Indian Journal of Agricultural Sciences **95** (9): 1094–1100, September 2025/Article
https://doi.org/10.56093/ijas.v95i9.164004

Effects of pruning intensity and nutrient spray on growth, yield and quality attributes of guava (*Psidium guajava*) cv. Allahabad Safeda under central Uttar Pradesh

V K TRIPATHI[1]*, JAY YADAV[1], SHIWANAND PANDEY[1], AMIT KUMAR[1] and RIDDHIMA TRIPATHI[1]

Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh 208 002, India

Received: 27 January 2025; Accepted: 8 August 2025

ABSTRACT

The present experiment was conducted during 2023 and 2024 at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh to evaluate the effect of pruning intensity and chemical applications on growth, yield and quality parameters of guava (*Psidium guajava* L.) cv. Allahabad Safeda under central Uttar Pradesh. The experiment was laid out in a randomized block design (RBD) having 10 treatments including one as control, viz. three pruning levels (20%, 40% and 60% of shoot) and combinations with calcium nitrate @1%, 2% and 3% and potassium nitrate @1.5%, 3% and 4.5%. Results revealeded significant improvement in growth parameters with T_9, Pruning of 40% shoot + $Ca(NO_3)_2$ @2.0% having maximum plant height (7.17 m), trunk girth (29.44 cm), shoot length (22.83 cm) and shoot girth (7.87 mm). Flowering and fruit set parameters were also optimized in T_9, with minimum days to flower bud initiation (22.33 days), days to first flower (23.67 days), flowers dropped/shoot (4.05) and no. of fruit set/shoot (11.58). T_9 also resulted highest fruit retention/shoot (8.96), fruit width (6.12 cm), fruit length (7.12 cm), fruit weight (171.18 g) and fruit volume (266.55 cm^3). Yield improvements were evident in T_9 with maximum yield/tree (45.34 kg) and per hectare (11.87 t/ha). Biochemical analysis showed superior quality of fruits in T_9 resulted highest TSS (9.93°Brix), lowest titratable acidity (0.16%), highest TSS: acid ratio (68.73), maximum vitamin C (235 mg/100 g), highest total sugars (8.63%) and maximum sugar: acid ratio (59.11). These results highlighted the synergistic effect of pruning and calcium nitrate in enhancing vegetative growth, flowering, fruiting and quality attributes. This integrated approach offers the potential for optimizing guava production under sub-tropical conditions in north India.

Keywords: Biochemical quality, Calcium nitrate, Growth and yield, Guava, Pruning levels

Guava (*Psidium guajava* L.), often called the "Apple of the Tropics," is a vital fruit crop belongs to the Myrtaceae family. Its high nutritional, economiced and ecological value makes it a corner stone of fruit production in tropical and subtropical regions (Mor *et al.* 2024). Originated from tropical America, guava is widely cultivated in countries like India, Brazil and Mexico (Menzel and Paxton 1985). In India, it ranks fifth among fruit crops, with major production hubs in Uttar Pradesh, Maharashtra and Bihar, particularly Allahabad region is particularly known for superior fruit quality**.** Despite its adaptability, guava cultivation faces challenges such as irregular flowering, inferior rainy season fruit quality and pest infestations (Roussos 2024).

Renowned for its nutritional profile, guava provides high levels of vitamin C (150–350 mg/100 g), pectin and essential phytochemicals, making it a valuable fruit for fresh consumption and processed products like jellies and juices (Bhattacherjee and Tandon 2021). However, the rainy season crop often produces fruits of substandard quality compared to the winter crop, necessitating improved cultivation practices, particularly cultural and nutrient management strategies.

Pruning, a vital horticultural practice, plays a pivotal role in balancing vegetative and reproductive growth in guava. Since guava flowers and fruits are produced on current-season growth, appropriate pruning can enhance yield, regulate flowering and improve fruit quality (Mishra *et al.* 2021). Despite its importance, the optimal pruning levels for improving guava productivity remain underexplored. As well, integrating pruning with effective nutrient management can further enhance yield and fruit quality.

Calcium and potassium are two critical nutrients influencing fruit quality and post-harvest performance. Calcium applications improve firmness, reduce respiration rates and minimize post-harvest losses. Potassium, on the other hand, contributes to physiological processes such as photosynthesis, enzyme activation and the development of quality traits like flavour and sugar content. Foliar

[1]Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh. *Corresponding author email: drvktripathicsa@gmail.com

application of potassium nitrate (KNO_3) has demonstrated rapid uptake efficiency, offering a promising approach for enhancing fruit quality compared to soil applications (Kaur *et al.* 2025).

Despite the documented benefits of pruning and nutrient management, there is limited research on the combined effects of these practices in guava cultivation under north Indian conditions. Therefore, the present study, was carried out to bridge these research gaps. The findings aim to provide insights into sustainable guava cultivation practices, enhancing both productivity and profitability under sub-tropical agro-climatic conditions.

MATERIALS AND METHODS

The present experiment was conducted during 2023 and 2024 at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (25.260°–26.580°N and 79.310°–84.340°E, with a mean elevation of 125.90 m amsl), Uttar Pradesh. The area experiences a semi-arid subtropical climate, characterized by hot, dry summers and cold winters. The annual rainfall is 80–85 cm, primarily received during the northeast monsoon from July to September. Temperatures ranged from 24–47°C in summer and 5–27.8°C in winter, with relative humidity varying from 35–98%.

Experimental design: The experiment was laid out in a randomized block design (RBD) replicated thrice having 10 treatments comprising T_1, Control; T_2, Pruning of 20% shoot; T_3, Pruning of 40% shoot; T_4, Pruning of 60% shoot; T_5, Pruning of 20% shoot + KNO_3 @1.5%; T_6, Pruning of 40% shoot + KNO_3 @3.0%; T_7, Pruning of 60% shoot + KNO_3 @4.5%; T_8, Pruning of 20% shoot + $Ca(NO_3)_2$ @1.0%; T_9, Pruning of 40% shoot + Ca $(NO_3)_2$ @2.0% and T_{10}, Pruning of 60% shoot + $Ca(NO_3)_2$ @3.0%. Pruning was performed in May, followed by foliar applications using a fine mist sprayer. Uniform orchard management practices, including fertilization, irrigation, weeding and plant protection measures, were applied across all treatments. Intercultural operations and irrigation were conducted at 10-day intervals. Firm fruits were harvested when the fruit changed their colour from dark green to greenish yellow or pale yellow at maturity and yield/tree was calculated as the total weight of all pickings.

Observations recorded: Data collection involved recording growth, flowering, fruit and biochemical parameters using standardized methods.

Growth parameters: Growth parameters included plant height, measured vertically from the ground to the tree's top using a scaled bamboo pole at the experiment's start and end, and trunk girth, determined by measuring the circumference 30 cm above ground level with a measuring tape. Shoot length and girth were assessed by measuring the shoot's length with a measuring tape and the girth near its base using vernier calipers.

Flowering parameters: Flowering parameters encompassed days to flower bud initiation and flowering, recorded by observing the appearance of the first flower bud and full bloom. Fruit set and retention were calculated as the percentage of tagged flowers and fruits that matured.

Fruit parameters: Fruit parameters included dimensions, measured for length and width using vernier calipers, weight and volume were determined using a top-pan balance and water displacement method, respectively. The yield was expressed as the total fruit weight/tree in kg and extrapolated to yield/hectare in tonnes.

Biochemical parameters: Biochemical parameters were also evaluated. Total soluble solids (TSS as °Brix) were determined using a hand refractometer (Erma) corrected at 20°C as per Ranganna (1977). Titratable acidity (%) was measured by titrating fruit juice with 0.01N NaOH using phenolphthalein as an indicator. The TSS: acid ratio was calculated by dividing TSS by acidity. Ascorbic acid content (mg/100 g) was assessed following Ranganna (1977) method. Guava pulp was grind using a pestle and mortar. 5 ml of the working standard solution were mixed with 10 ml of 4% oxalic acid in a 100 ml conical flask and titrated against the dye to obtain the endpoint (V_1 ml). For sample estimation, 0.5–5 g of pulp was extracted in 4% oxalic acid, volume made up to 100 ml and centrifuged. A 5 ml aliquot of the supernatant was taken, mixed with 10 ml of 4% oxalic acid and titrated with dye to record the titer value (V_2 ml). The dye consumed was equivalent to the ascorbic acid content.

$$\text{Ascorbic acid (mg/100 g)} = \frac{0.\ 05 \times V_2 \times 100 \text{ ml} \times 100}{V_1 \text{ ml} \times 5 \text{ ml} \times \text{Weight of the sample (5 g)}}$$

Total sugars were estimated using the Lane and Eynon (1943) method. 50 ml of clear guava juice extract were mixed with 5 g citric acid and 50 ml distilled water in a 250 ml conical flask and gently boiled for 10 min to invert sucrose. The solution was neutralized using 1.0 N NaOH and the volume was adjusted to 250 ml with distilled water. A 50 ml aliquot of the clarified and de-leaded solution was treated with 10 ml HCl and kept at room temperature for 24 h. It was then neutralized with concentrated NaOH, the volume was adjusted, and an aliquot was taken for the estimation of total sugars.

$$\text{Total sugars (\%)} = \frac{\text{Factor} \times \text{Dilution} \times 100}{\text{Titre value} \times \text{Weight of sample or volume}}$$

Statistical analysis: The data were analyzed using analysis of variance (ANOVA) as per Panse and Sukhatme (1985). Treatment means were compared using Duncan's Multiple Range Test (DMRT) at a significant level of $p<0.05$ and were conducted to validate results using XLSTAT 2014.5.03 software, ensuring accuracy and statistical reliability.

RESULTS AND DISCUSSION

Growth and flowering parameters: In the present investigation, pooled data in Table 1 revealed that significantly maximum plant height and trunk girth were significantly recorded in T_9 (7.17 m and 29.44 cm, respectively), followed by T_{10} (6.58 m and 28.18 cm, respectively), while the minimum was observed in T_1 (4.23

Table 1 Effect of different pruning levels and chemical substances on vegetative and flowering parameters based on pooled data from May to October 2023 and 2024

Treatment	Plant height (m)	Trunk girth (cm)	Shoot length (cm)	Shoot girth (mm)	Days to flower bud initiation	Days to first flower	Number of flowers drop/shoot
T_1, Control	4.23 ± 0.03f	26.33 ± 0.57d	4.41 ± 0.01g	2.52 ± 0.05g	36.33 ± 0.11a	45.00 ± 0.40a	7.94 ± 0.01a
T_2, Pruning of 20%	4.54 ± 0.12e	26.54 ± 0.41d	7.07 ± 0.19f	4.07 ± 0.0f	34.36 ± 0.46b	31.67 ± 0.59c	6.71 ± 0.18c
T_3, Pruning of 40%	4.72 ± 0.05e	27.70 ± 0.56bcd	7.49 ± 0.16ef	4.12 ± 0.08f	30.02 ± 0.36c	30.20 ± 0.61cd	5.42 ± 0.08b
T_4, Pruning of 60%	4.76 ± 0.07e	28.54 ± 0.20ab	7.68 ± 0.05ef	7.11 ± 0.09b	30.33 ± 0.02c	42.00 ± 1.02a	7.25 ± 0.05d
T_5, Pruning of 20% + KNO_3 @1.5%	5.18 ± 0.01d	26.87 ± 0.54cd	8.40 ± 0.17d	4.95 ± 0.03d	26.02 ± 0.20e	35.33 ± 0.02a	5.40 ± 0.14d
T_6, Pruning of 40%+ KNO_3 @3.0%	5.99 ± 0.08c	28.99 ± 0.42ab	8.50 ± 0.06d	4.98 ± 0.05d	25.33 ± 0.01ef	29.90 ± 0.63d	5.05 ± 0.11e
T_7, Pruning of 60%+ KNO_3 @4.5%	5.28 ± 0.02d	28.80 ± 0.21ab	7.83 ± 0.04de	4.69 ± 0.13e	28.02 ± 0.02d	33.33 ± 0.19b	5.64 ± 0.04d
T_8, Pruning of 20% + $Ca(NO_3)_2$ @1.0%	6.78 ± 0.03b	28.34 ± 0.15ab	19.79 ± 0.08b	5.28 ± 0.09c	25.03 ± 0.18f	28.00 ± 0.18e	4.36 ± 0.02f
T_9, Pruning of 40% + $Ca(NO_3)_2$ @2.0%	7.17 ± 0.04a	29.44 ± 0.48a	22.83 ± 0.45a	7.87 ± 0.14a	22.33 ± 0.23g	23.67 ± 0.39f	4.05 ± 0.0g
T_{10}, Pruning of 60% + $Ca(NO_3)_2$ @3.0%	6.58 ± 0.15b	28.18 ± 0.60abc	17.16 ± 0.42c	5.18 ± 0.08cd	28.08 ± 0.36d	33.33 ± 0.50b	4.40 ± 0.01f

m and 26.33 cm, respectively). The significantly maximum shoot length was recorded in T_9 (22.83 cm), followed by T_8 (19.79 cm), while the minimum was observed in T_1 (4.41 cm). The significantly maximum shoot girth was recorded in T_9 (7.87 mm), followed by T_4 (7.11 mm), while the minimum was observed in T_1 (2.52 mm). These results highlighted the significant role of pruning and nutrient application in enhancing plant growth, trunk girth, shoot length and shoot girth. The beneficial effects observed in growth parameters under treatments like T_9 can be attributed to the physiological roles of calcium and potassium, which have been widely reported to influence membrane stability, cell division and enzymatic activity. Kumar *et al.* (2015) and Sharma *et al.* (2021) observed that calcium nitrate, as a dual source of calcium and nitrogen, promotes cell wall stabilization through lignin and cellulose deposition, enhancing structural integrity. Similarly, potassium is essential for regulating osmotic balance and stomatal conductance, thereby facilitating efficient nutrient uptake and water regulation. These findings align with the current results, where the combined application of calcium nitrate and potassium nitrate led to improved plant vigour. Pruning effectively reduces intra-plant competition by directing assimilates toward fewer, more productive shoots, thereby enhancing the leaf-to-fruit ratio, as also observed by Gomasta *et al.* (2024) and Yadav and Tripathi (2024). This adjustment improves light penetration, boosts photosynthetic efficiency and supports more balanced vegetative growth.

Significantly, minimum days to flower bud initiation were recorded in T_9 (22.33 days), followed by T_5 (26.02 days), while the maximum was observed in T_1 (36.33 days), which was significantly higher than the other treatments. The significantly minimum days to first flowering was recorded in T_9 (23.67 days), significantly lower than all other treatments. The maximum days to first flowering were observed in T_1 (45.00 days), which was significantly higher than the remaining treatments. The significantly minimum number of flowers dropped/shoot was recorded in T_9 (4.05), which was significantly lower than all other treatments.

The maximum flower drop was observed in T_1 (7.94), which was significantly higher compared to the rest of the treatments (Table 1). These findings suggest that pruning combined with calcium nitrate application significantly accelerated flower bud initiation, advanced flowering and effectively reduced flower drop (Kumar *et al.* 2017). In guava, which bears fruit on axillary buds of the current season's growth and possesses a mixed bud type (bearing both vegetative and floral components), pruning plays a foundational role in crop regulation. The axillary bearing habit necessitates the induction of new, healthy shoots each season, making judicious pruning essential to stimulate such growth. By removing apical dominance, pruning breaks bud dormancy, releases axillary buds from inhibition and promotes synchronized shoot emergence, critical pre-requisites for uniform flowering (Jain *et al.* 2023). However, this also temporarily diverts stored assimilates towards vegetative regeneration, sometimes delaying flowering, as observed in certain treatments. Such a delay is consistent with Dhaliwal and Singh (2004), who reported that early post-pruning carbohydrate utilization for shoot regrowth in guava may defer floral transition. Nonetheless, when pruning is strategically combined with calcium nitrate, this setback is mitigated. Calcium supports rapid cell division, stabilizes membranes and enhances the differentiation of floral meristems, while potassium improves chlorophyll content and photosynthetic efficiency. The combined effect improves light interception, nutrient distribution and flower retention, leading to higher yield. Furthermore, post-pruning metabolic adjustments such as reduced phenolic accumulation and increased proline biosynthesis create a favourable biochemical environment for flowering. These outcomes are in line with earlier studies by Shukla *et al.* (2011), Lal *et al.* (2016), Tripathi and Shukla (2011) and Srivastava *et al.* (2022), reinforcing the importance of integrating pruning with targeted nutrient management in guava to optimize flowering and productivity.

Fruit yield parameters: Pooled data presented in Table 2 revealed that significantly maximum number of fruits set and fruits retained/shoot were recorded in T_9 (11.58 and 8.96, respectively), followed by T_6 (11.52 and 8.48, respectively) and T_3 (11.34 and 8.29, respectively). The minimum fruit set and fruit retention/shoot were observed in T_1 (8.60 and 3.65, respectively). The significantly maximum fruit width was recorded in T_9 (6.12 cm), followed by T_8 (5.97 cm), while the minimum was observed in T_1 (4.58 cm). The significantly maximum fruit length was recorded in T_9 (7.12 cm), followed by T_{10} (6.61 cm), while the minimum was observed in T_1 (5.24 cm). The significantly maximum fruit weight and volume were recorded in T_9 (171.18 g and 266.55 cm³, respectively), followed by T_8 (166.51 g and 266.25 cm³, respectively), while the minimum values were observed in T_1 (139.38 g and 240.05 cm³, respectively). The significantly maximum fruit yield/tree was recorded in T_9 (45.34 kg), followed by T_8 (42.98 kg), while the minimum was observed in T_1 (33.00 kg). The significantly maximum fruit yield/ha was recorded in T_9 (11.87 t/ha), followed by T_8 (11.22 t/ha), whereas the minimum was observed in T_1 (8.45 t/ha). These findings underscore the significant impact of pruning and calcium nitrate application on improving fruit set, fruit retention, fruit size, fruit length, fruit weight, fruit volume, fruit yield/tree and fruit yield/ha. Moderate pruning significantly improved fruit set, retention and yield by achieving an optimal balance between vegetative and flowering growth. Pruning enhanced canopy light penetration and photosynthesis while reducing resource competition, resulting in higher fruit set and retention. These findings align with Brar *et al.* (2007), Lal *et al.* (2015), Tripathi *et al.* (2018) and Yadav and Tripathi (2024) who reported similar trends in guava and stone fruits.

The increase in fruit size, weight and volume were due to better redistribution of stored carbohydrates and a higher leaf-to-fruit ratio, ensuring adequate photosynthates for fruit development. Enhanced light interception within the canopy further contributed to improved fruit quality,

Table 2 Effect of different levels of pruning and chemical substances on fruit and fruit yield parameters based on pooled data from May to October 2023 and 2024

Treatment	Number of fruit set/shoot	Number of fruit retention/ shoot	Fruit width (cm)	Fruit length (cm)	Fruit weight (g)	Fruit volume (cm³)	Fruit yield (kg/tree)	Fruit yield (t/ha)
T_1, Control	8.60 ± 0.14e	3.65 ± 0.04g	4.58 ± 0.07f	5.24 ± 0.09e	139.38 ± 0.34e	240.05 ± 5.22d	33.00 ± 0.14f	8.45 ± 0.01f
T_2, Pruning of 20%	10.58 ± 0.01c	4.30 ± 0.05f	4.71 ± 0.06ef	5.53 ± 0.01de	143.73 ± 3.69de	243.93 ± 0.13cd	33.99 ± 0.60f	8.73 ± 0.04f
T_3, Pruning of 40%	11.34 ± 0.31ab	8.29 ± 0.01b	5.15 ± 0.01c	6.15 ± 0.15c	152.70 ± 3.12cd	254.89 ± 2.00abc	38.70 ± 0.78de	10.03 ± 0.14de
T_4, Pruning of 60%	10.48 ± 0.29c	6.30 ± 0.03e	4.86 ± 0.00de	5.75 ± 0.03d	141.33 ± 2.67e	252.05 ± 5.40bc	37.25 ± 0.04e	9.63 ± 0.21e
T_5, Pruning of 20% + KNO_3 @1.5%	10.78 ± 0.25c	7.65 ± 0.08c	5.24 ± 0.13c	6.43 ± 0.13bc	161.58 ± 0.25abc	258.21 ± 1.48ab	40.65 ± 0.82cd	10.57 ± 0.11c
T_6, Pruning of 40%+ KNO_3 @3.0%	11.52 ± 0.02a	8.48 ± 0.19b	5.68 ± 0.12b	6.54 ± 0.14b	161.66 ± 3.90abc	261.55 ± 1.37ab	40.66 ± 0.71cd	10.58 ± 0.25c
T_7, Pruning of 60%+ KNO_3 @4.5%	10.92 ± 0.12bc	7.68 ± 0.02c	5.09 ± 0.02cd	6.11 ± 0.04c	158.48 ± 3.32bc	254.88 ± 2.53abc	40.37 ± 0.67cd	10.50 ± 0.01cd
T_8, Pruning of 20% + $Ca(NO_3)_2$ @1.0%	10.81 ± 0.12bc	7.78 ± 0.04c	5.97 ± 0.12a	6.70 ± 0.16b	166.51 ± 2.88ab	266.25 ± 4.73a	42.98 ± 0.57b	11.22 ± 0.20b
T_9, Pruning of 40% + $Ca(NO_3)_2$ @2.0%	11.58 ± 0.05a	8.96 ± 0.07a	6.12 ± 0.08a	7.12 ± 0.14a	171.18 ± 4.04a	266.55 ± 5.43a	45.34 ± 1.18a	11.87 ± 0.17a
T_{10}, Pruning of 60% + $Ca(NO_3)_2$ @3.0%	9.50 ± 0.13d	7.26 ± 0.09d	5.65 ± 0.05b	6.61 ± 0.03b	153.46 ± 3.70c	263.38 ± 3.72ab	42.25 ± 0.54bc	11.02 ± 0.26bc

Table 3 Effect of different levels of pruning and chemical substances on quality parameters based on pooled data from May to October 2023 and 2024

Treatment	TSS (ºBrix)	Titratable acidity (%)	TSS: acid ratio	Ascorbic acid (mg/100 g)	Total sugars (%)	Sugar: acid ratio
T_1, Control	7.94 ± 0.01g	0.40 ± 0a	20.16 ± 0.21f	153.74 ± 2.17g	6.18 ± 0.07g	15.59 ± 0.16g
T_2, Pruning of 20%	8.61 ± 0.08f	0.38 ± 0bc	23.07 ± 0.14f	184.99 ± 1.36f	6.55 ± 0.15f	17.43 ± 0.18fg
T_3, Pruning of 40%	8.77 ± 0.07ef	0.37 ± 0.01c	24.16 ± 0.39f	193.57 ± 0.81ef	7.08 ± 0.15e	19.39 ± 0.26f
T_4, Pruning of 60%	8.84 ± 0.01def	0.39 ± 0.01fab	23.07 ± 0.35f	199.36 ± 3.76e	6.72 ± 0.04f	17.42 ± 0.22fg
T_5, Pruning of 20% + KNO_3 @1.5%	8.76 ± 0.08ef	0.21 ± 0bef	44.11 ± 0.54d	216.10 ± 5.43d	7.62 ± 0.12cd	38.04 ± 0.19cd
T_6, Pruning of 40%+ KNO_3 @3.0%	9.07 ± 0.05cd	0.22 ± 0e	43.41 ± 0.46d	225.15 ± 3.89bcd	7.81 ± 0.19bc	37.07 ± 0.48d
T_7, Pruning of 60%+ KNO_3 @4.5%	8.90 ± 0.13de	0.24 ± 0d	38.74 ± 0.46e	223.99 ± 1.29cd	7.32 ± 0.06de	31.59 ± 0.18e
T_8, Pruning of 20% + $Ca(NO_3)_2$ @1.0%	9.63 ± 0.01b	0.17 ± 0g	61.95 ± 2.00b	234.48 ± 2.45ab	8.13 ± 0.00b	51.72 ± 1.18b
T_9, Pruning of 40% + $Ca(NO_3)_2$ @2.0%	9.93 ± 0.06a	0.16 ± 0g	68.73 ± 2.54a	235.84 ± 4.32a	8.63 ± 0.18a	59.11 ± 2.14a
$T_{10,}$ Pruning of 60% + $Ca(NO_3)_2$ @3.0%	9.19 ± 0.18c	0.20 ± 0.01f	49.03 ± 2.10c	229.38 ± 1.08abc	7.66 ± 0.00cd	40.43 ± 0.83c

as noted by Adhikari and Kandel (2015) in guava fruits. Calcium promotes cell division and elongation, boosting fruit size and quality, as observed by Tripathi and Shukla (2011) in aonla.

Potassium played a vital role in stomatal regulation, chlorophyll synthesis and photosynthesis, improving yield and fruit quality, corroborating findings by Omar and Alam-Eldein (2014) in date palm, Harit *et al.* (2014) in ber and Kumar *et al.* (2017). Severe pruning reduced yields due to fewer bearing shoots, aligning with observations by Adhikari and Kandel (2015). The study highlighted that moderate pruning is an effective orchard management practice for optimizing fruit production and quality.

Bio-chemical parameters: In the present investigation, pooled data in Table 3 revealed that significantly maximum TSS (°Brix) and minimum titratable acidity were recorded in T_9 (9.93°Brix and 0.16 %, respectively), followed by T_8 (9.63°Brix and 0.17%, respectively), while the minimum was observed in T_1 (7.94°Brix and 0.40%, respectively). The data for TSS: acid ratio showed significant improvement in treatments with pruning combined with calcium nitrate. The highest TSS: acid ratio was observed in T_9 (68.73), followed by T_8 (61.95), whereas the control treatment (T_1) had the lowest ratio (20.16). The treatments with pruning and calcium nitrate significantly enhanced the significantly ascorbic acid content in the fruit. The highest ascorbic acid content was observed in T_9 (235.84 mg/100 g), followed closely by T_{10} (229.38 mg/100 g), showing that the combination of pruning and calcium nitrate led to higher levels of ascorbic acid compared to the control (T_1), which had 153.74 mg/100 g. These results indicated that both pruning and the application of calcium nitrate have a positive impact on the nutritional quality of the fruit, particularly in boosting ascorbic acid levels. The treatment combinations involving pruning and application of calcium nitrate or potassium nitrate led to significant increases in total sugar content compared to the T_1, Control (6.18 %). The significantly highest total sugar content was observed in T_9 (8.63), where pruning of 40% shoots was combined with 2.0% calcium nitrate, followed by T_8 (8.13), where pruning of 20% shoots was combined with 1.0% calcium nitrate. The significantly sugar-to-acid ratio significantly improved in all treatments compared to the control (15.59). The highest sugar-to-acid ratio was observed in T_9 (59.11), where pruning of 40% shoots was combined with 2.0% calcium nitrate, followed by T_8 (51.72), where pruning of 20% shoots was combined with 1.0% calcium nitrate. These treatments, particularly those involving both pruning and calcium nitrate, showed a marked enhancement in the fruit quality, like TSS, titratable acidity, TSS: acid ratio, ascorbic acid content, total sugar and sugar-to-acid ratio, indicating a more favourable fruit, which could enhance its taste quality.

The present study revealed significant improvements in key fruit quality parameters due to foliar applications of nutrients, particularly potassium nitrate. Total soluble solids (TSS) increased due to enhanced sugar accumulation, attributed to potassium's role in starch hydrolysis and translocation of sugars from leaves to fruits. This aligns with findings from Goutam *et al.* 2010 and Shirzadeh and Kazemi (2012), who also observed TSS enhancement with potassium application. As well, a decrease in acidity was noted, likely caused by the conversion of organic acids into sugars, a process facilitated by potassium's alkaline properties. This result is consistent with Gill *et al.* (2012) in pears.

The improved TSS: acid ratio indicates a better balance between sweetness and acidity, reflecting enhanced fruit quality. Ascorbic acid levels increased due to potassium's role in slowing ascorbic acid oxidation and promoting its synthesis, as reported by Yadav and Tripathi (2025). The increase in total sugars was a result of hydrolytic changes during ripening, further supported by potassium's effect on carbohydrate accumulation in fruits. The study also showed a rise in both reducing and non-reducing sugars, attributed to nutrient translocation, which enhanced carbohydrate levels in fruits, as corroborated by Prasad *et al.* (2015). Overall, the application of potassium and other nutrients significantly contributed to better fruit quality by improving TSS, sugar content and ascorbic acid levels while reducing acidity.

The present investigation demonstrated that the combination of pruning and nutrient application significantly enhanced growth, flowering, physical and biochemical parameters of guava. Treatments involving pruning and calcium nitrate application (T_9) consistently outperformed others, recording the highest plant height, trunk girth, shoot length and girth, alongside early flowering and reduced flower drop. Enhanced fruit set, retention, size, volume, weight and yield were also observed with T_9 achieving maximum fruit yield/ha (11.87 t/ha). Improved light penetration and optimized resource allocation through pruning contributed to these outcomes. Calcium nitrate and potassium nitrate played pivotal roles in improving fruit quality by increasing TSS, reducing acidity and enhancing TSS: acid ratio, vitamin C and sugar content. The findings underscore the synergistic effects of pruning and nutrient management, particularly calcium and potassium, in optimizing vegetative and flowering growth, resulting in superior yield and quality. These results provide a robust basis for recommending moderate pruning combined with calcium nitrate application to enhance guava productivity under similar agro-climatic conditions.

REFERENCES

Adhikari S and Kandel T P. 2015. Effect of time and level of pruning on vegetative growth, flowering, yield and quality of guava. *International Journal of Fruit Science* **15**(3): 290–301.

Bhattacherjee A K and Tandon D K. 2021. Composition and processing. *(In) Guava: Botany, Production and Uses*, pp. 33–63. CABI, Wallingford, UK.

Brar J S, Thakur A and Arora N K. 2007. Effect of pruning intensity on fruit yield and quality of guava (*Psidium guajava* L.) cv. Sardar. *Haryana Journal of Horticultural Sciences* **36**(1/2): 65–66.

Dhaliwal G S and Singh G. 2004. Effect of different pruning levels on vegetative growth, flowering and fruiting in Sardar guava. *Haryana Journal of Horticultural Sciences* **33**(3/4): 175–77.

Gill J, Dhillon W S, Gill P P S and Singh N. 2012. Fruit set and quality improvement studies on semi-soft pear cv. Punjab Beauty. *Indian Journal of Horticulture* **69**(1): 39–44.

Gomasta J, Sarker B C, Haque M A, Anwari A, Mondal S and Uddin M S. 2024. Pruning techniques affect flowering, fruiting, yield and fruit biochemical traits in guava under transitory sub-tropical conditions. *Heliyon* **10**(9): 1–17.

Goutam M, Dhaliwal H S and Mahajan B. 2010. Effect of pre-harvest calcium sprays on post-harvest life of winter guava (*Psidium guajava* L.). *Journal of Food Science and Technology* **47**(5): 501–06.

Harit K, Katiyar P N, Singh A K and Rajkumar B V. 2014. Effects of different pruning severity on physico-chemical properties of ber (*Zizyphus mauritiana* Lamk.) cv. Banarasi Karaka. *International Biannual Journal of Environmental Science* **8**(3/4): 203–06.

Jain S, Rathod M, Banjare R, Nidhi N, Sood A and Sharma R. 2023. Physiological aspects of flowering, fruit setting, fruit development and fruit drop, regulation and their manipulation: A review. *International Journal of Environment and Climate Change* **13**(12): 205–24.

Kaur K, Gupta M, Rattanpal H S, Chahal T S and Singh G. 2025. Improving fruit set and quality of daisy mandarin through foliar application of nutrients. *Journal of Plant Nutrition* **48**(3): 3–14. DOI: 10.1080/01904167.2024.2415477

Kumar A, Tripathi V K, Dubey A K and Dubey V. 2015. Influence of integrated nutrient management on fruit set, yield and physico-chemical parameters of winter season guava. *Progressive Research* **10**(Special-VII): 3722–24.

Kumar A, Tripathi V K, Dubey V, Katiyar N K and Tiwari P. 2017. Influence of foliar application of calcium, zinc and boron on fruit drop, yield and quality attributes of aonla (*Emblica officinalis*) cv. NA-7. *Research on Crops* **18**(1): 91–97.

Lal D, Tripathi V K, Kumar S and Nayyar M A. 2015. Effect of pre-harvest application of gibberellic acid, naphthalene acetic acid and calcium nitrate on yield and shelf-life quality of Kinnow mandarin. *Research in Environment and Life Science* **8**(4): 561–64.

Lal D, Tripathi V K, Nayyar M A, Kumar S, Ahmad M and Siddiqui M W. 2016. Pre-harvest spray of gibberellic acid, NAA and calcium nitrate on fruit retention, yield and quality of Kinnow mandarin. *Environment and Ecology* **34**(4C): 2288–92.

Lane J H and Eynon L. 1943. Determination of reducing sugar by Fehling solution with methylene blue as indicator. *Journal of the Society of Chemical Industry* **42**: 327.

Menzel C M and Paxton B F. 1985. The pattern of growth, flowering and fruiting of guava varieties in sub-tropical Queensland. *Australian Journal of Experimental Agriculture* **26**: 123–27.

Mishra D S, Singh S, Singh A K, Rao V A, Yadav V and Saroj P L. 2021. Crop regulation in fruit crops for improving quality and income of farmers. *(In) Dryland Horticulture*, pp. 415–34. CRC Press.

Mor R, Rana G S, Kumar S, Kumari S and Jat M L. 2024. Influence of foliar application of boron, iron and magnesium on quality attributes and leaf nutrient status of guava cv. Hisar Surkha. *Journal of Plant Nutrition* **47**(3): 423–32.

Omar A E and Alam-Eldein S M. 2014. Effect of strand thinning on yield and fruit quality of Egyptian dry date palm (*Phoenix dactylifera* L.) cv. Sultani. *Journal of the American Pomological Society* **68**(3): 135–40.

Panse V C and Sukhatme P V. 1985. *Statistical Methods for Agricultural Workers*. ICAR, New Delhi.

Prasad B, Dimri D C and Bora L. 2015. Effect of pre-harvest spray of calcium and potassium on fruit quality of pear cv. Pathernakh. *Scientific Research and Essays* **10**(11): 376–80.

Ranganna S. 1977. *Manual of Analysis of Fruit and Vegetable Products*. Tata McGraw Hill Publishing Company Limited, New Delhi.

Roussos P A. 2024. Climate change challenges in temperate and sub-tropical fruit tree cultivation. *Encyclopedia* **4**(1): 558–82.

Sharma N, Kaushik L, Kumar R and Reddy D K. 2021. Pre-harvest application of calcium chloride and salicylic acid enhances morphological and biochemical characteristics of guava (*Psidium guajava*). *Agricultural Mechanization in Asia* **52**(1): 2545–52.

Shirzadeh E and Kazemi M. 2012. Effect of essential oils treatments on quality characteristics of apple (*Malus domestica* var. Gala) during storage. *Trends in Applied Sciences Research* **7**(7): 584–89.

Shukla H S, Kumar V and Tripathi V K. 2011. Effect of gibberellic acid and boron on development and quality of aonla fruits 'Banarasi'. *Acta Horticulture* **890**: 375–80.

Srivastava K K, Kumar D, Singh S R, Barman P and Kumar P. 2022. Pruning in guava (*Psidium guajava*): A review. *Current Horticulture* **10**(2): 12–15. https://www.indianjournals.com/article/chr-10-2-002

Tripathi V K and Shukla H S. 2011. Influence of calcium chloride and calcium nitrate on physico-chemical composition of aonla 'Banarasi'. *Acta Horticulture* **890**: 371–74.

Tripathi V K, Pandey S S, Kumar A, Dubey V and Tiwari P. 2018. Influence of foliar application of gibberellic acid, calcium and boron on fruit drop, yield and quality attributes of aonla cv. NA-7. *The Indian Journal of Agricultural Sciences* **88**(11): 1784–88.

Yadav R K and Tripathi V K. 2024. Effect of pruning intensity and foliar feeding of nutrients on plant growth, fruiting and fruit quality parameters of Phalsa. *Biochemical and Cellular Achieves* **24**(Supplementary 1): 3749–55. DOI: 10.51470/bca.2024.24.0000

Yadav R K and Tripathi V K. 2025. Effect of pruning intensity and foliar nutrition on growth, yield and quality of Phalsa cv. Sharbati. *Indian Journal of Horticulture* **82**(1): 49–54. DOI: 10.58993/ijh/2025.82.1.9