~~Impact of plant bioregulators on growth, yield, and quality of Guava (*Psidium guajava* L.) in central region of Punjab~~

Impact of plant bioregulators on growth, yield, quality and economic feasibility of Guava (*Psidium guajava* L.) in central region of Punjab

ABSTRACT

Guava ~~holds significant is an importance in India~~ is one of the most promising fruit crops of India due to its high nutritional value, affordability, and ability to grow in diverse climatic conditions. It plays a vital role in the economy and is a major source of vitamins, especially Vitamin C, ~~for millions~~. A study conducted from 2022 to 2024 at the Department of Agriculture, Agriculture Research Farm, Mata Gujri College, Fatehgarh Sahib, Punjab, evaluated the effects of various plant growth regulators on guava. The experiment involved ten treatments, each replicated three times using a randomized block design. The treatments included: PBR_1 (NAA 50 ppm), PBR_2 (NAA 75 ppm), PBR_3 (NAA 100 ppm), PBR_4 (GA_3 50 ppm), PBR_5 (GA_3 100 ppm), PBR_6 (GA_3 150 ppm), PBR_7 (Triacontanol 25 ppm), PBR_8 (Triacontanol 50 ppm), PBR_9 (Triacontanol 75 ppm), and a control (C). Among the treatments, PBR_3 (NAA 100 ppm) produced the best results in terms of growth, productivity, and quality, followed by PBR_2 (GA_3 75 ppm). The highest net return of Rs. 454,237 and the best benefit-cost (B:C) ratio were also recorded for PBR3 (NAA 100 ppm). Based on these findings, the use of plant growth regulators, particularly NAA 100 ppm, is recommended to enhance both the yield and quality of guava fruits.

Keywords: bioregulators, firmness, growth regulator, triacontanol, yield

Introduction

Guava is a globally significant fruit due to its rich nutritional profile, particularly its high Vitamin C content, and adaptability to various climates. In India, guava is vital for both its economic contribution and as a highly affordable, nutritious fruit consumed by millions (Angulo-López *et al.*, 2024). It plays a key role in improving public health and supporting rural livelihoods. India's leading guava-producing states include Gujarat, Uttar Pradesh, Madhya

Pradesh, Punjab, Haryana, West Bengal, and Bihar.*Just write in sequence according area or production* With an annual production of 983.59 thousand tonnes, Uttar Pradesh is in the lead, followed by Madhya Pradesh (434.41 thousand tonnes) and Bihar (776.75 thousand tonnes) (NHB, 2023). With an area of 8.2 thousand hectares and an annual production of 183.4 thousand tonnes, guava is the second most productive fruit in Punjab, after citrus (NHB, 2023). Key districts for guava cultivation in Punjab include Patiala, Ludhiana, Jalandhar, Muktsar Sahib, Sangrur, and Bathinda.

Despite its widespread appeal, a number of obstacles that have a detrimental influence on this guava cultivar's economic viability have prevented it from reaching its full production potential. Key issues faced by guava producers include poor fruit set, a high percentage of early fruit drop, improper fruit development, and the high perishability of the fruit (Singh and Singh, 2008). Promoting vegetative development and flowering necessitates the administration of plant growth regulators. Due to their beneficial effects on the fruit's physical, chemical, and reproductive properties, it has also been noted that employing these regulators can increase fruit set and yield without affecting fruit quality (Gomsata *et al.*, 2024).

Gibberellic acid (GA_3), a key growth-promoting chemical, stimulates cell elongation and division, supporting growth and development of various plants. The application of GA_3 enhances fruit size, shape, and weight, while also improving fruit set and retention in trees. Gibberellins regulate fruit development through different mechanisms at various stages. They are frequently applied to improve fruit quality and to prevent fruit drop. Many factors contribute to the loss of some fruits at different stages of ontogenic development, from fruit set to ripening and final maturity (Suman *et al.*, 2017).

Plant growth processes such as cell elongation, division, vascular tissue differentiation, and root initiation, apical dominance, leaf senescence, and the control of leaf and fruit abscission are all aided by NAA, a synthetic version of auxin. Additionally, it contributes to raising floral sex ratio, minimising fruit drop, and enhancing fruit setting ratios (Mehraj *et al.*, 2015). NAA treatments have been shown to increase fruit production, size, and total yield per tree in loquat, without negatively affecting the fruit's nutritional ~~or~~ and organoleptic qualities. In guava, NAA has significantly improved fruit collection, length, diameter, weight, total soluble solids, sugars content, vitamin C levels, and has reduced overall fruit drop. The translocation of metabolites from other sections of the plant towards the developing fruits is known to be enhanced by auxins and GA_3 (Mahmood *et al.*, 2016).

Triacontanol, a naturally occurring regulator of plant growth present in epicuticular waxes, is extensively employed to increase crop yields, particularly on millions of hectares in Asia. Studies on various crops have shown that TRIA enhances growth, yield, photosynthesis, protein synthesis, water and nutrient absorption, nitrogen fixation, and enzyme activity, and the levels of soluble proteins, reducing sugars, free amino acids, and components of essential oils (Kumar et al., 2021). It is a natural plant hormone, present in beeswax and plant cuticles, that regulates numerous physiological processes in fruit crops. They consist of enhancing photosynthesis, transpiration, stomatal conductance, growth promotion, and nutrient absorption. TRIA also enhances stress tolerance in crops by modulating the expression of photosynthetic genes, stress-related genes, and antioxidant levels in response to stresses such as acid mists, heavy metals, salt, water, and by regulating the expression of genes linked to photosynthetic processes, stress-related genes, and antioxidant levels in response to various stimuli, including acid mists, heavy metals, salt, water, and temperature, TRIA further improves crops' ability to withstand stress (Pankaj *et al.*, 2022). In Punjab, guava productivity has declined due to factors like poor soil health, pest infestations, and erratic weather conditions. To counter this, farmers have turned to plant growth regulators (PBRs) such as gibberellic acid and NAA, which help enhance flowering, fruit size, and yield. These PBRs have shown promising results, leading to increased guava production and improved fruit quality.

Material and Methods

The research was conducted at the Department of Agriculture~~'s~~, Agriculture Research Farm at Mata Gujri College in Sri Fatehgarh Sahib, Punjab, India. The farm is located at a latitude of 30°56'11.90°N and a longitude of 76°18'13.18°E, with an average elevation of 279 meters above sea level. There are three different seasons in Sri Fatehgarh Sahib's subtropical climate: winter, summer, and the rainy season. Temperatures can drop as low as 4–8°C during the winter (December–January), and they can climb as high as 42–45°C during the summer (May–June). Winter brings sporadic frost and precipitation. Most of the rainy season falls between mid-July and the end of September, when it starts to get less intense. An estimated 67 centimetres of rain fall on the area each year on average. The study was conducted in a guava orchard with the Allahabad Safeda variety, planted at a spacing of 5x5 meters.

The treatments detail are given in Table 1.

Fruit physical and quality parameters

Fruit volume, firmness, specific gravity

A digital Vernier calliper is used to measure the volume of the fruit, and the mean of the observations is calculated and represented in millimeters (mm). A fruit's crispness is its firmness. Pressing it is one of the simplest ways to measure it. Penetrometers and pressure testers are two types of equipment that can be used to measure stiffness. They cause damage because a fruit is pressed or a probe is put inside of it to distort it. Five randomly chosen fruits were weighed and the results were noted. These fruits were put in a glass jar with water, and a measuring cylinder was used to determine how much water needed to be changed. The specific gravity was calculated as per formula given below-

$$\Rightarrow \text{Specific gravity} = \frac{\text{Total weight of five fruits}}{\text{Total volume of water replaced by five fruits}}$$

Formula should be in text formats

Sugars and Vitamin C

Fruit juice (10 ml) is taken in a conical flask and 3% HPO_3 solution is added to make final volume of 100 ml. A 10 ml sample of this newly made and filtered stock solution is then taken. Standard dye 2, 6-Dichlorophenol-Indophenol, is used to titrate this solution until it has a pink end point look. Titrated quickly and assessed the titer in an initial manner. The vitamin C content of the sample, calculated by the following formula

$$Ascorbic\ acid\ \left(\frac{mg}{100g}\right) of fruit = \frac{Titre \times Dyefactor \times Volumemadeup \times 100}{Weightofsample}$$

Formula should be in text formats

Total sugar content is stated as a percentage based on the weight of fresh fruit (A.O.A.C. 1980).

$$\text{Total sugar} = \frac{\text{Fehling factor} \times \text{Dilution}}{\text{Titre value} \times \text{Vol. of aliquate taken for measurement} \times \text{Wt. of sample taken}} \times 100$$

Formula should be in text formats

Fehling Factor = 0.052

The results are presented as a percentage based on the weight of fresh fruit as given in (A.O. A.C. 1980).

$$\text{Reducing sugar} = \frac{\text{Fehling factor} \times \text{Dilution}}{\text{Titre value} \times \text{Wt. of sample taken}} \times 100$$

Formula should be in text formats

Fehling Factor = 0.052

Non-reducing sugars = (Total sugars - reducing sugars) x 0.95

Total Soluble Solids

Using an Erma-hand refractometer (0-32 0 Brix), the total soluble solid of the juice is calculated by placing a few drops of juice on the prism. Prior to usage, the refractometer is calibrated using purified water. Whenever the temperature went over or below 20 ˚C, an adjustment was performed (A.O.A.C. 2002).

Acidity

The percentage of acidity was computed with the use of a particular

$$Acidity\ (\%) = \frac{1 \times Eq.wt.of\ acid \times Normality\ of\ NaOH \times Titer\ volume \times 10}{Aliquet\ \times 10}$$

Formula should be in text formats

TSS/acid ratio:

Divide the total soluble solids by the acidity to find the total soluble solids to acid ratio.

Yield attributes

Fruit weight, No. of fruits per tree, fruit yield

To determine weight of the fruit, we weighed the ten selected fruits and calculated the average weight in grams (g). At the time of harvesting, the number of fruits harvested from five randomly chosen plants was recorded. Next, the average quantity of fruits produced by each plant was determined. At each harvest, the entire quantity of fruit produced by each plant is weighed, recorded, and reported as the yield of fruits per plant in grams (g).

Economic Parameters

The cost of cultivation per hectare is determined by calculating the expenses for inputs, managerial aspects and cultural practices. The net profit per hectare is obtained by deducting these costs from the gross income according to the going market selling rate. The net return is then divided by the cultivation cost to determine the benefit-cost ratio.

Cost of cultivation

Each treatment's cultivation cost was determined using the variables, fixed inputs, and corresponding prices.

Gross income

In a similar manner, the market rate of the produce was used to determine gross income for each treatment.

Net returns

The total cost of cultivation is then subtracted from the gross income for each treatment to determine net returns.

Net return = Gross income – Total cost of cultivation

Benefit: cost ratio

Net returns are divided by total cost of production to get the benefit-cost ratio.

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$$\text{Benefit : cost ratio} = \frac{\text{Net return}}{\text{Total cost of production}}$$

Formula should be in text formats

Statistically analysis:

The statistical analysis conducted in R (R Studio version 2022.07.1) involved performing a one-way analysis of variance (ANOVA) at a 5% significance level, using the "stats" package. Additionally, a Duncan Multiple Range Test (DMRT) was applied as a post-hoc analysis to compare the means of various treatment combinations, utilizing the "agricolae" package.

Result and Discussion

Fruit physical parametrers (Fruit volume, firmness and specific gravity)

The result showed in Table 2 demonstrated the significant effects of GA_3, Tricontonal, and NAA on the volume of guava fruits. The rsults demonstrated that PBR_3 NAA (100ppm) had the largest fruit volume (85.72 mm), which was statistically equivalent to PBR_2 (NAA 75ppm) at 83.12 mm and PBR_4 GA_3 50ppm (82.73) whereas in C (control), the lowest fruit volume (57.36 mm) was noted.

An examination data for firmness has been presented in Table 1. It showed the impact of NAA, GA_3, and Tricontonal on guava fruits volume. The results showed that minimum firmness (8.05) was found in PBR_3 NAA (100ppm) while the maximum firmness (8.73) was recorded in C (control) PBR_3 NAA (100ppm) which was statistically followed by PBR_7 (Tricontonal 25ppm) i.e., 8.63

The data regarding the effect of NAA, GA_3, and Tricontonal on the specific gravity of guava is presented in Table 2. The maximum specific gravity (1.02) was recorded in PBR_3 (NAA 100ppm), which was statistically equivalent with PBR_2 NAA 75ppm (0.99) and PBR_4 GA_3 50ppm (0.96) while in C (control), the lowest specific gravity (0.83) was noted. Awasthi and Lal (2009) suggest that an increase in fruit size (length and breadth) could result from a balanced supply of nutrients and growth regulators to the plant throughout the entire crop growth period, which would drive the plant's vigorous vegetative development and ultimately increase the amount of photosynthates produced.

Fruit quality parameters

Ascorbic acid

In Table 3, data on the presence of ascorbic acid is presented. The result indicate that PBR_3 (NAA 100ppm) had the highest ascorbic acid content (252.85 mg/100g), followed by PBR_2 NAA 75ppm (248.14 mg/100g), and C (control) had the lowest ascorbic acid content (205.14 mg/100g).

Total sugar

The total sugar content data has been shown in Table 3 Maximum total sugar content (10.73%) was recorded in PBR_3 (NAA 100ppm), which was statistically equivalent with PBR_2 NAA 75ppm (10.68%) and minimum total sugar (7.84%) was observed in C (control).

Reducing sugar

The data analysis showed that the response of NAA, GA_3, and Tricontonal was significant.. The results indicated that PBR_3 (NAA 100ppm) had the highest reducing sugar content (5.17%), which was statistically comparable to PBR_2 NAA 75ppm (5.16%) and PBR_4 (GA3 50ppm), or 5.14%. In C (control), the lowest reducing sugar content (3.86%) was recorded.

Non-reducing sugar

Table 3 displays the non-reducing sugar content data. The maximum non-reducing sugar content (5.57%) was found in PBR_3 (NAA 100ppm), which was statistically comparable with PBR_2 (5.55%) and minimum non-reducing sugar (3.98%) was observed in C (control).

The combined action of plant regulators may result in a higher sugar concentration. The larger amount of growth may be the cause of the increase in total sugars. In addition, because these regulators aid in photosynthesis, there is an increased build-up of polysaccharides and oligosaccharides. Along with this, they also control the activity of the enzymes, which rapidly converted starch into soluble sugars and accelerated ripening in response to building blocks (Kaur and Kaur, 2017)

TSS and acidity

Table 4 presents the examination data for total soluble solids. The data showed that the maximum TSS resulted in PBR_3 NAA 100ppm (10.86 ^{0}Brix) and statistically followed by PBR_2 (NAA 75ppm) i.e., 10.36 ^{0}Brix whereas the minimum (8.34 ^{0}Brix) was observed with the control. The Table 4. showed the data for titratable acidity and data revealed that minimum titratable acidity was recorded in PBR_3 NAA (100ppm) (0.24%). Whereas the maximum was (0.43%) observed and statistically followed by PBR_7 Tricontanol (25ppm) having value (0.41%).

TSS: Acid Ratio

Table 4 presents the results of the TSS: Acid ratio analysis. The results demonstrated that maximum TSS: Acid ratio (37.24%) was recorded in PBR_3 NAA 100ppm and statistically followed by PBR_2 NAA 75ppm i.e., 35.38%, whereas in control the minimum TSS: Acid ratio was (18.82%) observed.

TSS may have increased because auxin synthesised more metabolites, which were then rapidly translocated from other areas of the plant to growing fruits (Garasiya, 2013). As a result, fruits treated with NAA served as a powerful sink for metabolites extracted from the leaves. According to Rajput et al. (2016), fruits' higher metabolic activity was caused by the TSS's ability to transform complicated chemicals into simpler ones. Auxin-mediated mobilisation of carbohydrates from the sink source (fruits) may be the cause of the rise. This could be explained by the possibility that NAA boosted amylase activity, resulting in a rapid metabolic conversion of starch to soluble sugars and a rise in TSS from early ripening in response to growth chemicals. Agnihotri et al. (2013) gave similar findings in his research on guava. The results of Dubey et al. (2002) are likewise consistent with the current findings.

Yield parameters (Weight, number of fruits, yield/tree)

Table 5 displays the fruit weight data where the effect of different treatments was found significant. PBR_3 (NAA 100ppm) had the largest fruit weight (182.6 g), statistically followed by PBR_2 (175.86 g), and C (control) had the lowest fruit weight (132.16 g). Table 4 data demonstrates that plants treated with 100 ppm of NAA produced the greatest number of fruits per tree (167.86), statistically followed by PBR_2 (141.06), while C (control) showed the lowest number of fruits per tree (102.33). An examination data for fruit yield per plant data under different treatment was found significant shown in Table 4. The data indicates that 100ppm NAA resulted in the maximum fruit yield per plant (30.65 Kg/tree) and followed by treatment PBR_2 (24.80 Kg/tree) while in control the minimum fruit yield per plant (13.52 Kg/tree) was observed.

The weight gain of the fruit may have contributed to the increase in yield, and this weight gain may have strengthened the cell walls and middle lamella. This improvement probably allowed more solutes to freely flow to the fruits, increasing their length, diameter, and ultimately weight. The application of NAA (naphthaleneacetic acid) may contribute to this by promoting higher metabolite flow from the leaves to the fruits, resulting in heavier fruits. Furthermore, the intermediate lamella and cell walls may have been reinforced by the exogenous NAA supply, which would have made it easier for nutrients and minerals to be transferred from other plant sections to the growing fruits, which are extremely active metabolic sinks. The weight of the fruit may have increased as a result. Therefore, the increased weight and volume of the fruits account for the increase in yield per plant (Katiyar *et al*., 2008).

Economic parameters

Table 6 presents the average statistics for the cost of cultivation, gross income, and net return (Rs/ha) under the different treatments. The cost at which guava fruit was sold was set at Rs. 40 per kilogram.

Cost of cultivation

The cost of cultivation per hectare for different doses of plant growth regulators was calculated to be the lowest (Rs 1,30,790) with the control, and the highest (Rs 2,10,790) in PBR_3 NAA 100ppm.

Gross income

An examination of data from different treatments of plant growth regulators revealed that the highest gross income (Rs 586074.9) was calculated in PBR_3 (NAA 100ppm), whereas the lowest gross income (Rs 258599.1) was calculated in C control.

Net returns

The net income data showed that the cost of cultivation per hectare was lowest (Rs 127809.1) in the control, while it was highest (Rs 454237.9) in PBR_3 (NAA 100ppm).

Benefit: cost ratio

Data regarding the B: C ratio revealed that the cost of cultivation per hectare among different treatments of plant growth regulators was calculated to be lowest (0.98) with the control, while it was highest B: C ratio (3.45) in PBR_3 (NAA 100ppm).

Conclusion

The study highlights the significant role of plant growth regulators in enhancing guava yield, quality, and economic returns. Among the various treatments tested, NAA 100 ppm (PBR3) delivered the best performance in terms of growth, fruit yield, and quality, resulting in the highest net return of Rs. 454,237 and the most favorable benefit-cost (B:C) ratio. GA_3 75 ppm (PBR_4) also showed promising results but was outperformed by NAA 100 ppm. Therefore, the use of NAA 100 ppm is strongly recommended for guava cultivation to improve both production efficiency and profitability for farmers in India.

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Please put all reference in sequence and follow the same pattern as journal pattern.

~~**Table 1. Treatment detail of plant bioregulators**~~

~~Treatments code~~	~~Plant bioregulators~~
~~PBR_1~~	~~NAA 50 ppm~~
~~PBR_2~~	~~NAA 75 ppm~~
~~PBR_3~~	~~NAA 100 ppm~~
~~PBR_4~~	~~GA_3 50 ppm~~
~~PBR_5~~	~~GA_3 100ppm~~
~~PBR_6~~	~~GA_3 150ppm~~
~~PBR_7~~	~~Tricontonal 25 ppm~~
~~PBR_8~~	~~Tricontonal 50 ppm~~
~~PBR_9~~	~~Tricontonal 75 ppm~~
~~C~~	~~Control (Water spray)~~

Please add treatment details in method materials as running matter.

Table 2 Effect of foliar application of plant bioregulators on fruit volume, firmness and specific gravity on guava cv. Allahabad Safeda.

Treatments	**Fruit volume (mm)**	**Firmness (Kg/cm^2)**	**Specific gravity**
Treatments	71.39e	8.20^{de}	0.93^{cd}
PBR_1 (50 ppm NAA)	83.12bc	8.07^{fg}	0.99^{ab}
PBR_2 (75 ppm NAA)	85.72b	8.05^{g}	1.02^{a}

PBR$_3$ (100 ppm NAA)	82.73bc	8.13^{efg}	0.96^{abc}
PBR$_4$ (GA$_3$ 50 ppm)	76.21d	8.14^{ef}	0.95^{bc}
PBR$_5$ (GA$_3$ 100ppm)	65.34f	8.24^{d}	0.92^{cd}
PBR$_6$ (GA$_3$ 150ppm)	60.09g	8.63^{b}	0.85^{ef}
PBR$_7$ (Tricontonal 25 ppm)	81.58c	8.27^{d}	0.89^{de}
PBR$_8$ (Tricontonal 50 ppm)	93.47a	8.36^{c}	0.94^{bcd}
PBR$_9$ (Tricontonal 75 ppm)	57.36g	8.73^{a}	0.83^{f}
C (Control)	1.09	0.02	0.01
SE(m)±	3.28	0.06	0.04

Table 3 Effect of foliar application of plant bioregulatots on ascorbic acid, total sugar, reducing sugar, and non-reducing sugar on guava cv. Allahabad Safeda.

Treatments	Ascorbic acid (mg/100g)	Total sugar (%)	Reducing sugar (%)	Non reducing sugar (%)
PBR$_1$ (50 ppm NAA)	232.33^{e}	8.84^{f}	4.35^{bc}	4.49^{d}
PBR$_2$ (75 ppm NAA)	248.14^{b}	10.68^{a}	5.16^{a}	5.55^{a}
PBR$_3$	252.85^{a}	10.73^{a}	5.17^{a}	5.57^{a}

(100 ppm NAA)				
PBR_4 (GA_3 50 ppm)	247.95^{b}	10.41^{b}	5.14^{a}	5.26^{b}
PBR_5 (GA_3 100ppm)	242.75^{c}	9.55^{d}	4.54^{b}	4.94^{c}
PBR_6 (GA_3 150ppm)	224.04^{f}	8.64^{g}	4.55^{bc}	4.45^{d}
PBR_7 (Tricontonal 25 ppm)	209.52^{h}	7.96^{h}	3.56^{e}	4.02^{e}
PBR_8 (Tricontonal 50 ppm)	212.77^{g}	9.36^{e}	4.21^{c}	4.05^{e}
PBR_9 (Tricontonal 75 ppm)	240.78^{d}	9.93^{c}	4.40^{bc}	4.51^{d}
C (Control)	205.14^{i}	7.84^{i}	3.86^{d}	3.98^{e}
SE(m)±	0.62	0.02	0.07	0.02
CD $_{(0.05)}$	1.86	0.08	0.23	0.08

Table 4 Effect of foliar application of plant bioregulators on total soluble solid, acidity, and TSS: Acidity ratio on guava cv. Allahabad Safeda.

Treatments	TSS (^{0}Brix)	Acidity (%)	TSS: acidity ratio
PBR_1 (50 ppm NAA)	9.06^{f}	0.30^{de}	26.94e
PBR_2 (75 ppm NAA)	10.36^{b}	0.34^{bcd}	35.38b
PBR_3 (100 ppm NAA)	10.86^{a}	0.24^{e}	37.24a
PBR_4 (GA_3 50 ppm)	10.24^{c}	0.32^{cde}	32.05c

PBR$_5$ (GA$_3$ 100ppm)	9.84^{d}	0.03^{de}	32.07c
PBR$_6$ (GA$_3$ 150ppm)	8.93^{g}	0.35^{bcd}	24.85f
PBR$_7$ (Tricontonal 25 ppm)	8.44^{i}	0.41^{ab}	20.46h
PBR$_8$ (Tricontonal 50 ppm)	8.06^{h}	0.34^{bcd}	23.88g
PBR$_9$ (Tricontonal 75 ppm)	9.77^{e}	0.39^{abc}	28.32d
C (Control)	8.34^{j}	0.43^{a}	18.82i
SE(m)±	0.02	0.02	0.30
CD $_{(0.05)}$	0.06	0.07	0.90

Table 5. Effect of foliar application of plant bioregulators on fruit weight, no. of fruits and fruit yield on guava cv. Allahabad Safeda.

Treatments	Fruit weight (g)	No. of fruits per tree	Fruit yield(kg/tree)
PBR$_1$ (50 ppm NAA)	167.66^{d}	119.03^{f}	38.25^{f}
PBR$_2$ (75 ppm NAA)	175.86^{b}	141.06^{b}	46.11^{d}
PBR$_3$ (100 ppm NAA)	182.6^{a}	167.86^{a}	48.34^{c}
PBR$_4$ (GA$_3$ 50 ppm)	172.36^{c}	131.93^{c}	46.45^{d}
PBR$_5$ (GA$_3$ 100ppm)	170.93^{c}	125.66^{d}	43.47^{e}
PBR$_6$	163.05^{e}	115.76^{g}	38.30^{f}

(GA$_3$ 150ppm)			
PBR$_7$ (Tricontonal 25 ppm)	143.06^{g}	109.43^{i}	37.82^{f}
PBR$_8$ (Tricontonal 50 ppm)	154.56^{f}	110.53^{h}	64.26^{b}
PBR$_9$ (Tricontonal 75 ppm)	169.76^{cd}	120.07^{e}	79.75^{a}
C (Control)	132.16^{h}	102.33^{j}	33.86^{g}
SE(m)±	0.89	0.32	0.54
CD $_{(0.05)}$	2.67	0.96	1.64

Table 6. Effect of foliar application of plant bioregulators on total cost, Gross income, Net returns, Benefit: cost ratio of guava cv. Allahabad Safeda.

Treatments	Total cost	Gross income	Net returns	Benefit: cost ratio
PBR$_1$ (50 ppm NAA)	131313.0	381595.5	250282.5	1.91
PBR$_2$ (75 ppm NAA)	131575.0	474346.6	342771.6	2.61
PBR$_3$ (100 ppm NAA)	131837.0	586074.9	454237.9	3.45
PBR$_4$ (GA$_3$ 50 ppm)	133085.0	434806.2	301721.2	2.27
PBR$_5$ (GA$_3$ 100ppm)	135340.0	410709.5	275369.5	2.03
PBR$_6$ (GA$_3$ 150ppm)	137635.0	361900.5	224265.5	1.63
PBR$_7$ (Tricontonal 25 ppm)	132515.0	300463.7	167948.7	1.27

PBR_8 (Tricontonal 50 ppm)	134240.0	326660.8	192420.8	1.43
PBR_9 (Tricontonal 75 ppm)	135990.0	391784.8	255794.8	1.88
C (Control)	130790.0	258599.1	127809.1	0.98