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Evaluation of Three Nutrient Compositions for Lettuce Cultivers in two Hydroponic Systems

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ABSTRACT

A greenhouse field experiment was conducted at Plasticulture Farm in MPUAT, Udaipur Rajasthan in 2021 to examine the effects of different EC levels on the growth and weight of two lettuce cultivars grown in two hydroponic systems. Two lettuce cultivars, Ice Berg (V1) and Green Rapid (V2), were subjected to three levels of EC i.e. 0.75 dS/m, 1.0 dS/m and 1.25 dS/m and two hydroponic systems (DWC and NFT). The Green Rapid cultivar with 1.0 dS/m and NFT treatment combination proved significantly more productive than the other cultivar/treatment combinations. Based on the results, for all parameters, i.e. plant height, number of leaves, fresh weight, plant spread and dry matter were found more effective in Green rapid with 1.0 dS/m EC and NFT treatment combination. It is expected that the development of a good and easy-to-use hydroponic system will help growers produce high-quality vegetables including lettuce.

Key words : *Hydroponics, Lettuce, EC, Nutrient Solution and NFT*

Introduction

Lettuce is a cool-season vegetable which thrives in temperatures ranging from 7 to 24 °C and is commonly consumed in salad mixes (Sublett *et. al.,* 2018). Lettuce is very nutritious and a rich source of vitamin C, minerals and fiber (Mulabagal *et at.,* 2010). Due to the rapidly expanding global population, rapid urbanization, and growing health concerns, consumption of vegetables, especially lettuce, is on the rise today. However, one significant factor that limits vegetable cultivation is inadequate land space.

Hydroponic culture is a cheap and easy option for organic vegetable production. It is a technique that involves growing plants in water using mineral nutrients without soil (Spehia *et al.,* 2018). Hydroponics is a significant alternative plant production method due to its simple nutrient composition management, lack of soil contamination, faster plant development, shorter crop cycles, excellent product quality, and favorable consumer acceptance (Petropoulos *et al.,* 2016). In tropical regions, a lettuce crop cycle takes about 70 days under soil cultivation, but only 30 days under hydroponics (Cometti *et al.,* 2013). Plants grown in hydroponics contain more minerals compared to those produced in a conventional soil-based system (Spehia *et al.,* 2018).

Despite the fact that hydroponic culture can result in optimal plant growth (higher yield and quality), its effectiveness is influenced by a variety of factors,

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including fertilizer availability, crop genotype, growing technique, and pest management. (Sapkota *et al.,* 2019). Although studies have been conducted on the hydroponic culture of lettuce, thus, the goal of this study was to examine the influence of two cultivars, two hydroponic structure and three EC levels on lettuce performance.

Materials and Methods

The experiment was carried out in a greenhouse belonging to the MPUAT campus at Plasticulutre Farm, Udaipur, India from November to December, 2021. The whole experiment was divided into two parts on the basis of Lettuce crop varieties, one for *Ice Berg* (V1) and second for *Green Rapid* (V2) for both cultivation methods (soil and hydroponics) under naturally ventilated polyhouse. These both varieties were tested for two hydroponic techniques viz. A) Nutrient Film Technique (S1=NFT) and B) Deep Water Culture (S2=DWC). Further it were tested also for three different concentration of Nutrient Solutions with three different level of Electrical Conductivity (C1=1.25 dS/m, C2=1.0 dS/m and C=0.75 dS/m). The experiment was laid out using Factorial Complete Randomized Block Design with 14 treatment combinations. 1] **T1** = V1 + S1 + C1, 2] **T2** = V1 + S1 + C2, 3] **T3** = V1 + S1 + C3, 4] **T4** = V1 + S2 + C1, 5] **T5** = V1 + S2 + C2, 6] **T6** = V1 + S2 + C3, 7] **T7** = V2 + S1 + C1, 8] **T8** = V2 + S1 + C2, 9] **T9** = V2 + S1 + C3, 10] **T10** = V2 + S2 + C1 , 11] **T11** = V2 + S2 + C2, 12] **T12** = V2 + S2 + C3, 13] **T13** = Soil (control) - Ice Berg (V1) and 14] **T14** = Soil (Control) - Green Rapid (V2).

There were two hydroponic systems used namely DWC and NFT. In case of DWC one nutrient solution tank has been used with 150 liter capacity and having length was 2.5 m, width was 1.5 m, depth 0.15 m and covered 3.75 m^2 area. In case of NFT, total area used for the A-frame NFT system is 4.5 m^2 (3 m x 1.5 m). This area contains 10 NFT channels and each having 3 m length with 0.3 m spacing between two consecutive NFT channels.

The growth parameters observed and measure in this research were plant height, number of leaves, fresh weight of the plant, plant spread and dry matter of the plant. The secondary parameter observed to support data analyze of main parameter. The secondary parameters were temperature and humidity of greenhouse, pH nutrients and EC of nutrient solution. The data of growth parameters or main parameters then analyze with analyze of variance

Table 1. Effect of different structures and concentration of Nutrient solution on various parameters of *Ice berg* and *Green Rapid* lettuce at Harvesting

	Parameters at Harvesting				
Treatment	Plant Height	No. of Leaves	Fresh weight	Plant spread	Dry Matter
		For Variety 1			
T1	15.30	4.05	81.95	1878.05	7.67
T2	16.03	4.15	93.54	1906.53	7.87
T3	13.20	3.75	45.90	1827.76	7.32
T4	13.73	3.80	65.30	1379.17	7.11
T5	14.18	3.90	73.45	1498.78	7.24
T6	10.83	3.60	41.95	1323.27	6.93
		For Variety 2			
T7	15.88	4.13	89.12	1884.08	7.75
T8	16.23	4.80	93.67	1936.77	7.99
T9	13.38	3.78	61.05	1846.28	7.66
T10	13.75	3.85	66.20	1421.84	7.15
T11	14.50	4.00	79.60	1531.10	7.28
T12	11.83	3.68	43.55	1351.63	7.05
		Control (Soil Cultivation)			
T13	7.64	3.05	69.92	2056.11	8.28
T14	8.83	3.48	72.13	2244.61	8.91
Mean	15.30	3.86	69.81	1720.43	7.59
SE	0.74	0.21	3.95	60.48	0.31
CD5%	1.04	0.29	5.53	84.63	0.44
CD1%	1.37	0.38	7.30	111.84	0.58

α=5%. From this experiment we can conclude that which EC level, hydroponic structure and crop variety is best for better production of Lettuce crop.

Results and Discussion

Plant height and No. of leaves, plant fresh weight, plant spread and plant dry matter of Lettuce crop. It was observed that the plant height and No. of leaves of *Ice Berg* and *Green Rapid* varieties mean values significantly increased from 7, 15 and 25 days after transplanting and at the time of harvesting. Based on observations of all these parameters (Table 1), it was found that in case of *Ice Berg* variety (V1) the maximum values of all these parameters has been found in treatment combination T2 followed by T1, T5, T4, T3 and minimum value has been observed in T6 treatment. However same trend was found in *Green rapid* variety (V2) within the treatments, i.e., maximum values of all these parameters has been found in treatment combination T8 followed by T7, T11, T10, T9 and minimum value has been observed in T12 treatment. From the result it was found that for both varieties, the best structure has been found S1, i.e. Nutrient Film Technique (NFT), the best nutrient solution concentration has been foundC2 and S1C2, i.e. NFT (Structure) and 1.0 dS/m EC concentration combination found to be best.

As far as the growth characters are concerned, plants using hydroponic system did indeed grow faster than traditional soil system and also hydroponic plants grew overall taller than the soil plants (Cometti *et al.,* 2013). The findings are in accordance with (Petropoulos *et al*., 2016) in which they noticed that Lettuce grown in the nutrient solution generally had a significantly greater number of leaves compared to soil.

Conclusion

Hydroponics growing systems have been developed to get higher yield and growth, to preserve water and land, to save labour and to protect the environment. The application of different concentration of nutrient solution the 1.0 dS/m EC level; the NFT hydroponic structure has a significant effect on the growth of Lettuce crop for both the varieties.

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