A Study on Contemporary and Sophisticated Strategy for Agricultural Growth

*Dr. Pushpa Agarwal

Abstract

Global population growth has highlighted several difficulties. While many studies have been conducted on plant cultivation in soil and in vitro, few focus on soilless cultures. Soilless agriculture is a viable way for cultivating several revenue crops. Soilless farming, particularly the close-loop technique, has other benefits beyond reserving and restoring cultivated areas. This method uses recycled water, saves 85-90% of irrigation water, and may be used in locations that are unsuitable for traditional farming. It also produces higher yields with less environmental impact. This research explores soilless agricultural practices and proposes an eco-friendly design for such a unit.

Keywords: Soilless, nutrient-rich, land-saving, hydroponic culture

INTRODUCTION

Plant development may not always need soil. It only offers every macro and micronutrient required for plant growth and development. As the globe wants to feed more people, fertile soil is rapidly vanishing due to intensive farming and climate change. By offering a more productive and sustainable substitute for conventional cultivation, soilless farming has the potential to revolutionize the agricultural industry.

According to Nagraj et al. (2015), soilless culture is a synthetic method of giving plants support and a reservoir for water and nutrients. Water and fertilizer management in crop production, as well as water usage efficiency, may be enhanced by soilless production systems (Mazahreh et al. 2015). Media have the ability to contain water and nutrients, provide the root system enough oxygenation, provide light, and be devoid of pathogens and chemicals that are harmful to plants. Physical attributes, availability, and pricing should all be taken into consideration when selecting a media (Asghari, 2014). According to Aktas et al. (2013), a good growing medium should contain certain qualities that allow for optimum root development, water and aeration, and physical support for the plant.

Higher crop quality, yield, and early plant development are all facilitated by soilless culture, which raises economic revenues and competitiveness (EI-Sayed et al. 2015). Plant protection issues, soil-borne diseases, and environmental rules against ground water contamination with nitrate pesticides are all addressed by substituting soils with soilless growth medium (Nagaraj et al. 2015). According to Mazahreh et al. (2015), soilless medium improved plant nutrition management and eradicated soil-caused plant illnesses. Compared to dirt, soilless growth medium are simpler to manage and could provide a superior growing environment (Aktas et al. 2013).

Recently, a variety of soilless agricultural approaches have been used. These methods include hydroponics, aquaponics, aeroponics, and agriculture with the use of helpful intermediaries. Soilless agriculture may be practiced on a variety of surfaces, including rooftops, balconies, greenhouses, and unsuitable agricultural land.

There are many types of agriculture that do not include soil, such as hydroponics, aquaponics, aeroponics, and agriculture that uses supporting mediators. In contrast, plants in soilless culture did not require soil; instead, they required the minerals nitrogen (N), potassium (K), phosphorous (P), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), molybdenum (Mo), boron (B), chlorine (Cl), and vitamins. They also required light, carbon dioxide, oxygen, water, and light at the root zone. Soilless culture may be a method of cultivating modern, sophisticated demands to search for human cadres who are capable of being qualified for this activity and may be uncommon. In this context, these methods will be evaluated with a short emphasis on the paragraphs that follow.

Classifications of Sustainable Agriculture

There are two common forms of soilless agricultural techniques: open soilless culture and closed soilless culture.

Open farming culture

This technique uses diluted fertilizers for each pattern of irrigation. Nutrient solutions, often supplied by a dripping system, are absorbed by the plants. This technique synchronizes a sufficient quantity of nutrients in the root zone. Below are a few open soilless cultivation approaches.

The root dipping method involves growing plants in pots with tiny holes on the bottom. These are put in a container with nutritional solution and filled with substrate material, such as coconut fiber. The lowest part of the pots stays in close touch with the nutrient media for at least 1 to 3 cm. Some roots just dangle in the air, while only a small number are partially immersed in the nutritional medium. This is a simple and affordable method for growing little flowers or herbs.

The hanging bag method makes use of long, cylinder-shaped polythene bags. These are joined to PVC pipes at the top part and closed at the bottom end. Above a tank of vitamin supplements, they are suspended vertically. Seeds, fruits, and other planting materials that have been acclimated in netted pots are firmly pushed into the hanging bags' perforations. The nutritional medium is moved to the top of each hanging bag using a micro sprinkler. The sprinkler evenly distributes the nutritional solution throughout the hanging bag. To collect extra nutritional solution, the solution stock tank is positioned at the bottom of the bag. To stop mold from growing within, the tubes holding the nutrition solution should be black in color. This method is used to cultivate crops like lettuce, tiny floral plants, climbers, etc.

Trench method: This technique involves growing tiny plants and shrubs on above-ground or brick-or concrete-block trenches. Thick polythene sheets are placed over the inner linings of trenches to keep the growth medium from coming into direct touch with the earth. Each crop produced in the trenches has a different size and form. The dripping procedure is used to distribute water and any nutritional additives. Tall vine plants and herbs may both be grown using this technique (Bohme, 1995).

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Aeroponic technique: One of the most sophisticated varieties of hydroponic systems is the aeroponic system. This method involves spraying the supplement solution within the chamber to produce a fine mist around the root system. Expanded polystyrene or other inert materials with holes are utilized to support plant development. The roots of the plants growing in the chamber are contained inside a spraying box and held in midair directly underneath the panel. Similar to other hydroponic techniques, the nutrient pump is controlled by a timer. In contrast, the aeroponics system has a short cycle timer that runs the pump for 5–10 seconds every 2–3 minutes. Most green crops, such as spinach, lettuce, and so on, are cultivated using aeroponics. The system's ability to use the least amount of space is its most significant benefit. Compared to previous methods, this culture allows for twice as many plants to be produced on each unit floor surface. The main drawback of this approach is that the roots will quickly dry up and the plant will die if the nutrient spreading cycles are not functioning correctly.

Fish, prawns, and other aquatic creatures are raised in water tanks using aqua agriculture, also known as aquaponics, in a symbiotic environment with a variety of hydroponic plants. As it passes through the hydroponics system, the tank's water is cleansed and recycled back into the aquaculture system, while the byproducts are broken down by microorganisms that reside on the top of the culture medium and are used as nutrients by the plants.

Water Quality

Water quality and availability are key factors in the success of soilless agricultural systems. Water is available from a variety of sources, including lakes, rivers, subterranean reservoirs, rainwater, and other treatments. However, Van et al. (1991) state that the viability of agriculture without soil depends on high-quality, pathogen-free water.

DISINFECTION OF WATER

The potential for soilborne infections to spread quickly due to the recirculating fertilizer solution is one of the drawbacks of closed systems. The following are a few of the disinfection techniques that may be used to get rid of these pathogens:

Ozone treatment

The drain water may be disinfected using ozone treatment. The purpose of ozone, the second-strongest disinfectant in the world, is to eliminate viruses, germs, and smells. All infections may be eliminated with an ozone supply of 10 g/h/m3 water and a one-hour exposure period.

UV disinfection

UV light is another method of disinfecting drain water. A tried-and-true method for cleaning solid surfaces, water, or air that are microbiologically polluted is ultraviolet light, or UV. A 100 mJ/cm2 energy dosage is advised to eradicate germs and fungus. A dosage of 250 mJ/cm2 is advised for viruses. At 14% transparency, the recommended dose of 100 mJ/cm2 to control Fusarium provided sufficient control. However, 110 mJ/sq. cm was needed at 8% transparency, and over 174 mJ/sq. cm was needed at 4% transparency. The farmer may either increase the UV light or dilute the water to combat Fusarium.

Heat treatment

When heat treatment is used, a solution is heated to 95˚C for around 30 seconds. All pathogens are eliminated at this temperature. The use of gas during heat treatment is a drawback. Also, there is less oxygen in warm waste water.

Slow sand filtration

Commercial growers have been removing pathogens using a slow sand filtering system for a number of years. Sand filtration is a popular and reliable technique for removing suspended particles from water. Multiple layers of sand with varying sizes and specific gravities make up the filtering medium. Sand filters come in a variety of sizes and materials, and they may be operated manually or completely mechanically.

ADVANTAGES OF SOILLESS CULTURE

a. Where there is no adequate soil or where the soil is disease-contaminated, crops may nevertheless be cultivated.

b. Traditional methods of farming, watering, fumigating, tilling, and other labor are mostly abandoned.

c. The method is economically viable in high-density and costly land locations since maximum yields are achievable.

d. All systems have the ability to save nutrients and water. Since useful chemicals don't have to be lost, pollution of the land and streams may decrease as a result.

g. In closed systems that may be completely inundated with an eradicant, soil-borne plant diseases are more easily eliminated.

f. The system often offers more thorough environmental control (i.e., root environment, timely nutrient delivery, or irrigation), and greenhouse-type operations allow for manipulation of light, temperature, humidity, and air composition.

g. If done carefully, water with highly soluble salts might be utilized. If regular leaching of the growth medium is taken care of to lessen the salt accumulations, an open hydroponics system may be employed if the soluble salt concentrations in the water supply are more than 500 ppm.

h. Even in high-rise buildings, a hydroponic system may be adapted for patio-style gardens and homes by an amateur horticulture. Cleanliness, portability, and automation are all possible with a hydroponic system.

DISADVANTA GES

a. The initial cost of building per acre was quite expensive.
b. The expanding organization has to be managed by skilled staff. Understanding how
c. Plants develop, and understanding nutritional concepts is crucial.
d. In a closed system, nematodes and introduced soil-borne illnesses may spread swiftly to every bed on the same nutrient tank.
e. Research and development will be necessary for the majority of plant kinds that are now accessible and suited to regulated growth conditions.
f. The plant responds very quickly to either excellent or bad nourishment.

CONCLUSION

Although soilless farming offers numerous benefits and drawbacks, innovative alternative methods for agricultural mass production are required due to the global slow loss of arable land. Even if soilless farming doesn't appear important right now, it has a lot of promise for the future. The technology and methods used in soilless production may be referred to as next-generation agricultural science as, with appropriate investigation and assessment, they will pave the way for the establishment of a new extraterrestrial society.

***Department of Botany**
Baba Gangadas Govt. Girls College
Shahpura Jaipur (Raj.)

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