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Hydroponic culture in agriculture crop

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In 1936, Dr. W.F. Gericke given the term "hydroponics" to describe the growing of edible and decorative plants in a solution of water and dissolved nutrients. This is a new production technology called hydroponic. The term "hydroponics" is derived from the Greek words "Hydros" (water) and "Ponos" (labor). Hydroponics was first defined by Gericke as crop development in mineral solutions without the need of a solid substrate for the roots. Soilless culture is a term that encompasses both hydroponics and soil culture. Hydroponics is always soilless cultivation, but not all soilless cultivation is hydroponics. Hydroponics utilises only around a tenth to a fifth of the water utilised in traditional soil farming. It conserves a significant amount of water. Plants can be cultivated in either simple nutrient solution or sterile substrates, both of which are devoid of microbes. Hydroponics is a new method of agriculture which uses nutrient solution and not soil to produce crops.

Commercially hydroponics cultures are maintained in large shallow tanks made up of concrete, cement, wood or metal sheets. In such containers the gravels and solutions are kept. The tanks are generally equipped with pumps and empty auxiliary tanks to pump out and circulate the growth solution and to maintain satisfactory aeration open of the solution.

The hydroponics have been used for the production of horticultural and floricultural crops. This practice provided better yield than soil in gladiolus, carrots, radish, potatoes, roses, cucumbers, green peppers, tomatoes and lettuce et. Such large yield of various plants led to speculation that hydroponics agriculture might some day replace soil agriculture. The gardeners are utilizing hydroponics methods in such localities where good soil is not available.

Hydroponic Techniques

Many hydroponic techniques investigations have been performed. In general, there are two types of hydroponics techniques: solution culture and sand culture.

1. **Solution culture method:**In this method the roots of the plant are placed in liquid nutrients solution. The solution which contains those essential minerals

which the plants absorb from the soil by roots, is called nutrient solution. When all the mineral elements are present in a solution, it is called *normal nutrient solution* and when one of the essential is not added in the nutrient solution, it is called *deficient nutrient solution*.

2. **Sand culture method:** In this method the plants are grownon sand and nutrient solutions are added to sand culture by slop culture (pouring over the surface) or drip culture (dripping on the surface) or sub-irrigation (forcing solution up from the bottom of the container).

Aeroponic System

Aeroponics is a technology that is comparable to hydroponics in several ways. The main difference is that with aeroponics, plants are grown with the assistance of support and fine droplets of nutrient solution (fog or aeroponic mist), and they do not require a single particle of soil or substrate to sustain them. ame "aeroponic" comes from the Latin words "aero" which means "air" and "póno" which means "labour," and it refers to a soilless cultivation method for growing plants in a controlled environment.

Essential elements for hydroponic culture

Many research on crop nutrient requirements have been undertaken. Plant development and growth need the presence of seventeen essential elements. These elements are classified as macronutrients or micronutrients. These elements are classified in table 1.

Table No 1: Essential elements for hydroponic culture

Type of Elements	**Name of essential elements**	**Major function in plants**
Macro-element	Nitrogen	Protein, chlorophyll and amino acids synthesis
	Phosphorous	Plant development and photosynthesis process
	Potassium	Involve in several enzyme activity
	Hydrogen	All cellular constituents, water formation
	Oxygen	All cellular constituents, Energy release
	Carbon	All cellular constituents, formation of organic compounds
	Calcium	Cell wall structure, photolysis of water
	Magnesium	Component of chlorophyll, enzyme activation
	Sulphur	Formation of amino acids, lipid synthesis
Micro-elements	Iron	Chlorophyll synthesis, component of porphyrin molecules

	Zinc	Component of enzymes, tryptophan synthesis
	Boron	Translocation of sugar, pollen germination
	Chlorine	Electron transfer to PS II, cell division
	Copper	Oxidase enzyme, enzyme activation
	Manganese	Chlorophyll synthesis, enzyme activation
	Molybdenum	Component of nitrate reductase
	Nickel	Hydrogenase, Urease

Nutrient Solutions for hydroponics:

All needed macro and micro nutrients are supplied to hydroponic plants in the form of nutrient solution, which is made up of dissolved chemical salts in water. The stringent nutrient management programme determines whether a hydroponic technique succeeds or fails. A good hydroponic system requires careful manipulation of the nutrient solution pH level, temperature, and electrical conductivity (EC), as well as replacement of the solution as necessary. Different nutrient solutions have formulated by eminent scientists like Sachs, Knop, Pfeffer, Shive and Hoagland with minor variation in their salts composition (Table 2).

Table 2. Chemical compositions of plant nutrient solutions

Salts	**Sachs solution (1860) gm/l.**		**Knop's solution (1865) gm/l**		**Pfeffer's solution (1900) gm/l**	**Shive's solution (1915) gm/l**	**Hoagland's solution (1920) gm/l**
$Ca(NO_3)_2.4H_2O$	-	0.8	-	I	II	Sol. I	Sol. II
$Ca_3(PO_4)_2$	0.5	-	-	1.22	1.84	1.18	0.95
$Ca(NO_3)_2$	-	-	0.8	-	-	-	-
$CaSO_4$	0.5	-	-	-	-	-	-
KNO_3	0.1	0.2	0.2	-	-	-	-
KCl	-	-	0.2	-	-	0.51	0.61
$MgSO_4.7H_2O$	0.5	0.2	-	-	-	-	-
$MgSO_4$	-	-	0.2	3.7	0.49	0.49	0.49
KH_2PO_4	-	0.2	0.2	-	-	-	-
NaCl	0.25	-	-	2.45	1.47	0.14	-
$FeSO_4$	trace	trace	-	-	-	-	-
$FeCl_3$	-	-	trace	-	-	-	-
Fe	-	-	-	1 cc of 0. 5%	1 cc of 0. 5%	-	-
$NH_4H_2PO_4$	-	-	-	-	-	-	0.12

Ferric tartrate	-	-	-	-	-	0.5	0.5

Advantages of Hydroponics:

1. Plant nutrient can be manipulated as per requirement for the experiments or farming.
2. The acid - base balance pH of the nutrient solution can be easily set and maintained in the range most adequate for aparticular cop
3. There are no soil colloids present to immobilise any of the nutrients through absorption
4. Frequent replacement of the nutrient solution prevents the accumulation of toxic organic decomposition products such as often occurring in soils.
5. The equipment can be made automatic, avoiding the labour and expense of watering the plants.
6.
7. The nutrition can be altered at any time to coordinate with fluctuations in the weather especially changes in light and temperature.
8. Nutrient can be changed at any time in order to regulate the vegetative or reproductive phases of the plant
9. More water use efficiency is nearly 90%
10. Reduce the environmental pollution as no use of mechanical plow so that that reduce the burning of stubble.
11. Roof top gardening or cultivation of horticultural crop can be grown
12. Crop can be protected from insect, pathogen and no use of pesticides

Disadvantages of Hydroponics

1. As compared with field production, production by hydroponics is limited
2. In the economic sense, its use under greenhouse conditions is generally limited to high - value speciality crops
3. Considerable technical skill is required to design equipment, plan routine procedures and handle special problems which may arise
4. If a disease develops, it may damage all plants in the container since the nutrient solution circulates, allowing pathogenic organisms to spread to the roots of all plants.
5. Special modifications of technique are necessary for certain crops.