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HYDROPONIC - A NEW METHOD OF GROWING CROPS WITHOUT SOIL

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Soil is the most accessible growing medium which gives anchorage, water and nutrients etc for crop growth but soils create severe restrictions for growth and development of plant due to disease-causing organisms and pest present in the soil, inappropriate soil reaction, soil degradation, bad drainage, compaction of soil etc. In addition to that, in some places, the soil is not available for crop productions. Under such situation, soil-less culture i.e. hydroponics can be utilized effectively.

Hydroponics is a technique of growing crops using nutrient solutions or in an inert medium, such as perlite, vermiculite, gravel, coir, or mineral wool etc. to provide mechanical support. Giro et al., (2016) reported that hydroponics system is a suitable technique to produce vegetables in urban areas to enhance food security. The basic idea behind this technology is to allow the plant roots to come in contact with the nutrient solution. Hydroponics used for the production of vegetables (tomatoes, lettuce, cucumbers and peppers), fruits (strawberry), ornamental crops (carnations, rose and marigold) and medicinal crops (Aloe vera and coleus) etc., (Sardare and Admane, 2013). Plants grown by hydroponics had high yield, rapid harvest and high nutrient content.

Different hydroponic structures

The hydroponic system is classified and modified according to space and other available resources, availability of growing medium and supporting media. Generally used systems are wicked system, ebb and flow system, drip system, deep water culture system and nutrient film technique.

Volume 2 – Issue 3
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- **Wick System**

Wick system is the most simple and basic form of hydroponics. It is a passive type system because it does not require electricity, pump and aerators. This system, consist of grow tray, reservoir, wick and aeration system and works on the principle of capillary action in which plants are placed in an absorbent medium like vermiculite, perlite with a nylon wick running from the reservoir of nutrient solution to plant roots. This system is useful for small plants, herbs and spice. It doesn't work effectively because it requires a lot of water.

- **Ebb and Flow system**

It is the first commercial hydroponic system which is based on the principle of flooding and draining in which nutrient solution and water are flooded from the reservoir through a water pump to growing area at a definite point and stay there for certain interval of time after that solution is drained back into the reservoir. Different kinds of vegetables are grown. The main drawback is rooted can dry rapidly when the watering phase is interrupted and the problem of root rot, algae and mould are very frequent (Nielsen et al., 2006).

- **Drip system**

In this system, the individual plant gets nutrient from the reservoir in proper quantity with the help of a pump in the root zone area (Rouphael and Colla, 2005). It is the most commonly used system with more saving of water.

- **Deepwater culture system**

It is simplest form of all active hydroponic systems. In water culture, plants root is suspended in nutrient solution and the air is provided directly to the roots by an air stone. Supervision of oxygen and nutrient concentrations is essential to check the salinity and pH (Domingues et al., 2012) as algae and moulds can grow rapidly in the reservoir. This system is useful for cucumber and tomato.

- **Nutrient Film Technique (NFT) system**

In NFT system, the nutrient solution enters into the growth tray via a water pump without a time control (Domingues et al., 2012). The system is slightly tilted so that the nutrient solution runs through roots and down back into a reservoir. Nutrient Film Technique is commercially used for lettuce production and other leafy green vegetables.

Volume 2 – Issue 3
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www.agriallis.com

Supply of nutrients to the plants

In a hydroponics system, frequency and amount of the nutrient supplied depend on the substrate type, crop type, container size, irrigation systems and the existing environmental conditions. 6.00 to 8.00 am a good time to supply the nutrient and the nutrients should be given to the roots zone to keep away from disease.

Desirable pH range of nutrient solutions

Control of pH is essential in a hydroponic system because it changes continuously as the plant grows. For most nutrient solutions, the optimum range of pH is 5.5 to 6.5 for the accessibility of nutrients for the majority of species.

Advantages of the hydroponics system

In this system, nutrient solutions are provided directly to the root of plant consequently plants grow faster compared to field crop. Hydroponics offers efficient nutrient management, higher planting density, better quality, clean product and increased yield of the produce. As compared to soil-based culture, $1/5^{th}$ of total area and $1/20^{th}$ of overall water are requiring to growing of plants under hydroponics system (Silberbush and Ben-Asher, 2001). In this system, no possibility of infestation of soil-borne disease, pest or weed thus reduces the use of insecticide, pesticides, fungicide and herbicide. This technique is useful for the area where cold stress, heat stress and dessert etc is a major problem (Polycarpou et al., 2005). Crops are not influenced by climate change thus offseason cultivation of produce is possible (Manzocco et al., 2011).

Table- 1: Soilless culture averages compared with ordinary soil yields (Singh and Singh, 2012)

Name of crop	Hydroponic average/acre (tonnes)	Agricultural average/acre (tonnes)
Potato	70	8-10
Beetroot	9	4
Cabbage	8	5-6
Peas	6	1-2
Tomato	180	7
Cauliflower	13	5
Lettuce	9-10	4
Cucumber	12-14	3

Volume 2 – Issue 3
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www.agriallis.com

Limitations of hydroponics system

Technical knowledge, experience and the high initial investment are essential for hydroponics system. For plant health, great care and quality water are required.

Conclusion

Hydroponics is seen as a promising strategy for growing different vegetables round the year in limited spaces with improved yield, quality of products, so hydroponics can play a great contribution in areas with limitation of soil and water and for the poorer and landless people. In India, it is projected that hydroponic industries grow exponentially in future. To encourage commercial hydroponic farm, it is important to develop low-cost hydroponic technologies that reduce dependence on human labour and lower overall startup and operational costs.

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Volume 2 – Issue 3
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