To Study the Correlation between the Traditional Techniques and Aeroponic System for Conservation of Water and Land

[1]Padmashree, [2]Rohan S Gurav
[1]P.G. Student, [2]Asst.Professor
[1]Department of studies in Water and Land Management, VTU, Belagavi, India

Abstract— **Scarcity of water and degrading in the land are the two common problem faced by all over world. Because of fast urbanization and industrialization and additionally liquefying of chunks of ice, arable land under development is further going to diminish. Once more, soil richness status has achieved an saturation level, and efficiency isn't expanding further with expanded level of manure application. In addition, poor soil ripeness in a portion of the cultivable zones, les shot of normal soil richness develop by microorganisms because of constant cultivation, visit dry spell condition and undependability of atmosphere and climate, ascend in temperature, waterway contamination, poor water administration and wastage of enormous quantity of water, decrease in ground water level, and so on are decline food generation under tradition soil-based culture. Under this situation it is difficulty to fulfill the entire population by conventional technique. To solve such problems experiment was carried out on aeroponics and compared with conventional method (by available data). Aeroponics is process of growing plants in air or mist condition without the utilization of soil. We were chosen the Lettuce plants for study. Observation was done continuously. This study helped to conservation of land and water and therefore proving to be best technology for current problems in the world.**

Key words—**Aeroponics system, growth, coco peat, traditional method.**

I. INTRODUCTION

The present world is its own speed of going to the innovation in each part of everyday life. The expanding innovation additionally has put parcel more harmful effect on human life. The principle downside is that the expanding rate of shortage of water and ascent of solid structures by making an inaccessibility of fruitful land for agribusiness. So to control such negative effects another innovation has developed called aeroponics. It is the way toward developing plants in air or fog condition without the utilization of soil. The word aeroponics is gotten from the Greek. Aer implies air and ponics implies work. When looking at hydroponics and aeroponics, a portion of the fundamentals standards are comparable however one thing unique, in aeroponics does not utilize a developing medium. This is mostly because of the way that an aeroponics framework utilized water (as air or fog) to convey the supplements.

II. OBJECTIVES

- To build up a pilot scale framework for the aeroponics and.
- To select the two crops which is belonging to leafy group and monitoring the growth of those crops in aeroponics system and comparison with the conventional method.
- To monitoring the nutrient value of the aeroponics system.
- To monitoring quantity of water required for the system.
- To concentrate the costing between the aeroponics system and conventional method.
- To concentrate on the crop period and yield of chosen plants in aeroponics framework in comparison with the traditional method.

III. MATERIALS AND METHODOLOGY

A. Fundamental Requirements of Aeroponics

1. Germination Medium

The germinating medium for aeroponic growth is an inert medium which does not give any supplements to the plant. It just gives the support to the roots to create in. Coco coir fiber, Rockwool, Perlite, Vermiculite, LECA, Expanded mud, Pulverized shake, Sand, Scoria, Gravel are the varied sorts of creating mediums open for germinating plants aeroponically. A germinating medium empowers us to incorporate the correct measure of supplements and moreover screen the pH in a aeroponics system. Moreover, using a germinating medium other than soil has a few interesting reason that includes:

1. Abhorrence of root penetrations.
2. Sustenance of palatable oxygen and water and
3. Extended air course and draining.

The creating medium favored for the examination

Coco Coir: Coir is produced using the external husk of coconuts; it is a byproduct of the coconut industry. It is normally sold as stuffs, pieces, or slabs. It is greatly absorptive and holds water well between irrigation cycles while likewise giving great root air circulation. It contains anti-fungal microorganisms and can likewise be vaccinated with extra beneficial organisms. It should

keep going for quite a long while of utilization before it should be supplanted. Depending on production methods, coir may contain high salt levels at the season of procurement; it is important, in this manner, to purchase coir that is named as having low EC or low salt levels. Coir isn't inactive; it contains potassium. Subsequently, you might need to utilize a coir-particular supplement absolution which will give supplements at a proportion proper for developing in coir. Not at all like Rockwool, coir is biodegradable and renewable.

It comes in two designs:

1. The customary one includes in hard squares, or chips in plastic sacks, which will expand hugely when watered. This brand has incredible water support and cation exchange constrains, and is adequately relentless so as not to separate too snappy.
2. The most cutting-edge marks come in woven 3D squares and pieces which have hardly any water support farthest point, and should simply be used as a piece of occasions of predictable watering cycles. The accomplice is their optimal waste and air dissemination limits.

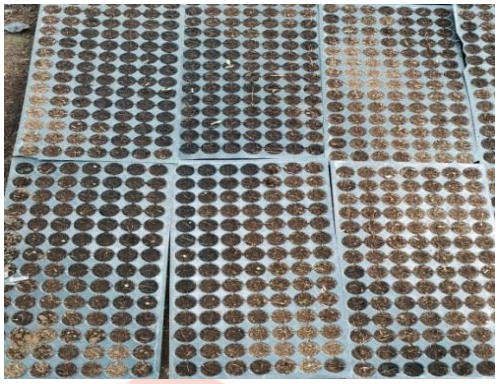


Fig.1 Coco peat

3. A simple aeroponic system

A PVC pipe of length 4 feet, 6 inch diameter. Carefully cut the pipe openings for the net pots utilizing a drill. Totally comprising if 26 slots. Place the pump with riser and sprinkler head in the base of the container (tank).Water tank of capacity 20 litres is used for the study. A motor of ¼ HP is used for pumping of water blended with nutrient solution to the arrangement. Place the net pots in the gaps and place the lettuce plants in the net pots.

Fig.2 Aeroponics system

4. Nutrient solution

Most herbs grow well with a basic nutrient solution. Many readymade choices are available. Care must be taken to avoid minor nutrient deficiencies. Several different herbs may be grown in a single nutrient solution.4 ml of supplement arrangement was added to each one litre of water that is at initially added 80ml of supplement arrangement for 20litres of water.

Table 1 Macro and Micro Nutrients

Sl. No	Macro-nutrients	Micro-nutrients
1	Carbon – Formation of organic compounds	Iron- Used in Photosynthesis
2	Oxygen- Release of energy from sugar	Boron – Vital for reproduction
3	Hydrogen- Water formation	Chlorine - Helps root growth
4	Nitrogen- Chlorophyll, Amino Acids and Proteins synthesis.	Copper- Enzyme activation
5	Phosphorus- Vital for photosynthesis and growth.	Manganese- Component of chlorophyll, Enzyme activation
6	Potassium- Enzyme activity	Zinc- Component of enzymes and auxins
7	Calcium- Cell growth, cell division and the components of cell wall	Molybdenum-Nitrogen fixation
8	Magnesium-Component of chlorophyll, enzyme activation	Cobalt-Nitrogen fixation
9	**Sulphur - Formation of Amino Acids and Proteins**	

a. Other Elements

Sodium- Vital for water movement,
Nickel- Nitrogen liberation,
Silicon- Cell wall toughness
The pH adjusted to 6 – 7.5
TDS- It should be 560 – 840 ppm

- **Temperature:** It affects plant in two ways. High temperatures tend to accelerate the growth of the plant which increases the plant need for water.
- Air movement has a dramatic influence on the plants consumption of water particularly when combined with high temperature.
- **Water**: As a general rule, all water suitable to drink or used to irrigate greenhouses is ideal for aeroponics.
- **Light**: Areas that already get sunlight will need fewer aeroponic lights than an aeroponic garden grown in a fully enclosed room.

5. Seeds Selected

Fig.2 lettuce seeds

The lettuce goes under the daisy family.it is an annual plant. It is a standout amongst the most imperative vegetable harvests on the planet. Lettuce is used for salads, soups and sandwiches. Lettuce is rich in vitamin A, C and minerals like calcium and iron. It likewise contains protein and starches. There is variety in nutritive values in various kinds of lettuce, leaf composes being the wealthiest taken after by margarine header and fresh heads.

Plants for the most part have tallness and spread of 15 to 30 cm (6 to 12 in).The leaves are colorful, fundamentally in the green and red shading ranges, with some variegated varieties. There are additionally a couple of groups with yellow, gold or blue-greenish blue leaves. Lettuces have an extensive variety of shapes and surfaces, from the thick heads of the chunk of ice compose to the indented, scalloped, and frilly or roughly leave of leaf groups.

Contingent upon the assortment and season, lettuce commonly lives 65–130 days from planting to collecting. Since lettuce that blooms turns out to be intense and unsalable, plants developed for utilization are once in a while permitted to develop to development. Lettuce blooms all the more rapidly in hot temperatures, while cold temperatures cause slower development and sometimes harm to external plants.

B. Methodology

1. Germination

On 22nd of March 2018, the seeds of Lettuce seeds were placed in the media of Coco peat. 98 3D squares coco peat are used. Coco peat strong shapes where drilled with openings at the base to ensure the water squander was sensible as this will shield the plants from drying. 24 number of chosen seeds of lettuce where put in 3D square coco peat for germination. Seeds starts germinating, it required 20 days to complete germination.

Germination growth of lettuce seeds:-

At the end of 1st week - No leaf, only seed breaking will take place

At the end of 2nd week - Small tree

At the end of 3rd week - 5 leafs

Fig.4 Lettuce seeds at the germination stage

2. Transplantation

Once the germination is completed the seedling from coco peat media are transferred to aeroponic system on 2nd of April. Once the transplantation is done the working system on the aeroponics was with the goal that 4 ml of supplement was added to every one liter of water that is 100ml of nutrient was added for 52 liters of water.

The essential parts considered for the advancement in the aeroponic system where the pH and the TDS. The pH and TDS values where noted down weekly twice, determining of PH and TDS where influenced using pH to meter and TDS meter. The supply of nutrient solution for the aeroponic system was made for the term as a 4min per hour.

As the perception was under process it was seen that the plants in the aeroponic framework had a fast development than that of the conventional media.

3. pH and TDS

The fundamental parts measured for the improvement in the aeroponic were the pH and the TDS. The pH and TDS were recorded for reliably on a typical, Reading of pH level and TDS level were measured using pH meter and TDS meter.

One of the greatest purposes important to aeroponics is regulate, and one of the key parts to regulate is the water. Both the pH regard and TDS accept a crucial part in the soundness of the aeroponic system. In the event that the water's pH regard is too low or too high the plants encounter trouble utilizing a whole display of different supplements. In case your supplement quality is too small it will possible cause needs, too high and you get supplement devour or dart out. TDS stay for signify separated solids and suggests the measure of all substances contained in a liquid. It is the estimation used to choose supplement quality. TDS in aeroponics for this examination is taken similarly as Parts per Million (PPM).

In aeroponics, plants alike it barely more acidic, and pH regard between 6– 7.5 is regularly best. The pH scale is an instrument to check the Acid or Basic in supplement solution. The official significance of pH is: a unit of measure that depicts the level of sharpness or alkalinity of a liquid solution.

The pH of the supplement solution is fundamental to the plants since it will impact how well every part can experience the root cell divider and bolster the plant. Right when the pH of the supplement solution is out of altering the plants are not able take-up the supplements in the water, basically starving them, despite when there is a ton of sustenance.

When estimating the pH the supplements are mixed with the water absolutely first to ensure a certifiable examining. If the scrutinizing isn't at the right level there is need to adjust it using pH specialists called "pH up" and "pH down," Depending on atmosphere the examining is too high or too low. If it's too high use the pH down, and if it's too low use the pH up. The pH operators can touch base in a dry or liquid shape; either will work fine yet guarantee you mix it absolutely before taking another examining. The pH specialist used for the examination was in liquid frame.

The supplement retention rate is also enhanced by the reducing the TDS, which decreases osmotic weight and empowers the roots to draw the supplements "less difficult". Young, developed seedlings or recognized cuttings are started at cut down TDS. The TDS is increased to higher motivator in the midst of peak vegetative advancement by including again few ml of supplement solution. In the midst of the move from ideal on time to overpowering sprouting, TDS is furthermore raised. It is then diminished to in the midst of the most recent 2 weeks of flushing.

The trimming strategy required for the aeroponic system was blended editing technique thus as far as possible for the TDS is kept up to be 1200-1400.

IV. Results And Discussions

1. Readings of per day growth of lettuce plants in aeroponic system.

The below table show every day growth of plant in aeroponic system. The plants in aeroponic framework were examined as needs be to their product period suited for the framework and at a rough temperature at the located area was around 32o centigrade.

Table 2 Growth of Lettuce Plant

Days	Height of lettuce plant (cm)
1	7
2	8
3	9
4	10
5	10
6	11
7	12
8	13
9	14
10	15
11	16
12	17
13	18
14	19
15	20
16	22
17	23
18	25
19	27
20	29
21	30
22	32
23	38
24	34
25	36
26	38
27	40
28	41
29	43
30	44
31	46
32	47
33	48
34	50
35	Here onwards bunching of plants will start
36	
37	
38	
39	
40	
41	
42	
43	
44	
45	

2. Observation done for lettuce plant

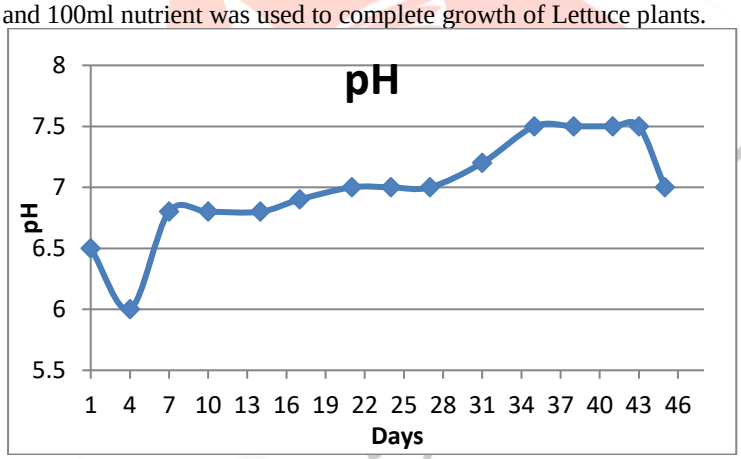
From the below table we can observe that the pH will be maintained in between 6 to 7.5 and TDS will be maintained in between 560-840 ppm. The time taken by Lettuce leaves for their growth was 45 days in aeroponic system and 20 days in germination process. The total days of complete growth 65 days and water used by Lettuce leaves 50 litters for 24 pots.

Table 3 Observation done for lettuce plant

Days	pH	TDS (ppm)	Water added (Liter)	Nutrients added (ml)
2-04-2018	6.5	578	20	80

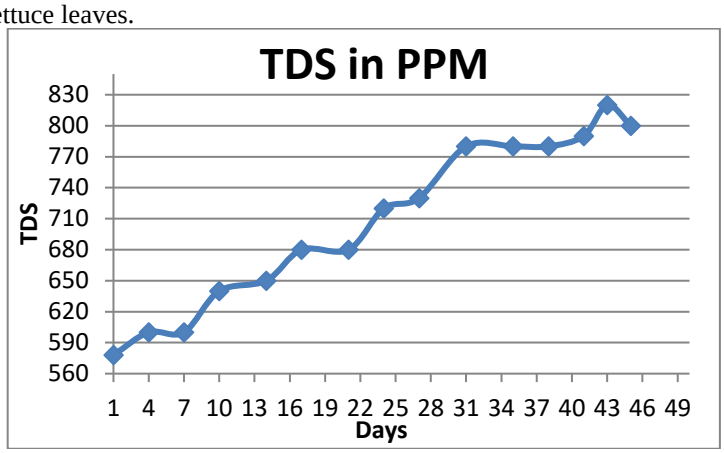
6-04-2018	6	600	1	
9-04-2018	6.8	600	2	
12-04-2018	6.8	640	2	
16-04-2018	6.8	650	3	
19-04-2018	6.9	680	3	10
23-04-2018	7	680	4	
26-04-2018	7	720	5	
29-04-2018	7	730	3	
03-05-2018	7.2	780	3	
07-05-2018	7.5	780	2	10
10-05-2018	7.5	780	2	
13-05-2018	7.5	790	1	
15-05-2018	7.5	820	1	
17-05-2018	7	800	0	
			52(Total)	

Totally 52 liter water and 100ml nutrient was used to complete growth of Lettuce plants.



Graph 1: pH graph

The above graph shows the values of pH in nutrient solution measured using pH meter. The maximum value is 7.5 and the minimum value is 6 for the Lettuce leaves.



Graph 2. TDS graph

The above graph shows the values of TDS in nutrient solution measured using TDS meter. The maximum value is 820ppm and the minimum value is 578ppm for the Lettuce leaves.

3. Calculation and Estimation

1. Area we used for 24 lettuce plants is
   $A = 2\pi h + 2\pi r^2$
   $A = 2 \times \pi \times 4 + 2 \times \pi (6)^2$
   $A = 824.66\ cm^2$ or
   $A = 0.0824\ m^2$ or $0.887\ ft^2$
   Total area is $0.887\ ft^2$ for 24 lettuce plants.
2. Cost of nutrients = 150 Rs per liter + 18 % GST
   Hence we used 100ml (0.1 liter) of nutrients
   So, 0.1 x (150 + 18%) = 17 Rs for 100ml of nutrients.
3. Electricity consumption = 26 units
   = 80 Rs
4. Cost of seeds
   110 Rs for 100 seeds
   For 24 lettuce seeds = 26 Rs
5. For $0.887\ ft^2$ area we get yield 7.2 kg
   Rate of 1 kg lettuce = 90 Rs
   Earning after first cycle (90 x 7.2) = 648
   Hence, total expenditure is 123 Rs for 24 lettuce plants
   Net profit for each cycle is 525 Rs
   Expenditure to create a aeroponics system is 5000 Rs
6. Water used by aeroponics system was 52 liter per $0.088ft^2$ for 24 plants.

For conventional method

In conventional method according to available data (The food project, growing guide 2010) 4 lettuces per ft^2 are to be planted. By utilizing vertical aeroponics system 24 plants per $0.887\ ft^2$ are planted.

According to Jack Rabin (2012) yield to be 0.54kg per ft^2 is expected in conventional method. Yield of lettuce plats in aeroponics system = 7.9kg per $0.0887\ ft^2$.

As per the Guilherme Lages Barbosa et al., (2015) water consumption of lettuce plants is 965 liter per m^2. In aeroponics we used 52 liter per $0.887\ ft^2$. That means 27.5 % less than the conventional method.

Fig 6. Final Yield of Lettuce

The above fig 6.1 shows the yield of lettuce from aeroponics system. It is free from diseases.

CONCLUSION

1) In the above examination it was proved that the development of the plants was seen to be speedier, health and wellbeing giving in the aeroponic framework than in the traditional strategy. The development in the tallness of the plants was observed to be more in aeroponic framework than that of the traditional technique.
2) The plant considered for the investigation was observed to be without sickness in the aeroponic framework.
3) The yield obtained from aeroponic framework is more compared to traditional technique because in traditional technique some of seeds are not found any growth.
4) The plants in aeroponics system are less crop period compared to traditional technique.
5) The water used in aeroponics system was very much less compared to traditional technique.
6) In aeroponics system plants can grow in all season.
7) There is no utilization of pesticides in aeroponics system. So it is eco-friendly.
8) Possibility of executing aeroponic framework in any sort of non-agricultural land or waste land.
9) Conservation of water by aeroponics system was highly achieved. It is consumed 27.5% less water than conventional method.
10) Conservation of land also greatly archived in aeroponics system. Utilizing vertical aeroponics system we get yield 7.2kg per $0.887\ ft^2$. According to Jack Rabin (2012) yield to be 0.54kg per ft^2 is expected in conventional method.

REFERENCES

1) Jernej Demsar, Joze Osvald, and Dominik Vodnik "The Effect of Light-dependent Application of Nitrate on Growth of Aeroponically Grown Lettuce," J.Amer.Soc.Hort, Sci, 129(4):570-575, 2004.
2) P Mithunesh, Kiran Gupta, Sujata Ghule, Prof. Shailesh Hule "Aeroponic Based Controlled Environment Based Farming System," IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 17, Issue 6, Ver. II (Nov – Dec. 2015), PP 55-58 www.iosrjournals.org.
3) P Gopinath, P. Irene Vethamoni and M. Gomathi "Aeroponics Soilless Cultivation System for Vegetable Crops," Chem Sci Rev Lett 2017, 6(22), 838-849, ISSN 2278-6783, Article CS072048042.
4) Amrita Sengupta and Hirak Banerjee "Soil-less culture in modern agriculture," World Journal of Science and Technology 2012, 2(7):103-108 ISSN: 2231 – 2587 www.worldjournalofscience.com.
5) Lindsey J. du Toit, H. Walker Kirby, Wayne L. Pedersen "Evaluation of an Aeroponics System to Screen Maize Genotypes for Resistance to Fusarium graminearum Seedling Blight," Publication no. D-1996-1217-04R © 1997 the American Phytopathological Society.
6) Richard W. Zobel, Peter Del Tredici, And John G. Torrey "Method for Growing Plants Aeroponically," Plant Physiol. (1976) 57, 344-346.
7) R.E. Wagner and H.T.Wilkinson "An Aeroponics System for investigation Disease Development on Soybean Taproots Infected with Phytophthora sojae," 1992 American Phytopathological Society, Plant Disease/vol. 76 No. 6.
8) Suman Chandra, Shabana Khan, Bharathi Avula, Hemant Lata, Min Hye Yang, Mahmoud A. ElSohly and Ikhlas A. Khan "Assessment of Total Phenolic and Flavonoid Content, Antioxidant Properties, and Yield of Aeroponically and Conventionally Grown Leafy Vegetables and Fruit Crops: A Comparative Study," Hindawi Publishing Corporation Evidence-Based Complementary and Alternative Medicine Volume 2014, Article ID 253875, 9 pages,http://dx.doi.org/10.1155/2014/253875.
9) Margaret Chiipanthenga, Moses Maliro, Paul Demo and Joyce Njoloma "Potential of aeroponics system in the production of quality potato (solanum tuberosum l.) seed in developing countries," African Journal of Biotechnology Vol. 11(17), pp. 3993-3999, 28 February, 2012 Available online at http://www.academicjournals.org/AJB DOI: 10.5897/AJB10.1138 ISSN 1684–5315 © 2012 Academic Journals.
10) Georgios Salachas, Dimitrios Savvas, Konstantina Argyropoulou, Petros Andrea Tarantillis, Georgios Kapotis "Yield and nutritional quality of aeroponically cultivated basil as affected by the available root-zone volume," Emirates Journal of Food and Agriculture. 2015. 27(12): 911-918 doi: 10.9755/ejfa.2015-05-233 http://www.ejfa.me/