IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A REVIEW ON HYDROPONIC PLANT WITHOUT SOIL

[1]Sonali Jadhav,[2]Prof. S. D. Jawale

Department of electrical engineering,
MGMU's Jawaharlal Nehru engineering college Chatrapati Sambhajinagar.

Abstract: Hydroponics is a soil-less farming method that uses water containing nutrients to grow crops, eliminating the need for a wide area of arable land. Hydroponic plant systems have gained popularity in recent years as a sustainable and efficient method of growing plants without soil. By controlling the nutrient solution and other environmental factors, it is possible to optimize plant growth and increase yields. Hydroponic systems are highly adaptable and can be used in a variety of settings, including urban areas where space is limited. The objectives of a hydroponic plant project can vary depending on the intended application of the system, but may include improving plant growth and yield, conserving water, promoting sustainable agriculture, or developing cost-effective systems.

***Index Terms*–Hydroponics, nutriculture, soil less culture .**

1. INTRODUCTION

Hydroponics is an efficient way of cultivating crops in a soil less manner with increased productivity per area, reduced water and fertilizer usage.[1] Hydroponics can be used to produce variety of plants/crop in compact spaces such as the backyard, terrace, or in offices, by using a nutrient rich water solution. The areas of the world with poor or infertile soils can completely rely on hydroponics system. [2]This gives people in these areas access to healthy and fresh produce. Other advantage of this method is that it enriches the crops with full flavor and taste delicious with higher nutrients values. The proposed method would be tremendously used as main crop production technique to support the ever increasing world population and mainly for the countries with severe draught over the time.[3]

A microcontroller-based hydroponic system is a plant growing system that uses a microcontroller to monitor and control various parameters of the hydroponic environment. Hydroponics is a soilless method of growing plants in a nutrient-rich water solution. In this system, plants are grown in a controlled environment where they receive all the necessary nutrients, light, and water. The microcontroller-based hydroponic system helps to automate the process of plant growth, making it easier for gardeners to maintain and monitor the hydroponic environment. The microcontroller monitors several parameters such as pH, temperature, humidity, and nutrient levels, and adjusts them accordingly to ensure optimal plant growth.[4]

The microcontroller is programmed with specific software that allows it to control various components of the hydroponic system, such as pumps, fans, and lights. For example, if the pH level of the water becomes too high or too low, the microcontroller will activate the pH sensor and adjust the nutrient solution by adding acid or base to bring it back to the desired pH level.[5]

This system is an efficient way to grow plants, as it reduces the amount of water and nutrients needed, and provides faster growth rates compared to traditional soil-based systems. It is also an environmentally friendly method, as it eliminates the need for pesticides and herbicides, which can harm the environment and human health.[6]

Sensors are used to monitor various environmental parameters such as temperature, humidity, nutrient levels, and light intensity. A microcontroller is the brain of the system that receives input from the sensors and makes decisions based on the programmed logic. It controls the various components of the hydroponic system such as pumps, fans, and lights.[7]Actuators are used to control the various components of the hydroponic system based on the signals received from the microcontroller. For example, pumps can be activated or deactivated to control the flow of water and nutrients to the plants.The nutrient solution tank holds the nutrient-rich water solution that is used to feed the plants.[8]The plant growing area is where the plants are grown. It can be a simple container or a more complex hydroponic setup with channels, tubes, and reservoirs.A lighting system is used to provide the necessary light for plant growth. LED grow lights are commonly used in hydroponic systems as they provide the right spectrum of light for optimal plant growth.The water reservoir is used to store the water that is used in the hydroponic system.[9]The water pump is used to circulate the water and nutrient solution through the hydroponic system.An air pump and fan are used to provide air circulation and ventilation to the plants.

In summary, a microcontroller-based hydroponic system includes a range of components that work together to create a controlled environment for plant growth. The sensors monitor the environmental parameters, the microcontroller processes the data and controls the various components, and the actuators implement the decisions made by the microcontroller. Together, these components create an efficient and sustainable method of plant growth.

There are several types of hydroponic systems, each with its own advantages and disadvantages. Here are some of the most common types of hydroponic systems:

- Deep Water Culture (DWC): In this system, plants are suspended above a reservoir of nutrient-rich water. The roots dangle in the water, and an air pump provides oxygen to the roots.
- Drip Irrigation: This system uses a drip emitter to slowly drip nutrient solution onto the base of each plant. Excess solution is collected and recycled.
- Nutrient Film Technique (NFT): In this system, a thin film of nutrient solution flows over the roots of the plants. The excess solution is collected and recycled.
- Aeroponics: This system uses a mist of nutrient solution to bathe the roots of the plants. The roots hang in the air, allowing for maximum oxygenation.
- Wick System: In this system, nutrient solution is drawn up from a reservoir into the growing medium via a wick.
- Ebb and Flow: This system floods the growing medium periodically with nutrient solution and then drains it back into a reservoir.

2. RESEARCH METHODOLOGY

In 1960, when the world population was 3 billion, the per capita land was 0.5 ha. However, with the current population of 6 billion, it has reduced to 0.25 ha and is expected to further decline to 0.16 ha by 2050 due to factors such as rapid urbanization, industrialization, and melting icebergs caused by global warming. The arable land available for cultivation is also decreasing. In addition to this, soil fertility has reached a saturation point, and increasing fertilizer application is not enhancing productivity any further. Poor soil fertility in some cultivable areas, lack of natural soil fertility build-up due to continuous cultivation, frequent droughts, unpredictable climate patterns, rising temperatures, river pollution, poor water management, excessive water wastage, and declining groundwater levels are all contributing to a decline in food production under conventional soil-based agriculture. In the near future, it may become impossible to feed the entire population with the open field system of agricultural production alone. Therefore, soil-less cultivation is becoming increasingly relevant to overcome these challenges. Soil-less culture involves growing plants without soil, and improved space and water conserving methods have shown promising results worldwide.

Hydroponics is a farming system using planting media other than soil. The planting media may contain rock, husk charcoal, or rockwoll which are used to support the growth of plants. In nature, hydroponics only relies on water for the distribution of nutrients required by plants (Roidah, 2014). It is expected that implementing a hydroponic system, will produce better quality crops.

In this final project, the researchers used a vertical type of hydroponic or so-called Verticulture. The advantage of this arrangement is that it is more space-efficient for cultivation and does not require a lot of material to compile the arrangements (Nori Andrian, Mariati, 2018). Besides, the dripping system in irrigating plants allows roots to appear and be submerged in water so that stem rot can be avoided and plant roots obtain more oxygen intake.

According to Maria, in her research entitled "Automation of Irrigation Systems and Nutrition Based on Total Dissolve Solid (TDS) Value in Hydroponic Nutrient Film Technique (NFT)". Hydroponic farming methods rely on water for nutrient distribution, so plant watering must be regular and continue to rely on water pumps. If plant care is not following the schedule and the time is not enough in maintenance, the plant growth might be under average or even not optimal so that the yields will be reduced (Parikesit, 2017)

Similar research entitled "Application of IoT Technology to Hydroponic Using Arduino and Blynk Android". The research discusses the hydroponic series of the NFT (Nutrient Film Technique) type which utilized Adruino Uno to read humidity and air temperature around the hydroponic circuit, regulated nutrient content levels automatically using the YS-F201 sensor, and monitored sensor readings through the Blynk application on Android (Ciptadi & Hardyanto, 2018).

Another research "Hydroponic Management and Monitoring System for an IOT Based NFT Farm Using Web Technology" implemented a control and monitoring system to facilitate website-based maintenance, using Adruino Uno, esp 8266, and Raspberry Pi 2. Furthermore, the hydroponic NFT web interface management system used a responsive web framework, such as Bootstrap for front-end libraries, JQuery, and JavaScript (Crisnapati et al., 2017).

Based on explanations from previous researches, the researchers concluded that to cover the shortcomings of the hydroponic system can be overcome by building a simple system that can reduce maintenance costs and high production costs. The researchers attempted to apply a hydroponic system combined with the use of monitoring through the Androidbased application, Blynk. Blynk application was chosen because of the easy installation on the smartphone, in which users can select the appearance of the application according to their preference and the Blynk application can be accessed for free (Wahyu Adi Prayitno, Adharul Muttaqin, 2012). As an alternative power supplier, solar panel systems are used to reduce dependence on PLN electricity (Suryawinata et al., 2017). By utilizing the IoT concept in agriculture, farmers can easily monitor the agricultural condition and environment from anywhere, can control production support tools, such as irrigation pumps and nutrient regulation easily.

3. DIFFERENT AVAILABLE TECHNIQUES FOR HYDROPONICS COMMERCIAL SYSTEM:

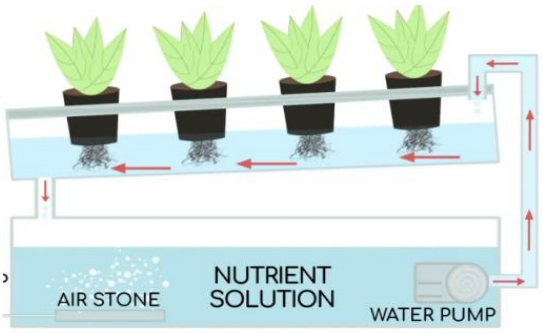
A. Indoor Space (NFT System)
B. Outdoor Space (NFT System
   1. water culture system
   2. cocopeat based system
   3. hydroton based system

1) Water Cultural System:

In water culture system there are three types:

i. NFT system
ii. Horizontal NFT
iii. Vertical NFT.

i) NFT system: NFT stands for Nutrient Film Technique and is a hydroponic system where a thin film of nutrient-rich water is continuously circulated over the plant roots, providing a constant supply of water, oxygen, and nutrients. There are two common types of NFT systems: horizontal and vertical.



ii) Horizontal NFT System: In a horizontal NFT system, plants are grown in channels or gutters that are inclined slightly to allow the nutrient solution to flow continuously over the roots. The excess nutrient solution is collected at the end of the channel and returned to the reservoir for recirculation. This system is suitable for growing small plants like lettuce, herbs, and strawberries.

iii) Vertical NFT System: In a vertical NFT system, plants are grown in vertical channels or towers, allowing for high plant density and efficient use of space. The nutrient solution is circulated in a closed-loop system, flowing down the channels and back to the reservoir. This system is often used for growing leafy greens, herbs, and other small plants in a limited space.

2) Cocopeat Based Systems:

In cocopeat based system there are four types:

a. Single planter growbag system
b. Trough system
c. Multiplanter growbag system
d. Vertigro system

a) Single Planter Growbag System**:**

A single planter growbag system is a type of container gardening system where plants are grown in bags filled with a growing medium. The cocopeat-based single planter growbag system is a popular way of growing plants in a small space, such as balconies or rooftops.

b) Trough System:

A trough system is a type of hydroponic or aquaponic gardening system that uses long, narrow containers or troughs to grow plants. The troughs can be made of various materials, such as plastic or metal, and are usually lined with a waterproof material to prevent leaks.

c) Multiplanter growbags:

Multiplanter growbags are a type of container gardening system that allows you to grow multiple plants in a single bag. These bags are typically made of durable, breathable fabric and come in various sizes, allowing you to grow plants of different sizes and types.

d) Vertigrow system

The Vertigrow system is a vertical hydroponic gardening system designed for indoor or outdoor use. It consists of multiple tiers of stacked containers or trays that are used to grow plants without soil, using a nutrient-rich water solution.

3). Hydroton based system:

a) Dutch bucket:

These systems are normally used for growing crops like tomato, cucumber and capsicum.

4. Problem in soil farming:

- More infection ,soil insect and diseases
- Good quality soil is not available every area
- More water need to grow vegetable
- Lots of energy required for farming

5. Benefits in soil less farming:

- No need of soil so grow easy in any location
- No need of land we also go vertical forgrow
- Less water is required easily operation and stress free
- No fungal or algae infection
- Easily manageable

6. OBJECTIVES

- The objective of hydroponic farming is to supply the ideal nutritional environment for optimum plant perform.
- To cultivate vegetables with minimum use of hydroponic nutrient water.
- Hydroponics is a technique of growing plants without soil, where the plants are grown in a nutrient-rich water solution. One of the main objectives of hydroponic plant projects is to improve plant growth and yield. Hydroponic systems use significantly less water than traditional soil-based farming methods, making them an attractive option for regions with limited water resources. Hydroponic systems can be designed to be highly sustainable, using renewable energy sources and closed-loop systems that recycle water and nutrients. A project may aim to develop a sustainable hydroponic system that can be used to grow food in an environmentally-friendly way.

7. ADVANTAGES

- Water Conservation
- Better Nutrient Control
- High Quality
- 0% Pesticide
- High Crop Protection
- Environment Friendly
- Economical
- Flexibility in Production
- Low Maintenance
- Higher Yield
- No Weed
- Year Round Production

8. DISADVATAGES

- Higher initial cost
- Requires constant monitoring and maintenance

9. LIMITATION

- Requires technical knowledge and high initial investment
- Considering the high cost
- The soil-less culture is limited to high value crops.

10. CONCLUSION

In conclusion, hydroponic plant systems are a promising technology for sustainable agriculture and food production. By growing plants without soil and controlling the nutrient solution and other environmental factors, it is possible to optimize plant growth and increase yields. Hydroponic systems are highly adaptable and can be used in a variety of settings, including urban areas where space is limited. The objectives of a hydroponic plant project can vary widely depending on the intended application of the system. Projects may aim to improve plant growth and yield, conserve water, promote sustainable agriculture, or develop cost-effective systems.

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