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Soilless Culture: A Boon to Agriculture

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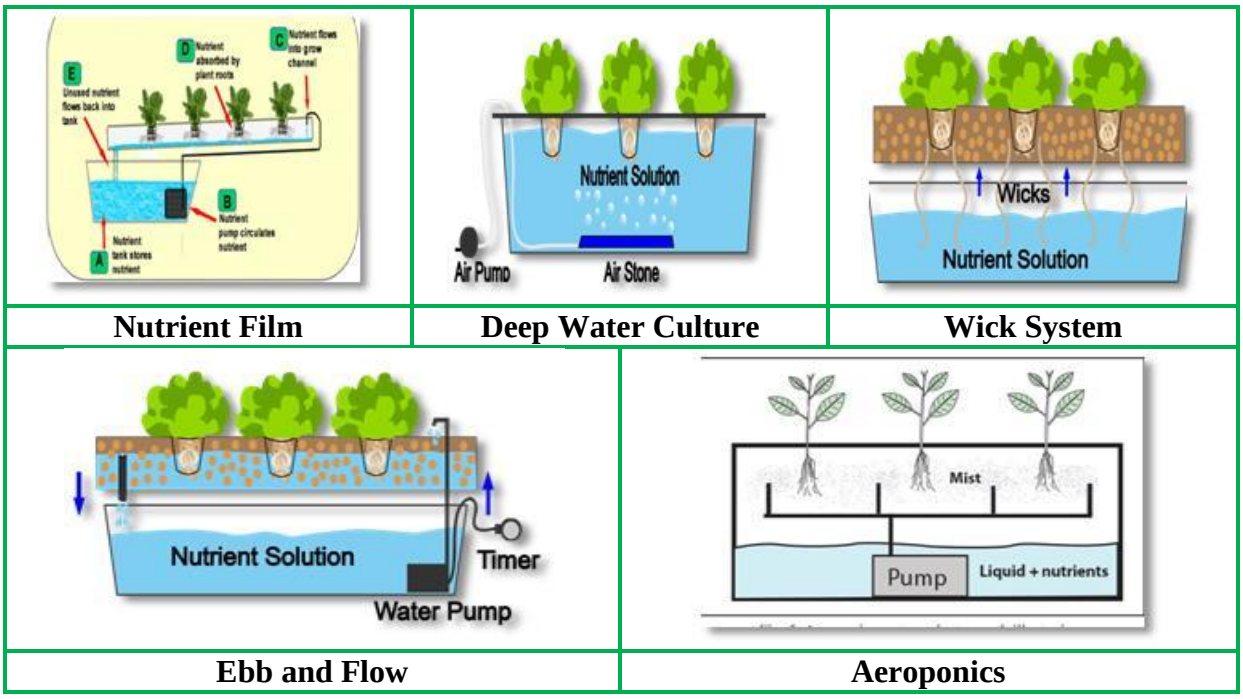
The most readily available growing medium for plants is typically soil. It gives plants the anchoring, nutrients, water, air, and other necessities for healthy growth. However, there are significant barriers to plant growth in the soil, such as cultivating conventional crops in soil requires a lot of area, labor, and water in addition to this the presence of nematodes and disease-causing bacteria , fungi etc., inappropriate soil reactivity, unfavorable soil compaction, inadequate drainage, erosion-related deterioration etc. which can be challenging. Furthermore, in certain locations such as metropolitan areas the soil is completely unsuitable for growing crops, while in other places due to poor topographical or geographical conditions fertile cultivable arable lands are scarce. Soil-less culture can be successfully introduced in these conditions.

An artificial method of giving plants support and a source of nutrients and water is called soilless cultivation. "Soil-less culture" mostly refers to "Hydroponics" and "Aeroponics" methods. The Greek words "hydro" (which means water) and "ponos," which implies labor, are the origin of the name "hydroponics." It's a technique for growing plants without soil by employing mineral nutrition solutions. The roots of terrestrial plants can be cultivated in an inert media, like perlite, gravel, or mineral wool, or they can be grown only in the mineral nutrient solution. According to Singh and Singh (2012), hydroponics is a method of growing plants without the use of soil by submerging their roots in a solution containing nutrients. This system supports both production system management and addressing the issues posed by climate change.

Classification of soilless culture system

1. **Nutrient Film Technique (NFT):** This closed hydroponic system recycles and recirculates the nutrient solution to supply the roots of plants with a highly oxygenated solution via a PVC pipe channel.
2. **Deep Water Culture (DWC) or Deep Flow Technique (DFT):** In deep water culture, also known as deep flow technique (DFT) or deep water culture (DWC), plants are grown in a container with a 10–20 cm nutrient solution on floating or hanging supports such as rafts, panels, or boards.
3. **Wick or passive systems:** In wick systems the plant system absorbs the nutrient solution by the capillary action of the roots and the fibers that carry water to the plants. These are far less expensive methods There is no recycling of the nutrient solution in this system.

4. **Ebb and flow system**: It is also known as flood and drain system. The drip hydroponics system and the hydroponics Ebb and Flow system are extremely comparable. The nutrients are flooded to the roots of the plants rather than being pumped through drippers
5. **Aeroponics:** This method of growing plants involves suspending the roots of the plants in an opaque trough or supporting container and misting them with nutrients.



Nutrient Film	Deep Water Culture	Wick System

Ebb and Flow	Aeroponics

Fig 1.Soil-less culture systems

Medium for soil-less culture

- **Sphagnum Moss:** It should be utilized extensively since, by preventing water flow, it will preserve moisture and nutrients.
- **Peat Moss**: It is a decayed and dried sphagnum moss. In growing environments, peat moss holds onto moisture.
- **Coconut Coir:** Also referred to as coconut fibre or Ultrabeat, Cocopeat, and Coco-tek in trade is extracted from coconut's outer husk natural fibre. It blends perlite's air retention with vermiculite's ability to retain water. The organic matter derived from activated coconut husks provides a comprehensive source.
- **Vermiculite**: It is a hydrous phyllosilicate mineral. Magnesium and potassium are both present in vermiculite. Despite being marginally stronger than other elements like sand and perlite, it retains a lot of water, aids in water drainage, and allows air to enter the soil.
- **Perlite:** Perlites are amorphous volcanic natural glass pebbles that have a high water content. The silicone minerals that create volcanoes are the source of the extremely basic perlite grains. They improve aeration and water movement.
- **Sand:** Plants that require dry, open soil can be planted in sand. Much water can be submerged in the sand, just as it can be in the mud, and will drain the flow.

Sphagnum Moss	Peat Moss	Coconut coir

		
Vermiculite	Perlite	Sand

Fig 2. Medium for soil-less culture

Advantages of Soil-Less Culture

Growing plants in soilless culture has many benefits over soil-based culture. Compared to open-field agriculture, soilless culture offers the chance to create the ideal growing conditions for plants, which can result in larger yields. Gardening is also much easier and cleaner, requiring very little work. Controlling soil-borne illnesses and pests is possible with soilless culture, which is particularly helpful in the tropics where the threat of infection and the life cycles of these organisms persist unhindered. Additionally, it works well in regions where there is a dearth of arable or productive ground for farming. It cuts down on the time and expense of doing a number of operations that are avoided in soilless agriculture. It provides a hygienic workplace, making labor hiring possible.

Limitations of Soil-Less Culture

Although soilless culture offers numerous benefits, it is not without its limitations. Commercial application necessitates more initial cash investment and technical expertise. If soilless cultivation is coupled with controlled environment agriculture, this will increase much more. To prepare solutions, maintain pH and EC, diagnose and treat nutritional deficiencies, ensure aeration, maintain favorable conditions inside protected structures, and other tasks, a high level of management abilities is required. When it comes to plant health control, extreme caution is needed. Lastly, energy inputs are required for the system to function. High-value crops are the only ones that can be grown in the soil-less culture due to its astronomically high cost.

Conclusion

Soilless culture is the fastest-growing area of agriculture and is gaining momentum and appeal quickly. In certain nations, especially when it comes to the commercial production of vegetables, soilless culture is more recognized and well-liked, and it is swiftly gaining traction in other regions of the world. Future food production may very possibly be dominated by soilless culture. People will turn to new technologies, such as the soilless culture of agricultural production, as the population grows and arable land decreases as a result of poor land management.

Providing farmers or gardeners with scientifically proven soilless culture technology and raising public awareness in potential areas at the national level are crucial for the popularization of soilless culture, as the industry is still relatively small and lacks proper marketing. Further, study and development could result in more affordable materials and structures, a decrease in the amount of energy that must be purchased, new cultivars better suited for mechanized systems and controlled environments, and enhanced plant resistance to diseases and pests.

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