**Hydroponics Agriculture: Its Status, Scope and Limitations**

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**Abstract**

Hydroponics is the technique of growing plants in nutrient solutions with or without inert media such as gravel, vermiculite, rockwool, peat moss, sawdust, coco flour, coir as mechanical support. The term “hydroponics” comes from the Greek words “hydro” meaning water and “ponos” meaning work, literally meaning “water work”. The term hydroponics was coined by Professor William Gericke in the early 1930s. Rapid urbanization and industrialization are not only reducing arable land, but traditional farming practices are having multiple negative environmental impacts. More methods of growing enough food to feed a growing world population need to be developed. Changing growing media is an alternative for achieving sustainable production and conserving depleting land and water resources. In the current scenario, soilless cultivation can be successfully initiated and may be considered as an alternative option for growing healthy food crops.

Keywords: Hydroponics, Agriculture, soil less cultivation, mineral solution.

**WHAT IS HYDROPONICS?**

* Hydroponics is a method of growing plants with mineral nutrients solutions without soil. It is also called "controlled environment agriculture" (CEA) because growing plants hydroponically requires environmental factors such as light intensity and duration, temperature, humidity, pH of the solution/environment and mineral nutrients.
* Hydroponics is a subset of hydro culture, which is a method of growing plants without soil using mineral nutrient solutions in a water solvent.

**Why grow without soil?**

This seemingly subtle change in the way food is prepared (i.e., skipping the soil) is actually revolutionary—it allows farmers to grow food anywhere in the world, at any time of the year, and produce greater yields with less resource.

**HYDROPONICS SYSTEM:**

There are several approaches to designing hydroponic systems, but the basic elements are essentially the same.

**What you need?**

**Fresh water:**

We talked about prime, filtered things that are pH balanced. Most plants prefer water with a pH around 6-6.5. You can adjust the acidity of your water with over-the-counter solutions available at your local hardware store, garden center or aquarium.

**Oxygen:**

Don't drown your plants! In traditional cultivation, the roots get the oxygen they need to breathe from air pockets in the soil. Depending on your hydroponics setup, you either need to leave space between the bottom of the plant and the water tank, or you need to oxygenate your tank (think aquarium bubbles), which you can do by buying air. Stone or air pump installation.

**Root support:**

Even if you don't need soil, your plant's roots still need something to hold on to. Typical materials are vermiculite, perlite, peat moss, coir and rock wool. Keep away from materials that can compact (eg sand) or that do not retain moisture (eg crushed stone).

**Nutrients:**

Your plant needs plenty of magnesium, phosphorus, calcium and other nutrients to stay healthy and productive - just as plants growing in the ground need healthy soil and fertilizer. If you grow plants without soil, this "plant food" must be contained in the water that feeds your plants. While you can technically make your own nutrient solution, mixes are easy to buy online and in stores.

**Light:**

If you grow your plants indoors, you may need to invest in special lighting. Each type of plant has a different requirement for the amount of light and placement of the lights (usually called Daily Light Integral or DLI).

**Historical background of hydroponics:**

The study of crop nutrition began in the thousands years ago According to the ancient history, various tests Theophrastus (372-287 BC) while several writings of Dioscorides on the subject Botany dates back to the first century AD still present (Douglas and James, 1975). Classic work of farming plants without soil published by Sir Francis Bacon in 1627, a book called "Sylva Sylva rum". After Bacon's work water culture became a popular study technique In 1699 John Woodward published his aquaculture experiments with mint He found that plants grew better in less pure water than plants in distilled water. Examination German botanists, Julius von Sachs and Wilhelm Knop (1859-65) led a development of groundless technology cultivation It was Professor William Frederick Gericke (1937) who later coined the term hydroponics and wrote a book called "The Complete Guide to Soilless". Gardening'. Two other plant-based nutritionists, Dennis R. Hoagland and Daniel I. Arnon, at The University of California wrote a classic In 1938 in the agricultural bulletin The Water Cultivation method togrow plants without ground These two scientists developed several mineral nutritional formulas solutions known as Hoagland solutions. Modified Hoagland solutions are still used today One of the earliest successes of hydroponics took place in the 1930s on Wake Island, where it used to grow vegetables Pan American Airlines passengers. Since beginning of hydroponics, research paper improvement of the method continued. In the year Late 1960s researchers at Glasshouse Crop Research Institute (GCRI), Littlehampton, England was formed nutrient membrane technology as well as the number of subsequent improvements (Graves, 1983). From this research hydroponics was born of the systems used today. Jensen and Collins (1985) published a complete review hydroponics brings out many new cultural Systems developed in Europe and the United States in the states. In recent decades, NASA has done just that their extensive hydroponics research Managed ecological life support System' (CELSS). Hydroponics is for On Mars, this is done with LED lighting grows in a different color spectrum much less heat.

**Techniques of hydroponics:**

There are mainly two types hydroponics so called i) solution culture and ii) medium-sized culture. The solution is in the culture there is no solid substrate for the roots, nutrient solution and medium only the culture has a fixed growth substrate for the roots and is named after the type of media used, e.g. sand, gravel or stone wool culture

**Solution Culture:**

There are three main ones methods of growing plants in solution culture: Static solution culture In a static solution culture, there are plants grown in nutrient solution tanks, for example, glass vessels (usually at home applications), plastic buckets, tubs or containers. The solution may or may not be aerated, but gentle ventilation is usually required. Answer because still a solution is the solution level hold down so enough roots are up solution to get enough oxygen. There is a hole which is made on the lid of the container factory The cover can be polystyrene foam (thermocol) or other sufficient material to support the weight of the shoots. There you can have one to several plants per container. The size of the container can be increased according to the size of the plant is growing It is possible to order air conditioning aquarium pump, aquarium hoses and aquarium valves Transparent containers are covered with aluminum foil, copy paper, black plastic or other material excluded to eliminate light formation Algae The nutritional solution is either change according to schedule or when concentration falls below a certain level determined by electrical conductivity meter When the solution is used up below a certain level, fresh nutrient solution was added. There are plants in the floating solution culture placed on a floating plastic plate floats on the surface of the food solution In this way, the solution level never falls under the roots.

**Continuous flow culture :**

The nutritional solution continuously flows in a steady stream past the roots culture The main advantage of this method is that it is much easier to automate than static solution culture after sampling and temperature and nutrient regulation concentrations can be made in large quantities a storage container that could serve thousands of plants. One of the most popular methods are nutrient film technology (NFT) with very low flow water containing all dissolved nutrients necessary for plant growth, is recycled waterproof beyond the bare roots of the plants known as channels. the depths again circulation flow remains very low, little more than a film of water and that's why it's called a "food movie". It ensures that thick root mat at the bottom the channel, although moist, is in the air and that there is a lot of oxygen for plant roots. For proper planning NFT system should have it is the correct channel slope, flow rate and channel length The main advantage NFT system compared to others hydroponics is that plants have roots open to an adequate water supply, oxygen and nutrients. Their result the advantage is that the higher the performance, the higher quality products are available extended harvest time. The bad side The thing about NFT is that it has very little buffer against power lines, e.g. power interruptions, but overall this is probably one of them more productive techniques. Same design features applies to all traditional NFT systems. it is it is recommended that the slopes be 1:30-1:40 used by channels. it allows small irregularities on the surface, but even on these slopes, of ponds and irrigation can happen Flow rates for each well should be 1 l/min. The flow rate can be 0.5 l/min during planting, during the upper limit 2 l/min seems to be the maximum. flow Prices above these extremes are common related to nutritional problems. The the length of the channel must not exceed 10-15 the otherwise reduced growth rate of meter plants sprout.

**Aeroponics:**

In this system, roots are suspended in air in a closed chamber and are saturated with fine drops, in the form of a mist or aerosol of nutrient solution intermittently. In this method no substrate is required. Plants are grown with their roots suspended in a deep air or growth chamber with the roots periodically wetted with fine mist of atomized nutrients. Main advantage of aeroponics is the excellent aeration.

**Medium Culture:**

This method has two main aspects variations for each medium, ie. submersion and watering. For all technologies, for the majority hydroponic ponds have now been established plastic, but other materials were also used including concrete, glass, metal and wood. The containers must be such that it blocks light to prevent the growth of algae in the nutrient solution.

**Media:**

One of the most important decisions a hydroponic grower has to do is type he should use Different media suitable for different agricultural techniques

**Dihydro:**

Diahydro is a natural sediment petrified aggregate remains of diatoms. Diahydro is very rich in silica (87-94%), important plant growth component and strengthening of cell walls.

**Expanded clay:**

It is made by baking clay pellets and by a well-known trade name "Hydroton" or LECA (light expanded clay unit). Anhydrous or expanded clay pellets are suitable for hydroponic systems where all nutrients are carefully is checked in aqueous solution. Clay pellets are inert, pH neutral and contain nothing nutritional value. The clay is molded into round pellets and fired at high temperatures (1200°C) in a rotating clin. It will be fine the clay appears and becomes porous. The the main advantage of the hydroton is that it is light does not compress or compact over time. It is environmentally sustainable and the growth medium used therefore ability to clean and sterilize wash in solutions of white vinegar, chlorine bleach or hydrogen peroxide and wash completely.

**Rock wool:**

Rock wool, also called mineral wool is the most used media hydroponics It is an inert substrate for both free drainage and recycling systems. This occurs as an aerosol of alloy mineral compounds that result in a fibrous medium entering the capillary a function that is not compromised by microbiological activity.

**Coir:**

Coconut peat, also known as coir is the residual material after the fibers was removed from the outer shell of coconut is a 100% natural growing medium

**Perlite:**

Perlite is made from volcanic rock after it is well heated light glass stones. it is worn either loose or in plastic sleeves soaked in water. It is also used in potting soil mixtures to reduce soil density and facilitates drainage.

**Vermiculite:**

Like perlite, vermiculite is another a mineral that has been heated to this point swelled into pale stones. Vermiculite contains more water than perlite and has a a natural "wick" property that can draw water and nutrients in passive aquaculture system

**Sand:**

Sand is the cheapest and easiest available media. However, the most important The disadvantages of using sand is that it is heavy, it doesn't always flow well and that must be sterilized between uses.

**Nutrient solution:**

Plant nutrients used in hydroponics are soluble in water and are mostly inorganic and ionic forms. All 17 elements e.g. C, H, O, N, P, K, S, Mg, Ca, Important Fe, Mn, Cu, Zn, B, Cl, Mo and Ni plants are provided using different for growth chemical combinations.

**Scope of Hydroponics:**

Cultivation of plants in aquaculture protected cultivation may be considered the most complex production system available today Regarding agricultural systems, Ruthenberg (1980) classified hydroponics agriculture "high input - high yield - high risk system. Actually available current technologies demand a lot specializing in complex management and know-how and high realize the expected financial contribution production potential, otherwise performance failures can be devastating. Before leaving large scale hydroponics system farmers should be much more critical selection of sites, structures, harvesting system, pest control and markets.

**Site Selection:**

One of the most important environmental problems factors influencing the choice of site because CEA should be done is brightness and near a instead of duration population center. The highest light levels are especially important as a greenhouse vegetables must be grown during in winter, when tomato and cucumber prices is at the highest level. Generally, 1% light wrinkling will reduce performance by 1%. A in the light-filled area of ​​the greenhouse can produces more than 500 tons of winter tomatoes per hectare per year. Produces such harvest is possible only in northern latitudes when crops are grown throughout the summer at a time when market prices are lowest.

**Energy and water:**

There are many options available energy sources such as natural gas, propane, fuel oil and electricity. Early hydroponic growers did not consider the cost differences between energy types used in CEA. Many used natural gas and fuel oil. Carbon was also used, but air pollution standards and regulations allow the use of this fuel too expensive Water quality is one of the most important care of hydroponics. Plant growth is affects the interaction of solutes chemical elements in water supply, chemical properties of the growing substrate to which water is applied

**Status of Hydroponics:**

**International Status:**

Area under Hydroponics/CEA began to expand significantly in Europe and In Asia in the 1950s and 1960s and large hydroponic systems were developed in The deserts of California, Arizona, Abu Dhabi, and Iran (1970). In these desolate places, the advantages of technology were plus duration and interest solar radiation that maximizes photosynthetic radiation

**National Status:**

Hydroponics has not reached India until 1946. The first studies were started in Bengal Govt Experimental farm in Kalimpong in in Darjeeling district. At first several problems, but then a careful evaluation of key issues 1946-47, Bengal Aquaculture System was developed to represent aspiration to meet India's requirements.

**Advantages of hydroponics over conventional agriculture:**

Today, hydroponics is well established The field of agricultural science. Progress is being made quickly and achieved different results countries have fully demonstrated this practical and very accurate advantages over traditional methods agriculture/horticulture. Two bosses benefits of growing plants without soil is above all much higher performance and second, the fact that hydroponics can be used in places where normal farming or gardening is impossible. Except those there has other benefits listed below:

• It takes less space to produce the same amount of harvest compared to that grew up in the field.

• Requires less growing time. growth the plant is faster because there is no mechanical barrier to roots and more groceries are available plant abundantly. Also adding plants growth, lighting systems like metal Halogen or high pressure sodium lamps are used to extend the day or as a dietary supplement natural sunshine.

• Work and garden maintenance are with intercultural activities often no or very little fertilization and watering is automated and not difficult manual labor is required.

• Water saving is the biggest an advantage Hydroponics saves money incredible amount of water because it uses only 1/20 of the usual amount the farm will produce the same amount about food Water never happens.

• Saves money on nutrient recycling and water For a closed system hydroponics like NFT, food is is recycled, thus avoiding waste nutrient and soil inhibition pollution There can be large amounts of water recycled, which the factory has not used since aerated and removed to anoxic to the conditions.

• There may be problems with pests and diseases easy to manage if weeds are in practice non-existent

• Hydroponically grown plants avoid soil plagues spread.

 • Increase plant rooting control as an environmental root zone temperature, humidity, darkness, etc easy to handle.

 • Better returns can be obtained because the number of plants per unit is higher compared to traditional agriculture and The products can be received in a longer period of time harvest time

 • Greater return. Some plants can be cultivated in the off-season, which can go higher income for farmers.

 • Excellent product quality without dirt or to smell • Aquaculture breeder in Virginia a Ca- and K-enriched head developed salad claimed that their aquaculture salad uses 90% less water than traditional farming.

• Besides being commercially useful technology, hydroponics is also standard Technology used in biology research and teaching.

**Limitations of Hydroponics:**

Although it has many advantages hydroponics over traditional agriculture, there are also some limitations:

• Higher installation costs

• Farmers require skills and knowledge maintain optimal production commercial applications

 • Because every plant in hydroponics the system distributes exactly the same feed, diseases and pests can easily strike anyone factory

 • Plants react more quickly to changes but when this change occurs at worst, plants react quickly this; signs of deficiency or problems.

• Hot weather and limited oxygen can limit production and cause loss harvests Like most things, it matters to understand the benefits and disadvantages of hydroponics. It will come enabling a person to make informed decisions which application is "right" for his person.

**Conclusion:**

Hydroponic farms offer a path to a more sustainable food ethic, where the health of our food, body and environment comes first without the use of many chemicals. Far from being just a dream, hydroponic agriculture is already rapidly becoming integrated into current food webs.

Additionally, as the industry becomes more competitive, such increased partnerships will help lower aquaculture product prices and make aquaculture farms more competitive compared to traditional farms. Although our global climate problem is multidimensional and the result of many different practices, reducing the impact of the agricultural industry is a big step forward. At the beginning of the 21st century, aquaculture had not yet been invented. Now, just 20 years later, the industry has gained a strong foothold and is already dramatically changing our farming practices and the future of our food system.

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