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COMPARATIVE STUDY OF SWETA ANAND ORGANIC GROWTH SOLUTION, HOAGLAND SOLUTION AND SOIL IN THE GROWTH OF PLANTS WITHOUT SOIL

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Abstract: *Hydroponics is a technique for growth of plants without soil in a Organic nutrient solution medium. Although it is an advance technique for plant cultivation but use of Organic Nutrient solution medium for plant growth is always in demand and needed. Various studies have beendone on it. It has been a topic with so much potential still Left out unexplored. As there is a variation in terms of land quality, climate and also the dependence on rain and physical space, hydroponics can be one of the options that can be explored as it allows the plants to grow in small spaces and that too without soil, But what we would need for this will be a constant supply of nutrients that will come in the form of nutrients. There are many different solutions available and the present experiments were designed to validate the minimum amounts of solutions as well as the quality and quantity of them required for good growth of the plants. The study was undertaken to compare the nutrients of Sweta-Anand solution with the standard Hoagland's solution and study the variations in terms of nutrients required.*

Plant Nutrients and their Functions: *Several elements take part in the growth and development of plants, and those absorbed from the soil are generally known as plant nutrients. Besides these, the plant takes up carbon, oxygen and hydrogen, either from the air or from the water absorbed by roots. In all, 16 elements have been identified and are established to be essential for plant growth. There are Carbon (C),Hydrogen (H), Oxygen (O), Nitrogen (N), Phosphorus(P), Potassium (K), Calcium(Ca), Magnesium (Mg), Iron (Fe), Sulphur(S), Zinc (Zn), Manganese (Mn), **C**opper (Cu), Boron (B), Molybdenum (Mo), and Chlorine(Cl). These elements serve as raw materials for growth and development of plants, and formation of fruits and seeds. Most of the essential elements are found in liberal quantities in the mineral soils. In spite of the fact that these are available in plenty, these may not be available to the plants, as they are tied up in mineral and chemical compounds. The roots cannot absorb and deliver them to the growing plants for synthesis, and hence, the need for assessing the plant available amounts of nutrients in the soil and meeting deficiency by application of manures and fertilizers to such soils for optimum crop production.*

Aims & Objectives: *To show SWETA ANAND GROWTH SOLUTION has the properties for healthy growth of plant in the absence of soil. The main purpose was to demonstrate that the solution being tested had enough nutrients to allow plant growth.*

Observations: *Comparative study of nutritive value of soil essential for the growth of plants and the nutritive value of SWETA ANAND GROWTH SOLUTION ,both are equally efficient and almost same nutritive value for growth of plants. All the essential nutrients C (Carbon), H(Hydrogen), N(Nitrogen), O(Oxygen), P(Phosphorus),K(Potassium), Ca(Calcium), S(Sulfur), Fe(Iron), Zn(Zinc), Cu(Copper), B(Boron), Mo(Molybdenum) and Cl(Chlorine) are present in nutritive SWETA ANAND GROWTH SOLUTION.*

Keywords: *Hydroponic, SWETA ANAND GROWTH SOLUTION, NASA, Babylon, Hnaging garden, Hoagland solution, Ebb and flow system, Nutrient film technique, Drip irrigation, Deep water culture, Red Soil, Lateritic soil, hydrated oxides, manganese oxide, Black soil, Alluvial soil, Desert soil, Forest and Hill Soil, Alfisol, Ultisol and Oxisol, Vertisol, Inceptisol and Entisol, Aridisol, Saline and Alkali soil, Acid soil, Peaty and Marshy soil, Major Nutrients, Secondary Nutrients, phosphorus, potassium, Magnesium, Manganese, Zinc, Copper, Nickel, Iron.*

Introduction: Hydroponics is made up of two words Hydro + Ponics which together means growth / culture in Hydros (Water). It is a science which if developed properly could lead to a better availability of growth medium for various kinds of vegetation. It could even be a method to grow vegetation in outer space. Solution culture hydroponics is still an important research technique and is the method NASA Scientists will use to grow plants in the space station (Schwartz Kopf 1992).Down the lane of history Hydroponics has not been pen down properly there seems many inaccuracies in it.

The hanging garden of Babylon, one of the seven wonders of the ancient world, is often considered the first use of Hydroponics (Resh 1990). The hanging gardens were supposedly built along the Emplirates River about 50 miles South of modern Baghdad, Iraq, by King Nebuchaduez– Zar (604-562 BC). There is no evidence of Hydroponics in the Hanging Gardens–Nutrient Solutions were unknown at that time and the only written description of the gardens are second hand account that say the gardens were similar to multilevel roof gardens with plants growing in deep layers of soil (Finkel 1980).

Indian History: Development in the field of Hydroponics has not been fast paced. These are simple opportunities in this field. The growth media for the plants is water and it could be used at places like flood affected regions, outer Space stations etc. for the growth of vegetation. Hydroponics did not reach India until 1946. In the summer of that year the first research studies were commenced at the Government of Bengal's Experimental Farm at Kalimpong in the Darjeeling District. At the very beginning a number of problems peculiar to this sub-continent had to be faced. Even a cursory study of the various methods which were being practised in Britain and in America revealed how unsuited they were for general adoption by the public of India. Various physiological and practical reasons, in particular the elaborate expensive apparatus required, were sufficient to prohibit them.

A novel system, of which practicability and simplicity must be the keynotes would have to be introduced if hydroponics was to succeed in Bengal, or in fact ever to prove of widespread value to the people of this part of Asia. Careful appraisal of salient problems during 1946-1947 resulted in the development of the Bengal System of hydroponics, which represented an effort to meet Indian requirements.

Hoagland Sol: A most popular Sol. known as Hoagland Sol. for growing plants was developed by Hoagland & Arnan in 1938.Hoagland Sol. consists of inspite of there not being much development in the system as such many people have tried to make it more simple and effective to use such that it gains more popularity. The various changes in design and solutions have been tried and some of them are:

N	210 ppm
K	235 ppm
Ca	200 ppm
P	31 ppm
S	64 ppm
Mg	48 ppm
B	0.5 ppm
Fe	1 to 5 ppm
Mn	o.5 ppm
Zn	0.05 ppm
Cn	0.02 ppm
Mo	0.01 ppm

Types of Hydroponics Systems

1. Ebb-and-flow (or Flood-and-Drain) system, plants in trays or on table are periodically fednutrient solution from a reservoir beneath the garden. The solution then empties back into the reservoir for future feedings. Popular mediums for holding the roots in these systems include expanded clay pellets (grow rocks) and rock-wool cubes or slabs.

2. Nutrient film technique (NFT) system, a constant shallow river of nutrient solution flowsthrough tubes, feeding the roots as they dangle down from net pots. Because there's a constant supply of water touching the roots,its very important to ensure that enough oxygen is present in the nutrient- fortified water.

3**.** Drip irrigation employs tubing that feeds each plant individually by almost constantly releasing droplets of nutrient solution through drip emitters placed at the base of each plant. A pump on a timer periodically sends liquid plant food through a manifold that then uses spaghetti tubes to deliver the nutrient solution.

4. Deep water culture (DWC) systems incorporate individual buckets for each plant, sometimes regulated by a main feeder bucket and sometimes as standalone containers. The roots dangle down into oxygenated nutrient solution and grow extremely quickly as a result, supporting monster plants up above when all of the other factors are at optimum levels.[1]

Material & Methods

Major Soil Types of India: Some dominant groups of Indian soil, classified according to soil

taxonomy and chemical property are mentioned below:

1. Red Soil is quite wide in their spread. The red colour is due to diffusion of iron in the profile.
2. Lateritic soil is composed of a mixture of hydrated oxides of aluminium and iron with small amounts of manganese oxide.
3. Black soil contains a high proportion of Calcium and Magnesium Carbonates and have a high degree of fertility.
4. Alluvial soil is the largest and agriculturally most important group of soils.
5. Desert soils occurs mostly in dry areas and important content is quartz.
6. Forest and Hill Soils are high in organic matter.

Taxonomically these Soils are Classified as Follows

- Red soil: Alfisol, Inceptisol and Ultisol
- Lateritic soil: Alfisol, Ultisol and Oxisol
- Black soil: Vertisol, Inceptisol and Entisol
- Alluvial soil: Entesol, Inceptisol and Alfisol
- Desert soil: Entisol and Aridisol
- Forest and Hill soils Alfisol

Problem Soils: According to Salt Content

(i) Saline and Alkali soil
(ii) Acid soil
(iii) Peaty and Marshy soil [2]

Plant Nutrients: Although plants absorb a large number of elements, all of them are not essential forthe growth of crops. The elements are absorbed became they happen to be in the soil solution and those taking active part in the growth and developmental processes are called the essential ones. Some of these are required in large amounts and some in traces. These are classified as major and micro nutrients, and are further classified as follow:

Major Nutrients

Group I: Carbon, Hydrogen and Oxygen.
Group II: Nitrogen, Phosphorus, Potassium
Secondary Nutrients: Calcium, Magnesium, Sulphur [2]

Nutrients Essential for Plant Growth and Forms in which Taken up by Plants

S.N.	Nutrient	Chemical symbol	Form taken up by plant
A	**Primary Nutrients**		
1.	Carbon	C	CO_2, HCO_3
2.	Hydrogen	H	H_2O
3.	Oxygen	O	H_2O, O_2
4.	Nitrogen	N	NH_4, NO_3(negative)
5.	Phosphorus	P	H_2PO_4,,HPO_4(2 negative)
6.	Potassium	K	K (positive)
B.	**Secondary Nutrients**		
7.	Calcium	Ca	Ca2 positive
8.	Magnesium	Mg	Mg2 positive
9.	Sulphur	S	SO4 (2 negative)
C.	**Micro Nutrients**		
10.	Iron	Fe	Fe^{2+} , Fe^{3+}, chelate
11.	Zinc	Zn	Zn^{2}+, $Zn(OH)_2$, chelate
12.	Manganese	Mn	Mn^{2+} , chelate
13.	Copper	Cu	Cu^{2+} , chelate
14.	Boron	B	$B(OH)_3$
15.	Molybdenum	Mo	MoO_4 -
16.	Chlorine	Cl	Cl negative [2]

Sweta Anand Growth Solution: Hobby of man may be a layman, Gardner or a scientist has nothing to do with his/her caste, religion, age etc, it is the only outset, which makes it praise worthy. Interest takes the work to a new height because interest makes the work a joyable experience. I have inherited this scientific skill from my father & forefathers.

My father had made a society in the year 2006 .He named our society "Anand Hydroponics Soilless Horticulture Society". Society registration has completed now 9 years .We are paying Income Tax returns also.

Countries Involved in Hydroponics & Difference in our Technique: Since from 1936 this technique has been very popular & many countries in the world are working on this technique & growing plants by this process to make their country developed & to increase food production. Countries, which are working in this field are America, Russia, Australia, Israel, England, China (our nearest country) has also developed this technique to increase the food production.

These Countries are working by using inorganic (chemicals) medicine but we have made a Biofertilizer or Ayurvedic medicine. The food that above countries are growing contains pesticides, but food or plants which we are growing will be free from pesticides because we are giving Ayurvedic medicine.

Recently Indian agriculture has made rapid strides and production level has risen to 234.50 million tonnes but there is a formidable challenge to produce 345 million tonnes by 12th plan, by the year 2017. This gap can be removed by applying new and different method of growing plants by HYDROPONIC SCIENCE.

Observation: The 100ml sample of SWETA ANAND GROWTH SOLUTION when compared with Hoagland sol. And soil following was observed.

S.N.	Nutrient	SWETAANAND GROWTH SOLUTION	Hoagland Solution	Average nutrient Content of the Indian[3]
1.	Nitrogen (N)		210 ppm	0.071 ppm
2.	Phosphorus (P)	60 ppm	31 ppm	0.8 ppm
3.	Potassium (K)	500 ppm	2235 ppm	177 ppm
4.	Calcium (ca)	29.35 ppm	200 ppm	3820 ppm
5.	Magnesium	156 ppm	48 ppm	475 ppm
6.	Sulphur (S)		64ppm	
7.	Manganese (Mn)	0.875 ppm	0.5ppm	8.3 ppm
8.	Zinc	2.36 ppm	0.05 ppm	
9.	Copper (Cu)	27.1 ppm	0.02 ppm	6.2 ppm
10.	Nickel	0.58 ppm		
11.	Iron (Fe)	63.98 ppm	1 to 5 ppm	
12.	Boron (B)		0.5 ppm	0.67 ppm
13.	Molybdenum (Mo)		0.01 ppm	0.190 ppm
14.	pH	9.12 pH	5.5-6.2 pH	6.5 – 8.4 pH

It is observed from the above by comparing the tables of nutritive value of soil essential for the growth and nutritive value of SWETA ANAND GROWTH SOLUTION, the value of both are near to equal. All the essential nutrients CHNOP K Ca S Fe Zn Cu B Mo Cl are present in nutritive SWETA ANAND GROWTH SOLUTION. Theoretically this shows that SWETA ANAND GROWTH SOLUTION contains all essential element for the growth of plant.

Results & Discussion

In SWETA ANAND GROWTH SOLUTION level of phosphorus is greater than Hoagland solution and soil. Level of potassium is

Conclusion: Comparative study shows that the nutritive value of soil and SWETA ANAND GROWTH SOLUTION with Hoagland sol has all the nutritive value and pH required for the growth of vegetation / plant but further study is required to reach to a conclusion that the SWETA ANAND GROWTH SOLUTION is better for growth of plants.

Plant require essential nutrients for their growth and some of the important ones are: C H N O P K Ca S Fe Zn Cu B Mo Cl.

In SWETA ANAND GROWTH SOLUTION, level of phosphorus is greater than Hoagland solution and soil. Level of potassium in SWETA ANAND GROWTH SOLUTION is greater than soil. Level of Magnesium is greater than Hoagland solution. Level of Manganese is better than Hoagland solution. Level of Zinc is better than Hoagland solution. Level of Copper is better than both Hoagland solution and soil. Nickel is only present in SWETA ANAND GROWTH SOLUTION. Level of Iron is better than Hoagland solution. Basic nutrients are available so that plants can sustain themselves to grow in the SWETA ANAND GROWTH SOLUTION.

Soil phosphorus level is most important factor after organic matter and humus levels. Many fertile soils have always superior levels of humus and phosphorus. Phosphorus controls and activates plant roots, flowering, fruit & bud formation, as well as the process of cell division and sugar formation in the sap. Sugar level regulates the plant's resistance to insects, diseases and cold, and determines the fruit's eating and keeping qualities. Phosphorus also impacts N fixation and growth of legumes, the formation of seeds in all crops, crop maturation, and more. The level in soil is constantly changing due to the action of the microbes. Soil phosphorus is held for the plant's roots in the humus. Optimum availability of phosphorus in

soil ranges from 20 PPM to 60 PPM. Among major macro elements, phosphorus in SWETA ANAND GROWTH SOLUTION is 60 PPM i.e. so far maximum in any growth solution.

Iron is essential for chlorophyll formation and photosynthesis. It activates elements in several enzyme system. It is also plays important role in respiration and other oxidation processes of plant and is a vital part of oxygen carrying system. Soil iron levels should be from 29 PPM to 50 PPM for most of the crops. Among micronutrient our solution has shown best possible results [4].

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