Low pH aquaponic systems should increase the rate of growth of bacteria and the quality and yield of plants. The effects of lowered pH on the productivity of fish and plants is studied in this research.

### INTRODUCTION

- Bridging the gap in pH requirements within one integrated system by using blackwater fish
- Blackwater is characterized by naturally acidic water caused by tannins released during plant decomposition in the rivers and streams of places like Brazil

### SYSTEM COMPONENTS

**BLACKWATER FISH**

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
<th>Environment</th>
<th>Temperature</th>
<th>pH</th>
<th>Max Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardinal tetra</td>
<td>Paracheirodon axelrodi</td>
<td>Freshwater (a)</td>
<td>23°C - 27°C</td>
<td>4.0 - 6.0</td>
<td>2.5 cm</td>
</tr>
<tr>
<td>Neon tetra</td>
<td>Paracheirodon innesi</td>
<td>Freshwater (b)</td>
<td>20°C - 26°C</td>
<td>5.0 - 7.0</td>
<td>2.2 cm</td>
</tr>
</tbody>
</table>

(a) Blackwater stream tributaries of the Solimões River (South America)
(b) Upper Orinoco and Negro River basins (South America)

**NITRIFYING BACTERIA**

- We will isolate nitrifying bacteria from acidic soils
- To test the limits of these nitrifying bacteria, the system will be cycled at a pH of approximately 6.0 prior to introducing the plants and fish

**EXTRA CURLED DWARF PARSLEY**

- Prefers a pH range of 4.0 to 8.5
- High market value and rich in nutrients
- Harvest for fresh or dried leaves, petioles, and essential oils

### OBJECTIVES

- Establish a biofilter capable of processing ammonia and nitrites within tolerable levels for the fish
- Compare advantages and disadvantages of systems using blackwater fish species
- Improve plant nutrient uptake and growth by maintaining acidic aquaponic system conditions

### METHODS

<table>
<thead>
<tr>
<th>Tank</th>
<th>Fish Species</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cardinal tetra</td>
<td>5.8 - 6.2</td>
</tr>
<tr>
<td>B</td>
<td>Cardinal tetra</td>
<td>6.8 - 7.2</td>
</tr>
<tr>
<td>C</td>
<td>Neon tetra</td>
<td>5.8 - 6.2</td>
</tr>
<tr>
<td>D</td>
<td>Neon tetra</td>
<td>6.8 - 7.2</td>
</tr>
</tbody>
</table>

Temperature 25.0°C
Cycling 2 months
Duration 10 months
Harvests 3

Stocking density: (1 fish / 2 L water)

### DATA COLLECTION

- Plant stalk heights, stalk diameters, average number of leaves per stem
- Dried samples of fish, plants, and fish feed will be ground to determine the nitrogen content
- Nutrient Use Efficiency (NUE) measures the effectiveness of any additional nitrogen added to the system

\[ \text{NUE} = \frac{\text{(N applied)}}{\text{(N removed at harvest)}} \]

### AVAILABLE NUTRIENTS FOR PLANTS

Aquaponic plants struggle with accessing nutrients like P, K, and Fe. Thicker lines indicate a greater prevalence of that nutrient.

### ANTICIPATED RESULTS

- Parsley plants will be more valuable than the plants grown in alkaline conditions since they will be free from nutrient deficiency
- Grow significantly faster in systems operated at pH 6.0
- Will report greater NUE values due to a preference for acidic conditions
- The neon tetra and cardinal tetra populations should face no mortalities
- Microbes within the biofilter that are unable to process the N within the system to nontoxic levels will report much lower NUE values

A greater NUE percentage indicates a better ROI since available nutrients are maximized by the plants.

### POTENTIAL PROBLEMS

- Lack of information about these species in aquaponic settings
- Establishing the biofilter with microbes isolated from acidic soils
- Sensitivity to poor water quality is common with tropical fish
- Securing tropical ornamental fish from local breeders

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References: Please use this QR code to see a complete list of references.