

Hydroponics: A Complete Solution for Soilless Production

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Introduction

Hydroponics is the growing of plants in a liquid nutrient solution with or without the use of artificial media. Aquaculture, nutriculture, soilless culture, and tank farming are all terms used to describe hydroponics. Plants are grown in nutrient-rich water with or without the use of an inert media such as sand or gravel for mechanical support. Hydroponics is made up of two Greek words: Hydro, which means water, and Ponos, which means work. It is a method of producing plants, mainly crops that does not require the use of soil. Plants are grown in this way on water that is rich in critical nutrients. Plants cultivated hydroponically develop faster and healthier than plants grown in soil, according to research, since they receive essential nutrients directly from water to roots. Nutrients are dissolved in the water that surrounds the root, making it easier for plants to get the nutrition they require. Commonly used mediums include expanded clay, coir, perlite, vermiculite, brick shards, polystyrene packing peanuts and wood fiber. Hydroponics has been recognized as a viable method of producing vegetables (tomatoes, lettuce, cucumbers and peppers) as well as ornamental crops such as herbs, roses, freesia and foliage plants. Due to the ban on methyl bromide in soil culture, the demand for hydroponically grown produce has rapidly increased in the last few year



Advantages

- It can be used in places where in-ground agriculture or gardening is not possible for example, dry desert areas(Thar) or cold climate regions (ladakh).
- More complete control of nutrient content, pH and growing environment.
- Lower water and nutrient costs associated with water and nutrient recycling.
- Faster growth due to more available oxygen in root area; Elimination or reduction of soil related insects, fungi and bacteria.
- Much higher crop yields.
- No weeding or cultivation required.
- Some crops, such as lettuce and strawberries, can be lifted from ground level to a much better height for planting, cultivation and harvesting.
- This gives much better working conditions and hence lowers labor costs.
- Crop rotation/fallowing is not necessary.
- Transplant shock is reduced.

Disadvantages

- Initial and operational costs are higher than soil culture: Skill and knowledge are needed to operate properly.
- Some diseases like Fusarium and Verticillium can spread quickly through the system.
- However, many varieties resistant to the above diseases have been bred.

Future

Hydroponics may be used in underdeveloped countries for food production in limited space. It is even feasible to grow hydroponically in areas of poor soil conditions such as deserts. The desert sand serves as a good growing medium and seawater can be used to mix nutrient solution once the salts have been removed. The popularity of hydroponics has increased dramatically in a short period of time leading to an increase in experimentation and research in the area of indoor and outdoor hydroponic gardening.

Nutrients

Major element and micronutrient ionic forms and normal concentration range found in most nutrient solutions (Jones, 2005).

Macronutrients

Major Elements	Element Ionic Form	Concentration Range mg/L, ppm
Nitrogen (N)	NO ₃ ⁻ , NH ₄ ⁺	100 to 200
Phosphorus (P)	HPO ₄ ²⁻ , H ₂ PO ₄ ⁻	30 to 15
Potassium (K)	K ⁺	100 to 200
Calcium (Ca)	Ca ²⁺	200 to 300
Magnesium (Mg)	Mg ²⁺	30 to 80
Sulfur (S)	SO ₄ ²⁻	70 to 150

Micronutrients

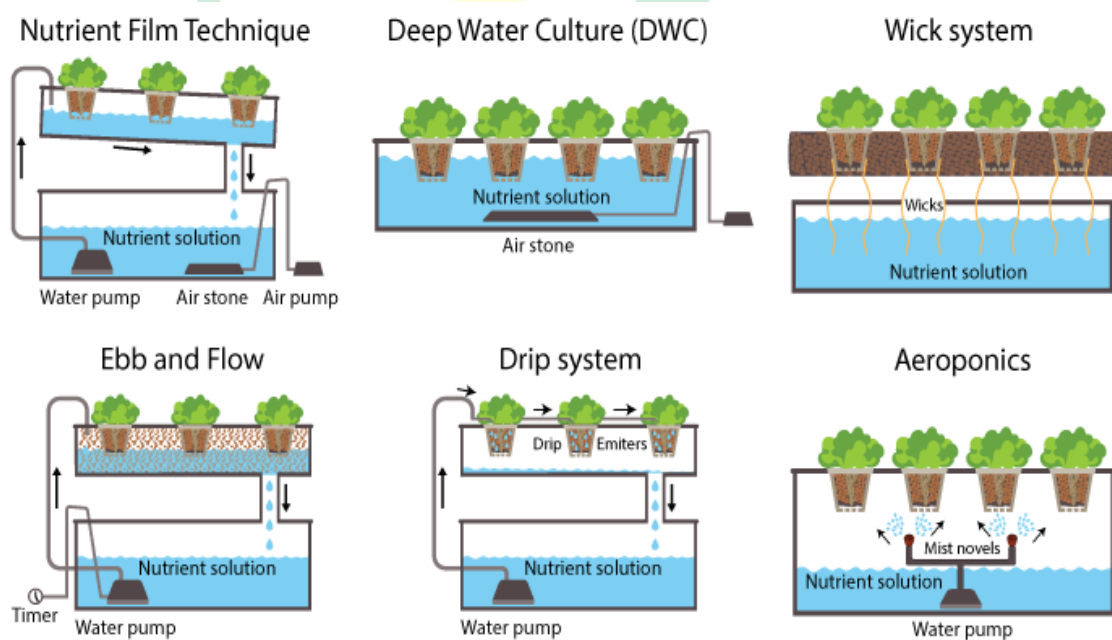
Boron (B)	BO ₃	30.03
Chlorine (Cl)	Cl ⁻	
Copper (Cu)	Cu ²⁺	0.01 to 0.10
Iron (Fe)	Fe ²⁺ , Fe ³⁺	2 to 12
Manganese (Mn)	Mn ²⁺	0.5 to 2.0
Molybdenum (Mo)	Mo	0.05 to 4
Zinc (Zn)	Zn ²⁺	0.05 to 0.5

Types of hydroponics:

Following are some of the types of Hydroponics:-

- Ebb and Flow System:** It requires a medium such as perlite to give stability. Water and mineral solutions are periodically pumped into the tray containing plants. Plants absorb the solution and the remaining solution drains back to the reservoir. This method is simple and used in home gardens. Herbs are grown by this method.

- **Nutrient Film Technique (NFT):** No medium is required. Hydroponic plants are kept in wooden channels having a slope. The mineral solution is pumped to the high end of the channel and slope down water is collected and reused. Plants with large roots are grown by this method.
- **Drip Systems:** It is similar to ebb and flow but here water goes through smaller tubes and drain on top of plants. Small plants having less developed root systems are grown using this method.
- **Wick Systems:** This is a medium based system where perlite or rockwool is used. Nylon rope is placed at the base of each root which extends to the reservoir. It takes up minerals and water and releases it in the medium which makes it available for plants. It is an economical method of hydroponic farming because no pumps are required.
- **Aeroponics:** This is a water-based system similar to NFT and doesn't require a medium. The mineral solution is sprayed onto the plants in the form of mist. This is difficult to set up but is beneficial in the large commercial setting.
- **Deep Water Culture (DWC):** In a container, the plant's root is suspended in oxygenated water containing minerals. An air pump is used. This is an easy method and requires low maintenance.



Types of Hydroponic Systems

Liquid Hydroponic System: Closed System.

- **Nutrient Film Technique (NFT):** Plants are placed in a polyethylene tube that has slits cut in the plastic for the roots to be inserted. Nutrient solution is pumped through this tube.
- **Floating Hydroponics:** Plants are grown on a floating raft of expanded plastic.
- **Aeroponics:** Plant roots remain suspended in an enclosed growing chamber, where they are sprayed with a mist of nutrient solution at short intervals, usually every few minutes.

Aggregate Hydroponic System: Open System.

Rockwool Culture:

It is the most widely used medium in hydroponics. Rockwool is ground-up basalt rock that is heated then spun into threads making wool. It is very light and is often sold in cubes. Rockwool can hold water and retain sufficient air space (at least 18 percent) to promote optimum root growth. Sand Culture

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Summary

Aquaculture, nutriculture, soilless culture, and tank farming are all terms used to describe hydroponics. Plants are grown in nutrient-rich water with or without the use of an inert media such as sand or gravel for mechanical support. Hydroponics is made up of two Greek words: hydro, which means water, and ponos, which means work. It is a method of producing plants, mainly crops, that does not require the use of soil. Plants are grown in this way on water that is rich in critical nutrients. Plants cultivated hydroponically develop faster and healthier than plants grown in soil, according to research, since they receive essential nutrients directly from water to roots. Nutrients are dissolved in the water that surrounds the

root, making it easier for plants to get the nutrition they require. Throughout history, many different civilizations have adopted hydroponic gardening techniques; examples include the hanging garden of Bablon and the floating garden of Aztecs in Mexico. Because of the numerous advantages, scientists and horticulturists are experimenting with various methods of hydroponics. NASA has also integrated hydroponics into their space program, as they consider the feasibility of growing food in long-term space missions. It allows plants to grow 50 percent faster than they would on soil throughout the year. It produces a larger yield, reduces the need of excessive pesticides, consumes just 10% of the water, and can be reused. It's also a fantastic solution for those who don't have access to land or yard area for gardening.

References

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