International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(11): 787-792
www.biochemjournal.com
Received: 05-08-2025
Accepted: 11-09-2025

Navale PK
Division of Soil Science, Dr. Sharadchandra Pawar Collage of Agriculture, Baramati, Pune, Maharashtra, India

Gaikwad RD
Assistant Professor, Division of Soil Science, Dr. Sharadchandra Pawar Collage of Agriculture, Baramati, Pune, Maharashtra, India

Pondkule RG
Assistant Professor, Division of Soil Science, Dr. Sharadchandra Pawar Collage of Agriculture, Baramati, Pune, Maharashtra, India

Tambe BN
Assistant Professor, Division of Soil Science, Dr. Sharadchandra Pawar Collage of Agriculture, Baramati, Pune, Maharashtra, India

Pawar KS
Division of Soil Science, Dr. Sharadchandra Pawar Collage of Agriculture, Baramati, Pune, Maharashtra, India

Shinde PV
Division of Soil Science, Dr. Sharadchandra Pawar Collage of Agriculture, Baramati, Pune, Maharashtra, India

Corresponding Author:
Navale PK
Division of Soil Science, Dr. Sharadchandra Pawar Collage of Agriculture, Baramati, Pune, Maharashtra, India

Impact of graded potassium fertigation on yield and quality of bell pepper

Navale PK, Gaikwad RD, Pondkule RG, Tambe BN, Pawar KS and Shinde PV

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i11Sj.6323

Abstract
The present study, entitled "Impact of graded potassium fertigation on bell pepper yield and quality" was conducted at the Instructional Farm Polyhouse, Dr. Sharadchandra Pawar College of Agriculture, Baramati, Maharashtra, during June to October 2024. The experiment was laid out in a Completely Randomized Design (CRD) with five treatments and four replications. The treatments consisted of: T_1 - Control; T_2 - Recommended dose of fertilizer, T_3 - Recommended dose of nitrogen and phosphorus combined with 125% of the recommended dose of potassium, T_4 - Recommended dose of nitrogen and phosphorus combined with 150% of the recommended dose of potassium and T_5 - Recommended dose of nitrogen and phosphorus combined with 175% of the recommended dose of potassium.
Application of graded levels of potassium fertigation significantly enhanced the yield and quality of bell pepper. Treatment T_5 (recommended dose of nitrogen and phosphorus + 175% of the recommended dose of potassium) produced the highest number of fruits per plant, maximum fruit weight, total fruit yield, along with higher Vitamin C content and increased total soluble solids (TSS). These results indicate that higher potassium fertigation effectively maximizes both productivity and quality of bell pepper grown in red bole soil under polyhouse conditions.

Keywords: Bell pepper, potassium fertigation, yield, fruit quality, vitamin c, total soluble solids, polyhouse

1. Introduction
Bell pepper (*Capsicum annuum* L. var. *grossum* Sendt.), commonly known as sweet pepper or Shimla mirch, is an important Solanaceous vegetable with a chromosome number of 2n = 2x = 24. Native to tropical South America (Shoemaker and Teskey, 1995) [17], it was introduced to India by the British during the 19th century, with initial cultivation reported in the Shimla hills.
Globally and in India, bell pepper is valued for its high nutritional content, distinct flavour and attractive colour, making it the second most economically important vegetable after tomato. Its fruits exhibit remarkable variability in shape (elongated, spherical, triangular, bell-shaped, blocky) and colour (red, yellow, green, white, purple, orange), which largely influence consumer preference and market value (Banerjee *et al*., 2023) [1]. In general, blocky, thick-fleshed fruits with three to four lobes and non-pungent flavour are most preferred. In India, bell pepper is cultivated mainly in West Bengal, Haryana, Karnataka, Jharkhand, Madhya Pradesh, Himachal Pradesh, Maharashtra, Tamil Nadu and Uttarakhand. The total national output during 2023-24 was 5,590.76 thousand metric tonnes, with Uttar Pradesh ranking first (989.20 thousand MT) and Maharashtra ranking seventh (39.27 thousand MT). Within Maharashtra, major producing regions include Dhule, Jalgaon, Pune, Satara, Nagpur, Kolhapur, Solapur, Yavatmal, Aurangabad and Sangli.
Bell pepper thrives under warm, humid tropical to subtropical conditions and grows well in a range of soils, with loamy, well-drained soils rich in organic matter being most suitable. Its non-pungent fruits, known for their distinct aroma and shape, are popularly referred to as "sweet pepper" or "bell pepper" (Mohanty *et al*., 2018) [10]. Potassium is an essential macronutrient that plays a key role in enhancing both yield and quality of vegetable crops (Bidari and Hebsur, 2011) [2]. It is involved in activating enzymes for respiration, photosynthesis, protein synthesis, sugar transport and carbohydrate metabolism.

Potassium also regulates nutrient uptake, stomatal activity, water-use efficiency and cellular ionic balance, thereby ensuring optimal plant growth and reproductive performance (Selim *et al*., 2021) [16].
In bell pepper, potassium nutrition is particularly critical, as it improves yield, fruit size, and nutritional quality. Adequate potassium levels are associated with higher accumulation of health-promoting compounds, greater soluble solids and ascorbic acid content, enhanced fruit coloration, prolonged shelf life and better post-harvest quality. Thus, potassium fertigation plays a vital role in achieving maximum productivity and superior fruit quality in bell pepper cultivation.

2. Materials and Methods

The experiment was carried out at the Instructional Farm Polyhouse, Dr. Sharadchandra Pawar College of Agriculture, Baramati, Pune, from June to October 2024. It was conducted using a Completely Randomized Design (CRD) with five treatments and four replications. The recommended dose of fertilizer (250:150:150 kg N, P_2O_5, K_2O ha^{-1}) was applied through urea, phosphoric acid, sulphate of potash, and potassium schoenite. Healthy seedlings were transplanted on raised beds of 1 m width at a spacing of 90 × 45 cm.

2.1 Treatment details

Table 1: The experimental details of treatment, which were comprised 5 treatments are presented

Treatment no.	Treatment
T_1	Control
T_2	GRDF - 250: 150: 150 (N, P_2O_5, K_2O kg ha^{-1})
T_3	GRDFNP +125% K_2O
T_4	GRDFNP + 150% K_2O
T_5	GRDFNP + 175% K_2O

Note - FYM @ 20 t ha^{-1} common to all the treatment except control.

2.1 Yield contributing characters

2.1.1 Number of fruits per plant

The number of fruits harvested from five selected plants in each treatment was recorded at each picking.

2.1.2 Weight of fruit

The weight of five individual fruits was measured separately using a digital weighing balance and the average weight was determined for each treatment.

2.1.3 Fruit yield per plant

The total weight of fruits harvested from five randomly selected plants in each treatment and replication was recorded at each picking. The cumulative average weight of harvested fruits from all pickings was calculated and expressed in grams per plant.

2.1.4 Fruit yield per plot

The total weight of fruits harvested at each picking was recorded for the entire plot including the tagged plants. The cumulative yield from all harvests was summed up and expressed in kilograms per plot.

2.1.5 Fruit yield: Marketable fruits were harvested weekly from each plot and the total yield was recorded. The overall yield per hectare was then calculated using the appropriate formula.

$$\text{Yield (ton ha}^{-1}\text{)} = \frac{\text{Fruit yield (kg plot}^{-1}\text{)}}{\text{Net plot area (m}^2\text{)}}$$

2.2 Quality contributing characters

2.2.1. Ascorbic acid (mg 100 g^{-1})

The ascorbic acid content in bell pepper was estimated using the 2,6-dichlorophenol indophenol dye titration method, as prescribed by Sadasivam and Manickam (1992) [15].
Mature fruits were analysed for their ascorbic acid content. The fruits were cut into 2 to 3 mm pieces and a sample 0.5-5 gram was blended with a 4% oxalic acid solution. The mixture was then filtered through muslin cloth and the ascorbic acid content in the collected extract was determined using the 2,6-dichlorophenol indophenol dye titration method.

2.2.1.1 Materials

1. Oxalic Acid (4%)
2. Dye Solution: Dissolve 42 mg sodium bicarbonate in distilled water. Add 52 mg 2,6-dichlorophenol indophenol, dissolve and make up to 200 ml with distilled water.
3. Stock Standard Solution: Dissolve 100 mg ascorbic acid in 100 ml of 4% oxalic acid (1 mg/ml).
4. Working Standard Solution: Dilute 10 ml of stock solution to 100 ml with 4% oxalic acid (100 µg/ml).

2.2.1.2 Procedure

1. Pipette 5 ml of the working standard solution into a 100 ml conical flask.
2. Add 10 ml of 4% oxalic acid and titrate against the dye solution (V_1 ml) until a pink colour appears and persists for a few minutes. The volume of dye used corresponds to the amount of ascorbic acid present.
3. Extract 0.5-5 g of the sample in 4% oxalic acid, adjust the volume to 100 ml and centrifuge the solution.
4. Pipette 5 ml of the supernatant, add 10 ml of 4% oxalic acid and titrate against the dye solution (V_2 ml).

$$\text{Ascorbic acid mg /100 g sample} = \frac{0.5\text{ mg} \times V_2 \times 100\text{ ml}}{V_1\text{ ml} \times 5\text{ ml} \times \text{Wt. of the sample}} \times 100$$

2.2.2. Total soluble solids

Brix reading was measured after harvesting of the fresh fruits using hand held refractometer. The juice was extracted from the pulp of fresh fruits of bell pepper and the reading was noted.

3. Results and Discussion

3.1 Yield contributing characters

3.1.1 Number of fruits per plant

The number of fruits per plant was significantly influenced by potassium fertigation, ranging from 11.65 to 17.58 (Table 2, Figure 1). The highest fruit number was recorded in T_5 (RDNP + 175% RDK, 17.58), which was statistically at par with T_4 (RDNP + 150% RDK, 17.38), while the control (T_1) produced the lowest (11.65 fruits). Enhanced potassium availability promotes floral development, pollen viability, fruit set, carbohydrate translocation and hormonal regulation, which collectively reduce flower and fruit drop, leading to higher fruit numbers. Similar results have been reported by Mishra and Sahu (2016) [9], Razzaq (2016) [14] and Hegazi *et al*. (2017) [6], who observed that increased potassium improved fruit number and yield traits in Capsicum under both open and protected cultivation.

Table 2: Effect of graded levels of potassium fertigation on number of fruits per plant of bell pepper

Tr. No.	Treatments	Number of fruits per plant
T_1	Control	11.65
T_2	RDF- (250:150:150) (N, P_2O_5, K_2O)	16.86
T_3	RDNP + 125% RDK	17.05
T_4	RDNP + 150% RDK	17.38
T_5	RDNP + 175% RDK	17.58
	S.E.(m) ±	0.10
	CD at 5%	0.30

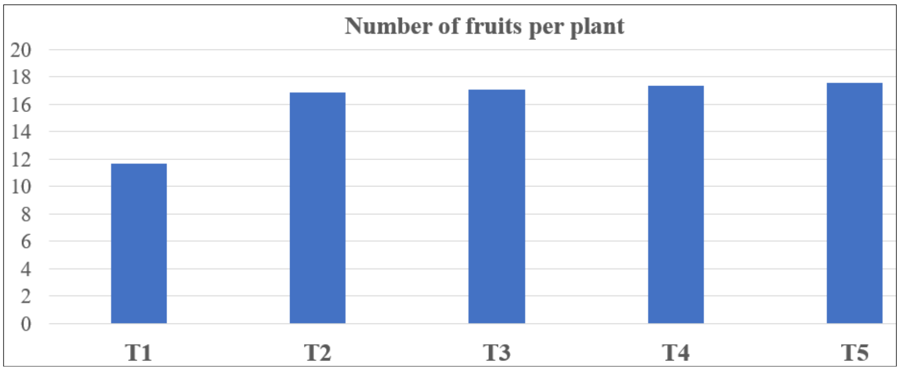

Fig 1: Effect of graded levels of potassium fertigation on number of fruits per plant of bell pepper

3.1.2 Weight of fruit

Fruit weight was significantly influenced by graded levels of potassium fertigation (Table 3; Figure 2). The highest fruit weight was recorded in T_5 (RDNP + 175% RDK, 183.23 g), which was statistically at par with T_4 (RDNP + 150% RDK, 181.96 g), while the control (T_1) produced the lowest fruit weight (110.28 g). Enhanced potassium improves carbohydrate translocation, flower retention, fruit set, water-use efficiency, fruit filling and cell expansion, resulting in heavier fruits. Similar observations were reported by Mishra and Sahu (2016) [9] and Hegazi *et al*. (2017) [6], who found that higher potassium doses significantly increased fruit weight and other yield parameters in Capsicum under protected cultivation.

Table 3: Effect of graded levels of potassium fertigation on weight of fruit of bell pepper

Tr. No.	Treatments	Weight of fruit (g)
T_1	Control	110.28
T_2	RDF- (250:150:150) (N, P_2O_5, K_2O)	176.38
T_3	RDNP + 125% RDK	179.07
T_4	RDNP + 150% RDK	181.96
T_5	RDNP + 175% RDK	183.23
	S.E.(m) ±	0.90
	CD at 5%	2.75

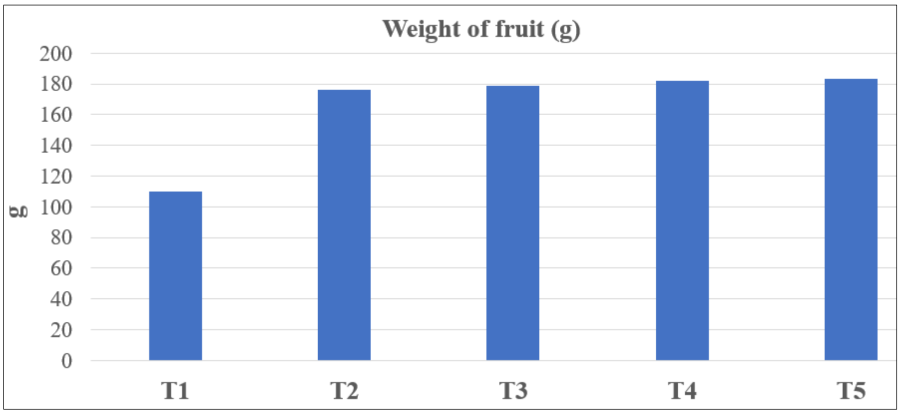

Fig 2: Effect of graded levels of potassium fertigation on weight of fruit of bell pepper

3.1.3 Fruit yield: Fruit yield was significantly influenced by graded levels of potassium fertigation (Table 4, Figure 3). The highest yield was recorded in T_5 (RDNP + 175% RDK, 77.30 t/ha), which was at par with T_4 (RDNP + 150% RDK, 75.81 t/ha), while the control (T_1) produced the lowest yield (31.14 t/ha). Increased potassium enhances plant health, flowering efficiency, fruit retention and uniform fruit development, resulting in higher yield and better-quality fruits. Similar findings were reported by Neelima *et al*. (2023) [13] and Razzaq *et al*. (2016) [14], confirming that higher potassium application improves Capsicum productivity under protected cultivation.

Table 4: Effect of graded levels of potassium fertigation on fruit yield of bell pepper

Tr. No.	Treatments	Fruit yield (ton ha $^{-1}$)
T_1	Control	31.14
T_2	RDF- (250:150:150) (N, P_2O_5, K_2O)	71.86
T_3	RDNP + 125% RDK	73.29
T_4	RDNP + 150% RDK	75.81
T_5	RDNP + 175% RDK	77.30
	S.E.(m) ±	0.51
	CD at 5%	1.56

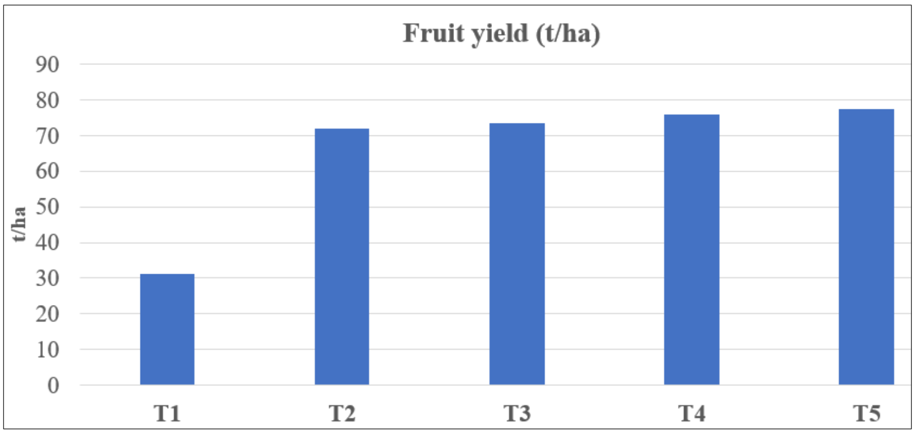

Fig 3: Effect of graded levels of potassium fertigation on fruit yield of bell pepper

3.2 Quality contributing characters
3.2.1 Ascorbic acid
Ascorbic acid content in bell pepper fruits increased with higher potassium fertigation, with T_5 (RDNP + 175% RDK) recording the highest value (103.33 mg/100g), followed by T_4 (102.90 mg/100g). Treatments T_3 (100.01 mg/100g) and T_2 (99.69 mg/100g) while the control had the lowest content (65.43 mg/100g). Potassium enhances ascorbic acid synthesis by activating ascorbate metabolism enzymes and maintaining cellular redox balance. These findings are supported by earlier reports showing increased vitamin C under higher potassium and balanced nutrient application (Mishra and Sahu, 2016, Botella *et al*. 2017, Ngupok *et al*. 2018, Malik *et al*. 2011) [9, 3, 13, 8].

Table 5: Effect of graded levels of potassium fertigation on ascorbic acid of bell pepper

Tr. No	Treatments	Ascorbic acid (mg 100g^{-1})
T_1	Control	65.43
T_2	RDF- (250:150:150) (N, P_2O_5, K_2O)	99.69
T_3	RDNP + 125% RDK	100.01
T_4	RDNP + 150% RDK	102.90
T_5	RDNP + 175% RDK	103.33
	S.E.(m) ±	0.16
	CD at 5%	0.48

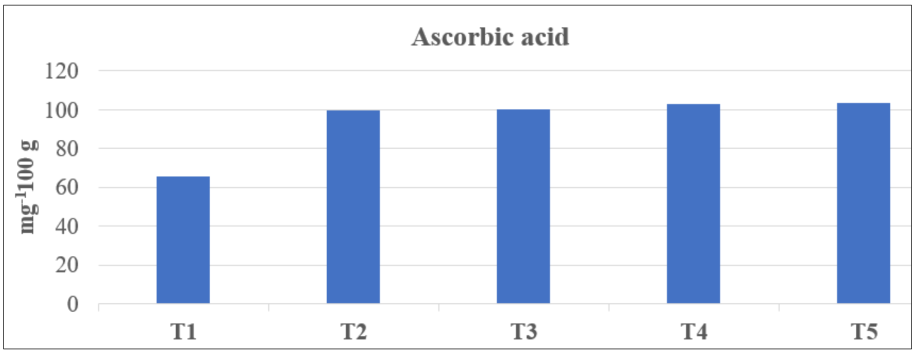

Fig 4: Effect of graded levels of potassium fertigation on ascorbic acid of bell pepper

3.2.2 Total soluble solids (TSS)
Total Soluble Solids (TSS) content in bell pepper fruits was significantly influenced by potassium fertigation, showing a rising trend with increasing potassium levels. The highest TSS value of 7.38 °Brix was recorded in T_5 (RDNP + 175% RDK), which was at par with T_4 (7.35 °Brix), while T_3 (7.27 °Brix) and T_2 (7.25 °Brix) were slightly lower but comparable. The control exhibited the lowest TSS content (5.46 °Brix). Potassium enhances photosynthesis and carbohydrate translocation to fruits, promoting sugar accumulation (°Brix), a major contributor to TSS. These findings are consistent with previous reports showing increased TSS in capsicum and other vegetables under higher potassium levels (Majumdar *et al*. 2000, Botella *et al*. 2017, El-Nemr *et al*. 2012, Moshileh *et al*. 2017, Gouthami *et al*. 2024) [7, 3, 4, 11, 5].

Table 6: Effect of graded levels of potassium fertigation on Total soluble solids of bell pepper

Tr. No.	Treatments	TSS (ºBrix)
T_1	Control	5.46
T_2	RDF- (250:150:150) (N, P_2O_5, K_2O)	7.25
T_3	RDNP + 125% RDK	7.27
T_4	RDNP + 150% RDK	7.35
T_5	RDNP + 175% RDK	7.38
	S.E.(m) ±	0.01
	CD at 5%	0.04

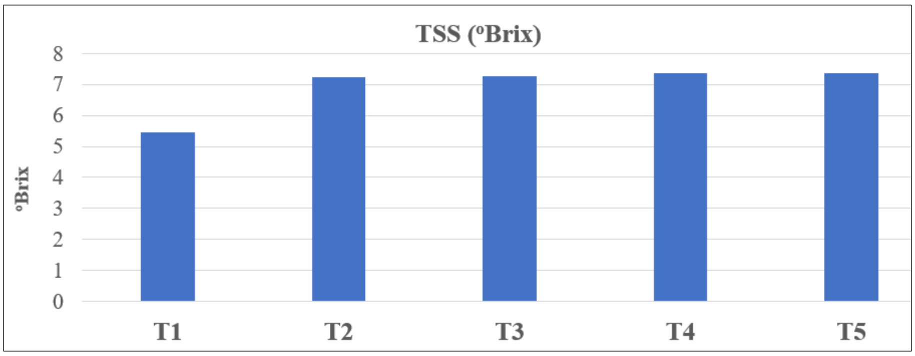

Fig 5: Effect of graded levels of potassium fertigation on TSS of bell pepper

4. Conclusion

Graded potassium fertigation significantly enhanced both yield and quality of bell pepper. Treatment T_5 (RDNP + 175% RDK) recorded the highest fruit number, weight, yield, Vitamin C content, and total soluble solids (TSS). This indicates that 175% RDK potassium fertigation is the most effective strategy for maximizing productivity and fruit quality under polyhouse conditions.

5. Acknowledgement

The authors sincerely acknowledge Dr. Sharadchandra Pawar College of Agriculture, Baramati, for providing the necessary facilities to conduct this research work. They also express their heartfelt gratitude to Prof. R. D. Gaikwad, Prof. R. G. Pondkule and Prof. B. N. Tambe for their continuous guidance, encouragement and invaluable support throughout this research.

References

1. Banerjee S, Bhattacharjee T, Maurya PK, Pramanik S, Ghosh T, Kundu S, *et al*. Breeding potential of sweet pepper genotypes involving different fruit colors and shapes using multivariate analysis. Indian Journal of Ecology. 2023;50:1425-1439.
2. Bidari BI, Hebsur NS. Potassium in relation to yield and quality of selected vegetable crops. Karnataka Journal of Agricultural Sciences. 2011;24(1):512-555.
3. Botella MA, Arevalo L, Mestre TC, Rubio F, Sanchez FG, Rivero RM, *et al*. Potassium fertilization enhances pepper fruit quality. Journal of Plant Nutrition. 2017;40(2):145-155.
4. El-Nemr MA, Abd El-Baky MMH, Salman SR, El-Tohamy WA. Effect of different potassium levels on growth, yield and quality of tomato grown in sand-ponic culture. Australian Journal of Basic and Applied Sciences. 2012;6(3):779-784.
5. Gouthami B, Devi MU, Kumar K, Ramulu V. Influence of various nitrogen and potassium fertigation levels on the quality parameters of capsicum (*Capsicum annuum* var. *grossum* L.) under polyhouse. Plant Archives. 2024;24(2):1-? (No page numbers provided.)
6. Hegazi AM, El-Shraiy AM, Ghoname AA. Growth, yield and nutritional quality of sweet pepper plants as affected by potassium and phosphate fertilizers varying in source and solubility. Current Science International. 2017;6(2):445-457.
7. Majumdar SP, Meena RL, Baghel GDS. Effect of levels of compaction and potassium on yield and quality of tomato and chilli crops grown on highly permeable soils. Journal of the Indian Society of Soil Science. 2000;48(2):215-220.
8. Malik AA, Chattoo M, Sheemar G, Rashid R. Growth, yield and fruit quality of sweet pepper hybrid SH-SP-5 (*Capsicum annuum* L.) as affected by integration of inorganic fertilizers and organic manures (FYM). Journal of Agricultural Technology. 2011;7(4):1037-1048.
9. Mishra N, Sahu GS, Ray M. Effect of nitrogen and potassium on yield and quality of bell pepper (*Capsicum annuum* L. var. *grossum*) under open field and shade net condition. International Journal of Tropical Agriculture. 2016;34(1):45-48.
10. Mohanty N, Swain S. Adaptation of *Capsicum annuum* in various soil types. International Journal of Vegetable Science. 2018;24(1):45-55.
11. Moshileh AM, Errebhi MA, Obiadalla-Ali HA. Effect of potassium fertilization on tomato and cucumber plants under greenhouse conditions. Journal by Innovative Scientific Information and Services Network. 2017;14(1):68-71.
12. Neelima TL, Devi MU, Chaitanya K, Madhurya D. Optimizing fruit yield and water productivity of *Capsicum* (*Capsicum annuum* L.) hybrids in peninsular India through N and K fertigation under shade net cultivation. The Pharma Innovation Journal. 2023;12(8):2777-2780.
13. Ngupok O, Warade SD, Das S, Raghavan M. Effect of NPK on quality parameters of capsicum (*Capsicum annuum* L. var. *grossum*) under protected condition.

International Journal of Chemical Studies. 2018;6(4):451-453.
14. Razzaq OI. Effect of potassium on yield of pepper (*Capsicum annuum* L.) cv. Charisma under protected cultivation. International Journal of Scientific and Engineering Research. 2016;7(9):1-5.
15. Sadasivam S, Manickam A. Biochemical Methods for Agricultural Sciences. Madras: Wiley Eastern Ltd; 1992. 246 p.
16. Selim A, Al-Mahmoudi H. Impact of foliar potassium on pepper growth and quality. Journal of Plant Nutrition. 2021;44(3):317-324.
17. Shoemaker M, Teskey R. Origin and domestication of *Capsicum* species. Economic Botany. 1995;49(2):217-226.