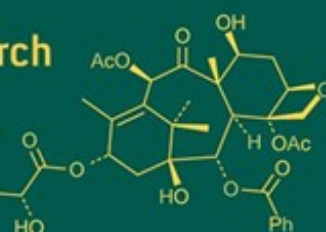
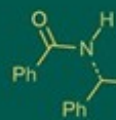


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Effect of growth regulators and manual thinning of fruits on the quality of guava cv. Taiwan lite pink super gold

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ABSTRACT

The present investigation on the effect of growth regulators and manual fruit thinning on quality attributes of guava (*Psidium guajava* L.) cv. Taiwan Lite Pink Super Gold during 2025-26 at a farmer's field in Kallanganguru village, Shivamogga, Karnataka. The experiment was conducted in a Randomized Complete Block Design with ten treatments and three replications, comprising manual fruit thinning at 20, 40 and 60 per cent, NAA at 50, 100 and 150 ppm, Ethrel at 500, 1000 and 1500 ppm, along with an unthinned control. The fruit parameters and quality attributes including fruit size, weight, volume, firmness, shelf life, TSS, titratable acidity, sugars, vitamin C and lycopene were evaluated. Among the treatments, 60 per cent manual fruit thinning recorded the highest fruit weight (369.50 g), firmness (8.68 kg cm⁻²), shelf life (10.53 days), TSS (12.33 °Brix), total sugars (8.24%), vitamin C (231.01 mg 100 g⁻¹) and lycopene (5.23 mg 100 g⁻¹), along with the lowest titratable acidity (0.30%). Ethrel @ 1000 ppm also performed comparatively well for several quality attributes. The improvement was attributed to reduced crop load and enhanced assimilate partitioning towards retained fruits. Thus, 60 per cent manual fruit thinning was the most effective treatment for improving overall fruit quality of guava.

Keywords: Guava, Fruit thinning, Growth regulators, Quality

Introduction

Guava (*Psidium guajava* L.), popularly known as the "apple of the tropics," is an important tropical and sub-tropical fruit crop valued for its nutritional richness, adaptability and pleasant flavour. The fruit is particularly valued for its high vitamin C content, dietary fibre, sugars, minerals and bioactive compounds, making it an important component of a healthy diet (Semwal *et al.*, 2024) [1]. Among the commercially cultivated cultivars, newer selections with attractive fruit colour, large size and improved eating quality have gained considerable importance. Fruit quality in guava is influenced by genetic characteristics, environmental conditions, crop load and cultural practices. Excessive fruiting increases competition among developing fruits for assimilates, water and nutrients, which may result in smaller fruits, reduced total soluble solids, sugars, colour development and other desirable quality attributes. Therefore, regulation of crop load is important for improving the quality and market value of guava fruits.

Fruit thinning is an important crop management practice that involves the removal of excess young fruits to reduce competition among the remaining fruits. It can be carried out manually or through chemical growth regulators such as naphthalene acetic acid (NAA) and ethephon (Ethrel). Chemical thinning promotes fruit abscission by modifying hormonal balance and enhancing ethylene-mediated separation of young fruits. The effectiveness of thinning depends on the concentration of the growth regulator, degree of manual thinning and stage of application. Appropriate thinning can improve the allocation of assimilates towards the retained fruits, thereby enhancing fruit size, total soluble solids, sugars, vitamin C, colour, firmness and other biochemical constituents. It may also influence titratable acidity and the overall balance between sugars and acids, which are important determinants of consumer acceptability and eating quality. Thus, optimizing crop load through manual and chemical thinning can be an effective approach for producing larger, nutritionally superior and more marketable guava fruits.

The cultivar Taiwan Lite Pink Super Gold is characterized by attractive fruit appearance and desirable eating quality, but information on the influence of different thinning levels and growth regulator concentrations on its quality attributes is limited. Hence, the present investigation was undertaken to evaluate the effect of growth regulators and manual thinning of fruits on the quality attributes of guava cv. Taiwan Lite Pink Super Gold.

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Materials and Method

Experimental site

The study was conducted during 2025-26 at a farmer's field in Kallaganguru village, Shivamogga district, *Karnataka*. The experimental site is situated at 13°56' N latitude and 75°33' E longitude, at an elevation of about 569 m above mean sea level and falls under the Southern Transition Zone of *Karnataka*. The region experiences a tropical monsoon climate with distinct summer, monsoon and winter seasons. The soil of the experimental site was red loamy to red lateritic, acidic and non-saline in nature.

Experimental design and treatment details

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The experiment comprised ten treatments with four plants per treatment in each replication, resulting in 120 plants in total. Four-year-old healthy and uniform guava plants of *cv. Taiwan Lite Pink Super Gold*, spaced at 2.4 × 2.4 m, were selected for the experiment.

Table 1. Treatment details

Treatment	Treatment details
T ₁	Control (No thinning)
T ₂	20 per cent fruit thinning
T ₃	40 per cent fruit thinning
T ₄	60 per cent fruit thinning
T ₅	NAA @ 50 ppm
T ₆	NAA @ 100 ppm
T ₇	NAA @ 150 ppm
T ₈	Ethrel @ 500 ppm
T ₉	Ethrel @ 1000 ppm
T ₁₀	Ethrel @ 1500 ppm

Treatment imposition

The treatments were imposed one month after fruit set at the pea stage during the last week of December. Manual fruit thinning was carried out by removing the required proportion of young fruits using a secateur at 20, 40 and 60 per cent levels. Chemical thinning treatments were imposed using NAA at 50, 100 and 150 ppm and Ethrel at 500, 1000 and 1500 ppm concentrations (Table 1).

Observations recorded

Observations on fruit quality parameters were recorded at commercial maturity. Physical quality parameters, viz., fruit length, fruit diameter, fruit weight, fruit volume, fruit firmness and shelf life were recorded, while chemical quality parameters viz., total soluble solids, titratable acidity, TSS ratio, total sugars, reducing sugars, non-reducing sugars, vitamin C and lycopene content were estimated.

The data on all quality parameters were subjected to analysis of variance (ANOVA) for a Randomized Complete Block Design. Significant differences between treatment means were compared using the critical difference (CD) at 5 per cent level of significance.

Results and Discussion

The results obtained from the present investigation are presented and discussed in this chapter. The findings are interpreted based on the effects of manual fruit thinning and growth regulator treatments on fruit quality and are compared with the findings of earlier researchers.

Physical parameters

The physical characteristics of fruits, viz., fruit length, fruit diameter, fruit weight and fruit volume, were significantly influenced by manual fruit thinning and growth regulator treatments (Table 2). The highest fruit length (8.93 cm), fruit diameter (10.12 cm), fruit weight (369.50 g) and fruit volume (399.94 cc) were recorded in T₄ (60% fruit thinning), followed by T₃ (40% fruit thinning), whereas the lowest values were recorded in T₁ (control). The improved fruit size under higher thinning levels might be attributed to reduced crop load and better partitioning of assimilates towards the developing fruits. Similar improvement in fruit growth with crop-load regulation and growth regulator application has been reported by Tahir *et al.* (2002) [2], Mishra *et al.* (2020) [3] and Lal *et al.* (2023) [4].

Table 2. Effect of growth regulators and manual thinning of fruits on physical parameters of guava *cv. Taiwan Lite Pink Super Gold*

Treatments	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit volume (cc)
T ₁ - Control (No thinning)	6.03	6.12	163.04	176.21
T ₂ - 20 per cent Fruit thinning	7.11	7.37	217.14	231.45
T ₃ - 40 per cent Fruit thinning	8.62	9.76	316.53	339.54
T ₄ - 60 per cent Fruit thinning	8.93	10.12	369.50	399.94
T ₅ - NAA @ 50 ppm	6.13	6.17	171.09	184.80
T ₆ - NAA @ 100 ppm	6.86	6.85	183.01	191.28
T ₇ - NAA @ 150 ppm	7.84	8.08	225.66	243.54
T ₈ - Ethrel @ 500 ppm	7.06	7.70	217.64	236.57
T ₉ - Ethrel @ 1000 ppm	7.93	8.69	246.99	264.09
T ₁₀ - Ethrel @ 1500 ppm	7.90	8.70	242.10	259.50
S.Em. ±	0.19	0.33	7.99	9.19
CD @ 5%	0.58	1.06	23.92	27.54

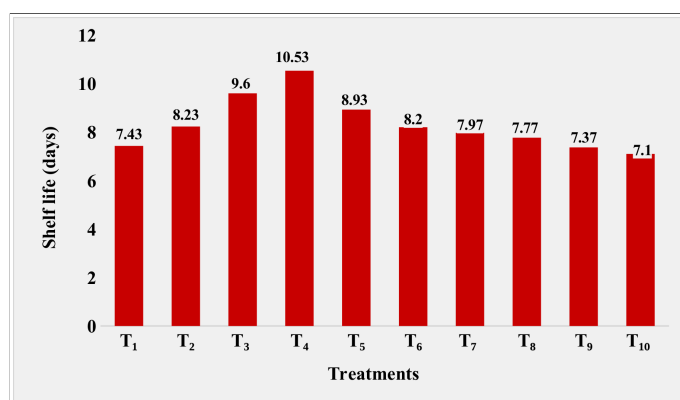
Fruit firmness and shelf life

Fruit firmness and shelf life were significantly influenced by the treatments (Table 3). The highest fruit firmness (8.68 kg cm⁻²) and shelf life (10.53 days) were recorded in T₄ (60% fruit thinning), followed by T₃ (40% fruit thinning), whereas the lowest firmness (5.93 kg cm⁻²) and shelf life (7.10 days) were recorded in T₁₀ (Ethrel @ 1500 ppm). The enhanced firmness and shelf life under higher thin-

ning may be attributed to reduced crop load, improved assimilate and mineral partitioning, particularly calcium and delayed cell-wall degradation. In contrast, the lower firmness and shelf life under higher Ethrel concentration may be due to its ethylene-releasing action, which accelerates ripening and softening (Fig. 1). Similar findings were reported by Deshmukh *et al.* (2022) [5], Jemric *et al.* (2005) [6], Devlal *et al.* (2017) [7], Kumar *et al.* (2017) [8] and Kaur *et al.* (2024) [9].

Table 3. Effect of growth regulators and manual thinning of fruits on fruit firmness and shelf life of guava cv. Taiwan Lite Pink Super Gold

Treatments	Fruit firmness (kg/cm ²)	Shelf life (Days)
T ₁ - Control (No thinning)	6.57	7.43
T ₂ - 20 per cent Fruit thinning	7.07	8.23
T ₃ - 40 per cent Fruit thinning	8.33	9.60
T ₄ - 60 per cent Fruit thinning	8.68	10.53
T ₅ - NAA @ 50 ppm	6.70	8.93
T ₆ - NAA @ 100 ppm	7.43	8.20
T ₇ - NAA @ 150 ppm	8.07	7.97
T ₈ - Ethrel @ 500 ppm	6.13	7.77
T ₉ - Ethrel @ 1000 ppm	5.96	7.37
T ₁₀ - Ethrel @ 1500 ppm	5.93	7.10
S.Em. ±	0.18	0.24
CD @ 5%	0.54	0.73

**Figure 1.** Effect of growth regulators and manual thinning of fruits on shelf life of guava cv. Taiwan Lite Pink Super Gold

TSS, acidity and TSS:acid ratio

The TSS, acidity and TSS ratio of fruits were significantly influenced by manual thinning and growth regulator treatments (Table 4). The highest TSS (12.33 °Brix) and TSS:acid ratio (41.40), along with the lowest acidity (0.30%), were recorded in T₄ (60% fruit thinning), whereas the lowest TSS (10.20 °Brix) and TSS ratio (22.63) were recorded in T₁ (control). The increase in TSS and TSS:acid ratio with higher thinning may be attributed to reduced crop load and improved source-sink balance, resulting in greater accumulation of soluble solids, while the reduction in acidity may be associated with increased utilization of organic acids during fruit maturation. Similar results were reported by Tahir *et al.* (2002) [2], Mishra *et al.* (2020) [3], Rahman *et al.* (2017) [10], Lal *et al.* (2023) [4] and Makvana *et al.* (2024) [11].

Table 4. Effect of growth regulators and manual thinning of fruits on TSS, acidity and TSS:acid ratio of guava cv. Taiwan Lite Pink Super Gold

Treatments	TSS (° Brix)	Acidity (%)	TSS: Acid Ratio
T ₁ - Control (No thinning)	10.20	0.45	22.63
T ₂ - 20 per cent Fruit thinning	10.63	0.44	24.28
T ₃ - 40 per cent Fruit thinning	11.87	0.39	30.92
T ₄ - 60 per cent Fruit thinning	12.33	0.30	41.40
T ₅ - NAA @ 50 ppm	10.43	0.45	23.52
T ₆ - NAA @ 100 ppm	10.87	0.43	25.64
T ₇ - NAA @ 150 ppm	11.47	0.38	30.67
T ₈ - Ethrel @ 500 ppm	11.18	0.41	27.65
T ₉ - Ethrel @ 1000 ppm	12.03	0.36	33.99
T ₁₀ - Ethrel @ 1500 ppm	11.53	0.33	34.84
S.Em. ±	0.09	0.004	0.44
CD @ 5%	0.27	0.012	1.33

Sugar composition

The reducing sugars, non-reducing sugars and total sugars were significantly influenced by the treatments (Table 5). The highest reducing sugars (5.03%), non-reducing sugars (3.21%) and total sugars (8.24%) were recorded in T₄ (60% fruit thinning), while the lowest values (3.73, 2.43 and 6.17%, respectively) were recorded in T₁ (control). The higher sugar accumulation under fruit thinning may be attributed to reduced competition among developing fruits and greater availability of assimilates for individual fruits, together with enhanced conversion of stored carbohydrates into soluble sugars during ripening (Fig. 2). Similar findings were reported by Tahir *et al.* (2002) [2], Patel *et al.* (2014) [12], Jain *et al.* (2011) [13], Silva *et al.* (2022) [14] and Kumari *et al.* (2023) [15].

Table 5. Effect of growth regulators and manual thinning of fruits on sugar composition of guava cv. Taiwan Lite Pink Super Gold

Treatments	Reducing sugars (%)	Non reducing sugars (%)	Total sugars (%)
T ₁ - Control (No thinning)	3.73	2.43	6.17
T ₂ - 20 per cent Fruit thinning	3.90	2.85	6.75
T ₃ - 40 per cent Fruit thinning	4.37	2.97	7.33
T ₄ - 60 per cent Fruit thinning	5.03	3.21	8.24
T ₅ - NAA @ 50 ppm	3.80	2.68	6.48
T ₆ - NAA @ 100 ppm	4.17	2.85	7.02
T ₇ - NAA @ 150 ppm	4.57	3.08	7.65
T ₈ - Ethrel @ 500 ppm	4.13	2.77	6.90
T ₉ - Ethrel @ 1000 ppm	4.73	3.15	7.88
T ₁₀ - Ethrel @ 1500 ppm	4.40	3.13	7.53
S.Em. ±	0.07	0.04	0.08
CD @ 5%	0.22	0.11	0.24

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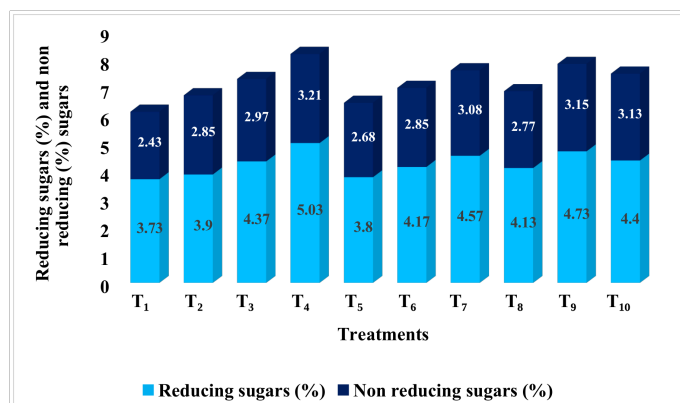


Figure 2. Effect of growth regulators and manual thinning of fruits on reducing sugars and non-reducing sugars of guava cv. Taiwan Lite Pink Super Gold

Bioactive compounds

The bioactive compounds, viz., vitamin C and lycopene, were significantly influenced by manual fruit thinning and growth regulator treatments (Table 6). The highest vitamin C (231.01 mg/100 g) and lycopene (5.23 mg/100 g) contents were recorded in T₄ (60% fruit thinning), which were at par with T₉ (Ethrel @ 1000 ppm), whereas the lowest values were recorded in T₁ (control). The enhancement in bioactive compounds under higher thinning may be attributed to improved source-sink balance, greater assimilate availability and advanced physiological maturity of the fruits. Similar improvements in vitamin C and lycopene content with crop-load regulation and growth regulator application have been reported by Tahir *et al.* (2002) [2], Santos *et al.* (2023) [16], Singh (2019) [17], Silva *et al.* (2022) [14], Kumari *et al.* (2023) [15] and Presman *et al.* (2020) [18].

Table 6. Effect of growth regulators and manual thinning of fruits on vitamin C and lycopene content of guava cv. Taiwan Lite Pink Super Gold

Treatments	Vitamin C (mg/100g)	Lycopene content (mg/100g)
T ₁ - Control (No thinning)	185.10	4.29
T ₂ - 20 per cent Fruit thinning	187.49	4.62
T ₃ - 40 per cent Fruit thinning	224.47	4.92
T ₄ - 60 per cent Fruit thinning	231.01	5.23
T ₅ - NAA @ 50 ppm	186.48	4.60
T ₆ - NAA @ 100 ppm	198.18	4.85
T ₇ - NAA @ 150 ppm	212.41	4.90
T ₈ - Ethrel @ 500 ppm	205.85	4.85
T ₉ - Ethrel @ 1000 ppm	227.81	5.04
T ₁₀ - Ethrel @ 1500 ppm	217.78	4.94
S.E.m. ±	3.66	0.10
CD @ 5%	10.95	0.29

Conclusion

The present investigation revealed that manual fruit thinning and growth regulator treatments significantly influenced the quality attributes of guava cv. Taiwan Lite Pink Super Gold. Among the treatments, 60 per cent manual fruit thinning was most effective in improving overall fruit quality, recording the highest fruit weight, firmness, shelf life, TSS, sugars, vitamin C and lycopene, along with the lowest titratable acidity. The improvement in quality may be attributed to reduced crop load and better allocation of assimilates towards the retained fruits, resulting in enhanced fruit development and bio-

chemical quality. Ethrel @ 1000 ppm also showed comparatively better performance for several quality attributes. Thus, 60 per cent manual fruit thinning can be recommended as an effective practice for producing larger, firmer and nutritionally superior guava fruits of cv. Taiwan Lite Pink Super Gold under the conditions of the present study.

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