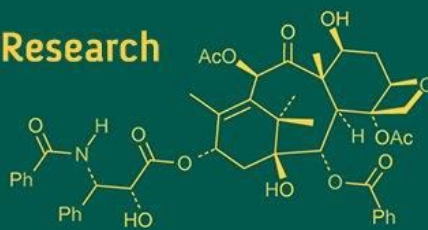


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating: 5.29
IJABR 2025; 9(4): 367-371
www.biochemjournal.com
Received: 02-02-2025
Accepted: 08-03-2025

Latesh Kumar
Department of Horticulture,
College of Agriculture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

BP Bisen
Department of Horticulture,
College of Agriculture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Amul Yadav
Department of Horticulture,
College of Agriculture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Anil Chouhan
Department of Horticulture,
College of Agriculture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Corresponding Author:
BP Bisen
Department of Horticulture,
College of Agriculture,
Jawaharlal Nehru Krishi
Vishwa Vidyalaya, Jabalpur,
Madhya Pradesh, India

Influence of nutrient application on growth and yield of strawberry (*Fragaria × ananassa* Duch.) cv. Camarosa in Kymore Plateau

Latesh Kumar, BP Bisen, Amul Yadav and Anil Chouhan

DOI: <https://www.doi.org/10.33545/26174693.2025.v9.i4e.4121>

Abstract

An investigation was carried out to assess the influence of nutrient application on growth and yield of strawberry (*Fragaria × ananassa* Duch.) cv. Camarosa in Kymore Plateau. The experiment was laid out in Randomized Block Design with eleven treatments and three replications. Growth Parameters such as maximum plant height (18 cm), plant spread, number of trifoliate leaves (35.95), leaf length (11.60 cm), leaf width (13.97), and leaf area (113.27 cm²) were observed best in treatment with NPK 50% (Soil application) + 1st, 2nd and 3rd Spray of 19:19:19 at 45, 60 and 75 DAT (T₂). Treatment with 100% RDF-Soil application (NPK-80:40:40 kg/ha) recorded minimum days to first flower initiation (43.51). Minimum days to 50 % flowering (62.00) was recorded with treatment NPK 50% (Soil application) + 1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT, 3rd Spray of 0:0:50 at 75 DAT (T₄). Maximum flowers per plant (45), fruits per plant (32.94), fruit length (22.40 mm), fruit diameter (18.40 mm), fruit volume (28.33 ml), fruit weight (21.33 g), fruit yield per plant (305.27g), yield per hectare (169.59 q) and B:C ratio (3.02) was recorded with treatment NPK 50% (Soil application) + 1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT, 3rd Spray of 13:0:45 at 75 DAT (T₅).

Keywords: Strawberry, *Fragaria*, NPK, 19:19:19, ammonium phosphate, potassium nitrate

Introduction

Strawberry is a highly valued, soft fruit and major global cash crop. It is an herbaceous perennial plant with a shallow root system belonging to the Rosaceae family (Yadav *et al*, 2010) [18]. While strawberries are predominantly grown in temperate zones, day-neutral cultivars have made it possible to cultivate them in subtropical and tropical climates as well. Optimal growth requires a day temperature of around 24 °C and a night temperature below 10 °C. During blossom development, strawberries need a photoperiod of 8 to 12 hours for approximately 10 days (Samad *et al*, 2021) [14]. The fruit is notably soft, small, and highly perishable, with a remarkable 98% of the fruit being edible. It is consumed fresh and are also utilized in the production of jams, squashes, ice cream, syrups, ready-to-serve products, cosmetics, and confectionery (Sharma and Sharma, 2003) [17]. In India, the total area and production of strawberry were 2420 hectares and 18870 MT, respectively (Anonymous, 2022-23) [4].

Nutritional status is crucial for the growth, yield, and quality of strawberries, which are highly sensitive to nutrient balance (Maurya *et al*. 2017) [11]. Macronutrients like nitrogen, phosphorus and potassium are essential for plant growth and development, significantly impacting various physiological and morphological processes (Ali *et al*, 2023) [3]. Fertilizer plays an important role in maintaining soil fertility as well as proper nutrient management, enhancing nutrient response efficiency, maintaining an ideal C: N ratio and maximizing crop productivity to the desired quality. (Barooah and Datta, 2020) [6]. There is increasing interest in using water-soluble fertilizers for foliar feeding to boost nutrient absorption, reduce pollution, and increase utilization. Foliar application can be up to 20 times more effective than soil application (Lodhi, 2022) [10].

Nitrogen is essential for cell division, photosynthesis, and nutrient absorption, and promotes vegetative growth, yield, and fruit firmness (Bai *et al*, 2023) [5]. Phosphorus is vital for cell formation, photosynthesis, and energy storage, and supports root development, stem

elongation, flower production, and fruit size (Ahmad *et al.*, 2017) ^[1]. Potassium is crucial for protein and sugar production, phenolic content, antioxidant capacity, and disease resistance. It enhances growth, yield, and quality of strawberry fruits (Maurya *et al.*, 2017) ^[11]. These macronutrients play critical roles in strawberry development, and their deficiency can impact yield and quality. This study aims to optimize NPK fertilizers and assess their impact on different growth stages to increase the yield of strawberry cv “Camarosa” while reducing costs.

Materials and Methods

The experiment was conducted at the new nursery, Jawaharlal Nehru Krishi Vishwavidyalaya, Adhartal, Jabalpur during winter season of 2023-24 with a view to evaluating the influence of nutrient application on growth and yield of strawberry (*Fragaria × ananassa* Duch.) cv Camarosa in Kymore Plateau. The experiment was laid out in a randomized block design with eleven treatments and three replications. The treatments details were: T₁ (Control) [100% RDF-Soil application (NPK-80:40:40 kg/ha)], T₂ [NPK 50% (Soil application) + 1st, 2nd and 3rd Spray of 19:19:19 at 45, 60 and 75 DAT], T₃ [NPK 50% (Soil application) + 1st and 2nd Spray of 19:19:19 at 45 and 60 DAT, 3rd Spray of 0:0:50 at 75 DAT], T₄ [NPK 50% (Soil application) + 1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT and 3rd Spray of 0:0:50 at 75 DAT], T₅ [NPK 50% (Soil application) + 1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT and 3rd Spray of 13:0:45 at 75 DAT], T₆ [NPK 50% (Soil application) + 1st and 2nd Spray of 19:19:19 at 45 and 60 DAT, 3rd Spray of 13:0:45 at 75 DAT], T₇ (1st, 2nd and 3rd Spray of 19:19:19 at 45, 60 and 75 DAT), T₈ (1st and 2nd Spray of 19:19:19 at 45 and 60 DAT, 3rd Spray of 0:0:50 at 75 DAT), T₉ [1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT and 3rd Spray of 0:0:50 at 75 DAT], T₁₀ [1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT and 3rd Spray of 13:0:45 at 75 DAT] and T₁₁ [1st and 2nd Spray of 19:19:19 at 45 and 60 DAT, 3rd Spray of 13:0:45 at 75 DAT]. Tissue cultured plants were transplanted into each hole of polythene mulch at a 60 cm × 30 cm distance. Fertilizers were applied in the field through soil (RDF-NPK @80:40:40 kg/ha) and foliar applications as per the combination of treatments. All water-soluble fertilizers were applied at the rate of 0.5% in three intervals for all treatments. The observations with regards to the growth and yield was recorded from the randomly selected tagged plants and analysed using the OPSTAT statistical package.

Result and Discussion

Soil application of RDF at transplanting time and foliar sprays of NPK resulted in significant increase in growth and yield of strawberry under different treatments (Table 1). Maximum plant height (18 cm) and trifoliate leaves per plant (35.93), plant spread (33.63 cm east-west and 32.69 cm north-south direction), leaf length (11.60 cm), leaf width (13.97 cm) and leaf area (113.27 cm²) was recorded in T₂ [NPK 50% (Soil application) + 1st, 2nd & 3rd Spray of 19:19:19 at 45, 60 & 75 DAT] at 75 DAT. Foliar spray of the nutrient especially nitrogen showed increased vegetative growth of the plant system due to the acceleration of many physiological and metabolic processes including synthesis of proteins, nucleic acids, coenzymes, secondary metabolic products, enzyme activation, osmotic regulation, respiration

and photosynthesis. These results are in confirmation with the findings of Sampada (2018) ^[15], Santos and Chandler (2009) ^[16] and Dixit *et al.* (2023) ^[8].

Application of RDF and foliar sprays of NPK showed significant differences in flowering, and fruit growth and development (Table 2). The minimum days to first flower initiation (43.51) was recorded in T₁ [Control 100% RDF-Soil application (NPK-80:40:40 kg/ha)]. The reason for the earlier flowering of plants treated with 100% RDF in the soil could be attributed to the positive impact of phosphorous on early flower development. It boosts growth of reproductive organs, encourages flowering and fruit production. The current results aligned with Gill *et al.* (1974) ^[9]. Minimum days to 50 % flowering (62.00) was recorded in T₄ [NPK 50% (Soil application) + 1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT, 3rd Spray of 0:0:50 at 75 DAT]. The decreased time to reach 50% flowering could be attributed to the efficient use of NPK water soluble fertilizers, which contain increased amount of phosphorus which works to decrease flowering time by spraying on the leaves, thereby promoting robust plant growth and faster formation of flower buds. Similar findings were also reported by Sampada (2018) ^[15] and Narayan *et al.*, (2012) ^[12]. Foliar application of phosphorus, especially during flowering stage, increased the number of flowers per plant. Treatment T₅ [NPK 50% (Soil application) + 1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT, 3rd Spray of 13:0:45 at 75 DAT] recorded maximum number of flowers (45.00). This could be a result of improved cytokinin synthesis from optimal levels of nitrogen and phosphorus, leading to an increased number of flowers. These findings are in conformity with results of Premsekhar and Rajashree, 2009 ^[13]. The highest (32.94) fruits per plant of was recorded in the treatment T₅ that received NPK 50% (Soil application) + 1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT, 3rd Spray of 13:0:45 at 75 DAT. An increased supply of NPK nutrients throughout crucial stages of growth might be the cause of the increase in fruits per plant. A higher amount of N and P at the optimal cytokinin synthesis level might have produced a more favourable sink to produce more fruitful blooms, which in turn might have contributed to the production of more fruit per plant. These findings are conformity with results of Ahmad *et al.*, (2017) ^[1] and Ali *et al.*, (2023) ^[3] Premsekhar and Rajashree (2009) ^[13], Dixit *et al.*, (2023) ^[8]. The maximum fruit length (22.40 mm), fruit diameter (18.40 mm), fruit weight (21.33 g) and fruit volume (28.33 ml) was recorded in T₅ [NPK 50% (Soil application) + 1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT, 3rd Spray of 13:0:45 at 75 DAT]. There is a higher demand for K as the plant grows, therefore, by supplying enough foliar application of K to the strawberry plants, water efficiency is enhanced through increased osmotic pressure in cells, resulting in greater turgidity and increase fruits in terms of length, diameter, volume, and weight. Results are in collaboration with Ali *et al.*, (2023) ^[3], Dixit *et al.*, (2023) ^[8] and Maurya *et al.*, (2017) ^[11].

The influence of nutrient application showed significant effects on yield attributes (Table 3). Treatment T₅, which received NPK 50% (Soil application) + 1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT, 3rd Spray of 13:0:45 at 75 DAT recorded maximum fruit yield per plant (305.27 g) and fruit yield per hectare (169.59 q). It was also concluded that 50% RDF application in soil and

foliar application of water-soluble fertilizers increased the fruit yield per hectare. It is possible that this is a result of an enhanced absorption of nutrients and improved efficiency of photosynthesis, leading to the accumulation of food in the edible portions. Similar findings were reported by Maurya *et al*, (2017) ^[11], Narayan *et al*, (2012) ^[12] and Dixit *et al*, (2023) ^[8]. The influence of nutrient application showed significant effects on economics of cultivation (Table 3). Treatment T₅ [NPK 50% (Soil application) + 1st Spray of 19:19:19 at 45 DAT, 2nd Spray of 0:52:34 at 60 DAT, 3rd Spray of 13:0:45 at 75 DAT] produced the highest gross return (33,91,817.93 ₹/ha), net return (27,58,527.89 ₹/ha)

and B:C ratio (4.36). The application of NPK foliar spray enhances the utilization of nutrients by plants, reducing nutrient losses caused by leaching and volatilization. As a result, the yield and quality of fruits improves (Narayan *et al*, 2012) ^[12]. It was also concluded that 50% RDF application in soil and foliar application of water-soluble fertilizers increased the fruit yield per hectare, which in turn led to higher gross returns and net return as well as a higher benefit to cost ratio. Similar findings were also reported by Chaurasia *et al*, (2005) ^[7], Dixit *et al*, (2023) ^[8], Ajeet *et al*, (2023) ^[2], Premsekhar and Rajashree, (2009) ^[13] and Kumar *et al*, (2017) ^[11].

Table 1: Influence of nutrient application on growth parameter of strawberry

Treatments	Plant height (cm)	Trifoliolate leaves per plant	Plant spread (E-W)	Plant spread (N-S)	Leaf length (cm)	Leaf width (cm)	Leaf area (cm ²)
T ₁ : (Control) [100% RDF-Soil application (NPK-80:40:40 kg/ha)]	15.21	29	27.97	28.49	10.27	12.27	98.17
T ₂ : NPK 50% (Soil application) + 1 st , 2 nd and 3 rd Spray of 19:19:19 at 45, 60 and 75 DAT	18	35.93	33.63	32.96	11.6	13.97	113.27
T ₃ : NPK 50% (Soil application) + 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 0:0:50 at 75 DAT	16.51	34	32.63	32.13	11.1	13.37	109
T ₄ : NPK 50% (Soil application) + 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 0:0:50 at 75 DAT	16.09	33.5	31.04	31.06	10.8	13.03	106
T ₅ : NPK 50% (Soil application) + 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 13:0:45 at 75 DAT	16.17	33.67	31.17	31.97	10.93	13.23	106.67
T ₆ : NPK 50% (Soil application) + 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 13:0:45 at 75 DAT	17.26	35.53	33.01	32.48	10.73	13.57	109.43
T ₇ : 1 st , 2 nd and 3 rd Spray of 19:19:19 at 45, 60 and 75 DAT	16.09	31.77	30.05	29.64	9.73	13.2	101.1
T ₈ : 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 0:0:50 at 75 DAT	15.65	30.07	29.01	27.97	9.6	12.67	100.21
T ₉ : 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 0:0:50 at 75 DAT	15.38	29.67	28.31	28.02	9.27	12.5	99.8
T ₁₀ : 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 13:0:45 at 75 DAT	15.29	29.93	28.15	28.89	9.47	12.67	100.17
T ₁₁ : 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 13:0:45 at 75 DAT	15.88	31.93	29.97	29.37	9.73	12.33	98.9
SEm (±)	0.55	1.31	1.28	1.07	0.47	0.35	3.35
C.D. @ 5%	1.62	3.87	3.78	3.18	1.39	1.03	9.89

Table 2: Influence of nutrient application on flowering and fruit development

Treatment	Days to first Flowering	Days to 50% Flowering	Flower per Plant	Fruit per Plant	Fruit length (mm)	Fruit Diameter (mm)	Fruit volume (ml)	Fruit weight (g)
T ₁ : (Control) [100% RDF-Soil application (NPK-80:40:40 kg/ha)]	43.51	69.66	34.67	24.55	18.87	17.13	21.00	17.73
T ₂ : NPK 50% (Soil application) + 1 st , 2 nd and 3 rd Spray of 19:19:19 at 45, 60 and 75 DAT	45.95	67.11	42.27	29.97	21.53	17.30	21.33	19.00
T ₃ : NPK 50% (Soil application) + 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 0:0:50 at 75 DAT	49.53	67.55	41.50	29.50	21.63	17.10	22.33	18.83
T ₄ : NPK 50% (Soil application) + 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 0:0:50 at 75 DAT	53.52	62.00	43.83	32.11	22.17	17.47	25.67	19.33
T ₅ : NPK 50% (Soil application) + 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 13:0:45 at 75 DAT	52.02	64.33	45.00	32.94	22.40	18.40	28.33	21.33
T ₆ : NPK 50% (Soil application) + 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 13:0:45 at 75 DAT	55.33	68.28	41.49	28.22	21.37	17.47	23.00	20.50
T ₇ : 1 st , 2 nd and 3 rd Spray of 19:19:19 at 45, 60 and 75 DAT	56.49	73.44	39.31	26.61	21.13	16.13	17.33	16.00
T ₈ : 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 0:0:50 at 75 DAT	63.05	78.78	39.11	25.49	20.27	15.67	18.33	16.67
T ₉ : 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 0:0:50 at 75 DAT	57.61	71.00	41.00	27.61	21.03	17.17	20.00	18.50
T ₁₀ : 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 13:0:45 at 75 DAT	55.44	73.33	39.33	27.61	21.20	16.20	21.00	16.67
T ₁₁ : 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 13:0:45 at 75 DAT	58.35	75.11	34.33	23.82	16.80	15.07	17.33	15.00
SEm (±)	3.60	2.84	2.05	1.83	0.78	0.59	1.32	1.12
C.D. @ 5%	10.63	8.38	6.07	5.40	2.32	1.75	3.90	3.30

Table 3: Influence of nutrient application on yield and economics

Treatments	Fruit yield (g/plant)	Fruit yield (q/ha)	Gross return (₹/ha)	Net Return (₹/ha)	B:C Ratio
T ₁ : (Control) [100% RDF-Soil application (NPK-80:40:40 kg/ha)]	259.35	144.08	2881637.85	2247680.49	3.55
T ₂ : NPK 50% (Soil application) + 1 st , 2 nd and 3 rd Spray of 19:19:19 at 45, 60 and 75 DAT	296.09	164.49	3289855.99	2656905.95	4.20
T ₃ : NPK 50% (Soil application) + 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 0:0:50 at 75 DAT	285.78	154.88	3097523.91	2464541.37	3.89
T ₄ : NPK 50% (Soil application) + 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 0:0:50 at 75 DAT	303.71	168.73	3374521.81	2741319.27	4.33
T ₅ : NPK 50% (Soil application) + 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 13:0:45 at 75 DAT	305.27	169.59	3391817.93	2758527.89	4.36
T ₆ : NPK 50% (Soil application) + 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 13:0:45 at 75 DAT	259.70	144.28	2885526.70	2252456.66	3.56
T ₇ : 1 st , 2 nd and 3 rd Spray of 19:19:19 at 45, 60 and 75 DAT	230.23	128.09	2561752.16	1931077.16	3.06
T ₈ : 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 0:0:50 at 75 DAT	220.83	122.68	2453642.13	1822934.63	2.89
T ₉ : 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 0:0:50 at 75 DAT	247.87	137.70	2754083.57	2123156.07	3.37
T ₁₀ : 1 st Spray of 19:19:19 at 45 DAT, 2 nd Spray of 0:52:34 at 60 DAT and 3 rd Spray of 13:0:45 at 75 DAT	237.81	132.12	2642306.91	2011291.91	3.19
T ₁₁ : 1 st and 2 nd Spray of 19:19:19 at 45 and 60 DAT, 3 rd Spray of 13:0:45 at 75 DAT	197.10	109.50	2189978.10	1559183.10	2.47
SEm (±)	7.48	5.11	-	-	-
C.D. @ 5%	22.06	15.07	-	-	-

Conclusion

In conclusion, the results of the present investigation showed that the application of NPK fertilizers with soil and foliar application had a significant impact on various aspects of vegetative growth and yield attributes. Among the treatments studied, T₂ [NPK 50% (Soil application) + 1st, 2nd and 3rd Spray of 19:19:19 at 45, 60 and 75 DAT] showed the maximum vegetative growth at 75 DAT. It could be suggested that the NPK 50% (soil application) + 1st spray of 19:19:19 at 45 DAT, 2nd spray of 0:52:34 at 60 DAT and 3rd spray of 13:0:45 at 75 DAT (T₅), significantly improves total yield and benefit-cost ratio.

Acknowledgment

The authors express their gratitude to Department of Horticulture, College of Agriculture, Jabalpur for providing the necessary facilities.

References

- Ahmad H, Sajid M, Hayat S, Ullah R, Ali M, Jamal A, *et al.* Growth, yield, and fruit quality of strawberry (*Fragaria × ananassa* Duch.) under different phosphorus levels. *Research in Agriculture*. 2017;2(2):19-28.
- Ajeet, Trivedi J, Sharma D, Kharsan M, Gupta P, Devi S. Effect of foliar application of water-soluble fertilizers and micronutrients on economics of cultivation of vegetable pea. *The Pharma Innovation Journal*. 2023;12(7):839-841.
- Ali B, Babar M, Fatima RN, Mahmood A, Sher A, Siddique T, *et al.* Effect of different doses of NPK at different time intervals on growth, yield and quality of strawberry CV. Chandler (*Fragaria × ananassa*). *Journal of Survey in Fisheries Sciences*. 2023;10(2S):4095-4108.
- Anonymous. Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare. Area and production of horticulture crops (Final Estimates), 2022-23 [Internet]. Available from: <https://agriwelfare.gov.in/en/StatHortEst>
- Bai X, Liu K, Ning T, Deng C, Wang L, Li D, *et al.* Effects of multiple N, P and K fertilizer combinations on strawberry growth and the microbial community. *PLOS One*. 2023;18(11):e0293088.
- Barooah A, Datta HS. Response of nutrient management on growth, yield, and quality of strawberry: A review. *Journal of Pharmacognosy and Phytochemistry*. 2020;9(5):3222-3228.
- Chaurasia SNS, Singh KP, Rai M. Effect of foliar application of water-soluble fertilizers on growth, yield and quality of tomato (*Lycopersicon esculentum* L.). *Sri Lankan Journal of Agricultural Sciences*. 2005;42:66-70.
- Dixit G, Bisen BP, Prajapati SK, Ukey P, Lodhi R. Performance of nutrient management on morpho-phenological parameters of muskmelon (*Cucumis melo*). *The Pharma Innovation Journal*. 2023;12(10):2016-2020.
- Gill HS, Thakur PC, Thakur TC. Effect of nitrogen and phosphorus application on seed yield of sweet pepper (*Capsicum annuum* L.). *Indian Journal of Horticulture*. 1974;31(1):74-78.
- Lodhi R. Effect of foliar application of nutrient sources on growth, yield & quality of watermelon [M.Sc. thesis]. Jabalpur: JNKVV; 2022. 86 p.
- Maurya JK, Singh JP, Tomar S, Kumar R. Optimization of NPK fertilizers for higher yield and quality of strawberry (*Fragaria × ananassa* Duch.) fruits. *International Journal of Current Microbiology and Applied Science*. 2017;6(9):1534-1538.
- Narayan K, Dubey P, Sharma D, Katre VT, Tiwari SP, Mishra A. Effect of soil and foliar application of nutrients on growth and yield in tomato (*Lycopersicon esculentum* Mill.). *Journal of Horticultural Sciences*. 2012;7(1):101-103.
- Premsekhar M, Rajashree V. Performance of hybrid tomato as influenced by foliar feeding of water-soluble fertilizer. *American-Eurasian Journal of Sustainable Agriculture*. 2009;3(1):33-36.
- Samad S, Butare D, Marttila S, Sonstebj A, Khalil S. Effects of temperature and photoperiod on the flower

- potential in everbearing strawberry as evaluated by meristem dissection. *Horticulturae*. 2021;7(11):484.
15. Sampada CM. Performance of strawberry (*Fragaria × ananassa* Duch.) as influenced by humic acid and water-soluble fertilizers on growth, yield, and quality under naturally ventilated polyhouse [Ph.D. thesis]. Shivamogga: University of Agricultural & Horticultural Sciences; 2018. 80 p.
 16. Santos BM, Chandler CK. Influence of nitrogen fertilization rates on the performance of strawberry cultivars. *International Journal of Fruit Science*. 2009;9(2):126-135.
 17. Sharma VP, Sharma RR. The Strawberry. New Delhi: Indian Council of Agricultural Research; 2003. p. 166.
 18. Yadav SK, Khokhar UU, Yadav RP. Integrated nutrient management for strawberry cultivation. *Indian Journal of Horticulture*. 2010;64(4):445-449.