

Original Research Article

Effect of foliar feeding of plant growth regulator and nutrients on phenological attributes of Guava (*Psidium guajava* L.) cv. Apple Colour.

Comment [MF1]: Is that Variety name ..delete it

ABSTRACT:

Comment [MF2]: The abstract must be compound from Introduction ,methods, results and conclusion

The experiment was carried out on a 10-year-old guava plant in a high-density plantation (3x3) at the Fruit Research Station Imaliya, Department of Horticulture, J.N.K.V.V., Jabalpur (M.P.) during the mrig-bahar season of 2022-23. The study employed a Factorial Randomised Block Design (FRBD) with 20 treatment combinations involving Plant Growth Regulators (PGR) like salicylic acid and various nutrients, replicated three times. Results indicated that the combination of salicylic acid (200 ppm) + borax (0.5%) significantly influenced several phenological parameters. This treatment resulted in the earliest flower bud initiation (18.33 days) after foliar application, the highest average number of flower buds per shoot (7.05), minimum days to 50% flowering (33.67 days), maximum average number of flowers per shoot (6.95), the highest fruit set percentage (92.18%), the highest fruit retention percentage (81.23%), and the lowest fruit drop percentage (18.77%). These results were closely followed by the combination of salicylic acid (300 ppm) and borax (0.5%), both showing superior performance compared to the control.

Key words: foliar spray, phenological attributes, flower, PGR, nutrients, FRBD

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1. INTRODUCTION

Guava (*Psidium guajava* L.), a prominent fruit crop in tropical and subtropical regions, belongs to the Myrtaceae family. Originating from tropical America, specifically from Mexico to Peru, guava has grown in commercial importance across various countries. Introduced to India in the early 17th century, it has since become a widely cultivated commercial crop. Major guava-producing states in India include Uttar Pradesh, Madhya Pradesh, Bihar, Gujarat, Karnataka, Andhra Pradesh, and Maharashtra. India has a total guava cultivation area of 328,000 hectares, with an annual production of 4.8 million metric tonnes and a productivity rate of 24.2 metric tonnes per hectare. In Madhya Pradesh, specifically, the guava cultivation area spans 45,000 hectares, with a production of 820,000 metric tonnes and a productivity rate of 20.1 metric tonnes per hectare (NHB 2022-23).

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Guava stands out among many other fruits due to its high commercial and nutritional value. It is an inexpensive and rich source of vitamin C, containing 2 to 5 times more vitamin C than fresh orange juice, with levels reaching 260 mg per 100 grams. Additionally, guava is a good source of pectin, a type of polysaccharide. The ripe fruit comprises 12.3-26.3% dry matter, 77.9-86.9% moisture, 0.511% ash, 0.10-0.70% crude fat, 0.82-1.45% crude protein, and 2.0-7.2% crude fiber (Mitra and Bose, 2001).

Comment [MF5]: IN references list 2021

In recent years, nutrient deficiencies in guava orchards across India have been linked to reduced yield and quality compared to international standards. Nutrients play a crucial role in fruit production, and their deficiency can significantly impact the yield, productivity, and quality of fruits. Among trace elements, zinc and boron are particularly important for the flowering and fruiting processes. These elements enhance fruit set, reduce fruit drop, and improve fruit quality in various crops (El. Sherif *et al.*, 1997). Boron is essential for cell wall formation and reproductive development, while zinc influences auxin metabolism and protein synthesis, both of which are critical for optimal flowering and fruiting (Harsha *et al.*, 2024).

Comment [MF6]: IN references list 2023

Plant growth regulators (PGRs) function as essential messengers in plants, required in minute quantities to induce significant physiological changes, thereby enhancing crop productivity and quality. Salicylic acid (SA), a notable plant hormone, has demonstrated considerable effectiveness in influencing the flowering parameters of fruit crops. SA plays a critical role in the regulation of flowering by modulating various physiological processes, including the induction of flowering, flower retention, and overall floral development.

Research indicates that SA treatment can lead to earlier flower bud initiation, increased number of flower buds per shoot, and improved flower retention rates. For instance, studies have shown that SA application results in the early initiation of flower buds and a higher number of flowers per shoot, which directly impacts fruit set and overall yield (Rahmani *et al.*, 2017). Moreover, SA has been observed to enhance the plant's resistance to stress conditions, thereby supporting sustained flowering and fruiting under adverse conditions (Suman, Pency, Meghawal, & Sahu, 2017). The basic concept of nutrient and plant growth regulators is the adjustment of plant nutrient supply to an optimum level for sustaining the desired crop productivity. The foliar application of nutrients and plant growth regulator plays a significant role in improving the phenological attributes of plants.

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2.0 MATERIALS AND METHODS

The experiment was conducted at the Fruit Research Station Imaliya, Department of Horticulture, J.N.K.V.V., Jabalpur (M.P.) on 10-year-old guava plants grown in a high-density (3x3) plantation during the mrig-bahar season of 2022-23. The trees were maintained with a consistent cultural regimen. The experimental design was a Factorial Randomized Block Design (FRBD) with 20 treatment combinations, each replicated three times. The study involved two factors: plant growth regulator (Salicylic acid) with four levels and nutrients with five levels. Plants were sprayed with varying concentrations of Salicylic acid (100, 200, and 300 ppm) and nutrients (KNO₃ 0.5%, ZnSO₄ 0.5%, Ca(NO₃)₂ 2%, and Borax 0.5%), along with a control. Treatments were applied three times: before bud initiation, at the fruit setting stage, and post-pre-harvest stage. The treatment combinations used in the study are detailed in Table 1.

Table 1: Various treatment combinations

S.No.	Notation	Treatment combination
1	S ₀ M ₀	Control
2	S ₀ M ₁	KNO ₃ 0.5 %
3	S ₀ M ₂	ZnSO ₄ 0.5%
4	S ₀ M ₃	Ca(NO ₃) ₂ 2%
5	S ₀ M ₄	Borax 0.5%
6	S ₁ M ₀	Salicylic acid 100 ppm
7	S ₁ M ₁	Salicylic acid 100 ppm + KNO ₃ 0.5 %
8	S ₁ M ₂	Salicylic acid 100 ppm + ZnSO ₄ 0.5%
9	S ₁ M ₃	Salicylic acid 100 ppm + Ca (NO ₃) ₂ 2%
10	S ₁ M ₄	Salicylic acid 100 ppm + Borax 0.5%
11	S ₂ M ₀	Salicylic acid 200ppm
12	S ₂ M ₁	Salicylic acid 200 ppm + KNO ₃ 0.5 %
13	S ₂ M ₂	Salicylic acid 200 ppm + ZnSO ₄ 0.5%
14	S ₂ M ₃	Salicylic acid 200 ppm + Ca(NO ₃) ₂ 2%
15	S ₂ M ₄	Salicylic acid 200 ppm + Borax 0.5%
16	S ₃ M ₀	Salicylic acid 300 ppm
17	S ₃ M ₁	Salicylic acid 300 ppm + KNO ₃ 0.5 %
18	S ₃ M ₂	Salicylic acid 300 ppm + ZnSO ₄ 0.5%
19	S ₃ M ₃	Salicylic acid 300 ppm + Ca(NO ₃) ₂ 2%
20	S ₃ M ₄	Salicylic acid 300 ppm + Borax 0.5%

2.0 Data Collection

		after foliar applicatio n	shoot	after foliar applicatio n	flowers per shoot	%		
1	S ₀ M ₀	23.667	4.73	43.333	4.64	65.68	65.24	34.76
2	S ₀ M ₁	20.667	5.54	38.333	5.48	74.15	70.42	29.58
3	S ₀ M ₂	20.000	5.85	37.000	5.74	77.84	73.80	26.20
4	S ₀ M ₃	21.667	5.28	40.000	5.28	72.00	68.28	31.72
5	S ₀ M ₄	19.667	6.12	36.333	6.12	80.35	74.84	25.16
6	S ₁ M ₀	22.667	4.95	41.667	4.80	68.23	65.86	34.14
7	S ₁ M ₁	20.000	5.76	37.667	5.66	75.84	73.04	26.96
8	S ₁ M ₂	19.000	6.38	35.667	6.24	83.68	77.76	22.24
9	S ₁ M ₃	20.667	5.46	38.667	5.36	74.00	69.94	30.06
10	S ₁ M ₄	19.000	6.66	35.333	6.54	85.60	78.23	21.77
11	S ₂ M ₀	22.000	5.14	40.333	5.14	69.45	66.68	33.32
12	S ₂ M ₁	19.333	6.25	35.667	6.15	81.30	75.46	24.54
13	S ₂ M ₂	18.667	6.73	34.667	6.73	87.94	79.14	20.86
14	S ₂ M ₃	20.000	5.76	37.333	5.68	77.05	73.48	26.52
15	S ₂ M ₄	18.333	7.05	33.667	6.95	92.18	81.23	18.77
16	S ₃ M ₀	21.000	5.34	38.667	5.28	72.74	69.22	30.78
17	S ₃ M ₁	19.667	6.05	36.667	5.86	78.66	74.16	25.84
18	S ₃ M ₂	19.000	6.46	35.333	6.46	85.00	78.12	21.88
19	S ₃ M ₃	20.333	5.66	37.667	5.66	75.00	72.28	27.72
20	S ₃ M ₄	18.667	6.95	34.333	6.86	89.25	79.62	20.38
SEm±		0.185	0.077	0.343	0.077	0.842	0.640	0.638
CD at 5%		0.530	0.220	0.983	0.219	2.410	1.833	1.828

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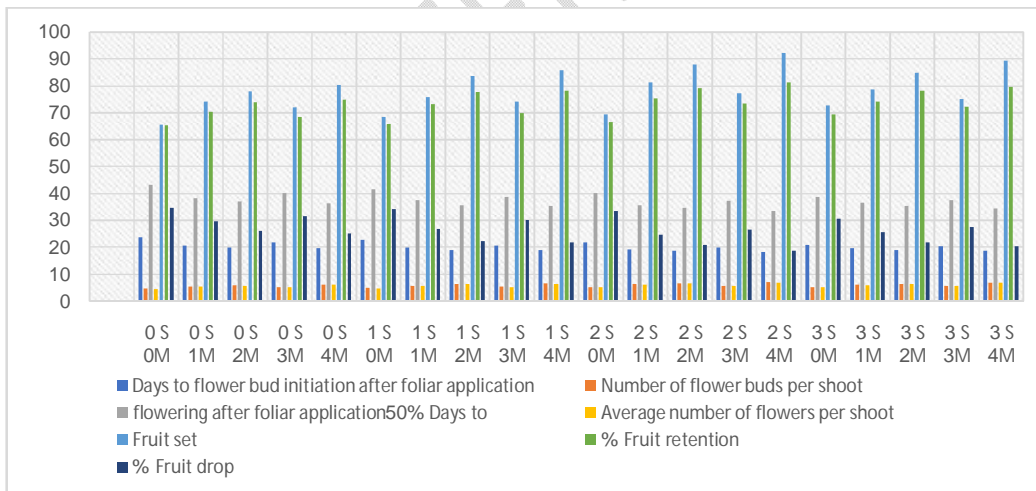


Fig. 1. Interaction effect of foliar spray of PGR and nutrients on Days to flower bud initiation after foliar application, Number of flower buds per shoot, Days to 50% flowering after foliar application, Average number of flowers per shoot, Fruit set %, Fruit retention % and Fruit drop % of guava (*Psidium guajava* L.) cv. Apple Colour.

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CONCLUSION

Foliar application of both plant growth regulators (PGRs) and nutrients emerged as a potent strategy for enhancing the phenological attributes of guava. Among the treatment combinations, the application of salicylic acid at 200 ppm in conjunction with borax at 0.5% (S₂ M₄) followed by salicylic acid at 300 ppm with borax at 0.5% (S₃ M₄) demonstrated exceptional efficacy in significantly optimizing phenological parameters when compared to the control.

REFERENCES

Anonymous National Horticulture Board database 2021. Ministry of agriculture government of India. 2022.

Comment [MF21]: NHB in text 2023

Brown, P. H., & Hu, H. Phloem mobility of boron is species dependent: evidence for phloem mobility in sorbitol-rich species. *Annals of Botany*. 1996;77(5), 497-505.

Cleland CF, Ben-Tal Y. Influence of giving salicylic acid for different time periods on flowering and growth in the long-day Plant Lemnagibba G3. *Plant Physiology*. 1982; 70:287-90 23.

El-Sherif AA, Saeed WT, Nauman UF. Effect of foliar application of potassium and zinc on behaviour of montakhab E.L. Kanater guava true. *Bull. Hort. Res. Ins. Gizd, Jat, G., & LAXMIDAS, K. H. (2014)*. Response of guava to foliar application of urea and zinc on fruit set, yield and quality. *Journal of agrisearch*. 1997-1998; 1(2).

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Fu L, Huang M, Han B, Sun X, Sree S, et al. Flower induction, microscope aided cross-pollination, and seed production in the duckweed Lemnagibba with discovery of a malesterile clone. *Scientific Reports*. 2017; 7:3047

Comment [MF23]: ????????????????

Goldbach, H. E., Wimmer, M. A., & Bangerth, F. Boron in plants and animals: Is there a role beyond cell-wall structure? *Journal of Plant Nutrition and Soil Science*. 2001;164(2), 139-148.

Harsha, P. K. G., Raipuriya, S., Parihar, C., Dangi, J. P., Malik, V., Kantwa, R. C., & Sonaniya, P. Effect of foliar feeding of plant growth regulators and nutrients on morphological and yield attributing characteristics of guava (*Psidium guajava* L.) cv. Gwalior-27. *Metabolism*. 2023;35,36.

Lee TT, Skoog F. Effects of substituted phenols on bud formation and growth of tohaceo tissue cultures. *Physiologia Plantarum* 1965; 18:386-402

Marschner, P. Mineral nutrition of higher plants. Academic Press. 2012.

Mitra, S.K. and Bose, T.K. Fruits: Tropical & Sub tropical VI. Astral Publication Nayaudyog, Calcutta, pp.2001; 610-611.

O'Neill, M. A., Eberhard, S., Albersheim, P., & Darvill, A. G. Requirement of borate cross-linking of cell wall rhamnogalacturonan II for *Arabidopsis* growth. *Science*. 2004;294(5543), 846-849.

Rahmani, A. H., Aldebasi, Y. H., & Khan, M. A.). The role of salicylic acid in plants. *Journal of Plant Sciences*. 2017;12(4), 214-225.

Rahmani, N., Ahlawat, T., Kumar, S., & Mohammadi, N. Improving productivity in Mango (*Mangifera indica* L.) cv. Kesar through foliar sprays of silicon and salicylic acid. *International Journal of Chemical Studies*. 2017;5(6), 1440-1443.

Sharma, J., Gupta, A. K., Kumar, C., & Gautam, R. K. S. Influence of zinc, calcium, and boron on vegetative and flowering parameters of gladiolus cv. Aldebran. *The Bioscan*. 2013;8(4), 1153-1158.

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Shelp, B. J., Bown, A. W., & McLean, M. D. Metabolism and functions of gamma-aminobutyric acid. *Trends in Plant Science*. 1999; 4(11), 446-452.

Shorrocks, V. M. The occurrence and correction of boron deficiency. *Plant and Soil*. 1997;193(1-2), 121-148.

Suman, S., Pency, V. K., Meghawal, P. R., & Sahu, V. Plant growth regulators and their impact on fruit crops: A review. *International Journal of Agriculture and Biology*. 2017;19(3), 533-542.

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Wada KC, Yamada M, Shiraya T, Takeno K. Salicylic acid and the flowering gene FLOWERING LOCUS T homolog are involved in poor-nutrition stress-induced flowering of *Pharbitis nil*. *Journal of Plant Physiology*.2010; 167:447-52

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