

Review Article

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

ABSTRACT

An investigation was carried out to study of the "Effect of Plant Growth Regulators and Brassinosteroids on Growth, Yield and Quality of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda)" in meadow orchard was successfully carried out in the years 2021–2022, at Central Research Farm, Department of Horticulture, Sam Higginbottom Institute of Agriculture & Sciences, Prayagraj (U.P.). The experiment carried out using Randomised Block Design (RBD) with replicated thrice and ten treatments made up the experiment with: control, three concentrations of gibberellic acid (GA_3) at 100, 150 and 200 ppm, three concentrations of naphthalene acetic acid (NAA) at 50, 100, and 150 ppm, and three concentrations of Brassinosteroids at 200, 400, and 600 ppm. From the experiment, T_9 (Naphthalene Acetic Acid (NAA) @150ppm) was the best treatment in all the parameters for growth, yield and quality and overall the treatment gave the significant response in respect to all the parameters i.e. Plant height (335.7 cm), number of flowers per plant (61.3), fruiting buds per plant (151.8), number of fruits per plant (48.23), fruit weight (137.7 g), Fruit length (5.36), fruit diameter (7.33), weight of pulp/fruit (104.57 g), weight of seed/fruit (6.74g), total soluble salts (TSS) 10.97° Brix, vitamin C content (188.52), total sugar (8.03), acidity (1.27) and yield/ha (33.3). During the observation period in Research field, SHUATS, Prayagraj.

Comment [U1]: what is the idea or problem formulation, so this research is important to do. Describe it in a sentence or two

Keywords: NAA, GAA, Brassinosteroids, growth, Yield, Guava.

INTRODUCTION

Guava (*Psidium guajava* L.) is certainly considered one among maximum crucial fruit plants of the tropics and sub-tropics elements of the world. Guava fruit includes 82.50 according to cent water, 2.45 percentage decreasing sugar, 2.23 percentage non-decreasing sugar, 9.73 percentage general soluble solids, 0.48 percentage ash and 260 mg nutrition-C according to one hundred gm of fruit pulp in addition to exact quantity of iron, calcium and phosphorus. It is the fourth maximum crucial fruit crop in place in addition to manufacturing after Mango, Banana and Citrus. It additionally has huge adaptability, cap potential of fruiting all 12 months spherical and it is able to face up to drought condition. Over all Guava is a hardy plant however the younger vegetation is at risk of extreme frost that may bring about mortality. Guava is propagated via sexual approach in addition to vegetative strategies of propagation TanishkaThapa and Vijaya Rawat[1]. Though guava may

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be effectively propagated through seeds however the vegetative strategies of propagation are favored as via seedling propagation genetic purity cannot be maintained considering the fact that it is able to bring about genetical versions that may have an effect on the fruit first-class, form length and yield. There are many strategies of vegetative propagation in Guava like layering, slicing, grafting, stooling and budding. Propagation through cuttings can both be performed through root slicing or shoot slicing. Since, propagation through root slicing can handiest be performed from figure vegetation which have been started from cuttings (Shiguera *et al* [2]. Stem slicing is a vegetative approach of propagation wherein a bit of stem with at the least 3 nodes and internodes are used for propagation. The cuttings ought to be handled with plant boom regulators to sell rooting.

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In current years, guava is getting greater recognition withinside the worldwide alternate because of its dietary price and numerous processing merchandise like jelly, jam, sherbat, ice cream, cheese, canned fruit, RTS, nectar, squash and powders Singh *et al* [3]. Vegetative propagation of guava is extensively practiced to make sure proper to kind and early bearing of culmination. The call for of first-class planting shares of fruit plants like guava is developing swiftly. Conventional strategies of propagation consisting of air layering, inarching or stooling can not completely meet the requirement of planting stock, due to the dependency of climate situations and coffee fulfillment rate. The fruit have excessive nutritive price and sells at low prices, however isn't always pretty famous to all training of people, especially because of its seediness; The wide variety of the seeds varies in distinct sorts from three hundred to 500 according to fruit Sardoei, A.S. Therefore, it's miles crucial to expand seedless cultivar or to set off seedless fruit through the exogenous utility of plant boom regulators (PGRs). Auxins specially IBA, NAA and IAA had been mentioned to set off rooting in the various plant species with various fulfillment. In present day times, air layering propagation strategies the usage of boom regulators all through wet seasons are getting used to gain greater fulfillment. Role of brassinosteroid in fruit ripening became studied through. Brassinosteroids manage a vast variety of responses in plant, inclusive of seed germination, stem and root elongation, vascular differentiation, leaf enlargement and apical dominance. In addition to their position in plant development, brassinosteroids have the cappotential to defend vegetation from numerous environmental stresses, inclusive of drought, severe temperatures, heavy metals, herbicidal damage and salinity.

Growth regulators like GA₃ and NAA impacts flower and fruit setting, yield and first-class of fruit, mobileular boom, apical dominance, geotropism and photoperiod. GA₃ had the very best fruit retention accompanied through Amcotone, activated dry yeast and NAA in each iciness and wet seasons. The boom regulators spray similarly will increase fruit weight, Total Soluble Salts (TSS), carotene, decreasing sugars, general sugars and nutrition-C and reduced tannin and fruit acidity. Hence, the present study was undertaken to find out the effect of different Plant growth regulators Brassinosteriod growth and fruit quality of Guava (*Psidium Guajava* L.) Cv. Allahabad Safeda and to study the yield and yield attributes of Guava (*Psidium Guajava* L.) Cv. Allahabad Safeda.

MATERIALS AND METHODS

The field experiment was conducted at Central Research Farm, Department of Horticulture, Sam Higginbottom Institute of Agriculture & Sciences, Prayagraj (U.P.). During the year of 2021-2022.

The experiment material consists of Guava (*Psidium guajava* L. Cv. Allahabad Safeda). The experiment was layout in Randomised Block Design (RBD) with three replications and ten treatments and the treatment consists of Brassinosteroids @200ppm, Brassinosteroids @400ppm, Brassinosteroids @600ppm, Gibberellic Acid (GA3) @100ppm, Gibberellic Acid (GA3) @150ppm, Gibberellic Acid (GA3) @200ppm, Naphthalene Acetic Acid (NAA) @50ppm, Naphthalene Acetic Acid (NAA) @100ppm, Naphthalene Acetic Acid (NAA) @150ppm.

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The experiment site is fairly levelled land with sandy loam soil of uniform fertility status with low clay and high sand percentage. Soil samples were collected randomly from depth of 0-30 cm and the soil was analyzed for pH, organic carbon, available nitrogen, available phosphorus and available potassium.

Experimental plot was prepared 15 days prior to transplanting. The soil was ploughed manually, levelled and the weeds were rooted out. The land was brought to a fine tilth by thorough tillage. The experimental area was laid out with plot size (1m × 1m) with 30cm bunds between the plots. Irrigation channels of 50cm were provided between rows of plots. The plants were irrigated immediately after application of fertilizers. During Zaid season, irrigation was applied as and when required during fruit development stages.

The fruits were harvested at full matured stage. During the experimental period harvesting was done in three pickings at an interval of eight to ten days. For the present study, 10 plants of guava Var. Allahabad Safeda were selected randomly, replicated thrice and treated with plant growth regulators. The observations were recorded from 30 plants that were selected randomly and tagged in each replication. The observations on growth, flowering and flowering, yield and quality parameters were determined and Economics of each treatment were computed and statistically analyzed.

The yield and yield contributing characters of guava were recorded after the picking of ripe fruits of each plant. The total soluble solids contents was determined with the help of ERMA Hand Refractometer (0 to 30° Brix) by putting a drop of juice on the prism slide and readings were taken.

The refractometer were calibrated with distilled water before use of every time. Ascorbic acid was estimated titrimetrically using 2,6-dichlorophenolindophenol method (Sadasivam and Manickam, 1992). Twenty gram of fruit pulp was homogenized in 10% metaphosphoric acid (extracted solution) and the volume was

make to 100ml in avolumetric flask and was titrated against dye, the reading was noted and content of ascorbic is calculated (mg/100g fresh fruit pulp). Five millilitre of the working standardsolution was pipette in a conical flask then 100 ml of of 4.0 % oxalic acid was added and into it and titrated against the dye till the appearance of pink colour. Burette reading was recorded at the point at which colour of the solution changed to pink.

Total Sugar (%):50 ml of the clarified solution was pipetted into 250ml flask and added 5g of citric acid and 50 ml of water. It was boiled gently for 10 min to complete inversion of sucrose, and then cooled. Transferred to 250 ml flask and neutralized with 1N NaOH using phenolphthalein and was titrated with Fehling solution.

3. RESULTS AND DISCUSSION

3.1 Growth parameters

3.1.1 Plant height

The data on plant height (cm) Effect Of Plant Growth Regulators On Growth, Yield And Quality Of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). Treatment T9 (Naphthalene Acetic Acid (NAA) @150ppm) was found best and recorded significantly the highest plant height i.e., 5.85 m followed by T8 (Naphthalene Acetic Acid (NAA) @100ppm) i.e., 5.68 m. where-as treatment T0 Control recorded significantly the lowest plant height i.e., 3.77 m. The increase in plant height due to application of NAA was due to the fact that NAA enhances the growth of plant by cell enlargement and cell elongation mechanism through increasing amylase activity, permeability, formation of energy rich phosphate (ATP) and cell wall plasticity while, decreases viscosity and wall pressure. The results are in accordance with the findings of Singh et al [4] in guava tree.

Comment [U6]: do not use only one comparative research literature. Look for more to strengthen the argument

3.2 Flowering and Fruiting

3.2.1 Number of flowers

The data on Number of flowering on the Effect of Plant Growth Regulators on Growth, Yield and Quality of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The max. Number of flowers was recorded in treatment T9 Naphthalene Acetic Acid (NAA) @150ppm (61.3) followed by treatment T8 Naphthalene Acetic Acid (NAA) @100ppm (57.73) and minimum number of flowers was recorded in treatment T0 control i.e, (50.4). The increase in number of flowers per plant due to application of NAA might be due to the fact that NAA treatments significantly increased the plant

height. It important to note that increased plant height increased the production offlowers, mentioned that NAA effect might be due enhancement of cell enlargement, not cell division . this also reported that Ghora, Y., Vasilakakis, M. and Stavroulakis, G. [5]

3.2.2 Number of fruits per plant

The data on Number of fruits per plant on the Effect Of Plant Growth Regulators On Growth, Yield And Quality Of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The max. Number of fruits per plant was recorded in treatment T9 Naphthalene Acetic Acid (NAA) @150ppm (48.23) followed by treatment T8 Naphthalene Acetic Acid (NAA) @100ppm (44.5) and min. was recorded in treatment T0 control (30.89). Application of NAA significantly increased the number of fruits/plant. The increasing number of fruits per plant by NAA treatment might be due to the rapid and better nutrient translocation from roots to apical parts of the plant. The increase in concentration resulted in increasing number of fruits per plant. These results are in accordance with Bhosle et al [6] and Singh et al [7].

Table 1. Effect of Plant Growth Regulators on Growth parameters of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda)

Comment [U7]: recheck the way the table is presented

Treatment	Treatment combination	Plant height (cm)	Number of flowers	Number of fruits per plant
T ₀	Control	3.77	50.4	30.89
T ₁	Brassinosteroids@200ppm	4.36	51.4	34.5
T ₂	Brassinosteroids @400ppm	4.71	53.46	37.46
T ₃	Brassinosteroids @600ppm	4.83	54.77	39.3

T ₄	Gibberellic Acid (GA3) @100ppm	5.25	53.13	36.15
T ₅	Gibberellic Acid (GA3) @150ppm	4.37	53.6	37.13
T ₆	Gibberellic Acid (GA3) @200ppm	4.59	56.57	40.4
T ₇	Naphthalene Acetic Acid (NAA) @50ppm	5.07	54.83	41.47
T ₈	Naphthalene Acetic Acid (NAA) @100ppm	5.68	57.73	44.5
T ₉	Naphthalene Acetic Acid (NAA) @150ppm	5.85	61.3	48.23
F-test		S	S	S
C.D. at 0.5%		0.13	0.55	0.66
S.Ed. (+)		1.61	0.18	0.22

3.3 Yield parameters

3.3.1 weight of fruits

The data on Weight of fruit on the Effect Of Plant Growth Regulators on Growth, Yield And Quality Of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The maximum weight of fruit was recorded in treatment T₉ Naphthalene Acetic Acid (NAA) @150ppm (137.7 g) followed by treatment T₈ Naphthalene Acetic Acid (NAA) @100ppm (130.37 g) and minimum weight of fruit was recorded in treatment T₀ Control (103.5 g). This increased fruit weight due to NAA concentration might be due to the fact that NAA mediated higher level of metabolites from the leaves towards fruits which resulted in heavier fruits as compared to other treatments. The results are in accordance with findings of Bhosle et al [8]. NAA induced cell elongation by enlargement of vacuoles and loosening of cell wall which caused increase in fruit weight, fruit number and yield and is being confirmed by the findings of Yadav et al [9] in guava fruits.

3.3.2 Fruit yield per hectare(Kg/ha)

The data on Fruit yield on the Effect of Plant Growth Regulators on Growth, Yield and Quality of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The maximum Fruit yield per hectare was recorded in treatment T9 Naphthalene Acetic Acid (NAA) @150ppm (33.33 kg) followed by treatment T8 Naphthalene Acetic Acid (NAA) @100ppm (31.73 kg) and minimum was recorded in treatment T0 Control (21.47 kg). The foliar application of NAA maintains the ongoing physiological and biochemical functions which influence the pattern of organ differentiation that might have changed the uptake translocation and accumulation mineral nutrients in plant. Similar results observed by, which supports the results obtained in the present investigation. Iqbal, M., Khan, M. Q., Jalai-ud-Din Khalid and Rehman, M. [10]

3.3.3 Fruit length

The data on Fruit length on the Effect of Plant Growth Regulators on Growth, Yield And Quality Of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The maximum fruit length was recorded in treatment T9 Naphthalene Acetic Acid (NAA) @150ppm (5.36 cm) followed by treatment T8 Naphthalene Acetic Acid (NAA) @100ppm (5.30 cm) and minimum was recorded in treatment T0 Control (4.56 cm). This could be due to the fact that NAA treatment might have produced a dominant role in increasing the cell division and cell enlargement and consequently cell wall which later might have increased the free passage of solutes to the fruits. Similarly also reported that fruit diameter (7.30 cm) increased due to the application of NAA @200 ppm in guava. Similar findings were also reported Abbas et.al [11] in guava.

3.3.4 Fruit diameter

The data on Fruit diameter on the Effect of Plant Growth Regulators on Growth, Yield And Quality Of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The maximum fruit diameter was recorded in treatment T9 Naphthalene Acetic Acid (NAA) @150ppm (7.33) followed by treatment T8 Naphthalene Acetic Acid (NAA) @100ppm (7.13) and minimum was recorded in treatment T₀ Control (6.05). This could be due to the fact that NAA treatment might have produced a dominant role in increasing the cell division and cell enlargement and strengthening of middle lamella and consequently cell wall which later might have increased the free passage of solutes to the fruits. Similarly also reported that fruit diameter (7.30 cm) increased due to the application of NAA @200 ppm in guava. Similar findings were also reported by Abbas *et.al.*, [12] in guava.).

3.3.5 Volume of fruit

The data on Volume of fruit on the Effect of Plant Growth Regulators on Growth, Yield and Quality of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The max.

Volume of fruit was recorded in treatment T9 Naphthalene Acetic Acid (NAA) @150ppm (178.4 cc) followed by treatment T8 Naphthalene Acetic Acid (NAA) @100ppm (174.5 cc) and min. was recorded in treatment T0 Control (148.5 cc). The above result might be due to the fact that NAA induced cell elongation and loosening of cell wall which caused increase cell mass as a result the volume of the fruit increased. Similar observations were reported by Prajapati and Singh [13].

3.3.6 Weight of pulp per fruiting

The data on Weight of pulp per fruit on the Effect of Plant Growth Regulators on Growth, Yield and Quality of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The max. Weight of pulp per fruit was recorded in treatment T9 Naphthalene Acetic Acid (NAA) @150ppm (104.57 g) followed by treatment T8 Naphthalene Acetic Acid (NAA) @100ppm (99.08 g) and min. was recorded in treatment T0 Control (78.90 g). This increased pulp weight due to NAA concentration might be due to the fact that NAA mediated higher level of metabolites from the leaves towards fruits which resulted in heavier fruits as compared to other treatments. The results are in accordance with findings of Bhosle et al. [14]. NAA induced cell elongation by enlargement of vacuoles and loosening of cell wall which caused increase in fruit weight, fruit number and yield and is being confirmed by the findings of Yadav et al., [15] in guava fruits.

3.4 Quality parameters

3.4.1 Total Soluble Solids (°Brix)

The data on Total Soluble Salts on the Effect of Plant Growth Regulators on Growth, Yield and Quality of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The maximum Total Soluble Solids was recorded in treatment T9 Naphthalene Acetic Acid (NAA) @150ppm (11.27) followed by treatment T8 Naphthalene Acetic Acid (NAA) @100ppm (10.97) and minimum was recorded in treatment T₀ Control (9.43). The increased in total soluble solids might be due to the auxin synthesis, which increased the metabolites available for total soluble solids formation. Similar types of results were also obtained by, Garasiya et.al.[16] in guava & Agrawal and in sapota.

3.4.2 Vitamin C(mg)

The data on Vitamin C on the Effect of Plant Growth Regulators on Growth, Yield and Quality of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda) The max. Vitamin

C content was recorded in treatment T₉ Naphthalene Acetic Acid (NAA) @150ppm (188.52) followed by treatment T₈ Naphthalene Acetic Acid (NAA) @100ppm (186.63) and min. was recorded in treatment T₀ Control (149.36). Similar types of results were also obtained by Garasiya et.al.[17] in guava in sapota

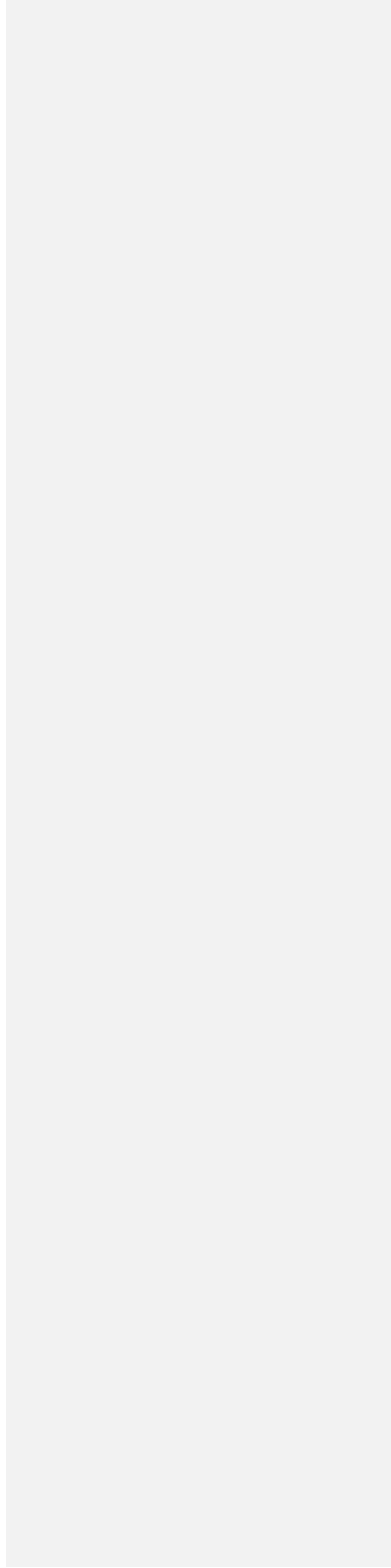
3.4.3 Total sugar

The data on Total Sugar on the Effect of Plant Growth Regulators on Growth, Yield and Quality of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The maximum Total Sugar content was recorded in treatment T₉ Naphthalene Acetic Acid (NAA) @150ppm (8.17) followed by treatment T₈ Naphthalene Acetic Acid (NAA) @150ppm (8.03) and minimum was recorded in treatment T₀ Control (7.15). The application of plant growth regulators may have increased the activity of the enzymes such as amylases, which hydrolyze the complex polysaccharides in to simple sugars. Auxin has been reported to accelerate the translocation of metabolites from other parts of the plant towards developing fruits. These findings are supported by the results obtained by Garasiya et.al.[18] in guava in sapota.

3.4.4 Acidity (%)

The data on Acidity on the Effect of Plant Growth Regulators on Growth, Yield and Quality of Guava (*Psidium Guajava* L. Cv. Allahabad Safeda). The max. acidity was recorded in treatment T₁ Brassinosteroids @200ppm (1.48) followed by treatment T₂ Brassinosteroids @400ppm (1.36) and min. was recorded in treatment T₉ Naphthalene Acetic Acid (NAA) @150ppm (1.20). Contrary to the observation, Acidity is generally reduced by the foliar application of NAA because it helps in preventing excessive polymerization of sugar and accumulation of more sugar in the cells of plant. However high level of NAA may lead to antagonistic effect which leads to accumulation of more sugar. Similar reports wereJaya lakshmi [19], Singh [20] in guava.

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Treatment	Treatment combination	Weight of fruit (g)	Fruit yield per hectare (kg)	Fruit length (cm)	Fruit diameter	Volume of Fruit (cc)	Weight of pulp per fruit (g)	Ascorbic Acid (mg/100g) (90 days)	Total Soluble Solids ("Brix)	Total Sugar	Acidity
T ₀	Control	103.5	21.47	4.56	6.05	148.5	78.90	149.36	9.43	7.15	1.48
T ₁	Brassinosteroids@200ppm	105.3	22.43	4.86	6.14	153.2	81.35	156.62	9.50	7.24	1.36
T ₂	Brassinosteroids @400ppm	112.19	24.33	4.91	6.23	158.6	85.87	162.03	9.67	7.47	1.35
T ₃	Brassinosteroids @600ppm	113.71	27.86	5.09	6.37	166.1	89.54	165.57	9.92	7.57	1.33
T ₄	Gibberellic Acid (GA3) @100ppm	106.3	25.83	5.14	6.27	157.1	86.78	171.46	10.17	7.49	1.28
T ₅	Gibberellic Acid (GA3) @150ppm	113.97	28.76	5.08	6.38	162.3	90.34	175.48	10.27	7.73	1.27
T ₆	Gibberellic Acid (GA3) @200ppm	118.76	30.43	5.18	6.49	168.3	92.65	184.54	10.33	7.86	1.23
T ₇	Naphthalene Acetic Acid (NAA) @50ppm	128.23	31.8	5.23	6.83	172.7	95.86	184.54	10.89	7.97	1.26
T ₈	Naphthalene Acetic Acid (NAA) @100ppm	130.37	31.73	5.30	7.13	174.5	99.08	186.63	10.97	8.03	1.27
T ₉	Naphthalene Acetic Acid (NAA) @150ppm	137.7	33.33	5.36	7.33	178.4	104.57	188.52	11.27	8.17	1.20
F-test		S	S	S	S	S	S	S	S	S	S
CD (5%)		4.71	0.46	0.01	0.03	1.12	0.02	0.90	0.009	0.01	0.04
SE. d (+)		1.38	0.15	0.006	0.01	0.37	0.13	0.30	0.02	0.04	0.01

Table 2. Effect of Plant Growth Regulators on Yield and Quality of Guava (*Psidium Guajava* L. Cv.(Allahabad Safeda).

CONCLUSION

On the basis of present investigation, it is concluded that the treatment T₉ (Naphthalene Acetic Acid (NAA) @150ppm) was found the best in terms of vegetative growth (Plant height (cm), number of flowers, and yield and quality parameters number of fruits per plant, weight of fruit, fruit yield per plant, fruit length, fruit diameter, volume of fruit, weight of pulp per fruit, TSS (°Brix), Acidity (%), Ascorbic Acid (mg/100g).

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Comment [U8]: use the Mendeley or Zotero app

Comment [U9]: use the latest literature in the last 5-10 years

Comment [U10]: use the latest literature in the last 5-10 years

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