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Systems for Soilless Culture: A New Approach in Horticulture

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INTRODUCTION

Any technique for cultivating plants without using soil as a rooting media is referred to as soilless cultivation. The main benefit of soilless agriculture is the decoupling of plant growth from soil-related issues, such as pests and diseases carried by the soil, non-arable soil, soil salinity, and poor soil quality, for example. The development of innovative growing techniques and a better understanding of crop physiology and its effects on quality characteristics have been the main areas of focus for the extensive research that has been stimulated by the increased interest in the commercial application of soilless farming in recent decades.

Description and function of soilless culture:-

Soilless culture is a man-made suggests that of providing plants with support and a reservoir for nutrients and water. 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 only and oldest technique for soilless culture may be a vessel of water during which inorganic chemicals melted (nutrient solution) to produce all of the nutrients that plants need. Typically is known as solution culture or water culture. The function of soilless cultivating method is stimulating plant growth while controlling the quantities of water, mineral salts and most important, dissolved oxygen. The basic concept is quite simple. When roots are suspended in moving water, they absorb food and oxygen rapidly. If the oxygen content is insufficient, plant growth will be slow. But if the solution is saturated with oxygen, plant growth will accelerate. Therefore, the grower's task is to balance the combination of water, nutrients, and oxygen, with the plan's needs, in order to maximise yield and quality. For the best results, a few important parameter need to be taken into account; temperature, humidity and CO_2 levels, light intensity, ventilation, pH and the plant's genetic make-up.

Essentially this is what any conscientious gardener would do. Agriculture outside of soil is including Hydroponics, Aquaponics, Aeroponics as well as agriculture using supportive mediators. However, In Soilless culture plants did not need soil but they need to be supplied with minerals Nitrogen (N), Potassium (K), Phosphorous (P), Calcium (Ca), Magnesium (Mg), Sulphur (S), Iron (Fe), Manganese (Mn), Copper (Cu), Zinc (Zn), Molybdenum (Mo), Boron (B), Chlorine (Cl) and vitamins also they need water, light, carbon dioxide, oxygen at their root zone.

Types of soilless cultures

Soilless culture is a method of growing plants without the use of soil, and instead using an artificial growing medium. There are several types of soilless cultures, including:

- Hydroponics
- Aeroponics
- Aquaponics:
- Rockwool Culture
- Coir Culture
- Vermiculite and Perlite culture

HYDROPONICS

Without using soil, hydroponics is a technique for growing plants in nutrient-rich water. The Greek terms "hydro," which means water, and "ponics," which means labour, are the origin of the phrase "hydroponics." The roots of the plants are suspended in the nutrient solution in a hydroponic system, and the plants are often grown in a greenhouse or other indoor facility because of the regulated atmosphere. In some circumstances, such as those involving low soil quality or space constraints, hydroponics can be a valuable technique for producing plants. The growing environment can also be precisely controlled, including the temperature, light, humidity, and nutrition levels.

There are several different types of hydroponic systems, including:

- **Deep water culture:** In this system, the plant roots are suspended in a nutrient-rich water solution, and the plants are typically grown in a floating raft.
- **Nutrient film technique:** In this system, a thin film of nutrient-rich water flows over the plant roots, and the plants are typically grown in a tray or channel.
- **Drip irrigation:** In this system, nutrient-rich water is dripped onto the plant roots, and the plants are typically grown in a tray or container.
- **Aeroponics:** In this system, the plant roots are suspended in the air, and the plants are misted with a nutrient solution.
- **Ebb and flow:** In this system, the plant roots are flooded with nutrient-rich water at regular intervals and then the water is drained back.

AEROPONICS

Without the use of soil or any growing medium, Aeroponics is a process for growing plants in an environment of air or mist. The Greek terms "aero" (for air) and "ponics" (for labour) are the origins of the English word "Aeroponics." The roots of the plants are suspended in the air and misted with a nutritional solution in an Aeroponics system.

A growing chamber where the plants are grown, a fertiliser delivery system, a misting system to feed the nutrient solution to the roots, and a light source to supply the necessary light for photosynthesis are the main components of an Aeroponics system.

AQUAPONICS

Aquaponics is a method of growing plants and fish together in a symbiotic system. The word "Aquaponics" is a combination of "aquaculture," which is the cultivation of fish, and "hydroponics," which is the cultivation of plants in water. In an Aquaponics system, fish are often raised in fish tanks, and the plants' primary source of nutrients comes from the waste produced by the fish. In a hydroponic system, such as a deep water culture or a nutrient film technology, the water from the fish tank is piped to the plants. By absorbing

the nutrients in the water, the plants subsequently aid in cleaning the water for the fish. The fish tank is then filled with the cleaned water. A fish tank, a hydroponic growing system, a water pump, a bio filter to remove poisonous ammonia and nitrite, and a sump tank to hold extra water are the usual components of an Aquaponics system.

ROCKWOOL

Rockwool is used as the plant's growing substrate in a hydroponic technique called Rockwool culture. Basalt rock and chalk are combined to create a type of insulation called Rockwool that may store nutrients and water. For seed germination and plant propagation, it is a sterile, pH-neutral media. Plants can be grown with Rockwool culture, which requires less water than conventional soil-based methods and provides for fine control over the growing environment. To run and maintain it effectively, though, a large degree of technical expertise is needed. Additionally, Rockwool is a manufactured product rather than a natural one, and it can include some chemicals that, if used improperly, could be hazardous to plants.

COIR CULTURE

Coir culture is a type of hydroponic method, which uses coir (coconut fiber) as the growing medium for plants. Coir is a by-product of the coconut industry and it is made from the husk of the coconut. It is a natural and biodegradable medium that is rich in lignin, cellulose, and other organic matter, making it an ideal growing medium for plants.Because coir is a natural, renewable, and biodegradable growing medium, it is a sustainable way to grow plants. Additionally, it is an economical strategy because coir is widely accessible and may be used to grow a variety of plants. To run and maintain it effectively, though, a large degree of technical expertise is needed. Additionally, it might not be appropriate for all plants and over time it can compact, necessitating replacement or re-fluffing.

VERMICULITE AND PERLITE CULTURE

Vermiculite and perlite are two types of minerals that are commonly used as growing media in soilless cultivation methods, particularly in hydroponics. Vermiculite is a hydrous phyllosilicate mineral that is formed by the weathering or alteration of biotite or phlogopite. It is lightweight and has a high water-holding capacity, making it a good choice for seed germination and rooting cuttings. Vermiculite also has a high cation-exchange capacity, which means it can hold onto nutrients and make them available to plants over time.

A volcanic glass that has been heated to a high temperature and expanded to produce tiny, white, airy, and porous particles is called perlite. The fact that perlite is sterile, pH-neutral, and does not compact over time makes it a popular choice for growing media. Additionally, perlite has a high air-to-water ratio, which helps to raise the rooting zone's oxygen levels and encourage strong root growth.

To create a well-aerated, moisture- and nutrient-retentive soilless growth medium, vermiculite and perlite can be used separately or in combination. Vermiculite to perlite ratios typically range from 1:1 to 2:1, depending on the type of crop and the growing environment.

Advantages:

- Higher agricultural yields per unit area are possible with soilless systems as opposed to conventional soil-based ones.
- Less water consumption: Because soilless systems can reuse and recycle water and nutrients, they can use less water than conventional soil-based systems.
- More nutrient level control: Soilless systems allow for more nutrient level management, which can result in healthier plants and larger crop yields.
- Possibility of growing crops in locations without or with

contaminated soil: Soilless systems can be used to grow crops in locations without or with polluted soil, such as urban areas or regions with poor soil quality.

- Reduced pests and diseases: Soilless systems can reduce the incidence of pests and diseases that can be caused by soil-borne pathogens.

Disadvantages:

- Cost and complexity: Soilless systems might be more difficult to install and maintain than conventional soil-based systems.
- Equipment and specialised knowledge are necessary for the proper operation of soilless systems.
- High maintenance: Soilless systems need frequent water and nutrient level monitoring and adjusting, which can take a lot of time and labour.
- Restrictions on crop varieties: Not all crops can be produced in soilless systems; some may need particular types of soil or have particular needs that can't be met in a soilless system.
- Electricity is required to power the pumps, lighting, and other equipment used in soilless systems in order to keep them functioning.

CONCLUSION

Fruits and vegetables can be grown using soilless methods, but it's vital to assess the advantages and disadvantages and carefully consider the cost, complexity, and resources needed before making a choice. In a soilless culture, the plants receive all the nutrients they need from nutrient solutions that are enough for their needs. In soilless culture, a small adjustment to nutrient management can have a significant impact on plant development and product quality. Therefore, even in artificial conditions, efficient plant growing depends on having a thorough grasp of the nutrient solution.

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