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EFFECT OF DIFFERENT LEVELS OF PRUNING INTENSITY AND MICRONUTRIENTS ON GROWTH, YIELD AND QUALITY ATTRIBUTES OF WINTER-SEASON GUAVA

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ABSTRACT

A field experiment was conducted during 2025 at the Department of Fruit Science, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, to evaluate the effect of different pruning intensities and foliar application of calcium nitrate and zinc sulphate on the growth, yield and quality of winter-season guava (*Psidium guajava* L.) cv. Lucknow-49. The experiment comprised thirteen treatments arranged in a Randomized Block Design with 3 replications. Among the treatments, T₁₁-30% pruning + Ca(NO₃)₂ @ 1.5% + ZnSO₄ @ 0.75% significantly improved vegetative growth, flowering, fruit set and yield compared with the control and other treatments. The same treatment recorded the highest fruit weight (178.97 g), fruit yield (60.87 kg tree⁻¹ and 16.86 t ha⁻¹), TSS (13.88 °Brix), reducing sugar (5.01%), non-reducing sugar (4.40%), and total sugar (9.41%), while exhibiting the lowest titratable acidity (0.42%). The results indicated that moderate pruning combined with balanced foliar nutrition enhanced canopy architecture, photosynthetic efficiency, and nutrient utilization, resulting in superior productivity and fruit quality. Therefore, 30% pruning, integrated with Ca (NO₃)₂ @ 1.5% and ZnSO₄ @ 0.75%, is recommended to improve winter-season guava production under the agro-climatic conditions of central Uttar Pradesh.

Key words : Pruning intensity, Micronutrients, Photosynthetic efficiency, Titratable acidity, Vegetative growth.

Introduction

Guava (*Psidium guajava* L.), a member of the family Myrtaceae (2n = 22), is one of the most important fruit crops cultivated in tropical and subtropical regions. It originated in tropical America, particularly the region extending from Mexico to Peru, and was introduced to India by the Portuguese during the 17th century (Singh, 1995; Rout *et al.*, 2025). In India, guava ranks fourth among fruit crops in terms of area and production owing to its wide adaptability, high productivity and nutritional value. Guava bears fruit on current-year growth; therefore, pruning is an essential cultural practice for regulating canopy architecture, stimulating new fruiting shoots, and improving yield and fruit quality. Under North Indian conditions, the winter (Mrig bahar) crop produces superior-quality fruits with lower incidence of pests and

diseases and better market value than the rainy season crop (Sarkar *et al.*, 2005; Prakash *et al.*, 2012). Besides pruning, balanced nutrition is crucial for maximizing productivity. Calcium improves cell wall strength, fruit firmness, and shelf life, whereas zinc plays a vital role in enzyme activation, protein synthesis, and growth regulation. Therefore, the present study was undertaken to evaluate the effects of different pruning intensities, in combination with foliar applications of calcium nitrate and zinc sulphate, on the growth, yield, and quality of guava cv. Lucknow-49.

Materials and Methods

The present investigation, entitled “Effect of different Levels of Pruning Intensity and Micronutrients on Growth, Yield and Quality Attributes of Winter Season

Guava,” was conducted in 2025 at the Department of Fruit Science, College of Horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India. The experiment was conducted in a 17-year-old guava orchard with a spacing of 6.0×6.0 m. The experiment comprised thirteen treatments with three replications, laid out in a Randomised Block Design (RBD). The treatments included: T_0 -Control (no pruning); T_1 -Pruning at 15%; T_2 -Pruning at 30%; T_3 -Pruning at 45%; T_4 -15% pruning + $\text{Ca}(\text{NO}_3)_2$ @ 1.0%; T_5 -30% pruning + $\text{Ca}(\text{NO}_3)_2$ @ 1.5%; T_6 -45% pruning + $\text{Ca}(\text{NO}_3)_2$ @ 2.0%; T_7 -15% pruning + ZnSO_4 @ 0.50%; T_8 -30% pruning + ZnSO_4 @ 0.75%; T_9 -45% pruning + ZnSO_4 @ 1.0%; T_{10} -15% pruning + $\text{Ca}(\text{NO}_3)_2$ @ 1.0% + ZnSO_4 @ 0.50%; T_{11} -30% pruning + $\text{Ca}(\text{NO}_3)_2$ @ 1.5% + ZnSO_4 @ 0.75% and T_{12} -45% pruning + $\text{Ca}(\text{NO}_3)_2$ @ 2.0% + ZnSO_4 @ 1.0%. Pruning was performed according to the treatment schedule, and foliar sprays of calcium nitrate and zinc sulphate were applied at the prescribed concentrations. Observations were recorded on vegetative growth parameters, namely plant height, canopy spread (East–West and North–South), shoot length, shoot girth, number of leaves per shoot, and leaf area. Flowering parameters, including days to first flowering, number of flowers per shoot, fruit set, and fruit retention, were also recorded. Yield and physical fruit characteristics, including fruit weight, fruit length, fruit width, fruit volume, specific gravity, pulp weight, seed weight, number of seeds per fruit, pulp-to-seed ratio, fruit yield per tree, and fruit yield per hectare, were evaluated at harvest. Biochemical analyses, including total soluble solids (TSS), titratable acidity, TSS: acid ratio, reducing sugar, non-reducing sugar, and total sugar, were determined using standard analytical procedures. The recorded data were subjected to analysis of variance (ANOVA) appropriate for a Randomized Block Design, and treatment means were compared at the 5% level of significance.

Results and Discussion

Vegetative parameters

The vegetative growth of guava cv. Lucknow-49 was significantly influenced by different pruning intensities and foliar application of calcium nitrate and zinc sulphate (Table 1). Among the treatments, T_{11} -30% pruning + $\text{Ca}(\text{NO}_3)_2$ @ 1.5% + ZnSO_4 @ 0.75% recorded the maximum plant height (6.90 m), canopy spread in the East–West (8.10 m) and North–South (8.03 m) directions, shoot length (29.30 cm), and shoot girth (7.11 mm). This was followed by T_{12} -45% pruning + $\text{Ca}(\text{NO}_3)_2$ @ 2.0% + ZnSO_4 @ 1.0% and T_{10} -15% pruning + $\text{Ca}(\text{NO}_3)_2$ @

1.0% + ZnSO_4 @ 0.50%). In contrast, the minimum values for all vegetative parameters were recorded under the control treatment (T_0), with plant height (4.83 m), canopy spread (5.17 and 4.90 m), shoot length (7.81 cm), and shoot girth (2.94 mm). Similar improvements in vegetative growth due to pruning and micronutrient application have also been reported by Yadav and Tripathi (2024), Pandey *et al.* (2025), Tripathi *et al.* (2025) and Shinde *et al.* (2020). The enhanced plant height and canopy spread observed under T_{11} may be attributed to the optimum pruning intensity, which removed unproductive branches, improved canopy aeration and light penetration, and stimulated the emergence of vigorous new shoots (Kumar *et al.*, 2015a; Singh *et al.*, 2021). The increase in shoot length and shoot girth under combined application of calcium nitrate and zinc sulphate may be due to the complementary physiological roles of these nutrients. Calcium is involved in cell division, cell elongation, cell wall formation, and membrane stability, which contribute to vigorous shoot growth (Jadhav *et al.*, 1998; Dongre *et al.*, 2022).

Flowering parameters

The flowering parameters of guava cv. Lucknow-49 were significantly influenced by different pruning intensities and foliar application of calcium nitrate and zinc sulphate (Table 1). Among the treatments, T_{11} -30% pruning + $\text{Ca}(\text{NO}_3)_2$ @ 1.5% + ZnSO_4 @ 0.75% recorded the earliest flower bud initiation (22.53 days) and first flower initiation (22.33 days), the highest number of flowers per shoot (18.07), the lowest flower drop per shoot (3.20) and the maximum fruit set per shoot (14.27). The next best treatments were T_{12} and T_{10} . In contrast, the control (T_0) showed the poorest performance, recording delayed flower bud initiation (38.33 days), delayed first flowering (44.00 days), the lowest number of flowers per shoot (9.67), the highest flower drop (7.33), and the minimum fruit set per shoot (2.67). The improved flowering behaviour under T_{11} may be attributed to the synergistic effect of moderate pruning and balanced foliar nutrition. Moderate pruning improves canopy architecture by enhancing light penetration and air circulation, thereby stimulating the emergence of vigorous current-season shoots, which are the principal fruit-bearing shoots in guava (Yadav *et al.*, 2017; Yadav *et al.*, 2020). Calcium plays an important role in cell division, pollen viability, pollen tube growth and flower retention, whereas zinc regulates auxin synthesis, enzyme activation, chlorophyll formation, and carbohydrate metabolism, thereby enhancing flowering and fruit set (Adhikari and Kandel, 2015; Yadav *et al.*, 2017). The present findings are in close agreement with those of Yadav and Tripathi (2025),

Table 1 : Effect of different levels of pruning intensity and micronutrients on vegetative and flowering parameters of winter-season guava.

Treatments	Plant height (m)	Plant canopy (m)		Shoot length (cm)	Shoot girth (mm)	Days to flowerbud initiation	Days to first flower initiation	Number of flowers per shoot	Number of dropped flowers/shoot	Number of fruit set per shoot
		E-W	N-S							
T ₀	4.83	5.17	4.90	7.81	2.94	38.33	44.00	9.67	7.33	2.67
T ₁	5.60	5.47	5.42	13.01	4.22	36.47	33.07	10.47	6.90	4.60
T ₂	5.83	5.83	5.90	14.08	4.34	32.23	32.10	11.60	6.73	5.27
T ₃	6.27	6.50	6.81	17.57	5.37	29.28	28.50	13.67	5.73	6.67
T ₄	6.57	6.96	6.97	22.49	5.80	27.98	25.31	15.60	4.73	8.40
T ₅	6.22	6.20	6.56	16.08	4.95	30.09	29.74	12.67	6.27	6.47
T ₆	6.28	6.27	6.62	16.69	5.17	29.88	29.73	13.13	5.93	6.47
T ₇	6.42	6.67	6.93	18.24	5.64	28.48	28.69	13.93	5.67	7.40
T ₈	6.12	6.13	6.39	15.57	4.72	31.26	30.06	12.47	6.40	6.00
T ₉	5.97	6.03	6.27	14.47	4.52	31.57	30.95	12.13	6.53	5.40
T ₁₀	6.62	7.17	7.05	23.97	6.12	25.18	23.72	15.80	4.13	11.60
T ₁₁	6.90	8.10	8.03	29.30	7.11	22.53	22.33	18.07	3.20	14.27
T ₁₂	6.71	7.33	7.33	25.39	6.35	24.30	23.08	16.60	3.60	12.60
SE(m) ±	0.20	0.61	0.57	1.21	0.28	0.91	1.28	0.78	0.67	0.72
C.D. at 5% level	0.06	0.21	0.20	0.41	0.10	0.31	0.44	0.27	0.23	0.25

who also reported that optimal pruning combined with micronutrient application significantly improved flowering and fruit set in guava.

Physical parameters

The physical attributes and yield of guava cv. Lucknow-49 were significantly influenced by different pruning intensities and foliar application of calcium nitrate and zinc sulphate (Table 2). Among the treatments, T₁₁ -30% pruning + Ca(NO₃)₂ @ 1.5% + ZnSO₄ @ 0.75% recorded the highest fruit weight (178.97 g), fruit length (7.88 cm), fruit width (7.28 cm), fruit volume (156.33 cc), specific gravity (1.13 g cc⁻¹), pulp weight (173.80 g), pulp ratio (33.61), yield per tree (60.87 kg) and fruit yield (16.86 t ha⁻¹). The same treatment also recorded the lowest seed weight (5.17 g) and number of seeds per fruit (222.10). The next best performance was observed in T₁₂, followed by T₁₀, whereas the control (T₀) recorded the minimum fruit weight (89.84 g), pulp weight (82.67 g), pulp ratio (11.52), yield per tree (31.59 kg) and fruit yield (9.25 t ha⁻¹), along with the highest seed weight (7.17 g) and number of seeds per fruit (306.90). The superior performance of T₁₁ may be attributed to the synergistic effect of moderate pruning and balanced foliar nutrition. Pruning at 30% maintained an optimum canopy architecture by removing overcrowded and non-productive shoots, thereby improving light interception, air circulation and photosynthetic efficiency. This increased the production and translocation of photosynthates from source leaves to developing fruits, resulting in greater fruit size and weight (Kumar *et al.*, 2015a; Kumar *et al.*, 2015b; Lal *et al.*, 2015; Ghatul *et al.*, 2019). Calcium nitrate further enhanced fruit development by promoting cell division, elongation, and cell wall biosynthesis. Calcium stabilizes cell membranes, strengthens the middle lamella by forming calcium pectate, and maintains cellular integrity, thereby promoting larger fruits with greater pulp weight and higher specific gravity (Singh and Kaur, 2019; Singh *et al.*, 2020). The lower seed weight and reduced number of seeds per fruit, coupled with a higher pulp ratio under T₁₁, indicate a more efficient partitioning of

Table 2 : Effect of different levels of pruning intensity and micronutrients on physical parameters of winter season guava.

Treatment	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Fruit volume (cc)	Specific gravity (g/cc)	Pulp weight (g)	Seed weight/ fruit	Number of seeds per fruit	Pulp: seed ratio	Yield (kg/tree)	Fruit yield (t/ha)
T ₀	89.84	5.33	4.63	101.13	1.08	82.67	7.17	306.90	11.52	31.59	9.25
T ₁	101.09	6.32	4.98	101.87	1.09	94.09	7.00	286.27	13.44	36.10	11.07
T ₂	105.06	6.41	5.52	102.97	1.09	98.23	6.83	282.53	14.38	39.60	11.58
T ₃	114.78	6.98	6.07	109.77	1.11	108.54	6.24	262.33	17.39	47.20	11.48
T ₄	123.03	7.17	6.41	113.90	1.11	117.05	5.98	250.77	19.57	54.10	11.87
T ₅	109.82	6.71	5.98	107.40	1.10	103.44	6.38	273.20	16.21	45.97	11.90
T ₆	112.98	6.89	6.05	109.23	1.10	106.64	6.34	265.13	16.82	46.47	12.58
T ₇	119.00	7.05	6.13	110.70	1.11	112.88	6.12	256.33	18.44	49.87	13.95
T ₈	107.76	6.61	5.93	106.07	1.10	101.10	6.66	278.20	15.18	42.93	13.71
T ₉	106.58	6.45	5.87	104.80	1.10	99.76	6.82	281.67	14.62	42.40	15.55
T ₁₀	139.10	7.35	6.65	124.47	1.12	133.24	5.86	242.33	22.73	55.17	15.28
T ₁₁	178.97	7.88	7.28	156.33	1.13	173.80	5.17	222.10	33.61	60.87	16.86
T ₁₂	158.14	7.53	6.91	140.80	1.12	152.48	5.66	233.70	26.93	58.30	15.59
SE(m) ±	10.43	0.29	0.28	7.33	0.01	9.77	0.25	7.48	2.56	3.55	1.52
C.D.at 5% level	4.33	0.10	0.09	2.50	0.02	4.35	0.08	2.55	0.87	1.21	0.52

assimilates toward pulp development rather than toward seed formation. Enhanced metabolic activity and better nutrient availability promoted mesocarp development, resulting in fleshy fruits with superior market quality (Kumar *et al.*, 2026; Bagal *et al.*, 2025; Tripathi and Shukla, 2011). The significantly higher yield per tree and per hectare under T₁₁ was mainly due to increased fruit size, higher fruit retention, and more efficient utilization of available assimilates, resulting from optimum canopy management and balanced nutrient supply. Although severe pruning (45%) also improved fruit characteristics compared with the control, it was inferior to 30% pruning, probably because excessive shoot removal temporarily reduced the photosynthetic surface available for carbohydrate production and delayed canopy recovery.

Biochemical parameters

The biochemical parameters of guava cv. Lucknow-49 were significantly affected by different pruning intensities and foliar application of calcium nitrate and zinc sulphate (Fig. 1). Among the treatments, T₁₁-30% pruning + Ca(NO₃)₂ @ 1.5% + ZnSO₄ @ 0.75% recorded the highest TSS (13.88 °Brix), TSS ratio (33.04), reducing sugar (5.01%), non-reducing sugar (4.40%) and total sugar (9.41%), along with the lowest titratable acidity (0.42%). T₁₂ and T₁₀ followed this, whereas the control (T₀) recorded the lowest TSS (11.25 °Brix), sugars and TSS ratio, with the highest acidity (0.68%). Moderate pruning enhanced light penetration, canopy aeration and photosynthetic efficiency, thereby increasing carbohydrate synthesis and their translocation to developing fruits (Bagchi *et al.*, 2008; Bhagawati *et al.*, 2015). Calcium and zinc play important complementary roles in enhancing sugar accumulation during fruit development. Calcium improves membrane stability, cell wall integrity and assimilate transport. At the same time, zinc acts as a cofactor for several enzymes involved in photosynthesis, carbohydrate metabolism and auxin synthesis, thereby promoting the accumulation of reducing, non-reducing, and total sugars (Zagade *et al.*, 2020; Brar *et al.*, 2007; Parmar *et al.*, 2014). The lower acidity observed in



Fig. 1 : Effect of different levels of pruning intensity and micronutrients on biochemical parameters of winter-season guava.

T₁₁ may be due to the conversion of organic acids into sugars during fruit ripening, resulting in a higher TSS ratio and improved fruit flavour (Brar *et al.*, 2007; Tripathi *et al.*, 2018; Bagchi *et al.*, 2008; Kumar *et al.*, 2017; Lal *et al.*, 2016; Shukla *et al.*, 2011).

Conclusion

The present study revealed that pruning intensity and foliar applications of calcium nitrate and zinc sulphate significantly influenced the growth, flowering, yield, and quality of winter-season guava cv. Lucknow-49. Among the treatments, 30% pruning combined with Ca(NO₃)₂ @ 1.5% and ZnSO₄ @ 0.75% (T₁₁) proved to be the most effective by producing superior vegetative growth, early flowering, higher fruit set, maximum yield and improved fruit quality. Moderate pruning maintained an optimum canopy architecture, while balanced nutrient application enhanced physiological and biochemical processes. Therefore, this integrated treatment can be recommended for the commercial cultivation of winter-season guava under the agro-climatic conditions of central Uttar Pradesh to achieve higher productivity and better fruit quality.

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