Soilless Cultivation: A Modern Technique

Deepak Sharma[a], Savita Rana[a], Munish Sharma[a], Shivani Sharma[b*], Gurwinder Singh[a] and Rohit Chaudhary[a]

[a]School of Agricultural Sciences, Baddi University of Emerging Sciences and Technology
[b]Faculty of agriculture, Maharishi Markandeshwar (deemed to be University), Mullana
Corresponding Author: shivanisharma050296@gmail.com

Introduction

Soilless culture can be defined as "any method of growing plants without the use of soil as a rooting medium, in which the inorganic nutrients absorbed by the roots are supplied via the irrigation water". The fertilizers containing the nutrients to be supplied to the crop are dissolved in the appropriate concentration in the irrigation water and the resultant solution is referred to as "nutrient solution". In soil-less crops, the plant roots may grow either in porous media (substrates), which are frequently irrigated with nutrient solution or directly in nutrient solution without any solid phase. The technique is gaining popularity mainly in metropolitan cities, where there is shortage of agriculture land. Soilless culture plays a crucial role in achieving sustainability and food security (Joshi et al. 2022).

Types of soilless culture

Wick System

- It is the most basic form
- It is a passive system i.e., it contains no moving parts
- Easier to establish and cheaper
- Consist of Grow tray (filled with growing medium), reservoir, wick and aeration system
- Reservoir is a nothing but tank filled with nutrition solution.

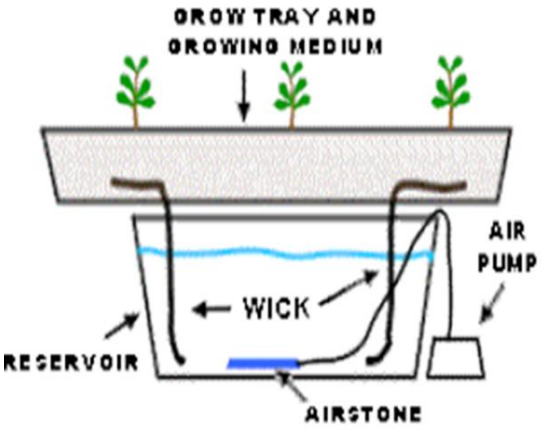

Fig. 1. Wick System (Dhansekaran, 2020)

- Wicks are used to transport nutrition solution to the roots of plants in grow tray through capillary action
- Aeration system is required to maintain level of oxygen in nutrition solution which is useful for the health of plants

Water Culture System

- Simplest of all active hydroponic systems
- Roots of plants are in direct contact of nutrition solution
- Floating platform generally made up of Styrofoam is used to hold the plants
- Aeration system consisting of air pump, airline and air stone is needed for necessary supply of oxygen
- Fast growing water loving plants such as leaf lettuce, herbs are ideal choice for this type.

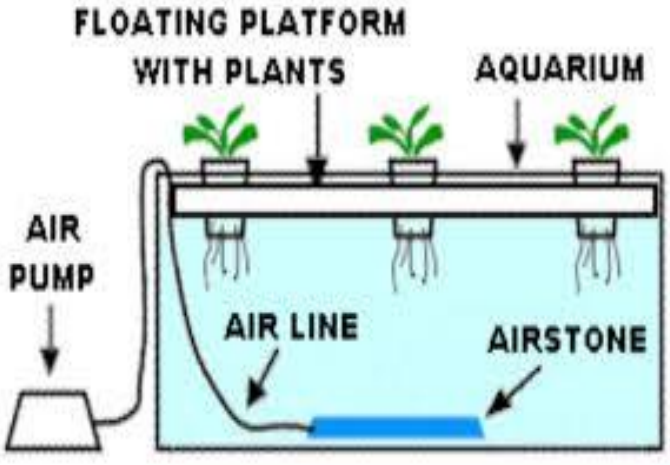

Fig. 2. Water Culture System (Sharma et al. 2018)

Ebb and Flow System

- As the name suggest this system follow a continuous process of flowing (flooding) nutrition solution to the roots and then falling back from the flood stage to the reservoir with certain period of time
- The time period depends on the type of plants, temperature and humidity and the type of growing medium used.

- Solution is flooded using water pump and drained out using drain tube.
- Main drawback is there is a vulnerability to power outages as well as pump and timer failures. The roots can dry out quickly when the watering cycles are interrupted (Pandya et al. 2021).

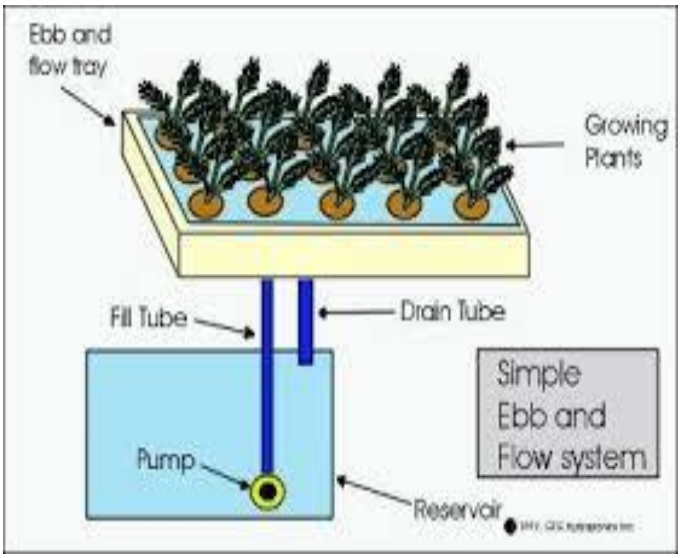

Fig. 3. Ebb and Flow system (Varun Kumar and Ravi Verma, 2024).

1. **Nutrient Film Technique**
   - NFT is a hydroponic technique whereby a very thin layer (film) of nutrient solution flows through watertight channels (also known as gullies, troughs or gutters), wherein the bare roots of plants lie.
   - The thin water stream (1–2 mm deep) ensures sufficient oxygenation of the roots, as the thick root mat which develops on the bottom of the channel has its upper surface continuously exposed to the air.
   - At the lower end of the channels, the solution is drained to a large catchment pipe, which conducts the solution back to the cistern to be re-circulated.
   - very susceptible to power outages and pump failures. The roots dry out very rapidly when the flow of nutrient solution is interrupted.
2. **Aeroponics**

- In Aeroponic systems the roots hang in the air and are misted with nutrient solution.
- The mistings are usually done every few minutes.
- Because if the roots are exposed to the air they will dry out rapidly if the misting cycles are interrupted.
- In aeroponic, growing medium is primarily air
- The aeroponic system is probably the most high-tech type soilless agricultural system (Sharma et al. 2019).

Fig. 4. Lettuce grown in Nutrient Film Techniques in Dr. YS Parmar, UHF, Nauni, Solan

Fig. 5. Roots of lettuce grown in Nutrient Film Techniques in Dr. YS Parmar, UHF, Nauni, Solan

Fig. 5. Potato grown in aeroponics in CPRI, Shimla

Advantages of soilless culture

- Crops using hydroponic can be grown where soil is unsuitable for traditional agriculture like desert areas.
- Plant diseases are highly reduced due the absence of soil
- Hydroponics uses less than 1/10th-1/5th of the water used in soil cultivation.
- Bigger and higher yields are obtained
- Crops are grown close together, so more crops can be grown.
- Plants are not exposed to soil disease or bacteria, so no pesticide is needed, which means healthier crops.
- The crops mature faster, which means there will be more harvests.

Conclusion

- Hydroponics is relatively modern technology and can be proved as a good option for traditional cultivation using soil for better yield of crops.
- Hydroponics are easier to establish and one can make a small garden in front of home and can get good quality of vegetables with a little more effort.
- Aeroponics helps to conserve water, land and nutrients, so the aeroponics system is the way of the future, making cultivation of crops easier.
- Aeroponic growing allows plants and crops to grow without the use of pesticide and thus it will be disease free.

References

Dhansekaran D. 2020. Performance of foliage ornamental in hydroponic nutrient solution. *Journal of Floricultural and Landscaping* 6:09-13.

Joshi D, Nainabasti A, Bhandari R and Awasthi P. 2022. A review on soilless cultivation- the hope of urban agriculture. *Archives of Agriculture and Environmental Sciences* 7(3):473-481.

Kumar TV and Verma R. 2024. A comprehensive review on soilless cultivation for sustainable agriculture. *Journal of Experimental Agriculture International* 46(6):193–207.

Pandya D, Mankad A, Pandya H. 2021. Review on soilless method: Hydroponics. *International Journal of Recent Scientific Research* 11(1):37122-37127.

Sharma N, Acharya S, Kumar K, Singh N. 2019. Hydroponics as an advanced technique for vegetable production – an overview. *Journal of Soil and Water Conservation* 17(4):364 371.

Sharma N, Somen A, Kaushal K, Narendra S and Chaurasia OP. 2018. Hydroponics as an advanced technique for vegetable production: An overview. *Journal of Soil Water Conservation* 17(4):364-371.

* * * * * * * * *