



Influence of New Generation Plant Growth Regulators and Fruit Bagging on Organoleptic Properties of Guava (*Psidium guajava* L.) cv. G-27

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The current study was performed at the field of Horticulture Research Orchard, Department of Horticulture, College of Agriculture, RVSKVV, Gwalior (M.P.) during 2022-23 and 2023-24. The main aim of the study was to identify the effect of new generation Plant Growth Regulators and fruit bagging techniques on the organoleptic characteristics (appearance, taste, color, aroma and overall acceptability) of guava fruits. The experiment was laid in Factorial Randomized Block Design

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comprising of 20 treatment combinations. The individual as well as combined effect of novel PGRs and fruit bagging was studied. Maximum score on various organoleptic characteristics was recorded in treatment P₅B₃ (Salicylic acid 600 ppm + White polyethylene bag) while the minimum score was attained in P₁B₁ (control). The experiment shows the possibility of using white polyethylene bags in combination with salicylic acid 600 ppm treatment to improve the organoleptic properties of fruits of *Psidium guajava* L., maturity while reducing damage from insect pests

Keywords: Novel PGRs; fruit bagging; organoleptic properties; guava.

1. INTRODUCTION

Guava (*Psidium guajava* L.), is one of the foremost imperative tropical and subtropical fruit crops of India, which has a place to the family Myrtaceae. It is local of tropical America, extending from Mexico to Peru and continuously has ended up a commercial level of natural product in a few nations. It is developed in India since early 17th century and gradually got to be edit of commercial centrality. Guava is fourth important fruit crop in area and cultivation after mango, banana and citrus. It is cultivated all through the tropical and subtropical locale. Guava variety Gwalior-27 variety is a selection from Allahabad Safeda seedlings. The fruit size ranges from medium to medium large having cream white, thick flesh with few seeds, acid sweet in taste and good quality. It is a heavy bearer variety with fruits mostly round in shape.

Plant bio-regulators (PBRs) are biochemical compounds which fortifies plant growth and efficiency when applied, indeed in little amounts at suitable plant growth stages. These are being broadly utilized in agribusiness to upgrade the productivity especially in horticultural crops but are not as predominant in field crops. The major part of Plant bio-regulators is to advance plant development and advancement through nutrient assignment and source-sink moves. Salicylic acid is also an endogenous growth regulator with phenolic nature, which participates in the regulation of several physiological processes in plants, such as stomata closure, ion uptake, inhibition of ethylene biosynthesis and transpiration (Bindhyachal et al., 2016). Foliar application of Salicylic Acid may stimulate various plant physiological parameter *i.e.*, stomatal activity, ions uptake, seed germination, leave membrane response to electrolytes and growth rate. Salicylic acid acts as a growth regulator, is a natural compound present in the plant system, which plays an important role in many physiological processes. Salicylic acid is accepted as safe and natural chemical

compound for pre and post-harvest application on fruits to delay ripening, softening and reduction in lipid peroxidation and chilling injury in fruits (Zhang et al., 2003). Generally, salicylic acid could maintain firmness, reduce the loss of chlorophyll content, alleviate chilling injury, induce pathogenic resistance and improve nutritional value by enhancing bioactive compounds and antioxidants also maintain post-harvest quality, control diseases and alleviate physiological disorders during storage (Asghari et al., 2010).

Bagging techniques can protect fruits from pests and eliminates the use of pesticides, thus improves the quality of fruit. In the present study, different materials (newspaper bags, perforated polyethylene bags, muslin cloth bags and netted cloth bags) were used for on-tree bagging of guava fruit to improve fruit quality. Polyethylene bags reduced the damage by fruit fly to maximum extent followed by newspaper and muslin cloth bags. Economic analysis that all bagging techniques were cost effective. However, fruit covered with perforated polyethylene bags exhibited maximum BCR (benefit cost ratio) with better fruit quality.

2. METHODOLOGY

2.1 Experimental Site

The present experiment was laid out in the field of Horticulture Research Orchard, Department of Horticulture, College of Agriculture, RVSKVV, Gwalior (M.P.). The investigation was conducted during 2022-23 and 2023-24. Gwalior is situated at 26° 13' N latitude and 78° 14' E longitudes at an altitude of 211.5 m above mean sea level in Gird region. It has a subtropical climate with hot and dry summer where maximum temperature exceeds 45 °C in May-June. The winters are cold and minimum temperature reaches as low as 2 °C in December and January. Frost is expected from the last week of December to first week of February. Usually the monsoon arrives in the second fortnight of June and lasts till

September. Occasionally light rains are expected during winter.

2.2 Experimental Design

The experiment comprised of 20 treatments consisting of foliar spray of new generation PGR's (Brassinosteroid & Salicylic acid) and fruit bagging (different material) and control. It was laid in Factorial Randomized Block Design. Table no. 1 represents the treatment combination.

2.3 Experimental Procedure

For the observation of organoleptic parameters of fruits, five healthy fruits were selected randomly from each plant at full mature stage. The samples were evaluated for the organoleptic parameters on the score card called hedonic scale. The organoleptic parameters were quantified for different fruit grades and mean score of 5 judges was calculated, analyzed and used for further interpretations. Organoleptic evaluation by 5 panelist was carried out using a less than 2.50 to 7.5- 9.0 hedonic scale (< 2.50 = poor and 7.5 – 9.0 = excellent) water was also provided for the testers to rinse their mouth after

each evaluation under a well-lighted room. The fruits were washed thoroughly before evaluation for the following heads:

2.3.1 Appearance

The appearance of guava fruit was judged by hedonic scale. For this panel of five judges was chosen who examined the appearance of fruit and score given by them was average.

2.3.2 Taste

The taste of guava fruit was judged by hedonic scale. For this panel of five judges was chosen who examined the taste of fruit and score given by them was average.

2.3.3 Color

The color of guava fruit was judged by visual method. For this panel of five judges was chosen who examined the color of fruit and score given by them was averaged.

The scoring was done by following pattern.

Table 1. Treatment combination

S.No.	Notation	Treatment combination
1	P ₁ B ₁	Control
2	P ₁ B ₂	News paper
3	P ₁ B ₃	White polyethene bag
4	P ₁ B ₄	Brown paper bag
5	P ₂ B ₁	Brassinosteroid (0.75 ppm)
6	P ₂ B ₂	Brassinosteroid (0.75 ppm) + News paper
7	P ₂ B ₃	Brassinosteroid (0.75 ppm) + White polyethylene bag
8	P ₂ B ₄	Brassinosteroid (0.75 ppm) + Brown paper bag
9	P ₃ B ₁	Brassinosteroid (1.5 ppm)
10	P ₃ B ₂	Brassinosteroid (1.5 ppm) + News paper
11	P ₃ B ₃	Brassinosteroid (1.5 ppm) + White polyethylene bag
12	P ₃ B ₄	Brassinosteroid (1.5 ppm) + Brown paper bag
13	P ₄ B ₁	Salicylic acid (400 ppm)
14	P ₄ B ₂	Salicylic acid (400 ppm) + News paper
15	P ₄ B ₃	Salicylic acid (400 ppm) + White polyethylene bag
16	P ₄ B ₄	Salicylic acid (400 ppm) + Brown paper bag
17	P ₅ B ₁	Salicylic acid (600 ppm)
18	P ₅ B ₂	Salicylic acid (600 ppm) + News paper
19	P ₅ B ₃	Salicylic acid (600 ppm) + White polyethylene bag
20	P ₅ B ₄	Salicylic acid (600 ppm) + Brown paper bag

Table 2. sensory score for color of guava fruit

Color	Sensory scale
Yellow	7.5 – 9.00
Light green	5.0 – 7.49
Dark green	2.5 – 4.99
Green	< 2.50

2.3.4 Aroma

The aroma of fruits was evaluated by a panel of five judges on the basis of smell and blend of the fruit.

2.3.5 Overall acceptability

The overall acceptability of guava fruit was judged by hedonic scale. For this panel of five judges was chosen who examined the overall acceptability of fruit and score given by them was averaged.

3. RESULTS AND DISCUSSION

3.1 Appearance

Through the analysis of the data presented in Table 3 it was found that the interaction effect of the two factors i.e. novel PGRs and fruit bagging exerted statistically significant effect on the appearance of guava fruits. Maximum score on appearance of fruits in the first year, second year and pooled data was recorded in treatment P₅B₃ (Salicylic acid 600 ppm + White polyethylene bag) with 7.99, 7.81 and 7.90, whereas minimum score on appearance of guava fruits in the first year, second year and pooled data was observed in P₁B₁ (control) with 4.94, 4.28 and 4.61 respectively. Madhav et al., (2016) conducted a study on guava fruits of cv. Allahabad Safeda and treated with SA, kept at 10°C for 12 days. It was discovered that fruits applied with SA at 2 mM, showed lowest colour change without any conflicting effect on fruit appearance and taste. When SA is applied as post-harvest application, lead to the deferment of the ripening activity of guava fruits significantly, possibly through inhibition of ethylene production process. Behera and Pathak, (2016) reported that pre-harvest application of CaCl₂ + Polyethylene bagging proved the best in enhancing post-harvest quality attributes viz., fruit size, fruit weight, fruit firmness, organoleptic quality, total soluble solids, acidity, reducing sugar, non-reducing sugar and total sugar

3.2 Taste

Through the evaluation of the data presented in Table 4 it was found that the interaction effect of the two factors i.e. novel PGRs and fruit bagging imposed statistically significant influence on the taste of guava fruits. Highest score on taste in the first year, second year and pooled data was found in treatment P₅B₃ (Salicylic acid 600 ppm + White polyethylene bag) with 8.88, 8.34 and

8.61, whereas minimum score on taste of fruits in the first year, second year and pooled data was recorded in P₁B₁ (control) with 5.17, 4.57 and 4.87 respectively. The results are in agreement with Kim et al., (2008) who studied the effect of bagging material on fruit colouration and quality of fruit 'Janghwon Hwangdo' peach and reported that the peach fruits bagged with white coated bags had higher soluble solids concentration, lower percentage of damaged fruits, increased sugar content up to 6.25% and higher anthocyanin and chlorophyll contents in the fruit skin. While those bagged with white bags showed higher soluble solids concentration, faster maturity and increased glucose content. This is because bagging can improve fruit skin colour through the reduction of chlorophyll content and increase fruit flavour through the increase in aroma volatile content. Ezzaz et al. (2016) investigated the effect of methyl jasmonate and salicylic acid on 6 sensory properties (skin and flesh colour, texture, taste, visual appearance and overall acceptability). All parameters were generally increased by methyl jasmonate and salicylic acid treatments compared to water-treated control and the water-treated fruits showed the lowest scores below the acceptability limit except for skin colour.

3.3 Color

The examination of the data presented in Table 5 revealed that the interaction effect of the two factors i.e. novel PGRs and fruit bagging imposed statistically significant effect on the color of guava fruits. Maximum score on the color of fruits in the first year, second year and pooled data was found in treatment P₅B₃ (Salicylic acid 600 ppm + White polyethylene bag) with 8.62, 8.74 and 8.68, while the minimum score on the color of fruits in the first year, second year and pooled data was recorded in P₁B₁ (control) with 5.27, 5.45 and 5.36 respectively. The findings are in accordance with Lo'ay and Khateeb (2011) who while working on guava cv. 'Baladi' concluded that immersion in salicylic acid at high level 500 µM had advanced effect on fruit color (ho) compared with other concentrations of salicylic acid and control treatment. In the untreated fruits, rapid loss of green colour was experienced than the treated fruits during storage. The reason behind this is SA as pre-treatment application delays the fruit ripening process. Untreated fruits of guava lost their green colour after 7th day in storage. However, salicylic acid @ 300 ppm treated fruits retained green under ambient condition fruits up to 7th

day of storage (Kaur, 2016). Sikandar et al. (2017) in present study guava fruits were treated with different concentration of salicylic acid (0, 400-, 500-, 600- and 700-micron mol) and stored at room temperature for attributes evaluation. Data for fruit colour, weight loss per cent, fruit weight, decay per cent, fruit firmness, TSS, TA,

total phenolic contents and total antioxidants were calculated at five days interval at ambient storage condition. Results depicted that treated fruits with 600-micron mol had lower values for colour loss 1.5, fruit decay 14.97 per cent and weight loss 20.03 per cent as compared to other SA concentration. Liu et al., (2015)

Table 3. Interaction effect (A X B) of novel PGR's and fruit bagging on Appearance of guava during 1st year, 2nd year and pooled data

Appearance					
Novel PGR's					
1st year					
Fruit bagging	P₁	P₂	P₃	P₄	P₅
B ₁	4.94	6.64	6.88	6.92	7.76
B ₂	6.89	7.19	6.96	7.10	7.10
B ₃	7.36	6.91	7.36	7.70	7.99
B ₄	7.30	6.68	7.14	7.44	7.50
2nd year					
B ₁	4.28	7.31	6.79	6.93	7.07
B ₂	6.61	6.83	7.08	7.57	7.35
B ₃	7.01	7.29	7.41	7.17	7.81
B ₄	6.81	7.11	7.25	7.40	7.58
Pooled					
B ₁	4.61	6.98	6.84	6.93	7.42
B ₂	6.75	7.01	7.02	7.34	7.23
B ₃	7.19	7.10	7.39	7.44	7.90
B ₄	7.06	6.90	7.20	7.42	7.54
	1st year		2nd year		Pooled
SE(M)	0.285		0.328		0.256
CD (5%)	0.816		0.940		0.732

Table 4. Interaction effect (A X B) of novel PGR's and fruit bagging on Taste of guava during 1st year, 2nd year and pooled data

Taste					
Novel PGR's					
1st year					
Fruit bagging	P₁	P₂	P₃	P₄	P₅
B ₁	5.17	6.67	7.04	7.20	7.40
B ₂	6.40	6.91	7.21	7.41	7.59
B ₃	6.57	7.15	7.33	7.53	8.88
B ₄	6.48	7.21	7.25	7.44	7.64
2nd year					
B ₁	4.57	6.87	7.03	7.17	7.36
B ₂	6.75	6.99	7.18	7.32	7.50
B ₃	6.84	7.09	7.26	7.45	8.34
B ₄	6.78	7.05	7.22	7.38	7.58
Pooled					
B ₁	4.87	6.77	7.03	7.18	7.38
B ₂	6.58	6.95	7.19	7.36	7.54
B ₃	6.71	7.12	7.29	7.49	8.61
B ₄	6.63	7.13	7.24	7.41	7.61
	1st year		2nd year		Pooled
SE(M)	0.211		0.179		0.159
CD (5%)	0.603		0.512		0.456

tested non-woven polypropylene bags of different collars to overcome the poor peach fruit colour problem and found that fruit bagged with white non-woven polypropylene (WH-N) developed the deepest red colour and accumulated the highest amount of anthocyanin in peels of peach cv. 'Hujingmilu' and 'Yulu'.

3.4 Aroma

The interaction effect of the two factors i.e. novel PGRs and fruit bagging on score on aroma of guava fruits presented in Table 6 demonstrates that the interaction effect of novel PGRs and fruit bagging have significant impact on the aroma of guava fruits. Maximum score on aroma of fruits was recorded in the combination P₅B₃ (Salicylic acid 600ppm + White polyethylene bag) i.e. 8.19, 6.68, 8.40 in the first year, second year and pooled data. While the minimum score on aroma of fruits was recorded in the combination P₁B₁ (control) i.e. 4.06, 4.40 and 4.23 in the first year, second year and pooled data. Jia et al. (2005) studied the influence of bagging on aroma volatiles and skin colouration of 'Hakuho' peach and indicated that bagging enhanced fruit skin colour and increased the aroma volatile content. The results are in agreement with Sharma et al. (2020) observed the effects of five different types of bags on the rainy-season crop of 'Allahabad Safeda' guava. All bags significantly advanced fruit maturity and improved fruit weight, texture,

visual appeal, quality, and functional attributes over unbagged (control) fruits.

3.5 Overall Acceptability

The interaction effect of the two factors i.e. novel PGRs and fruit bagging on the overall acceptability of guava fruits presented in Table 7 reveals that the interaction effect of novel PGRs and fruit bagging have significant effect on the overall acceptability of guava fruits. Highest score on overall acceptability of fruits was observed in the combination P₅B₃ (Salicylic acid 600ppm + White polyethylene bag) i.e. 8.29, 8.37, 8.33 in the first year, second year and pooled data respectively. While the lowest score on overall acceptability of fruits was recorded in the combination P₁B₁ (control) i.e. 5.82, 5.12 and 5.47 in the first year, second year and pooled data respectively. Buganic et al., (2006) revealed the pre-harvest bagging with brown paper just after two months of flower initiation in mango fruits cv. Carabao minimized the rejected fruit percent and resulted in 70% of export-quality fruits, whereas 50% export-quality fruits were obtained from unbagged trees. Abbasi et al. (2018) noticed that bagging techniques can protect fruits from pests and eliminates the use of pesticides, thus improves the quality of fruit, by different materials viz. newspaper bags, perforated polyethylene bags, muslin cloth bags and netted cloth bags used for on-tree bagging of guava fruit to improve fruit quality.

Table 5. Interaction effect (A X B) of novel PGR's and fruit bagging on color of guava during 1st year, 2nd year and pooled data

Fruit bagging	Colour				
	Novel PGR's				
	1 st year				
	P ₁	P ₂	P ₃	P ₄	P ₅
B ₁	5.27	6.72	6.91	7.04	7.29
B ₂	6.54	6.93	7.13	7.28	7.52
B ₃	6.77	7.15	7.37	7.50	8.62
B ₄	6.63	7.02	7.24	7.38	7.73
	2 nd year				
B ₁	5.45	6.76	6.96	7.09	7.37
B ₂	6.52	6.95	7.14	7.31	7.56
B ₃	6.73	7.13	7.36	7.49	8.74
B ₄	6.61	7.01	7.23	7.37	7.70
	Pooled				
B ₁	5.36	6.74	6.93	7.07	7.33
B ₂	6.53	6.94	7.14	7.29	7.54
B ₃	6.75	7.14	7.37	7.50	8.68
B ₄	6.62	7.02	7.24	7.37	7.72
	1 st year	2 nd year		Pooled	
SE(M)	0.177	0.180		0.175	
CD (5%)	0.506	0.517		0.502	

Table 6. Interaction effect (A X B) of novel PGR's and fruit bagging on Aroma of guava during 1st year, 2nd year and pooled data

Aroma					
Novel PGR's					
1st year					
Fruit bagging	P₁	P₂	P₃	P₄	P₅
B ₁	4.06	7.02	6.50	6.64	6.78
B ₂	6.32	6.53	6.78	6.88	7.06
B ₃	6.71	7.00	7.12	7.29	8.19
B ₄	6.51	6.83	6.97	7.11	7.30
2nd year					
B ₁	4.40	6.42	5.90	6.04	6.04
B ₂	5.72	5.93	6.18	6.29	6.29
B ₃	6.11	6.40	6.52	6.68	6.68
B ₄	5.93	6.23	6.37	6.51	6.51
Pooled					
B ₁	4.23	6.72	6.20	6.34	6.62
B ₂	6.02	6.23	6.48	6.58	6.62
B ₃	6.41	6.70	6.82	6.98	8.40
B ₄	6.22	6.53	6.67	6.81	7.00
1st year		2nd year		Pooled	
SE(M)	0.327		0.329		0.347
CD (5%)	0.938		0.941		1.071

Table 7. Interaction effect (A X B) of novel PGR's and fruit bagging on overall of guava during 1st year, 2nd year and pooled data

Overall					
Novel PGR's					
1st year					
Fruit bagging	P₁	P₂	P₃	P₄	P₅
B ₁	5.82	6.74	6.83	6.95	7.30
B ₂	6.62	6.76	7.02	7.16	7.31
B ₃	6.53	6.89	7.24	7.44	8.29
B ₄	6.76	6.99	7.20	7.40	7.66
2nd year					
B ₁	5.12	6.84	6.67	6.80	6.99
B ₂	6.42	6.67	6.89	7.12	7.21
B ₃	6.62	6.93	7.09	7.25	8.37
B ₄	6.58	6.89	7.05	7.10	7.44
Pooled					
B ₁	5.47	6.79	6.75	6.87	7.15
B ₂	6.52	6.72	6.95	7.14	7.26
B ₃	6.58	6.91	7.16	7.34	8.33
B ₄	6.67	6.94	7.13	7.25	7.55
1st year		2nd year		Pooled	
SE(M)	0.131		0.115		0.115
CD (5%)	0.378		0.329		0.330

4. CONCLUSION

A thorough observation of the result obtained in this study reveals that a combination of novel PGRs and fruit bagging has significant influence organoleptic properties of guava. It is concluded that P₅B₃ (Salicylic acid 600ppm + White polyethylene bag) played the most prominent role in enhancement of appearance, taste, aroma, color and overall acceptability of guava fruits among all the treatment combinations. Therefore, it can be adopted by the guava growers to enhance the marketability of fruits.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Authors have declared that no competing interests exist.

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