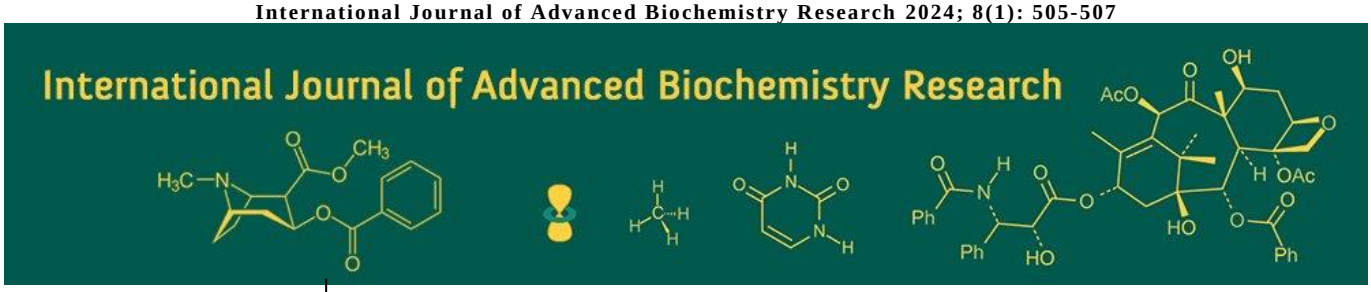

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Influence of GA_3 and NAA on growth, flowering, fruiting and yield of guava (*Psidium guajava* L.) cv Sardar under Northern Dry Zone of Karnataka

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Abstract
The present experiment was carried out at Guava orchard of ICAR, KVK- Vijayapura-1 during Mrig Bahar to find out the effect of Gibberellic acid (GA_3) and Naphthalene acetic acid (NAA). Five treatments were employed *viz*., T_1- control, T_2-100 ppm GA_3, T_3- 200 ppm GA_3, T_4- 150 ppm NAA, T_5- 250 ppm NAA and each treatment were replicated for three times. All treatments significantly performed better as compared to control. According to the results obtained, the maximum plant height was recorded in the plants treated with 150 ppm NAA (T_4 treatment), whereas, minimum plant height was noticed in control treatment of no growth regulator treatment (T_1). In the same way, maximum number of flowers/plant (63.22), maximum fruits per plant 48.20), higher fruit weight (178. 41 g), higher fruit diameter (7.18 cm) and maximum fruit yield per plant (24.53 kg) was recorded in T_4 treatment of 150 ppm NAA foliar feeding and minimum values for all these parameters were recorded in control treatment (T_1). Therefore, foliar feeding of NAA (150 ppm) followed by GA 3 (200 ppm) are recommended better growth, flowering, fruiting and final yield of guava and which is may be used for commercial cultivation of guava with good economic returns.

Keywords: Gibberellic acid (GA_3), Naphthalene acetic acid (NAA), Flowering, Fruiting, Yield

1. Introduction
Guava (*Psidium guajava* L.) is very important tropical fruit crop grown throughout the tropical and sub-tropical areas. it is also called the apple of tropics and poor man's apple due to its affordable price, nutritional content and tasty flavour, is enjoyed by both the rich and the poor throughout India's tropical and subtropical regions. The guava, which has chromosomal number 2n-22, is a native of tropical America and a member of the botanical family Myrtaceae and the natural order Myrtles. The world's top producer of guava is India. The berry has modest energy content (66 calories per 100g), but it is a good source of pectin (0.5–1.8%) and vitamin C (210–305 mg/100 g fruit pulp). 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 are all present in the ripe fruits. It is found that, by applying plant bio-regulators, fruit set and production can be increased without compromising fruit quality since the physical, chemical, and reproductive factors can also be increased. One of the key growth-stimulating chemicals, gibberellic acid (GA_3), encourages cell elongation and division, aiding in the growth and development of numerous plants. The use of GA_3 enhances the size, shape and weight of the fruits. GA_3 improves the tree's fruit set and retention. The synthetic auxin naphthalene acetic acid (NAA) stimulates cell elongation, cell division in the cambium, phloem and xylem differentiation, flowering, and fruiting. It can also cause phenotypic changes in plants and affect growth either by enhancing or by stimulating the natural growth regulatory system from seed germination to senescence. Auxins as well as GA_3 have been found to accelerate the translocation of metabolites from other parts of the plant towards developing fruits (Mahmood *et al*., 2016) [4]. However, due to a variety of factors such cultivar, unrestricted conditions, environment, and soil type, the published results are not all alike. This highlights the necessity of standardizing chemical dosages and cultural methods for guava plants that are grown in a variety of soil types and climate conditions.

This study presents the findings of an experiment on the impact of GA and NAA spraying on guava crop that was carried out in Guava orchard of ICAR- KVK, Vijayapura^{-1} under Northern Dry Zone of Karnataka.

2. Materials and Methods

2.1 Experimental design and treatments preparation

This investigation was carried out on three-year-old Sardar Guava variety orchard of ICAR, KVK- Vijayapura-1, which is having a semi-arid tropical type of climate, located 530 km from Northwest of states capital Bengaluru. The orchard was established during 2020 in North to South direction, the plants were planted with the spacing of 2 metres within the plant and three metres between the rows. The experiment was laid out in randomized block design with three replications and five treatment combinations including control *viz*., T_1- control, T_2-100 ppm GA_3, T_3- 200 ppm GA_3, T_4- 150 ppm NAA, T_5- 250 ppm NAA during Mrig bahar season, flowering occurred during June-July and crop harvested during November- December.

2.2 Observations Recorded

Observations were recorded from five randomly selected and labelled plants in each treatment in a replication. The data obtained from all plants per replication under each treatment were averaged and analysed. The plant height is measured 90 days after implementing treatments. Four branches were chosen at random from every direction on a tree in order to record the flowering and fruiting traits. The fruits were harvested at their harvest maturity stage when those were green and medium hard in texture. Fruits were harvested at 110 days after anthesis. The yield parameters of the fruits were noted, and the yield per tree (measured in kilograms) was calculated by multiplying the total number of fruits by the average fruit weight of four fruits.

2.3 Data Analysis

The experimental data were subjected to the statistical analysis by using variance for completely randomized design (CRD). The treatment differences were tested by F-test of significance based on null hypothesis, critical difference (CD) at 5% level of probability was worked out to compare the treatment means, where the treatment effects were significant.

3. Results and Discussion

3.1 Plant height

The growth parameter i.e., plant height was significantly influenced by different treatments growth regulators treatments, maximum increment in plant height was recorded in T_4 treatment (373.09 cm) with 150 ppm NAA growth regulator application, followed by 200 ppm GA_3 treatment (341.04 cm) whereas minimum plant height was recorded in control treatment (202.85 cm) with no growth regulator treatment. This enhanced increment in plant height with the application of NAA @150 ppm may be due to immediate absorption of auxins, which increased the endogenous auxin level that resulted in cell elongation and enhanced vegetative. Similar findings are reported by Manish, P and Singh, D (2018) [5].

Table 1: Effect of GA_3 and NAA on growth and reproductive parameters of Guava

Treatments	Plant height (cm)	Flowers/plant	Fruits/plant
T_1	202.85	54.64	36.85
T_2	303.71	59.70	40.20
T_3	341.04	61.17	41.17
T_4	373.09	63.22	48.20
T_5	223.13	56.50	38.02
F-test	S	S	S
CD (5%)	3.94	2.08	2.27

T_1- control, T_2-100 ppm GA_3, T_3- 200 ppm GA_3, T_4- 150 ppm NAA, T_5- 250 ppm NAA

3.2 Flowers per plant

The result indicated that, the number of flowers per plant was found maximum in the plants treated with 150 ppm NAA (63.22) followed by application of GA_3 (61.17) of 200 ppm treatment, whereas minimum number of flowers were recorded in control treatment. This enhanced increment in number of flowers with the application of NAA @150 ppm than 200 ppm GA_3 might be due to antagonistic activity of GA to flowering, whereas auxin like NAA contributes to increased flowering. Similar results are reported by Jain and Dashora (2007) [3].

3.3 Fruits per plant

The result indicated that, the number of fruits per plant was found maximum in the plants treated with 150 ppm NAA (48.20) followed by application of GA_3 (40.20) of 200 ppm treatment, whereas minimum number of flowers were recorded in control treatment (36.85). This reduction in number of fruits with the application of 200 ppm GA_3 than NAA @150 ppm might be decrease in number of flowers, whereas auxin like NAA contributes to increased flowering. Similar these results are in close proximity with the findings as reported by Jain and Dashora (2007) [3], and Manish, P and Singh, D (2018) [5] in Guava. Further, foliar application of NAA significantly influence flower number, controls flower drop, fruit drop and improves fruit retention per shoot as well as fruit set (Badal & Tripathi, 2021) [2].

Table 2: Effect of GA_3 and NAA on fruit and yield parameters of Guava

Treatments	Fruit weight (g)	Fruit diameter (cm)	Yield/ plant (kg)
T_1	111.10	6.42	18.30
T_2	120.26	6.57	22.23
T_3	170.41	7.10	22.19
T_4	178.41	7.18	24.53
T_5	164.03	6.76	20.93
S.Em ±	S	S	S
CD (5%)	2.08	0.78	0.03

T_1- control, T_2-100 ppm GA_3, T_3- 200 ppm GA_3, T_4- 150 ppm NAA, T_5- 250 ppm NAA

3.4 Fruit weight (g)

It is evident from the data that, fruit weight varied significantly among the treatments, the T_4 treatment (150 ppm NAA) recorded maximum fruit weight (178.41 gm) followed by 200 ppm GA_3 treatment (T_3), whereas minimum fruit weight (111 gm) was recorded in T_1 treatment (control). The increase in fruit weight in NAA and GA_3 treated plant might be attributed to positive role of these hormone in cell division, elongation and better translocation of food assimilates by Gibberellic acid and due to immediate absorption of auxins, which increased the endogenous auxin level that resulted in cell elongation, enhanced vegetative growth with better photosynthesis by NAA application. These results are in conformity with those results reported by Manish, P and Singh, D (2018) [5].

3.5 Fruit diameter (cm)

As recorded during the course of experiment, fruit diameter was found maximum in T_4 treatment (178. 41 cm) followed by T_3 treatment (170.41 cm), while minimum diameter of fruit noticed in T_1 treatment. This increase in ripened ovary diameter due to increase in flower quality with enhanced diameter of flower especially ovary part due to increased cell division and elongation especially after fertilisation and early fruit growth. So, Application of auxin accelerated the development of fruit. Similar findings were reported by Yadav *et al*. (2001) [6] in guava.

3.6 Yield/plant (kg)

The data (Table 2) indicate that yield per plant influenced signicantly by the application of growth regulators such as auxin and gibberellin, and it is found that, yield per plant was found maximum (24.53 kg) in the plants treated with 150 ppm NAA (T_4) followed by (22.19 kg) 200 ppm GA_3 treatment (T_3), while minimum yield (18.30 kg) recorded in control treatment (T_1). This increased trend in yield per plant in growth regulators treated plant is attributed to improvement in many factors such as number of flowers, number of fruits, diameter of fruit and fruit weight. This overall improvement in yield enhancing factors might be due to certain changes in metabolism of fruit which reflected in more accumulation of water and enhanced deposition of soluble solids. Exogenous application of auxin increased the sink strength of treated organs with strong movement of metabolites takes place from weaker sink to stronger sink depending upon the hormonal level (Agnihotri, Tiwari and Singh, 2013) [1], and these results are in conformity with the results revealed by Badal & Tripathi (2021) [2].

4. Conclusion

From the present investigation, it is concluded that, treatment T_5 (NAA @150 ppm) is best suited and beneficial for the plant growth, flowering fruit yield of guava fruit followed by GA_3 treatment at 200 ppm (T_3).

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