



# Standardization of Nutrient Sources and Foliar Calcium Nutrition for Productivity Enhancement in Grafted Tomato

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## ABSTRACT

Tomato is one of the most important vegetable crop and is highly demanding in case of fertilizer and water use. A field experiment was carried out during *rabi* season of 2023-24 at College of Agriculture, Vellayani, Thiruvananthapuram to standardize the nutrient sources for fertigation and to find out the effect of foliar nutrition of Ca for productivity enhancement in grafted tomato grown under polyethylene mulching. Experiment was laid out in split plot design with four replications. The main plot treatments were four nutrient sources(S) (100% NPK fertigation through water soluble fertilizer (WSF), 100% NPK fertigation through conventional fertilizer (CF), 50 % NPK (WSF) + 50 %

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NPK (CF) and 100% NPK through soil (CF)) and the three sub plot treatments were Ca fertilization (F) ; No Ca fertilization, foliar application of 0.5% Calcium Ammonium Nitrate (CAN) at 1 MAP and foliar application of 0.5 % CAN at 1 and 2 MAP. The results revealed that 100% NPK fertigation through WSF recorded taller plants with higher leaf area and dry matter production. The yield attributes viz., fruits per truss, fruit set percentage, average fruit weight, yield per plant and higher TSS were observed with 100% NPK fertigation through water soluble fertilizer. The results revealed that application of nutrients through 100 % WSF(S1) or 50% through WSF and 50 % through CF (S3) recorded 28.6 % and 18.8 % increase in fruit yield over soil application of conventional fertilizers. The results also revealed that foliar application of 0.5% CAN at 1 and 2 MAP had significant influence on growth, yield and quality of grafted tomato.

**Keywords:** Calcium nutrition; conventional fertilizers; fertigation; tomato graft; water soluble fertilizers.

## 1. INTRODUCTION

Tomato (*Solanum lycopersicum* L.) holds an important place in global agriculture due to its widespread consumption and economic importance. The tomato plant is water and nutrient demanding, requiring substantial amounts of nitrogen (N), phosphorus (P), and potassium (K) to support its growth, fruit development, and yield quality. The hardest agronomic challenge is the optimization of nutrient use, which is often inefficiently performed by farmers. Traditional fertilizer application methods often lead to inefficient nutrient utilization due to runoff, leaching, and uneven distribution. An environmentally friendly way to maximize water and fertilizer inputs, minimize pollution in vegetable growing facilities, and cut labor costs in agricultural operations is through intelligent fertigation (Wang *et al.*, 2024).

According to Hebbar *et al.*, (2004), fertigation, especially when using water-soluble fertilizers, is a highly efficient method for boosting tomato production. The advantages include not only increased yield but also improved fruit quality, nutrient-use efficiency, and environmental sustainability due to reduced nutrient leaching.

Grafting of tomato is widely used to improve the production and improve the quality under stress situations. By selecting the suitable root stock, grafting can manipulate scion morphology and manage biotic stresses, abiotic stresses with enhanced nutrient and water use efficiency. Polyethylene mulching enhanced early root growth in tomato which stimulated above ground growth as expressed through branching, flowering and fruit yield. Several studies concluded that the early uptake of phosphorous by tomato was enhanced under mulching.

Calcium is crucial throughout the plant life cycle as it affects nitrogen and boron uptake, supports early root formation and growth, and helps to reduce the occurrence of blossom end rot. Tejashvini and Thippeshappa (2017) revealed that foliar application of tomato crop with different calcium sources increased the nutrient content and uptake by tomato fruit and leaves significantly over the control. The foliar spray of 0.5 per cent CAN resulted in increase in nutrient content in fruit and in leaves at different stages (vegetative, flowering & fruiting stage) (Munnaf, 2020). The foliar application of calcium at 1.5% notably improved plant height, branch count, total yield, and fruit firmness, while also minimizing the number of infected fruits per plot and increasing the total soluble solids (TSS) content (Sajid *et al.*, 2020).

Hence the present investigation was carried out for standardizing the nutrient sources for fertigation for tomato graft grown under polyethylene mulching and also to find out the effect of Ca nutrition on growth, yield and quality of tomato.

## 2. MATERIALS AND METHODS

A field experiment was conducted during rabi season of 2023-24 at Instructional farm attached to College of Agriculture, Vellayani, Thiruvananthapuram, Kerala. Soil of experimental site was sandy clay loam soil, moderately acidic with a pH of 5.72, medium in available N, high in available P and medium in available K. Experiment was laid out in Split plot design with four replications. The main plot treatments were four nutrient sources(S)-100% NPK fertigation through water soluble fertilizer (WSF)-S1, 100% NPK fertigation through conventional fertilizer (CF)-S2, 50 % NPK WSF + 50 % NPK fertigation CF-S3 and 100% NPK through soil application (CF)-S4 and the three

**Table 1. Nutrient sources and fertigation schedule of tomato during the experiment**

Treatments Nutrient Sources (S)	Nutrient Sources (S) and Quantity of fertilizer	Application interval
S <sub>1</sub> - 100% NPK fertigation through WSF	19:19:19-39.5 kg ha <sup>-1</sup> Urea-113 kg ha <sup>-1</sup> 12:61:00- 4.1 kg ha <sup>-1</sup> 13:0:45- 23.3 kg ha <sup>-1</sup>	Fertigation in 30 equal splits from 3 DAP in S <sub>1</sub> , S <sub>2</sub> and S <sub>3</sub>
S <sub>2</sub> - 100% NPK fertigation through CF	Urea -137 kg ha <sup>-1</sup> SSP -62.5 kg ha <sup>-1</sup> MOP -30 kg ha <sup>-1</sup>	
S <sub>3</sub> - 50 % NPK WSF + 50 % NPK fertigation CF	Urea 125 kg ha <sup>-1</sup> SSP- 31.25 kg ha <sup>-1</sup> MOP 15 kg ha <sup>-1</sup> 19:19:19 -19.75 kg ha <sup>-1</sup> 12:61:00-2.05 kg ha <sup>-1</sup> 13:0:45 -11.65 kg ha <sup>-1</sup>	
S <sub>4</sub> - 100% NPK through soil (CF)	Urea -137 kg ha <sup>-1</sup> SSP- 62.5 kg ha <sup>-1</sup> MOP-30 kg ha <sup>-1</sup>	Soil application ½ N + full P + ½ K as basal and ¼ N + ½ K at 1 MAT and ¼ N at 2 MAT

sub plot treatments were Ca fertilization (F) - No Ca fertilization, foliar application of 0.5% Calcium Ammonium Nitrate (CAN) at 1 MAP (month after transplanting) and foliar application of 0.5% CAN at 1 and 2 MAP. The nutrient sources for WSF were NPK Complex (19:19:19), Monoammonium Phosphate (12:61:00) and Potassium Nitrate (13:0:45) and conventional fertilisers were urea, single super phosphate and muriate of potash. Raised beds of 30 cm height, with a length of 3.0m length and 1.8 m width were taken and mulched with silver black polyethylene mulch of 30 micron. Tomato variety Vellayani Vijay grafted on to rootstock of brinjal variety Haritha released from Kerala Agricultural University was planted at 60 x 60 cm spacing during 2<sup>nd</sup> week of September 2023. Irrigation was provided through drip irrigation on alternate days based on pan evaporation to 75% Field Capacity. Four submains were laid out in the field. From the submains, three laterals were laid to each plot and inline emitters were placed at a spacing of 60 cm with a discharge rate of 4 L per hour. Fertilizer was provided through fertigation in 30 equal splits from 3 DAP (days after transplanting) through ventury. The tomato was fertilized based on RDF 75:40:25 kg ha<sup>-1</sup>NPK (KAU, 2016) which was modified based on soil test values. The modified recommendation was 68:10:18 kg ha<sup>-1</sup> NPK. The quantity and sources of fertilizers used were shown in Table 1. Observations on biometric characters, viz., plant height, branches, leaf area index (LAI) and dry matter production were recorded at 60 DAT and at harvest. Yield attributes, viz., fruits per truss, average fruit

weight and yield were recorded. Statistical analysis of data was carried out by applying the technique of analysis of variance (ANOVA) for split plot design (Panse and Sukhatme, 1985).

### 3. RESULTS AND DISCUSSION

The experimental results are discussed below.

#### 3.1 Effect of Different Nutrient Sources on Growth Attributes

The analysed results clearly indicated that the different nutrient sources had a significant influence on growth attributes of grafted tomato (Table 2). The robust roots of brinjal rootstock in grafted tomato helped for easy absorption and translocation of nutrients during the growth phases resulted in enhanced growth attributes. This is in conformity with the findings of Pilli et al., (2019) who reported the highest nutrient concentration and nutrient uptake in grafted tomato when compared to the non-grafted one. Often, this was explained by variations in root shape and traits, including the quantity, density, and length of root hairs all of which actively aid in nutrient uptake as well as the lateral and vertical growth of roots.

Plant vegetative development may be impacted differently by various nutrient sources. Among different nutrient sources, S<sub>1</sub> (100% NPK fertigation through WSF) recorded taller plants at 60 DAT and at harvest, and was found on par with S<sub>2</sub> (100% NPK fertigation through CF). The

extremely stimulating effect of readily available nitrogen on numerous physiological phases in cell division and cell elongation may have contributed to the rise in plant height found in plants grown with inorganic fertilizer (Razaq *et al.*, 2017). The easy absorption of water soluble fertilizers can contribute to enhanced growth attributes compared to conventional sources.

According to Adekaidu *et al.* (2021), more branches leads to more active fruit-bearing nodes, higher photosynthetic rates, and ultimately higher fruit yields for crops. The results revealed that the highest number of branches at 60 DAT (7.93) and at harvest (11.73) recorded with 100% NPK fertigation through WSF (S<sub>1</sub>) and the lowest branches were observed in soil application of conventional fertilizers.

Both the number of branches and leaf area, at 60 DAT and at harvest were found to be the highest for S<sub>1</sub> (100% NPK fertigation through WSF) and was significantly superior to other nutrient sources. This effect could be attributed to the improved supply of nutrients in the rhizosphere, leading to increased nutrient uptake and contributing to enhanced growth characteristics. From the study, it was clearly found that water soluble fertigation significantly increased the tomato leaf area than the soil application. This may be due to the enhanced available P in early phase which promote the root growth and uptake of phosphorous along with balanced N and K.

The study findings by Neha (2018) demonstrated that utilizing water soluble fertilizers led to notable improvements in various growth and yield parameters of tomato plants. These enhancements were observed in characteristics such as plant height, branch count per plant, dry matter content, fruit quantity per plant, individual fruit weight, and overall tomato yield.

Nikzad *et al.*, (2020) studied the effect of fertigation on growth and yield of cabbage. The tallest plants were observed when 100% of recommended dose of fertiliser was applied in 12 equal splits through fertigation, while the shortest plants were observed when 100% recommended dose of fertiliser was applied as soil application.

Imamsab *et al.*, (2011) reported that the application of 100 per cent water soluble fertilizers through drip resulted in significantly higher growth attributes like plant height, number of branches, stem diameter and leaf area index in tomato.

Continuous supply of nutrients by splitting the entire requirement over the days of growth after proper establishment till the final yield by split application can be achieved through fertigation. Observation on growth of plant has indicated that due to continuous supply of nutrients through fertigation, the plant was not affected by any abiotic stresses.

### 3.2 Effect of Different Nutrient Sources on Yield and Yield Attributes

The results presented in Table 3 revealed that application of nutrients through fertigation with 100 % WSF(S<sub>1</sub>) or 50% through WSF and 50% through CF (S<sub>3</sub>) showed 28.6% and 18.8% increase in fruit yield over soil application of fertilizers. Number of fruits per truss and average fruit weight was significantly higher when 100% NPK was given as WSF through fertigation (S<sub>1</sub>). Days to 50 per cent flowering was least in S<sub>1</sub>(100% NPK fertigation through WSF) which was on par with S<sub>2</sub> (100 % NPK fertigation through CF) and S<sub>3</sub> (50 % NPK WSF + 50 % NPK fertigation CF). Thus fertigation promoted early reproductive phase in all fertigation treatments. Tomato grown under polyhouse conditions supplemented with 125 per cent of RDF i.e. 225 kg N, 125 kg each of P and K per ha with three days interval of fertigation record the highest fruit yield (Ameta *et al.*, 2021).

Application of water-soluble fertilizers viz., NPK complex 19:19:19, KNO<sub>3</sub>, DAP and urea significantly increased the yield attributes when applied through fertigation. Effect of different sources of fertilizer were significant on average fruit weight and yield. The positive effect of water-soluble fertilizer on tomato yield and yield attributes were mainly due to the enhanced physiological and metabolic process in tomato as it increases the uptake of nutrients.

Tomatoes receiving 100% fertigation (74.87 t ha<sup>-1</sup>) outperformed those receiving 50% (64.45 t ha<sup>-1</sup>) and 75% fertigation (68.76 t ha<sup>-1</sup>) in terms of total fruit yield (Badr *et al.*, 2010). The superior yield observed with drip irrigation compared to furrow irrigation is further enhanced by the application of fertilizers through the irrigation water, as plants are provided with nutrients in sync with its's needs.

When 100% NPK water-soluble fertilisers were applied via fertigation, tomato fruit yield increased significantly (58.76 t ha<sup>-1</sup>) in comparison to other techniques. Also, compared

to drip and furrow irrigation methods, the fertigation treatments produced a significantly higher number of fruits and major fruit weight per plant (Shedeed *et al.*, 2009).

Studies on drip fertigation scheduling were carried out on tomatoes (cv. Kashi Aman) in order to maximize the amount and technique of fertilizer application. The findings demonstrated that the highest fruit yield (6.11 kg per plant and 68.86 t ha<sup>-1</sup>), fruit weight (147.22 g), and fruit number (54.33) were produced by 100% NPK using WSF. Compared to control and 100% NPK administration through soil, this treatment demonstrated yield increases of 83.1% and 53.7%, respectively (ICAR-IIVR, 2018).

The data on number of fruits per plant indicated that fertigation was significantly better than soil application method.

### 3.3 Effect of Different Nutrient Sources on Quality of Tomato

Nutrient sources significantly affected the quality parameter of tomato. The results presented in Table 3 revealed that Total Soluble Solids (TSS) was higher in S<sub>1</sub> (100% NPK fertigation through WSF) which was on par with S<sub>2</sub> (100 % NPK fertigation through CF) and S<sub>3</sub> (50 % NPK WSF + 50 % NPK fertigation CF). The fertigation improved the TSS content in tomato.

The application of water-soluble fertilizers positively influenced quality factors, including total soluble solids (TSS) and acidity of the tomatoes (Neha, 2018).

Significantly highest values for TSS (4.85%), vitamin C (17.4 mg/100 g), lycopene content (7.13 mg/100 g), and total sugar (3.80%) were obtained by fertilization with 80% required NPK through drip irrigation compared to soil application of fertilisers (Gupta *et al.*, 2015).

### 3.4 Effect of Ca on Growth, Yield Attributes, Yield and Quality of Tomato

Calcium had a significant effect on the growth and yield of tomato. From the results, it is clear that foliar application of Ca can increase the yield and quality of tomato. Thus, application of 0.5% CAN at 1 MAP and 2 MAP (F<sub>2</sub>) resulted in higher growth, yield and quality of tomato.

The foliar application of Ca at vegetative and reproductive phases helped the plant to attain

improved growth attributes and this in turn resulted in better yield attributes and yield. Foliar application of 0.5% CAN at 1 and 2 MAP (F<sub>2</sub>) recorded the highest plant height at 60 DAT and at harvest indicated the superiority of treatments. The number of branches were not influenced by Ca nutrition. Foliar application of 0.5% CAN at 1 MAP and 2 MAP (F<sub>2</sub>) showed higher leaf area which showed on par results with foliar application of 0.5% CAN at 1 MAP (F<sub>1</sub>).

The results indicated that fertigation treatments and foliar application of Ca had a significant effect on assimilatory area of tomato plant during reproductive phase. The results may be due to role of Ca in cell division, mitosis and carbohydrate metabolism. The net assimilation rate was significantly superior in foliar Ca application treatments (Table 3) over no Ca fertilization treatment. Foliar application of calcium enhanced the leaf area, which in turn enhanced photosynthesis and metabolic activity that leads to more carbohydrates assimilation. Along with these, readily available water soluble nutrient sources enhanced the metabolism with high assimilation.

The incidence of blossom end rot (BER) is a critical problem for tomato growers globally. During the study, tomato was grown under mulched sheet, and irrigation was given to 75% field capacity. Moisture was maintained uniformly so that, there was no BER noticed during the study.

The study revealed that the yield attributes viz, fruits per truss, fruit weight and yield were significantly influenced by foliar application of Ca as 0.5% CAN at 1 and 2 MAP. Foliar application of 0.5% CAN at 1 MAP and 2 MAP (F<sub>2</sub>) recorded the highest fruit per truss (5.82) and fruit weight (39.66 g). Tomato yield was significantly higher in F<sub>2</sub> (Foliar application of 0.5% CAN at 1 MAP and 2 MAP) which was 1419 g per plant. The higher uptake of Ca (Table 3) was noticed with water soluble fertilizer application through fertigation (S<sub>1</sub>, S<sub>2</sub> and S<sub>3</sub>) and with foliar application of Ca (F<sub>1</sub> and F<sub>2</sub>).

Foliar application of 0.5% CAN at 1 MAP and 2 MAP (F<sub>2</sub>) resulted in the highest TSS. Application of Ca can increase weight of fruit, yield and firmness. It also influences the quality parameters like Vitamin C and soluble sugar and decrease the organic acid content and soluble solids of tomato (Xia and Yang, 2005).

**Table 2. Effect of nutrient sources and calcium fertilization on growth attributes in grafted tomato**

Treatment	Plant height at 60 DAT (cm)	Plant height at harvest (cm)	Branches at 60 DAT	Branches at harvest	Leaf area at 60 DAT (cm <sup>2</sup> )	Leaf area at harvest (cm <sup>2</sup> )
<b>Nutrient Sources(S)</b>						
S <sub>1</sub> - 100% NPK fertigation through WSF	81.02	96.93	7.93	11.73	685.47	812.36
S <sub>2</sub> - 100% NPK fertigation through CF	80.71	96.25	6.88	11.15	671.32	800.99
S <sub>3</sub> - 50% NPK WSF + 50% NPK fertigation CF	78.84	94.09	6.96	10.47	659.99	787.96
S <sub>4</sub> - 100% NPK through soil (CF)	74.51	89.20	6.33	9.36	655.36	775.51
±SE(m)	0.575	0.773	0.160	0.158	1.340	0.938
CD (0.05)	1.84	2.47	0.51	0.51	4.29	3.00
<b>Ca fertilization (F)</b>						
F <sub>0</sub> - No Ca fertilization	77.65	93.47	7.09	10.72	662.66	785.47
F <sub>1</sub> - Foliar application of 0.5% CAN at 1MAP	78.41	93.65	6.93	10.55	670.07	796.30
F <sub>2</sub> - Foliar application of 0.5% CAN at 1 and 2 MAP	80.25	95.23	7.06	10.76	671.37	800.85
±SE(m)	0.405	0.516	0.101	0.171	1.360	1.753
CD (0.05)	1.18	1.51	NS	NS	3.97	5.12
<b>S x F interaction</b>						
s <sub>1</sub> f <sub>0</sub>	79.60	96.00	8.14	12.00	672.84	798.41
s <sub>1</sub> f <sub>1</sub>	80.45	96.73	7.81	11.48	691.90	818.23
s <sub>1</sub> f <sub>2</sub>	83.00	98.05	7.83	11.70	691.66	820.43
s <sub>2</sub> f <sub>0</sub>	79.88	96.38	6.98	10.95	671.43	793.04
s <sub>2</sub> f <sub>1</sub>	80.50	95.63	6.68	11.16	670.83	801.57
s <sub>2</sub> f <sub>2</sub>	81.75	96.75	6.98	11.33	671.71	808.37
s <sub>3</sub> f <sub>0</sub>	76.88	92.63	6.98	10.60	653.73	780.21
s <sub>3</sub> f <sub>1</sub>	79.05	94.00	6.91	10.30	663.05	789.15
s <sub>3</sub> f <sub>2</sub>	80.60	95.65	7.00	10.50	663.19	794.52
s <sub>4</sub> f <sub>0</sub>	74.25	88.88	6.28	9.33	652.66	770.22
s <sub>4</sub> f <sub>1</sub>	73.63	88.25	6.30	9.25	654.50	776.26
s <sub>4</sub> f <sub>2</sub>	75.65	90.48	6.43	9.50	658.94	780.06
±SE(m)	0.810	1.032	0.201	0.342	2.719	3.507
CD (d <sub>s</sub> x d <sub>f</sub> )	NS	NS	NS	NS	7.94	NS
CD (d <sub>f</sub> x d <sub>s</sub> )	NS	NS	NS	NS	7.76	NS

**Table 3. Effect of nutrient sources and calcium fertilization on yield attributes, yield and quality in grafted tomato**

Treatment	Days to 50% flowering	Fruits per truss	Average fruit weight (g)	Yield per plant (g)	TSS (%)	NAR (g cm <sup>-2</sup> day <sup>-1</sup> )	Ca uptake (kg ha <sup>-1</sup> )
<b>Nutrient Sources(S)</b>							
S <sub>1</sub> - 100% NPK fertigation through WSF	39.50	6.24	41.21	1500.33	4.98	0.011	47.15
S <sub>2</sub> - 100% NPK fertigation through CF	39.55	5.92	39.62	1345.42	4.96	0.010	46.25
S <sub>3</sub> - 50% NPK WSF + 50% NPK fertigation CF	40.59	5.34	37.08	1385.67	4.89	0.011	45.45
S <sub>4</sub> - 100% NPK through soil (CF)	42.46	5.18	34.89	1165.67	4.70	0.010	38.93
±SE(m)	0.475	0.087	0.435	40.290	0.054	0.0002	0.6772
CD (0.05)	1.52	0.28	1.39	128.89	0.17	0.0006	2.1664
<b>Ca fertilization (F)</b>							
F <sub>0</sub> - No Ca fertilization	40.22	5.54	37.32	1252.13	4.51	0.010	33.01
F <sub>1</sub> - Foliar application of 0.5% CAN at 1MAP	40.86	5.64	37.63	1376.69	4.99	0.011	49.67
F <sub>2</sub> - Foliar application of 0.5% CAN at 1 and 2 MAP	40.50	5.82	39.66	1419.00	5.14	0.011	50.65
±SE(m)	0.619	0.059	0.456	19.303	0.037	0.0002	0.5103
CD (0.05)	NS	0.17	1.33	56.34	0.11	0.0005	1.4895
<b>S x F interaction</b>							
s <sub>1</sub> f <sub>0</sub>	37.82	6.06	40.38	1443.50	4.49	0.010	34.24
s <sub>1</sub> f <sub>1</sub>	40.26	6.20	40.63	1552.50	5.13	0.012	53.12
s <sub>1</sub> f <sub>2</sub>	40.43	6.45	42.63	1505.00	5.32	0.011	54.08
s <sub>2</sub> f <sub>0</sub>	39.81	5.85	38.15	1207.00	4.69	0.010	36.01
s <sub>2</sub> f <sub>1</sub>	39.45	5.88	39.00	1349.25	5.01	0.011	51.52
s <sub>2</sub> f <sub>2</sub>	39.40	6.03	41.70	1480.00	5.17	0.011	51.22
s <sub>3</sub> f <sub>0</sub>	40.55	5.15	36.88	1288.00	4.47	0.010	33.10
s <sub>3</sub> f <sub>1</sub>	41.49	5.38	36.50	1417.50	4.99	0.011	50.35
s <sub>3</sub> f <sub>2</sub>	39.73	5.50	37.88	1451.50	5.21	0.011	52.92
s <sub>4</sub> f <sub>0</sub>	42.70	5.10	33.88	1070.00	4.40	0.009	28.70
s <sub>4</sub> f <sub>1</sub>	42.23	5.13	34.38	1187.50	4.84	0.010	43.71
s <sub>4</sub> f <sub>2</sub>	42.45	5.30	36.43	1239.50	4.87	0.011	44.39
±SE(m)	1.237	0.117	0.911	38.607	0.075	0.0003	1.0206
CD (d <sub>s</sub> x d <sub>f</sub> )	NS	NS	NS	NS	NS	NS	NS
CD (d <sub>f</sub> x d <sub>s</sub> )	NS	NS	NS	NS	NS	NS	NS

In the northern Swat Valley's agroclimatic conditions in the tomato cultivar Rio-grand, foliar calcium spray at 1.5% was advised for improved tomato yield and quality production (Sajid et al., 2020).

The interaction effect of nutrient sources and Ca fertilization revealed that fertigation through water soluble fertilizers and foliar application of 0.5% CAN at 1 MAP and foliar application of 0.5% CAN at 1 and 2 MAP recorded the higher leaf area at 60 DAT over other treatments (691.90 cm<sup>2</sup> and 691.66 cm<sup>2</sup>).

#### 4. CONCLUSION

From the study, it can be concluded that 100% NPK fertigation through water soluble fertilizers in 30 equal splits along with foliar application of CAN 0.5% at 1MAP and 2 MAP had a significant influence on growth, yield and quality of mulched grafted tomato.

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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