



## Comparative Analysis of Growth Parameters of Gram (*Cicer Arietinum*) Grown in Hydroponics and Soil Based System.

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### Abstract:

With the overgrowing population explosion and limited land resources for agriculture there is a need to find alternate method to prevent the food crisis that is likely to occur in the near future as land resources are limited due to urbanization, natural calamities, climate issues, exponential population explosion etc. To resolve this problem, method of hydroponic cultivation can be used as an alternative where water is used to cultivate plants and crops. The scope of current study was comparative analysis of soil based growth rate versus hydroponics based plant growth of *Cicer arietinum* without any nutrient supplements to that of hydroponics containing MS media as a supplement source without growth hormones. It was observed that the plant growth was found to be maximum in hydroponics supplemented with MS media with an average plant length of 44 cm (having shoot length of 23 cm and root length of 21cm), followed by hydroponics containing normal tap water with average plant length of 39 cm and the plant grown on soil with average plant length of 34.5 cm.

**Key words:** Food crisis, Hydroponics, MS media.

### Introduction:

Soil is the main growth medium available for plant growth which provides nutrients, anchorage, water and aeration for growth of plants. The exponential growth in world population and high demand of food has resulted in food crisis especially in underdeveloped countries. Farmers being totally dependent on soil for production and have faced various challenges namely floods, drought, erosion, poor irrigation facilities, unsuitable soil, limited land area and poor quality of soil, unfavorable geographical and topographical conditions, and financial disparities resulted in unavailability of resources needed for crop production (Pandey et al., 2009, Okemwa, 2015, Gashgari et al., 2018) during production of crops and vegetables. The need of the hour is to develop an alternate method of crop production that can aid the farmer without compromising with the yield and nutritional quality. Further in this direction to innovate, soilless methods must be employed and one such method is Hydroponics which in Greek *hydro*-water and *ponos*-labour and employs mineral nutrients infused water for growth of plants and aids in growth of plants where land availability is the major problem. The concept of hydroponics in India has been employed in 1946 in Kalimpong, West Bengal by W.J. Shalto Douglas, English scientist (Sharma et al., 2018). Hydroponics is the fastest growing sector of agriculture. It could be very useful for food production in the future. As the population is increasing day by day and land is limiting due to poor land management practices, people are shifting their focus on new technology like Hydroponics and Aeroponics to feed the growing population of nation. Due to climatic changes and natural disasters like drought and floods, it is the need of hour to switch to new technology, which promises food productions safely.

### Material Method:

The experiment was conducted in Department of Biotechnology and Biochemistry Career College, Bhopal by using already available low-cost material such as plastic cups and filter paper. The hydroponics employed non-circulating system. Seeds of *Cicer arietinum* (Gram) were used for experiment. The viability of seeds was checked by soaking the seeds in water prior to sowing. The seeds which were viable sink at the bottom while the non-viable seeds float at the top and were discarded.

#### i) *Soil-sown experiment:*

*In vitro* experiment, pot trial was conducted in which 50 g potting mixture containing soil, sand and gravel were taken in a plastic pot. 5 seeds were inoculated in this pot and allowed to grow on the terrace of college and watered on regular basis. The experiment was conducted on 5 replicates. The plants were monitored for 30 days (Gashgari et al., 2018).

#### ii) *Hydroponics (Non-Circulating System) without supplements:*

*In vitro* experiment, hydroponic trial were conducted in which normal tap water were taken in a plastic container and another cup containing pores were inserted with Whatman filter paper no.1 and 5 seeds were inoculated on the filter-paper. These inoculated pots were allowed to grow on the terrace of college and watered on regular basis. The experiment was conducted on 5 replicates. These plants were monitored for monitored for 30 days.

### iii) Hydroponics (Non-Circulating System) with supplements:

*In vitro* experiment, hydroponic trial was conducted in which normal tap water supplemented with MS media was taken in a plastic pot and another cup containing pores were inserted in the container containing the water and within which Whatman filter paper no.1 was inserted. 5 seeds were inoculated on the filter-paper and allowed to grow on the terrace of college and watered on regular basis and monitored for 30 days. The experiment was conducted on 5 replicates.

### Harvesting:

The plants grown under above mentioned conditions were harvested after 30 days. These plants were washed under tap water and blot dried. Plant length, root and shoot length were observed and noted. The average of all parameters was calculated and this data was used in comparative analysis.

## Result and Discussion:

The entire experiment took a month to complete and plant growth was monitored for 30 days from 1st November to 1st December 2021. The height of the plant is indicative of growth and indicates that the plants grown via hydroponics are far better in terms of growth in comparison to traditional method of plant cultivation. Current study focused on the comparative growth analysis of *Cicer arietinum* plants under soil based system, hydroponics without any nutrient supplements and hydroponics containing MS media as a nutrient supplement without growth hormones. Plant growth was found to be maximum in hydroponics supplemented with MS media with maximum average length (AL) of plant (44 cm) with average shoot length (ASL) and root length (ARL) 23 cm and 21 cm respectively. In hydroponics without any nutrient supplements average plant length of *C. arietinum* was found to be 39 cm with average shoot length and root length 22.3 cm and 16.7 cm respectively. In soil based system average plant length of 34.5 cm was recorded with average shoot length and root length of 20.4 cm and 14.1 cm respectively. The reason for better growth in hydroponics may be the absence of soil borne insects and pathogens which generally hinders the growth of plants in soil based system. In addition to it the aqueous medium (hydroponics) surrounding roots facilitates easy absorption of nutrients. In hydroponics the plants are at minimal risk of abiotic stress.

On the other hand in all type of planting systems no significant difference was noticed in in the number and length of leaves. In future work, the experiment can be done on a larger scale, this will help in analyzing whether the hydroponic system will meet the demand of future market. Also, the period of the experiment should be extended till flowering and fruiting stage to analyze actual results as new changes may appear in later stages. In this experiment, only one plant was considered. However, the experiment can be done with different types of seeds to see if the results can be generalized to more plants.

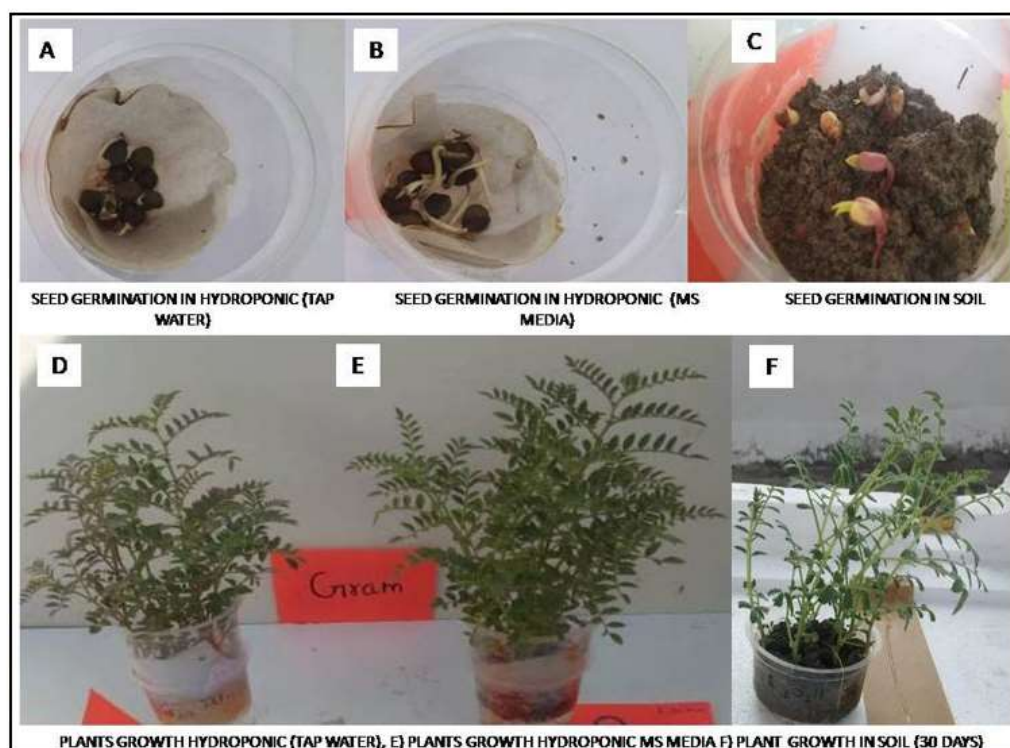
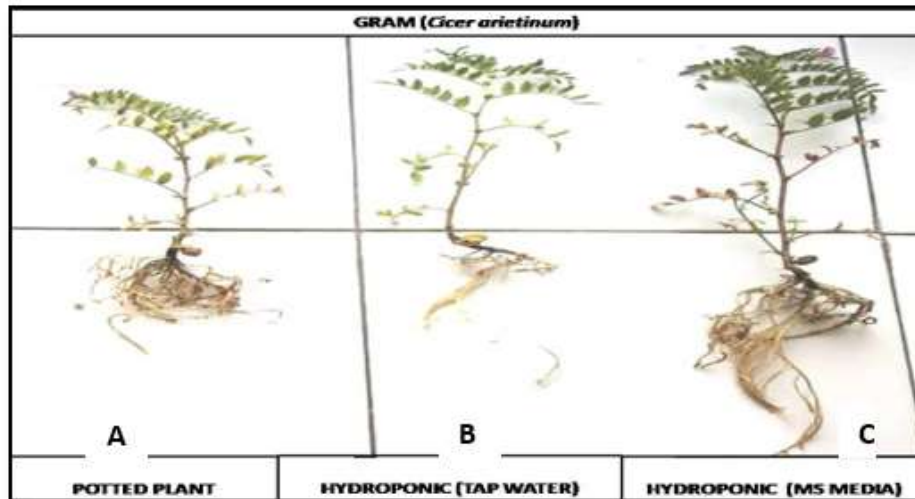


Figure 1. (A) Seed Germination via hydroponics without any nutrients (normal tap water); (B) Seed Germination via hydroponics supplemented with Murashige and Skoog Media; (C) Seed Germination on normal soil.; (D) Plant grown via hydroponics without any nutrients (normal tap water) (Day 30); (E) Plant grown via hydroponics supplemented with Murashige and Skoog Media (Day 30); (F) Plant grown on normal soil (Day 30)



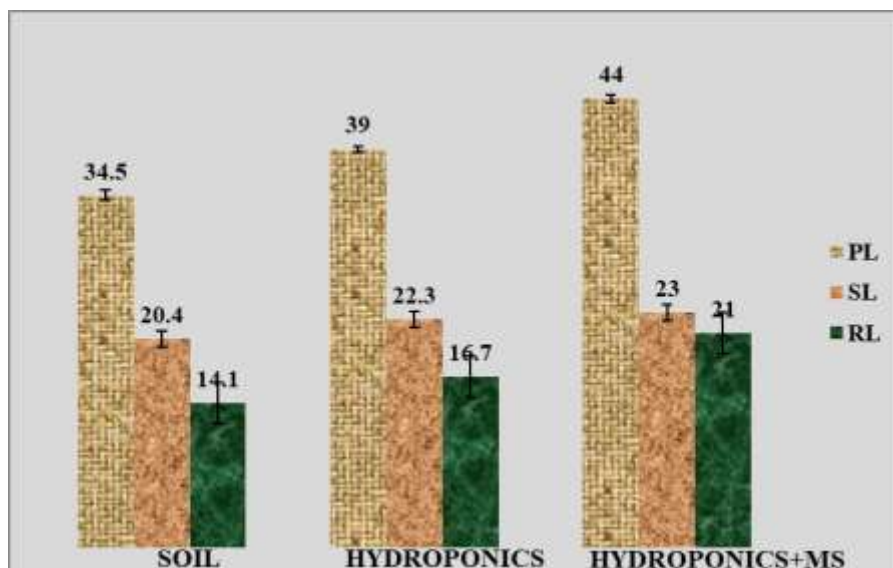
**Fig 2.** Out of the 5 plants in individual pots of soil and hydroponics with and without supplements the healthiest plant was taken out and length of plant, shoot length

**Table 1.** Comparative analysis of growth parameters of *Cicer arietinum* plants after 30 days under soil based system, hydroponics without any nutrient supplements and hydroponics containing MS media (without growth hormones) as a nutrient supplement

Results are expressed as  $\pm$  SE (n=5)

Days	Average length of plants grown in soil (cm)	Average length of plants grown in tap water (Hydroponics) (cm)	Average length of plant grown in MS media (Hydroponics) (cm)	Average shoot length of plants grown in soil (cm)	Average shoot length of plants grown tap water (Hydroponics) (cm)	Average shoot length of plants grown on MS media (Hydroponics) (cm)	Average root length of plants grown in soil (cm)	Average root length of plants grown in tap water (Hydroponics) (cm)	Average root length of plants grown in MS media (Hydroponics) (cm)
30	34.5 $\pm$ 0.03	39 $\pm$ 0.02	44 $\pm$ 0.04	20.4 $\pm$ 0.05	22.3 $\pm$ 0.02	23 $\pm$ 0.01	14.1 $\pm$ 0.05	16.7 $\pm$ 0.02	21 $\pm$ 0.06

Results are expressed as  $\pm$  SE (n=5)



**Fig. 3** Comparative analysis of growth parameters of *Cicer arietinum* plants under soil based system, hydroponics without any nutrient supplements and hydroponics containing MS media (without growth hormones) as a nutrient supplement.

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## Conclusion:

The height of the plants was measured to compare the difference in growth. The information thus obtained indicates that the plants grown in soil showed comparatively less growth than the plants grown in hydroponic system. Further enhancement in growth was achieved by addition of MS media to the hydroponics setup which might have fulfilled the nutritional requirement of the plants. Faster growth rate was noticed in hydroponics than the conventional soil system. It was further noticed that all the seeds sown in hydroponics developed into plantlets while it was not in the case of soil as tabulated in table (1). All plants in the hydroponic and soil systems germinated and developed into plants and as observed the hydroponics system has better prospects when supplemented with nutrients externally like in the case of current experiment of using MS media.

Thus Hydroponic systems are highly effective techniques and can be used in several agricultural systems and can also be used to combat natural calamities like drought. However this technique of farming requires less working hands, but still it is expensive and technical but the productivity is high. Development of some equipment can be done by the farmers or agriculturists to make it cheaper and user friendly. This system if used wisely, can lead to enhance economic growth of our country.

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