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Influence of bio-stimulant on fruit quality of Guava (*Psidium guajava* L.) under South-East Zone of Rajasthan

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ABSTRACT

The present investigation was conducted during the session 2025-2026 at the Horticulture Field Experimentation Centre, Department of Horticulture, School of Agricultural Sciences, Career Point University, Kota (Rajasthan). The experiment comprised various combinations of Bio magic (bio stimulant/bioproduct) and Salicylic Acid applied at different concentrations. The study was carried out using a Randomized Block Design (RBD) with different treatment combinations and replications. The results revealed that the growth regulator treatments significantly affected fruit quality characteristics of guava. Among all the treatments, Bio magic @ 5 ml per liter water + Salicylic Acid @ 200 ppm (T_7) recorded the best performance for most of the parameters studied. The maximum fruit length (7.95 cm), fruit weight (182.66 g), fruit volume (186.84 ml), total soluble solids (13.92 °Brix), and total sugars (8.68%) were obtained under this treatment. The treatment was followed by Bio magic @ 5 ml per liter water + Salicylic Acid @ 300 ppm (T_8) and Bio magic @ 4 ml per liter water + Salicylic Acid @ 300 ppm (T_6), which also showed superior results over individual applications and control. The improvements in fruit quality parameters may be attributed to enhanced cell division, cell elongation, increased photosynthetic activity, better assimilate translocation, and improved metabolic processes induced by the combined application of Bio magic and salicylic acid. The combined treatments enhanced hormonal balance and promoted efficient utilization of nutrients, resulting in improved fruit growth and quality.

KEYWORDS

Bio-magic, Fruit, Guava, Quality

HOW TO CITE THIS ARTICLE

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Guava (*Psidium guajava* L) is one of the most important commercial fruit crops of tropical and subtropical regions worldwide. The fruit is native to tropical America, particularly to the region stretching from southern Mexico to Northern South America, but has now been successfully cultivated in more than 70 countries across diverse agro- climatic zones including Asia, Africa and the Caribbean. In India, guava is recognized as the fourth most important fruit after mango, banana and citrus, reflecting its substantial contribution to agricultural production and rural livelihoods. India has established itself as one of the leading guava-producing nations globally, with major production concentrated in states such as Uttar Pradesh, Bihar, West Bengal, Maharashtra and Chhattisgarh, where the crop demonstrates remarkable adaptability to diverse soil and climatic conditions. The economic viability of guava cultivation has been well-documented, with studies indicating that the benefit-cost ratio of guava orchards reaches 1:3.09.

The internal rate of return reaches 26.11 percent, making it an attractive enterprise for agricultural diversification and income enhancement (Kumar and Gupta, 2017). Quality assessment in guava fruits encompasses a comprehensive set of physical and biochemical parameters that collectively determine marketability and consumer acceptance. Physical attributes include fruit weight, size dimensions (diameter and length), fruit volume, specific gravity and pulp weight, which collectively govern the commercial grade and market value of the produce (Gethe *et al*., 2015). Biochemical quality parameters, which are critical determinants of organoleptic appeal, nutritional content and consumer satisfaction, include total soluble solids measured in degrees Brix (ranging typically from 10 to 14 °Brix in quality cultivars), titratable acidity expressed as percentage of citric acid, the ratio of total soluble solids to titratable acidity (TSS: acidity ratio), total sugar and reducing sugar content and ascorbic acid concentration, which serves as a major biomarker of nutritional quality (Gethe *et al*., 2015).

Recent studies have demonstrated that guava genotypes exhibiting superior quality characteristics include the highest TSS (13.86 °Brix), optimal TSS: acidity ratios reaching 33.00, total sugar content of 8.24%, reducing sugar content of 4.19% and low acidity levels at 0.38%, along with excellent lycopene content valued at 1.52 mg per 100 grams, thereby demonstrating the wide variability in quality parameters among different guava cultivars (Gethe *et al*., 2015). The L-49 cultivar, also known as Lucknow-49, is a particularly prolific bearer with distinctive characteristics including greenish-yellow coloration at maturity, milky-white sweet pulp, rough surface texture, relatively thick shell and fewer seeds in the inner portion of the fruit, making it highly valued in commercial cultivation and processing applications in India. This cultivar is particularly popular in Maharashtra and Andhra Pradesh and yields approximately 25 tons per hectare under optimized management, demonstrating its commercial potential for both fresh market and processing purposes. However, despite the inherent quality among the various classes of plant growth regulators, auxins, particularly naphthalene acetic acid (NAA) and naphthalene acetamide (NAAm), have emerged as the most widely utilized for chemical management of flowering, fruit set and yield regulation in horticultural crops including fruit trees (Mitra, 2017). Auxins function through GA-dependent mechanisms that promote parthenocarpic fruit development and enhance fruit set by promoting cell division and expansion in developing ovaries, thereby increasing the proportion of flowers that successfully develop into marketable fruits (Interplays between auxin and GA signaling, 2022). Gibberellins, particularly gibberellic acid (GA_3) and $GA_{4/7}$ mixtures, represent another critical class of growth regulators that exert profound effects on flowering induction, fruit set improvement and fruit development by modulating cell elongation and promoting xylem development, while their application during specific developmental windows can either enhance or suppress flowering depending on the timing and concentration used (Rana *et al*., 2020). Cytokinin's contribute to fruit quality improvement and enhance cell proliferation through their synergistic interaction with auxins and gibberellins, thereby promoting balanced vegetative-reproductive growth and facilitating uniform fruit development (Rana *et al*., 2020). Abscisic acid (ABA) and ethylene occupy unique roles in regulating fruit maturation, ripening processes and the development of quality attributes including color development, sugar accumulation, acid degradation and the synthesis of aromatic compounds that determine consumer appeal and market value (Abscisic acid and fruit ripening, 2021).

Materials and Methods

Location

Kota district is located at 25.18° N to 75.83° E Latitude in South Eastern Rajasthan. It covers an area of 221.36 km^2. Agro-climatically, the district falls in Zone V, known as Humid South Eastern Plain. The average rainfall in the region is 660.6. mm. Maximum temperature range in the summer is 40 to 48°C and minimum 1.0-2.6°C during winter.

Treatment Details

Experimental materials for the present study variety of L-49 obtained from Department of Horticulture, CPU, Kota, during mrig bahar 2025-2026. Experiment was replicate three times in randomized block design. In this experiment 8 treatments combination was selected for study, details of combinations are given below all the treatments were applied as per the experimental design.

The experiment comprised eight treatments, namely T_1: control, T_2: bio magic (bio stimulant/bioproduct) @ 5 ml per liter water, T_3: salicylic acid @ 200 ppm, T_4: salicylic acid @ 300 ppm, T_5: bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 200 ppm, T_6: bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 300 ppm, T_7: bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 200 ppm and T_8: bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 300 ppm.

Experimental Details
Measurement of Fruit Quality Parameters

The longitudinal dimension of fruits was measured using a digital vernier caliper by taking readings from the stalk end to the calyx end of randomly selected fruits, with a minimum of ten fruits sampled from each treatment. The average fruit length was then calculated and expressed in centimeters. Similarly, fruit breadth was determined by measuring the maximum transverse diameter (equatorial breadth) at the midpoint of the fruit using a digital vernier caliper, and the mean value was expressed in centimeters. Fruit weight was recorded by weighing ten randomly harvested fruits from each treatment individually on a calibrated digital balance, after which the average fruit weight was calculated and expressed in grams to assess fruit growth and maturity. Fruit volume was estimated using the water displacement method, where individual fruits were immersed in a graduated measuring cylinder containing water and the displaced water volume was recorded. The mean fruit volume was expressed in milliliters.

Total soluble solids (TSS) content of freshly extracted guava fruit juice was measured using a handheld refractometer calibrated at room temperature. A few drops of juice were placed on the prism and the readings were recorded in °Brix, indicating the sugar concentration and sweetness of the fruits. Total sugars in guava pulp juice were estimated using the Lane and Eynon volumetric method, which is based on the reduction of copper ions by reducing sugars followed by titration. The results were expressed as percentage total sugars, representing important quality attributes related to fruit taste and processing suitability.

Results and Discussion
Fruit Length (cm)

The data presented in table 1 indicate that fruit length was significantly influenced by different growth regulator treatments. The maximum fruit length (7.95 cm) was recorded under bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 200 ppm (T_7), which was superior over all other treatments. This was followed by Bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 300 ppm (T_8) (7.81 cm) and Bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 300 ppm (T_6) (7.68 cm). and bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 200 ppm (T_5) (7.42) Among individual treatments, bio magic (bio stimulant/bioproduct) @ 5 ml per liter water (T_2) recorded higher fruit length (7.15 cm) compared to control (T_1) (6.84 cm), whereas salicylic acid @ 300 ppm (T_4) (6.68 cm) and salicylic acid @ 200 ppm (T_3) (6.52 cm) recorded lower values.

Fruit Breadth (cm)

The data regarding fruit breadth as influenced by different treatments are presented in table 2. The maximum fruit breadth (7.18 cm) was recorded under bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 200 ppm (T_7), which was significantly superior over all other treatments. This was followed by bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 300 ppm (T_8) (7.04 cm) and Bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + Salicylic Acid @ 300 ppm (T_6) (6.92 cm) and Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 200 ppm (T_5) (6.68). Among individual treatments, Bio magic (bio stimulant/bioproduct) @ 5 ml per liter water (T_2) recorded higher fruit breadth (6.45 cm) compared to control (T_1) (6.12 cm), whereas salicylic acid @ 300 ppm (T_4) (6.05 cm) and salicylic acid @ 200 ppm (T_3) (5.88 cm) recorded comparatively lower values. The increase in fruit length and breadth may be attributed to enhanced cell division and elongation processes, which are regulated by growth hormones such as gibberellins. The application of bio magic (bio stimulant/bioproduct) might have improved metabolic activity and osmotic balance, thereby facilitating elongation of fruit tissues.

Salicylic acid likely contributed to maintaining hormonal equilibrium and improving vascular differentiation. These results are in agreement with (Sharma and Singh, 2014), who reported increased fruit length due to gibberellin-induced cell elongation. Similar findings were also reported by (Sandhu *et al*., 2024), who highlighted the role of growth regulator combinations in improving fruit size.

Fruit Weight (g)

The mean fruit weight of guava (*Psidium guajava* L.) cv. L-49 as influenced by different growth regulator treatments is presented in table 3. The results indicated that fruit weight was significantly affected by the application of different treatments. The highest mean fruit weight (182.66 g) was recorded under bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 200 ppm (T_7), which was followed by bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 300 ppm (T_8) (176.94 g), bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 300 ppm (T_6) (171.58 g) and bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 200 ppm (T_5) (162.74 g). Among the individual treatments, salicylic acid @ 300 ppm (T_4) and control (T_1) recorded mean fruit weights of 140.36 g and 136.42 g, respectively. Lower values were observed under Bio magic (bio stimulant/bioproduct) alone, where Bio magic (bio stimulant/bioproduct) @ 5 ml per liter water (T_2) recorded 151.68 g, while the minimum mean fruit weight (136.42 g) was observed under salicylic acid @ 200 ppm per liter water (T_3).

Fruit Volume (ml)

The maximum mean fruit volume (186.84 ml) was recorded under bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 200 ppm (T_7), followed by bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 300 ppm (T_8) (179.92 ml), bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 300 ppm (T_6) (174.56 ml) and bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 200 ppm (T_5) (165.72 ml).

Among the individual treatments, salicylic acid @ 300 ppm (T_4) and control (T_1) recorded mean fruit volumes of 146.18 ml and 142.35 ml, respectively, whereas bio magic (bio stimulant/bioproduct) @ 5 ml per liter water (T_2) recorded 156.48 ml. The minimum mean fruit volume (148.62 ml) was observed under salicylic acid @ 200 ppm per liter water (T_3) table 4. The increase in fruit weight and volume may be attributed to enhanced pulp development and reduced seed proportion, resulting from improved cell division and cell enlargement. The combined application of bio magic (bio stimulant/bioproduct) and salicylic acid might have promoted hormonal balance, particularly through gibberellin-like activity, leading to increased cell expansion and improved vascular development for efficient assimilate transport. Salicylic acid also played an important role in reducing ethylene-induced fruit drop, thereby maintaining fruit retention and contributing to higher fruit weight. The improved source-sink relationship ensured continuous supply of photosynthates to developing fruits. These findings are in accordance with (Choudhary and Singh, 2014), who reported increased fruit weight due to enhanced cell expansion under growth regulator application. Chauhan *et al*. (2024) also reported that combined use of growth regulators improved fruit weight through better metabolic activity and assimilate translocation.

Total Soluble Solids (°Brix)

The total soluble solids (TSS) content of guava (*Psidium guajava* L.) cv. L-49 as influenced by different growth regulator treatments is presented in table 5. The results indicated that TSS was significantly affected by various treatments. The maximum TSS content (13.92 °Brix) was recorded under bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 200 ppm (T_7), which was followed by bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 300 ppm (T_8) (13.56 °Brix), Bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 300 ppm (T_6) (13.38 °Brix) and bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 200 ppm (T_5) (12.96 °Brix). Among the individual treatments, salicylic acid @ 300 ppm (T_4) and control (T_1) recorded TSS values of 11.74 °Brix and 11.86 °Brix, respectively, whereas bio magic (bio stimulant/bioproduct) @ 5 ml per liter water (T_2) recorded 12.42 °Brix.

Table 1. Effect of growth regulator treatments on fruit length (cm) in guava cv. L- 49

Symbols	Treatments	Fruit Length (cm)
T_1	Control	6.84
T_2	Bio magic (bio stimulant/bioproduct) @ 5 ml per liter water	7.15
T_3	Salicylic Acid @ 200 ppm	6.52
T_4	Salicylic Acid @ 300 ppm	6.68
T_5	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 200 ppm	7.42
T_6	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 300 ppm	7.68
T_7	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 200 ppm	7.95
T_8	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 300 ppm	7.81
SEm±		0.18
CD (P=0.05)		0.54
CV %		3.92

Table 2. Effect of different treatments on fruit breadth (cm) of guava cv. L-49

Symbols	Treatments	Fruit Breadth (cm)
T_1	Control	6.12
T_2	Bio magic (bio stimulant/bioproduct) @ 5 ml per liter water	6.45
T_3	Salicylic Acid @ 200 ppm	5.88
T_4	Salicylic Acid @ 300 ppm	6.05
T_5	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 200 ppm	6.68
T_6	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 300 ppm	6.92
T_7	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 200 ppm	7.18
T_8	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 300 ppm	7.04
SEm±		0.16
CD (P=0.05)		0.48
CV%		3.75

Table 3. Effect of different treatments on fruit weight (g) of guava cv. L-49

Symbols	Treatments	Fruit Weight (g)
T_1	Control	142.55
T_2	Bio magic (bio stimulant/bioproduct) @ 5 ml per liter water	151.68
T_3	Salicylic Acid @ 200 ppm	136.42
T_4	Salicylic Acid @ 300 ppm	140.36
T_5	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 200 ppm	162.74
T_6	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 300 ppm	171.58
T_7	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 200 ppm	182.66
T_8	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 300 ppm	176.94
SEm±		3.25
CD (P=0.05)		9.68
CV %		4.21

The minimum TSS (11.28 °Brix) was observed under salicylic acid @ 200 ppm per liter water (T_3). The increase in TSS may be attributed to enhanced carbohydrate metabolism and improved conversion of starch into soluble sugars. Bio magic (bio stimulant/bioproduct) might have improved metabolic activity and delayed senescence, while salicylic acid enhanced translocation of sugars to developing fruits. The improved TSS indicates better fruit quality and higher consumer acceptability. These findings are in agreement with (Gethe *et al*., 2015), who reported increased TSS due to improved carbohydrate accumulation under growth regulator application.

Table 4. Effect of different treatments on Fruit Volume (ml) of guava cv. L-49

Symbols	Treatments	Fruit Volume (ml)
T_1	Control	148.62
T_2	Bio magic (bio stimulant/bioproduct) @ 5 ml per liter water	156.48
T_3	Salicylic Acid @ 200 ppm	142.35
T_4	Salicylic Acid @ 300 ppm	146.18
T_5	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 200 ppm	165.72
T_6	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 300 ppm	174.56
T_7	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 200 ppm	186.84
T_8	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 300 ppm	179.92
SEm±		3.12
CD (P=0.05)		9.29
CV %		4.08

Table 5. Effect of different treatments on Total Soluble Solids (°Brix) of guava cv. L-49

Symbols	Treatments	TSS (°Brix)
T_1	Control	11.86
T_2	Bio magic (bio stimulant/bioproduct) @ 5 ml per liter water	12.42
T_3	Salicylic Acid @ 200 ppm	11.28
T_4	Salicylic Acid @ 300 ppm	11.74
T_5	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 200 ppm	12.96
T_6	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 300 ppm	13.38
T_7	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 200 ppm	13.92
T_8	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 300 ppm	13.56
SEm±		0.28
CD (P=0.05)		0.83
CV %		3.96

Table 6. Effect of different treatments on Total sugars (%) of guava cv. L-49

Symbols	Treatments	Total Sugars (%)
T_1	Control	7.12
T_2	Bio magic (bio stimulant/bioproduct) @ 5 ml per liter water	7.58
T_3	Salicylic Acid @ 200 ppm	6.84
T_4	Salicylic Acid @ 300 ppm	7.05
T_5	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 200 ppm	7.92
T_6	Bio magic (bio stimulant/bioproduct) @ 4 ml + SA @ 300 ppm	8.24
T_7	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 200 ppm	8.68
T_8	Bio magic (bio stimulant/bioproduct) @ 5 ml + SA @ 300 ppm	8.42
SEm±		0.21
CD (P=0.05)		0.62
CV %		3.88

Total Sugars (%)

The total sugar content of guava (*Psidium guajava* L.) cv. L-49 as influenced by different growth regulator treatments is presented in table 6. The data revealed significant variation among treatments. The maximum total sugar content (8.68%) was recorded under bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 200 ppm (T_7), followed by Bio magic (bio stimulant/bioproduct) @ 5 ml per liter water + salicylic acid @ 300 ppm (T_8) (8.42%), bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 300 ppm (T_6) (8.24%) and bio magic (bio stimulant/bioproduct) @ 4 ml per liter water + salicylic acid @ 200 ppm (T_5) (7.92%). Among the individual treatments, salicylic acid @ 300 ppm (T_4) and control (T_1) recorded total sugar contents of 7.05% and 7.12%, respectively, whereas bio magic (bio stimulant/bioproduct) @ 5 ml per liter water (T_2) recorded 7.58%. The minimum total sugar content (6.84%) was observed under salicylic acid @ 200 ppm per liter water (T_3). The increase in total sugars may be attributed to enhanced photosynthetic efficiency, increased assimilate translocation and improved enzymatic activity involved in sugar metabolism. Bio magic (bio stimulant/bioproduct) might have facilitated osmotic regulation and sugar accumulation, while salicylic acid helped in maintaining metabolic balance. The higher sugar content reflects improved fruit quality and sweetness. These results are supported by (Gethe *et al*., 2015), who reported improved sugar content in guava due to enhanced carbohydrate metabolism.

Conclusion

The study revealed that different growth regulator treatments significantly influenced the fruit quality of guava cv. L-49. Among all treatments, bio magic @ 5 ml per liter water + salicylic acid @ 200 ppm (T_7) proved to be the most effective, recording the highest fruit length, fruit weight, fruit volume, TSS, and total sugars. The combined application improved fruit growth and quality due to enhanced metabolic activity and assimilate translocation. Hence, this treatment can be recommended for improving fruit quality and yield in guava under similar agro-climatic conditions.

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