

Original Research Article

INFLUENCE OF NEW GENERATION PLANT GROWTH REGULATORS AND FRUIT BAGGING ON ORGANOLEPTIC PROPERTIES OF GUAVA (*Psidium guajava* L.) cv. G-27

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 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).

KEY WORDS: Novel PGRs, fruit bagging, organoleptic properties, guava

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 Safedaseedlings. The fruitsize 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.

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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).

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Comment [C4]: It is necessary to substantiate this statement through reference to scientific literature

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.

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METHODOLOGY

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

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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. 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.

Table no. 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

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:

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.

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.

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: 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

Comment [C8]: Or in the table you should choose the term colour, not color. Since in the text below you use the term colour

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.

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.

RESULT and DISCUSSION

4.1. Appearance

Through the analysis of the data presented in table 3 and figure 1 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.

Comment [C9]: Color. If color is used, then the term used throughout the text should be the same

Table no. 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				
	1 st year				
Fruit bagging	P ₁	P ₂	P ₃	P ₄	P ₅
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
	2 nd 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
	1 st year		2 nd year		Pooled
SE(M)	0.285		0.328		0.256
CD (5%)	0.816		0.940		0.732

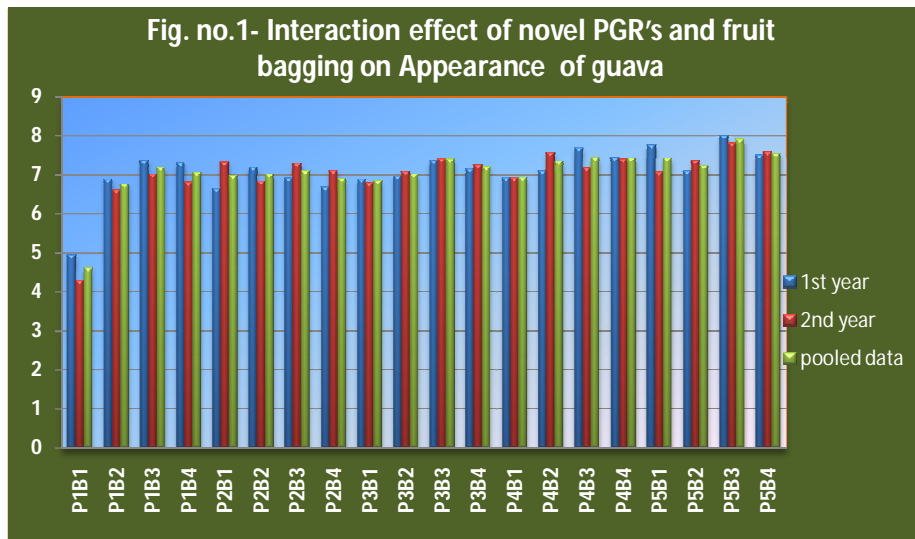
Comment [WU10]: Since the table 3 and fig no 1 repeat each other's data, it may make sense to show the difference between the variants in the table and link CE and SD to specific data in the columns...

Comment [WU11]: Pooled ???

Comment [WU12]: see note above in section

Comment [WU13]: see note above in section

Comment [WU14]: I don't understand what data SE(M) and SD refer to. Combined for the first year, for the second year, and for the average values (pooled) for all variants from P1 to P5?



Comment [WU15]: the fig no 1 repeats the table 3 except for the statistical data SE(M) and CD

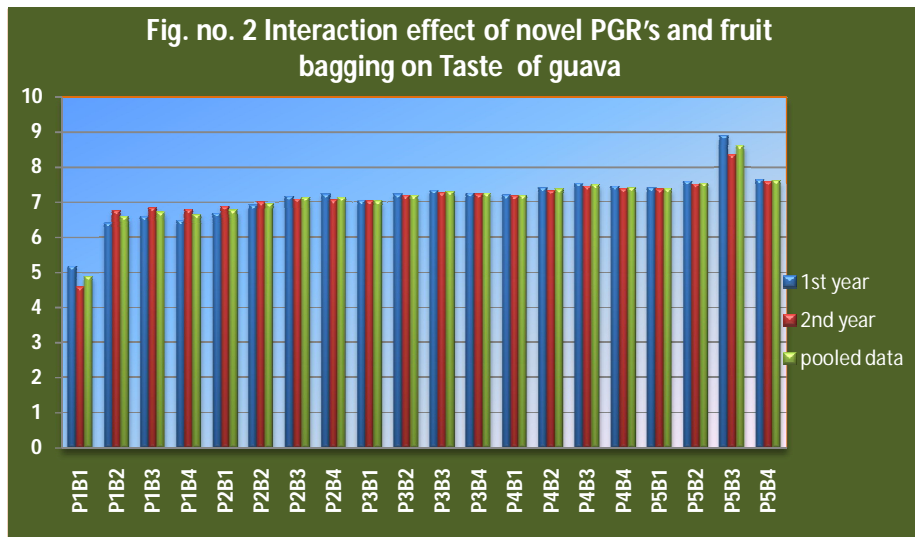
4.2. Taste

Through the evaluation of the data presented in table 4 and figure 2 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 'JanghowonHwangdo' 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.

Table no. 4 Interaction effect (A X B) of novel PGR's and fruit bagging on Taste of guava during 1st year, 2nd year and polled data

Comment [WU16]: I have the same questions about this table 4 as I did about table 3.

	Taste				
	Novel PGR's				
	1st year				
Fruit bagging	P₁	P₂	P₃	P₄	P₅
B₁	5.17	6.67	7.04	7.20	7.40
B₂	6.40	6.91	7.21	7.41	7.59
B₃	6.57	7.15	7.33	7.53	8.88
B₄	6.48	7.21	7.25	7.44	7.64
	2nd year				
B₁	4.57	6.87	7.03	7.17	7.36
B₂	6.75	6.99	7.18	7.32	7.50
B₃	6.84	7.09	7.26	7.45	8.34
B₄	6.78	7.05	7.22	7.38	7.58
B₁	4.87	6.77	7.03	7.18	7.38
B₂	6.58	6.95	7.19	7.36	7.54
B₃	6.71	7.12	7.29	7.49	8.61
B₄	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



Comment [WU17]: the fig no 2 repeats the table4 except for the statistical data SE(M) and CD

3. Color

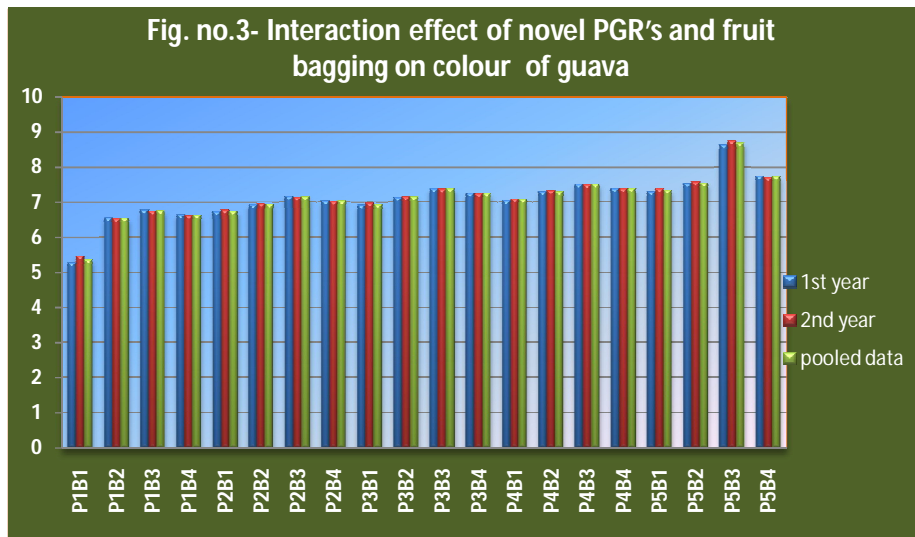
The examination of the data presented in table 5 and figure 3 revealed that the interaction effect of the two factors i.e. novel PGRs and fruit bagging imposed statistically significant effect on the color of guava fruits. Maximum score on the color of fruits in the first year, second year and pooled 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.

Table no. 5 Interaction effect (A X B) of novel PGR's and fruit bagging on color of guava during 1st year, 2nd year and polled data

Comment [WU18]: I have the same questions about this table 4 as I did about table 3.

	Colour
	Novel PGR's

	1st year				
Fruit bagging	P₁	P₂	P₃	P₄	P₅
B₁	5.27	6.72	6.91	7.04	7.29
B₂	6.54	6.93	7.13	7.28	7.52
B₃	6.77	7.15	7.37	7.50	8.62
B₄	6.63	7.02	7.24	7.38	7.73
	2nd year				
B₁	5.45	6.76	6.96	7.09	7.37
B₂	6.52	6.95	7.14	7.31	7.56
B₃	6.73	7.13	7.36	7.49	8.74
B₄	6.61	7.01	7.23	7.37	7.70
B₁	5.36	6.74	6.93	7.07	7.33
B₂	6.53	6.94	7.14	7.29	7.54
B₃	6.75	7.14	7.37	7.50	8.68
B₄	6.62	7.02	7.24	7.37	7.72
	1st year		2nd year		Pooled
SE(M)	0.177		0.180		0.175
CD (5%)	0.506		0.517		0.502



Comment [WU19]: the fig no 3 repeats the table5 except for the statistical data SE(M) and CD

4. Aroma

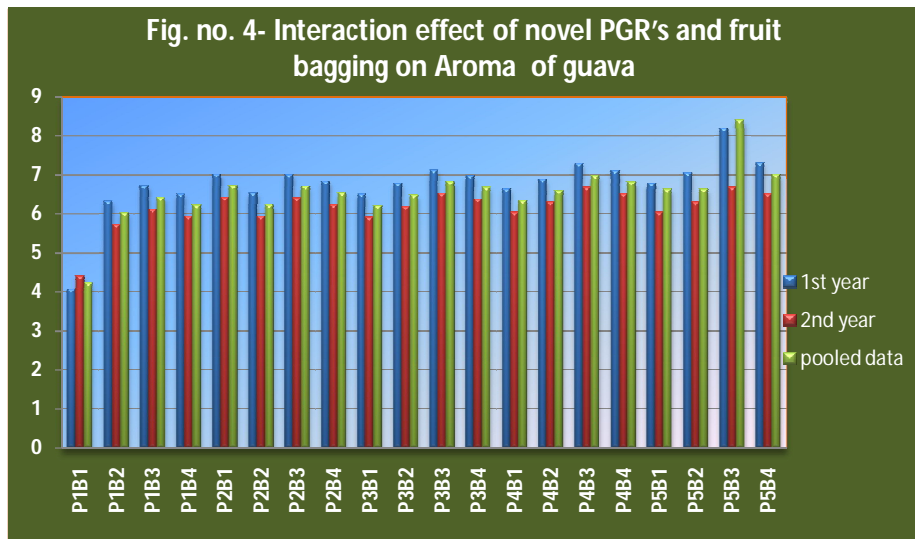
The interaction effect of the two factors i.e. novel PGRs and fruit bagging on score on aroma of guava fruits presented in table 6 and figure 4 demonstrates that the interaction effect of novel PGRs and fruit bagging have significant impact on the aroma of guava fruits. Maximum score on aroma of fruits 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 4.23in 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.

Table no. 6 Interaction effect (A X B) of novel PGR's and fruit bagging on Aroma of guava during 1st year, 2nd year and polled data

	Aroma
	Novel PGR's
	1st year

Comment [WU20]: I have the same questions about this table 4 as I did about table 3.

Fruit bagging	P₁	P₂	P₃	P₄	P₅
B₁	4.06	7.02	6.50	6.64	6.78
B₂	6.32	6.53	6.78	6.88	7.06
B₃	6.71	7.00	7.12	7.29	8.19
B₄	6.51	6.83	6.97	7.11	7.30
	2nd year				
B₁	4.40	6.42	5.90	6.04	6.04
B₂	5.72	5.93	6.18	6.29	6.29
B₃	6.11	6.40	6.52	6.68	6.68
B₄	5.93	6.23	6.37	6.51	6.51
B₁	4.23	6.72	6.20	6.34	6.62
B₂	6.02	6.23	6.48	6.58	6.62
B₃	6.41	6.70	6.82	6.98	8.40
B₄	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



Comment [WU21]: the fig no 4 repeats the table 6 except for the statistical data SE(M) and CD

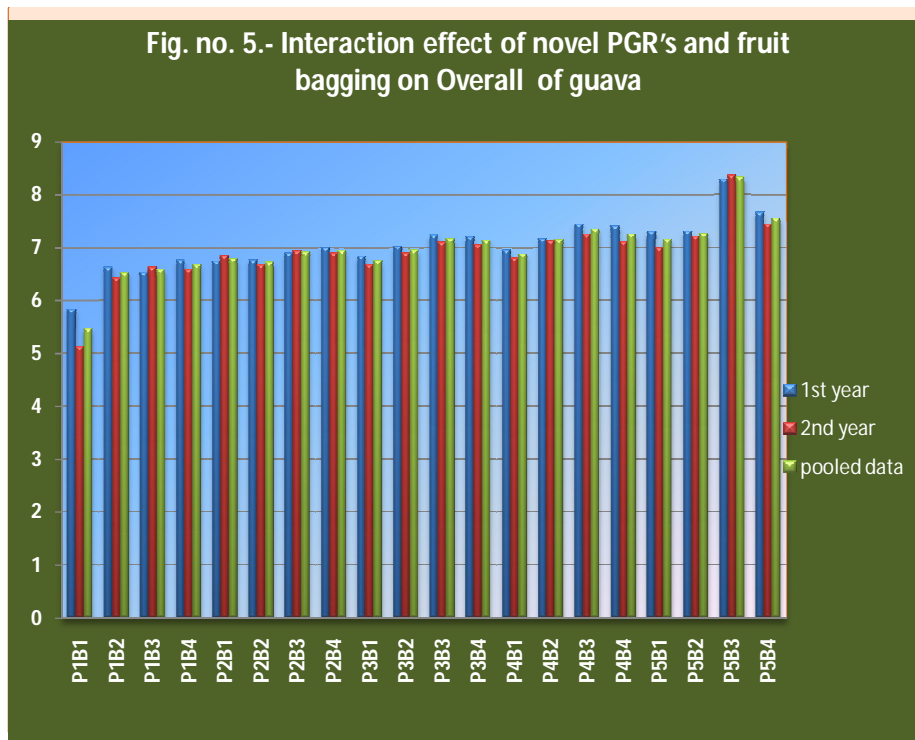
5. Overall acceptability

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 and figure 5 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. Buganicet *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. Apple improved the organoleptic quality, reduced weight loss and extended the shelf life of fruit at ambient temperature.

Table no.7 Interaction effect (A X B) of novel PGR's and fruit bagging on overall of guava during 1st year, 2nd year and polled data

Comment [WU22]: I have the same questions about this table 4 as I did about table 3.

	Overall				
	Novel PGR's				
	1 st year				
Fruit bagging	P ₁	P ₂	P ₃	P ₄	P ₅
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
	2 nd 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
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
	1 st year		2 nd year		Pooled
SE(M)	0.131		0.115		0.115
CD (5%)	0.378		0.329		0.330



Comment [WU23]: the fig no 5 repeats the table 7 except for the statistical data SE(M) and CD

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.

REFERENCES

1. Bindhyachal, R., Mandal, B.K., Udit, K., Ravindra, K., and Kumar, P. (2016). Response of guava to boron and growth regulators spray. *Asian Journal of Horticulture*, 11(1): 146-150.

2. Zhang, Y.; Chen, K.S, Zhang, S.L and Ferguson I. (2003). The role of salicylic acid in post-harvest ripening of kiwifruit. *Postharvest Biology and Technology*, 28:67-74.
3. Asghari, Mohammadreza, A, and Morteza S. (2010). Impact of salicylic acid on postharvest physiology of Horticultural crops. *Trends in Food Science and Technology*, 21: 502- 509.
4. Lo'ay, A.A. and A. Y. El Khateeb, (2011). Delaying guava ripening by exogenous salicylic acid. *J. Plant Prod. Mans. Univ.*, 2: 715-724.
5. Madhav, J, V., S. Sethi, R.R. Sharma, and S. G. Rudra(2016). Impact of Salicylic acid on the physiological and quality attributes of guava (*Psidium guajava* L.) fruits during storage at low temperature. *Indian J. of Agri. Sci.*, 86(9): 2390- 2397.
6. Kim, Y. H., Kim, H. H., Youn, C. K., Kweon, S. J., Jung, H. J. and Lee, C. H. (2008). Effects of bagging material on fruit coloration and quality of 'JanghowonHwangdo' peach. *ActaHorticulturae*, 772: 81-86.
7. Jia, H.J., Araki, A. and Okamoto, G. (2005). Influence of fruit bagging on aroma volatiles and skin coloration of 'Hakuho' peach (*Prunus persica* Batsch). *Postharvest Biology and Technology*, 35(1): 61-68.
8. Buganic, R.D., Lizada, M.C.C. and Ramos, M.B. (2006). Disease control in Philippine Carabao mango with pre-harvest bagging and post-harvest hot water treatment. *Acta Hort.* 455: 797-804.