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Growing Plants Using Nutrient Medium (Hydroponics)

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Abstract
The main objective of hydroponics is to supply the ideal nutritional environment for optimum plant performance. Plant performance may be further optimized by controlling the climate and lighting. Plants grown hydroponically are generally healthier than their soil-grown counter-parts, because they receive an almost perfectly balanced diet and rarely come in contact with soil-borne pests and diseases. Since hydroponic systems reduce water and nutrient stress to the plants, they grow faster and can be grown closer together without starving each other. Healthier plants also produce higher yields. Hydroponic systems conserve water by preventing evaporation and runoff.

Keywords
Ebb and flow system, hydroponic solution.

I. Introduction
Conservation and sustainability are a big part of hydroponic growing. Hydroponic nutrient solutions are recycled in recirculating systems, and can be reused in other garden areas such as potted plants or lawn areas. Many types of grow media can be sterilized and reused in your hydroponic system. Inert media, such as coconut coir, perlite and Grows tones, is designed for excellent water absorption as well as air circulation, so they can also be reused in potted plants or soil gardens. Reusing and recycling these products reduces the amount of waste that ends up in landfills.

II. Concept
Hydroponics is a subset of hydro culture and is a method of growing plants using mineral nutrient solutions, in water, without soil. Terrestrial plants may be grown with their roots in the mineral solution only, or in an inert medium, such as perlite or gravel.

III. Future scope of hydroponics
Hydroponics is the fastest growing sector of agriculture, and it could very well dominate food production in the future. As population increases and arable land declines due to poor land management, people will turn to new technologies like hydroponics and vertical farming to create additional channels of crop production. Currently, arable land comprises only around 3 percent of the Earth's surface, and the world population is around 6 billion people. By 2050, scientists estimate that the Earth's population will increase to 9.2 billion, while land available for crop and food production will decline. To feed the increasing population, hydroponics will begin replacing traditional agriculture.

IV. Details of the assembly
In this experiment an ebb and flow hydroponic system was constructed. First a large plastic tray with the hydroponic solution was filled. A smaller tray is then fitted above the larger one. This tray is used for supporting the plants. The smaller tray is lined with supporting material like rice husk. A small pump is attached the larger tray and it is connected to the smaller one using a pipe. This is so that the solution keeps on circulating through the plants. Then the plant seedlings are planted in the supporting material ie rock wool.

V. The compounds used in hydroponic solution and why they are used-

1. Ammonium Phosphate
It is recommended for use at the beginning of the growth season when phosphorus availability is crucial for the establishment of the root system.

2. Potassium And Nitrogen
It is a source of potassium and nitrogen, two macronutrients (primary nutrients) ,these elements have to be added to the soil in order to achieve healthy growth.

3. Magnesium
It is added in sulphate form. It is at the centre of the chlorophyll molecule. A deficiency shows up in pale, yellowish leaves, usually starting from the base.

4. Boric Acid
It is necessary as a trace element to eliminate several undesirable features in vegetables, such as brittle stems, dying growing tips.

5. Chlorine
Cl ions along with potassium/Sodium ions regulate the shrinking and turgidity of the guard cells surrounding the stomatal opening thus controlling the opening and closing of the stomatas. Chlorine ions are also needed for the water splitting system in photosynthesis.
Deficiency of chlorine causes wilting, leaf molting and leaf blade tips.

6. Sodium
Na ions are needed in metabolism and synthesis of chlorophyll in plants. Sodium ions along with chlorine ions help in the opening and closing of stomatas.

7. EDTA
EDTA is required for the growth of plants because it forms chelating ligands with metals such as Cu, Fe, Zn, etc and this helps in better uptake of these nutrients by the plants.

VI. Figures and Tables
In order to prepare hydroponic solution the following compounds was mixed with tap water in a specific proportion:

Compound Name	Weight in grams
$NH_4H_2PO_4$	1gm
KNO_3	3gms
$MgSO_4.7H_2O$	1gm
H_3BO_3	0.05gm
$MnCl_2$	0.01gm
$ZnSO_4$	0.01gm
$CuSO_4$	0.01gm
$FeSO_4$	0.05gms
NaCl	0.05gms
NaEDTA	0.05gms
$Mg(NO_3)_2$	2gms

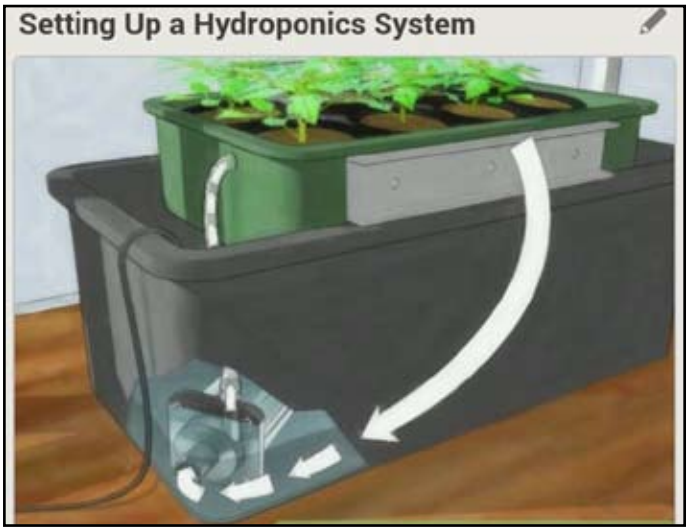

Fig. 6.1 The design of ebb and flow system:

VII. Details Of The Problems Faced With Solution

7.1First floral foam was used as the supporting material , but then it had to be replaced with rice husk ,as it was toxic to the plants.
7.2 Ca $(NO_3)_2$ couldn't be obtained as a source for nitrate ions, so Mg $(NO_3)_2$ had to be used as a substitute.
7.3 The first hydroponic solution had a Ph of more than 6.5 so it had to be diluted to a certain extent. 7.4. The first onion bulb which was planted, rotted due to excess watering, so the position of the bulb had to be adjusted, so that only the roots got wet and not the entire bulb. And also the time period had to be adjusted for which it got watered by the solution.

VIII. Conclusion

Hydroponics gives hope for food production to areas of the world with poor or infertile soils. This gives populations of people in these areas access to healthy produce. The vegetables grown in these areas, and other places with hydroponic systems, are fresh, delicious and full of flavor- even more so than their soil counterparts. Hydroponics empowers communities that would otherwise not have access to fresh and delicious food.
From a scientific perspective, hydroponics is the way to go. Closed, recirculating systems allow for complete control over the nutrient solution so growers are able to know exactly what nutrients their plants receive. Various nutrient formulas are designed specifically to suit different types of plants at different growth stages. Growers can choose the nutrients based on the crop they are growing, and can tweak the formula for the vegetative stage or the flowering stage. This leads to higher yields than traditional soil-based agriculture. Healthy plants are naturally more pest resistant than unhealthy plants or plants that don't receive optimum nutrition. In addition, nutrient meters can be used to regularly test the nutrient concentration. Tests allow growers to add elements when they see a sign of nutrient deficiency. This ensures that all elements are present in their desired concentrations, allowing for optimum growing conditions that are tailored to each plant's specific needs.

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