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HYDROPONICS: AN ALTERNATIVE TOOL FOR GROWING CROPS

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ABSTRACT

Soil-based agriculture is facing some major challenges with the advent of civilization all over the world, such as decrease per capita land availability. Apart from this, due to rapid urbanization and industrialization as well as threats from climate change and its related adverse effect, the land cultivation is going to further facing challenging threats. Under such circumstances, in the near future it becomes intricate to feed the entire population using the production from soil field system. Hydroponics (soilless culture) techniques involve producing crops in nutrient solution with a sterile media to support the roots. Hydroponics growing uses mineral nutrient solutions to feed the plants in water, without soil. The nutrient solutions usually contain micronutrients, secondary and trace nutrients. Soilless culture is the fastest growing sector of agriculture, and it could be impetus to food production in the future.

Introduction

Soil is usually the most available growing medium for plants. It provides anchorage, nutrients, air, water, etc. for plant growth (Ellis *et al.,* 1974). However, soils do pose serious limitations for plant growth too, at times. Some of them are presence of disease causing organisms and nematodes, unsuitable soil reaction, unfavorable soil compaction, poor drainage, degradation due to erosion etc. Soilless culture is the technique of growing plants in soil-less condition with their roots immersed in nutrient solution (Maharana and Koul, 2004). When the mineral nutrients in the soil dissolve in water, plant roots are able to absorb them. When the required mineral nutrients are introduced into a plant's water supply artificially, soil is no longer required for the plant to thrive. The simplest and oldest method for soilless culture is a vessel of water in which inorganic chemicals are dissolved to supply the nutrients that plants require. Various modifications of pure-solution culture have occurred in the past. The retention of nutrients and water can be further improved through the use of spaghnum peat, vermiculite, or bark chips. Hydroponics is a subset of hydroculture and is a method of growing plants using mineral nutrient solutions, in water, without soil. Terrestrial plants may be grown with their roots in the mineral nutrient solution only or in an inert medium, such as perlite or gravel.

Soilless culture is an artificial means of providing plants with support and a reservoir for nutrients and water. The simplest and oldest method for soilless culture is a vessel of water in which inorganic chemicals are dissolved to supply all of the nutrients that plants require. Often called solution culture or water culture, the method was originally termed hydroponics (*i.e.,* "water working") by W. F.Gericke in the 1930s.

History: The hanging garden of Babylon is also a fine example of soilless culture. In India, Hydroponics was introduced in year 1946 by an English scientist, W. J. Shalto Duglas and he established a laboratory in Kalimpong area, West Bengal. He written a book on

Hydroponics, named as Hydroponics The Bengal System.

Why do the grower turn to Soilless culture?

- The difficulty and cost of controlling soil borne pests and diseases.
- Soil salinity.
- Lack of fertile soil.
- Water shortage.
- Banding of using Methyl Bromide.
- Controlling the root environments.
- Increasing water use efficiency.

Classification: Soilless culture systems are classified according to the type of substrate (soilless medium) they use, how the nutrient solution is delivered to the plants (drip irrigation, flowing or stagnant nutrient solution) and what happens to the solution after it drains away such as open (free drain) or closed (recirculating water). Soilless media can be inorganic (e.g. sand, gravel, pebbles, perlite, rock wool, vermiculite), organic (e.g. rice hulls, peat, sawdust, straw, coconut coir) or synthetic (e.g. foam ship, sponges, moisture absorbent plastic fibre).

The medium for soilless culture should have following characteristics:

- Provide structural support for the plant.
- Regulate water flow.
- Serve as reservoir of nutrients.
- Provide a healthy environment for the plant grow in.

Nutrient Film Technique (NFT)

NFT, (Nutrient film technique), is a technique for cultivation in water in which the plants grow with heir root system within a sheet or opaque plastic, through which the nutrient solution is continuously circulated. The plastic forms tubes that are closed around each plant, and clipped together. At the base of the plastic, below the plant, a thin sheet of rock wool is placed as capillary mulch. This ensures that none of the plants dries out in the early phases of growth, while leaving most of the roots exposed, allowing good aeration. The roots grow freely and are mainly located at the bottom of the plastic tube, in direct contact with the solution.

Aeroponics: In an unusual application of closed system hydroponics, plants are grown in holes in panels of expanded polystyrene or other material. The plant roots are suspended in midair beneath the panel and enclosed in a spraying box. The box is sealed so that the roots are in darkness (to inhibit algal growth) and in saturation humidity. A misting system sprays the nutrient solution over the roots periodically. The system is normally turned on for only a few seconds every 2.3 minutes. This is sufficient to keep roots moist and the nutrient solution aerated. An apparent disadvantage of such a system is uneven growth resulting from variations in light intensity on the inclined crops. An advantage of this technique for lettuce or spinach production is that twice as many plants may be accommodated per unit of floor area as in other systems

Principle of soil less media: In principle the soilless medium is a substrate that is part of an artificial system of cultivation in which plants are grown without soil. The medium provides plants with physical support, regulates the water flow, serves as reservoir of nutrients and permits gas exchange to and from the roots.

Crops which can be grown in soil-less culture

- Vegetables - Tomato, Chilli, Brinjal, Green bean, Beet, Bell pepper, Cabbage, Cauliflower, Cucumbers, Melons, Radish, Onion, Lettuce
- Condiments - Parsley, Mint, basil
- Flower / Ornamental crops - Marigold, Rose, Carnations, Chrysanthemum
- Medicinal crops - Aloe vera, Coleus
- Fruits – Strawberry

(Source: Singh and Singh, 2012)

Advantages of hydroponics

- High density planting
- Maximum crop yield earlier maturity and rapid turn over of crops
- Crop production where no suitable soil exists
- Freedom from the constraints of ambient temperatures and seasonality,
- More effective use of water and fertilizers.
- Minimal use of land area
- Suitable for mechanised production and plant protection.
- Isolation of the crop from the underlying soil which may have problems associated with nematodes disease, weeds, salinity, alkalinity, poor structure and drainage.
- Soil containing harmful microbes is not used and hence the produce is healthy, fresh and nutrition.
- No hazards of continuous cropping.

- Production of crops during off-season and also throughout the year.
- Produce of vegetables grown in hydroponic system are free from paffiness (due to Ca and K deficiency) and therefore possess better shelf life and long distance transport.

Disadvantages of hydroponics are:

- High costs of capital and energy inputs relative to conventional open-field agriculture (OFA).
- It requires more capital investment than soil cultivation.
- The nutrients have to be mixed in water and applied to plants.
- Some water borne borne disease can spread rapidly in circulating system.
- High degree of competence in plant science and engineering skills required for successful operations.

Conclusion

Soil less farming or hydroponics enables crop to be grown closer tone another which maximize land area. It is found to be effective to the outputs of the crops. It has advantages and disadvantages. The advantages can conserve our environment. It provides regular and abundant supply of fresh greens can be produced and barren and sterile areas can be made productive at lower cost. As a conclusion, soilless farming has benefits if compared to soil culture. The industry is expected to grow exponentially also in future, as conditions of soil growing becoming difficult. The application of a soilless culture system using artificial substrates would result in efficient and effective use of water and fertilizers and minimize the use of chemicals for pest and disease control.

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