

## Hydroponics in Protected Cultivation

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### SUMMARY

Hydroponics (or soil-less culture) is a broad term that includes all the techniques for growing plants in solid media other than soil (substrate culture) or in aerated nutrient solution (water culture). Soil-less cultivation refers to growing wide range of horticultural crops in different growing media or substrates contained inside grow bags, pots, conduits, pipes and trays. Soil is usually the most common growing media used for growing plants throughout the world as it provides adequate support, nutrition, air and water required for optimum growth of the plants. However, soil poses some serious limitations mainly in sustainable growing of crops in protected cultivation due to presence of soil-borne diseases, nematodes, drainage and other factors. The basic requirements of any hydroponics system are optimum EC and pH, optimum aeration and temperature, buffer action of water and nutrient solution on the growing media and supply of all micro and macro nutrients to the plants through the growing media.

### INTRODUCTION

Hydroponics refers to cultivation of plants without soil, either in water or based on various soil-less media. Utilizing this technology, the roots absorb balanced nutrients dissolved in water that meet all the developmental requirements of plants. The word hydroponics was derived from the Greek words, HYDRO (water), and PONOS (labor), literally "water working". Hydroponics system is scientifically possible because in the photosynthetic process, soil is not mentioned. Photosynthesis process: (Carbon Dioxide + Water → Glucose + Oxygen) ( $6\text{CO}_2 + 6\text{H}_2\text{O} = \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ ). Hydroponics or soil-less culture is a technology for growing plants in nutrient solutions that supply all nutrient elements needed for optimum plant growth with or without the use of an inert medium such as gravel, vermiculite, rockwool, peat moss, sawdust, coir dust, coconut fibre, etc. for important characteristics of different hydroponics systems.

### Major advantages of hydroponics cultivation are as follows:

- Soil-borne pathogens and diseases avoidance
- Soil disinfection and treatment avoidance
- Cultivate greenhouse crops in poor quality soil
- Precision nutrition control in inert media
- Optimum control of environmental parameters
- High yield and better quality of products
- High water and nutrient use efficiency
- Round the year production

### Major disadvantages/limitation of hydroponics cultivation are as follows:

- High initial investment
- Highly technical
- Precision surveillance

Classification of Hydroponics cultivation depends upon type of substrate and container, nutrient delivery system to the plant and drainage.

**Solution culture or liquid hydroponics** refers to growing plant in fully liquid medium contained in pipe or suitable container. In Circulating closed system nutrient solution circulates around the plant root system and it can be collected, replenished and reused as per the plant need.

**Nutrient Film Technique (NFT)** is a hydroponics system, where the plant roots are directly exposed to the thin film of (thickness 0.5mm) nutrient solution flowing through the channel. The channel is made of flexible PVC or plastic sheet on the top of which seedlings with growing media inside tailor made pots are anchored properly. The growing media absorbs the nutrient solution through the porous root system of the plant. The length of channel varies from 5-10 meter kept at the slope of 1in50 to 1in70. The flow rate of nutrient solution is 2-3 liters per minute and its salt concentration is monitored at regular interval through the important indices like EC, pH and TDS.



Nutrient Film Technique



Deep Flow technique

**Deep Flow technique (DFT)** is a hydroponics system in which 2-3 cm deep nutrient solution flows through PVC pipes. The plants are inside plastic pots fitted with the PVC pipe at regular or desired interval. The main and submain pipes are fixed over the raised platform made inside the protected structure. Pump, tanks, valves, timers and other accessories including nutrient monitoring system are placed over the floor of the protected structure. PVC pipes are arranged in single horizontal plain or in multiple zig-zag vertical plain.

Non-Circulating Open system is the system in which nutrient solution is not circulated but used only once for a longer duration depending upon the EC and pH of the nutrient solution.

**Root Dipping Technique:** Plants are grown in small pots filled with growing media. The bottom 2-3 cm of the pots is submerged in the nutrient solution. Roots are hanged in air and also submerged in the nutrient solution. This technique is very simple, cheap and can be constructed easily.

**Floating Technique:** It uses shallow containers (10 cm deep) and is similar to box method. In this technique plants are established in small pots and fixed to Styrofoam sheet or other similar light plate and allowed to float on the nutrient solution filled in the container. Artificial aeration is required for the solution.

**Capillary Action Technique:** In this technique planting pots of different shapes and sizes are used. Pots are filled with highly porous material like old coil dust filled with sand or gravel. Nutrient solution rises to the pots filled with porous material by capillary action. This technique is suitable for indoor plants and ornamental flowers. Artificial aeration is required for the solution.

**Solid media culture (Aggregate systems):** Solid media with high porosity, better aeration, high water and air holding capacity and efficient drainage are used in sterilized form for growing plants. The most common examples are coco-peat, perlite, vermiculite, vermi-compost, gravel, tur, rockwool, saw dust, coconut fibre and peat moss.

**Hanging bag Technique:** In this technique thick UV stabilized polyethylene bags filled with cocopeat or coconut fibre in cylindrical shape one meter high are used to grow plants. The bags are suspended vertically and supported overhead and collecting channel is placed below for the nutrient solution. Micro sprinklers are attached inside the hanging bag for supply of nutrient and water to the plants attached to the holes inserted in the bag. It is suitable for growing lettuce, leafy vegetables, strawberry and small flower plants.

**Grow Bag Technique:** In this technique grow bags made with UV stabilized polyethylene sheets of 1 meter length, 15-20 cm width and 8-10 cm height are used for growing plants. Single or paired rows can be used with the plant spacing kept at 30-60 cm depending on the type of crops. Fertigation is done with special stake drippers fitted with poly tubes and lateral pipes. It is very common, cheap and easy technique. The entire floor is covered with white UV resistant polythene before placing the grow bags for efficient sunlight supply, lowering of relative humidity and fungal diseases incident.



**Hanging bag Technique**



**Grow Bag Technique**

**Trench or trough technique:** In this technique plants are grown in trenches or trough made with UV stabilized PVC/HDPE sheet, bricks, concrete or other local material. Trench or trough is filled with inert organic, inorganic or mixture of materials like coco-peat, sand, perlite, vermiculite with the depth ranging from 30-60 cm depending on the type of crops. Fertigation is done with special stake drippers fitted with poly tubes and lateral pipes. Drainage is very important, which can be provided with holes or separate drainage pipe.

**Pot technique:** In this technique readymade pots made of plastic in the range of 4 inch to 12 inch diameter are used for growing plants. Pots are filled with inert organic, inorganic or mixture of materials like coco-peat, sand, perlite, vermiculite etc. The volume of the container and growing media depends on type of crops and it varies from 01-10 litres. Fertigation is done with special single/multiple outlet stake drippers fitted with poly tubes and lateral pipes.



**Trench or trough technique**



**Pot technique**



**Aeroponics Technique**

**Aeroponics technique:** It is a technique of growing plants in suspended air in Styrofoam panels with the roots hanging inside dark chamber created to promote growth. Plants are supported by tailor made holes in Styrofoam panels. The nutrient solution is sprayed in fine mist form to the suspended roots in calculated cyclic form for few seconds in every 2-3 minutes. Roots are kept properly hydrated and aerated as per the need of the plant. Aeroponics is practised inside protected structures and is found to be suitable for leafy vegetables like spinach, lettuce etc. It is found to be very efficient technique for space utilization inside protected structures as in some cases almost double no of plants can be grown in aeroponics system.

### **CONCLUSION**

Soil-less culture helps in intensive production of crops in greenhouse. It guarantees flexibility and intensification of crop production system in areas with adverse growing conditions. The main advantages of soil-less culture are the precise control over the supply of water and nutrients, pH and root temperature, elimination of soil-borne diseases, reduction of labour requirement, more crops per year etc. Therefore it is necessary to develop a sound fertigation strategy for growing horticultural crops in soil-less media.

### **REFERENCES**

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