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Aeroponics: Modern Plant Cultivation Technology

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With the increasing population growth the demand for the more food and more land to grow food is ever increasing. As the world population continues to grow, the rising demand for agricultural production is significant. Prime agricultural land can be scarce and expensive. Some of the drawbacks of the traditional farming system are long time to harvest hence being sold for more expensive price, soil used in traditional system, decomposition of organic materials takes up long time, hence a high risk of getting soil disease, used pesticides harmful for health etc. Aeroponics is an alternative for people with limited spaces to grow plants. It is an advanced form of hydroponics. Aeroponics is the process of growing plants with only water and nutrients. This innovative method results in faster growth, healthier plants, and bigger yields with fewer resources. Aeroponic culture differs from conventional hydroponics, aquaponics and in-vitro (plant tissue culture) growing. Unlike hydroponics, which uses a liquid nutrient solution as growing medium and essential minerals to sustain plant growth, or aquaponics, which uses water and fish waste, aeroponics is conducted without a growing medium (Stoner et al., 1998). It is sometimes considered a type of hydroponics, since water is used in aeroponics to transmit nutrients. Aeroponic farming is a form of hydroponic technique and a type of vertical farming. The word aeroponic is derived from the Latin word ‘aero’ (air) and ‘ponic’ means labour (work). Aeroponic techniques have proven to be commercially successful for propagation, seed germination, seed potato production, tomato production, leaf crops, and micro-greens. Vegetable crops like potato, yams, tomato, lettuce and some of the leafy vegetables are being commercially cultivated in aeroponic system. Aeroponics appeared to be a highly feasible method for the production of both aerial parts and roots.

Methods

The basic principle of aeroponic growing is to grow plants suspended in a closed or semi-closed environment by spraying the plant's dangling roots and lower stem with an atomized or sprayed, nutrient-rich water solution (Stoner et al., 1998). The leaves and crown, often called the canopy, extend above. The roots of the plant are separated by the plant support structure. Often, closed-cell foam is compressed around the lower stem and inserted into an opening in the aeroponic chamber, which decreases labor and expense; for larger plants, trellising is used to suspend the weight of vegetation and fruit. Ideally, the environment is kept free from pests and disease so that the plants may grow healthier and more quickly than plants grown in a medium. However, since most aeroponic environments are not perfectly closed off to the outside, pests and disease may still cause a threat. Controlled environments advance plant development, health, growth, flowering and fruiting for any given plant species and cultivars. Due to the sensitivity of root systems, aeroponics is often combined with conventional hydroponics, which is used as an emergency "crop saver" – backup nutrition

and water supply – if the aeroponic apparatus fails. High-pressure aeroponics is defined as delivering nutrients to the roots via 20–50 micrometre mist heads using a high-pressure (80 pounds per square inch (550 kPa) diaphragm pump.

Mainly N-NH_4 (0.54 g/L), N-NO_3 (0.35 g/L), P(0.40 g/L), K (0.35 g/L), Ca (0.17 g/L), Mg(0.08 g/L), Na(0.04 g/L), Fe (0.09 g/L), Zn (0.03 g/L) and B(0.03g/L) are commercially being used in most of the crops. Water to be used in aeroponics should have a low EC, not exceeding one mS/cm. Water pH is also a useful indicator. In vitro plants are preferred because of sanitary reasons. However, they need to be handled with proper care by experienced technicians.

Aeroponic Technology in Vegetable Crops

Vegetables	Chilli (*Capsicum Annuum*), Brinal (*Solanum melongena*), Tomato (*Lycopersicon esculentom*), Potato (*Solanum tuberosum*),Pea (*Pisum sativum*), Beet (*Beta vulgaris*), Bell pepper (*Capsicum annum*), Cucumber (*Cucumis sativus*), Cabbage (*Brassica oleracea* capitata), Cauliflower (*Brassica oleracea*), Radish (*Raphanus sativus*), Onion (*Allium cepa*)
Leafy vegetables	Lettuce (*Latuca sativa*)

Advantages:

Requires little space and high yield: Aeroponic systems can be stacked up in layers to build vertical farms that take up much less space than traditional farming methods.

Fast plant growth: Plants grow fast because their roots have access to a lot of oxygen.

Round the year cultivation: Since plants are grown in a controlled environment crops can be grown year-round without being dependent on the weather or atmosphere conditions outside.

Less need for nutrients and water: Aeroponic plants need less nutrients and water on average, because the nutrient absorption rate is higher, and plants usually respond to aeroponic systems by growing even more roots.

Disease free produce: Due to clean and sterile growing conditions, plant diseases and infections reduce up to agreat extent.

Disadvantages:

Dependence on the system: A typical aeroponics system is made up of high pressure pumps, sprinklers and timers. If any of these break down, plants can be damaged or killed easily.

Technical knowledge required: Initially some training is required for system maintenance.

Sanitary conditions of the root chamber: The root chamber must not be contaminated, or else diseases may strike the roots.

High cost: Most aeroponic systems are not exactly cheap. Aeroponic systems may cost many hundreds of dollars each.

Conclusion:

By using aeroponic systems, we can save 98 per cent of total water because of recirculatory system. Fresh, clean, healthy, efficient and rapid food production can be obtained from aeroponic systems throughout the year. This soil- less culture can overcome all the constraints that are present in soil culture production. Enhanced disease-free yield leads India to be at top growers and exporters in near future. Aeroponic system has the potential to produce enhanced vegetative growth without use of any artificial hormones, pesticides or insecticide.

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