International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

A STUDY ON DEVELOPMENT OF CROPS BY FOGPONIC SYSTEM USING COCO COIR

VENKATESH S[1], VICTOR EBENEZER R D[2], VIGNESH A C[3], VISHNU A[4], SREE LEKHA S[5]

[1,2,3,4] Students, Department of civil Engineering, SRM Valliammai Engineering College, Chengalpattu, Tamilnadu
[5]Assistant professor, Department of civil Engineering, SRM Valliammai Engineering College, Chengalpattu, Tamlinadu

---

Abstract - *With increasing demand on technological development and westernization of cities, availability of land and water (that is fit for irrigation) diminishes day by day. Further, the cost and fertility of land in city makes it impossible for crop cultivation to flourish in city. In this paper on "Fogponic cultivation", we focus on growing plants in a soil free medium in the absence of natural sunlight. The method involves indoor gardening techniques ruling out the atmospheric consideration for safe agriculture. Vertical stack farming facility improves yield within a controlled premise. The soil free cultivation environment provides no home for any insects; therefore, pesticides free organic fruits and vegetables are easily harvested. The system involves the consumption of only 10% of water used in the conventional agriculture. The energy needed by a plant from natural sunlight is provided by using special Light Emitting Diode (LED) growth light. Such growth lights emit the specific wavelength range depending on the plant's requirement, therefore enhancing the quality of cultivation. The nutrient solution is chosen carefully to meet all the fertility demands of the plant. Plants for cultivation must be technically chosen and short listed based on its adaptability to the technique. The technique mainly aims at providing fruits and vegetable at any part of world as it is temperature independent. The controlled process of cropping enhances the quality of the growth and product of the plant.*

Key Words: **Aeroponic cultivation, soil free medium, LED, Nutrient Solution, temperature independent.**

1.INTRODUCTION

Agricultural land is reducing day by day due to growing population needs. It is a challenge for a farmer to provide food to such a great population with the available land and water. Aeroponic cultivation method focuses on growing plants in a soil free medium under the absence of sunlight.

In this method, the plant roots are constantly misted with nutrient solution. The parameters to be controlled are temperature, humidity, pH and electrical conductivity of nutrient solution etc. resulting in a conditioned environment. The benefits of using aeroponics is growing healthier and nutritious roots by consuming fewer amount of nutrients and water. By adopting this technique fresh and healthier product are harvested throughout the year.

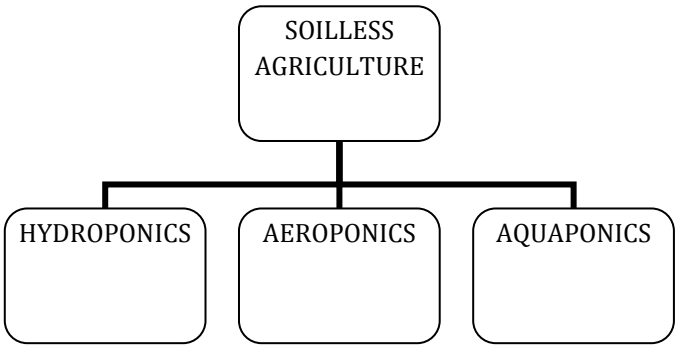
Such controlled environment has a strong potential to improve plant's developmental stages, health and growth. Aeroponic system has more advantage than hydroponic in terms of spraying high air content in the nutrient solution to provide oxygen to plant roots. The focus of attention variables in the aeroponic system research are

1. Micro environment – Temperature, humidity and pH.
2. The effectiveness of nutrition – spraying or fogging.

Further, production of pesticides free product with the consumption of comparatively very minimal water content makes it an ideal choice for urban cultivation. Cultivation of crop under such controlled environment enhances the product's and the technique's quality.

Aeroponic system is an endless process in a confined space and therefore it cuts down agricultural labour. A monitoring and controlled system intended for water and nutrient distribution must be designed to support the optimal application of aeroponic cultivation system for plant. The success of this technique depends on a well-built system, understanding of the system's technicalities and a measure of nutrients needed for various plants that you grow.

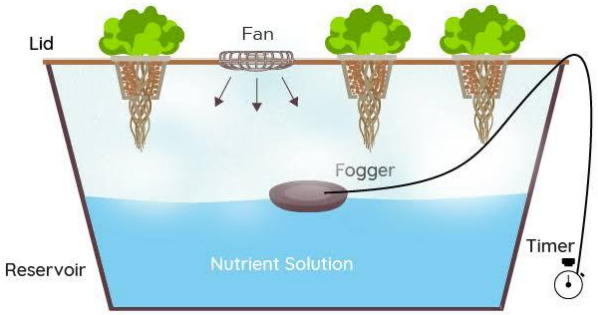
1.2 TYPES OF SOILLESS AGRICULTURE



These are the major types of soilless agriculture but these types also have different forms and methods of agriculture. Fogponic system is one of the advanced method of aeroponic system.

2 FOGPONIC SYSTEM

Fogponics is an advanced form of aeroponics which uses water in an vapourised form to transfer nutrients and oxygen to enclose suspended plant roots. Using the same general idea behind aeroponics, fogponics uses a 5-30µm mist within the root chamber and as for a foliar feeding mechanism. The nutrients solution is vapourised on the roots with an ultrasonic atomizer.



The ultrasonic atomizer is an electronic device which transforms the water into a mist of very fine droplets (about 4 microns). Plants best absorb particles size means faster absorption. These droplets are so fine that they can be absorbed immediately through the pores of the root. This technique is particularly suitable for horticulture industry. The added benefit of using foponics system over traditional hydroponics system is that the plants require less energy in root growth and mass, and are able to still sustain a large plant.

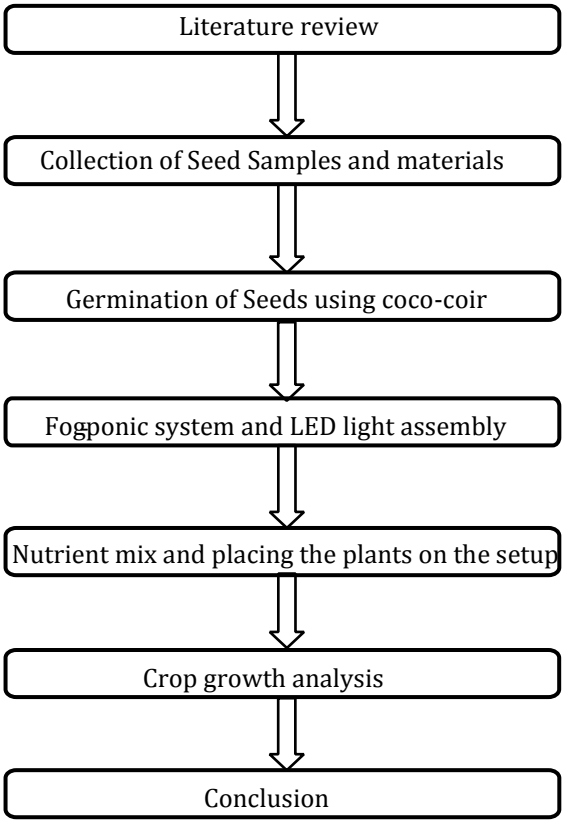
3 COMPARISON OF FOGPONIC SYSTEM WITH CONVENTIONAL FARMING

There are so much discussion surrounding the three soilless agriculture system sweeping the globe today namely – Hydroponics, Aeroponics & Aquaponics. However, there are many significant differences between these three techniques. The cost of fertilizers used to supply nutrients to the roots in hydroponic system is expensive when compared to aquaponics which depends on fish waste for nutrient supply. Although, aeroponics and hydroponics are similar in using nutrient rich water, hydroponic uses certain media other than soil to retain and distribute nutrients to the plants and aeroponic uses misting system to deliver the nutrients. Unlike any other technique, aeroponic succeeds maximum yield per unit area through vertical growing arrangement. Hydroponics uses only 10% of water resources when compared to conventional method. With no growing medium and nutrient rich mist atmosphere aeroponic system reduces water usage by 98%, fertilizer usage by 60% and pesticides usage by 100%, while maximizing crop yields.

Aquaponics would require a more frequent monitoring on the ammonium content from the fish waste and periodic cleaning, making its maintenance more complex. While on the other hand hydroponics due to stagnation of nutrient rich solution there are possibilities for the spread of disease to the plants and surroundings.

The flexibility of fogponics to take up vertical cultivation allows greater yield per unit area, encouraging maximum utilisation of the available area. Also, the indoor gardening facility restricts the dependency of plants to external environmental conditions, thereby promoting controlled cultivation.

4. METHODOLOGY



4. FOGPONIC CHAMBER

The fogponic chamber is made up of a number of important components namely – a box for cultivation with fogponics kit with timer arrangement, irrigation and nutrient solution and LED lighting system.

4.1 SUBMERGIBLE FOGGER

The fogger must be selected in such a way that it is non-reactive with the nutrient solution in which it will be submerged. There is no need to install a fogger of very high head to circulate nutrients in an fogponics system. Therefore, a generic 12 LED humidifier fogger is used. The

fogger must be connected with the electronic timer to allow periodic irrigation.

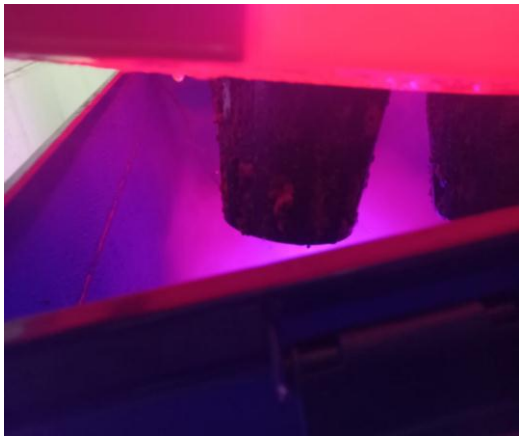
Figure 8.3 Ultrasonic fogger

The submergible fogger is placed on the box where the nutrient solution is already poured. The fogger is kept on for 8 hours a day. The box should be tightly sealed so no fog goes out of the closed box.

4.2 NUTRIENT SUPPLY AND IRRIGATION

Nutrient solution is synthesized by mixing a particular quantity of each nutrient with measured amount of water. The ratio of the selected nutrients widely varies with different plants. A detailed study on the plant's need may help is determining the nutrient ratio. Proper procedure is followed for mixing major nutreints and minor nutrients. The nutrients are based on the plants chosen.

Irrigation system is based on the submergible fogger used. It is placed in the mixed nutrient solution. It is also called as Fog feed technique. The fog feed technique is very much similar to root mist technique except for the droplet size.



In FFT, the droplets are very fine and small in size that they could hardly moisten your palms. Researches and developments are practiced to enhance the quality of irrigation through this technique. Plants with aerial roots like orchids, anthuriums etc., would flourish well in this irrigation type.

4.3 LED GROWTH LIGHTS

LEDs as an illumination source in any indoor garden are much more suitable than other grow lights whose peak emissions widely differ from the absorption spectrum of plants. LEDs allow the growers to pick the spectrum of light they want, rather than relying on whatever colors the phosphors happen to make, are what color sodium glows at when it gets really warm.

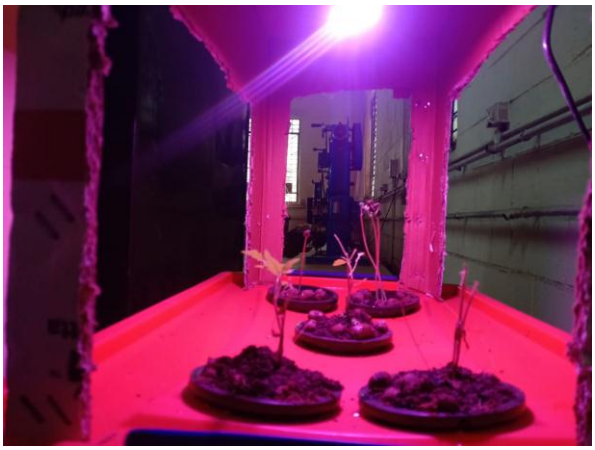
5. SETUP PROCEDURE

- A box that can hold water and plants. A lid that will cover the reservoir and keep the fog from escaping.
- Holes are drilled to place the net pot with the plants in it. The net cups are selected which will fit with your system. Fill the net cups with the growing medium (coco coir and clay balls).
- Place the net pot on the reservoir. It must be held by the lid so that when plants are put into the net pot, their roots are hung above the water of the reservoir.
- The prepared nutrient is poured in the box. The ultrasonic fogger (This is the most important apparatus as it decides whether you call it aeroponics or fogponics). Put it in the reservoir and turn it on. Let the fog come out.
- pH measurement tools are required to check the pH of the nutrient solution. Get a pH meter to first check the pH of the system, and occasionally recheck it later.
- A pH control kit is collected which has pH up solution and pH down solution. They are used to

control the pH of the nutrient solution. If the pH of our system is too low or too high, just add the appropriate pH control kit into the nutrient solution.

5.2 INITIAL OBSERVATION

The first week of transplanting the germinated seeds is considered to be one of the most crucial duration of the process. Sufficient and proper supply of LED lights and nutrient solution and its frequency must be maintained in order to stabilize the plants and establish adaption to the aeroponic atmosphere. At the end of the first week, the plant showed the development of fresh and white fibrous roots.



5.3 FINAL OBSERVATION

The plants started to adapt well and flourish under there aeroponic atmosphere. With corrective alterations in the LED lumen and its distribution and nutrient supply frequency, the heights of the plants showed steady and gradual development over the weeks. Tomato had a fast and rapid development in growth and attained the following heights.

6. ADVANTAGES

1. Fogponic technology gives high yield with less space requirements.
2. Early and easy harvest of crops can be done.
3. Plants can be grown at zero gravity (at space) through aeroponic method.
4. Water consumption is greatly reduced to about 98% when compared to the conventional method.
5. By this technique fresh and healthy fruits and vegetables can now be grown indoors and rooftops.
6. Higher consumption of oxygen is achieved under aeroponic condition, thereby enhancing plant growth.
7. Being independent on external temperature conditions, in this method plants can be grown throughout the year.
8. Grown under clean and controlled conditions, the harvests from this method are highly fresh and organic.
9. The soilless cultivation method provides no home for pests thereby, reducing the pesticide usage by 100%
10. The no soil requirement of the system enables crop cultivation even in cities.

7. DISADVANTAGES

1. Higher demand and consumption of electricity, makes the technique uneconomical.
2. Taking up aeroponic cultivation method requires technical knowledge about the plant and its demands and about the method itself.
3. Continuous and periodic monitoring of the entire system setup followed by proper sanitary maintenance are high demands of the method.

8. CONCLUSION

Fogponics is an inevitable method of cultivation in the areas where little arable land is available and is an efficient method of cultivation for better utilization of water and nutrients. Fogponics is a blessing to the cultivation system as it conserves water and avoids use of agrichemicals. This method is inclined to organic farming practices which fetch a better price than the inorganic food procedure. Being aware of the importance of the freshness and goodness of organic food, aeroponically large quantity of pesticide-free safe foods can be harvested. A variety of crops can be grown under controlled atmosphere, providing just what the plant needs thereby producing food at the best economical way.

REFERENCES

1) Ali Alshrouf "Hydroponics, Aeroponics and Aquaponics as compared with conventional farming" American Scientific Research Journal for Engineering, Technology and Sciences (ASRJETS).
2) Gangandeep Kaur, Dhilip Kumar, "Aeroponic Technology: Blessing or Curse " in International Journal of Engineering Research & Technology (IJERT). ISSN: 2278 – 0181, Vol. 3 Issue 7, July - 2014
3) A.P Montoya, F.A Obando, J.G Morales, G Vargas, "Automatic Aeroponic Irrigation System Based On Arduino's Platform" in IOP Conf. Series: Journal of Physics: Conf. Series 850 (2017) 012003
4) Kiran Lakkireddy, Kasturi Kondapali, K.R.S Sambasiva Rao, "Role of Hydroponics and Aeroponics In Soilless Culture in Commercial Food Production", in Journal of Agricultural Science & Technology, Volume 1, Issue 1, April 2012.
5) Jae Young Cho, Ramasamy Rajesh Kumar, "Reuse of Hydroponic Waste Solution" in Environ Sci Pollut Res (2014) 21:9569-9577, DOI 10.1007/s11356-014-3024-3
6) Dharam Singh, "Hydroponics – Soilless Culture of Plants"
7) D.K Singh, K.V Peter, "Protected Cultivation of Horticultural Crop"
8) Toyoki Kozai, Genhua Niu, Michiko Takagaki, "Plant Factory – An Indoor Vertical Farming System for Efficient Quality of Food Production", Elsevier Inc, ISBN: 978-0-12-801775-3
9) Howard M. Resh, Plant Culture, "Hydroponic Food Production", 7th revised edition, 2012
10) Van Os, E.A. "Closed Soilless Growing System: Greenhouse Horticulture"

BIOGRAPHIES

VENKATESH S
Student, B.E. Department of civil Engineering, SRM Valliammai Engineering College, Chennai.

VICTOR EBENEZER R D
Student,B.E. Department of civil Engineering, SRM Valliammai Engineering College, Chennai.

VIGNESH A C
Student, B.E. Department of civil Engineering, SRM Valliammai Engineering college, Chennai.

VISHNU A
Student,B.E. Department of civil Engineering,SRM Valliammai Engineering College, Chennai.

SREELEKHA S M.E(Ph.D)
Assistant professor(O.G), Department of Civil Engineering, SRM Valliammai Engineering college, Chennai.