Effect of plant growth regulators on Growth, Fruit setting and Quality of Guava (*Psidium guajava* L.) in meadow orchard

ABSTRACT

The present study, **"Effect of plant growth regulators on growth, fruit setting, and quality of guava (*Psidium guajava* L.) in meadow orchard,"** was carried out in the years 2021–2022, at Central Research Farm, Department of Horticulture, Sam Higginbottom Institute of Agriculture & Sciences, Prayagraj (U.P.). Ten treatments made up the experiment with: control, three concentrations of gibberellic acid (GA_3) at 75, 100, and 125 ppm, three concentrations of naphthalene acetic acid (NAA) at 200, 250, and 300 ppm, and three concentrations of chlormequat (CCC) at 400, 500, and 600 ppm. These treatments were evaluated in Randomized Blocked Design with three replications. The results showed that a combination of different plants growth regulators had a significant impact on the guava plant's growth and yield parameters, including its height (5.81 m), total number of flowers per plant (178.6), fruiting buds per plant (151.8), number of fruits per plant (127.1), fruit set (71.2 %), plant spread (E-W-6.00 m & N-S- 5.89 m), fresh fruit weight (115.5g), and dry weight (78.5g), Fruit diameter (polar-8.46cm & radial-8.16cm), total soluble solids (TSS) 10.170Brix, total sugar (9.2%), and yield/plant (14.7kg) were all found to be higher under the treatment T4 Naphthalene acetic acid (NAA) @200ppm, whereas acidity (0.56 %) was at its highest in T_0 Control.

Key words: *CCC , Economics, GA_3, Guava, , NAA, , Yield,*

*Post graduate student. Department of Horticulture, Naini Agriculture Institute SHUATS, Prayagraj.

** Associate professor, Department of Horticulture, Naini Agriculture Institute SHUATS, Prayagraj

1. INTRODUCTION

Guava (*Psidium guajava* L.), belongs to the Myrtaceae family, It is a fruit that originated in Mexico or Central America and is now found across tropical America and the Caribbean. It

was first introduced to India in the 17th century. It is known as the apple of the tropics and is a crucial tropical fruit crop that is produced throughout tropical and subtropical regions. It is referred to as poor man's fruit. Guavas are a highly common and well-liked fruit because of its affordable pricing, nutritional content, and pleasant taste. Although the fruit (berry) has a great source of pectin (0.5–1.8%) and ascorbic acid, it is poor in calories (Adsule & Kadam, 1995). Due to its hardy nature and prolific bearing even on marginal lands, the guava is a significant fruit crop throughout the country's tropical and subtropical areas. Its cultivation takes minimal attention and resources. The production method for this crop, however, has recently undergone a paradigm change from subsistence farming to commercial agriculture. Due to the extensive tree canopy, the traditional style of farming sometimes presented difficulties in achieving required levels of output. As a result, it became necessary to enhance the current manufacturing system in addition to raising its productivity. Modern fruit farming techniques like the Meadow Orchard use tiny or dwarf trees with modified canopies. This system can support 5000 plants per hectare, which are planted at 2.0 m × 1.0 m spacing and are regularly topped at especially during initial stages. Guava topping and hedging are useful for limiting tree growth and increasing fruit supply. To assess the potential of this method, a comparison between the meadow orchard system and the conventional method of fruit cultivation is required. The best-quality fruits are produced in Uttar Pradesh, which is the major producer state in India. But since they are so fragile, the fruits are blemished, and biochemical post-harvest alterations make them softer, causing rotting. Fresh fruit rotting can be efficiently reduced, however its storage life can be extended. Plant hormones play a key role in guava production by influencing directly or indirectly various physiological processes. Hormones usually move within plant from a site of production to site of action are physiological intercellular messengers that are needed to control the complete plant lifecycle, including germination, rooting, growth, flowering, fruit ripening, foliage and death. In addition, plant hormones are secreted in response to environmental factors such as abundance of nutrients, drought conditions, light, and temperature, chemical or physical stress. Hence, levels of hormones will change over the lifespan of a plant and are dependent upon season and environment.

Traditionally five major classes of plant hormones are listed: auxins, cytokinins, gibberellins, abscisic acid and ethylene. However as research progresses, more active molecules are being found and new families of regulators are emerging: one example being polyamines such as putrescine or spermidine. This classification is based partially on the

chemical structure and partially on the commonalities of plant physiological effects that certain substances exhibit. Members of one class may not relate from a structural point of view to another. Besides, PGRs are also used for regulation of flowering bahar in guava (Lal et al., 2017)

2. MATERIALS AND METHOD

A field experiment was conducted during 2021-22 at Central Research Farm, Department of Horticulture, Sam Higginbottom Institute of Agriculture & Sciences, Prayagraj (U.P.). The experiment was conducted in randomized block design. The experiment consist of ten treatments of foliar spray of GA_3, NAA and CCC. The treatment were control (T_0) Gibberellic acid (GA_3) @75ppm (T_1), Gibberellic acid (GA_3) @100ppm (T_2), Gibberellic acid (GA_3) @125ppm (T_3), Naphthalene acetic acid (NAA) @200ppm (T_4), Naphthalene acetic acid (NAA) @250ppm (T_5), Naphthalene acetic acid (NAA) @300ppm (T_6) Chlormequat (CCC) @400ppm (T_7), Chlormequat (CCC) @500ppm (T_8), Chlormequat (CCC) @600ppm (T_9). Eight years old guava trees of uniform vigor and size were selected for investigation. Whole tree was used as single experimental unit. All the treatments were arranged in randomized block design and each treatment was replicated thrice. Thus, total of 30 plants were selected for each set of experiment. The selected trees were sprayed 3 times at 15 days interval with the treatments of different concentration of GA_3, NAA and CCC during experiment. A very small quantity of teepol was mixed in each spray solution of treatments as a surfactant. Spraying was done by knapsack sprayer @ 25 liter plant. For control plants were sprayed with distilled water. The different concentration ofGA_3, NAA and CCC were sprayed three times during winter season crop.

The growth criteria which were recorded are, plant girth (cm), quantity of blooms per plant overall, a plant's fruiting bud count, fruit yields per plant, at the time of application of the treatment and at harvest, The spread of the plants was measured with the use of a measuring equipment, and the increase in that spread during the course of the experiment was determined. By randomly choosing five branches from a tree's various directions, flowering

and fruiting traits were noted. The observations on the fruit yield factors were noted, and the yield per tree (in kg) was calculated using the average fruit weight of five fruits and the total number of fruits. Fruit quality characteristics were noted in the data. Utilizing average-sized fruits randomly selected from each replication, physical and chemical characteristics of fruits were assessed. A hand refractometer was used to calculate the TSS (0Brix). The A.O.A.C.'s simple acid-alkali titration technique was used to assess acidity (1970). The Nelson technique was used to determine the sugars in fruits (1944). Ranganna's instructions for the ascorbic acid assay technique were followed (1977).

3. RESULT AND DISCUSSION

The growth parameter characters of the tree were significantly influenced by different treatments (Table 1). Maximum increase in Plant height, Total number of flowers per plant, Number of fruiting bud per plant, Numbers of fruits per plant, Plant spread in N-S and E-W direction with foliar application of NAA @200ppm may be due to immediate absorption of auxins, which increased the endogenous auxin level that resulted in cell elongation and enhanced vegetative growth. Maximum fruit was reported with application of foliar spray of @ 200ppm NAA. It was also found that Treatment T_5 was found to be at par with treatment T_4. Similar findings are reported by Jain and Dashora (2007) & Prajapati and Singh (2015). Increased fruit can be attributed to deblossoming of rainy season crop which increased the carbohydrate content and shoot and high carbohydrate was thought to increase fruit set in following winter.

The various Fruit development Characteristics parameters were significantly influenced by application of different PGR (Table 2). Maximum Fresh Fruit weight (115.5 g), Dry fruit weight (78.5 g), Fruit diameter at harvest Polar (8.46 cm) and Radial (8.16 cm), Garasiya et al., (2012) was and maximum yield /plant (14.68 kg) recorded with foliar spray of @200ppm NAA.

According to the findings (Table 3), applying different PGR greatly enhanced the fruit quality of guavas in terms of TSS (^{0}Brix) total sugars, fruit acidity content, and ascorbic acid percentage.

According to the results of the current experiment, the administration of treatment T_4 (Naphthalene acetic acid (NAA) @ 200 ppm had a substantial impact on the vegetative development, yield, and fruit quality of guava (*Psidium guajava* L.) under Prayagraj conditions.

Since the F Cal value was higher than the F Tab value, the plant height data suggests that the differences were considerable. The maximum plant height was substantially recorded by treatment T_4 (5.81 m), which was followed by T5 (5.67 m), whereas the lowest plant height was significantly recorded by treatment T_0 Control (3.73 m). Additionally, it was discovered that Treatment T_5 was on par with Treatment T_4.

Because the F Cal value was higher than the F Tab value, the impact of plant growth regulators on the plant spread (m) (E-W) and (N-S) of guava was determined to be significant. Control treatment (T_0) recorded significantly the lowest plant spread (m) (E-W) and (N-S) of guava, i.e., 4.21 m and 3.28 m respectively. Treatment T_4 was found to be the best and recorded significantly the highest plant spread (m) (E-W) and (N-S) of guava, i.e., 6 m and 5.9 m respectively.

The results showed that treatment T_4 produced considerably more guava flowers per plant (178.6), followed by treatment T_5 (176.1), whereas Treatment T_0 control produced significantly less guava flowers per plant (144.33).

Since the F Cal value was higher than the F Tab value, the data on the number of fruiting buds per plant of guava suggests that the differences were significant. In comparison to treatment T_0 control, which recorded considerably the lowest number of flowers per plant of guava (122.7), treatment T_4 was shown to be the best and recorded significantly the largest number of fruiting buds per plant of guava (151.80), followed by T_5.

. The results showed that treatment T_4 produced the maximum number of guava fruits per plant (127.1), followed by treatment T_5 (123.1, whereas treatment T_0 Control produced the fewest number of guava fruits per plant (82.94).

The data in the table makes it clear that there were substantial differences between the treatments in terms of the fresh weight of the fruits. The treatment T_4 (Spray of NAA 200 ppm), which was much better than all the treatments, produced the highest fresh weight (115.5g). The treatment T_5 (250 ppm) was comparable to T_4 and T_6. Under T_0, the smallest fresh weight (84.1g) was noted (Control).

The F Cal value was higher than the F Tab value, according to the data on the Fruit polar and radial diameter (cm) of guava indicating that the differences were significant. Control treatment (T_0) recorded significantly the lowest Fruit polar and radial diameter (cm) of guava, i.e., 6.46 cm & 6.66 cm. Treatment T_4 was found to be the best and recorded significantly the highest fruit polar and radial diameter (cm) of guava, i.e., 8.46 cm & 8.16 cm, respectively. This was followed by T_5, i.e., 8.42 cm & 8.11 cm.

All of the treatments had a noticeable impact on the percentage of fruit set (Table 1). NAA usage had a favourable impact on the plants' ability to produce fruit. The treatment T_4 (Spray of NAA @ 200 ppm), which was discovered to behave much better than all the treatments under evaluation, produced the highest fruit set percentage (71.2 percent). Under T_0, the smallest fruit set percentage (57.5%) was seen (Control).

The treatment T_4 (NAA @ 200 ppm), which was discovered to behave much better than all the treatments under evaluation, had the highest fruit output per plant (14.68 kg). Under T_0, the smallest fruit output per plant (6.97 kg per plant) was noted (Control).

The treatment of NAA @ 200 ppm (T_4) recorded the highest TSS (10.17 °Brix), which was noticeably better than the other treatments. whereas the control group had the lowest TSS (8.08 °Brix).

The findings demonstrated that treatment of NAA at 200 ppm resulted in the least amount of acidity (0.40 %) (T_4). A high of 0.52 percent acidity was found in the control treatment (T_0), in contrast.

The treatment with NAA @ 200 ppm (T_4) had the highest total sugars (9.20 percent), outperforming all other treatments statistically except for T_5, which was statistically equal to it. In contrast, the control group had the lowest level of total sugars (6.48 percent) (T_0).

The treatment with NAA at 200 ppm (T_4) had the highest amount of ascorbic acid in the fruit (201.63 mg/100g pulp), and it was statistically comparable to the other treatments with the exception of T_5 (which had the highest ascorbic acid content overall). Contrarily, the control group's minimal amount of ascorbic acid in the fruit (171.8 mg/100g pulp) was found (T_0). Lal and Das (2017) also exhibited the positive effect of plant growth regulators on yield and quality parameters in guava.

The treatment with NAA @ 200 ppm (T_4) recorded the highest pectin content of the fruit (1.58 %), which was substantially higher than the other treatments. In contrast, the control group's fruit had the lowest pectin content (0.71 %) (T_0).

4. CONCLUSION

From the present investigation it may be concluded that effect of Treatment T_4 i.e., NAA (200 ppm) was found significantly highest on growth, Fruit setting, Fruit drop and Quality of Guava (Psidium guajava L.) in meadow orchard where-as Treatment 5_6 was found at par with T_4

From the economics point of view, It may be concluded that Treatment T_4 i.e., NAA (200ppm) was found the highest B:C ratio.

Since this is based on one season trail therefore, further evaluation trails are needed to substantiate the findings.

Table no. 1 : Effect of Plant growth regulators on growth attributes of Guava

Treatments	Plant height (cm)	Flowers/Plant	Buds/Plant	Fruits/Plant	Plant Spread (m)	
					(E-W)	(N-S)
T_0 CONTROL (Water spray)	3.73	144.33	122.68	82.94	4.21	3.28
T_1 GA_3 (75 ppm)	4.75	148.36	126.11	87.34	5.15	4.55
T_2 GA_3 (100 ppm)	5.02	152.51	129.63	92.12	5.37	4.83
T_3 GA_3(125 ppm)	5.25	156.41	132.95	97.24	5.60	5.17
T_4 NAA (200 ppm)	**5.81**	**178.58**	**151.80**	**127.13**	**6.00**	**5.89**
T_5 NAA (250 ppm)	5.67	176.06	149.65	123.08	5.87	5.68
T_6 NAA (300 ppm)	5.50	175.73	149.37	120.07	5.78	5.52
T_7 CCC (400 ppm)	4.49	168.60	143.31	112.46	4.91	4.21
T_8 CCC (500 ppm)	4.25	164.64	139.95	107.57	4.66	3.92
T_9 CCC (600 ppm)	4.01	160.68	136.58	102.41	4.44	3.61
F- test	S	**S**	**S**	**S**	**S**	**S**
C.D (5%)	0.13	2.65	2.26	1.94	0.21	0.24

Table no.2:Effect of plant growth regulators on fruit development characteristics of guava

Treatments	Fresh fruit weight (g)	Dry fruit weight (g)	Yield/plant (kg)	Fruit diameter (cm)	
				Polar	Radial
T_0 CONTROL (Water spray)	84.04	57.14	6.97	6.46	6.66
T_1 GA_3 (75 ppm)	88.75	60.35	7.75	6.75	6.86
T_2 GA_3 (100 ppm)	92.43	62.85	8.51	7.03	7.06
T_3 GA_3(125 ppm)	96.16	65.39	9.35	7.26	7.25
T_4 NAA (200 ppm)	**115.47**	**78.52**	**14.68**	**8.46**	**8.16**
T_5 NAA (250 ppm)	114.05	77.56	14.04	8.42	8.11
T_6 NAA (300 ppm)	113.67	76.96	13.65	8.29	8.08
T_7 CCC (400 ppm)	107.11	72.83	12.05	8.08	7.85
T_8 CCC (500 ppm)	103.45	70.35	11.13	7.82	7.66
T_9 CCC (600 ppm)	99.82	67.87	10.22	7.54	7.46
F- test	S	S	S	**S**	**S**
C.D (5%)	1.48	1.43	0,26	1.43	0.1

Table no.3: Effect of Plant growth regulators on Yield attributes of Guava

Treatment	(TSS)^{0}Brix	Total sugar (%)	Acidity(%)	Ascorbic acid (mg/100 ml)	Pectin content (%)
T_0 CONTROL (Water spray)	8.08	6.48	0.56	171.76	0.71
T_1 GA_3 (75 ppm)	8.34	6.75	0.41	175.53	0.79
T_2 GA_3 (100 ppm)	8.59	7.15	0.44	179.08	0.9
T_3 GA_3(125 ppm)	8.86	7.34	0.46	182.63	0.99
T_4 NAA (200 ppm)	**10.17**	**9.2**	**0.4**	**201.63**	**1.58**
T_5 NAA (250 ppm)	10.03	9.05	0.56	199.57	1.55
T_6 NAA (300 ppm)	9.94	8.72	0.54	199.06	1.41
T_7 CCC (400 ppm)	9.66	8.36	0.52	193.64	1.31
T_8 CCC (500 ppm)	9.38	8.09	0.5	189.73	1.19
T_9 CCC (600 ppm)	9.12	7.67	0.48	186.18	1.1
F- test	S	S	S	S	S
C.D (5%)	0.08	0.151	0.014	2.3	0.036

REFERENCES

A.0.A.C. (1970). Official methods of analysis Association of the Official Analytical chemists. Washington D.C. 8a Edn

Adsule, R.N. and Kadam, S.S. (1995). Hand book of fruit science and Technology production composition, storage and processing (Eds.D.K. Salinkhe and S.S. Kadam), Marcel Dekker Inc., New York pp., 419-433.

Dubey, A. K.; Singh, D. B. and Dubey, N. (2002). Crop regulation in guava (*Psidium guajava* L.) cv. Allahabad Safeda. *Prog. Hort.*, **34**(2): 200-203.

Garasiya, V. R.; Patel, N. M.; Bhadauria, H. S.; Verma, L. R.; Rathore, B. S.; and Vaghela, P. O. (2012). Effect of plant growth regulators on the yield components of winter season guava (Psidium guajava L.) cultivar L-49 (Sardar). Gaurav Society of Agricultural Research Information Centre, 13 (2): 770-772.

Jain, M. C. and Dashora, L. K. (2007). Growth, flowering, fruiting and yield of guava (Psidium guajava L.) cv. Sardar as influenced by various plant growth regulators Hind Agri-Horticultural Society, 3(1): 4-7.

Katiyar,P.N.; Singh, J.P.; and Singh, P.C.; Gangwar,A.P.S.(2008). Effect of preharvest application of plant growth regulators on post-harvest quality of organically grown guava (Psidium guajava L.) fruits. The asian journal of horticulture., 3: 330-332.

Kumar B (2021) Plant Bio-regulators for Enhancing Grain Yield and Quality : A review Agricultural Reviews, 42(2): 175-182.

Lal, Narayan.: Das, R.P.; and Verma. Lakh Ram. (2013). Effect of plant growth regulators on flowering and fruit growth of guava (Psidium guajava L.) cv. Allahabad Safeda the *asian journal of horticulture*, 8: 54-56.

Lal S, Tiwari. J.P.;. Awasthi. P;. Singh.G.; and Singh .G. (2007). Effect of IBA and NAA on Rooting Potential of Stooled Shoots of Guava(Psidium guajava L.) cv. Sardar. Acta Hort, 735-742.

Mankar, J. M.; Wankhade, R. S.; and Bhople, S. R. (2009). Effect of some plant growth regulators on rooting and survival of layerage in guava by polybag method. Annals of Plant Physiology, 23(2): 192-195.

Prajapati, M., and Singh, D. (2018). Effect of Plant Growth Regulators on Flowering, Fruit Growth and Quality of Guava (Psidium guajava L.). cv. Allahabad Safeda. *International Journal of Current Microbiology and Applied Sciences*. Special Issue-7: 3355-3361