

Original Research Article

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## Effect of Plant Growth Regulators on Yield and Quality of Guava (*Psidium guajava* L.) cv. Allahabad Safeda

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### ABSTRACT

#### Keywords

Guava, Foliar application, Fruit, Yield, Quality.

#### Article Info

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An experiment was carried out to see the effect of plant growth regulators on yield and quality of guava cv. Allahabad safeda. Low production and poor quality of fruits are major constraints in guava production in Assam. The results showed significance difference among the treatments. The maximum yield (37.13 kg/plant), pulp weight (173 g), Juice content (63.17 cc), TSS (12.50 °Brix), ascorbic acid (135.30 mg/100gm), total sugar (10.13 %), seed weight (6.67 gm), sugar-acid ratio (33.13) and lowest titrable acidity (0.16 %) was recorded under T<sub>5</sub> (50 ppm GA<sub>3</sub>) while maximum pulp-seed ratio was recorded in T<sub>6</sub> (100 ppm GA<sub>3</sub>).

### Introduction

Guava (*Psidium guajava* L.) is one of the most important and extensively cultivated tropical crops of India. It is good source of vitamin-C, pectin, also contains fair amount of calcium and widely used for making of jelly. The ascorbic acid content of guava is four-five times higher than the citrus fruit. It is hardy fruit which can be grown in alkaline and poorly drained soil. Important guava growing states in the country are Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Andhra Pradesh, West Bengal, Tamil Nadu, Gujrat, Punjab, Assam, Karnataka, Orissa, Kerala and Rajasthan. Allahabad district of Uttar Pradesh has the reputation of growing the best quality of guava fruits in the world (Mitra and Bose,

1990). The three times flowering seasons have been observed in North Indian conditions while two flowering seasons have been reported in the climatic condition of Assam. This fruit crop has immense potential in increasing productivity and yield sustainability in Assam. In Assam, guava occupies 4.522 thousand hectare of area and it produces 87.195 MT of guava with 19282 kg per hectare of productivity (Anon., 2009). The plant growth regulators play very important role in flower induction in many plants. The process of pollination and fertilization induces production of growth regulators in the ovary, the ovary enlarge and fruit development is initiated. However, good fruit set is prevented by adverse weather which hinders pollen

production, pollination and fertilization and also low level of auxin. The auxin from the pollen grain and pollen tube might be responsible for the early stage of fruit growth. However, small amount of pollen necessary to pollinate a flower may not carry enough auxin to account for early fruit development. The growing pollen tube may secrete auxin which helps in fruit growth (Muir, 1942). Exogenous application of plant growth regulators (PGRs) not only increases the number of flower but also increases the quality of fruit and retention capacity of on the tree till maturity and reduces fruit drop.

The percentage of flowering and fruiting, poor fruit retention, poor yield and quality fruits are of major concern of the fruit growers. So, the present investigation was undertaken to find out response of plant growth regulators on yield and quality of guava.

## **Materials and Methods**

The study was conducted in the orchard of Assam Agricultural University, Jorhat during 2009. Six years old plants of uniform size planted at 6 x 6 m in square system were selected for the studies. The experiment was laid out under Randomized Block Design with 11 treatments having three replications. The Orchard is located at 26°47'N latitude and 94°12'E longitude having an elevation of 86.6 meters above the mean sea level. The experimental location was considered to be well drained with a uniform topography.

The climate condition of Jorhat as a whole is sub-tropical humid having hot and dries summer and cold winter. The average monthly rainfall was 36.53 to 137.46 mm with heavy rains from April to September month. During the experimentation September and July was recorded hottest and coldest month, respectively.

## **Details of the treatments**

There were five plant growth regulators selected for the experiment. These regulators were used in two concentrations in each. For reference letters keys were used as notation to designate the growth regulators and their concentration.

Growth regulators	Concentration	Notation
Control	Water spray	T <sub>0</sub>
2,4-D	10 ppm	T <sub>1</sub>
2,4-D	20 ppm	T <sub>2</sub>
NAA	50 ppm	T <sub>3</sub>
NAA	100 ppm	T <sub>4</sub>
GA <sub>3</sub>	50 ppm	T <sub>5</sub>
GA <sub>3</sub>	100 ppm	T <sub>6</sub>
Ethrel	50 ppm	T <sub>7</sub>
Ethrel	100 ppm	T <sub>8</sub>
CCC	500 ppm	T <sub>9</sub>
CCC	1000 ppm	T <sub>10</sub>

## **Yield per plant**

The total numbers of fruits were counted at harvest and multiplied average weight of fruit.

## **Pulp weight and Juice content of fruit**

The fruit was cut out into pieces and seeds are separated, then pulp was weighed and expressed in gm and pulp squeezed and determined of juice in cc.

## **Total soluble solid**

The fresh fruit is cut out into piece and squeeze it and the TSS of extracted juice was recorded directly by Zeiss Hand refractometer and expressed in percentage.

## **Titration acidity**

Titration acidity was estimated by adopting standard method of A.O.A.C. (1975), 5 mg of

fruit sample was dissolved in 50 ml of distilled water and filtered. 10 ml of filtrate was titrated against N/10 NaOH using phenolphthalein as indicator and expressed in percentage.

### Ascorbic acid

Ascorbic acid content was estimated by the visual titration of Freed (1966) as described below:

### Indophenols dye preparation

To 250 ml of distilled water 42 gm of Sodium bicarbonate and 52 mg of 2,6-dichlorophenol-indophenols were added and warm gently to dissolve. This reagent was kept in a amber colour bottle and stored in freeze and used within a week of its preparation.

$$\text{Ascorbic acid (mg/100gm)} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up}}{\text{Aliquot of extract taken for estimation} \times \text{Weight/volume of sample taken for estimation}} \times 100$$

### Sugar content

The sugar content in the fruit pulp was estimated by volumetric method of Lane and Eynon (1923). Reducing sugar was estimated by titrating the neutral juice solution of known concentration using methylene blue indicator, against Fehling's solution. From the amount of juice required to reduce the Fehling's solution, the percentage of reducing sugar was calculated using the factor that:

5 ml Fehling solution A + 5 ml Fehling solution B = 0.05 g of glucose

The total sugar in juice as inverted sugar was estimated by hydrolysing the juice with HCl (2:1) and then estimated like reducing sugar. Total sugar percentage was calculated by

### Standard Ascorbic acid

Took 2.5 ml of L-Ascorbic acid in 25 ml of volumetric flask and volume made up with 4 per cent oxalic acid.

Took 5 ml of above solution and 5 ml of 4 per cent oxalic acid in a 100 ml of conical flask and titrated against dye solution until the solution changed to pink colour.

### Estimation

5 mg of pulp was ground in a mortar and add 50 ml of 4 per cent oxalic acid and filtered. Took 5 ml of filtered solution and titrated against the dye solution. Amount of Ascorbic acid was calculated using the dye factor and expressed as mg/100 gm by following formula;

adding the percentage of reducing and non-reducing sugar.

### Results and Discussion

#### Yield

The fruit retention per shoot at harvest was the final yield of crop. The highest yield (37.13kg/plant) was found in 50 ppm GA<sub>3</sub> treatment and lowest yield (12.16kg/pant) was found in control. The increase yield under this growth regulators treatment was associated with increase the number of fruit, low percentage of fruit drop, more fruit retention and increased fruit size and weight. This result is in conformity the earlier report by Shawky *et al.*, 1978 in mango and Shikhamany and Reddy, 1989 in grape.

### **Pulp weight and juice content**

A marked increase in pulp weight and juice content was recorded when the plants were sprayed with different growth regulators. The highest pulp weight (173.0g) and juice content (63.17 cc) were recorded under 50 ppm GA<sub>3</sub> treatment while lowest pulp weight (75.40g) and juice content (25.23 cc) were recorded under control. The possible reason in this regard might be due to an enhanced deposition of solids in increased cell size and intercellular space which coupled with accumulation of water as reported by Coombe, 1960 in seeded and seedless variety of grape.

### **TSS**

The effect of various plant growth regulators on total soluble solids content was found to be significant. The highest TSS content (12.50%) was recorded in 50 ppm GA<sub>3</sub> treatment while minimum (7.90%) was found in control. This significant response in improving TSS content of fruit might be explained that GA<sub>3</sub> stimulated the functioning of number of enzyme in the physiological process which probably caused and increased in TSS content of fruit as reported by Singh *et al.*, 1986 in mango.

### **Titration acidity**

Titration acidity influenced significantly by various treatment. The lowest Titration acidity (0.16%) was found in 50 ppm GA<sub>3</sub> treatment while maximum acidity (0.34%) was reported under control. The reason for reduction in acidity in growth regulators applied treatments may be due to rapid utilization of organic acid during respiration at maturity as reported by Thakur *et al.*, 1990 in litchi.

### **Ascorbic acid**

The ascorbic acid content of fruit pulp was significantly influenced by the various

treatments. The highest ascorbic acid content (135.30mg/100g) was reported in 50 ppm GA<sub>3</sub> while lowest (64.27mg/100g) was found in control. The possible reason for increase in ascorbic acid of fruit by GA<sub>3</sub> treatment might be due to perpetual synthesis of glucose-6-phosphate throughout the growth and development of fruit which is thought to be the precursor of vitamin-C as reported by Kumar and Singh, 1993 in mango.

### **Total sugar**

The highest total sugar content (10.13%) was found in 50 ppm GA<sub>3</sub> while lowest (6.30%) was reported under control. The possible reason for increased sugar content in GA<sub>3</sub> treatment might be due the increased the activity of the hydrolytic enzyme which converted the complex polysaccharides into simple sugar. Growth regulators also increase translocation of photosynthetic metabolites from other parts of the plant towards to developing fruits. This finding is in conformity with the result of Kumar *et al.*, 1998 in guava.

### **Reducing sugar**

It is clear from the Table 2 that the reducing and non-reducing sugar content were affected due to various growth regulators. The maximum reducing sugar (5.30 %) was recorded under 50 ppm GA<sub>3</sub> (T<sub>5</sub>) treatment and minimum reducing sugar content (3.80 %) was found under control (T<sub>0</sub>) treatment. The maximum non-reducing sugar (4.80 %) was under 50 ppm GA<sub>3</sub> (T<sub>5</sub>) and minimum (2.50 %) was found in control (T<sub>0</sub>) treatment. The reason for increase in the content of reducing sugar and non-reducing sugar might be due to delayed the ripening of fruit and provided a long period of fruits to be remained on tree during which they accumulated more carbohydrates within them as reported by Singh *et al.*, (1986) in mango.

**Table.1** Effect of plant growth regulators on yield and quality parameters of guava

<b>Treatments</b>	<b>Yield/ plant</b>	<b>Pulp weight (g)</b>	<b>Juice content (cc)</b>	<b>Seed weight (g)</b>	<b>TSS (%)</b>	<b>Total sugar (%)</b>	<b>Ascorbic acid (mg/100g)</b>	<b>Titration acidity (%)</b>
Control	12.17	75.40	25.23	4.50	7.90	6.30	64.27	0.34
2,4-D-10 ppm	19.73	85.20	29.50	4.73	11.50	9.50	115.27	0.18
2,4-D-20 ppm	16.23	104.9	37.63	4.20	9.40	8.00	84.47	0.27
NAA-50 ppm	25.97	103.0	39.33	5.67	11.20	9.20	104.40	0.19
NAA-100 ppm	15.70	104.6	39.17	3.60	10.10	8.50	89.73	0.25
GA <sub>3</sub> -50 ppm	37.13	173.0	63.17	6.67	12.50	10.30	135.30	0.16
GA <sub>3</sub> -100 ppm	28.93	140.1	50.83	4.50	10.40	8.70	92.33	0.24
Ethrel-50 ppm	23.10	124.3	46.23	4.87	9.90	8.20	88.40	0.27
Ethrel-100 ppm	26.50	102.0	34.77	4.00	8.80	7.10	73.83	0.30
CCC-500 ppm	24.23	113.3	47.33	4.20	10.70	8.90	98.43	0.22
CCC-1000 ppm	32.53	101.1	34.27	4.23	10.40	8.70	92.37	0.24
S.Ed. ±	0.472	0.84	1.13	0.23	0.19	0.19	2.48	0.01
CD (5%)	0.984	2.48	2.35	0.49	0.40	0.40	5.19	0.3

**Table.2** Effect of plant growth regulators on quality parameters of guava

Treatments	Reducing sugar (%)	Non-reducing (%)	Pulp-seed ratio	Reducing sugar-acid ratio	Fruit Colour at maturity	Pulp texture	Benefit:Cost ratio
Control	3.80	2.50	16.7	11.20	Light green	Smooth	1.10:1
2,4-D-10 ppm	5.10	4.40	18.0	28.63	Light green	Smooth	1.78:1
2,4-D-20 ppm	4.30	3.70	25.0	15.90	Light green	Smooth	1.47:1
NAA-50 ppm	4.80	4.40	18.1	25.27	Light yellow	Granular	2.34:1
NAA-100 ppm	4.47	4.03	29.1	17.97	Light yellow	Granular	1.41:1
GA <sub>3</sub> -50 ppm	5.30	4.83	25.9	33.13	Light green	Granular	3.19:1
GA <sub>3</sub> -100 ppm	4.90	3.80	31.3	20.60	Light green	Granular	2.30:1
Ethrel-50 ppm	4.40	3.80	25.5	16.50	Light yellow	Granular	2.08:1
Ethrel-100 ppm	3.80	3.30	25.5	12.70	Light yellow	Granular	2.37:1
CCC-500 ppm	4.90	4.00	27.0	22.37	Light green	Smooth	2.05:1
CCC-1000 ppm	4.60	4.10	23.9	18.13	Light green	Smooth	2.60:1
S.Ed. ±	0.14	0.19	0.92	1.646			
CD (5%)	0.30	0.39	2.72	3.434			

### Seed content and pulp-seed ratio

It is evident from Table 1 that the highest seed weight (6.67 g) was recorded under 50 ppm GA<sub>3</sub> (T<sub>5</sub>) treatment and lowest (3.60 g) in 100 ppm NAA (T<sub>4</sub>) treatment. The reason for increasing in seed weight might be due to larger size and maximum fruit weight and also larger seed size in 50 ppm GA<sub>3</sub> (T<sub>5</sub>) treatment. The lowest seed weight was under 100 ppm NAA (T<sub>4</sub>), it might be due to small size of seed.

The data presented on Table 2 revealed that maximum (31.3) pulp-seed ratio was found under 100 ppm GA<sub>3</sub> (T<sub>6</sub>) and minimum (16.7) was under control (T<sub>0</sub>) treatment. The possible reason for increasing pulp-seed ratio under GA<sub>3</sub> treated plant might be due to more pulp content and reduced seed weight of fruit.

### Sugar-acid ratio

A marked increase in reducing sugar-acid ratio was recorded when the plants were sprayed with different growth regulators (Table 2). The highest ratio (33.13) was recorded under 50 ppm GA<sub>3</sub> (T<sub>5</sub>) treatment and lowest ratio (11.20) was observed under control (T<sub>0</sub>) treatment. The reason for increasing sugar- acid ratio by GA<sub>3</sub> treated fruit might be due related to increased sugar content and reduced acid content of fruits.

### Pulp texture and Fruit colour

The data presented on Table 2 showed the effect of plant growth regulator on texture and colour of fruits. However, texture was ranged from smooth to granular and colour from light green to light yellow.



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