Production of strawberry (*Fragaria* × *ananassa*) Cultivars in Nutrient Flim Technique (NFT) System of Hydroponics

Abstract

A study was conducted in 2023-24 at the Department of Horticulture, NAI, SHUATS, Prayagraj (U.P.). In the experiment, a total of eight treatments comprising of different levels of macro nutrients were used to investigate the effects of different levels of macro nutrients on growth, yield and quality of strawberry plants (Fragaria x ananassa L.) in a Nutrient Film Technique (NFT) System of Hydroponics. The experiment followed a Completely Randomised Design. According to the findings of this study, treatment T_7: 23.5 ml NPK [3.5 (30 DAS) +5 (60 DAS) +7 (90 DAS) +8 (120 DAS)] ml was found best with vegetative attributes like [10.28 (30 DAT), 16.15 (60 DAT), 18.44 (90 DAT), 19.42 (120 DAT)] cm plant height, [17.45 (30 DAT), 23.69 (60 DAT), 24.36 (90 DAT), 25.48 (120 DAT)] cm plant spread, [17.45 (30 DAT), 23.69 (60 DAT), 24.36 (90 DAT), 25.48 (120 DAT)] number of leaves per plant, [4.67 (30 DAT), 7.89 (60 DAT), 11.45 (90 DAT), 12.91 (120 DAT)] cm^2 leaf area and 28.81 cm root length; flowering attributes like 45.24 total number of flowers per plant, 55.64 days taken to first flowering and 81.64 days taken to first fruit set; yield attributes like .18.45 number of fruits per plant, 50.47 g average fruit weight and 18.63 kg yield per setup and quality attributes like 73.61 mg/100 g of pulp ascorbic acid, 14.32 moisture and dry weight ratio, 9.18 °brix TSS and 1.68 % titrable acidity.

Keywords: Flowering, Growth, Hydroponics, Macro nutrients, Nutrient Film Technique, Quality.

1. INTRODUCTION

The strawberry (*Fragaria ananassa* Duch.), belongs to the Rosaceae family and Fragaria genus. This plant is essentially a small herbaceous perennial **(Ganhão*et al.*, 2019).** The strawberry plant is a result of crossbreeding between two distinct species, *Fragaria chiloensis* Duch. and *Fragaria virginiana* Duch. The octoploid organism possesses eight sets of chromosomes, denoted as 2n = 56.**(Bowling, 2000)**.

In the last two decades, there has been a notable increase in strawberry production and the area dedicated to cultivating them. The significant increase in agricultural production can be credited to the extensive implementation of greenhouse farming techniques, as highlighted by **Thakur and Shylla (2018).**Based on a recent study, China has established itself as the leading global producer of strawberries, boasting an impressive output of around 3.7 million metric tonnes (MT) **(Anonymous, 2019a).** India boasts an impressive cultivation area of 3000 hectares dedicated to this crop, yielding a substantial annual production of 14,000 MT **(NHB, 2021).** Based on the data provided by **Anonymous (2019b),** Haryana has emerged as the leading producer with an impressive 1,650 MT, while Mizoram is not far behind with 1,080 MT. The thriving strawberry production in Uttar Pradesh can be attributed to the favorable agroclimatic conditions, which greatly enhance its potential profitability as a crop.

In addition to vitamin C, it also offers a decent amount of vitamin A (60 IU/100 g of edible portion). According to a study conducted by **Wange and Kzlogoz (1998),** the high pectin content (0.55%) in the form of calcium pectate makes it an ideal ingredient for producing jelly. Strawberries have gained popularity as a nutritious and flavorful fruit enjoyed by millions worldwide **(Sharma and Singh, 1999).** Strawberries are known for their rich content of bioactive compounds, including anthocyanins, carotenoids, vitamins, flavonoids, and phenolics. These compounds have been found to possess strong antioxidant properties, as highlighted in a study by **Giampieri*et al.* (2017).**

Hydroponics is a method used to cultivate plants in nutrient-rich aqueous solutions, either with or without supporting materials **(Kumar and Ahad, 2012).** In recent years, there has been a significant increase in the production of hydroponically grown crops, with an impressive coverage of over 35000 ha **(Hickman 2011).** Various hydroponic systems are commonly implemented in greenhouse production. There are primarily two types of hydroponic systems: open systems and closed systems. Within open systems, the absence of reuse measures for the nutrient solution results in the solution flowing through the roots of the plants and subsequently leaching into the ground. This not only leads to pollution but also results in the wastage of fertilizer, as noted by **Jensen (2013).** When a nutrient solution is continuously circulated within a system, it is referred to as a closed system. This approach, as highlighted by **Nederhoff and Stanghellini (2010),** helps to minimize environmental pollution and cultivation costs, as noted by **Bugbee (2004).** The Nutrient Film Technique (NFT) is a modified circulating system that has been shown to reduce nutrient solution consumption when compared to other hydroponic system modifications **(Lennardand Ward, 2019).** When applying this method, it is crucial to consider the presence of excess water, as it can lead to a decrease in oxygen levels. The NFT system's nutrient layer is carefully designed to provide the optimal amounts of nutritional water and oxygen. Commercially available hydroponic fertilizers come in a variety of options, which are tailored to specific crops and the type of system being used. Reducing the use of fertilizers is a crucial goal in sustainable production, as certain horticultural crops, such as strawberries, require less fertilizer **(Tanan*et al*., 2019).** Cultivators can effectively manage the growth and yield of the crop by carefully managing the concentrations of individual nutrients **(Halbert-Howard*et al*., 2021).**

Hence, this experiment titled "**Production of strawberry (*Fragaria* × *ananassa*) Cultivars in Nutrient Flim Technique (NFT) System of Hydroponics**" was meticulously planned and executed, taking into consideration the aforementioned facts.

2. MATERIALS AND METHODS

The experiment took place at the Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology, and Science (SHUATS), Prayagraj, during the year 2023-24. The experimental site is situated on the left side of the Allahabad-Rewa Road, near the Yamuna River, about 8 kilometers away from Allahabad city. The experiment is situated at a latitude of 25.57°N and a longitude of 81.51°E. In the winter months, particularly in December and January, the temperature can drop to as low as 2°C-5°C or even lower. However, during the summer months (May-June), temperatures can reach an extremely high 49°C.During the summer months, there is often a significant increase in temperature, resulting in intense heat waves. Conversely, in the winter, there can be sporadic occurrences of frost. The annual precipitation typically ranges from 850 to 1100 mm, with the majority of rainfall occurring during the months of July to September.

A hydroponic system utilised the nutrient film method (NFT), incorporating a framework made from durable PVC pipes. For a particular setup, a pair of tyres were used to hold four

PVC pipes, each measuring 4 feet in length. Iron angles were used to secure the pipes in place. Additionally, 20 net pot holes, each measuring 4 inches in size, were carefully cut into the pipes. The perforations were utilised to accommodate the hydroponic net pots. The nutrient solution in the hydroponic unit was recirculated by a circulatory pump situated in the nutrient reservoir tank. A hydroponic system was established in an environment that promotes optimal natural growth.Inhydroponic,water-solublefertilizerwasusedtosupplythe micro-nutrienttoplants.Macronutrients like NPK were supplied according to the treatment combination as shown in list 1.

List 1. Treatment combination

Treatment Symbol	Amount of nutrients (N P & K) given at different days interval				Total Nutrient Used (ml)
	30 DAS (ml)	60 DAS (ml)	90 DAS (ml)	120 DAS (ml)	
T_1	0.5	0.6	1	1.3	3.4
T_2	1	1.2	2	2.6	6.8
T_3	1.5	2	3	4	10.5
T_4	2	3	4	5	14
T_5	2.5	4	5	6	17.5
T_6	3	4.5	6.5	7	21
T_7	3.5	5	7	8	23.5
T_8	4	6	8	9	27

A rectangular tank with a capacity of 100 litres (0.59m x 0.58m x 0.34m) was utilised to supply the nutrient solution to the plants in each treatment throughout the cycle. A 30-micron poly-film was used to cover the tank in order to prevent the formation of algae. Following each cycle, the nutrient solution tank underwent a thorough cleaning using fresh water.The experiment employed a Completely Randomised Design with three replications for each of the eight treatment combinations **(Fisher and Yates, 1953).**

3. RESULTS AND DISCUSSION

GROWTH ATTRIBUTES

Plant height (cm): Based on the data presented in Table 1, it was observed that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum plant height (cm) i.e., [10.28 (30 DAT), 16.15 (60 DAT), 18.44 (90 DAT), 19.42 (120 DAT)] cmwhereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowestplant height (cm) i.e.,[6.21 (30 DAT), 11.19 (60 DAT), 13.21 (90 DAT), 15.37 (120 DAT)] cm.

Plant spread (cm):The plant spread (cm) data is presented in Table 1. It was observed that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum plant spread (cm) i.e., [17.45 (30 DAT), 23.69 (60 DAT), 24.36 (90 DAT), 25.48 (120 DAT)] cmwhereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowestplant spread (cm) i.e.,[12.54 (30 DAT), 20.12 (60 DAT), 21.08 (90 DAT), 23.09 (120 DAT)] cm.

Number of leaves per plant: The data regarding the number of leaves per plant (Table 2) indicates that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum number of leaves per plant i.e., [17.45 (30 DAT), 23.69 (60 DAT), 24.36 (90 DAT), 25.48 (120 DAT)]whereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowestnumber of leaves per plant i.e.,[12.54 (30 DAT), 20.12 (60 DAT), 21.08 (90 DAT), 23.09 (120 DAT)].

Leaf area (cm^2): Based on the data presented in Table 2, it was observed that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum Leaf area (cm^2) i.e., [4.67 (30 DAT), 7.89 (60 DAT), 11.45 (90 DAT), 12.91 (120 DAT)] cm^2whereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowestLeaf area (cm^2) i.e.,[2.43 (30 DAT), 5.58 (60 DAT), 9.12 (90 DAT), 10.25 (120 DAT)] cm^2.

Root length (cm): According to data (Table 3), it was observed that the treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum root length (cm) i.e., 28.91 cmwhereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowestroot length (cm) i.e.,25.47 cm.

FLOWERING ATTRIBUTES

Total number of flowers per plant: The total number of flowers per plant data is presented in Table 3. It was observed that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum total number of flowers per plant i.e., 45.24whereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowesttotal number of flowers per plant i.e.,32.08.

Days taken to first flowering: The data regarding days taken to first flowering (Table 3) indicates that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the minimumdays taken to first flowering i.e., 55.64 dayswhereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with maximumdays taken to first flowering i.e.,73.98 days.

Days taken to first fruit set:Data depicting the days taken to first fruit set is shown in Table 3, where it was found that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the minimumdays taken to first fruit set i.e., 81.64 dayswhereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with maximumdays taken to first fruit set i.e.,119.69 days.

YIELD ATTRIBUTES

Number of fruits per plant: Based on the data presented in Table 4, it was observed that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum number of fruits per plant i.e., 18.45whereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowestnumber of fruits per plant i.e.,11.01.

Average fruit weight (g): The average fruit weight (g) data is presented in Table 4. It was observed that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum average fruit weight (g) i.e., 50.47 gwhereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowestaverage fruit weight (g) i.e.,41.98 g.

Yield per setup (kg):The data regarding the yield per setup (kg) (Table 4) indicates that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum yield per setup (kg) i.e., 18.63 kgwhereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowestyield per setup (kg) i.e.,9.25 kg.

QUALITY ATTRIBUTES

Ascorbic acid (mg/100g of pulp): Based on the data presented in Table 5, it was observed that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum Ascorbic acid (mg/100g of pulp) i.e., 73.61 mg/100 g of pulpwhereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowestnumber of fruits per plant i.e.,11.01.

Moisture and dry weight (ratio): Pertaining to the results presented in Table 5, it was observed that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the minimumMoisture and dry weight (ratio) i.e., 14.32whereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with highest Moisture and dry weight (ratio) i.e.,19.22.

TSS (°Brix):The TSS (°Brix) data is presented in Table 5. It was observed that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum TSS (°Brix) i.e., 9.18 °Brixwhereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowestTSS (°Brix) i.e.,6.01 °Brix.

Titrable acidity (%): The data regarding the titrable acidity (%) (Table 5) indicates that treatment T_7:23.5 ml NPK [3.5 (30 DAS)+5 (60 DAS)+7 (90 DAS)+8 (120 DAS)] mlrecorded the maximum titrable acidity (%) i.e., 1.68 %whereas effect of treatmentT_1**:** 3.4 ml NPK [0.5 (30 DAS)+0.6 (60 DAS)+1 (90 DAS)+1.3 (120 DAS)] ml was found significantly the least effective with lowesttitrable acidity (%) i.e.,1.19 %.

DISCUSSION: Different treatments had significant impacts on the growth, flowering, yield, and quality attributes of strawberry (*Fragaria x ananassa* L.).

Increase in plant height (cm) and plant spread (cm) of strawberry due to application of treatment T_7:23.5 ml NPK [3.5 (30 DAS) +5 (60 DAS) +7 (90 DAS) +8 (120 DAS)] ml can be attributed to the interactive effect of Nitrogen, Phosphorous, and Potassium on the plant. Nitrogen is essential for the synthesis of proteins, nucleic acids, nucleotides, and chlorophyll **(Murniati*et al.*, 2022).**Phosphorus is a crucial element that performs vital functions in assimilation and respiration processes, as highlighted by **Khan *et al.* (2023).** Potassium is essential for the activation of enzymes that are crucial for important biological processes such as photosynthesis, respiration, protein synthesis, and starch production **(Wang *et al.,* 2013).** Notable contributions include the reports by **Ahmed*et al.* (2002).**

Treatment T_7:23.5 ml NPK [3.5 (30 DAS) +5 (60 DAS) +7 (90 DAS) +8 (120 DAS)] mlalso recorded the maximum number of leaves per plant and leaf area (cm^2). The rise in the number of leaves and leaf area can be primarily attributed to the increased availability of

Nitrogen to the plants. Improved nitrogen availability contributes to the overall improvement of plant physiology. This is achieved by increasing the production of phytohormones, proteins, photosynthetic enzymes, and essential compounds. As a result, there is an increase in cell division and differentiation, leading to the production of more leaves per plant **(Umami *et al.*, 2019).**

Higher levels of NPK and their combined doses in treatment T_7:23.5 ml NPK [3.5 (30 DAS) +5 (60 DAS) +7 (90 DAS) +8 (120 DAS)] ml have increased the root length significantly. This finding is consistent with a previous study by **Narayanan (2006),** which demonstrated that the root length was positively influenced by higher levels of NPK and their combined doses.Similar results were also reported by **Noh *et al*. (2017)** and **Tohidloo*et al*. (2018).**

Treatment T_7:23.5 ml NPK [3.5 (30 DAS) +5 (60 DAS) +7 (90 DAS) +8 (120 DAS)] mlalso recorded highest total number of flowers and fruits per plant in strawberry plants. It is possible that this phenomenon occurred because there was a steady supply of nutrients at the ideal pH level, leading to a higher buildup of starch, carbohydrates, and photosynthates. As a result, there is an increase in the number of blooms per plant and a faster rate of fruit development, resulting in a higher yield of fruits per plant.

The decrease in the number of days to first flowering and fruit set observed in treatment T_7 may be explained by the improved plant height, leaf number, and leaf area per plant resulting from the application of fertiliser N and P in the nutrient solution. These nutrients provide the necessary elements for the plant's biological and physiological processes, such as carbon assimilation. This, in turn, supports the synthesis of essential nucleic acids DNA and RNA during cell division and tissue growth, contributing to the overall development of the plant.**(Patil *et al.*, 2016)**.

Due to optimum availability of Phosphorous and Potassium to plant in treatment T_7:23.5 ml NPK [3.5 (30 DAS) +5 (60 DAS) +7 (90 DAS) +8 (120 DAS)] ml, there might have efficient production of phytohormones and enzymes in plant **(Singh *et al.*, 2011)**. Due to the abundant supply of plant nutrients, the plant tends to prioritise reproductive growth early on. As a result, the number of fruits per plant also sees a significant increase, as noted by **Sharma *et al.* (2018)**.

According to **Tanan *et al.* (2019),** the increase in titrable acidity, TSS, and ascorbic acid could be attributed to the higher nitrogen application, which leads to an improved Nitrogen: Carbon balance in the plant.

Table 1:Effect of various treatments on Plant height (cm) and Plant spread (cm) of strawberry (*Fragaria* × *ananassa*) in Nutrient Flim Technique (NFT) System of Hydroponics cv. Winter Dawn

Treatment Symbol	Plant Height (cm)				Plant Spread (cm)			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
T_1	6.21	11.19	13.21	15.37	12.54	20.12	21.08	23.09
T_2	6.64	11.64	14.22	16.24	13.11	20.45	21.75	23.44
T_3	7.24	12.08	15.41	16.97	13.89	20.98	22.38	23.79
T_4	8.19	13.11	15.98	17.39	14.88	21.85	22.69	24.26
T_5	8.64	14.01	16.54	17.82	15.45	22.24	23	24.48
T_6	10.02	15.72	17.98	19.08	17.11	23.44	24.08	25.28
T_7	10.28	16.15	18.44	19.42	17.45	23.69	24.36	25.48
T_8	9.85	15.18	17.25	18.41	16.94	23.29	23.72	24.87
F-test	S	S	S	S	S	S	S	S
S.E. (m) (±)	0.17	0.22	0.21	0.16	0.21	0.15	0.13	0.09
C.D. @ 5%	0.5	0.66	0.64	0.48	0.64	0.45	0.4	0.28
CV	3.46	2.79	2.29	1.59	2.44	1.18	1.01	0.66

Table 2:Effect of various treatments on Number of leaves per plantand Leaf area (cm^2)of strawberry (*Fragaria* × *ananassa*) in Nutrient Flim Technique (NFT) System of Hydroponics cv. Winter Dawn

Treatment Symbol	Number of leaves per plant				Leaf area (cm^2)			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
T_1	12.54	20.12	21.08	23.09	2.43	5.58	9.12	10.25
T_2	13.11	20.45	21.75	23.44	2.65	5.79	9.38	10.83
T_3	13.89	20.98	22.38	23.79	3.02	6.28	9.71	11.25
T_4	14.88	21.85	22.69	24.26	3.48	6.84	10.15	11.65
T_5	15.45	22.24	23	24.48	3.67	7.11	10.38	11.79
T_6	17.11	23.44	24.08	25.28	4.59	7.76	11.21	12.72
T_7	17.45	23.69	24.36	25.48	4.67	7.89	11.45	12.91
T_8	16.94	23.29	23.72	24.87	4.46	7.61	10.81	12.24
F-test	S	S	S	S	S	S	S	S
S.E. (m) (±)	0.21	0.31	0.36	0.38	0.09	0.12	0.12	0.09
C.D. @ 5%	0.64	0.93	1.09	1.13	0.28	0.36	0.36	0.26
CV	3.91	3.42	3	2.95	4.42	3.06	2.04	1.28

Table 3:Effect of various treatments on Root length (cm), Total number of flowers per plant, Days taken to first flowering and Days taken to first fruit setof strawberry

(*Fragaria* × *ananassa*) in Nutrient Flim Technique (NFT) System of Hydroponics cv. Winter Dawn

Treatment Symbol	Root length (cm)	Total number of flowers per plant	Days taken to first flowering	Days taken to first fruit set
T_1	25.47	32.08	73.98	119.69
T_2	26.11	34.53	71.19	113.67
T_3	26.69	35.91	69.56	110.28
T_4	27.05	38.43	66	103.57
T_5	27.39	39.87	64.01	99.98
T_6	28.58	44.12	57.21	88.23
T_7	28.91	45.24	55.64	81.64
T_8	27.92	42.01	60.87	94.09
F-test	**S**	**S**	**S**	**S**
S.E. (m) (±)	0.15	0.54	0.74	1.51
C.D. @ 5%	0.45	1.63	2.22	4.53
CV	0.95	2.41	1.98	2.58

Table 4:Effect of various treatments on Number of fruits per plant, Average fruit weight (g) and Yield per setup (kg)of strawberry (*Fragaria* × *ananassa*) in Nutrient Flim Technique (NFT) System of Hydroponics cv. Winter Dawn

Treatment Symbol	Total number of fruits per plant	Average fruit weight (g)	Yield per setup (kg)
T_1	11.01	41.98	9.25
T_2	12.18	43.71	10.65
T_3	13.62	44.27	12.06
T_4	14.35	45.98	13.2
T_5	15.01	46.76	14.04
T_6	17.84	49.88	17.8
T_7	18.45	50.47	18.63
T_8	16.23	48.12	15.62
F-test	**S**	**S**	**S**
S.E. (m) (±)	0.28	0.34	0.37
C.D. @ 5%	0.85	1.02	1.09
CV	3.3	1.27	4.55

Table 5: Effect of various treatments on Ascorbic acid (mg/100g of pulp), Moisture and dry weight (ratio), TSS (°Brix) and Titrable acidity (%) of strawberry (*Fragaria* × *ananassa*) in Nutrient Flim Technique (NFT) System of Hydroponics cv. Winter Dawn

Treatment Symbol	Ascorbic acid (mg/100g of pulp)	Moisture and dry weight (ratio)	TSS (°Brix)	Titrable acidity (%)
T_1	43.08	19.22	6.01	1.19
T_2	48.87	18.28	6.47	1.29
T_3	51.66	17.75	6.94	1.32
T_4	57.45	16.92	7.35	1.41
T_5	60.24	16.41	7.91	1.44
T_6	70.82	14.85	8.93	1.65
T_7	73.61	14.32	9.18	1.68
T_8	65.03	15.68	8.38	1.52
F-test	**S**	**S**	**S**	**S**
S.E. (m) (±)	1.22	0.21	0.12	0.01
C.D. @ 5%	3.65	0.62	0.35	0.04
CV	3.59	2.16	2.62	1.75

CONCLUSION

According to the results found in the current study, it can be interpreted that plants grown utilising the hydroponic system with liquid N, P and K maximise yield in addition to displaying the highest growth, quality, and yield-contributing characteristics. Based on the findings of the above experiment, it can be interpreted that Treatment T_7:23.5 ml NPK [3.5 (30 DAS) +5 (60 DAS) +7 (90 DAS) +8 (120 DAS)] ml produced the greatest results. It was determined to have the greatest growth traits for every growth, blooming, yield, and quality criteria.

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