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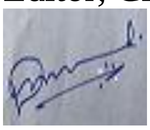
Editorial Note

CSIBER International Journal of Environment (CIJE) offers a venue where relevant interdisciplinary research, practice and case studies are recognized and evaluated. Increasingly, environmental sciences and management integrate many different scientific and professional disciplines. Thus the journal seeks to set a rigorous, credible standard for specifically interdisciplinary environmental research. CIJE is a multidisciplinary journal, publishing research on the pollution taking place in the world due to anthropogenic activities. CIJE welcomes submissions that explore environmental changes and their cause across the following disciplines like atmosphere and climate, biogeochemical dynamics, ecosystem restoration, environmental science, environmental economics & management, environmental informatics, remote sensing, environmental policy & governance, environmental systems engineering, freshwater science, interdisciplinary climate studies, land use dynamics, social-ecological urban systems, soil processes, toxicology, pollution and the environment, water and wastewater management, etc.

We invite authors to contribute original high-quality research on recent advancements and practices in Environment Management. We encourage theoretical, experimental (in the field or in the lab), and empirical contributions. The journal will continue to promote knowledge and publish outstanding quality of research so that everyone can benefit from it.

Er. D. S. Mali
Editor, CIJE



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Aquaponics as an Ecofriendly Method, to Study the Growth Parameters of Different Vegetables

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Abstract

Aquaponics is innovative method in agriculture which combines aquaculture with hydroponic for increased production of vegetables. As compared to world's population demand food production is essential and increase aquaponics a soil less culture is the fantastic way for complete this four demand with fewer harmful effect on environment and more benefits, and a feature of a contemporary agricultural technology. a method for producing plants and aquatic animals in which waste from feeding the aquatic organisms provides the bulk (>50%) of the nutrients needed for the best possible plant growth. Aquaculture and hydroponics are combined to form the word "aquaponics." According to the Food and Agriculture Organization of the United Nations (1988), aquaculture is "the farming of aquatic organisms, including fish, molluscs, crustaceans, and aquatic plants," whereas hydroponics is " the production of plants in a soilless medium whereby all of the nutrients supplied to the crop are dissolved in water." Despite the fact that hydroponics is a widely recognized technology, the name "aquaponics"

In aquaponics system the nitrification process involves two main kinds of nitrifying bacteria. The growth taken into account for parameters viz hight, root length, shoot length, leaf width, breadth of vegetables *Solanum lycopersicum* (tomato), *Capsicum frutescens* (chili), *solanum melongena*(brinjal),*Brassica oleraceavar.capitata* (Cabbage). The control group and the study group differed significantly, according to the study.

The primary goal of this aquaponics research is to boost the production of food crops and achieve high aquaculture yields in a single system.

Keywords: Aquaponics, Aquaculture, Hydroponics, Soil less Culture, Organic Food.

Introduction

The principle of recirculation and water reuse with high efficiency is made possible by the integration of the fish and the hydroponics plants (1) the beginning of aquaponics in 1997, James Rakocy grow beds in large scale aquaponic system. The fish waste provides and organic food source for the plants and the plants naturally filter the water for fishes. In aquaponics the effluents from the fish circulates and provide nutrients for the plants (2). Nitrogen cycle and nitrification process are connected to water flowing for plants. As a result, protein and vegetables get grown in the same system with no external fertilizers and pesticides. It contain ecosystem with higher vegetables yield per square then conventional farming and hence same concept can be implemented in rural ad agriculture system.This is understandable as the fish do not require these nutrients in the same quantities as the plants, thus it has to be supplemented in the system (3).

"A natural microbial process keeps both the fish and plants healthy and helps sustain an environment in which they both can thrive." (4)

Traditional aquaculture also causes a series of problems. First, traditional aquaculture is characterized by crude management based on the natural environment (5) The benefits of furthering aquaponics research and subsequent fish and vegetable cultivation, which provides an alternative to current monoculture, include balanced use of water, nutrients, and fertilizer. The practice of aquaponics production not only enhances water consumption efficiency but also improves efficiency of agricultural inputs through the reduction of land requirements for production. (6) These systems have the potential to employ microbial denitrification as a means of transforming nitrous oxide into nitrogen gas. This process can occur provided there is an adequate supply of carbon sources derived from waste materials. Consequently, bacteria that are heterotrophic or facultatively anaerobic are able to converting surplus NO_3- (nitrates) into N_2 (nitrogen gas) (7) and N_2O (nitrous oxide) has strong greenhouse gas properties, and the existing microbial population within enclosed aquaponics systems can effectively catalyse its transformation into N_2 (nitrogen gas). (8) The term aquaponics refers to a broad range of systems, plants, and fish that can be mixed in different ways. Costs and returns vary by kind and degree for every system. Raft or deep water culture systems, nutrient film systems, and systems based on media-filled beds are the three general types of systems, notwithstanding the variety. While the nutrient film technique (NFT), which is used in hydroponics, is limited to specific plant kinds (such as leafy green crops) that do not have massive, heavy root systems, raft culture is usually favoured for commercial operations. The removal of solids is necessary for both raft and NFT systems. For home-based aquaponics gardening, media-filled beds are more popular and require less stocking than raft systems. (26)

Aim-

To study aquaponics as an ecofriendly method and the growth parameters of different vegetables in aquaponics. In the aquaponics study following aspect were taken into account;

Aquaponics assembly
Collection of fishes from local aquarium
Selection and cultivation of vegetables in aquaponics
Studying growth parameters of vegetables
Comparative study on soil and aquaponics cultivated vegetables.

Material and methodology:

Build aquaponics system: (11)

A fish tank attached with two plastic buckets through water pipelines. Biofilter was added into fish tank for filtration of water. The filtered water was transported to the plastic buckets which was filled with clay pebbles and soil. Pipes were used to pump the water from fish tank to grow bed. Another pipes were attached for reverse filtered water to fish tank. Aeration pump attached to fish tank to maintained oxygen. Extension board used for power supply to filtration pump and aeration pump.

Collection of fishes: The different types of fishes were collected from local aquarium shop. Fishes added to fish tank containing tap water.

Carassius auratus (Gold fish)
Cyprinus capio (Koi)
Carassius auratus (Copper gold fish)

Selection of plants: The following vegetable plants were selected and were added in plastic bucket in triplicate.

Vegetable plants:
Solanum lycopersicum (tomato)
Capsicum frutescens (chili)
Solanum melongena (brinjal)
Brassica oleraceavar.capitata (cabbage)

Study of growth parameters

Height, root length, shoot, leaf width, breadth of vegetables were measured by scale every week.

Comparative study of soil and aquaponics vegetables

Four plastic buckets were taken and make two groups, in each group two buckets were used. Two filled with pebbles and another two filled with soil for comparative study in both groups one bucket is used for control and other for test. Control labelled as “A” and test labelled as “B” as a aquaponics set up fish tank was used from which supplied fish water to test (plants) for growth. The water pump was placed in the fish tank then set the grow bed on top of the tank and in control (plants) tap water was supplied for growth. Marketly available feed was given to the fish and changed fish tank water weekly and observed the growth of plants per weeks (1- 12 weeks)

Results –

Taken efforts were finally lead to successful comparative study of plants used fish water. There were two sets of samples taken as Test and Control which shown different growth aspects on water, in test and control pebbles and soil samples were used. Two water samples were used to check the growth of plants per week. Tap water and fish water used for it. There are various factors as temperature, humidity, p^H level was checked per week.

The different tables show differences in plant growth. As below the table values five tables were given. Four table shows growth parameters of different plants where fish water used for growth (Test). As some other four table shown growth of different plants where control tank used for growth. In test one pebble sample and other soil sample were used to check difference in growth.

Table-1: Height of plants in test sets: (fishes are average of triplicate in cm)

Name of plant	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Brinjal	5	7	9	10	12.5	15	17	18	18.5	19	20	21
Cabbage	3	4.5	6	6.5	7	8	9	11	13	15	17	19
Tomato	4	8	12	15	21	21	23	24	25	25.5	26	27
Chilli	4	5	7	10	21	15	17	20	21	25	28	32

This table shows aquaponics water effect on height of vegetables

Table-2: Height of plants in control set: (Average of triplicates in cm)

Name of plant	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Brinjal	5	6	8	10	10	15	26	16	18	19	19	19.5
Cabbage	3	4	5	5.5	6	7	7	8	9	10	11	12
Tomato	20	6	10	13	19	20	21	24	23	24	25	25
Chilli	4	4	6	9	10.5	18	13	14	26	28	29	30

This table shows tap water effect on height of vegetables

Table-3: Root length of vegetables in test sets: (Average of triplicates in cm)

Name of plant	Wee k 1	Wee k 2	Wee k 3	Wee k 4	Wee k 5	Wee k 6	Wee k 7	Wee k 8	Wee k 9	Wee k 10	Wee k 11	Wee k 12
Brinjal	3	4	5	7	8	10	13	14	14	16	17	18
Cabbage	2	3	3	4	5	5	7	8	9	10	11	12.5
Tomato	2	4	6	7	9	10	12	14	15	16.5	17	17
Chilli	3	3	4	6	8	10	11	13	15	17	18	20

This table shows aquaponics water effect on root length of vegetables

Table-4 Root length of vegetables in control set: (Average of triplicates in cm)

Name of plant	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Brinjal	3	4	5	8	8	10	14	15	17	17.5	18	18.2
Cabbage	2	3	4	5	7	7.5	8	8.5	10	10.5	13	13
Tomato	2	4	7	7.5	10	11	12	14	15	17	17.5	17.8
Chilli	3	3	7	8	8.5	10	11	12.5	14	15	19	21

This table shows tap water effect on root length of vegetables

Table-5: Average width of vegetable (leaves) in test sets: (Average of triplicates in cm)

Name of plant	Wee k 1	Wee k 2	Wee k 3	Wee k 4	Wee k 5	Wee k 6	Wee k 7	Wee k 8	Wee k 9	Wee k 10	Wee k 11	Wee k 12
Brinjal	2	2.5	3	4.6	5	5.2	5.8	6.2	6.5	7	7.5	8
Cabbage	3	4	6	7	9	10	12	14	16	17	18	20
Tomato	2	2.4	3	3.4	4	4.2	4.6	5	5.5	6	6.2	6.8
Chilli	1	1	1.5	1.5	1.5	2	2	2.5	2.5	3	3	3

This table shows aquaponics water effect on width of vegetables

Table-6: Average width of vegetable (leaves) in control sets: (Average of triplicates in cm)

Name of plant	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Brinjal	2	2	2.5	3	4	4.5	5	5.8	6.4	6.9	7.2	7.6
Cabbage	3	4	6	7	9	12	15	17	18	19	20	24
Tomato	2	2	2.3	3	3	3.5	3.9	4.2	4.5	4.7	5	5.6
Chilli	1	1	1.2	1.5	1.7	1.7	1.9	2	2	2.1	2.2	2.4

This table shows tap water effect on width of vegetable.

Table-7: Leaves height in test sets: (Average of triplicates in cm)

Name of plant	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Brinjal	1	2	2.5	4	5.5	7	7.8	9	10	11.9	12	12.4
Cabbage	3	5.7	6.4	7.5	8.7	9.4	10	12	14	16	18	20
Tomato	2	2.2	3	3.7	4	4.4	4.7	5	5.2	5.6	5.9	6.7
Chilli	1	1.7	2.5	2.8	3.2	3.6	3.8	4	4.6	5	5	5.2

This table shows aquaponics water effect on height of leaves of vegetables

Table-8: Leaves height in control sets: (Average of triplicates in cm)

Name of plant	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Brinjal	1	2	2.5	3	4	4.5	6.6	8.9	10.1	11.7	11.9	12
Cabbage	3	5	6.7	8	8.8	9.6	11	13	16	18	20	22
Tomato	2	2.2	3	3.5	4	4	4.5	4.7	5	5.2	5.6	6
Chilli	1	1.5	2	2.5	2.7	3	3.5	3.7	3.9	4.1	4.5	4.7

This table shows tap water effect on height leaves of vegetables

Discussion-

In the present study height of test group vegetable is greater than control group, in root length of vegetables test group vegetables are greater result then control only cabbage shows the different result in control group, in leaves length and width cabbage show greater result in control as compare to test group. In test group brinjal, tomato, chilli shows best result.

As per the result it is concluded that aquaponic system is the best for vegetables for better growth and yield. Aquaponics is an integrated multi-trophic system that combines elements of recirculating aquaculture and hydroponics (21) this is innovative method in agriculture have two profit centres vegetables and fish (22) both have large economic value in today's market as well as in future.

However, in course of our study we focused that we have coupled aquaponic with agriculture for sustainable use of water to increased yield. As per the commercial development of socially, ecologically, and environmentally sustainable aquaponic systems confronts several technical challenges are improved nutrient solubilization and recovery for a better use of the nutrient input and reducing extra-mineral addition, e.g., phosphorus recycling, adapted pest management, reduce water consumption to a high degree by limiting the need for water exchange (23).

Varieties of crops we studied showed faster growth in aquaponic system as compare to control. We get nitrite and potassium from fish waste which used to grow plants faster than normal water. Considering normal and increasing growth of plants can be implemented regular cultivation fields for additional supplements. It can be supportive, economically viable and soil quality enhancing option for Indian agriculture.

In this study, we have coupled aquaponics with agriculture for sustainable used of fish water as test to increased yield and growth of plants and enhancing the quality of soil by keeping a normal water as a control. It was observed that there is increased plant growth with the water supplied through aquaponics than control plants.

Considering its potential, as a coupled option can be implemented in rural agriculture land for additional and sustainable benefit through developing area and land specific models. Overall, it is a sustainable, economically beneficial and coupled agriculture model for the farmers for certain locations.

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