Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 03, Issue: 06 (NOV-DEC, 2023)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Aeroponics: A Revolution to Cultivation

(*Mahima)
Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India
*Corresponding Author's email: sharmamaahi235@gmail.com

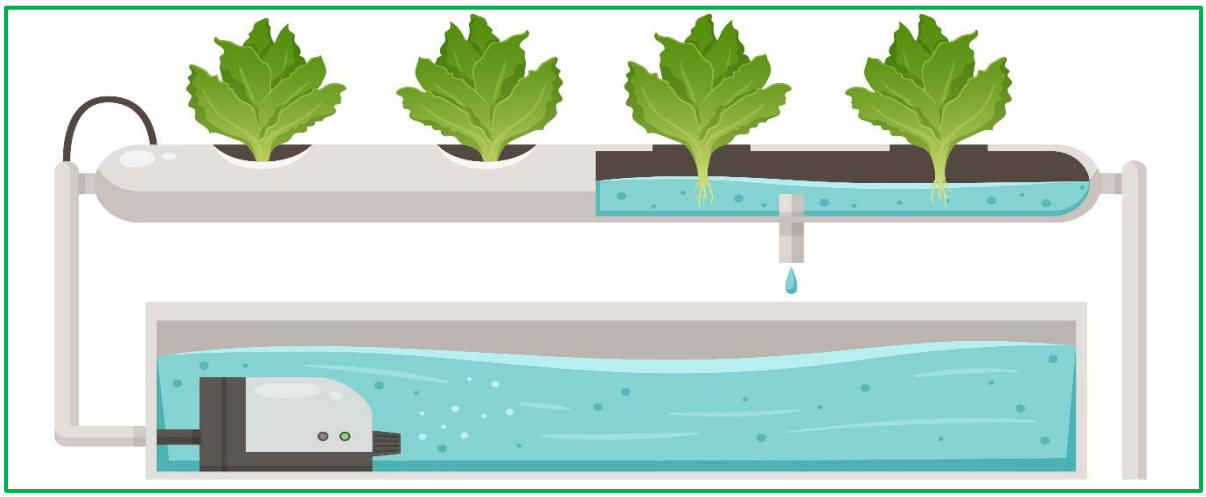
The term aeroponics is a Latin word "aero" which means air, and "ponic" meaning labor. Aeroponics is a technique by which plants or crops are grown in soil-less conditions, where nutrition is provided with the help of circulating nutrients in a medium that supports plant growth. This method provides nutrients not only to the roots but also to the aerial parts. Aeroponics offers numerous advantages, including efficient resource use, automated nutrient supply, and tracking of plant health. The nutrient solution that is used in aeroponics consists of vital macro and micronutrients. So, the roots may absorb the required moisture, oxygen, and nutrients according to demand. Therefore, it employs a method in which plants are placed in controlled-environment ampules rather than in soil. The main reason why this strategy is better than conventional methods is plants can grow properly without having to compete with weeds. Additionally, it ensures the quantitative and qualitative production of food without harming the environment.

History: Although growing plants in pots above ground is now regarded as a recent practice, it has been attempted numerous times throughout history (Gopinath *et al.*, 2017). Barker (1922) initially pioneered a rudimentary aeroponic cultivation system, employing it in laboratory studies to explore plant root structure. He observed that this technique of air plant cultivation is a natural and uncomplicated method of growing plants without the use of soil (Lakhiar *et al.*, 2018). In 1942, W. Carter conducted the first study on aeroponics and reported a technique for supplying nutrients to plants' roots by employing water vapor. This made root examination easier. Stoner was the pioneer in commercializing food grown through aeroponics, being the first to sell it. He gained recognition for his pioneering work in introducing aeroponic systems to greenhouses, with "**Genesis Technology Incorporated**" being one of his companies to successfully sell food through this innovative method. Thus, establishing a viable method for commercial crop production. The Genesis Machine, also known as the Genesis Root System, was created by GTi in 1983 and was the initial professional aeroponic device that is operated by a microprocessor and is attached to a water source and an electrical adapter (Kumari and Kumar, 2019).

Working: Aeroponic cultivation involves suspending plants in a sealed or partially sealed space and nourishing their suspended roots and stems with a mist of nutrient-rich solution (Sharat, 2023). The plants' upper part stands tall while their roots hang down in a container (Chittibomma *et al*., 2023).

To ensure the proper distribution of nutrients a monitoring and a control system are crucial. A distribution system consisting of pipes, pumps, spray nozzles and a timer is required to deliver the nutrient spray. This system utilizes a small internal micro jet spray that releases a high-pressure mist containing the nutrient solution to the rooting chamber. The nutrient solution is prepared by mixing the nutrients with water in a reservoir basin, filtered

and pumped into a tank and is intermittently misted onto the root system. A programmable cyclic timer activates the high-pressure aeroponic pump.



The root hairs play a crucial role in soaking nutrients from the moisture, and administering all nutrients through the root system is more efficient. Due to the small size of the particles, there is minimal wastage of nutrient solution. Additionally, an appropriate supply of oxygen prevents root rot.

Around the suspended roots, misting is typically provided for only a few seconds every 2-3 minutes. It must be completely dark within the chamber to prevent algal growth, which can contaminate the system.

The size of the droplets also plays a significant role, as oversized drops can restrict the flow of oxygen, and small ones may encourage the formation of root hair, which inhibits the development of side roots, and consequently affects the effectiveness of an aeroponic system. Therefore, it is crucial to ensure that water droplets are of appropriate size to deliver nutrients effectively without precipitating.

Conditions

pH and EC: In aeroponics, the nutrient solution and water is constantly recycled, making it crucial to adjust its pH and EC levels for optimal growth, and thus, these parameters must be carefully managed. The pH and EC of the plants depend on environmental conditions. The optimal pH and EC range for a nutrient solution is between 5.5-6.5 and 1.5-2.5 ds/m (Mangaiyarkarasi, 2020).

Light and Temperature: Plants require direct sunlight during their initial phase, however, once they have matured, direct exposure to the sun becomes less important. By using this knowledge, plant containers are moved periodically. Young plants start at the top of the growth column and gradually move down using a rotating mechanical system (Vasanth, 2023). Temperature has an impact on both the growing and harvesting phase (Hatfield and Prueger, 2015). As the temperature grows, plant chemical reactions happen more rapidly which can impair essential enzymatic reactions. As a result, it is essential to keep the growth chamber's temperature within the recommended range of not less than 4°C and not higher than 30°C (Otazú, 2010).

Humidity: Aeroponics relies on the complete saturation of moisture within the growth chamber, with humidity referring to the quantity of water available in the form of vapor. The plant's growth is greatly influenced by fluctuations in relative humidity, which can impact its physiological processes and make it vulnerable to diseases. Hence, it is essential to carefully monitor and adjust the humidity levels in the growth chamber according to the specific requirements of the plants being grown.

Examples of crops grown under Aeroponics

Vegetables	Broccoli (*Brassica oleracea var. italica*), Brussel sprouts (*Brassica oleracea var. gemmifera*), Cabbage (*Brassica oleracea var. capitata*), Capsicum (*Capsicum annuum*), Cauliflower (*Brassica oleracea var. botrytis*), Celery (*Apium gaveolens*), Cucumber (*Cucumis sativus*), Eggplant (*Solanum melongena*), Green beans (*Phaseolus vulgaris*), Kale (*Brassica oleracea var. sabellica*), Lettuce (*Lactuca sativa*), Peas (*Pisum sativum*), Spinach (*Spinacia oleracea*), Tomato (*Solanum lycopersicum*).
Herbs	Basil (*Ocimum basilicum*), Coriander (*Coriandrum sativum*), Mint (*Mentha sp.*), Parsley (*Petroselinum crispum*).
Flowers	Marigold (*Tagetes sp.*), Dianthus (*Dianthus sp.*).

Advantages

Commercial purpose: Aeroponics can be used as a business venture with the aim of generating profits through the year-round production of crops. This method not only conserves resources but also yields high-quality and abundant crops throughout the air. Consequently, it has the potential to supply raw materials consistently to industries, thereby contributing to the economic growth of a nation (AlShrouf, 2017). For instance, increased growth and root nodulation were observed in *Acacia mangium* (Sharma et al., 2018).

Space and Aeroponics: Researchers are looking into a number of strategies to provide astronauts with the nourishment they need while in space. NASA is interested in the intriguing solution is aeroponics. Aeroponic plants not only use less water, but they also typically have greater vitamin and nutritional content. For the space crew, this gives them a great supply of drinking water and oxygen (Oluwafemi, 2018).

Sustainability: Aeroponics utilizes resources in a precise manner, such as using recyclable nutrient solutions. Aeroponics also makes it possible to grow food without the requirement for land in urban places because it does not require soil (Gurley, 2020). It is a creative and innovative method to utilize our resources to the fullest.

Reduction in Labor Cost: Aeroponics makes use of an automated system that can perform several tasks at a time, reducing the need for manual labor (Szepesi, 2023). Thus, it is user-friendly and feasible.

Plant Protection: The fact that aeroponics produces a soil-free environment helps lower the danger of soil-borne illnesses and pests, which is one of its many wonderful benefits (Garzón,2023). Aeroponics reduces the possibility of crop contamination by eliminating the requirement of soil, enabling better growth and more disease-resistant crops.

Challenges

Technical Skills: Having the correct knowledge is essential for the plants and setup in aeroponics. Aside from knowing what the plants require, it is also important to adjust the pH, EC and humidity to correct level. Even a tiny error can have detrimental effects on quality and yield (Vatcharadze, 2021).

High Initial Cost: Aeroponics can be quite pricey and not everyone may have the means to afford it. A basic setup can indeed cost a minimum of hundreds of dollars (Malo, 2021).

Thorough Examination: Aeroponic systems feature many complex components and operations because of their unique design. Because of their complexity, it's crucial to provide them with the care, attention and routine maintenance they need (Thomas, 2023).

Conclusion

Air-growing, also known as aeroponics, is not a new concept in nature. Many plants near lakes have been observed to grow without taking support from soil or other substrate. With the drastic increase in population, climate change, and the ever-increasing demand for food, aeroponics has emerged as a possible solution. Furthermore, the quality of soil has been deteriorating due to various reasons, including human interventions. In order to adopt Aeroponics, one must possess the necessary skills and knowledge to utilize the technique fully. However, there are numerous successful examples of crops that have been grown successfully using this method. In addition, scientists have been using aeroponics to grow crops in zero-gravity conditions. It serves as a valuable research tool to effectively supply nutrients to the plants. This technique has made year-round production possible. Overall, aeroponics offers a sustainable solution for smart resource utilization and saves time and labor. It is crucial for achieving sustainable development in today's world.