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Aeroponics: Art of Growing Without Soil

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Introduction

Major challenges of today's agriculture are to meet the needs of growing population in a sustainable manner and efficiently utilize the natural resources for food production in world. But due to global climate change, the agriculture has been in a phase of serious risk. Anthropogenic interventions like rapid urbanization, industrialization, deforestation which causes various climate change events like global warming leads to increase prolonged drought conditions or unseasonal rains which drastically affect the natural system and agricultural land. Large area of fertile agriculture land also suffers from soil erosion due to water and wind. All these factors create an alarming situation with around quarter of arable land is declared non-productive and not suitable for cultivation. In future these traditional agricultural practices will not be sufficient to provide fresh and clean food to population which is growing at an alarming rate and eventually leads to increase in the number of malnourished and hunger index.

To tackle these issues researchers come up with new farming technologies of cultivating plants under controlled conditions. Have you ever thought of growing plants without soil? yes, it is possible but earlier it was a kind of wittiest thought but as of now our agriculture land is threatened, so soilless farming may change the face of traditional agriculture and come up as a breakthrough technique with higher productivity and sustainability. For the very first time Sir Francis Bacon in 1627 published the work on growing plants on water and called it as "water culture". In 1666 Robert Boyle, the Irish scientist had done the first experiment on plant with water submerged root system. All the vital elements required for plant growth were discovered between 1850 to mid-1900. This leads to the beginning of research and further modification in the technique to improve plant growth. Hydroponics come up as a revolutionary idea in the field of agriculture and the term first coined by Dr. W. F. Gericke in 1930s.

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Agriculture without soil include hydroponics, aquaponics, aeroponics and agriculture using supportive media. It is a technique of growing plants under controlled conditions without soil in a mineral solution with precise amount of nutrients. Soilless culture can be considered better in many ways like it reduces the requirement of water up to 90%, most crop succeed to grow in controlled environment which show recalcitrant behavior in ordinary culture and can easily be done on any land like balconies, rooftops and on land which was considered unproductive. Basic hydroponic technique uses nutrient filled water as a medium and the plants float on top of it. Aeroponics is a complicated type of hydroponics where the mineral source is nutrient containing mist-air instead of water. This article summarizes the basic idea of soil less system and brief knowledge on aeroponics.

Aeroponics: Techniques, Pros and Cons

In agriculture field, Aeroponics refers to grow plants in "air", that means without the requirement of soil as medium. It can be considered as the advanced version of hydroponics. There are few major basic equipment's required to set up aeroponics facility- a pump (to pump the nutrient water), pipes (to transfer media towards mist system), mist system (to wet the roots of the plants), stage/platform (to kept the plants), light facility (for normal growth of plants), drainage and reusing system for media, computer system (for automation). However, many big agriculture giants or farmers customize the facility according to their needs. So, what actually happens in aeroponics? The plants are placed on some stage having holes to fit the plants with some adjustments (like foam, or some specific structures) so that roots of plants remain hanged below the stage in dark chambers. Where, the misters or atomizers are also present which sprays the nutrient media on roots for specific time-period.

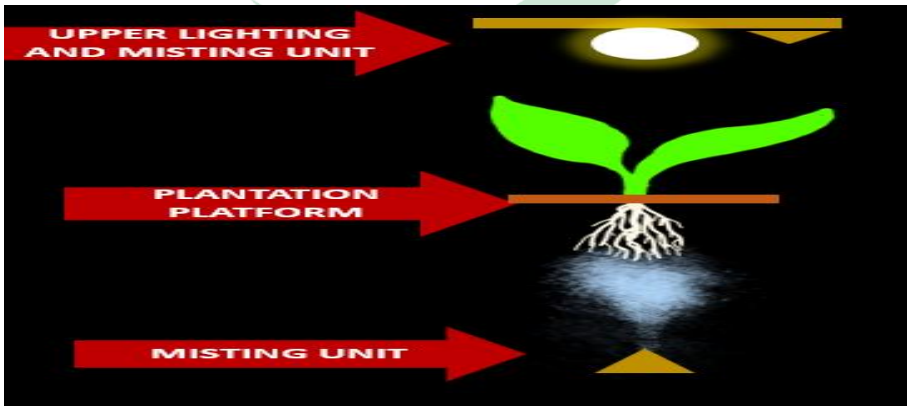

Figure 1: Basics of Aeroponics.

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Generally, the nutrient media are reused as there are facilities to drain out the extra sprayed media back again to nutrient tank and changed accordingly after some specific time.Nowadays, whole system is computer operated with other competence like pH measurement, temperature measurement, light, conductivity, etc. which help in maintenance of optimum conditions for root growth. In this system, the roots get much exposure to gases which also help in net assimilation of the plant. There are some drawbacks as well and advantages in this progressive technique of agriculture

Disadvantages

- Regular-continues supply of electricity is required as pumps, control system, light facility run on it.
- Many misters/atomizers require regular cleaning as they may get clog due to salt deposition or by dense root growth.
- Some kind of technical knowledge is required to handle the computer system
- Toxicity and deficiency of any nutrient expresses fast and also accelerates
- One type of media may be not fit for many crops

Advantages

- Many studies highlight increase in yield
- Initial set up is costly but later it balances with the profit
- Very little or no pesticide is required as the facility works in closed environment
- Nutrient's amount can be balanced as per requirement
- Large numbers of plants can be grown in smaller spaces as plants holding stages can be placed one on one vertically, hence increases the area
- Plant's nutrient uptake also increases
- Crops can be grown in any season by modifying the indoor conditions

There are many success stories related with aeroponics. This technique is especially very useful for the root crops like potato etc as the harvesting is easy compare to normal harvesting. The leafy vegetables like spinach, cabbage, lettuce, kale etc grow very efficiently in this system. The improvised aeroponics setups are now also used to grow various types of crops like creepers, vines etc. In many countries the yields from the aeroponics unit are much costlier due to different labels attached to it like "high in nutrient", "pesticide free" which

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also help in increase in the income of growers. Many big hotel companies like in Singapore, grow their own vegies which also help in cost reduction in investments in raw materials.

Our Viewpoints

Although it was invented decades back, several aspects of the system are still unclear and needs more investigation so as to produce a significantly higher cost-effective yield. It can be concluded that, although beneficial, large scale use of aeroponics like utilization by the farmers or making it a common household technique still require more advancement of current and emerging technologies, so that investments also come down. Lack of technical information and the need for more research also pulls back this technique from implementation among local farmers. To address the concerns, new and innovative tools and approaches are required. Also, local community especially farmers are needed to be aware about the new and upcoming modern agricultural techniques.

A significant reduction in the usage of water and nutrients, and complete elimination of pesticides makes this technique better over traditional soil based open field systems. Urban people can get a benefit as it may cut-short the time of food supply from fields to cities as the space occupied in this type of culturing is very less in comparison to open fields and big cities can easily fulfil its need to an appreciable extent. One of the major difficulties in aeroponics is its necessary parameters, there are very specific requirements and measurements which should be maintained for optimum growth; even minor fluctuations in these parameters such as nutrient, pH level etc. in the chamber can directly be lethal for the plants. The user should have enough knowledge of automatic control system. This requirement of in-depth knowledge and expertise makes it slightly complex for a local person. In a country like India where power cuts are very common, it should be taken care of beforehand. Apart from the management of control system, growth chamber and reservoirs are easily available and are easy to operate and maintain.

Conclusions

Through the use of modern farming techniques in agriculture such as substrate culture and water culture which further include hydroponics, aquaponics, vertical farming and aeroponics, it can be expected that we can get cost effective, high yielding crops with better quality and hence it can be a better alternative solution to combat the increasing hunger. Being comparatively new in the ground, aeroponics is less popular among local population,

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initiatives such as this article can help in reaching out to the people interested in aeroponics to make a better understanding of what its pros and cons are and how common people can use this technology. Considering its advantages, it cannot be ruled out that it is a breakthrough technique in the field of agricultural science. It can be an excellent technique for urban farming.

As it is estimated that world population will soon reach 11 billion by the end of this century from 7 billion now and which was 1 billion approximately 2 centuries ago. Hence food security becomes a major topic of concern. To feed this number of people in the whole wide world, there has to have better agricultural techniques, which work better, produce higher and be least harmful to the environment as well. Aeroponics proves to be a promising technique in this regard.

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