Aquaponics

HORT 4601

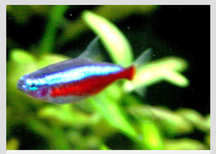
University of Minnesota
Driven to Discover℠

The Effects of Lowered pH on the Productivity of Fish and Plants

Hanna Hudepohl (CSOM), Anna Bride (CDES), Elliott Bussey (CLA), Andrew Heiserman (CFANS)

INTRODUCTION

- Bridging **the gap in pH requirements** within one integrated system by using **blackwater fish**



NEON TETRA

- Blackwater is characterized by naturally **acidic** water caused by tannins released during plant decomposition in the rivers and streams of places like **Brazil**

CARDINAL TETRA

- **Low pH** aquaponic systems should **increase**
  - the rate of growth of **bacteria**
  - the quality and yield of **plants**

SYSTEM COMPONENTS

BLACKWATER FISH

Species	Scientific Name	Environment	Temperature	pH	Max Length
Cardinal tetra	Paracheirodon axelrodi	Freshwater (a)	23°C - 27°C	4.0 - 6.0	2.5 cm
Neon tetra	Paracheirodon innesi	Freshwater (b)	20°C - 26°C	5.0 - 7.0	2.2 cm

(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

Tank	Fish Species	pH
A	Cardinal tetra	5.8 - 6.2
B	Cardinal tetra	6.8 - 7.2
C	Neon tetra	5.8 - 6.2
D	Neon tetra	6.8 - 7.2

Stocking density: (1 fish / 2 L water)

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

Nutrient deficiencies: Phosphorus (left) and Iron (right)

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

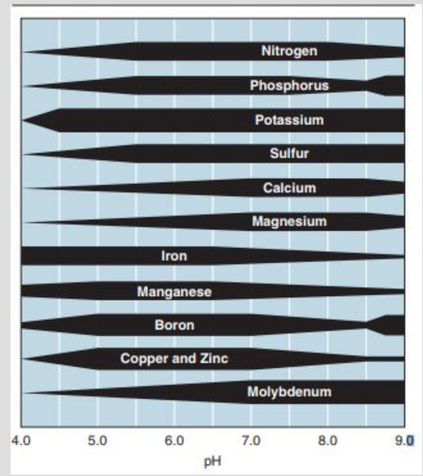
NUE = (N applied) / (N removed at harvest)

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

AVAILABLE NUTRIENTS FOR PLANTS



Aquaponic plants struggle with accessing nutrients like P, K, and Fe

Thicker lines indicate a greater prevalence of that nutrient

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

Acknowledgements: Funding for this research will be funded, in part, by the Minnesota Agricultural Experiment Station and a grant from the College of Food, Agricultural and Natural Resource Sciences Program for Creation of New or Revised Courses and Programs for Experiential and Interdisciplinary Education, entitled "Aquaponics: To fish and plant…for *life*!" A special thanks to Neil Andersen and Alex Primus as HORT 4601 professors.

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