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EFFECT OF PLANT GROWTH REGULATORS AND MICRONUTRIENTS ON FLOWERING AND FRUITING ATTRIBUTES OF GUAVA (*PSIDIUM GUAJAVA* L.) CV. L-49

Avdhesh Kumar[1] and Bhagwan Deen[2]

[1]Research Scholar, Department of Fruit science, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 U.P., India.
Email: avdheshk05797@gmail.com
[2]Professor, Department of Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 U.P., India.

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ABSTRACT

The present investigation entitled "Studies on effect of foliar feeding of micronutrients and plant growth regulators on fruiting behaviour, yield, quality and storability of Guava (*Psidium guajava* L.) fruits cv. L-49" was carried out during the year 2023-24 and 2024-2025 at Main Experiment Station, Department of Fruit Science, College of Horticulture and Forestry, ANDUAT, Kumarganj, Ayodhya, Uttar Pradesh, India. The treatments comprised of the spraying of different PGRs and micronutrients to study the flowering and fruiting attributes of guava fruits cultivar L-49. The experiment was conducted in randomized block design (RBD) with eleven treatments and three replications. The experiment consisted of eleven treatments including T_1 (Control), T_2 ($ZnSO_4$ 0.5%), T_3 (Borax 0.5 %), T_4 (NAA 40 ppm), T_5 (GA_3 40 ppm), T_6 ($ZnSO_4$ @ 0.5 % + Borax @ 0.5%), T_7 (ZnSO4 0.5% + NAA 40 ppm) T_8 (ZnSO4 0.5% + GA_3 40 ppm), T_9 (Borax 0.5% + NAA 40 ppm) T_{10} (Borax 0.5% + GA_3 40 ppm) T_{11} (GA_3 40 ppm + NAA 40 ppm) Were used for this study. The minimum days taken to 50% fruit set (8.56 days), maximum fruit set % (65.90 %), minimum fruit drop % (29.24 %) and maximum fruit retention (61.48 %) were observed with the foliar application of T_{11} (GA_3 40 ppm + NAA 40 ppm) under the agroclimatic condition of Eastern Uttar Pradesh of India.

INTRODUCTION

Guava (*Psidium guajava* L.) "Apple of the tropics" belongs to family Myrtaceae and is a highly remunerative fruit crop. The basic chromosome number is 2n=11 and the diploids have 2n=22. It is an important fruit of Tropical and Subtropical areas of the world and was introduced in India in the 17th century by the Portuguese. Guava is classified under genus *Psidium*, which consists of 150 species (Hayes, 1970) but only *Psidium guajava* L. has been exploited commercially. The most of species of guava are fruit bearing. It was originated in Tropical America (Peru) where it is grown as wild bush. It is one of the commercially important fruit crops of the country not because of its large area and production, but due to its wider edapho-climatic adaptability, hardiness to various biotic and abiotic stresses, precocious and prolific bearing habit, quality fruit with high nutritive value, medicinal attribute, as fresh fruit and suitability for different value-added products. Guava fruit is known for its "Vitamin-C", minerals like calcium, iron and phosphorous with pleasant aroma and flavour (Ulemale and Tambe, 2015). Nutritive value of guava is very high. Therefore, it is an ideal fruit for nutritional security. Guava is one of the cheapest and good sources of vitamin-C (210-305mg/100g fruit pulp) and pectin (0.5-1.8%) but has low energy (66cal/100g). The ripe fruits contain 12.3-26.3% dry matter, 77.9-86.9% moisture, 0.51-1.02% ash,0.10-0.70% crude fat, 0.82-1.45% crude protein and 2.0-7.2% crude fiber. The fruit fruits is also rich in minerals like Phosphorus (22.5-40.0 mg/100g pulp), Calcium (10.0-30.0 mg/100g pulp) and Iron (0.60- 1.39 mg/100g pulp), Pantothenic acid, Thiamine (0.03-0.07 mg/100g pulp), Riboflavin (0.02-0.04 mg/100g pulp) and Vitamin – A (Mitra and Bose, 2001).

Micronutrients are required for healthy plant growth and development playing critical roles in various enzymatic processes and synthesis. Severe deficiencies in these micronutrients can sometimes lead to irreversible problems (Kumar, 2002). Additionally, micronutrients facilitate the major nutrient absorption and are integral to numerous metabolic processes within plants involving activities like cell wall biosynthesis, metabolic respiration, photosynthetic activity, chlorophyll biosynthesis, enzymatic function, hormone production and the process of nitrogen integration (Das, 2003). Plant growth regulators are defined as the organic compound or other than nutrients, which small amount promote or inhibit or otherwise modify any physiological response in plants. Gibberellins may be defined as a compound which promotes growth in plants and processes gibbane ring structure. Mahmood *et al.,* (2016) reported that gibberellins resulted better on fruit set, increased ascorbic acid and better T.S.S. in guava. NAA is important growth regulator of auxin group, which helps to reduce fruit drop and improve fruit set. NAA reduce the number of seed of the fruits. It also induces heavier fruiting and promotes flowering (Meena *et al.,* 2022). In this experiment objectives are to determine the foliar feeding effect of nutrients on flowering and fruiting attributes of guava fruits.

MATERIAL AND METHODS

The experiment titled Studies on effect of foliar feeding of micronutrients and plant growth regulators on fruiting behaviour, yield, quality and storability of Guava (*Psidium guajava* L.) fruits cv. L-49 was carried out during 2023-24 and 2024-2025 at the Main Experiment Station of Horticulture, Acharya Narendra Deva University of Agriculture and Technology (ANDUAT), Kumarganj, Ayodhya. It involved ten-year-old L-49 guava plants planted at a spacing of 6 m × 6 m. The eleven treatments details are T_1 (Control), T_2 ($ZnSO_4$ 0.5%), T_3

(Borax 0.5 %), T_4 (NAA 40 ppm), T_5 (GA_3 40 ppm), T_6 ($ZnSO_4$ @ 0.5 % + Borax @ 0.5%), T_7 ($ZnSO_4$ 0.5% + NAA 40 ppm) T_8 ($ZnSO_4$ 0.5% + GA_3 40 ppm), T_9 (Borax 0.5% + NAA 40 ppm) T_{10} (Borax 0.5% + GA_3 40 ppm) T_{11} (GA_3 40 ppm + NAA 40 ppm). A Randomized Block Design with eleven treatments and three replications was involved, and nutrient sprays were applied twice in both year (2023-24 and 2024-2025) once prior to flowering in and once after fruit set**.** At Flowering and fruit setting stage, plant growth regulators and micronutrients were sprayed into the leaves of each treatment to give a homogeneous spray over the whole guava plant treatment.

Days taken to 50% fruit set: -

This observation was recorded by visiting the experimental field every day after inflorescence emergence and the number of days was counted from the date of first spraying to the day when 50 per cent of flowers opened on the inflorescence.

Fruit set (%): -

Fruit-set percentages for each treatment were recorded on four branches per experimental plant, one from each cardinal direction. During flowering, the number of flowers on these tagged branches was counted and after flowering the number of fruit set was recorded by visually assessing fertilized fruit identified by swollen ovaries and dry, fallen petals. The average fruit set percentage was then determined using the following formulae:

$$\text{Fruit set } (\%) = \frac{\text{Number of fruit set}}{\text{Number of flowers}} \times 100$$

Fruit drop (%)

The fruit drop, branches were tagged in each direction of plant and the numbers of fruits were counted at pea stage and the time of maturity. Per cent of fruit drop was calculated with the help of following formula:

$$\text{Fruit drop } (\%) = \frac{\text{Number of fruits at initial stage} - \text{Number of fruit retained at the maturity}}{\text{Number of fruits at initial stage}} \times 100$$

Fruit retention (%):

The fruit retention % Computed by the number of fruits retained till maturity divided by the number of fruit sets and expressed in per cent. The average fruit set percentage was then determined using the following formulae:

$$\text{Fruit retention}(\%) = \frac{\text{Total number of fruit set} - \text{fruit drop}}{\text{Total number of fruit set}} \times 100$$

RESULTS AND DISCUSSIONS

Days taken to 50% fruit set

A perusal of data on days taken to 50% flowering as influenced by micronutrients and plant growth regulators is presented in Table-1. The results revealed that all the treatments significantly reduced the days taken to 50% fruit set compared to control.

During 2023-24, the minimum days taken to 50% flowering (8.57 days) was recorded with foliar application of T_{11} (GA_3 40 ppm + NAA 40 ppm), which was significantly superior over all other treatments. This was followed by T_{10} (Borax 0.5% + GA_3 40 ppm), T_9 (Borax 0.5% + NAA 40 ppm) and T_6 ($ZnSO_4$ 0.5% + Borax 0.5%) treatments which required 9.43, 9.85 and 9.80 days, respectively. However, the maximum days to 50% flowering (12.64 days) was observed in control (T_1).

Similar trend was observed during 2024-25, wherein the minimum days taken to 50% flowering (8.54 days) was noted in T_{11} (GA_3 40 ppm + NAA 40 ppm), which was significantly superior over rest of the treatments. This was followed by T_{10} (Borax 0.5% + GA_3 40 ppm), T_9 (Borax 0.5% + NAA 40 ppm) and T_8 ($ZnSO_4$ 0.5% + GA_3 40 ppm) treatments with 9.23, 9.34 and 9.45 days, respectively. While, the maximum days to 50% flowering (12.23 days) was recorded under control (T_1).

The pooled data of both years demonstrated that all the treatments significantly hastened flowering as compared to control. The earliest flowering (8.56 days) was observed in plants treated with GA_3 40 ppm + NAA 40 ppm (T_{11}), which was significantly superior over all other treatments. It was followed by T_{10} (Borax 0.5% + GA_3 40 ppm), T_9 (Borax 0.5% + NAA 40 ppm) and T_8 ($ZnSO_4$ 0.5% + GA_3 40 ppm) treatments which took 9.33, 9.59 and 9.80 days, respectively. The maximum days to 50% flowering (12.44 days) was recorded in control (T_1). The enhancement in flowering could be attributed to improved nutrient availability, enhanced metabolic activities, and the regulatory role of growth hormones in flower bud differentiation and development. These findings corroborate with the results reported by Kumar and Shukla (2010) in guava, Trivedi *et al.* (2012) in guava, Khan *et al.* (2015) in guava, Badal and Tripathi (2021) in guava**,** Gaund *et al.* (2022) in guava, Meena *et al.* (2022) in guava, Shukla *et al.* (2022) and Shukla *et al.* (2025) in guava fruits.

Fruit Set %

The data presented in Table 1 demonstrates the effect of micronutrients and plant growth regulators on fruit set percentage across two consecutive years (2023-24 and 2024-25) of investigation. During 2023-24, the maximum fruit set (65.94%) was recorded with foliar application of T_{11} (GA_3 40 ppm + NAA 40 ppm). This was followed by T_{10} (Borax 0.5% + GA_3 40ppm), with fruit set percentages of 65.84 %. The minimum fruit set (55.27%) was observed in the control treatment.

A comparable trend was observed during 2024-25, wherein the highest fruit set (65.86%). This was closely followed by T_9 (Borax 0.5% + NAA 40 ppm), recording 64.85. The control treatment exhibited the lowest fruit set (55.50%).

Pooled analysis of the data revealed that all treatments enhanced fruit set percentage over the control. The maximum fruit set (65.90 %) was recorded in plants treated with T_{11} (GA_3 40 ppm + NAA 40 ppm), followed by T_{10} (Borax 0.5% + GA_3 40 ppm), 65.78. The control treatment recorded the minimum fruit set (55.39%) T_1.

The significantly higher fruit set observed with the combination of $ZnSO_4$ and GA_3 can be attributed to the synergistic action of zinc in auxin metabolism and gibberellic acid in promoting cell division and elongation, which collectively enhance reproductive processes. The beneficial effect of boron in combination with GA_3 on fruit set can be explained by boron's critical role in pollen tube germination, fertilization and carbohydrate translocation, while GA_3 enhances cell elongation and prevents abscission. These findings corroborate with the results reported by Kumar and Shukla (2010) in guava, Trivedi *et al.* (2012) in guava, Khan *et al.* (2015) in guava, Badal and Tripathi (2021) in guava**,** Gaund *et al.* (2022) in guava, Meena *et al.* (2022) in guava, Shukla *et al.* (2022) and Shukla *et al.* (2025) in guava fruits.

Fruit Drop %

A critical examination of the data in Table 2 reveals significant influence of micronutrient and plant growth regulator treatments on decreasing the fruit drop percentage in comparison to control during both years of experimentation. During 2023-2024, the significantly minimum (29.47 %) fruit drop was observed with the foliar application of T_{11} (GA_3 40 ppm + NAA 40 ppm) over rest of the treatments, which was followed by T_{10} (Borax 0.5% + GA3 40 ppm), T_9 (Borax 0.5% + NAA 40 ppm) and T_8 ($ZnSO_4$ 0.5% + GA_3 40 ppm) treatments with 31.49, 33.61 and 35.55 % fruit drop, respectively. However, the maximum (57.48%) fruit drop was recorded under control treatment.

During 2024-2025, a similar trend was observed and the minimum (29.01 %) fruit drop was recorded in T_{11} (GA_3 40ppm + NAA 40ppm), which effect was significantly superior over rest of the treatments. This was followed by T_{10} (Borax 0.5% + GA_3 40ppm), T_9 (Borax 0.5% + NAA 40 ppm) and T_8 ($ZnSO_4$ 0.5% + GA_3 40ppm) treatments with 31.70, 33.68 and 35.22 % fruit drop, respectively. While the maximum (57.15 %) fruit drop was observed in control treatment.

Pooled data demonstrates that all the treatments significantly reduced fruit drop percentage over the control. The minimum (29.24%) fruit drop was recorded in plants sprayed with T_{11} (GA_3 40 ppm + NAA 40 ppm), which was significantly reduced the fruit drop in comparison to rest treatments. It was followed by T_{10} (Borax 0.5% + GA_3 40 ppm), T_9 (Borax 0.5% + NAA 40 ppm), T_8 ($ZnSO_4$ 0.5% + GA_3 40 ppm) and T_7 ($ZnSO_4$ 0.5% + NAA 40 ppm) treatments with 31.60, 33.64, 35.39 and 38.31% fruit drop, respectively. The maximum (57.32 %) fruit drop was recorded in control treatment.

The reduced fruit drop with NAA application is primarily due to its anti-senescence properties and ability to inhibit the formation of abscission zones at the pedicel-fruit junction. GA_3, on the other hand, maintains cell turgidity and delays aging processes in reproductive tissues, thus contributing to better fruit retention. The superior performance of combined treatments over individual applications suggests synergistic interactions among these nutrients and growth regulators in regulating hormonal homeostasis and metabolic processes associated with fruit development and retention. These findings corroborate with the results reported by Gaund *et al.* (2022) in guava, Meena *et al.* (2022) in guava, Shukla *et al.* (2022) in guava and Suman *et al.,* (2021) in guava fruits.

Fruit Retention (%)

A perusal of Table 2 reveals significant influence of micronutrients and plant growth regulators on fruit retention percentage during both years of investigation. During 2023-24, the significantly maximum fruit retention of 61.50% was observed with the foliar application of T_{11} (GA_3 40 ppm + NAA 40 ppm) over rest of the treatments, which was followed by T_{10} (Borax 0.5% + GA_3 40 ppm), T_9 (Borax 0.5% + NAA 40 ppm) and T_8 ($ZnSO_4$ 0.5% + GA_3 40 ppm) treatments with 58.68, 56.47 and 54.72% fruit retention, respectively. However, the minimum fruit retention of 37.22% was recorded under control (T_1). During 2024-25, a similar trend was observed and the maximum fruit retention of 61.47% was recorded in T_{11} (GA_3 40 ppm + NAA 40 ppm) which was significantly superior over rest of the treatments. This was followed by T_{10} (Borax 0.5% + GA_3 40 ppm), T_9 (Borax 0.5% + NAA 40 ppm) and T_8 ($ZnSO_4$ 0.5% + GA_3 40 ppm) treatments with 58.64, 56.80 and 54.07% fruit retention, respectively. While the minimum fruit retention of 37.26% was observed in control (T_1). Pooled data in Table 4.1.6 shows that all the treatments increased fruit retention percentage significantly over the control. The significantly maximum fruit retention of 61.48% was recorded in plants sprayed with GA_3 40 ppm + NAA 40 ppm (T_{11}). It was followed by T_{10} (Borax 0.5% + GA_3 40 ppm), T_9 (Borax 0.5% + NAA 40 ppm) and T_8 ($ZnSO_4$ 0.5% + GA_3 40 ppm) treatments with 58.66, 56.63 and 54.40% fruit retention, respectively. Whereas lowest fruit retention of 37.24% was recorded in control (T_1). Higher fruit retention in treatments was might be due to promoting effect of zinc on auxin biosynthesis, boron effect on membrane stability and young fruit abscission and GA_3 and NAA level in the pedicle that temporarily inhibits abscission zone activity. These findings corroborate with the results reported by Sonam *et al.* (2024) in guava, Meena *et al.* (2022) in guava, Shukla *et al.* (2022) in guava, Gaund *et al.* (2022) in guava and Suman *et al.* (2021) in guava, Shukla *et al.* (2025) in guava fruits.

Table-1 Effect of Plant growth regulators and micronutrients on Days taken to 50% fruit set and Fruit setting of Guava cv. L-49.

Treatments	Days taken to 50% fruit set			Fruit set (%)		
	2023-24	2024-25	Pool	2023-24	2024-25	Pool
T_1: Control	12.64	12.23	12.44	55.27	55.50	55.39
T_2: $ZnSO_4$ 0.5%	11.98	11.87	11.93	57.61	57.61	57.61
T_3: Borax 0.5%	11.54	11.46	11.50	59.60	59.60	59.60
T_4: NAA 40 ppm	11.10	11.23	11.16	63.55	63.22	63.38
T_5: GA_3 40 ppm	10.93	10.78	10.85	62.33	62.33	62.33
T_6: $ZnSO_4$ 0.5% + Borax 0.5%	9.80	10.12	9.96	61.55	61.51	61.54
T_7: $ZnSO_4$ 0.5% + NAA 40 ppm	10.23	10.54	10.38	64.31	64.57	64.44
T_8: $ZnSO_4$ 0.5% + GA_3 40 ppm	10.14	9.45	9.80	65.47	65.50	65.48
T_9: Borax 0.5% + NAA 40 ppm	9.85	9.34	9.59	65.19	64.85	65.32
T_{10}: Borax 0.5% + GA_3 40 ppm	9.43	9.23	9.33	65.84	65.62	65.78
T_{11}: GA_3 40 ppm + NAA 40 ppm	8.57	8.54	8.56	65.94	65.86	65.90
SEm±	0.47	0.41	0.30	0.35	0.42	0.37
CD at 5%	0.16	0.14	0.10	1.04	1.25	1.10

Table-2 Effect of Plant growth regulators and micronutrients on Fruit Drop (%) fruit set and Fruit Retention (%) of Guava cv. L-49.

Treatments	Fruit Drop (%)			Fruit Retention (%)		
	2023-2024	2024-2025	Pooled	2023-2024	2024-2025	Pooled
T_1: Control	57.48	57.15	57.32	37.22	37.26	37.24
T_2: $ZnSO_4$ 0.5%	53.36	53.70	53.53	40.63	40.63	40.63
T_3: Borax 0.5%	50.33	50.63	50.48	42.54	42.48	42.51
T_4: NAA 40 ppm	47.47	47.45	47.46	46.37	46.71	46.54
T_5: GA_3 40 ppm	44.61	44.94	44.78	48.49	48.47	48.48
T_6: $ZnSO_4$ 0.5% + Borax 0.5%	41.57	41.23	41.40	50.28	50.29	50.29
T_7: $ZnSO_4$ 0.5% + NAA 40 ppm	38.24	38.38	38.31	52.58	52.52	52.55
T_8: $ZnSO_4$ 0.5% + GA_3 40 ppm	35.55	35.22	35.39	54.72	54.07	54.40
T_9: Borax 0.5% + NAA 40 ppm	33.61	33.68	33.64	56.47	56.80	56.63
T_{10}: Borax 0.5% + GA_3 40 ppm	31.49	31.70	31.60	58.68	58.64	58.66
T_{11}: GA_3 40 ppm + NAA 40 ppm	29.47	29.01	29.24	61.50	61.47	61.48
SEm±	0.52	0.66	0.58	0.45	0.60	0.46
CD at 5%	1.56	1.96	1.72	1.34	1.77	1.38

CONCLUSION

Based on the results of the present investigation, it can be concluded that foliar application of T_{11} (GA_3 40 ppm + NAA 40 ppm) was significantly superior to the control in enhancing fruiting behavior, and overall quality attributes of guava fruits. The T_{11} (GA_3 40 ppm + NAA 40 ppm) treatment effectively reduced the fruit drop. Additionally, it significantly improved parameters such as the fruit set and fruit retention.

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