Plant Archives Vol. 26, No. 1, 2026 pp. 1245-1249 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.no.1.169

RESPONSE OF PRE-HARVEST BAGGING ON QUALITY ATTRIBUTES OF GUAVA FRUITS (*PSIDIUM GUAJAVA* L.) CV. LALIT

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(Date of Receiving-03-12-2025; Date of Revision-22-01-2026; Date of Acceptance-18-02-2026)

ABSTRACT

The present study titled "Response of pre-harvest bagging on quality attributes of guava fruits (*Psidium guajava* L.) cv. Lalit" was conducted during the 2023-24 *Rabi* season at Precision Farming Development Centre (PFDC), Department of Fruit Science, College of Agriculture, IGKV, Raipur (C.G.). A Split-Plot in Time Experimental Design employed for quality attributes with 8 treatments replicated 3 times. The different bagging materials used in this experiment are - (T_1) Yellow polythene, (T_2) White polythene, (T_3) Butter paper, (T_4) Brown bag, (T_5) English newspaper (60gsm), (T_6) Hindi newspaper (35gsm) and (T_7) Muslin cloth. Perforations were made on both sides of the bags to ensure proper ventilation, which is essential for the growth and development of the fruits. Fruits that were 35 days after fruit set were selected for bagging. The study's results indicated that Treatment and storage days interaction was found to be having significant effect on chemical and physiological parameters of Total soluble solids, Acidity, Ascorbic acid and physiological weight loss. The minimum value of Acidity (0.37, 0.30, 0.23 and 0.18 %), the maximum value of ascorbic acid (172.5, 167.50, 157.08 and 144.06 mg/100g) and lowest physiological weight loss (1.57, 2.76 and 4.26%) was observed in treatment T_4: Brown bag. The maximum value of total soluble solids was recorded in treatment T_2: White polythene (9.82, 9.93, 10.5, 10.21 °Brix) followed by T_4: Brown bag (9.53, 9.66, 9.79, 9.97 °Brix), respectively at 0, 2, 4 and 6 days of storage period.

Key words : Guava, Bagging materials, Quality attributes.

Introduction

Guava (*Psidium guajava* L.), commonly known as the "Apple of the Tropics," belongs to the Myrtaceae family and originated in Tropical America. Guava is a highly nutritious fruit and is an excellent source of vitamin C, lycopene, antioxidants, minerals and dietary fibre. It also contains provitamin A (carotene) and B-complex vitamins such as thiamine, riboflavin, pantothenic acid and niacin (Sing and Sing, 2005; Kherwar and Usha, 2016).

The Lalit variety of guava is well known for its wide adaptability and high yield. It was selected from a half-sib population with apple-coloured fruits. A six-year-old Lalit guava plant can produce about 100 kg of fruits per year, which is higher than most other commercial guava varieties. The fruits have a total soluble solids (TSS) of 12° Brix and contain about 250 mg of vitamin C per 100 g of pulp.

After the COVID-19 pandemic, improved living standards and greater health awareness have increased consumer demand for safe and high-quality fruits. This has created challenges for traditional farming practices. In this context, fruit bagging technology has emerged as an effective solution (Ali *et al*., 2021).

In recent years, the demand for premium-quality guava has increased due to better market prices. However, climate change factors such as irregular rainfall, sudden temperature changes and fog have negatively affected fruit quality. To overcome these problems, pre-harvest fruit bagging is increasingly used as an important phytosanitary practice. It improves the external appearance of fruits by enhancing colour and also helps improve internal quality. (Ram *et al*., 2013).

Pre-harvest fruit bagging influences several fruit quality parameters, including fruit size, maturity, peel colour and overall quality. The type of bag used plays a significant role in determining these quality characteristics.

Materials and Methods

The current study was undertaken on 10-year-old guava trees of the "Lalit" variety, cultivated under High Density Planting (HDP) with a spacing of 2 × 1 meter at the Precision Farming Development Centre (PFDC), Department of Fruit Science, College of Agriculture, IGKV, Raipur (C.G.). The experiment employed statistical designs: A Split-Plot in Time Experimental Design for quality attributes, with each treatment replicated three times. All our statistical analysis was obtained using R codes of R software (2023). Various bagging materials were utilized in the experiment, including: Yellow polythene (T_1), White polythene (T_2), Butter paper (T_3), Brown bag (T_4), English newspaper (60gsm) (T_5), Hindi newspaper (35gsm) (T_6), Muslin cloth (T_7).

The acidity of fruits was estimated using the procedure given by Ranganna (1986). The total soluble solids (TSS) content of the fruit was measured using a Hand Refractometer with a range of 0-32° Brix. A drop of fruit juice was placed on the prism of the Refractometer, and the TSS value at 0 ° Brix was directly recorded. These values were adjusted for the room temperature of 20°C and expressed as the percentage unit for total soluble solids in the fruits. (A.O.A.C., 2007). The ascorbic acid of guava fruit was determined by the procedure given by Ranganna (1986). The weight of guava fruits was taken at 2 days interval i.e. 2nd, 4th and 6th days after storage and percentage of physiological loss in weight (PLW) of fruit was calculated with the help of following formula:

$$\text{Physiological loss in weight (\%)} = \frac{W_1 - W_2}{W_1} \times 100$$

Where,

W_1 = Initial weight of fruits

W_2 = weight of 2nd, 4th and 6th days of storage

Experiment details

Fruit crop : Guava (*Psidium guajava* L.)

Variety : Lalit

Design of experiment : Split plot in time experimental design

(This is split - plot design in RBD having three blocks with main plot consisting of factorial arrangement of treatments and directions and with sub plot having six storage days)

Number of blocks : 3 columns across fertility gradient

Number of treatments : 8 (Bagging treatments)

Directions : 4 (as average of 2 fruits each from 4 branches)

Number of sub treatments : 6 storage days (at 0, 2, 4 and 6 days)

Results and Discussion

Effect of pre -harvest bagging on quality attributes of guava

Acidity (%) : Since, acidity was recorded in percent units its analysis of variance was carried out from its Arc sin transformed values and according to that analysis of variance, treatment and storage days interaction was found to be having significant effect on Acidity. The maximum value of acidity (%) was recorded under treatment T_0: Control (0.59, 0.54, 0.48 and 0.41 %) and minimum value of acidity (0.37, 0.30, 0.23 and 0.18 %) was recorded in T_4: Brown bag respectively at 0, 2, 4 and 6 days of storage period. From given value of treatments it was noted that under the extended storage period the acidity content of guava decreased up to 6th days. Over the storage period examined, both acidity percentage and duration showed a consistent linear decline, primarily due to this conversion process from organic acids to sugars. The results also collaborate with the findings of Sharma and Pal (2013) in apple.

Total Soluble Solids (° Brix) : According to that analysis of variance, treatment and storage days interaction was found to be having significant effect on Total soluble solids. The maximum value of total soluble solids (° Brix) was recorded in treatment T_2: White polythene (9.82, 9.93, 10.5, 10.21 ° Brix) followed by T_4: Brown bag (9.53, 9.66, 9.79, 9.97 ° Brix). While minimum value was recorded in treatment T_0: Control (8.70, 8.84,

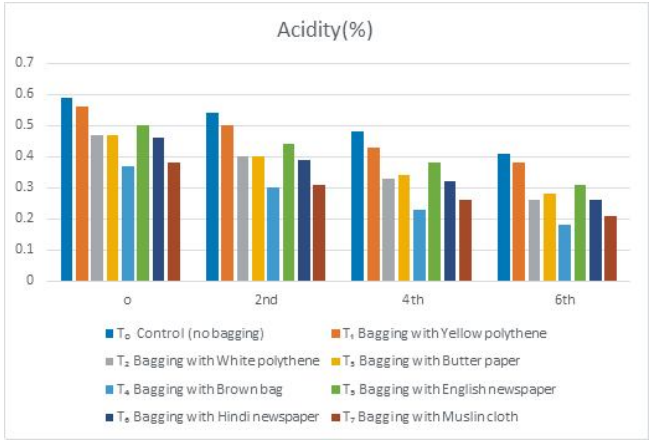


Fig. 1 : Effect of pre- harvest bagging on average acidity (%) of guava during storage.

Table 1 : Effect of pre- harvest bagging on average Acidity (%) of guava during storage.

Notations	Treatment details	Acidity (%) Storage period (Days)			
		0	**2nd**	**4th**	**6th**
T_0	Control (no bagging)	0.077^{n}(0.59)	0.073^{lmn}(0.54)	0.069^{jklmn}(0.48)	0.064^{ghijkl}(0.41)
T_1	Bagging with Yellow polythene	0.075^{mn}(0.56)	0.070^{klmn}(0.50)	0.065^{hijkl}(0.43)	0.061^{efghij}(0.38)
T_2	Bagging with White polythene	0.068^{jklmn}(0.47)	0.063^{fghijk}(0.40)	0.057^{defgh}(0.33)	0.051^{bcd}(0.26)
T_3	Bagging with Butter paper	0.069^{jklmn}(0.47)	0.064^{ghijk}(0.40)	0.058^{defghi}(0.34)	0.053^{bcde}(0.28)
T_4	Bagging with Brown bag	0.061^{efghij}(0.37)	0.055^{cdef}(0.30)	0.048^{abc}(0.23)	0.042^{a}(0.18)
T_5	Bagging with English newspaper	0.071^{klmn}(0.50)	0.066^{ihklm}(0.44)	0.061^{efghij}(0.38)	0.056^{cdefg}(0.31)
T_6	Bagging with Hindi newspaper	0.068^{jklm}(0.46)	0.063^{fghijk}(0.39)	0.056^{cdefg}(0.32)	0.051^{bcd}(0.26)
T_7	Bagging with Muslin cloth	0.062^{fghijk}(0.38)	0.056^{cdefg}(0.31)	0.051^{abcd}(0.26)	0.046^{ab}(0.21)
S.E.m±		0.001			
CD at 5 % level		0.004			

*The value in parenthesis shows original mean of arc sin transformed value.

Table 2 : Effect of pre- harvest bagging on average Total Soluble Solids (°Brix) of guava during storage.

Notations	Treatment details	Total Soluble Solids (°Brix) Storage period (Days)			
		0	**2nd**	**4th**	**6th**
T_0	Control (no bagging)	8.74^{a}	8.84^{a}	8.97^{a}	9.11^{ab}
T_1	Bagging with Yellow polythene	9.41^{ab}	9.57^{ab}	9.72^{ab}	9.87^{ab}
T_2	Bagging with White polythene	9.82^{ab}	9.93^{ab}	10.5^{b}	10.21^{b}
T_3	Bagging with Butter paper	9.06^{ab}	9.22^{ab}	9.36^{ab}	9.49^{ab}
T_4	Bagging with Brown bag	9.53^{ab}	9.66^{ab}	9.79^{ab}	9.97^{ab}
T_5	Bagging with English newspaper	9.40^{ab}	9.53^{ab}	9.63^{ab}	9.77^{ab}
T_6	Bagging with Hindi newspaper	9^{ab}	9.14^{ab}	9.31^{ab}	9.47^{ab}
T_7	Bagging with Muslin cloth	9.38^{ab}	9.51^{ab}	9.62^{ab}	9.77^{ab}
S.E.m±		0.25			
CD at 5 % level		0.70			

8.97, 9.11 °Brix) respectively at 0, 2, 4 and 6 days of storage period. From the value of treatments, it concluded that the TSS content of fruit increased gradually in the early stages of storage. The rise in TSS could result from the transformation of stored starch and other polysaccharides into soluble sugars over time. Such result is also partially supported by Mishra *et al*. (2017) in guava.

Ascorbic acid (mg/100g) : Based on the analysis of variance, the interaction between treatment and storage days significantly affected ascorbic acid. The highest recorded value of ascorbic acid (mg/100g) was observed in treatment T_4: Brown bag treatments (172.5, 167.50, 157.08, and 144.06 mg/100g) across the 0, 2, 4 and 6 days of storage period, as presented in Table 3 and Fig. 3. Conversely, the lowest recorded value was found in T_0: Control (150.41, 145.41, 136.66, and 126.25 mg/100g) over the same storage durations. The ascorbic acid content was noted to decrease significantly during storage across different pre-harvest treatments. This could be attributed to the temperature rise inside the bags, which likely facilitated increased activation of phytochemical reactions and their synergistic effects, consequently boosting the levels of ascorbic acid in the bagged fruits. The findings of the present study also closely align with those reported by Islam *et al*. (2019) in guava and Debnath and Mitra (2000) in litchi.

Physiological weight loss (%) : The physiological weight loss was measured in percent units and its analysis of variance was conducted using arc sin transformed

Table 3 : Effect of pre- harvest bagging on average Ascorbic acid (mg/100g) of guava during storage.

Notations	Treatment details	Ascorbic acid (mg/100g) Storage period (Days)			
		0	**2nd**	**4th**	**6th**
T_0	Control (no bagging)	$150.41^{cdefghi}$	145.41^{bcdefg}	136.66^{abcd}	126.25^{a}
T_1	Bagging with Yellow polythene	150.83^{defghi}	145.83^{bcdefg}	137.91^{abcd}	125.41^{a}
T_2	Bagging with White polythene	162.50^{ijk}	157.50^{fghijk}	$147.50^{bcdefghi}$	138.75^{abcd}
T_3	Bagging with Butter paper	160.00^{ghijk}	155.00^{efghij}	144.58^{bcdef}	135.41^{abc}
T_4	Bagging with Brown bag	172.50^{k}	167.50^{jk}	157.08^{efghij}	144.16^{bcdef}
T_5	Bagging with English newspaper	160.41^{ghijk}	155.41^{efghij}	$147.08^{bcdefgh}$	135.83^{abcd}
T_6	Bagging with Hindi newspaper	155.00^{efghij}	$150.00^{cdefghi}$	142.08^{bcde}	132.91^{ab}
T_7	Bagging with Muslin cloth	162.08^{hijk}	157.08^{efghij}	$149.16^{cdefghi}$	138.75^{abcd}
S.E.m±		2.82			
CD at 5 % level		7.86			

Table 4 : Effect of pre- harvest bagging on average physiological weight loss (%) of guava during storage.

Notations	Treatment details	Physiological weight loss (%) Storage period (Days)			
		0	**2nd**	**4th**	**6th**
T_0	Control (no bagging)	0^{a}	$0.217^{hij}(4.62)$	$0.250^{jk}(6.14)$	$0.265^{k}(6.85)$
T_1	Bagging with Yellow polythene	0^{a}	$0.126^{bcd}(1.58)$	$0.175^{cdefg}(3.03)$	$0.208^{hij}(4.34)$
T_2	Bagging with White polythene	0^{a}	$0.165^{cdef}(2.70)$	$0.196^{fghi}(3.79)$	$0.217^{hij}(4.64)$
T_3	Bagging with Butter paper	0^{a}	$0.165^{cdef}(2.70)$	$0.191^{efghi}(3.61)$	$0.224^{ij}(4.94)$
T_4	Bagging with Brown bag	0^{a}	$0.153^{b}(1.57)$	$0.190^{efghi}(2.76)$	$0.219^{ghi}(4.26)$
T_5	Bagging with English newspaper	0^{a}	$0.142^{bc}(2.01)$	$0.181^{defg}(3.24)$	$0.196^{fghi}(3.78)$
T_6	Bagging with Hindi newspaper	0^{a}	$0.160^{bcde}(2.54)$	$0.186^{defgh}(3.40)$	$0.218^{hij}(4.66)$
T_7	Bagging with Muslin cloth	0^{a}	$0.126^{b}(2.32)$	$0.167^{cdef}(3.58)$	$0.210^{ghi}(4.71)$
S.E.m±		0.0068			
CD at 5 % level		0.019			

*The value in parenthesis shows original mean of arc sin transformed value.

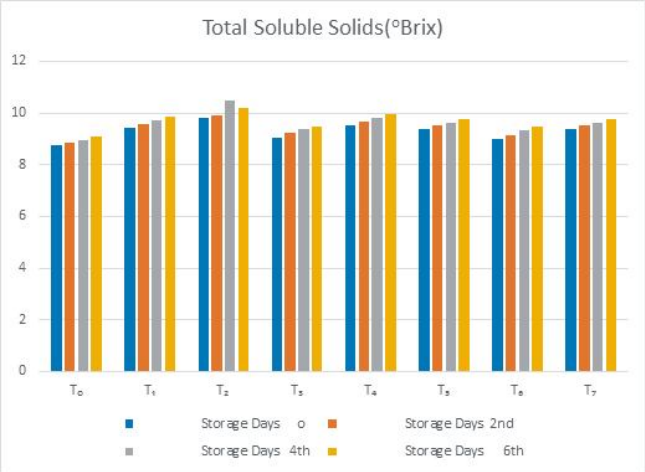


Fig. 2 : Effect of pre- harvest bagging on average Total Soluble Solids (°Brix) of guava during storage.

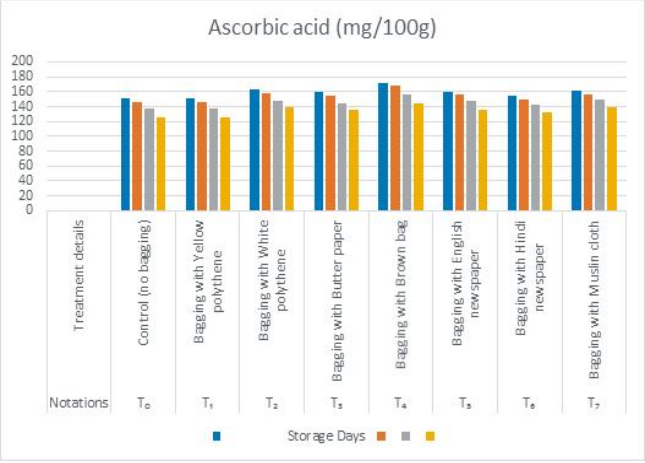


Fig. 3 : Effect of pre- harvest bagging on average ascorbic acid(mg/100g) of guava during storage.

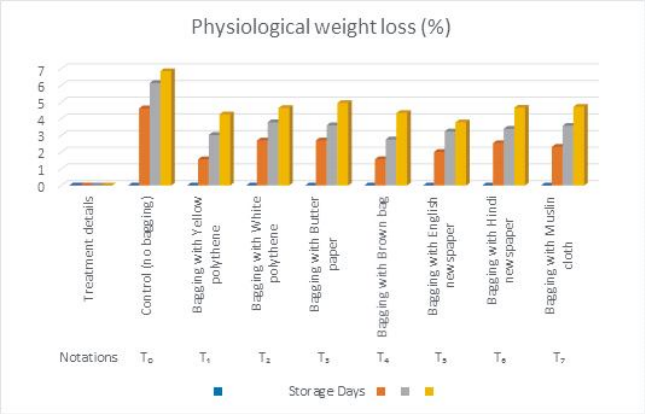
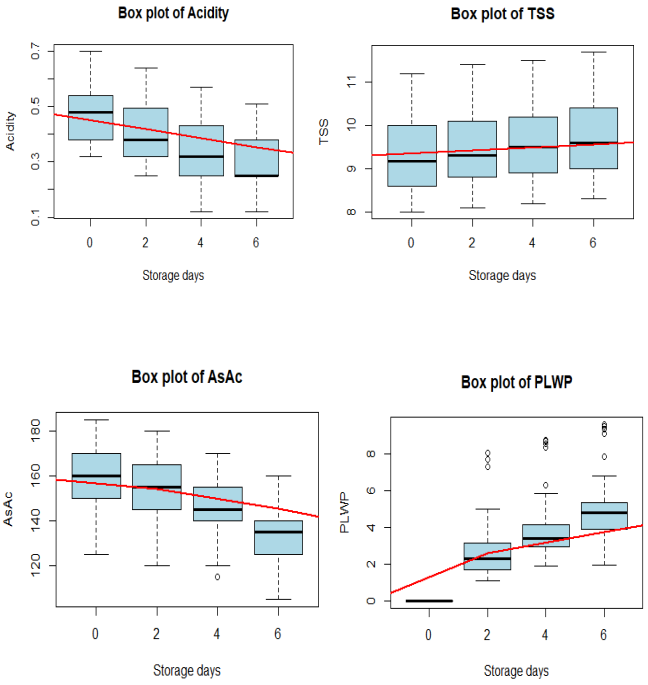


Fig. 4 : Effect of pre- harvest bagging on average Physiological weight loss (%) of guava during storage.



Note: AsAc: Ascorbic acid
PLWP: Physiological losses in weight

Fig. 5 : Box plot of Acidity, T.S.S., Ascorbic acid and physiological loss in weight.

values. The results indicated a significant effect of the interaction between treatment and storage day on physiological weight loss. The control (T_0) exhibited the highest physiological weight loss percentages: (4.62%) on the 2nd day of storage, (6.14%) on the 4th day, and (6.85%) on the 6th day. In contrast, the brown bag treatment (T_4) showed the lowest physiological weight loss percentages: (1.57%, 2.76% and 4.26%) on the 2nd, 4th and 6th days of storage, respectively. By reducing exposure to these factors, bagging helps maintain the fruit's moisture content more effectively. Bagging can also lead to a reduction in the rate of respiration of the fruit. The results also described align with findings from a study by Gethe *et al*. (2021) focusing on physiological weight loss in pomegranates.

Conclusion

Upon completion of the research, it may be concluded that pre-harvest bagging of guava fruits for quality parameters including TSS (Total Soluble Solids), acidity, total sugar, reducing sugar, non-reducing sugar, ascorbic acid content and physiological weight loss: The treatment T_4 (Brown bag) exhibited superior results, followed by T_5 (English newspaper) and T_1 (yellow polythene). Therefore, the treatment T_4 (bagging with Brown bag) should be considered for pre- harvest bagging in guava fruits for improving the quality attributes.

Bagging plays a crucial role in extending the shelf life of fruits as it provides a physical barrier that protects fruits from physical damage, abrasions and scratches during growth and handling.

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