STUDY ON PRACTICABILITY OF HYDROPONICAL CULTURE OF GRAM (*CICER ARIETINUM*)

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ABSTRACT

Agriculture is a chief supplier for the growth of Indian Economy. Rice, Wheat, Pieces, pulses and vegetables are some major plant species cultivated primarily. Due to rise in population and contradictory decline in land size available for agriculture, situate to introduce a new method of agriculture for increasing potential of cultivation. Gram (Cicer arietinum) is one of them, also commonly known as chick pea. Hydroponical culture of chick pea plant showed some possibility for large scale production. Seed germination taken very less time in comparison to soil germinated seed. Growth of shoot was also measured after every 24hr, which illustrated elevated shoot length (cm) in short time period. Leaf initiation was also observed after 48hr of seed propagation. The feasibility of the technique for the selected plant species was predictable in liquid nutrient medium. Fruiting and flowering was not observed in the experiment and required some more attempts with modification in experimental design. Temperature, Humidity, light and other physical factors was maintained with natural surroundings.

Keywords: Hydroponics, Seed germination, Shoot length, Leaf initiation, propagation, Liquid Nutrient Medium.

I. INTRODUCTION

A big part of world population relies on agriculture development for their economy and growth. We all are well aware of importance of agricultural products in human life. Advancement of human life and shortage of agricultural land is a serious threat for future food security. Advancement in science and technology is playing a major role of therapeutic for healing problem of food security since last few decades. Somehow literature revealed that in some part of the world a technique named as "Hydroponics" is contributing a significant role in enhanced agriculture productivity (Craver and Williams, 2014; Das and Sing Majhi, 2009; Flores-López et al. 2009; Hoagland and Arnon, 1950; Koohakan, 2008). According to the reviewed literature this technique is significantly useful to avoid effect of many environmental factors at large scale. This is the technique to grow plant in controlled environment. Environmental factors like temperature, humidity, light intensity etc. can be maintained or manipulated according to the need of selected plant species. Hence decrease in final productivity due to adverse effect of environmental factor can be avoided (Ruiz and Taleisnik, 2013; Smeets et al., 2008).

In this study small experimental setup is used to determine the practicability of Hydroponical technique for agricultural crop. Chick pea (*Cicer arientinum*) commonly known as Gram or Chana, is selected as modal plant. This plant belongs to family Fabaceae, subfamily Faboideae categorized in shrub. Generally average height of

plant is about 20-55 cm. Two common types of chick peas are grown and available in all part of the India. These are Desi Chana and Bombay chickpeas. Early literature revealed physical characteristics of the selected plant species seems fruitful the proposed experiment in initial circumstances. Indian chickpea is very popular among the country people because of its nutrient richness. Chick pea is a rich source of protein, carbohydrates, lipid content, fibre and minerals i.e. iron, magnesium, phosphorus, zinc etc. Amino acids such as tryptophan, lysine, isoleucine etc. are abundant in the selected plant product. With high calorific value selected plant species is proved to be unsurpassed for the experiment.

II. MATERIAL AND METHOD

Establishment of Hydroponic System: Design of the Hydroponic System used for the experimentation was influenced by various source of research work done earlier through various novelist. (Du Toit, 2007; Ortiz et al., 2009; Kratky and Bowen, 1988; Roberto, 2000).

A miniature setup built for the accomplishment of experimental protocol. All the necessary articles were provided simultaneously. Some important features of the experimental setup has been discussed below;

Nutrient Reservoir: It is a collection and feeding unit for the model plant. All the necessary nutrients were dissolved in double distilled water in specific amount. Nutritional requirement of various organic and inorganic matters, such as Nitrogen (N), Carbon (C), Sulphur (S), Phosphorus (P), Potassium (K) etc. may differ in various plant species. This study may also demonstrate about stipulation of proper nutritional supply in plant species and the effect of concentration of various nutritional sources in plant species (Gericke, 1937; Shinohara et al., 2011Yan et al., 2012; Asao, 2013). Non-reactive material plastic material is used to construct Nutrient reservoir. Continuous flow of nutrients dissolved in water is provided but rate of flow is controlled by valve system. Sequentially concentration of dissolved nutrient is checked after precise time interval.

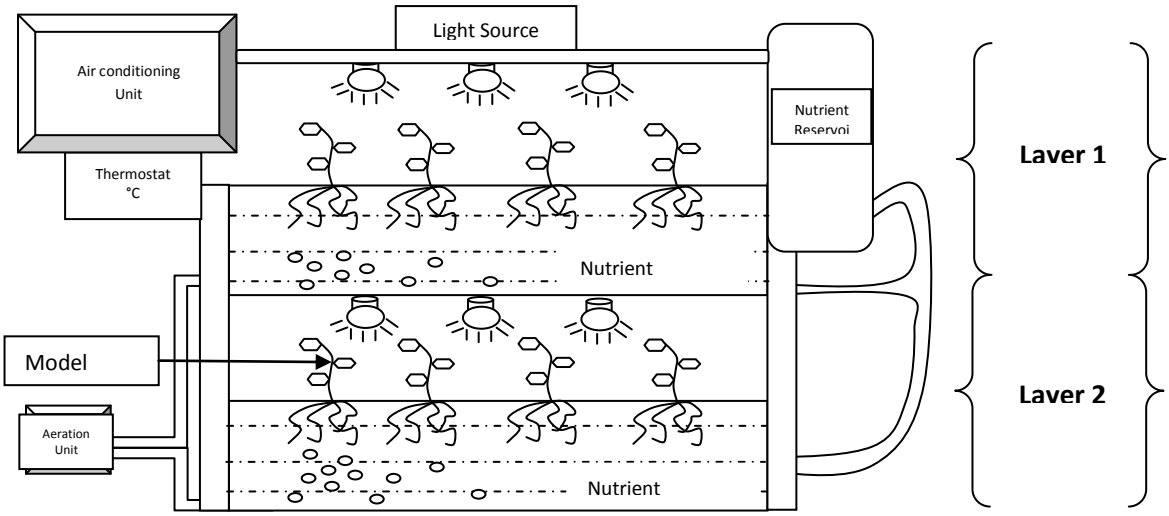
Temperature and Humidity: With the help of thermostat, standard value of temperature for plant growth between 30-35°C was maintained through air-conditioning unit. Room temperature outside environment was approximately 40-45°C during the study period in the month of June. Humidity was maintained up to 95% which is optimum for plant growth. Apical necrosis, blackening and other vital diseases are very common in plants due to temperature fluctuation above and below specific optimum value suitable for plant species.

Photoperiod and Light Intensity: It is well known subject that plant growth is affected by the light spectra. Optimum light intensity was achieved from maintaining common range of color spectra. Earlier, it has been demonstrated that red (600-800 nm) and blue light (380-480 nm) are most favorable for plant growth (Caruso et al., 2011). In the present study, light spectra from 400 to 700 nm were supplemented through LED on hydroponically cultivated selected shrub. **Photosynthetically active radiation**, often abbreviated as **PAR**, designates the spectral range (wave band) of solar radiation from 400 to 700 nm that photosynthetic organisms use to optimize the process of photosynthesis. During the experimentation neutral photoperiod of about (LD 12:12) was preserved (Carre, 2001; Martineau; 2012; Thomas, 2006).

Aeration: Aeration in nutrient solution was achieved by the use of aerator (pump). This is commonly available in market, specially used in aquariums. The aeration pump helps to grab atmospheric air and mix it to nutrient

 ISBN : 978-93-86171-09-2

solution. Maintenance of proper aeration helps to improve plant growth (Von-Bieberstein, 2014; Souret and Weather, 2000; Park and Kurata, 2009).



III. RESULT AND DISCUSSION

Hydroponical culture of chick pea plant showed some possibility for large scale production. In the beginning 50 chickpea seeds were propagated. Seed germination taken very less time in comparison to soil germinated seed. First significant physiological change in sowed seed was observed within 7hr. Growth of shoot was also measured after every 24hr, which illustrated elevated shoot length (cm) in short time period. It was about 1cm long structure with two cotyledons. Leaf initiation was also observed after 48hr of seed propagation (Wang, 1999). Root growth was also noteworthy, approximately 80% seeds showed root growth after 24hrs (Trang, 2010; Girdthai, 2010). The feasibility of the technique for the selected plant species was predictable in liquid nutrient medium. Fruiting and flowering was not observed in the experiment and required some more attempts with modification in experimental design. In aspect of total mass productivity it was found that the feasibility of the technique with selected plant species was good.

Some other characteristic for the accomplishment of the technique are following:

1. It was helpful to reduce reliance on climatic factors such as light, temperature and humidity.
2. Low land area with high mass productivity.
3. Reduction in soil born microbial and viral diseases.
4. Reduction in insect growth, helps to prevent use of harmful insecticides
5. Indoor hydroponical system helps to avoid productivity loss due to grazing.
6. Less water requirement: solution for irrigation.
7. There is no space for weed. Hence, prevention of use of weedicides.

 ISBN : 978-93-86171-09-2

3.1 Limitation

1. This new emerging technology is not suitable for the crops like rice, wheat etc. in which large field area is required.
2. This technique is most suitable for small herb, shrubs and climbers. Cultivation of trees and tall plants are not easy in hydroponics.
3. Proper knowledge and continuous safeguarding is required.
4. First time investment cost is higher than the cost of traditional technique.
5. Setup requires some scientific equipment and handling knowledge.

3.2 Future aspects

Future aspects from the mentioned technique are really very high. Pharmaceutical industries are facing problem of continuous supply of medicinal plant and their products. Many herbs and shrubs are known for their medicinal properties can be easily grown by hydroponic without altering their biochemical composition. Green house facility prevents the supply of plant and their product in specific season. In controlled environment we can cultivate plant throughout the year.

According to literature reviewed one of the best future aspects associated with hydroponics is space technology. It is well known practice that the space mission includes a long term accommodation at space station. It is really a big trouble to carry plenty of food products with many numbers of people in single spacecraft. Spoilage and maintenance of food product is also a significant problem in space missions. Hence, the scientists are trying to find out some substitute. Theoretically in place of large mass of food product, it is easy to carry seed and nutrients dissolved in water. Cultivation of plant, utilization and release of waste material in space eradicate burden from the spacecraft. We can reduce burden of weight in spacecraft in both the ways i.e. departure and arrival.

Indoor home gardening may be encouraged by this unique technique of horticulture. Many ornamental plant species are used to grow in indoor atmosphere frequently by the people. But the knowledge of plant cultivation with nutrient water medium will encourage them to cultivate economically important plant species. Not at very large scale but somehow slight load from the shoulder of farmer would be condensed inside home environment of the society. Desert and land with low water availability can also be used for horticulture activity with minimum requirement of water and nutrient sources (Thompson, 1978) .

Some of the earlier studies also showed vivid future possibilities in molecular biology. Study based on molecular marker through hydroponics and effect of various chemical and environmental factors on Genetic composition in hydroponical culture has been well illustrated (Tuberosa et al., 2002). Bioremediation through hydroponics is also possible via cultivation of various plant species. Many plant species are able to utilize and absorb harmful heavy metals and chemicals from water for their growth and development. Those heavy metals and chemicals are dreadful for human health (Singh et al., 2012; Singh, 2010; Snow, and Ghaly, 2008; Rababah and Al-Shuha, 2009; Paz-Alberto and Sigua, 2013).

IV. ACKNOWLEDGEMENT

We would like to express my sincere thanks to all the faculty members and staff member of the school who provide us all the necessary support to do this wonderful research activity. We came to know about lots of new things we are really thankful to them. Secondly we are also grateful to all the people directly or indirectly involved in this action of learning. We hope that we shall have such support, encouragement and inspiration in our future activity too.

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