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Effect of Different Levels of NPK and Micronutrients for Plant Growth, Bulb and Quality of Onion (*Allium cepa*) in NFT System of Hydroponics

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Authors' contributions

This work was carried out in collaboration among all authors. Author AS performed the experiment and statistical analysis and the first draft of manuscript. Author VB gave the idea for the study and wrote the protocol. Authors SET, VMP and AK inspected and evaluated the experimental field. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To evaluate the effect of different levels of NPK and micronutrients for plant growth, bulb and quality of Onion (*Allium cepa*) in NFT system of Hydroponics.
Study Design: Randomized Block design.
Place and Duration of Study: The experiment was carried out in 2022 at the shadenet of Department of horticulture, Naini Agricultural Institute, SHUATS, Prayagraj.

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Methodology: The experiment was conducted in Randomized Block Design with 7+1 (Control) with 3 replications. The treatments were T_0 Tap water, T_1 (8.12ml NPK/Pl), T_2 (9.37ml NPK/Pl), T_3 (10.62ml NPK/Pl), T_4 (11.87ml NPK/Pl), T_5 (13.12ml NPK/Pl), T_6 (14.37ml NPK/Pl), T_7 (15.62ml NPK/Pl). From the present investigation it is found that treatment T_7)15.62ml NPK/Pl) was found to be best in terms of Plant length, Number of leaves, diameter and weight of bulb, girth of bulb, days to maturity, Days to flowering, days to maturity, average fresh weight, neck thickness at maturity, sensory evaluation, TSS, ascorbic acid, dry matter content, moisture content and cost benefit ratio.
Results: The current study indicates that the maximum growth of Onion in terms of growth, yield and quality was observed in Treatment 7 (15.62ml NPK/Pl).

Keywords: Onion; NPK; hydroponics; growth; yield.

1. INTRODUCTION

Onion *(Allium cepaL.)* belongs to family Alliaceae and is one of the most important marketable vegetable crops cultivated considerably in India and world. It's an necessary item in every kitchen as spice, vegetable as well as salad, thus, commands considerably in internal request. Onion is preferred for its flavour and pungency which is due to the presence of a unpredictable sulphur emulsion allyl propyl disulphide. Onion bulb is a rich source of protein, carbohydrates, vitamin C and minerals like phosphorus, calcium, etc. India is the second largest patron of onion in the world, coming to China, counting for27.05 of the area and22.6 of the world product. In India, onion occupies about1.20 million hectare area under civilization with total product of19.40 million Mt and productivity of16.1 Mt/ ha. The nonstop and imbalanced use of inorganic diseases is negatively affecting the sustainability of agrarian product besides causing environmental pollution Greenland [1] suggested that for a sustainable crop product system, chemical nutrients removed by the crop must be replenished and physical conditions of the soil maintained. Integrated nutrient operation (INM) provides excellent openings to overcome all the imbalances besides sustaining soil health and enhancing crop product. It optimizes the benefits from all possible sources of factory nutrients in an intertwined manner [2,3]. Lately, organic nutrient operation has got rapid-fire instigation due to knowledge of health hazard and environmental safety. Organic manures not only balance the nutrient force but also ameliorate the physical and chemical parcels of soil [4]. Deficiency of micronutrients during the last three decades has grown in both, magnitude and extent. This has come a major constraint to product and productivity of vegetables in general and onion in particular [5-9]. Therefore, there's an critical need for correction of individual nutrient insufficiency and for arresting its farther spread. The lower productivity of Indian onion is primarily due to civilization of low yield implicit kinds mongrels, vulnerability to both biotic (pests and conditions) and abiotic factors (i.e. humidity stress, high temperature, imbalance nutrition etc). thus, imbalanced nutrition is treated as one of the major abiotic stress which negatively affects crop growth and yield in onion [10-14].

For optimal growth and development, bulb onions require temperature range of 12 – 25^{o}C and annual rainfall of 350 – 600 mm on well drained medium textured soils with a pH range of 6 – 7 [15] to achieve optimum yield of 17 Mgha-1.

One method of farming that can be applied to growing the onions is the hydroponic method. Hydroponics is a method of planting the crops without using soil. In simple terms, in hydroponics a plant utilizes water, nutrients, and oxygen. Hydroponics NFT channels are prevalent and resourceful systems. It is similar to Ebb tide and Flow tide in that the system uses a pump to deliver fertilized water to the grow tray and drain pipe to recycle the unused nutrient solution [16,17-19]. In the NFT system, the nutrient solution is continuously streaming over the roots. These nutrient film technique channels a.k.a. NFT channels are made up of UV stabilized plastic and have a long life. Plant roots get nutrients from solution flow where the flow rate is fixed. Hydroponics method is an alternative solution to cultivate vegetables in limited land. The changes in air temperature, light composition, plant temperature and humidity greatly affect hydroponic growth [20-23]. The difficulty of knowing the environmental conditions of hydroponic planting media often makes the farmers who use this planting method to fail in the middle of the process of plant growth.

2. MATERIALS AND METHODS

The area of Prayagraj district comes under subtropical belt in the south east of Uttar

Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46o C-48o C and seldom falls as low as 4oC- 5oC. The relative humidity ranges between 20 to 94%. The average rainfall in this area is around 1013.4 mm annually. However, occasional precipitation is also not uncommon during winter months.

The experiment was conducted in Randomized Block Design with 7+1 (Control) with 3 replications. The NPK used in the experiment is from the Brand "City Green" with composition of NPK as 19:19:19 .The treatments were T0 Tap water, T1 (8.12ml NPK/Pl), T2 (9.37ml NPK/Pl), T3 (10.62ml NPK/Pl), T4 (11.87ml NPK/Pl), T5 (13.12ml NPK/Pl), T6 (14.37ml NPK/Pl), T7 (15.62ml NPK/Pl).

2.1 Statistical Analysis

The Data recorded throughout the course of investigation was subjected to Statistical analysis by using analysis of variance (ANOVA) for randomized block design (RBD) by Fischer and Yates (1963). Whenever 'F' test was found significant for comparing the means of two treatments, a critical difference (C. D. at 5%) was worked out.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

The performance of Onion under different levels of NPK and Micronutrients were recorded through the crop growth and yield they are as follows:

3.2 Plant Height

The maximum plant height was recorded in the Treatment T7 (15.62ml NPK/Plant) with (44.50) cm followed by treatment T5 (13.12ml NPK/Plant) with (43.20) cm and minimum was recorded in the treatment T0 Control (Tap water) with (23.00) cm.

3.3 Number of Leaves

The maximum number of leaves was recorded in the Treatment T7 (15.62ml NPK/Plant) with (7.62) followed by treatment T5 (13.12ml NPK/Plant) with (6.78) and minimum was recorded in the treatment T0 Control (Tap water) with (5.03) number of leaves.

3.4 Diameter of Bulb

The maximum diameter of bulb was recorded in T7 (15.62ml NPK/Plant) with (17.65) mm which was followed by T5 (13.12ml NPK/Plant) with (16.39) mm which was significantly superior over T0 Control (Tap water) with (11.32) mm.

3.5 Girth of Bulb

The maximum girth of bulb was recorded in T7 (15.62ml NPK/Plant) with (7.95) mm which was followed by T5 (13.12ml NPK/Plant) with (7.21) mm which was significantly superior over T0 Control (Tap water) with (4.12) mm.

3.6 Weight of Bulb

The maximum weight of bulb was recorded in T7 (15.62ml NPK/Plant) with (4.95) g which was followed by T5 (13.12ml NPK/Plant) with (4.82) g which was significantly superior over T0 Control (Tap water) with (2.98) g.

3.7 Neck Thickness

The maximum neck thickness was recorded in the Treatment T7 (15.62ml NPK/Plant) with (7.56) mm followed by treatment T5 (13.12 ml NPK/Plant) with (7.21) mm and minimum was recorded in the treatment T0 Control (Tap water) with (5.53) mm.

3.8 Days to Maturity

The minimum days to maturity was recorded in T7 (15.62ml NPK/Plant) with (71.65) days which was followed by T5 (13.12ml NPK/Plant) with (72.15) days which was significantly superior over T0 Control (Tap water) with (82.39) days.

3.9 Total Soluble Solids (TSS)

The maximum T.S.S. was recorded in T7 (15.62ml NPK/Plant) with (7.05) 0B which was followed by T5 (13.12ml NPK/Plant) with (6.92) 0B which was significantly superior over T0 Control (Tap water) with (6.02) 0B.

3.10 Ascorbic Acid

The maximum ascorbic acid was recorded in T7 (15.62ml NPK/Plant) with (12.06) mg/100g which was followed by T5 (13.12ml NPK/Plant) with (11.57) mg/100g which was significantly superior over T0 Control (Tap water) with (9.26) mg/100g.

Table 1. Effect of NPK and Micronutrients on Plant height, number of Leaves, bulb diameter, bulb girth and bulb weight on onion in NFT system under Prayagraj agro climatic conditions

Treatment	Plant Height						Number of Leaves						Bulb Diameter(mm)	Bulb Girth (mm)	Bulb weight(g)
	Initial	15 DAP	30 DAP	45 DAP	60 DAP	75 DAP	Initial	15 DAP	30 DAP	45 DAP	60 DAP	75 DAP			
T_0	10.65	12.34	15.67	19.42	21.08	23.00	2.01	2.8	3.26	4.05	4.85	5.03	11.32	4.12	2.98
T_1	12.62	15.21	26.32	30.08	34.21	38.92	2.06	2.91	3.62	4.16	5.06	5.54	13.25	5.62	3.34
T_2	13.75	16.34	27.35	29.34	33.14	39.12	2.12	3.06	4.05	4.62	5.21	5.61	12.92	5.92	3.39
T_3	15.62	19.34	29.16	30.15	36.21	40.62	2.1	3.21	4.16	4.38	5.62	5.86	13.86	6.34	3.61
T_4	14.25	21.26	30.45	33.62	38.62	41.32	2.31	3.61	4.72	4.92	5.73	5.95	15.05	6.79	3.92
T_5	16.35	23.16	31.28	37.46	40.35	43.2	2.95	4.12	5.13	5.84	6.32	6.78	16.39	7.21	4.82
T_6	15.92	22.34	30.92	34.16	39.65	42.3	2.56	3.95	5.06	5.62	6.02	6.23	14.26	7.06	4.71
T_7	18.36	25.34	33.61	39.42	42.28	44.5	3.1	4.35	5.95	6.32	6.72	7.62	17.65	7.95	4.95
F-Test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
S.E.(d)	0.006	0.046	0.013	0.013	0.008	0.014	0.005	0.001	0.001	0.002	0.152	0.003	0.011	0.004	0.007
CD $_{@\ 5\%}$	0.012	0.016	0.028	0.028	0.018	0.029	0.001	0.002	0.002	0.004	0.329	0.005	0.024	0.009	0.015
CV	0.047	0.007	0.057	0.057	0.029	0.042	0.024	0.03	0.03	0.045	3.161	0.05	0.097	0.077	0.229

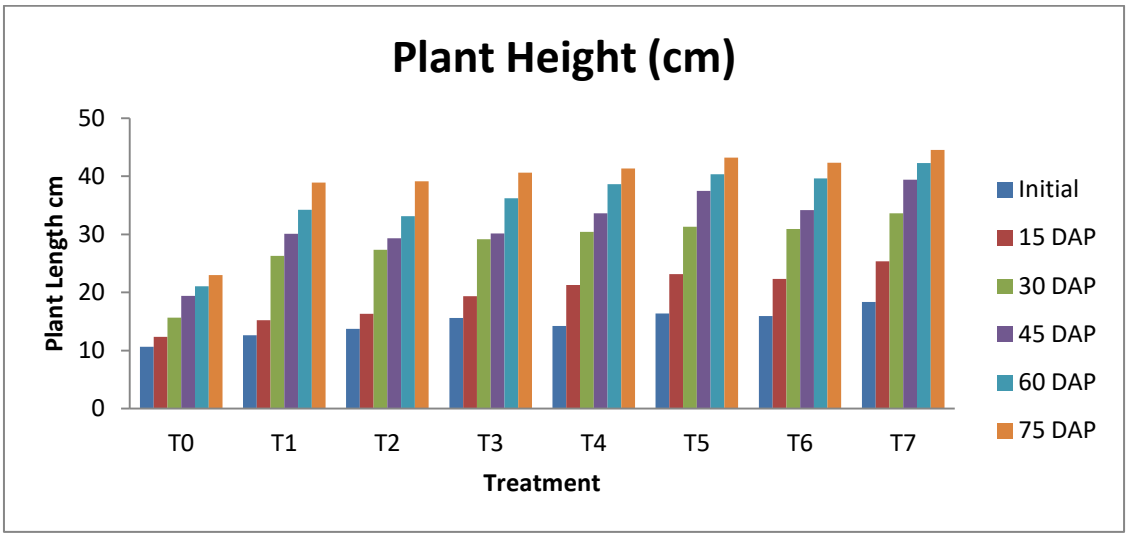


Fig. 1. Effect of different levels of NPK and micronutrients on plant height (cm) in NFT system of Hydroponics

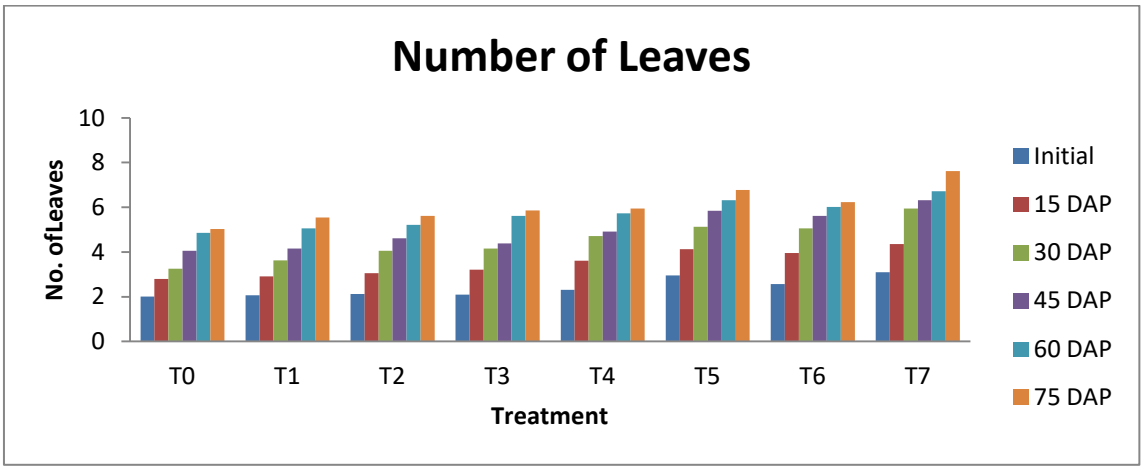


Fig. 2. Effect of different levels of NPK and micronutrients on Number of Leaves

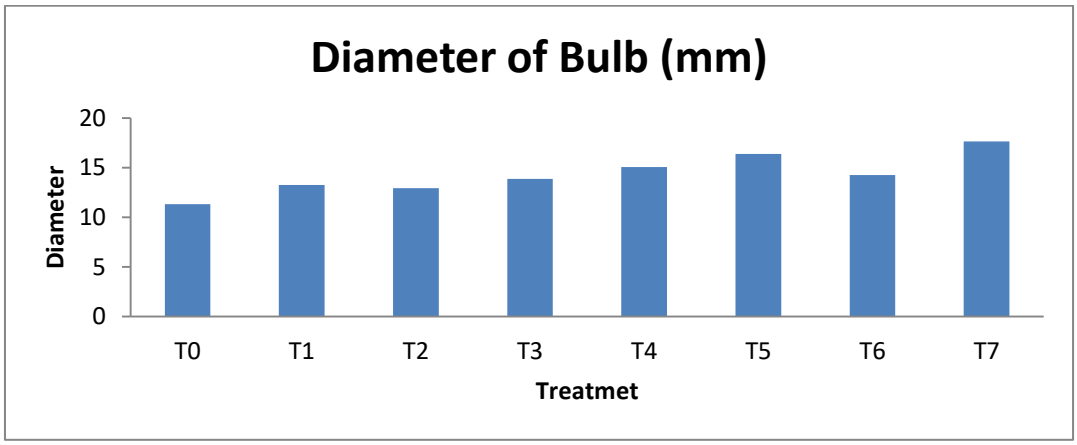


Fig. 3. Effect of different levels of NPK and micronutrients on Diameter of bulb (mm)

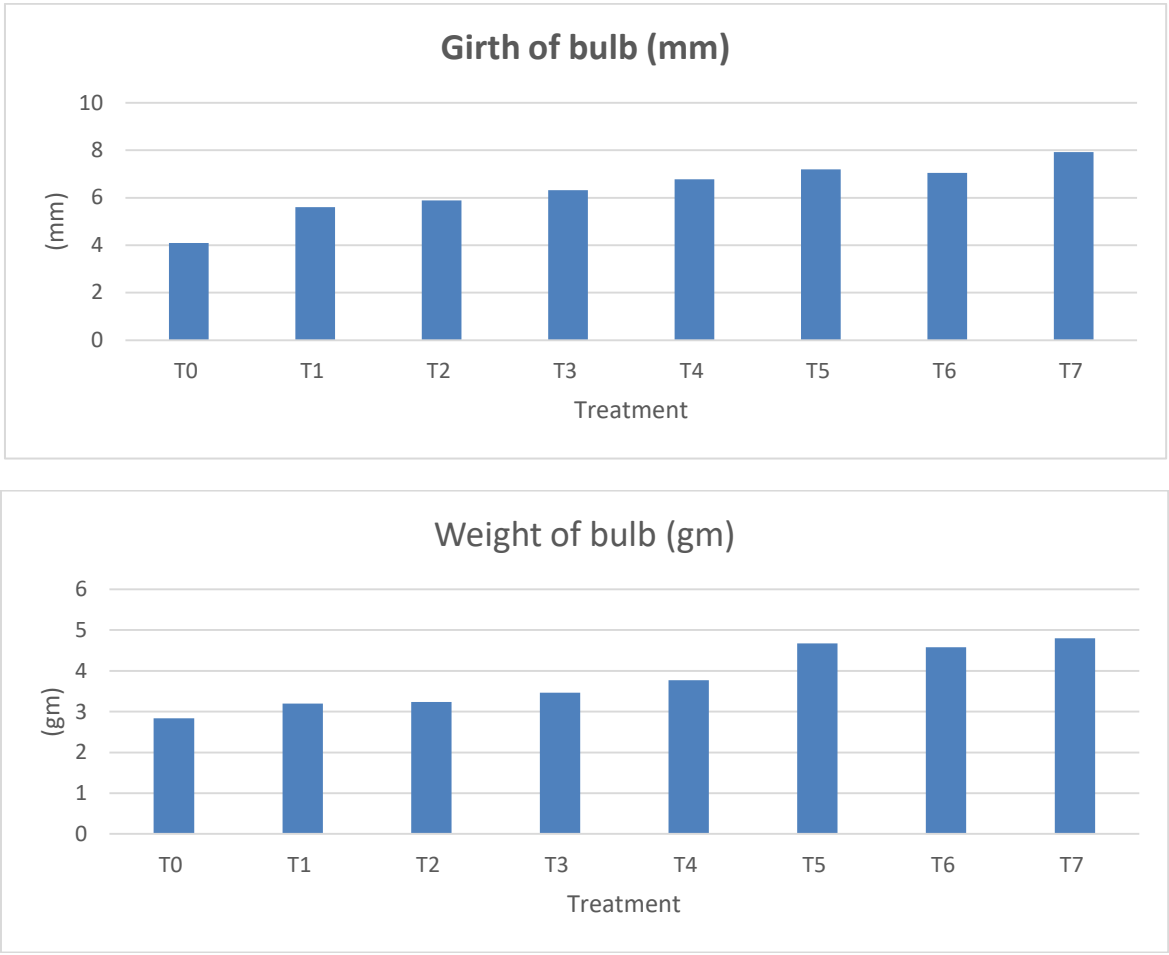


Fig. 4. Effect of different levels of NPK and micronutrients on Girth (mm) and Weight of Bulb (g)

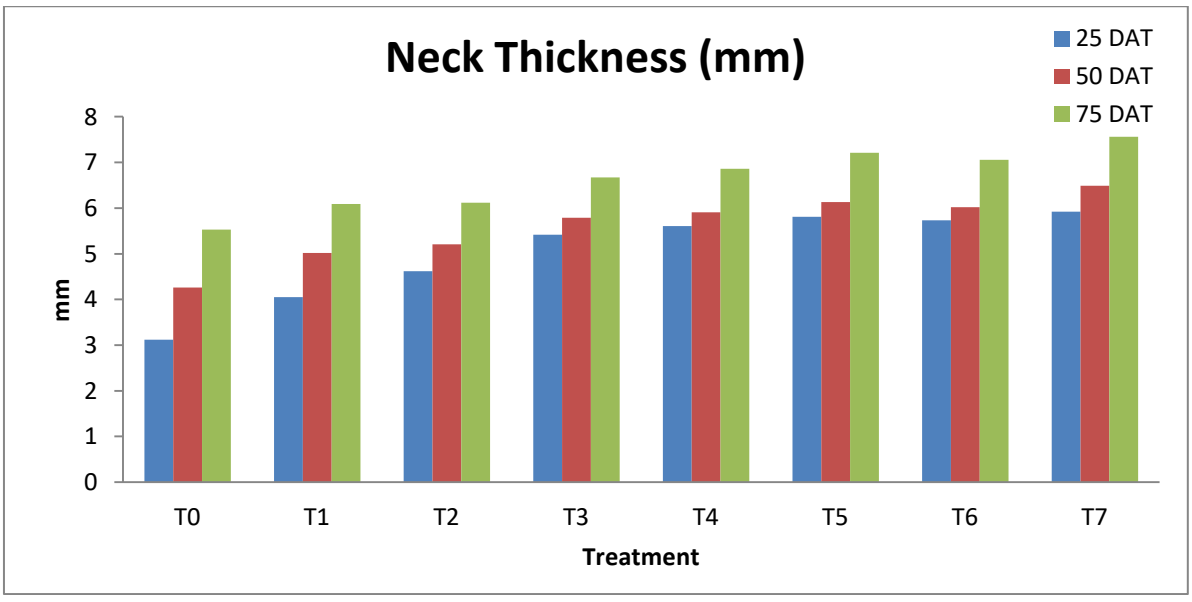


Fig. 5. Effect of different levels of NPK and micronutrients on Neck thickness in NFT system of Hydroponics

Table 2. Effect of NPK and Micronutrients on Neck thickness, Days to maturity, TSS, ascorbic acid, sensory evaluation, average fresh weight, yield per treatment, Neck thickness, dry matter content and Moisture content

Treatment	Neck thickness			Days to Maturity	TSS ^{0}Brix	Ascorbic acid (mg/100g)	Sensory Evaluation		Average Fresh Weight of bulb (g)	Yield per Treatment (kg)	Neck Thickness (mm)	Dry Matter Content (g)	Moisture Content %
	25 DAT	50 DAT	75 DAT				Taste	Pungency					
T_0	3.12	4.26	5.53	82.39	6.02	9.26	6.79	6.92	40.37	0.85	5.31	9.25	70.35
T_1	4.05	5.02	6.09	80.65	6.37	9.67	7.09	7.21	55.10	1.32	5.92	11.64	73.62
T_2	4.62	5.21	6.12	81.43	6.56	10.35	7.32	7.61	56.90	1.37	6.02	13.29	75.29
T_3	5.42	5.79	6.67	79.86	6.83	11.10	7.72	7.52	57.67	1.38	6.10	12.91	77.62
T_4	5.61	5.91	6.86	78.28	6.78	11.21	7.86	7.97	59.47	1.43	6.21	14.06	74.25
T_5	5.81	6.13	7.21	72.15	6.92	11.57	8.02	8.31	61.87	1.48	7.05	14.61	79.62
T_6	5.73	6.02	7.06	75.35	6.75	11.06	7.92	8.12	62.97	1.51	6.91	13.64	71.35
T_7	5.92	6.49	7.56	71.65	7.05	12.06	8.62	8.59	65.50	1.57	7.10	16.95	81.35
F-Test	S	S	S	S	S	S	S	S	S	S	S	S	S
S.E.(d)	0.002	0.006	0.005	0.166	0.008	0.002	0.007	0.009	0.006	0.091	.0.002	0.005	0.175
CD $_{@ 5\%}$	0.003	0.012	0.011	0.359	0.017	0.004	0.015	0.018	0.013	0.197	0.004	0.01	0.379
CV	0.039	0.123	0.094	0.266	0.139	0.021	0.113	0.139	0.161	0.055	0.04	0.045	0.285

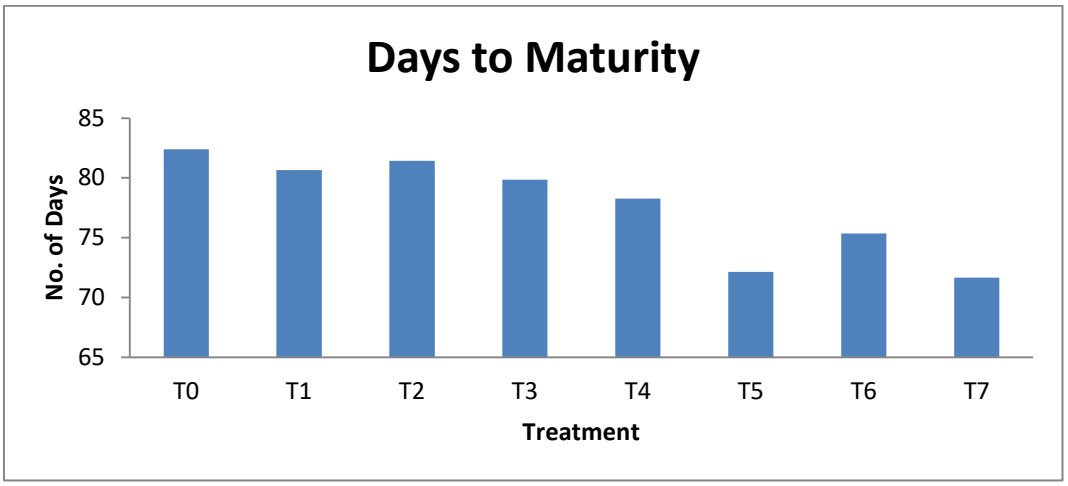
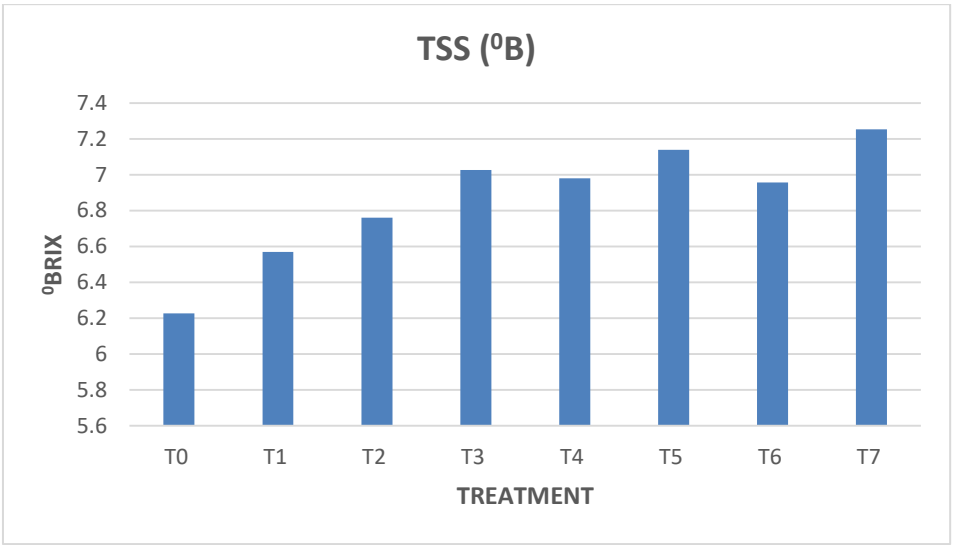


Fig. 6. Effect of different levels of NPK and micronutrients on Days to Maturity in NFT system of Hydroponics



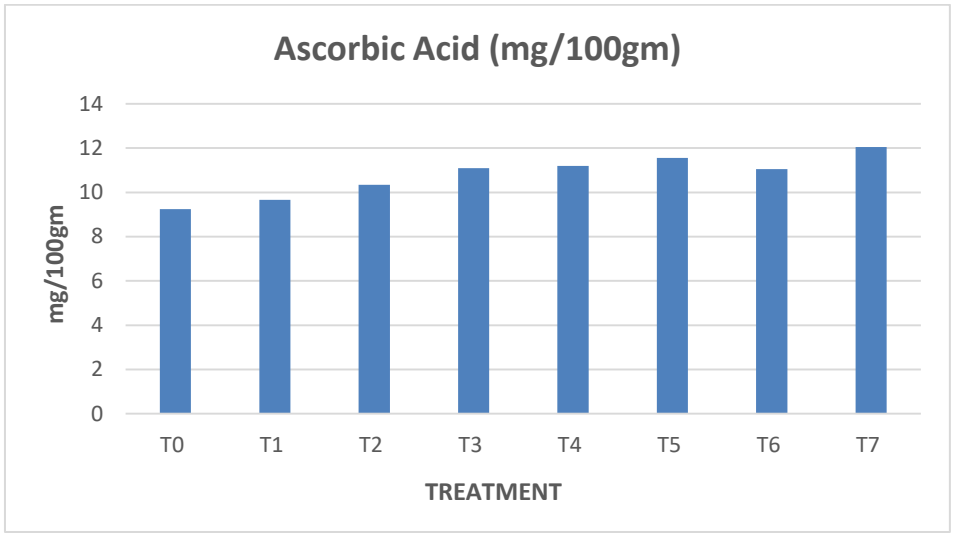


Fig. 7. Effect of different levels of NPK and micronutrients on TSS and Ascorbic acid in NFT system of Hydroponics

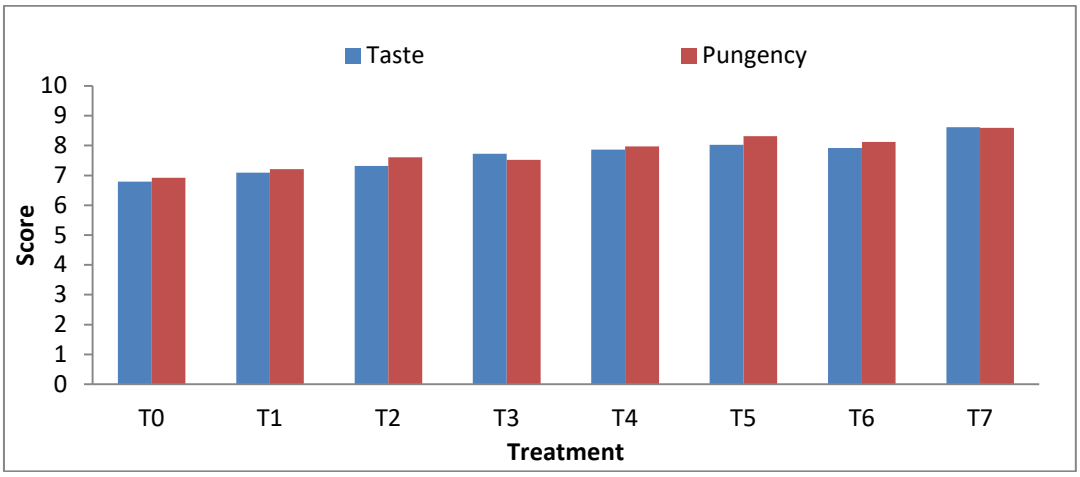


Fig. 8. Effect of different levels of NPK and micronutrients on Quality parameter (Sensory Evaluation) in NFT system of Hydroponics

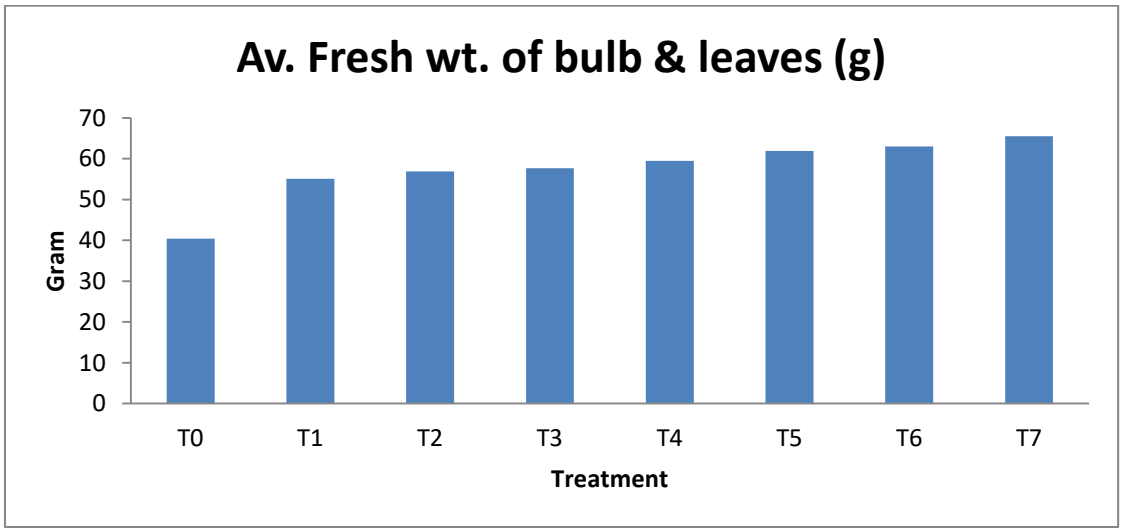


Fig. 9. Effect of different levels of NPK and micronutrients on fresh weight of bulb and leaves in NFT system of Hydroponics

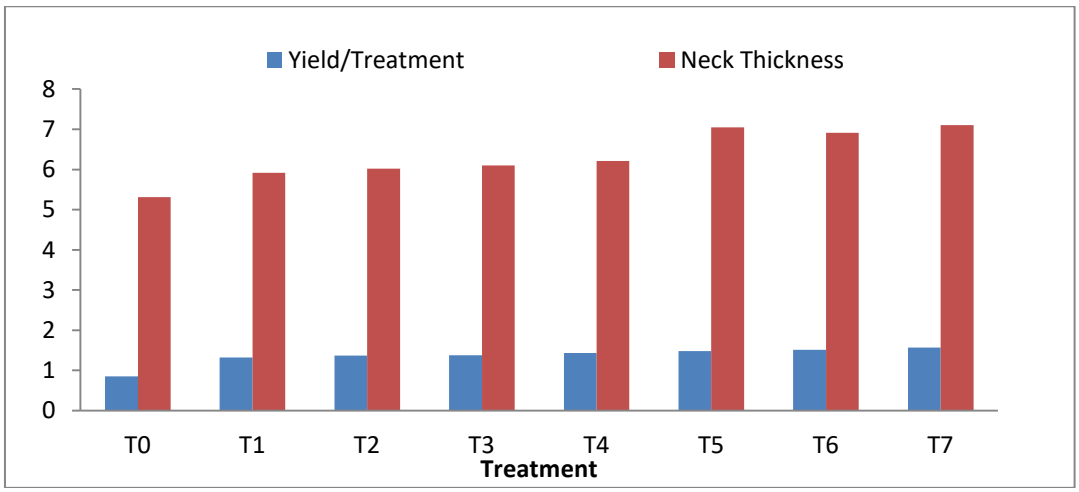


Fig. 10. Effect of different levels of NPK and micronutrients on Yield/Treatment (kg) and Neck Thickness at harvesting in NFT system of Hydroponics

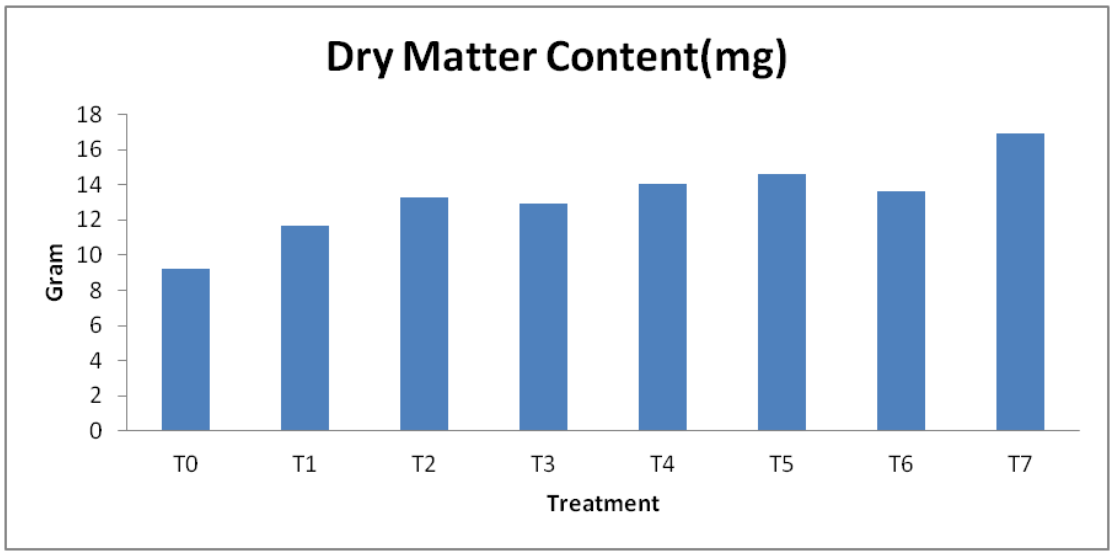


Fig. 11. Effect of different levels of NPK and micronutrients on Dry Matter Content at Maturity in NFT system of Hydroponics

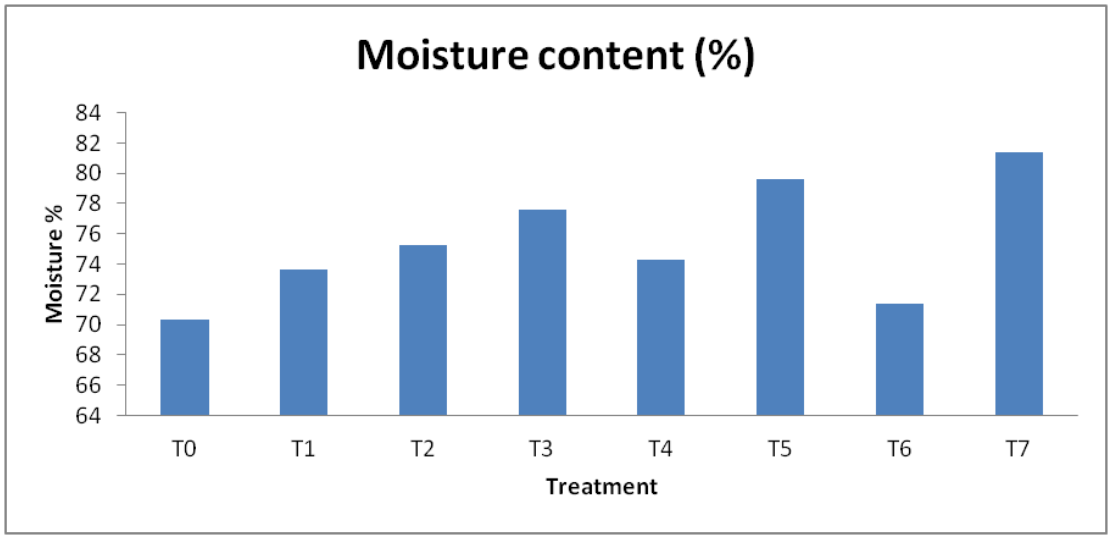


Fig. 12. Effect of different levels of NPK and micronutrients on Moisture Content % at Maturity in NFT system of Hydroponics

3.11 Sensory Evaluation

A. Pungency

The maximum score of Pungency was recorded in T7 (15.62ml NPK/Plant) with (8.59) which was followed by T5 (13.12ml NPK/Plant) with (8.31) which was significantly superior over T0 Control (Tap water) with (6.92).

B. Taste

The maximum score of taste was recorded in T7 (15.62ml NPK/Plant) with (8.62) which was followed by T5 (13.12ml NPK/Plant) with (8.02) which was significantly superior over T0 Control (Tap water) with (6.79).

3.12 Fresh Weight of Bulb

The maximum average fresh weight of bulb was recorded in the Treatment T7 (15.62ml NPK/Plant) with (65.50) g which was followed by T5 (13.12ml NPK/ Plant) with (61.87) g which was significantly superior over T0 Control (Tap water) with (40.37) g.

3.13 Yield per Treatment

The maximum Yield/Treatment was recorded in T7 (15.62ml NPK/Plant) with (1.57) kg which was followed by T5 (13.12ml NPK/Plant) with (1.48) kg which was significantly superior over T0 Control (Tap water) with (0.85) kg.

3.14 Dry Matter Content

The maximum dry matter content (g) was recorded in the Treatment T7 (15.62ml NPK/Plant) with (16.95) g followed by treatment T5 (13.12ml NPK/Plant) with (14.61) g and minimum was recorded in the treatment T0 Control (Tap water) with (9.25) g.

3.15 Moisture Content

The maximum moisture content % was recorded in the Treatment T7 (15.62ml NPK/Plant) with (81.35)% followed by treatment T5 (13.12ml NPK/Plant) with (70.35) % and minimum was recorded in the treatment T0 Control (Tap water) with (69.62)%.

4. CONCLUSION

From the present investigation it is concluded that the treatment T_7 (50, 55, 60, 65, 70, 75 ml/10 L) was found to be best in the terms of growth, yield and quality parameters of the onion in NFT system of Hydroponics.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Greenland. Imbalance occurred due to continuous use of inorganic fertilizers and its negative effect on sustainability of Agrairian products; 1975.
2. Brewster LJ, Rabinowich DH. Onions and allied crops, Volume III-Biochemistry favour, food science and minor crops; 1990.
3. Ines AVM, Gupta AD, Loof R. Application of GIS and crop growth models in estimating water productivity. Agric. Water Manag. 2002;54(3):205–225.
4. Nair, Peter. Effect of organic manure and micronutrients on health of soil for the growth of Onion; 1990.
5. Abdel-Mawgoud AR, Abou-Hussein SR, El-Nemr MA. Interactive effects of zinc and different nitrogen sources on yield and quality of onion, Journal Agriculture Science. 2005;13(3):863-875.
6. Acharya U, Venkatesan K, Saraswathi T, Subramanian KS. Effect of zinc and boron application on growth and yield parameters of multiplier onion (*Allium cepa* L. var aggregatum Don.) var. CO-5. International Journal of Research (IJR). 2015;2(1): 757-765.
7. Bahadur A, Maurya VN. Effect of GA3 and foliar feeding of urea on bulb production of onion (*Allium cepa* L.). Vegetable Science. 2001;28(1):90-91.
8. Bhattal B, Srevastava K, Singh MP. Studies on the effect of foliar application of micronutrients on growth, yield and economics of tomato (*Lycopersicon esculentum* Mill). Progressive Horticulture. 2004;36(2):331-334.
9. Ellerbrock LA, Burba JL, Galmini CR. Copper requirements for onion grown on organic soils in New York. Acta Horticulture. 1997;43(3):567-571.
10. Marilou P Pascual, Gina A Lorenzo, Arneil G Gabriel. NASA. Vertical Farming Using Hydroponic System: Toward a Sustainable Onion Production in Nueva Ecija, Philippines Open Journal of Ecology,10.4236/31001. 2018;8(1).
11. Chad D, Kane BS. Nutrient solution and solution pH influences on onion growth and mineral content. Texas Tech University; 2003.
12. Rahmat RF. Red onion growth monitoring system in hydroponics Environment. Department of Information Technology, Universitas Sumatera Utara, Medan, Indonesia; 2019.
13. Nerokremmydo of Zakynthos, impact of hydroponic cropping system on growth, yield and nutrition of onion Laboratory of vegetable production, department of agriculture, University of Peloponnese, Greece; 2021.
14. Philippine rural development project I-PLAN-Department of agriculture- value chain analysis and competitiveness strategy {bulb onion}.
15. Muendo, Tschirley. Effect of NPK on growth and development of Onion bulb under the temperature range id 12-21 ^{o}C in a well drained medium textured soil having pH. 2004;6-7.

16. Nigatu M, Alemayehu M, Sellassie AH. Optimum rate of NPS fertilizer for economical production of irrigated onion (*Allium cepa* L.) in Dembyia district of Amhara region. Ethiopia. Ethiop. J. Sci. Technol. 2018;11(2):113–127.
17. Lemma D. Onion production pamphlet (*Amharic version*). EARO, Melkassa Research Center; 2004.
18. Singh VI. Impact of integrated nutrient management on soil fertility and yield of onion (*Allium cepa*) on an alluvial soil.Ann. Plant Sci. Res. 2022;2024(2):337-41.
19. Kale AS, Shinde SJ, Garde AP. Effect of Inorganic Fertilizers (NPK) with Organic Sources (Biomix and Humic Acid) on the Bulb Quality and Storage Quality of Onions (*Allium cepa* L.). International Journal of Environment and Climate Change. 2022; 12(12):148-70.
20. Jensen M. plant life sciences, founder, controlled environment agriculture centre. The University of Arizona.
21. Banerjee C. Up, and away / the economics of vertical farming. Journal of agricultural studies; 2014.
22. Hanelt P. Taxonomy, evolution and history. In Onions and allied crops. Botany, physiology and genetics.(Eds HD Rabinowitch, JL Brewster). 1990;I:1–26.
23. Brewster JL. Onions and other vegetable alliums. CABI. 2008;15:1.

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