

# **“Fabrication of Hydroponic system for growing Exotic Vegetables”**

*Major Project Report submitted in fulfillment of*

BACHELORS OF TECHNOLOGY

IN

BIOTECHNOLOGY

by

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UNDER THE SUPERVISION OF

**DR. HEMANT SOOD**



**DECEMBER-2020**

DEPARTMENT OF BIOTECHNOLOGY AND BIOINFORMATICS  
JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY WAKNAGHAT,  
SOLAN

# CONTENT TABLE

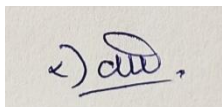
<u>CHAPTER NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
	DECLARATION	3
	SUPERVISOR'S CERTIFICATE	4
	ACKNOWLEDGEMENT	5
	ABSTRACT	6
<b>CHAPTER 1</b>	INTRODUCTION	7-11
<b>CHAPTER 2</b>	REVIEW OF LITERATURE	12-15
<b>CHAPTER 3</b>	RATIONALE AND OBJECTIVE	16-17
<b>CHAPTER 4</b>	MATERIAL AND METHODS	23-29
<b>CHAPTER 5</b>	RESULT	30-31
<b>CHAPTER 6</b>	CONCLUSION AND FUTURE SCOPE	28-29
<b>CHAPTER 7</b>	REFERENCES	31-33

# **DECLARATION**

I hereby declare that the major project work entitled “Fabrication of Hydroponic system for growing exotic vegetables” has been solely submitted to the Biotechnology and Bioinformatics Department of Jaypee University of Information Technology, Wakhnaghat, under the guidance of my supervisor **DR. HEMANT SOOD.**

Name - **Devashish (171806)**

Signature -


A rectangular box containing a handwritten signature in blue ink. The signature appears to be 'Devashish' written in a cursive style.

Department of Biotechnology and Bioinformatics  
Jaypee University of Information Technology, Solan  
Wakhnaghat.

**Date: 16<sup>th</sup> June 2021**

## **SUPERVISOR'S CERTIFICATE**

This is to certify that the minor project work titled “Fabrication of Hydroponic system for growing exotic vegetables” submitted by **Devashish** during his 8<sup>Th</sup> semester in May 2021 in fulfilment for the major project in Plant Biotechnology of Jaypee University of Information Technology, Solan has been carried out under my supervision. This work has not been submitted partially or wholly to any other University or Institute for the award of any degree or appreciation.

Name of Supervisor	-	<b>Dr. Hemant Sood</b>
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**Date – 16<sup>th</sup> June 2021**

## ACKNOWLEDGEMENT

I take this opportunity to express our first and foremost gratitude to our “DEPARTMENT OF BIOTECHNOLOGY AND BIOINFORMATICS” for the confidence bestowed upon me and entrusting my project title “Fabrication of Hydroponic system for growing exotic vegetables.”

At this stage, with proud privilege and keen sense of gratitude I feel honored expressing my deepest appreciation to **Dr. Hemant Sood**, for being a much more than just a supervisor and helping beyond the call of duty in my support, motivation, advice, and guidance throughout. She has been the source of my inspiration of come what may, these issues cannot bring you down. And Sincere thanks for her very invaluable guidance, insightful advice, motivating suggestions, , help and support in completion of this Project successfully and also for her constant advice and encouragement throughout my major project work.

Special thanks to my parents too for their infinite understanding and patience and also for the constant support and most importantly God, who in his mysterious ways, always made things possible to work out in the end.

In gratitude,

Devashish (171806)

## **ABSTRACT**

Food is an important element to life and is a quite essential for human survival. And that's why agriculture is the fastest growing sector in the world and talking about country it contributes 17-18% to India's GDP. Not only this but it also employed more than 50% of the our country's work force and continues to employ more people. According to the Global Hunger Index 2020 (GHI) report, is a important tool for comprehensively tracking and measuring the hunger at regional, national as well as global level, India ranks 94 among 107 countries in terms of the hunger and continues to be in serious hunger category. Moreover, Nobel peace prize 2020 was felicitated to World Food Programme (WFP) for raisng the concern to overcome the hunger of 1.38 billion which is not possible because of rapidly growing urbanization and industrialization and also melting of icebergs (which is an very obvious impact of global warming), arable land under cultivation is also going to decrease upto an extent. Furthermore, soil fertility has attained it's saturation level, no increase in productivity due to over utilisation of fertilizer, frequent condition of drought, unpredictable climate as well as weather conditions, abrupt increment in poor water management, temperature, huge amount of wastage of water, these all are threating Food production under Geoponics (the traditional soil-based farming method). Under such circumstances, It is and will be impossible to meet the food requirement of the entire population with geoponics only. All things considered, soil-less culture or soil-less farming is becoming more relevant to cope up with these challenges in the present scenario. In soil-less farming ( a new farming technique) i.e, Hydroponics, plants are raised without soil. Improved water conservation and space methods have shown some promising results for the food production sector all over the Global. There is a loophole in Fabrication of Hydroponics system i.e, It is a quite expensive equipment. Primarily the fact that, Technology itself is very expensive To sum up, I am working on the aspect to make a affordable hydroponic system and reduce the overall cost of the hydroponic system for growing Exotic vegetables ( Tomato, Strawberry, Brinjal) and the techniqies I'm implementing is an alternative to the traditional farming not the replacement for growing exotic crops. Till date no such study has been carried out on cost effective aspect. Number of the techniques and methods can often implemented to hold forward the research so as to grow exotic vegetables and lessen the cost of overall setup.

# CHAPTER 1

## INTRODUCTION



Soil is the most available, accessible and feasible growing medium for the plants and it is valuable component of agriculture. It provides support for the plants, water, air, nutrient which includes most important of all are Nitrogen (N), Phosphorus (P), Potassium (K) and other important nutrients that are Magnesium (Mg), Calcium (Ca) and Sulfur (S) for the growth of the plants. However soil also pose some serious limitations for the plant growth such as presence of the disease causing organisms and nematodes, unfavourable soil compaction, unsuitable soil reaction, poor drainage and degradation due to soil erosion. Additionally, Land based farming is difficult as it requires large space, lot of labour, large volume of water, sometimes, soil fertility is deteriorated due to over utilization of the pesticides lastly, in metropolitan cities, soil is not available for growing crops. Under these circumstances, Soil-less farming Hydroponics will be a game changer.

Soil-less farming mainly refers to the various methods or techniques of Hydroponics and Aeroponics. The word hydroponics is derived from greek word in which 'hydro' meaning water and 'ponos' meaning labour. Putting together these two words which means water based farming. Terrestrial plants can be grown with their roots immersed or dipped into the nutrient solution and in an inert medium , such as gravel, perlite and mineral wool. Hydroponics is a technique for growing plants in the mineral nutrient solution. Aeroponics is an another technique for growing plants in mist or aerosol (fine drops). In India, Hydroponics system of farming was introduced in the year 1946 by an English scientist, known as W. J. Shalton Douglas and set up the laboratory in Kalimpong area, West Bengal. Not only this, he also has written a book by the name Hydroponic The Bengal system. Later, It was being developed in Abu Dhabi, Arizona, Belgium, Denmark, Germany and many other countries of the world. During 1980s, many computerized and automated hydroponic farms were established and Home Hydroponics kits became a popular thing in the year 1990s.

### **Advantages of Hydroponics over Geoponics-**

1. It doesn't necessarily require soil .
2. It is a faster technique than Geoponics.
3. It requires less space and can be grown in any location.
4. It is independent of any environmental factors.
5. No or very less requirement of pesticides as well as herbicides.
6. It can be protected from soil borne disease.



7. Plants get complete range of nutrients from major to minor nutrients.

### Different types of Techniques available for Soil-Less farming-

1. **Hydroponics-** They are divided into seven types which includes Wick, Deep water culture (DWC), Ebb and Flow also known as Flood and Drain, Nutrient Film Techniqie (NFT), and Drip hydroponics.
2. **Aeroponics-** It is being further divides into two types Root mist technique and Fog Feed Techniques.
3. **Aquaponics-** It is the comination of Hydroponics and Aquaculture (Aquatic animals mainly fish). In which plants are grown in water in a symbiotic environment.

### Hydroponics-

1. **Wick Hydroponics-**As the name suggests, feeds the nutrient solution through or via a wick to the plants. The wikcs that are being commonly used are Pro-Mix, Coconut fible, Perlite and Vermiculite. It's advantage is that doesn't have any moving parts, thus no requirement of pumps and electricity on the other hand. It is able only to deliver a very less quantity of water to the plants at a time hence, the bigger plants may be starved.

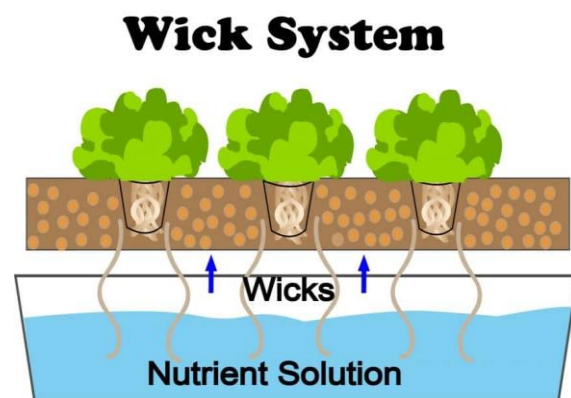


Figure 1. Wick Hydroponics

2. **Deep Water Culture (DWC) or Water Culture Hydroponics-**In this type of system Ususally, Growth medium is made up of Styrofoam. Oxygen is supplied by air pump that runs continuously. Most commonly plants grown which need large quantity of water such as, lettuce, strawberry and many more.

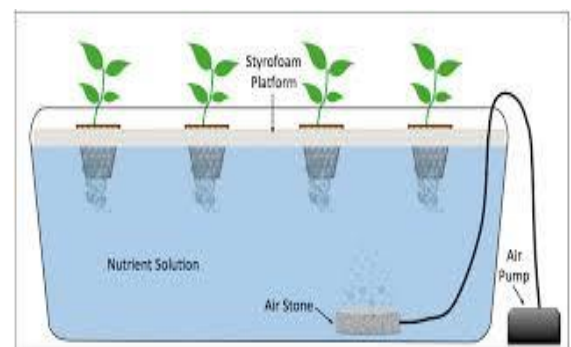


Figure 2. Deep Water Culture

**3. Ebb and Flow (Flood and Drain)-** As shown in Fig 3, Submersible pump is being installed in the nutrient solution where it pumps up the solution into the growth tray or growing tube to flood it. The pump can be controlled with a timer so that when it turns on the pump fills the growing tube and when it turns off then the solution flows back into the reservoir.

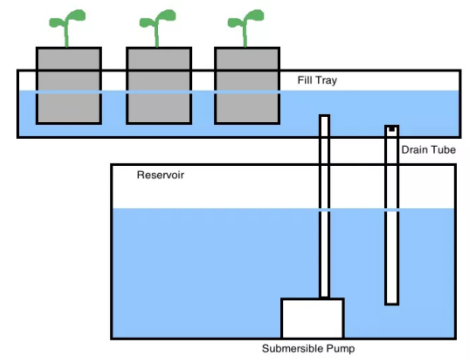


Figure 3. Ebb and Flow Hydroponics

**4. Nutrient Film Technique (NFT)-** Mostly commonly used technique nowadays, in this system, no requirement of timer and growth medium. The nutrient solution pumps in a tilted growth tray further, it is drained back to the reservoir.

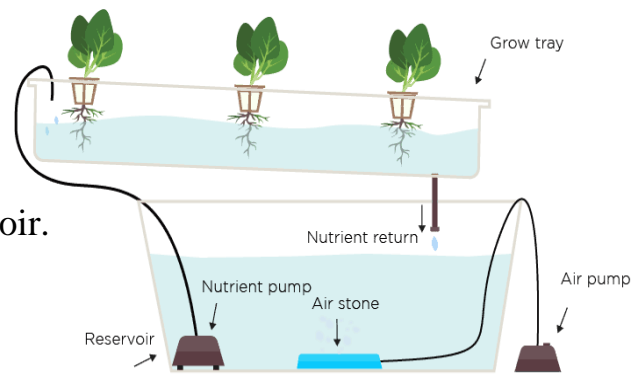


Figure 4. Nutrient Film Technique

**5. Drip Hydroponics-** As the name suggests, in this system drips are used to feed the plants with nutrient from the reservoir. Advantage of using this system is one can use with any plant since the flow rate can be adjusted.

**Drip System**

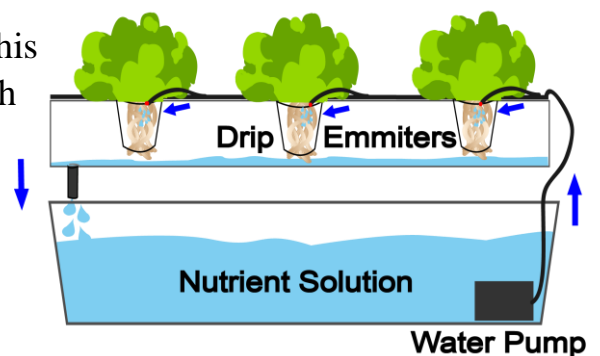


Figure 5. Drip system

**6. Aeroponics-**As aforementioned, It further divides into root mist and fog feed technique. As shown in figure 6, mist of the solution is being sprayed to the roots of plant at regular intervals which constantly supply aeration to the system. Also, small amount of nutrient is required as compare to other systems. The same principle applies to fog feed techniques as shown in figure 7.

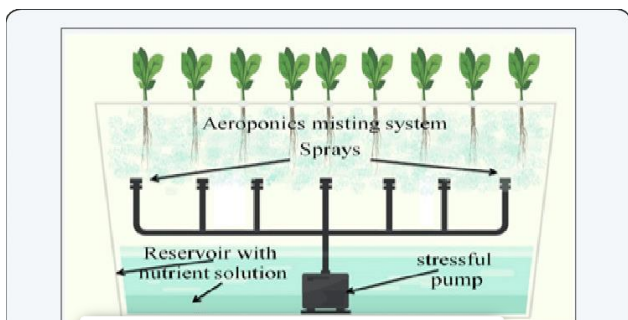


Figure 6. Hydroponics (Mist)

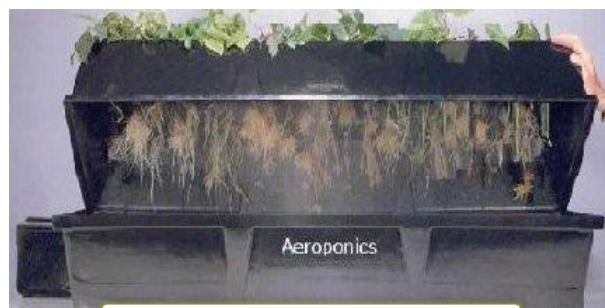


Figure 7. Aeroponics (Fog)

**Aquaponics-**

**Aquaponics System**

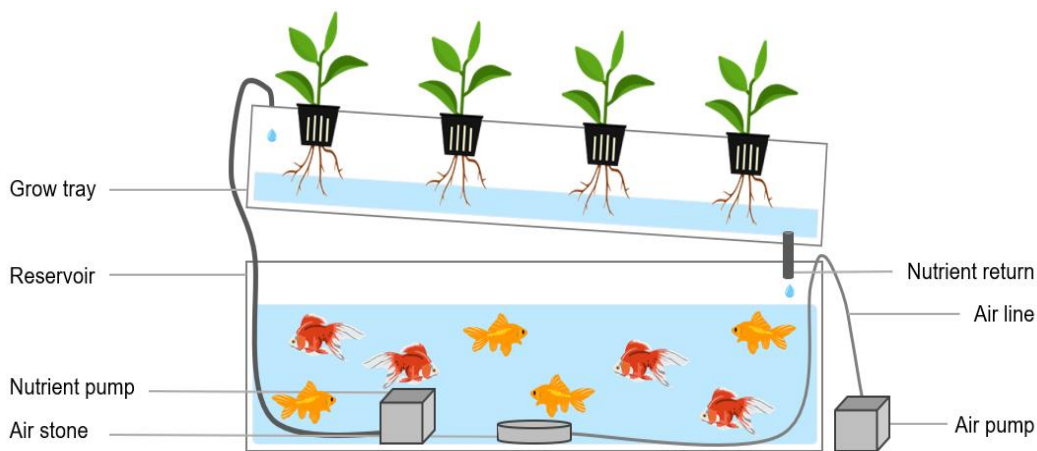


Figure 8. Aquaponics System

As shown in figure 8, In this system plants and aquatic animals are in symbiotic environment. In Aquaponics system, Water from the aquaculture system is passing to the hydroponics system where toxic byproduct are broken down by the nitrifying bacteria into nitrites and futher into the nitrates, which are then utilized by the plants as nutrients.

**CHAPTER-2**  
**REVIEW OF LITERATURE**



## **Hydroponic**

Numerous elements are responsible for the land damage that is used for the cultivation of plants and the major reasons are worldwide climate change, distinctive motives encompass soil erosion and over use of chemicals which results in fertile land damage. Influence of these elements are very much visible in flora, which fails to meet the requirement of enormous population. In this case hydroponics plays a very important role that could contribute in filling the wide gaps. This is the nutrient rich system that enables in dealing with many diverse problems. Hardening off of In vitro vegetation plant is one more part of the top soil less subculturing.

### **Various techniques of hydroponics :**

1. Continuous strategies ( goes with the flow solution cultured gadget) or non-stop.
2. Discontinuous mode of flow.

Thus hydroponics is no longer the most effective technique that meets the aspiration of the inhabitants but it still influences the productivity or yield of the flower. Hydroponics pivot is no longer the handiest on the enlarge of the medicinal vegetation however hardening off is the primary assignment. Various study profess that the product of secondary metabolite substance can be numerous whilst those vegetation that are kept under managed environment.

Therefore hydroponic technique is a very beneficial approach for raising different kinds of flora such as Catalogna frastagliata and many veggies by controlling numerous situations such as humidity, temperature, pH, fertigation slight means of irrigation and fertilizer can be given to the plant in the form of nutrients. The main aim of raising exceptional medicinal plants in hydroponic system is in order to attain sufficient increase yield with tremendous crop quality and huge quantity of secondary metabolite substances. Cheap source like the low price chemicals and organic wastes can be used in the hydroponic system for raising the medicinal plant , that serve in the defence of various plants and also fashion of untamed species.

Hydroponics is likewise being used in investigation the biotic pressure forbearance. Hydroponics also permits the scientist community take a look at the consequences of compound deficiencies and toxicities without any complexity and also to have a look at extraordinary additives of the plant improvement in the below precise situation. By using hydroponics system humans infer that the plant take up their food in many ways and with various awareness.

Shift of the in vitro grown flower to hydroponic setup differs from one flower species to other, fashionable boom solution posses the following essential macro nutrients such as: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg) and Sulphur (S) and some micro elements that are - Iron (Fe), Boron (B), Copper (Cu), Manganese (Mn), Molybdenum (Mo) and Chlorine (Cl), etc. and fabaceous species require Nitrogen fixation, Cobalt (Co). Also the additive solutions are boosted with carbon source taken by both the means organically or inorganically.

pH of the solution is also an important aspect to look at because it influences the dissociation of ions and uptake of the nutrients with the many aids of the flower. pH can be regulated with the help of computerized structure that is linked with the system. Acid and Base may be confer into the solution on every occasion so there can be changes within the pH of the solution. Hydroponics can manipulate the state of affairs in the biotic pressure condition such as it's salinity, toxicity and also compound deficiency in the plant. Several nutrients also affects the fulfilment of drug compounds in the medicinal plant.

### **Tissue Culture and Hardening off :**

Tissue Culture is a technique to cultivate plant using cells, tissue or explants on specific nutrient media under the synthetic state of affairs. Artificial state of affairs include room temperature 20-30°C, humidity 20-98%, fluorescent mild 10,000Lux. Both moderate and temperature ought to be adjusted in 24 hours length of the day. Tissue Culture is a very important strategy within many developing countries for producing healthy and high quality plants. It can be mainly classified into 2 category : Invitro rooting and Ex vitro rooting . Invitro rooting means cultivation of explants, plant cell where micro cuttings are rooted at the floor of solid media or immersed in the liquid

media in jar or test tube. On the other hand Ex vitro rooting of the plant tissue decreasing the use of hydroponic media. Furthermore Ex vitro rooted plant has been a better and advanced tool and are less time consuming due to simultaneous incidence of rooting as examine to In vitro rooted flora.

For the establishment of the survival of plant (tissue cultured) into the outer surroundings, hardening off method is being used which account for the survival of In vitro grown plants.

Hardening off in fact of manner is exposing plant to many aspects such as daytime, dry air, humidity and so on. It is typically a uninteresting technique in which various strategies are involved.

Direct shift of the tissue expanding flora to situation because of excessive price of demise, Direct shift to daytime moreover motives the charring and sizzling of leaves and drooping of the plants. It is very important to adjust the plants to its encircling environment through the hardening off process. Hydroponic is a way of growing plants inside for a brief span of time in nutrient rich medium. In this technique the required amount of nutrient is being supplied to the plants, nutrient toxicity and its deficiency are major problems in plant which increases which plant growing and that can be dealt with using hydroponic technique. There are many kinds of hydroponic system. Many factors affecting the growth of the In vitro grown plant at the same time as hardening off in hydroponics. Salinity is one of the major thing which contributes to the growth of the flora. This can be calculated with the help tool known as Electrical conductivity meter (EC meter). The plant shows best growth at 0.5- 2.5 ds m. Dissolved oxygen is another crucial thing contributing to the plant growth. Several studies has showed that the dissolved oxygen shows it's impact in the multiplication of the roots and is very important to complement the media with oxygen that can be done by the use of air pump.

One of the approach for growing and developing plant in hydroponic setup is Nutrient Film Technique (NFT) which is most commonly used technique these days where there is no requirement of timer and growth medium, the nutrient is being supplied to plants using water pump from nutrient tank to growing tubes. In this study we have got to know that how to optimiz subculture environment for the fastest possible growth of *Catalogna frastagliata*, *Oregano vulgare*, *Oriental Lilium* and *Orchid cymbidium*. Ex vitro rooting and hardening off has been also used along with the use of hydroponics.

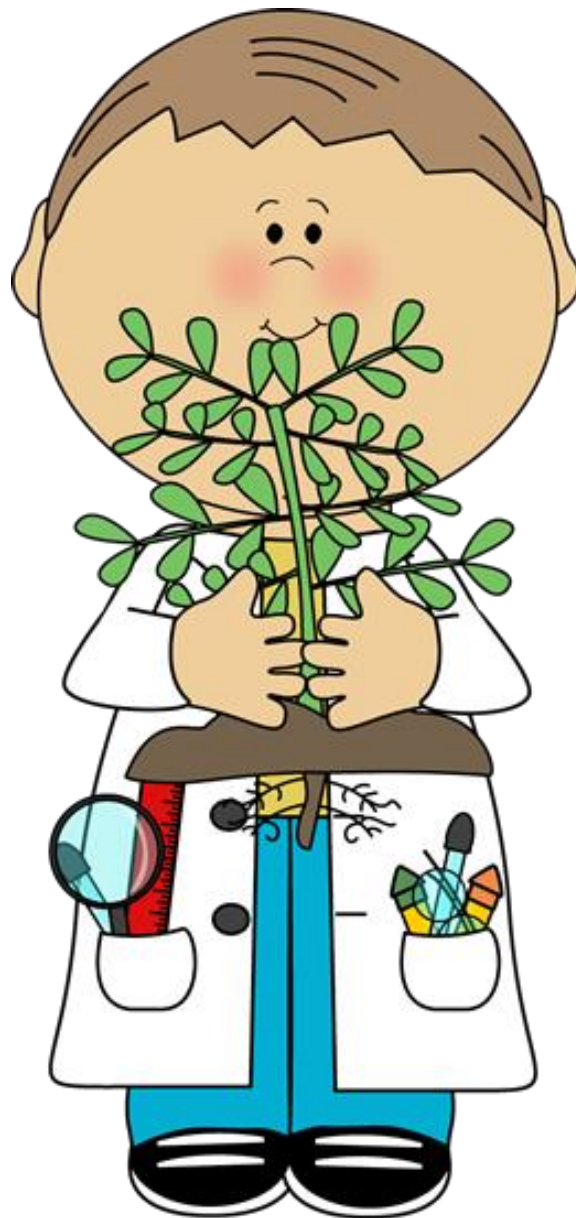


S.NO	Plants	Scientist	Method adopted by the Scientist	Hydroponic media	Result obtained by the scientist
1	<i>Catalogna frastagliata</i>	Lovro Sinkovic, Janez Heribar, Drgean Znidarcic	Seed sowing	Murashige and Skoog media+IBA+BAP.	5 out of 8 pots
2	<i>Oregano vulgare</i>	Stapleton, Suzanne C, Robert C Hochmuth	Vegetative propagation	Fe-EDTA Nutrient solution	6 out of 9 pots
3	<i>Black out</i>	Hassan M. Asker	Vegetative propagation	Black out were grown in these different nutrient solution: Rain water, Hoagland, Basal Salt Mixture, Murashige and Skoog Basal Salt Mixture and White's Basal Salt	8 out of 9 pots
4	<i>Orchid cymbidium</i>	Shahram Sedaghatoor, Gholamreza Golzari, Dehno, Rohangiz Naderi	Vegetative propagation	water	12 out 15 pots

Table 1 : Data collected from the preceding examine for the following flora species , where the scientist have grown those plant in the hydroponic system and desired results obtained.

## CHAPTER-3

### RATIONALE AND OBJECTIVES

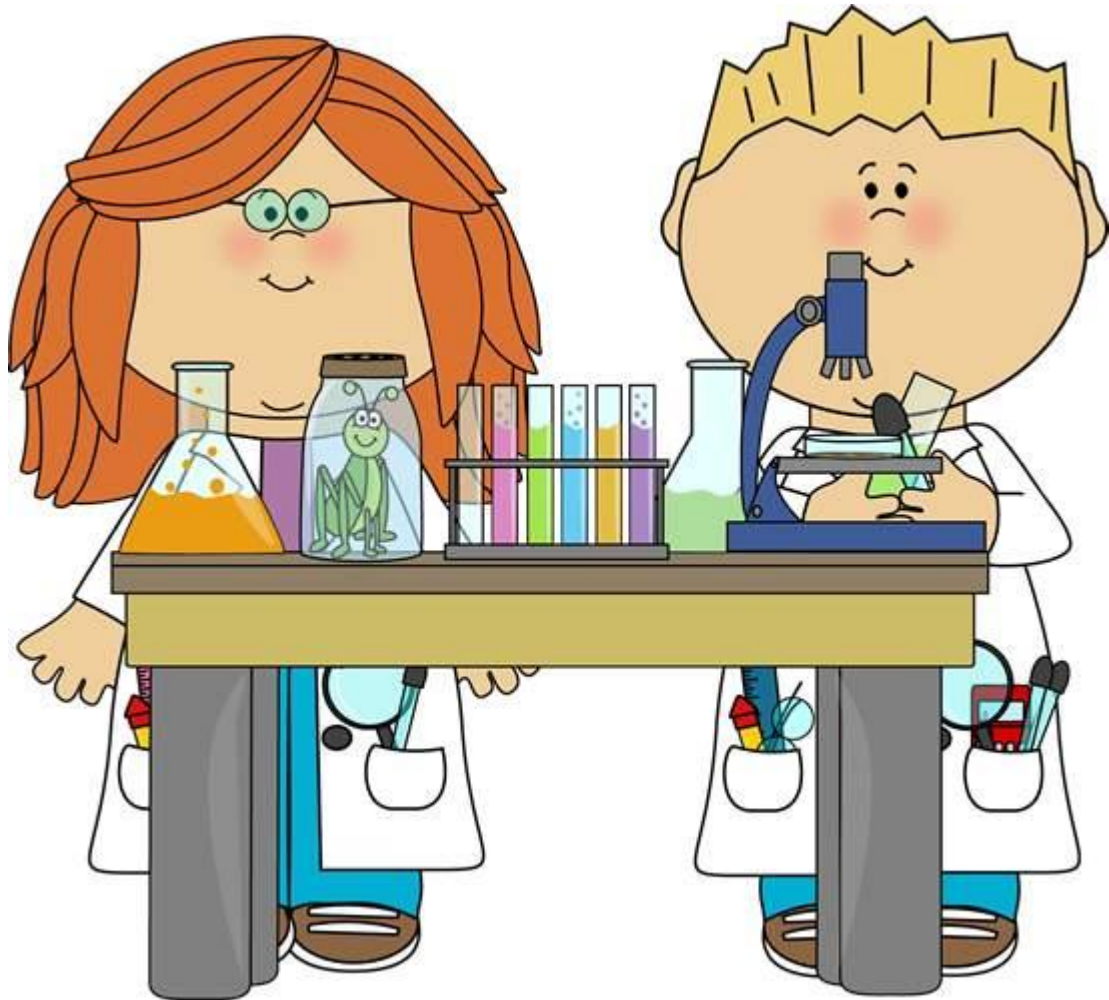


Food is the basic requirement of one's life. With the advent of industrialization , geonics is facing some challenges. As aforementioned, soil fertility has attained its saturation level, productivity is also not increasing due to over utilisation of fertilizer, drought condition, unpredictability of weather and climate conditions, abrupt increment in temperature, poor water management and huge wastage of water ; all of these are threatening Food production. Under these circumstances, Hydroponics can be a game changer. There is a negative aspect of hydroponics is it is quite expensive equipment and requires extensive technical knowledge which means setting up the whole plant, understanding all the operations such as water requirements and in case of smart hydroponics systems one should know the technicality of sensors. To put it briefly, we are working to reduce the overall cost of hydroponics set up to \$40.58 ( ₹3000) till now and no extensive technical knowledge is required. Most important of all, the techniques we are implementing is an alternative to traditional farming approach not the replacement for growing exotic crops and can be used by general public without any prior technical knowledge of farming same as “*Do it yourself*” hydroponics kits.

### **Objectives -**

1. To set up an cost effective Hydroponic System for growing various vegetables.
2. To prepare seedlings of plants.
3. To grow the exotic vegetables at a minimal cost with new approaches without any expensive technical knowledge for the same.

**CHAPTER-4**  
**MATERIALS AND METHODOLOGY**



Each strategy needs an alternate vehicle for developing plants and the different materials utilized or requires in this strategy for cultivating are:

**Clay :** Clay pellets are being prepared, unbiased and inactive are utilized for aqua-farming frameworks. The pellets are arranged and heated in furnaces at 1200 degree Celsius. The clay, in this way grows and gets permeable. These earth pellets are supportable and furthermore reusable on the grounds that they can be disinfected in arrangements like Hydrogen Peroxide, Vinegar and Chlorine.

**Growstones :** These are produced using glass squander and they have more water and air maintenance space that is utilized as substrates in hydroponic cultivation method.

**Coir peat :** Coir is usually the leftover part of the coconut that is fiber which being taken or extracted out. It is a characteristic wellspring of developing medium. It is being utilized alongside Trichoderma parasites to invigorate root development. Coir can also store minerals which are not utilized and delivery them when needed by plants. This movement is selective to the coir of substrate and is known as the cation trade.

**Rice husks :** Sometimes being used for tank-farming cultivating permit appropriate waste.

**Perlite :** These are superheated volcanic stone which is either utilized free or submerged in water. It can hold less water and more air.

**Vermiculite :** It is mineral being superheated to shape rocks which is able store more water and effectively draw supplements from the aqua-farming framework.

**Pumice :** It's a volcanic stone starting point discovers which can be used in hydroponic farming.

**Sand :** It is once in a while utilized on the grounds that its substantial and should be cleaned frequently.

**Rock :** This has different uses, for example, it depletes well, cleaner to keep up, doesn't log water and modest. There is only one disservice that if the roots don't get a flexibly of arrangement enough they may get dried out.

Wood fiber : Highly effective substrate for soil-less farming and is present naturally in nature.

Sheep fleece : The substrate helps in the better return and is an inexhaustible medium.

Rock fleece : This substrate is mostly utilized for hydroponic method of farming. During the cultivating stage this material is one of the most extreme significance since it is less inclined to microbial corruption. This substance some of the time can cause skin bothering while at the same time taking care of. The PH of rock fleece must be changed before use.

## **SOLUTION REQUIREMENT FOR HYDROPONIC**

There are mainly two prospects: Organic and Inorganic arrangement.

Organic culture arrangement : This arrangement is being set up from natural materials such as blood supper, bone remains, fish dinner, wood cinders, calfskin squander, poultry excrement, dairy animals fertilizer,vermicompost and cotton seed feast and so on there are two or three difficulties when natural substances are utilized as supplements, for example, the supplements might be deficient as the nature of compost relies upon the animal feed, likewise infection transmission via side-effect represents a danger, the natural manures are not as much fine as inorganic substances accordingly they can obstruct the gear utilized for tank-farming cultivating lastly they can deliver hostile odour in the cultivating territory.

Inorganic culture arrangement: the overall inorganic components found in the arrangement are Potassium, Calcium, Nitrogen, Sulphur, Phosphorus, Magnesium, Zink, Iron, Copper, Nickel, Boron, Chlorine, Silicon, Aluminum, Sodium, Cobalt and so forth the arrangement technique is unique in relation to the dirt innovation absolutely. The cation trade limit of aquaculture arrangements is unimportant subsequently this prompts lopsidedness in PH of the arrangement. Not all of the plants require similar supplements so there might be irregularity in

the structure of the arrangement as plants will in general ingest required supplement more structure the arrangement.

A prepared to utilize supplement arrangement can be set up at home for aqua-farming planting. This blend contains both essential supplements as well as auxiliary supplements. In 20 liters of water add 25 ml of Calcium Nitrate, 1.7 ml Potassium Sulfate, 8.3 ml Potassium Nitrate, 6.25 ml Mono Potassium Phosphate, 17.5 ml Magnesium Sulfate and 2 ml minor components are broken down to frame the supplement arrangement. Put this supplement at the room temperature and away from daylight in a compartment. The arrangement should be blended very well before using it. There is a sign by the leaves of plant if there is deficiency of supplements for example they start to turn yellow else if the grouping of arrangement is high they consume and turn earthy colored

### **Instruments Requirement For Hydroponics Farming**

Thermostat, filter, pH and EC indicator, indoor regulator, bug screens fans are being considered for climate and air balance. CO<sub>2</sub> generators help to control the air and temperature necessities. Metal halide and Glaring lights which control smell are being utilized. Different parts like plate, tables, tubes, attachments, holders, channel ropes, stores, plastic pots, Rockwool, cocopit compartments and so on are needed for setting up the hydroponics farming arrangement. Spreading materials like warming mats, roter plugs and so on are likewise utilized. Some serious gear is additionally considered for making supplement arrangement, for example, pump, pH and EC measuring devices and so on. The supplement combination is commonly accessible on the lookout yet at some tank-farming cultivating territories it is readied utilizing programming devices.

## **STEPWISE METHODOLOGY**

### **1. Constructction of green shade house**

A shade house is to be constructed to provide sterile condition, protect plants from air-bourne disease and to maintain the temperature. It also protect the growing tubes (PVC) from damage due to excess heat. It can be built using a green net shade and iron pipes. Fig.1 shows the green net house setup that I constructed.



Fig.1 : Green net house constructed at home using  
Green net and Iron rods.

### **2. Assembly of Hydroponics setup**

A hydroponics setup usually consists of growing tubes made up of PVC pipe, stand made of wood, a nutrient bucket, manifold, a water pump and regulators. The pump sits under or beneath the bucket to forcibly push up the nutrients to the plants via manifold made up of small lateral pipes. Each growing tubes are connected to each other with the help of manifold in vertical order and the last



growing tube has a drain-pipe that leads back to bucket and the force of water makes air bubbles so the plant gets enough amount of oxygen. Here's the setup that I've constructed and assembled. (Fig. 2)



Fig. 2 : Hydroponic setup built and assembled by me at home using wooden frame as stand, growing tubes, lateral pipes, cooler pump, bucket and connectors and regulators.

### **3. Mixing water and nutrients in the bucket**

Fill the bucket with water and then add required nutrients to the bucket and then turn on the system for about 20min so that the nutrients get thoroughly mixed.

### **4. Seedling preparation**

Take a seedling tray and fill it with the mixture of cocopit, vermiculite and perlite in ratio of 2:1:1 respectively. Sow the desired seed you want to grow on the system and spray a low concentration of Bavistin solution to prevent fungal growth and put the seedling tray in a sterile and moisturous condition for the better plant growth . The seedling will be prepared for transplantation in next 14-17 days.

### **5. Transplantation**

Choose the healthiest plants and pluck it from the seedling and transfer it into the planting cup ( a cup with a hole in the bottom for root expansion) and then transfer the planting cup into the growing tube.



Fig. 4 : Transplantation of Brinjal

## **6. Maintaining the plant and the system**

Check the water level twice or thrice a day which depends on water loss because of excessive heat and evaporation. Check the water force, pH and nutrient level in the bucket every few days and provide it with small amount of macro and micro nutrients by observing the plant and replace the nutrient media solution when required, prepare fresh hydroponic solution by mixing macro and micronutrient in the bucket and Remove the old nutrient media containing from the bucket and then add the freshly prepared hydroponic solution/nutrient solution into this container and gently and tightly pack the bucket with aluminium foil. Also because the pump runs all the time , timer is not needed, but make sure that the bucket doesn't dry out as the pump will be burnt up. It's very important to keep a close eye on the plant growth.

## **7. Check for pests and disease**

As hydroponic plants are very efficient at fighting off disease and there is less chance of them getting infected, but they still have to fight against pests and even if it's hydroponic the insects and catterpillars finds their way into the nethouse. So always look for signs of any diseases and pests, like presence of foliar disease, chewed leaf and insect pests because one diseased plant will swiftly and eventually infect all the other plants since they are nearby to each other. immediately find and remove those sick plants. Because plants that are growing on hydroponic don't have to spend energy trying to find their food, so they can spend more time on their growth and this very much helps them to be more stronger and helthier because they can now spend some of the energy to fight off the diseases. Also since the plant leaves are never get wet until ad unless it's raining, they are exposed to leaf fungus, mold and mildew.

## CHAPTER-5

### RESULTS

1. Seedlings of Brinjal ( Fig. 5.1 and 5.2) and Cherry tomato ( Fig 6.2) were successfully grown at home in the seedling tray in the mixture medium and strawberry (Fig. 6.1) is being grown on the net pot . Plant generation and development was very good. Also the leafs, stems and roots were disease off and healthier.



Fig. 5.1 : This photo was taken after 5<sup>th</sup> days Of seedling of Brinjal being done.The mixture used As a medium in the tray is Cocopit, Vermiculite and Perlite in the ratio of 2:1:1 respectively.



Fig 5.2 : 14 days older Brinjal grown on seedling tray which showed a positive growth and leaves and roots were fresh and disease off.



Fig. 6.1 - Strawberry



Fig. 6.2 - Cherry tomato

Fig. 6.1 : 25 days old grown strawberry on the netpot. And Fig 6.2 : 14 days old cherry tomato seedling being grown on the seedling tray.

2. Below figures showing successful transplation of Brinjal and Cherry tomato into the system.



Fig. 7 : Transplantation of Brinjal and Cherry tomato was being successfully done.

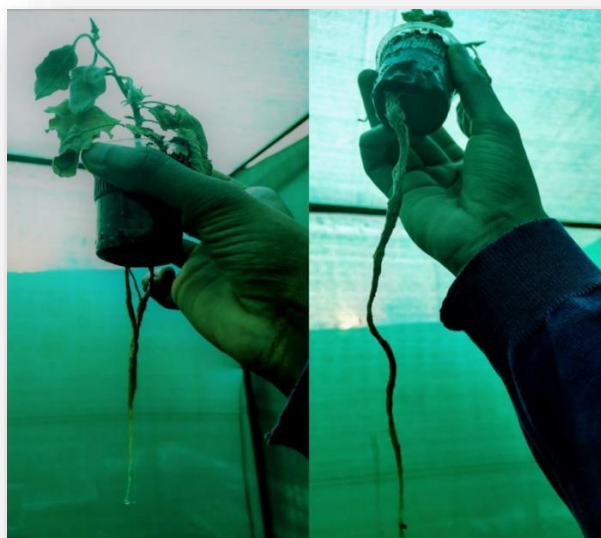


Fig. 8 : 2 weeks after the transplantation of Brinjal into the growing tube showing positive root growth.

3. Under the fabricated hydroponic system 2 different crops gave good result result in which good percentage of seedling developed by using mixture of cocopit, vermiculite and perlite and these seedlings were transplanted into the system which is rich in nutrient and gave good root growth in brinjal i.e 5-6 cm in 15 days and goes upto 8-8.5cm within 30 days of growth and as per the morphological status topup of nutrient solution were being used. Even flowering is observed, so it's being inferred that hydroponics is being widely tested for this kind of crops. Growth and development took place in Brinjal and cherry tomato under fabricated system where root growth was being positively observed in Brinjal whereas Cherry tomato also gave good significant result with respect to seed germination and growth of plantlet. During this Covid time certain experiment needs repetition but not possible to replicate because of Corona pandemic.

4. Below table is the statistical representation of plant growth.

<b>Plant</b>	<b>% of seedling formed</b>	<b>No. of shoots</b>	<b>No. of shoots (15 days)</b>	<b>No. of shoots (30 days)</b>	<b>Rooting %</b>
Brinjal	85				
Cherry Tomato	80				

**CHAPTER -6**  
**CONCLUSION AND FUTURE SCOPE**





A general conception among the farming community in our country is that staple crops can not be grown and produced in the absence of soil, plenty of water and sunlight which is true to some extent but certainly, the global farming trends are changing and our country is standing on the brink of adopting this important and valuable change. New farming techniques are being adapted today, which clearly shows that healthy plants need nutrients, water and high quality seeds. Soil necessity is not an essential requirement and there no better alternative technique than hydroponics to grow plants without land. Since it requires fewer resources and lesser space, farmers can grow and therefore can produce more without compromising the quality of plant and also has a very good profit potential. It has the ability to much amount of crops from a very small footprint which can solve overcrowding and can save nature from being torn down and turned into farms. And while indoor farming is not a new term anymore, the very recent hydroponic innovation breaks down the growing processes even further by eliminating all the unnecessary components of tradition farming. So in short and simple terms it's the next revolutionary in the agriculture field all ver the globe and the future of farming.

In a nutshell, this technique is expected to grow exponentially in future, as growing crops in lands is becoming more difficult especially in country like India, where climatic change is occurring and urban concrete conglomerate is increasing day by day, so adopting soil-less farming to help imrove the crop yield as well as quality of the product is a good and smart option. And the hydroponic system constructed by me can also be used to grow plants at home as it is affordable and easy to ue and can also be used in the research field to observe the growth, nutrient requirement ,etc. in the plant. The overall cost of the fabricated hydroponics system ( for 25 plants) that I constructed was be Rs. 2200.

## CHAPTER-9

## REFERENCES



# REFERENCES

## **RESEARCH PAPER REFERENCES**

- 1.S. Triyono, RM Putra, S Waluyo and M Amin, “The effect of three nutrient solution on the growth of vegetables cultured in DFT hydroponics 355 (2019) 012092 , pp. 01-08
  
2. Rajeswari Aravind, S Sasipriya, “A survey on Hydroponic methods of smart farming and its effectiveness in reducing pesticide usage, Volume 119 No. 12 2018, 1503-1509
  
3. Bishnu Prasad Mishra, Banashri Rath, Aamlan Saswat Mishra, “Simulation of Vertical Hydroponics Farming Setup for Growing Vegetables to address Nutritional Security, Vol. 6 Issue 8, December 2017, pp. 1010-1014
  
4. Chandran Ilango, “Food sustainability”, Volume 3, Issue 6, pp. 567-571
  
5. Ioan Grand, Camelia Manescu, Teodor Mateoc, Nicoleta Mateoc, “New trends in agriculture- crop systems without soil”, Vol. 14, Issue 1, 2014
  
6. Altaf Hossain, “Floating cultivation: an indigenous technology for adapting to water logging situation towards sustainable livelihood security in the low lying areas of Bangladesh”, Vol. (01): 54-58, 2014: 54-58
  
7. Arshdeep Singh, Mallikarjuna, Shreya S Hampole and Paras Panhare, “Hydroponics Farming”, Volume 5, Issue 6, June-2020, 786-790
  
8. F. Orsini, M. Morbello, M. Fecondini and G. Gianquinto, “Hydroponics Gardens: Undertaking Malnutrition and Poverty through Vegetable production in the Suburbs of Lima, Peru”, 173-175
  
9. Falmata Modu, Adam Adam, Farouq Aliyu, Audu Mabu, Mahdi Musa, “A Survey of Smart Hydroponics Systems’, Vol. 5, No. 1, 233-248 (2020)
  
10. Mamta D. Sardare, Shraddha V. Admane, “A review on Plant Without Soil-Hydroponics”, Volume : 2, Issue: 3, 299-304

11. George Van Patten, Gardening Indoors with soil & Hydroponics The fifth Edition
12. George Van Patten, Beginning Hydroponics Soilless Gardening.
13. Howard M. Resh, Hobby Hydroponics
14. Howard M. Resh, Hydroponics Home Food Gardens
15. Howard M. Resh, Hydroponic Questions and Answers
16. Ellis, N. K. , Jensen, M. , Larsen, J. and Oebker, N. , “Nutriculture Systems- Growing Plants Without Soil”, Station Bulletin No. 44. Purdue University, Lafayette, Indiana (1974)
17. Beibel, J. P. , “Hydroponics- The science of growing crops without soil”. Florida Department of Agric. Bull. P. 180, (1960)
18. Butler, J.P. and Oebker, N. F. , “Hydroponics as a Hobby- Growing Plants without soil”. Circular 844 Information Office, College of Agriculture, University of Illinois, Urbana, IL 61801. (2006)
19. Maharana, L and Koul, D. N. , The emergence of Hydroponics. Yojana (June). 55: 39-40 (2011)
20. Singh S. and Singh, B. S. “Hydroponics- A technique for cultivation of vegetables and medicinal plants”, In. Proceedings of 4<sup>th</sup> Global conference on- Horticulture for Food, Nutrition and Livelihood Options Bhubaneshwar, Odisha, India. p. 220. (2012)