

Hydroponically Cultivated and Soil Cultivated *Ocimum basilicum* (Italian Basil)- A study on its Yield and Quantity of Antioxidants

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Abstract- Growing of *Ocimum basilicum* in Hydroponic as well as in traditional soil system are well established, while the comparison between these two growing system is not studied in detail. This study is conducted to check the performance of *Ocimum basilicum* in both hydroponic as well as in traditional soil systems. The Italian Basil plants were grown in hydroponic beds with flowing of nutritional water and a set of the same plants was grown in soil pots. The studied parameters include morphological, biochemical and antioxidant levels. The number of leaves increased with age and found more in number about 111.00 and 185.00 with hydroponic system as compared to that of traditional soil system which reduced to 101.00 and 156.00 evaluated on 40 days and 70 days respectively. The total leaf area showed a similar trend representing 3.88 cm and 3.92 cm in the hydroponic system while in traditional soil system it is 3.18 cm and 3.75 cm at 40 and 70 days respectively. The hydroponic system significantly increased the ascorbic acid content of the plants as compared to that of the traditional soil system plants; it represented 3.67 mg/g in hydroponic system when compared to 3.2 mg/g in the traditional soil system evaluated on 70 days. The fresh weight was higher in hydroponic system plants when compared to traditional soil system plants. From the results of this study, it can be concluded that the hydroponic system is the better choice for growing of Italian Basil.

Keywords: *Ocimum basilicum*, Hydroponic system, Antioxidants and Biochemical activities.

Introduction

A suitable method like hydroponic system or Aeroponics system of cultivation would plays an important role in the coming era due to climate change, growing urbanization, water scarcity, war situation in many countries and shrinking land area for traditional agriculture. The current estimated population of world is about 8.23 billion and will reach to 9 billion people in 2037 on the planet.

There is also a rise in the urbanization rate from 50 to 70%, traditional soil agriculture system suffers from the growing consequences of climate change, drought, salinity, and extreme temperature swings. Soilless culture like hydroponic and Aeroponics system eliminate these bad effects and guarantee long-term, sustainable food security for world population. These systems include circulation of water/nutrient solution in such a manner that the solution continues to pass through the roots of plants and provide sufficient nutrients to grow them. The source of light will be attached on upper side of the system to mimic the sun light and help in the photosynthesis. In hydroponic system a well-known soilless culture system, is the process of cultivating plants without the need of soil, usually in combination with a nutrient solution. Hydroponics system involves submerging the plant roots in nutrient solution. This is important that the solution consists of water and fertilizers carefully dosed to produce the right concentration of macro- and micro-elements required for particular plant growth. The reduced planting area is efficiently utilized in this systems. The nutrient circulate

in hydroponic system and consume less water to grow the plants. The hydroponic system in large-scale cultivation runs in a closed circuit, with regular pumping, recycling, and renewal of the nutrient solution and pH is monitored which plays an important role in the growth of plants in this system. Plants grown in a hydroponic system collect nutrients from circulating water and hence no need for soil to grow. This system requires no need for pesticides to grow plants. Number of crops, including ornamentals, seasonal _lowers, cereal crops, radishes, beets, carrots, and potatoes can be grown on inert supporting material rather than traditional soil system. *Ocimum basilicum* is a significant plant that contains _flavonoids, polyphenols, phenolic, and essential oils. The Italian basil plant, which belongs to the Lamiaceae family and genus. It is one of the aromatic plants whose consumption gradually rises. It typically grows in tropical and subtropical climates and is a typical fresh vegetable or spice in human diets. Its potent and distinct scent makes it stand out in meat, vegetables, salad, sauce, herbal tea, and other culinary applications. However, medicinal properties of this herb increased its value and has expanded beyond its original just culinary uses. Italian basil leaves contain a unique and recognizable fragrance, thanks to unusual oil glands making it a highly beneficial herb. Hence, practically all nations and cultures utilize it in both fresh and dry conditions. Both soil and soilless cultures are appropriate for basil production. Cultivation of Basil through Hydroponic system is well-established and in use in most of the countries as per their requirements. Basil grows well in hydroponic systems because of its excellent growth potential while hydroponics and Aquaponic grown Basil have a very high demand because of its quality and is free from pesticides used in soil cultivation. Consequently, hydroponic farming of basil is believed to be more ecologically friendly and efficient than traditional soil system farming. Due to its great value along with its consumption, it is a cash crop, which make more concerns for farmers worldwide. Till date soil system is one of the most complex

and abundant methods of growing basil (*O. basilicum*). Hydroponically produced basil, requires less water and no soil and contains a high-quality crop output. This method is not dependent on the environment due to its controlled system and hence sudden changes in the climate and other environmental changes do not affect the crops production yield as well as its quality grown in hydroponic system. As per research data published previously revealed that basil is one of the most often utilized plants in the kitchen and various other business sectors due to its many medicinal qualities and attributes. This study is conducted to check the performance of *Ocimum basilicum* in both the hydroponic as well as in traditional soil systems¹⁻²³.

Material and Methods

Experiment Location

The experiment was carried out at Himalaya Wellness Company, Faridabad Unit, India.

Seed Collection and Germination

The certified seeds of it were obtained from agriculture material supplier in Faridabad, India. Seeds of it were sown in the nursery in foam plates under slight media layer and kept in the greenhouse conditions. Water spray was performed one time a day. Plants were germinated after 5–7 days. Normal soil cultivation practices were followed for soil-based plants in the using soil.

Plant Growth Conditions and Parameters Analyzed

Basil was harvested 40 and 70 days after sowing of seeds. Basil characteristics of each harvest was evaluated by measuring the root length, total weight, average leaf number per plant. The total number of fully developed leaves were counted and expressed as number of leaves per plant. The total leaf area of fully developed leaves was measured and expressed in cm per plant. Fresh weight was determined by using an electronic balance and the values were expressed in grams. The plants were dried for 48 hrs at 60 °C in a hot air oven just after taking its weight. After drying, the weight was measured and the values were expressed in grams²⁴⁻²⁵.

Ascorbic Acid Determination- total Ascorbic acid is determined according to the method described by Omaye et al. (1979). Water extract (100 µL) of sample was mixed with 900 µL of 5% TCA, 1 ml of 10% TCA and 100 µL of DTC reagent. The DTC reagent was prepared using 0.04 g thiourea, 0.05 g copper sulphate, 0.3 g 2, 4-DNPH and 10 ml of 9 N Sulphuric acid. The mixture was then incubated at 37°C for 3 hours for the formation of orange red osazone crystals. The osazone crystals were dissolved in 750 µL of 85% sulphuric acid and incubated at room temperature for 30 minutes. The absorbance was measured at 540 nm against 5% TCA as blank. Total ascorbic acid was expressed in mg per g of weight sample.

Result and Discussion

Morphological Parameters- The plants in hydroponic and soil system exhibited an increase in height with days, as they started growing since the first day. However, when compared to the hydroponic system at 40 days 49.42 cm height, the soil-grown plants exhibited 45.55 cm, a decreased height. A similar trend was noticed in the case of 70 days, when hydroponic-grown plants measured 72.05 cm, while the soil-grown plants measured only 68.21 cm in height. The root length increased with age in both systems. The root length increased in the hydroponic system when compared to soil-grown plants. The number of leaves increased with age and found more in number about 111.00 and 185.00 with hydroponic system as compared to traditional soil system which reduced to 101.00 and 156.00 evaluated on 40 days and 70 days respectively. The total leaf area showed a similar trend, representing 3.88 cm and 3.92 cm in the hydroponic system while in traditional soil system is 3.18 cm and 3.75 cm at 40 and 70 days respectively.

The fresh weight was higher in case of hydroponic system grown plant when compared to soil grown plants. This is due to the higher shoot and root growth of hydroponic plants as compared to soil grown plants and hence contributed to the increased

fresh and dry weights of the plants in the hydroponic system.

Ascorbic Acid- The hydroponic system significantly increased the ascorbic acid content of the plants as compared to the traditional soil system plants; it represented 3.67 mg/g in hydroponic system when compared to 3.2 mg/g in the traditional soil system evaluated on 70 days.

Conclusion`

The main aim of this research is to standardize the hydroponic production of Italian basil plants and to compare with the plants grown in soil system, regarding the growth parameters like size, weight of plant, leaves numbers and their size and content of vitamin C at different interval mainly after 40 and 70 days. Based on the obtained results, the growth parameters like plants weight, leaves number and their size along with vitamin C content is better in hydroponic system on both the interval of time that is after 40 days and after 70 days, as compared to soil system and hence we can say that production of herbal and aromatic plants in hydroponic system is better option as compared to that of traditional soil system.

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Disclaimer Statement

Authors declare that no competing interest exists. The products used for this research are commonly used products in research. There is no conflict of interest between authors and producers of the product.

Reference

1. <https://www.worldometers.info/world/>
2. Ahmed, N.; Thompson, S. and Glaser, M. Global Aquaculture Productivity, Environmental Sustainability, and Climate Change Adaptability. *Environ. Manag.*, 2019; 63:159–172.

3. AlShrouf, A. Hydroponics, aeroponic and aquaponic as compared with conventional farming. *Am. Acad. Sci. Res. J. Eng. Technol. Sci.*; 2017; 27:247–255.
4. Babmann, B.; Harbach, H.; Weißbach, S. and Palm, H.W. Effect of plant density in coupled aquaponics on the welfare status of African catfish, *Clarias gariepinus*. *J. World Aquac. Soc.*; 2020; 51:183–199.
5. Bahl, J.R.; Singh, A.K.; Lal, R.K. and Gupta, A.K. High-yielding improved varieties of medicinal and aromatic crops for enhanced income. *In New Age Herbs; Springer: Singapore*; 2018; pp. 247–265.
6. Barton, C. J. Photometric analysis of phosphate rock. *Anal. Chem.*; 1948; 20:1068–1073.
7. Batsatsashvili, K.; Kikvidze, Z. and Bussmann, R.W. Ethnobotany of the mountain regions of far eastern Europe: Ural, Northern Caucasus, Turkey, and Iran. Springer; 2020.
8. Benabdallah, H.; Benchikh, F. and Amira, S. Ethnopharmacological study and evaluation of the antioxidant activity of *Ocimum basilicum* L. Extracts. *J. Drug Deliv. Ther.*; 2020; 10:132–137.
9. Bremner, J.M. and Mulvaney, C.S. Nitrogen-total. In *Methods of Soil Analysis, Part 2. Chemical and Microbiological Properties*. 2nd ed.; *Agronomy series No. 9 ASA*; 1982; pp. 595–624.
10. Chapman, H.D. and Partt, F.P. Methods of analysis of soils, plant and water. *Cal. Univ.*; 1961; pp.150–200.
11. Danner, R.I.; Mankasingh, U.; Anamthawat-Jonsson, K.; Thorarinsdottir, R.I. Designing Aquaponic Production Systems towards Integration into Greenhouse Farming. *Water*; 2019; 11:2123.
12. Koshariya Kumar, Ashok. Climate-Resilient Crops: Breeding Strategies for Extreme Weather Conditions. *Plant science archives*; 2022; 01-03.
13. Heise, J.; Müller, H.; Probst, A.J.; Meckenstock, R.U. Ammonium Removal in Aquaponics Indicates Participation of Comammox Nitrospirae. *Curr. Microbiol.*; 2021;78:894–903.
14. Hosseinzadeh, S. *et al.* Recirculating water treatment in closed hydroponic systems: assessment of granular activated carbon and soft templated mesoporous carbon for adsorptive removal of root exudates. *Environ.*; 2019; 1–23.
15. CS, V.; Kalaimani, P. S.; Sharma, A. and Magrey, A. H. Enhanced wound care solutions: Harnessing cellulose acetate-EUSOL/polyvinyl alcohol-curcumin electrospun dressings for diabetic foot ulcer treatment. *Plant Science Archives*; 2022; pp. 5(07).
16. Hundley, G.C.; Navarro, F.K.S.P.; Filho, O.P.R. and Navarro, R.D. Integration of Nile tilapia (*Oreochromis niloticus* L.) production *Origanum majorana* L. and *Ocimum basilicum* L. using aquaponics technology. *Acta Sci. Technol.*; 2018; 40:35460.
17. Chawla, R.; Mondal, K. and Pankaj, M. S. Mechanisms of plant stress tolerance: Drought, salinity, and temperature extremes. *Plant Science Archives*; 2022; pp. 4(08).
18. Juliani, H.R. and Simon, J.E. Antioxidant activity of basil. In *Trends in New Crops and New Uses*; ASHS Press: Alexandria, VA, USA, 2002; Volume 575.
19. Anbarasan and S. Ramesh. Photosynthesis Efficiency: Advances and Challenges in Improving Crop yield plant science archives. 2022; pp. 19-21.

20. Lakkireddy, K.K.R.; Kasturi, K. and Sambasiva Rao, K.R.S. Role of hydroponics and aeroponics in soilless culture in commercial food production.s research & reviews. *J. Agric. Sci. Technol.*; 2012; 1(1):26–35
21. Li, Q.; Li, X.; Tang, B. and Gu, M. Growth responses and root characteristics of lettuce grown in aeroponics, hydroponics, and substrate culture. *Horticulturae*; 2018; 43(5):1–9
22. Nikhat Afroz. Exploring Traditional Medicine in South Africa: A Review of Ethnobotanical Studies on Medicinal Plants. *Plant Science Archives*; 2022; 14-18. DOI: <https://doi.org/10.5147/PSA.2022.7.3.14>.
23. Medina, M.; Jayachandran, K. Bhat, M. G. and Deoraj, A. Assessing plant growth, water quality and economic effects from application of a plant-based aquafeed in a recirculating aquaponic system. *Aquac. Int.*; 2016; 24:415–427.
24. Mehandru, P.; Shekhawat, N. S.; Rai, M. K.; Kataria, V. and Gehlot, H. S. Evaluation of aeroponics for clonal propagation of *Caralluma edulis*, *Leptadenia reticulata* and *Tylophora indica*-Three threatened medicinal Asclepiads. *Physiol. Mol. Biol. Plants*; 2014; 20:365–37.
25. Ashwini, M.; Janakiraman, B.; Srinivasan, B.; Shanmugaraj, B. M. and Ramalingam S., Antioxidant activity in *in-vivo* and *in-vitro* cultures of onion varieties (Bellary and CO3). *Food and Nutrition Sciences*; 2013; 4: 918-923.