Vertical Farming with Aeroponics

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Abstract- *AEROPONICS is a system of growing plants without soil in suspended air with intermittent application of nutrient laden water to the roots of the plants in the form of mist. In our project we are using the above technique to grow lettuce, radish and Cucumber .A hole is made into the sidewalls of the PVC pipe and then the mesh pots are placed in the hole to hold the plant. The bottom of the pot acts as a supporting structure and separate root from the plant. A mist chamber is provided inside the PVC pipe to supply nutrient laden water in the form of mist to the roots which is automated for the regular supply of nutrients by using motor. These conditions allow for better plant nutrition assimilation in a more balanced way. The plants are provided with best condition regarding oxygenation and moisture. The nutrient solution we are using is the fish amino acid. As it is a soil less cultivation we are using rock wool as a germinating media. We are doing Aeroponics vertically to do agriculture in a limited space to meet the demands of the people as in growing population and reduction in cultivable land. This technique is more beneficial when compared to current farming techniques as in this we are using the resources to a full extent like this is the only farming method where limited water is used, decreases labor ,expenses and environmental friendly.*

Keywords- Aeroponic kit, Mist Chamber, PVC pipes, Nutrient laden solution

I. INTRODUCTION

Recently, the application of Vertical Farming into cities has increased. Vertical farming is a cultivating vegetable vertically by new agricultural methods, which combines the design of building and farms all together in a high-rise building inside the cities. This technology needs to be manifest both in the agricultural technique and architectural technology together. However, little has been published on the technology of Vertical Farming. “We live vertically, so why can’t we farm vertically?” Due to the limited access to land for farming, there is a need for sustaining farming tasks so as to pave the way for adding to food needs. Many aspects press on food industry and processing such as growth of population and its growing needs accordingly, reduction of natural sources due to growing cities, earth erosion, different forms of contamination, advent of biofuels, restrictions imposed on food production techniques affected by customers and rule providers which requires better quality, less use of chemicals and many useful environmental attempts ‘from farm to fork’. Recently, environmental obsessions have been mixed with rising obsession with health as architecture design is concerned. Therefore, it has led to more interest in providing healthy food and incorporating it in the sustainable development project .

The answer to these issues is Vertical Farming (VF). VF has grown as a project which combines the design of building and farms all together in a high-rise building. VF is a system of growing crops in skyscrapers, to maximize the use of land by having a vertical design whereby plants, animals, fungi and other life forms are cultivated for food, fuel, fiber… by artificially stacking them vertically above each other .Vertical farms are now used in a lot of countries. At present, these farms are largely grown and produce different types of crops inside cities. Aeroponics growing of plants is becoming a household name for growing plants for their daily food at their kitchen table in metropolitan regions. When the prices of vegetables are growing high and the quality is not fresh farm, above all they all are not chemical free. Because this is a soil-less technique of growing plants, the manual work is cut down considerably while leaving no traces of soil stains. Once it is designed and placed, it begins to operate mechanically with minimum garden

Work is done to be taken care of. Aeroponics farming can be done to develop few plants to a high number of crops and types growing together by utilizing the maximum distance.

OBJECTIVE

The main objective is to face all the food requirement of the growing population, with the modern developed technology for cultivation which yields base equal to the field cultivation.

- To make farming easier to manage.
- To increase plant growth rate and yield.
- To produce disease free crops.
- To minimize the use of water.

SYSTEM ARCHITURE

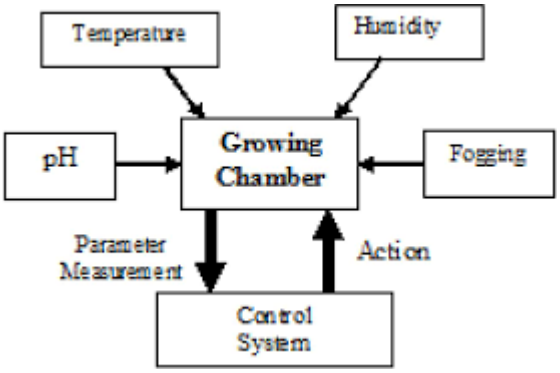


Fig.1 : System Working Procedure

II. MATERIALS USED

- PVC Pipe
- Fish Amino Acid
- Mesh Bucket
- Rockwool
- Motor
- Seed Tray
- Lettuce and Cucumber Seeds
- Mist Chamber

III. MATERIALS DESCRIPTION

1. PVC PIPE:

These pipes are used in making Aeroponics kit in fixing all their joints where the plants are transplanted from vertical farming to the Aeroponics cultivation.

PROPERTIES OF PVC PIPE:

- Tensile strength
- It helps to hold mesh buckets with plants
- Useful for vertical farming


Fig.2 PVC Pipe

2. MESH BUCKET:

They are used to hold the transplanted seed saplings into the Aeroponics kit over the side walls of the PVC pipes.

PROPERTIES OF MESH BUCKETS:

- Plant holder
- Promote healthy roots
- Even drainage
- Proper aeration


Fig.3 Mesh buckets

3. ROCK WOOL:

It is one of the soil substitute medium where the seeds are sown and grown instead of growing them over the soil.

PROPERTIES OF ROCKWOOL:

- It has better water holding capacity.
- It helps in increasing root zone activity
- It is light weight
- Soilless germinating medium.


Fig 4.Rock wool

4. SEED TRAY:

These trays are used to gro the seedlinds sown over the rockwool and the planned to be transplanted at a particular stage of their transplanting stage of growth.

PROPERTIES OF SEED TRAY:

- Non toxic
- Light weight

- Do not damage roots
- Save seeds

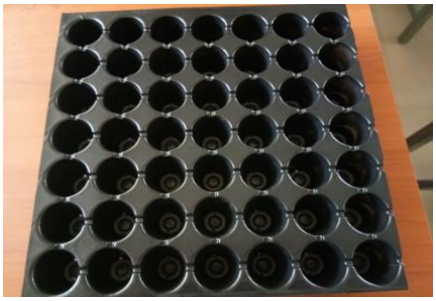


Fig 4: Seed tray.

5. LETTUSE SEEDS:

Kingdom	:	Plant
Order	:	Asterales
Family	:	Asteraceae

PROPERTIES OF LETTUSE SEEDS:

Lettuce is an annual plant of the daisy family, Asteraceae. It is most often grown as a leaf vegetable, but sometimes for its stem and seeds. Lettuce is most often used for salads, although it is also seen in other kinds of food, such as soups, sandwiches and wraps; it can also be grilled. One variety, the woju, or asparagus lettuce, is grown for its stems, which ar`e eaten either raw or cooked. In addition to its main use as a leafy green, it has also gathered religious and medicinal significance over centuries of human consumption. Europe and North America originally dominated the market for lettuce, but by the late Light – either direct sunlight for an outdoor vertical garden or artificial grow lights for an indoor one.

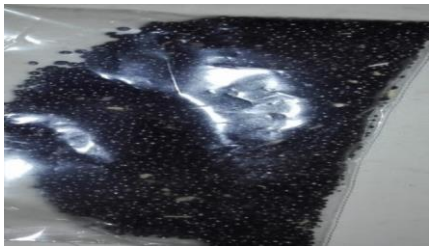


Fig 5: Lettuse seeds

6. RADISH SEEDS:

The radish (Raphanus raphanistrum subsp. sativus or Raphanus sativus) is an edible root vegetable of the family Brassicaceae that was domesticated in Asia in pre-Roman times. Radishes are grown and consumed throughout the world, being mostly eaten raw as a crunchy salad vegetable with bite.

Fig.6. Radish seeds

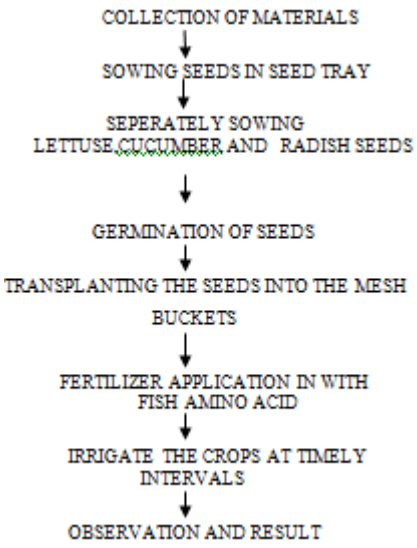
7. CUCUMBER SEEDS:

Cucumber (*Cucumis sativus*) is a widely cultivated plant in the gourd family, Cucurbitaceae. It is a creeping vine that bears cucumiform fruits that are used as vegetables. There are three main varieties of cucumber: *slicing*, *pickling*, and *seedless*. Within these varieties, several cultivars have been created. In North America, the term "wild cucumber" refers to plants in the genera *Echinocystis* and *Marah*, but these are not closely related. The cucumber is originally from South Asia, but now grows on most continents. Many different types of cucumber are traded on the global market.

8. AEROPONIC KIT:

Fig.8. Aeroponics kit.

IV. METHODOLOGY



V. RESULT AND DISCUSSION

Technical Analysis Informants reported on the possibility of transferring and replicating these technologies using local materials, equipment and personnel. None of the technologies have any patents and all have been adapted locally. The difference related to the degree of or local adjustment. The aeroponics and fiber-cement tiles technologies generally need a high degree of local adaptation, while the semi-hydroponics and conventional technologies require interme-diate to modest levels of adaptation respectively. With regard to the aeroponics and fiber-cement tiles technologies, potential for replicability in developing countries can be relatively low in light of requirements for equipment, external inputs and specialized personnel to ensure effective operations. Semi-hydroponics is characterized by an intermediate degree of replicability because the use of solid substrates provides robustness. The conventional technology has a high degree of replicability. With regard to requirements for equipment, materials and inputs, the greatest need exists for Aeroponics. There is direct relationship between the degree of complexity and efficiency of the technologies evaluated. Technologies that were more complex and demanding in expertise were also found to be more efficient in terms of their overall production output and economic performance. At the same time there is an inverse relationship between the degree of complexity and the robustness of the different mini-tuber production systems. The ability to withstand shocks, such as power or water cuts, is low for aeroponics and the fiber-cement tiles technology. The conventional solid-substrate-based technology is the least complex and certainly not as efficient as compared to the soilless system .However, it is the most robust technology among the different systems compared. In general, depending on a country or region's context, different technologies that carefully balance efficiency and robustness must be sought. Thus the yield and growth of the crops are observed and foud better with the comparitive cultivation with traditional cultivation and aeroponic system of cultivation.

VI. CONCLUSION

Aeroponics was a form of hydroponics technique where the plants are grown using mineral nutrient solutions instead of soil. Hydroponics and Aeroponics plays very important role for the commercial food production. Aeroponically grown plants will get perfectly balanced diet.In recent decades, NASA has done extensive project research for their Control Ecological Life Support System(CELSS). NASA sponsored Stoners research for natural liquid biocontrol, known then as ODC, that activates plants to grow without the need for pesticides as a means of control pathogens in closed loop culture system. Aeroponic bio-pharming is used to grow pharmaceutical medicine of plants. Due to increase in world population and the need to face all their food customs this technically developed form of agriculture can be used which yield more then conventional agriculture and are cultivated as disease free crops and grown organically.

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