to 8.0 for nitromonas and 7.3 to 7.5 for nitrospirulina. Levels below 7.0 slow down nitromonas and increase ammonia in the system. If the pH drops below 6.0, nitrification will be inhibited. If the pH value is to be adjusted, calcium hydroxide (hydrated lime) or calcium carbonate (agricultural lime) can be added slowly or together with potassium carbonate, bicarbonate or potassium hydroxide. Add slowly, check pH every few hours, and add more if necessary. It is important that this process be carried out slowly to avoid excessive addition of pH peaks too quickly.

There are two kinds of temperature, but they are controlled in different ways. The first temperature is the air temperature. The air temperature is determined by the plant needs at the seasonal conditions. We can use heaters, fans, sunshades and other common greenhouse practices to control air temperature. The second temperature is the water temperature. It depends on the type of fish. Some fish prefer a warm or cool environment. In order to control the water temperature in small fish tanks, traditional aquarium heaters and heated water can be used. The ideal temperature range for healthy and active breeding bacteria is 77 f to 86 F, and the activity drops below this range and stops at 39 F. Bacterial death will occur below 32 F and above 120 F.

Crop	pH	Spacing	Growth Time	Temperature	Crop	Light	Plant Size (Height x Width)	Aquaponics Method	Stocking Density
Basil	5.5-6.5	6"-10"	5-6 weeks	65°F-86°F Optimal: 68°F-77°F	Basil	Full* DWC, and NFT	12"-28"x12"	Media beds	High
Broccoli	6.0-7.0	16"-28"	60-100 days	56°F - 65°F	Broccoli	Full	12"-24" x 12"-24"	Media beds	Normal
Cabbage	6.0-7.2	24"-32"	45-70 days	59°F -68°F	Cabbage	Full	12"-24" x 12"-24"	Media beds	Normal
Cucumbers	5.5-6.5	12"-24"	55-65 days	72°F - 83°F (day) 65°F - 68°F (night)	Cucumbers	Full	8"-80" x 8"-32"	Media beds and DWC	High
Eggplant	5.5-7.0	16"-24"	90-120 days	72°F - 79°F (day) 59°F - 65°F (night)	Eggplant	Full	24"-48" x 24"-32"	Media beds	High
Lettuce	6.0-7.0	7"-12"	24-32 days	59°F - 72°F Flowering over 76°F	Lettuce	Full*	8"-12" x 10"-14"	Media beds, DWC and NFT	Normal
Parsley	6.0-7.0	6"-12"	20-30 days	59°F - 77°F	Parsley	Full*	12"-24" x 12"-16"	Media beds, DWC and NFT	Normal
Peppers	5.5-6.5	12"-24"	60-95 days	72°F - 86°F (day) 58°F - 61°F (night)	Peppers	Full	12"-36" x 12"-32"	Media beds	High
Swiss Chard	6.0-7.5	12"	25-35 days	61°F - 76°F	Swiss Chard	Full*	12"-24" x 12"-16"	Media beds, DWC and NFT	Normal
Tomatoes	5.5-6.5	16"-24"	50-70 days on to 8-10 months	72°F - 79°F (day) 56°F - 61°F (night)	Tomatoes	Full	24"-72" x 24"-32"	Media beds and DWC	High

Figure 2: Crop

	Tilapia	Trout	Catfish	Bass	Goldfish	Koi	Pacu
Edible	Yes	Yes	Yes	Yes	No	No	Maybe
Temperature range (°F)	60-90	35-68	35-95	40-90	35-90	35-90	60-95
Optimal Temperature (°F)	74-80	55-65	75-85	74-80	65-75	65-75	74-80
Carnivore or Omnivore	O	C	O	C	O	O	O
Mature Size	1.5 lb	0.8 lb	1.25 lb	1-3 lbs.	4"	20 lbs.	60 lbs.
Time to maturity	9-12 mos.	12 mos	12-18 mos.	15-18 mos.	3 yrs.	3 yrs.	4 yrs.
Oxygen Needs	Low	High	Low	Low	Low	Low	Low

Figure 3: Fish

3. Nutritional loss:

Nutrient loss occurs in many ways, such as sludge sedimentation, water loss, denitrification, ammonia volatilization, and nitrogen consumption by heterotrophic aerobic bacteria and so on. Reducing nutrient loss, improving nutrient cycling, and optimizing the growth of fish and plants are still the subject of many researchers. Unfortunately, I have not found a way to solve this problem once and for all.

Conclusion:

Based on the data I provided earlier, users can choose the plants and fish they want to grow to determine the pH and temperature of the system. This makes the system more likely to succeed.

Reference:

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