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NUTRIENT MANAGEMENT IN HYDROPONICS FOR VERTICAL FARMING

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Introduction

The nutrient supplied to the plant through hydroponics go straight to the root of the plant and the nutrients required for the growth of the plant is also provided. The nutrient supplied through hydroponic vertical system contain essential elements with soluble salts that contain inorganic ions. The growth of the plant is supported by media and aggregates. Farming through hydroponics in vertical farming system is increasing due to the increase in population, high demand for food material and lack of land resources.

Hydroponics

Hydroponics derived from Greek word hydro means water and pono means to work which is altogether known as working with water. The cultivation of plant without the use of soil is called hydroponics. In other words growth of plants in nutrient solution without soil for the mechanical support.

Vertical Farming

Growth of crops in stacked layers that are vertical is called vertical farming. In this method crops are planted in layers vertically that reduces the use of excess space. This method of farming is carried out in controlled environment like humidity, light, temperature, water and nutrients. Compared to traditional or other farming system high yield is attained through vertical farming system.

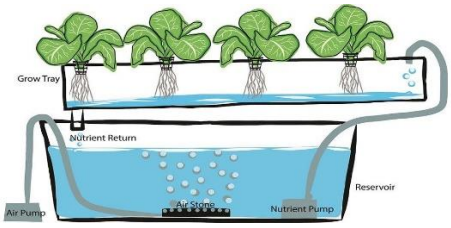


Fig.1. Hydroponics

Fig 2. Vertical Farming System

Hydroponics Vertical Farming System

Hydroponics uses nutrient solution for the growth of plants whereas in vertical farming system stacked layers are used. The nutrient solution used in hydroponics acts as soil medium and provide support to the plant, helps to provide high yield and reduce the dependence on water. The nutrient solution may contain Magnesium (Mg), Nitrogen (N), Calcium (Ca), etc,. the plants in each layers are supplied with nutrient solution without any interval regularly.

Fresh water (reservoir tank) → Fertigation machine (mix all nutrients with water)

From the reservoir tank the fresh water is pumped to the fertigation machine where all the nutrients and fertilizers are mixed together with water. The water containing nutrient solution is supplied to the plants with the helps of pump present in hydroponics vertical farming system. The nutrient solution supplied nourishes the plant, encourage the growth of new shoot, flowers and fruits. Proper irrigation and fertilizer application determines the crop's health. Along with nutrients supplied plants need light, carbon dioxide (CO_2) and water for photosynthesis and proper growth and development. Nutrient supplied to the plants may be macro nutrients and

micro nutrients that are essential for the growth of the plant.

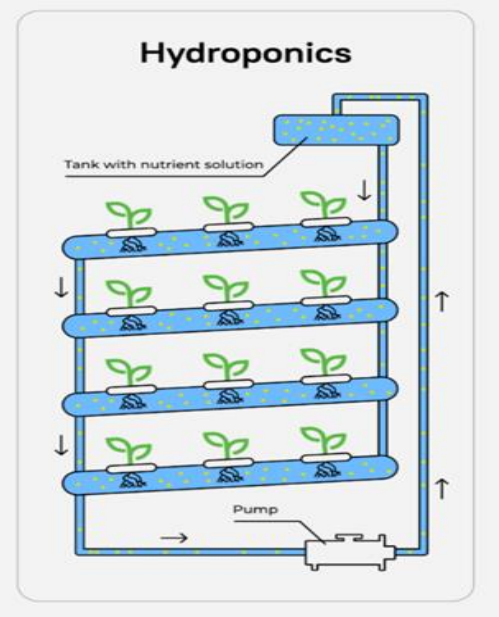
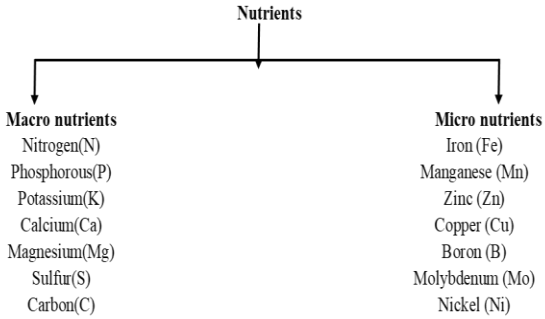


Fig 3. Hydroponics Vertical System



Macro nutrients

1) Nitrogen (N)
   - Nitrogen plays an important role in the metabolism of the plant
   - It is an essential building material for protein and nucleic acid
2) Phosphorous (P)
   - Phosphorous is essential for the plant for after growth cycle and development of root system
   - It also make the plant to tolerate stress conditions
3) Potassium (K)
   - Potassium helps to enhance the structure and quality of the plant
   - Helps to uptake water and nutrients and transport to other parts of the plant
4) Calcium (Ca)
   - Calcium helps in the functioning of the plasma membrane and ensures in the healthy plant growth
5) Magnesium (Mg)
   - Magnesium helps in the water management and provide strength to the plant to withstand in water medium
   - It is the important component of chlorophyll that helps to maintain the plant in green color
6) Sulphur (S)
   - Sulphur is important for the protein and fat synthesis
   - It is also an important element in plant growth
7) Carbon (C)
   - Carbon is the basis of all the elements necessary for the growth of the plant
   - It is needed for photosynthesis and also provide nutrition to the plant

Micro nutrients

1) Iron (Fe)
   - Iron helps the plant to undergo photosynthesis and respiration
   - It has direct effect on the growth of plant
2) Manganese (Mn)
   - Manganese helps in respiration, photosynthesis, carbon dioxide assimilation and synthesis of proteins
   - Enhance the development of root as it stimulates the uptake of phosphorous
3) Zinc (Zn)
   - Zinc helps in the breakdown of carbohydrates, proteins and phosphorus compounds

- Provide immunity to the plant to withstand short term stress influences the synthesis of growth hormone

4) Copper (Cu)
   - Copper stimulates the synthesis of lignin called mechanical tissue of the plant
   - It make the plant resistant against disease and withstand temperature
5) Boron (B)
   - Boron plays an important role in the metabolism of the plant
   - It affects the flower initiation, respiration and water management
6) Molybdenum (Mo)
   - The immunity of the plant is increased as the risk of incidence to pest and disease id reduced
   - It is one of the important element as it is helps in protein synthesis, chlorophyll
   - Helps in nitrogen metabolism
7) Nickel (Ni)
   - Nickel helps the plant to uptake required amount of water and nutrients

Nutrient excess and deficiencies in plants

Any irregularities in the entire crop cycle may be due to the nutrient supply by the plants. This results in the reduced crop yield and the quality may be reduced. Thus the profit is reduced. If the nutrient deficiencies or excess is assessed initially it is easy to recover the damage. Some deficiencies are easily visible.

Example:

Nitrogen deficiency in any plant inhibits the growth and flowering, copper deficiency causes abnormal yellowing and wilting of the plant that are visible through naked eye easily.

Importance of pH in plant nutrition

pH is used to measure the acidity of the substances as the medium is water. Commonly the scale of the pH is 0 – 14, here 0 is most acidic and 14 most alkaline. Mostly plant grows in 6 – 7 pH which is suitable for the absorption of majority of the elements. More basic substance is harmful to the plant and more acidic substance make the plant harder. Insufficient pH will affect the crops quality. For the development of healthy plant it is needed with frequent testing and making required adjustments.

Conclusion

Nutrient management is important for the development of the development of plant growth. It includes controlling and monitoring the water solution that provides necessary elements for the development of growth of the plant. The management includes managing the pH level, providing essential nutrients. Maintaining the nutrient of the nutrient containing water solution is essential for getting higher yield and improved quality of the produce.

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