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Effect of Different Level of Nutrient on Growth, Yield and Quality of Spinach Beet (*Beta vulgaris var. bengalensis*) in Hydroponic System under Shade Net Condition

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ABSTRACT: The present research experiment was carried out during January to February 2021 under Shade net condition Research Field of Department of Horticulture, SHUATS, Prayagraj. The experiment was conducted in Randomized Block Design (RBD), with eight treatments, replicated thrice in hydroponic system with variety all-green. From the present experimental finding it is found that the T_7 (Epsom salts and micros (17.5ml/10L) ($MnSO_4$, $ZnSO_4$, $CuSO_4$, B, Common Salt) + Iron Chelate (17.5m1/10L) + Mono Ammonium phosphate (17.5ml/10L)N:P:K 11:48:00 + Calcium Nitrate (27.5ml/10L) N:P:K 15:00:00 + Potassium Nitrate (27.5ml/10L) N:P:K 13:00:44)was found superior over other treatments in terms of plant height (44.08cm), Number of leaves per plant (25.33cm), leaf length (36.33cm), leaf width (8.95cm), root length (6.25cm), amount of water used (10.43L), plant weight per plant (37.21g), Yield per structure (4.06kg), TSS (5.47°Brix) and chlorophyll content (32.98) of Spinach Beet in hydroponic system.
Maximum gross return (₹ 973.32) and net return (₹ 292.38) with highest benefit cost ratio (1:1.67) was also obtained in T_7.

Keywords: Spinach Beet, Epsom salts and micros, Iron chelate, Mono ammonium phosphate, Calcium nitrate and Potassium nitrate.

INTRODUCTION

With each passing day, the demand and interest in clean, minimally processed foods grows in the global market place. People's life styles, on the other hand, have evolved into a practical and quick approach. Because employed or working women have less time to spend in the kitchen, they prefer freshly prepared, quick, practical, and healthy foods. Vitamins and antioxidants abound in edible leaf vegetables Yadav *et al.*, (2013).

Soil less culture, particularly hydroponic culture, has gained popularity in recent years as a way to simplify the cleaning of edible leaf vegetables and provide them for consumption with minimal processing Nicola *et al.*, (2007).

Static solution culture is the oldest and most simple soilless culture technique among hydroponic culture systems. Plants are placed on styrofoam platforms that float freely over the nutrient solution in today's modified version of the process, which is known as "floating water culture (Morgan, 1999; Gill, 2008).

In 1980, Arizona University invented and produced floating water culture, which was commercially used in vegetable culture in Florida a few years later. The approach is often employed in the creation of seedlings and standard or tiny vegetables (Carrasco *et al.*, 2011**)**. Easy system construction, low labour costs due to automation systems, rapid plant growth, homogeneous products, high quality yields, clean products, greater number of plants per unit area, easy harvest, optimised fertiliser and water use, minimal evaporative losses, environment-friendly production, and easy adaptation to small production areas are all advantages of hydroponic systems Oztekin *et al.*, (2018).

Dr. Alen Cooper created NFT in the mid 1960s in England to address the limitations of the ebb and flow method. Water or fertilizer solution circulates throughout the system and enters the growing tray via a water pump that does not have a timer Domingues *et al.*, (2012).

Many leafy greens may be easily produced in a hydroponics system, and spinach Beet production is the most extensively employed commercially. Several hydroponic experiments utilizing spinach as a model crop were recently undertaken Sharma *et al*., (2018).

In a hydroponic system, the spinach beet (*Beta vulgaris var. bengalensis*) is one of the most commonly grown plants. It is a perennial leafy crop that is grown in both traditional agricultural and hydroponic systems all over the world. Spinach is incredibly nutritious and offers numerous health benefits due to its high quantities of vitamins, minerals, protein, and omega-3. Spinach is a popular food to cultivate in hydroponic systems because of its rapid growth and high nutritional value Petrea *et al.*, (2013).

MATERIALS AND METHODS

The present investigation was carried out during January-February 2021 at The Research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) India. The experiment was laid out in Randomized Block Design (RBD) with 8 treatments and each treatment replicated thrice. Total number of treatments were eight *viz.* T_1 to T_7 Nutrients (Epsom salts and micros ($MnSO_4$, $ZnSO_4$, $CuSO_4$, B, Common Salt) + Iron Chelate + Mono Ammonium phosphate + Calcium Nitrate + Potassium Nitrate) used as different concentration and T_8 (Control tab water) treatment details are given in Table 1.

Table 1.

Treatments	Epsom salts and micros (ml/10L) ($MnSO_4$, $ZnSO_4$, $CuSO_4$, B, Common Salt)	Iron Chelate (ml/10L)	Mono Ammonium Phosphate (ml/10L)	Calcium Nitrate (ml/10L)	Pottasium Nitrate (ml/10L)
T_1	2.5	2.5	2.5	12.5	12.5
T_2	5	5	5	15	15
T_3	7.5	7.5	7.5	17.5	17.5
T_4	10	10	10	20	20
T_5	12.5	12.5	12.5	22.5	22.5
T_6	15	15	15	25	25
T_7	17.5	17.5	17.5	27.5	27.5
T_8	0	0	0	0	0

Climatic condition in the experimental site. The Prayagraj district is located in the subtropical section of Uttar Pradesh, which has extremely hot summers and relatively cold winters. The location's highest temperature ranges from 46°C to 48°C, with temperatures rarely falling below 4°C or 5°C. The relative humidity level varies from 20 % to 94 %. The yearly rainfall average in this area is roughly 1013.4 mm. During the winter, however, there is a higher chance of precipitation.

Research field visit by Hon'ble Vice Chancellor and Head of Department, Horticulture, SHUATS, Prayagraj.

General view of Spinach beet at 45 DAT.

RESULTS AND DISCUSSION

The result of the present investigation, regarding the Effect of different levels of nutrient on growth, yield and quality of Spinach Beet (*Beta vulgaris* var. *bengalensis*) in hydroponic system under shade net have been discussed and interpreted in the light of previous research work done in India and abroad. The experiment was conducted in Randomized block design with 8 treatments and three replications. The result of the experiment are summarized Table 2&3.

Among the growth, yield and quality components there was significant difference in treatments at 45 DAT. Significantly higher plant height (cm), Number of leaves per plant (cm), leaf length (cm), leaf width (cm), root length (cm), amount of water used (L.). (44.08cm, 25.33cm, 36.33, 8.95cm, 6.25cm, 27.58cm, 10.43L) in the treatment T_7 (Epsom salts and micros (17.5ml/10L) + Iron Chelate (17.5m1/10L) + Mono Ammonium phosphate (17.5ml/10L) + Calcium Nitrate (27.5ml/10L) + Potassium Nitrate (27.5ml/10L). However, in the treatment T_4, T_5 and T_6 was observed to be statistically at par with T_7.

It may attributed to the adequate supply of nutrient, higher uptake and recovery of applied nutrient with application of different nutrient particularly Calcium Nitrate and Potassium Nitrate might have enhanced cell division and formation of more tissues resulting in luxuriant vegetative growth and thereby increasing plant height similar finding was reported by Genuncio *et al.,* (2012). The increase in plant spread and number of leaves per plant in best treatment is due to different treatment combination of Mono Ammonium phosphate. With nitrogen fertilizer or recommended dose of nutrient the similar finding has been reported by Daniel *et al.,* (2017).

Significantly higher, plant weight (37.21g), Yield per structure (4.06kg), TSS (5.47°Brix) and Chlorophyll content (32.98) were observed in the treatment T_7 (Epsom salts and micros (17.5ml/10L) + Iron Chelate (17.5m1/10L) + Mono Ammonium phosphate (17.5ml/10L) + Calcium Nitrate (27.5ml/10L) + Potassium Nitrate (27.5ml/10L). However, in the treatment T_4, T_5 and T_6 was observed to be statically at par with T_7. Similar finding were reported by Maneejantra *et al.,* (2016); Wang *et al.,* (2017); Oztekin *et al*., (2018).

The maximum gross return was recorded in treatment T_7 (Epsom salts and micros (17.5ml/10L) + Iron Chelate (17.5m1/10L) + Mono Ammonium phosphate (17.5ml/10L) + Calcium Nitrate (27.5ml/10L) + Potassium Nitrate (27.5ml/10L), with Rs. 973.32 structure^{-1} and maximum net return was recorded in treatment T_6 with, Rs. 315.46 per structure. Maximum Cost benefit ratio was recorded in treatment T_7 with 1:1.67.

As the economics is the need of the farmers while taking decision regarding the adoption of the techniques and scientific knowledge Hence, T_7 (Epsom salts and micros, Iron Chelate and Mono Ammonium phosphate (17.5ml/10L) + Calcium Nitrate and Potassium Nitrate (27.5ml/10L) recorded highest cost benefit ratio is due to low cost of nutrient and high productivity and enhanced Chlorophyll content of leaves, which increase the market value of the crop.

Table 2: Effects of different levels of nutrients on Plant height (cm), Plant spread (cm), Number of leaves, Leaf length (cm), Leaf width (cm), Root length (cm), Amount of water used (in liter), Average plant weight (g), Total Yield (kg), TSS (°B), and Chlorophyll content of spinach Beet [*Beta vulgaris var. bengalensis*].

Symbol	Plant height (cm)	Plant spread (cm)	Number of leaves	Leaf length (cm)	Leaf width (cm)	Root length (cm)	Amount of water used (in liter)	Average plant weight (g)	Total Yield (kg)	TSS (°B)	Chlorophyll content
T_1	34	15.29	23.25	4.2	2.67	17.08	8.33	27.18	1.9	5.22	23.32
T_2	34.41	18.8	26.08	5.83	3.38	17.41	8.73	30.55	2.39	5.24	24.86
T_3	36.08	20.04	28.33	7.08	4.13	18.91	9.23	32.88	3.12	5.25	26.75
T_4	38.08	22.54	30.75	7.25	4.3	19.66	9.67	35.44	3.33	5.34	30.15
T_5	39.58	23.21	32.25	8.16	5.71	21.16	9.8	35.55	3.44	5.41	31.6
T_6	40.66	24.79	33	8.53	5.96	26.16	9.87	36.52	3.61	5.47	31.73
T_7	44.08	25.33	36.33	8.95	6.25	27.58	10.43	37.21	4.06	5.8	32.98
T_8	30.16	12.13	13.25	2.29	0.7	17.08	6.9	23.29	0.925	4.95	21.12
F-Test	S	S	S	S	S	S	S	S	S	S	S
S.Ed (±)	3.02	1.96	1.8	0.72	0.52	3.02	0.16	1.11	0.24	0.13	2.2
C.D. at 0.5%	6.46	4.21	3.87	1.55	1.12	6.49	0.35	2.38	0.51	0.27	4.73

Table 3: Gross return, Net return and cost benefit ratio of different treatments.

Treatment Symbol	Yield (Kg)	Gross Return	Cost of production	Net Return	Cost : Benefit ratio
T_1	15.16	455.00	400.94	54.06	1.13
T_2	19.12	573.60	430.94	142.66	1.33
T_3	24.96	748.80	460.94	287.86	1.62
T_4	26.64	799.20	490.94	308.26	1.63
T_5	27.52	825.60	520.94	304.66	1.58
T_6	28.88	866.40	550.94	315.46	1.57
T_7	**32.44**	**973.32**	**580.94**	**292.38**	**1.67**
T_8	7.40	222.00	220.94	1.06	1.01

CONCLUSION

It was concluded from the trial that treatment T_7 (Epsom salts and micros (17.5ml/10L) + Iron Chelate (17.5m1/10L) + Mono Ammonium phosphate (17.5ml/10L) + Calcium Nitrate (27.5ml/10L) + Potassium Nitrate (27.5ml/10L), was found superior over other treatments in term of growth, yield 32.44 kg per 12.8m^2 and quality of Spinach Beet (*Beta vulgaris var. bengalensis*.) in hydroponic system under shade net condition. Regarding economics of different treatments, maximum gross return (₹972.32) and net return (₹315.46) with benefit cost ratio (1:1.67) was also obtained in T_7.

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Conflict of Interest. None.

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