IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A REVIEW ON STUDY OF PLANT SPECIES GROWN BY METHODS OF HYDROPONICS.

Aanal Maitreya , Prof. Archana Mankad

Department of Botany, Bioinformatics and Climate Change Impacts Management
University School of Science, Gujarat University-Ahmedabad,Gujarat-380009

Abstract :
Plants are primary producers and play important role in all ecosystrems.Plants play important role to maintain environment and balance atmospheric gases and also produce food ,shelter and cloth requirements of Human beings. Its habitat mostly by means of soil part.Edaphic factors play important role for anchored plant and plants takes their nutritions and other minerals from soil. But now a days many more methods adopted for plant growing.if there are not possible to grow in sufficient land part or by horticulture and garden hobbies or for scientific reason plants grow in artificially Aquatic habitat.Hydroponics ,Where we can grow the plants only by providing Water part and other nourishment content . many kitchen garden or in green house many countries grown their vegetables and fruit crop by Hydroponics and they are successfully grown it.The present review paper give emphasis on Hydroponics.

Keywords: Plant species , Hydroponics, Horticulture.

1. INTRODUCTION :

The most available growing medium for plants is soil. Soil provides all the required nutrients, minerals and microorganisms which are beneficial for plants. But sometimes there could be some limitations in traditional farming, like, unsuitable soil reaction, poor drainage system which cause fungal infection, presence of disease causing organisms, soil erosion, non-fertile soil, etc. Traditional farming requires larger space, more amount of water, lot of labour work; it highly depends on sunlight, temperature, humidity and geographical or topographical conditions. To avoid all of these issues we can do soil less farming. And mainly soil less culture are referred as the techniques of Hydroponics & Aeroponics (IJRET). Hydroponics is a technique to grow plants in water which is rich in minerals & nutrients instead of growing in soil. The term Hydroponics is derived from a Greek word which means “hydro” means water and “ponos” means labour. Minerals and nutrients are absorbed by root system of the plant. Hydroponics system is sometimes supported by a coarse growing medium like coco peat, peat moss, vermiculate, perlite, rockwool or hydroton. This coarse growing medium is used for moisture contain. Aeroponics is also a soil less technique in which plants are grown with the help of few drops of nutrient solution in form of a mist or aerosol.

The plant roots are submerged in liquid solutions containing macro and micro nutrients, such as; Nitrogen, Phosphorus, Potassium, Sulphur, Calcium & Magnesium with some trace elements like; Iron, Chlorine, Manganese, Boron, Zinc, Copper & Molybdenum. (9 pdf) Hydroponics systems are mainly divided in 2 systems, such as; (i) Open hydroponic system – in which the nutrient medium is used in this technique cannot be recycled and reused (ii) Closed hydroponics system – the surplus solution can be recycled, recovered, and replenished. Hydroponics systems saves water and land, protect the environment and highly productive. Regulation of the plants’ aerial and root environment can be a little tricky, production of plants takes place in well designed and controlled artificial light, temperature, air, nutrition & water. Constant attention is required in the technique or it will not be economically useful. (hydroponics) The main aim of hydroponic system is to enhance control and efficiency in crop production. [1]

2. REVIEW LITURATURE OF HYDROPONIC :

The term 'Hydroponic' was coined by William Frederick Gericke in 1936. [2] Woodward from England used soil less farming to grow Mint plants in 1699. Around 1925 In the United States of America started to develop complete nutrient solutions for large scale production. (hydroponics). In India, Hydroponics technique was introduced by W. J. Shalto Duglas and he established a laboratory in Kalimpong, West Bengal, India. He wrote a book on Hydroponics named 'Hydroponics The Bengal System'. In around 1960s and 1970s Hydroponics farm were established in Abu Dhabi, Arizona, Belgium, California, Denmark, German, Holland, Iran, Italy, Japan, Russia. In 1980s, automated and computerized hydroponics farms were started to establish all around the world. In 1990s, Home Hydroponics kits started to be more popular (IJRET). Sachs and Knap developed the basic laboratory techniques to make nutrient solution in Germany around 1860. Aatif Hussain et All., Whom give a review on the science of growing crops without soil (soilless culture) – A novel alternative for growing crops. Abdellah Rababah give Hydroponics removal of wastewater's contaminants for the generation of commercially valuable plants and environmentally sound effluent for the dead sea communities. Aleksa Đurić et.All, giveNew concepts for cities that produce – food for billions (Technological, Economic, Social and Legal aspects of vertical farming) A. Sheikh gives contribution in Hydroponics as a Key to sustain agriculture in water stressed and urban environment. Gurdeep Singh Malhi et All , gives Hydroponics technology for green fodder production under resource deficit condition. Hamid R. Roosta et All. Gives Effects of different cultivation media on vegetative growth, ecophysiological traits and nutrients concentration in Strawberry under Hydroponic and Aquaponic cultivation systems. Zia-Ul-Haq et All.*, gives Hydroponics as an innovative technique for Lettuce production in greenhouse environment.

3. MATERIAL METHODS FOR HYDROPONIC TECHNIQUES:

3.1 Wick Hydroponic System

This system is a very simple and doesn't require electricity, pump or aerators. Plants are placed in an absorbent medium like coco coir, vermiculate, perlite with a nylon wick stripe. Wick strips supply water and nutrients for upward nutrient solution. It is steady and used for small plants which don't require much nutrient or moisture, because the wicks are not capable to supply nutrients too fast. [2,23]

3.2 Deep Water Culture

In this system the plant is grown in inert substrate blocks above the nutrient solution. Roots grow into the nutrient solution and are submerged. The nutrient solution must be oxygenated by use of air pump and constantly adjusted. [1] DWC systems are able to hold a large volume of water. Roots are suspended into 6-18 inches of oxygenated nutrient solution and it is preferable for short saturated leafy greens and herbs because they don't need much of a root support. [17]

3.3 Ebb & Flow Hydroponics System

The roots are inundated with water. Flow means the level of water in the root zone rising and Ebb means the period when it drains away. [2] The grow tray is temporarily flooded with solution in every few hours submerging the roots before returning to the reservoir. This method is suitable for almost every crops but especially for fruits. The setup should be supporting the weight of nutrient media, water and containers. [17]

3.4 Nutrient Film Technique

Channels or troughs are used in this technique, it is setup on a slight angle to make drainage system easier, running a very shallow stream of water towards the roots. That can be done with the help of a timer or a continuous flow. This technique is perfect for short saturated leafy greens. It holds very less water per plant and easily stackable, cleanable and customizable for growing space.

3.5 Drip Irrigation Hydroponic System

It is a common technique in which a pump on a timer delivers a slow feed of the solution to the base of each plant individually. Works good with growing mediums such as coco peat, peat moss and rockwool. Organic materials clog lines faster, that's why synthetic nutrients are used in this system.

3.6 Aeroponics System

It is more advanced technology than the traditional hydroponics system. The plant roots are suspended in a closed container which is waterproofed with black PE film
, instead of being submerged in nutrient solution. The nebulization frequency of the aeroponic system is adjusted to keep the roots moist and the leaves turgid. Three minutes of irrigation every 5 minute 24 hours a day is preferable to keep the plants turgid. [18]

3.7 . Plants that can be grown Hydroponically :

Many types of plants like fruits, vegetables, cereals, flower crops, medicinal crops, fodder crops and herbs can be grown using Hydroponics technology.

Plant Types	Hydroponically Grown Plants
Fruits	Strawberries, Blueberries, Grapes, Cantaloupes, Watermelons.
Vegetables	Lettuce, Cucumbers, Spinach, Beans, Bell Peppers, Tomatoes, Kale, Celery, Chili, Cabbage, Broccoli, Potatoes, Green onions.
Cereals	Rice, Maize.
Flower crops	Roses, Chrysanthemum, Marigold, Carnations.
Medicinal crops :	Coleus, Aloe vera.
Fodder crops	Alfa alfa, Bermuda grass, Carpet grass.
Herbs :	Chives, Basil, Sage, Coriander, Mint, Rosemary, Thyme, Oregano

3.8. Basic requirements of Hydroponics

Nutrient medium

Macro nutrients	Micro nutrients
Carbon	Iron
Oxygen	Boron
Hydrogen	Chlorine
Nitrogen	Copper
Phosphorus	Manganese
Potassium	Zinc
Calcium	Molybdenum
Magnesium	Cobalt
Sulphur	Sodium

Temperature

Right temperature plays important role in hydroponic system. High temperature is required for plant growth which increases the requirement of water consumption and it helps cooling themselves through evaporation. [2] Temperature range of 15ºC - 32ºC for Cucumber and 18ºC - 27ºC for Tomato & Capsicum are required for their production. Temperature range of 15ºC - 18ºC is optimum. [25]

pH : pH plays important role in hydroponic system. Basically 5.5 to 6.5 Acidic is required for better plant growth

Water

Water that is suitable for drinking can be used in hydroponic system. Some of the absorbed water It should have conductivity less than 500 µS/cm or a total concentration less than 350 ppm. Too much sodium and boron can be harmful and very soft water should be used with calcium containing nutrients. [2,25]

Sun light & Artificial LED light

Sunlight is an important requirement for hydroponic system. If the system is setup in a green house, it can get enough sunlight so doesn't require more artificial LED light. But if the system is setup indoor, it needs more LED lights. LED grow lights emit only one colour spectrum which is required for photosynthesis. They consumes less amount of electricity compared to traditional lighting system. The red spectrum gives natural sun rays and blue spectrum provides an ideal light for plant growth. These lights don't contain harmful mercury. Good quality LED grow lights can be used for 10-12 years. [2]

Air : We can provide Air to plants ,because plats roots are submerged in water.for optimal growth it is recommended to have 1 litre per minute of air pumped into each gallon of nutrient solution,likewise 100 gallon reservoir would require a 100 LPM air pump for maximum oxygenation.

Growth fortifiers

Certain solutions which can stimulate faster nutrient absorption and boost up stem & leaf growth are developed in commercial way, are called as growth fortifiers. Usually NPK fortifiers are used to enhance plant growth. [2]

4. RESULT AND DISCUSSION

Advantages & Disadvantages of Hydroponics

4.1 Advantages :

- Hydroponics technology is majorly used for water conservation, as it requires less water than traditional farming and saves a huge amount of water. It increases yield per unit area and reduce water usage. Less fertilizers are used in hydroponics system [2,5,18]
- Labour work and maintenance is lesser than that on the farm for the same amount of crop production. Fertilization and irrigation can be done by automated systems.
- It takes less time to grow. Plants grow faster in hydroponics technology because there is no mechanical impediment to the roots and nutrients are available in plenty of amount. High pressure sodium lamps & Metal halide are used to increase plant growth. It helps plants to grow faster and healthier. [2,18]
- Nutrients and water can be recycled and it can prevent soil pollution and doesn't pollute the environment. [2,18]
- It gives contamination free crops because of the use of good quality water, nutrients and sanitisation and free from nematodes too. [18]
- Hydroponic technology is useful for improving the incomes of people who are self-employed and can do this from their own houses and can sell veggies online or in the market. [18]

4.2 Disadvantages

- It is costlier than traditional farming. The equipment, nutrient solutions, containers, automated systems have high production cost. Lack of knowledge, experience, technical and scientific support can result it into failure. [18]
- Lack of knowledge of agricultural practices, the required use of nutrient solutions and perseverance & dedication to work can be the reasons for severe loss of plants. Patience, dedication and efforts are the most required things. [18]

5. REFERENCES:

1. Aatif Hussain*, Kaiser Iqbal, Showket Aziem, Prasanto Mahato & A. K. Negi. A review on the science of growing crps without soil (soilless culture) – A novel alternative for growing crops.
2. Abdellah Rababah. Hydroponics removal of wastewater's contaminants for the generation of commercially valuable plants and environmentally sound effluent for the dead sea communities.
3. Akashi Satoh. A hydroponic planter system to enable an urban agriculture service industry.
4. Aleksa Đurić*, Natalija Bogdanović, Vukašin Petrović, Mila Mihajilović, Gordana Bogdanovic, Vanja Šušteršič, Lazar Petrović, Anđelija Bogdanović. New concepts for cities that produce – food for billions (Technological, Economic, Social and Legal aspects of vertical farming)
5. Alexa Browne. Hydroponic towering agriculture vs traditional soil farming in Southern Arizona.
6. Ali AlShrouf. Hydroponics, Aeroponic and Aquaponic as compared with Conventional farming.
7. Amna Rafi Chaudhry* & Ved P Mishra. A comparative analysis of vertical agriculture systems in residential apartments.
8. Andrew Jezak*, Claire Pavelka*, Carson Edgerton, Alex Estrada, Katya Fairchok, Michele T. Parker, Hohyun Lee, Laura Doyle & Andrew Feldmeth. Addressing water insecurity with a Greywater Hydroponics system in South Africa.
9. Ankur Agarwal*, Tribhuwan Pant, A. S. Bhoj, R. P. Joshi, Om Prakash & Sanjai K. Dwiwedi. Vegetable cultivation under Hydroponics in Himalayas : Challenges and Opportunities.
10. Ann Mary Jephi*, Vipinkumar V. P., Athira P. V. & Jeethumol T. J. Assembling a small scale Aquaponics system.

11. Arshad Mahmood Malik*, Khalid Mahmood Mughal, Muhammad Aamir Khan, Amjad Masood. Impact of Hydroponics technology in Pakistan's fruits and vegetable sector and global trade : A CGE analysis.
12. A. Sheikh. Hydroponics : Key to sustain agriculture in water stressed and urban environment.
13. Beth McDonald* & Dr. Bierly. Hydroponics : Creating food for today and for tomorrow.
14. Biswajit Pramanick* & Akshita Bhatt. Hydroponics : A new frontier towards sustainable agriculture.
15. Chase Heffrnan. Bolivia : Using hydroponics to protect agriculture from erratic weather.
16. D Indira*, P Aruna, S Swetha Kanthi & K Kumar. Hydroponics as an alternative fodder for sustainable livestock production.
17. Dinkar J. Gaikwad* & Sagar Maitra. Hydroponics cultivation of crops.
18. Dr. Peter Wootton-Beard. Growing without soil – An overview of Hydroponics.
19. Edi Setiadi Putra*, J. Jamaludin & M. Djalu Djatmiko. Comparation of Hydroponic system design for rural communities in Indonesia.
20. Gurdeep Singh Malhi*, Manpreet Kaur, Kartik Sharma & Gaurendra Gupta. Hydroponics technology for green fodder production under resource deficit condition.
21. Hamid R. Roosta*, Simin Afsharipoor. Effects of different cultivation media on vegetative growth, ecophysiological traits and nutrients concentration in Strawberry under Hydroponic and Aquaponic cultivation systems.
22. Hardeep Singh* & Dunn Bruce. Electrical conductivity and pH guide for hydroponics.
23. Herman*, Demi Adidrana, Nico Surantha & Suharjito. Hydroponic nutrient control system based on internet of things.
24. Indira Roy*, Yelena Naumova, A. J. Both. Assessment of electricity-free Hydroponics in India : A proof of concept field study.
25. J. I. Filimonova*, M. V. Tkacheva. Automation of Hydroponics.
26. João Raúl Rodrigues Da Silva Lima. Low energy communication network for control and supervision of Hydroponic farms.
27. José de Anda* & Harvey Shear. Potential of vertical hydroponic agriculture in Mexico.
28. K. P. Ferentinos*, L. D. Albright. Predictive neural network modelling of pH and electrical conductivity in Deep-trough Hydroponics.
29. Kelly Jones* & William. Farming sustainably : Using renewable energy to power hydroponics farming.
30. Kiran George*, Vaibhav Palande, Adam Zaheer. Fully automated hydroponic system for indoor plant growth.
31. L. Q. Ma*, S. Tu. Interactive effects of pH, arsenic and phosphorus on uptake of As and P and growth of the arsenic hyperaccumulator *Pteris vittate* L. under hydroponic conditions.
32. Lemma Tessema*, Zebenay Dagne. Aeroponics and sand hydroponics : Alternative technologies for pre-basic seed Potato production in Ethiopia.
33. Libia Iris Trejo-Téllez* & Fernando C Gómez-Merino. Nutrient solutions for Hydroponic systems.
34. M. Fecondini*, A. C. Damasio de Faria, N. Michelon, M. Mezzetti, F. Orsini & G. Gianquinto. Learning the value of gardening : Results from an experience of community based simplified hydroponics in North-East Brazil.
35. M. Yuvaraj* & K. S. Subramanian. Different types of Hydroponics system.
36. Mamta D. Sardare* & Shraddha V. Admane. A review on plant without soil – Hydroponics.
37. Marianne Thomsen*, Daina Romeo & Eldbjørg Blikra Vea[a]. Environmental impacts of urban hydroponics in Europe : A case study in Lyon.
38. Marshall Song. Hydroponics : The easiest way to achieve sustainable agriculture in China.
39. Mouneshwari R Kumar*, Arjun Sulagitti, Mahesh Kadagi & AP Biradar. An experience of hydroponics fodder production by farmers of Bagalkot district.
40. Murli Mugundhan. R*, Soundaria. M, Maheshwari. V, Santhkumari. P and Gopal. V. "Hydroponics" – A novel alternative for Geoponic cultivation of medicinal plants and food crops. (P- 287-291,293,295)
41. N. A. Banu, N. C. Barman, M. M. Hasan & M. R. Islam. A review on present status and future prospective of hydroponics technique.
42. Nonigopal Shit. Hydroponic fodder production : An alternative technology for sustainable livestock production in India.
43. P Gopinath*, P. Irene Vethamoni & M. Gomathi. Aeroponics soilless cultivation system for vegetable crops.

44. Prof Chungui Lu. Feeding the future : Sustainable urban agriculture/ vertical farming.
45. Rhuanito Soranz Ferrarezi*, Roberto Testezlaf. Performance of wick irrigation system using self-compensating troughs with substrates for Lettuce production.
46. Robert W. Taylor*, J. S. Carandang, C. Alexander, J. S. Calleja. Making global cities sustainable : Urban rooftop hydroponics for diversified agriculture in emerging economics.
47. Rodríguez-Delfín[a]. Advances of Hydroponics in Latin America.
48. S. Boopathy*, Gokul Anand. K. R & N. R. Rajalakshmi. Smart irrigation system for Mint cultivation through Hydroponics using IOT.
49. S. Charumathi*, R. M. Kaviya, J. Kumariyarasi, R. Manisha & P. Dhivya. Optimization and control of hydroponics agriculture using IOT.
50. S. Krishna Praba* & R. Deepika. Promoting hydroponic cropping for future farming in agricultural sector with special reference to Coimbatore city.
51. Sachin Kumar*, Abha Sharma, SS Rana. Vertical farming : New agricultural approach for 21st century.
52. Sarah Gould. Internal design of a hydroponics greenhouse for tri cycle farms.
53. Sarah J. Morath. Hydroponics : The end of organic?
54. Shalini Kumari*, Pratibha Pradhan, Ramjeet Yadav & Santosh Kumar. Hydroponic techniques : A soilless cultivation in agriculture.
55. Shantanu Kumar SAHA. Soilless cultivation for landless people : An alternative livelihood practice through indigenous hydroponic agriculture in flood-prone Bangladesh.
56. Somen Acharya*, Nisha Sharma, Kaushal Kumar, Narendra Singh & O. P. Chaurasia. Hydroponics as an advanced technique for vegetable production : An overview.
57. Suzana L. Nixdorf*, Diego S. Domingues, Hideaki W. Takahashi & Carlos A. P. Camara. Automated system developed to control pH and concentration of nutrient solution evaluated in hydroponic lettuce production.
58. Tanveer Ahmad Ahngar*, Seerat Jan, Zahida Rashid, Sadaf Iqbal, M. Abbass Naikoo, Shabina Majeed, Tauseef Ahmad Bhat, Razia Gul & Insha Nazir. Hydroponics – A review.
59. W. H. Schnitzler. Urban hydroponics for green and clean cities and for food security.
60. Zia-Ul-Haq*, Abdul Qadeer, Shahid Javed Butt, Hamza Muneer Asam, Talha Mehmood, Muhammad Kazim Nawaz & Sohail Raza Haidree. Hydroponics as an innovative technique for Lettuce production in greenhouse environment.