

# SOILLESS PLANT PRODUCTION IN A RECIRCULATING SYSTEM: AQUAPONIC SYSTEM CYCLING

Andrew Stewart McArdle<sup>1</sup>, John Jifon<sup>1</sup>, Joe Fox<sup>2</sup>

<sup>1</sup>Texas A&M AgriLife Research – Weslaco,

<sup>2</sup>Texas A&M University – Corpus Christi

\*andrew.s.mcardle@gmail.com

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## ABSTRACT

Aquaponics is an innovative food production technique that pairs soilless plant production with that of fish production. This union of two separate cultivation practices has more than a few benefits including significant reductions in water usage. The aim of this study was to evaluate and further define the cycling phase required by the microbial communities in the initial start-up of an aquaponic system. The time-course of colonization by nitrifying bacteria was determined by monitoring relative changes in ammonia ( $\text{NH}_3$ ), nitrite ( $\text{NO}_2^-$ ), and nitrate ( $\text{NO}_3^-$ ) concentrations in the water after fish introduction to the system. Koi fish (*Cyprinus carpio*) were stocked as the source for ammonia and fertilization of the water for the plants. Temperature, pH, water mineral content, and nitrogen ( $\text{NH}_3\text{-N}$ ,  $\text{NH}_3\text{-N}$ ,  $\text{NO}_3^-\text{-N}$ ) were measured throughout the trial or at the end of the cycling process. Within three weeks after fish introduction (WAFI),  $\text{NH}_3$  concentrations peaked by 20 days, at which time,  $\text{NO}_2^-$  and  $\text{NO}_3^-$  concentrations started to also increase steadily. Nitrite concentrations peaked <5 WAFI and declined thereafter to less than 0.1 mg/L by ten WAFI. Starting at about three WAFI,  $\text{NO}_3^-$  concentrations started to increase gradually. Viable colonies of microbial populations (notably *Nitrosomonas* and *Nitrobacter*) capable of reducing  $\text{NH}_3$  and  $\text{NO}_2^-$  levels to sub-lethal levels and maintaining a steady source of  $\text{NO}_3^-$ , were established. Nitrate is the key nitrogen source and a key by product of the cycling process that plants require to sustain growth. The cycling duration or time taken for both  $\text{NH}_3$  and  $\text{NO}_2^-$  to decline to less than 1 ppm, was approximately 2.5-3 months at which time a sustainable system was established.