JUST AGRICULTURE
multidisciplinary e-Newsletter

Soilless Crop Growing in Vegetable Production

A.Senthilkumar[1]*, B. Bhakiyathu Saliha[2] and S. Sheeba[3]
[1,3]Department of Soils and Environment, Agricultural College and Research Institute, Madurai
[2]Department of Agronomy, Agricultural College and Research Institute, Madurai

ARTICLE ID: 58

Introduction

Soil is usually the most accessible medium for growing plants. It provides support, nutrients, air and water for the successful growth of plants. However, the soil sometimes severely limits plant growth. Soilless agriculture is a method of growing plants using mineral nutrient solutions, in water and other mediums, without soil. Ground plants can only grow with roots in mineral nutrient solutions or an inert medium such as perlite, gravel, rock wool, or coconut husks. According to the United Nations, the world's population is projected to rise from 7.6 billion in 2021 to approximately 8.6 billion in 2030 and 9.8 billion in 2050 (UN 2021). The World‘s total agricultural land has increased by 3% from 1978 to 2015 mainly in tropical countries but a decrease of 0.19% in agricultural land was recorded between 2015 to 2021.

Extreme population growth is accompanied by ecological destruction, resource scarcity, unequal distribution of food and, in many cases, malnutrition. To feed this growing population at least 6000 tons of food is required which is mostly imported from other sources out of which most of them are non-trusted sources in terms of quality standers. Soil-based agriculture faces several challenges, most notably a drop in per capita land availability. With rapid urbanization and industrialization and the melting of the iceberg, the area of arable land will shrink further. Soilless techniques such as hydroponics, aeroponics and aquaponics are designed to combat these issues.

Classification of soilless culture

1. Solid media culture
2. Solution culture
3. Aero phonics

Solid media culture

JUST AGRICULTURE
multidisciplinary e-Newsletter

Soilless media can be in the form of substrates originating from peat moss, bark, coir, compost, rice hulls, vermiculite and perlite. This soilless culture is a mainstream practice in developing countries as normal ground soils are typically discontented in usage for crop production. Hence, the rudimentary characteristics of good soilless media would be easy to acquire, economical, abundant in nature, lightweight, possess upright chemical properties and has a satisfactory water retention capability. The quality of the growing media must also be greatly maintained to ensure the good growth of seedlings. This was because sustainable production of ornamental flowers and other crops would need to compensate for decent growing media with sufficient water-holding capacity and aeration. The most commonly incorporated soilless media are coir-dust based substrates and sphagnum peat (Gruda, 2019). This was because it is occasionally acknowledged as substrates or growth media with the most prominent crop production mechanisms for containerized or raised beds with restricted volumes and was appropriate for the continuous supply of nutrients through fertilization.

Vertical farming

Vertical farming is one such solution that‘s been implemented around the world. By Vertical Farming, food crops can be cultivated easily in urban areas by planting in vertically stacked layers in order to save space and use minimal energy and water for irrigation. In India, Vertical Farming is inthe nascent stages, however, few startups and agri-tech companies are working to revolutionize the field.

Techniques of vertical farming

1. Hydroponics
2. Aeroponics
3. Aquaponics.

Hydroponics

Hydroponics' word has its origin inthe Greek language where 'hydro' refers to water and 'ponos' refers to labor. In the hydroponic system, it is assumed that soil is not necessary for plant growth it acts as a source of essential macro and micronutrients that regulate plant growth and development. Thus, if the soil is replaced with a solution having an appropriate combination of macro and micronutrients it is possible to raise a crop to its full maturity.

Nutrient solutions

JUST AGRICULTURE
multidisciplinary e-Newsletter

A nutrient solution for hydroponic systems is an aqueous solution containing mainly inorganic ions from soluble salts of essential elements for higher plants. Eventually, some organic compounds such as iron chelates may be present. An essential element has a clear physiological role and its absence prevents the complete plant life cycle. Currently, 17 elements are considered essential for most plants, these are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, iron, copper, zinc, manganese, molybdenum, boron, chlorine and nickel. Except for carbon (C) and oxygen (O), which are supplied from the atmosphere, the essential elements are obtained from the growth medium. Other elements such as sodium, silicon, vanadium, selenium, cobalt, aluminum and iodine among others, are considered beneficial because some of them can stimulate growth, or can compensate for the toxic effects of other elements, or may replace essential nutrients in a less specific role. The most basic nutrient solutions consider in their composition only nitrogen, phosphorus, potassium, calcium, magnesium and sulphur and they are supplemented with micronutrients. The nutrient composition determines the electrical conductivity and osmotic potential of the solution (Trejo-Téllez and Gómez-Merino, 2012). Moreover, other parameters define a nutrient solution as discussed below in detail. The nutrient composition determines the electrical conductivity and osmotic potential of the solution.

Aeroponics

A plant-cultivation technique in which the roots hang suspended in the air while a nutrient solution is delivered to them in the form of a fine mist. Aeroponic systems are a specialized version of hydroponics where the roots of the plant extend only in air and the roots are directly sprayed with a nutrient water mix (the recipe). In aeroponics, oxygen is surrounding the roots at all times. Surplus oxygen accelerates nutrient absorption at the root surface.

Hydroponics manages to grow crops up to 50% faster than in soil, but it still has a major drawback. Since the roots are always submerged in water, only crops that are more tolerant to water logging such as cabbages, lettuce and tomatoes are favored for growth (Fussy and Papenbrock, 2022). To overcome this demerit, the basic hydroponics setup was modified to use a high-pressure pump to blast freely hanging roots with a fine mist of the nutrient solution at regular intervals. This way the roots didn‘t face any water logging issues

JUST AGRICULTURE
multidisciplinary e-Newsletter

and it turned out that this method ended up saving more water and nutrients than most hydroponics setups.

Sánchez-del Castillo*et al.*, (2017) experimented witha greenhouse-type tunnel with a skirt and zenithal ventilation located in San Pablo TepetzingoTehuacan, Puebla and given that the number of nutrients applied and saved throughout the production cycle in bell pepper for the three treatments of hydroponic systems. The number of nutrients applied for the three treatments was similar because of the way the irrigations were controlled and the reused solutions adjusted. The percentage of nutrients saved was between 6% and 12% individually. Other works with pepper report higher savings with 78% or more than 80% with other crops nutrient savings in closed hydroponic systems are also relevant, in tomatoes, savings of 20-50% for fertilizer and 25% for cucumber have been obtained. The low nutrient reused may be due to the absorption by the plant and possibly to its being left in the substrate, as has been reported in other studies (Pineda et al., 2011).

Conclusion

Soilless farming is considered a newly developed technique for agricultural development, but it is not a simple technique. However, growers and gardeners in many countries lack knowledge of the new technique and require well-trained staff. Also, most of the substrates are international market, so they are expensive. So, you're better off looking for good, inexpensive substrates locally. Initially, terrestrial production systems were implemented by imitating traditional methods based on terrestrial production or land-based systems. Soilless culture can be an effective tool to increase crop yield and water-use efficiency and also reduce the environmental impact of greenhouses and nurseries. In the hydroponics method, more efficient use of water could be made and nutrients can be saved as well as it also avoids fertilizers from direct disposal to the environment. By implementing a soilless farming system, the better quality of agricultural products can be met to satisfy consumer preferences.

Reference

Fussy, A and Papenbrock, J. (2022). An Overview of Soil and Soilless Cultivation Techniques—Chances, Challenges and the Neglected Question of Sustainability. *Plants*, *11*(9), 1153.

Gruda, N. S. (2019). Increasing sustainability of growing media constituents and stand-alone substrates in soilless culture systems. *Agronomy*, *9*(6), 298.

Pineda, J. E., Goodman, A. A., Arce, H. G., Caselli, P., Longmore, S andCorder, S. (2011). Expanded very large array observations of the Barnard 5 star-forming core: embedded filaments revealed. *The Astrophysical Journal Letters*, *739*(1), L2.

Sánchez-del Castillo, F., Moreno-Pérez, E. D. C., Martínez-Gaspar, F. D. J., Colinas-León, M. T andRamírez-Árias, J. A. (2017). Effect of plant row arrangement on yield components of bell pepper. *RevistaChapingo. Seriehorticultura*, *23*(3), 147-162.

Trejo-Téllez, L. I and Gómez-Merino, F. C. (2012). Nutrient solutions for hydroponic systems. *Hydroponics-a standard methodology for plant biological researches*, 1-22.