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Effect of pre-harvest fruit bagging on sensory and economics of mango cv. Banganapalli

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Abstract

Fruit bagging has emerged as a novel technology in practice, which is simple, grower friendly, safe and beneficial for the production of quality mangoes. The present investigation entitled "Effect of pre-harvest fruit bagging on sensory and economics of mango cv. Banganapalli" was undertaken during the year 2024 at Fruit Research Station, Sangareddy, to determine the profitability and fruit quality of mango using different bagging materials consisting of newspaper bag, reddish brown paper bag, butter paper bag, yellow paper bag, muslin cloth bag, polythene bag, nylon bag, non-woven bag along with no bagging or control in a RBD design. Among the different bagging materials used in Banganapalli mango, non-woven bag and brown paper bag was found most effective in several sensory parameters and benefit cost ratio. The non-woven bag recorded the highest sensory scores for flavour (8.33), texture (8.67), taste (8.67) and overall acceptability (8.33), similar results were observed with Reddish brown paper bag with the highest benefit-to-cost ratio of 10.38. Bagging technology numerically increased the level of mango production per hectare with 13,470 kg and gross return of Rs. 8, 07,996 and net return of Rs. 6, 64,996, respectively. With higher production and price bagging technology adopters had numerically higher benefit to cost ratio of 4.94, followed by Non-woven bag of 4.65 and the least in Muslin cloth bag 1.90. The results of this study clearly demonstrate that it is advisable to use brown paper bag or Non-woven bag for getting golden yellow colored fruits. Apart from this, as the market price of the bagged mango is lucrative the growers can sell their produce at high price.

Keywords: Mango, banganapalli, benefit-cost ratio, sensory attributes, pre-harvest, fruit bagging, non-woven bag, reddish brown paper bag

Introduction

Mango (*Mangifera indica* L.), belongs to the family Anacardiaceae with a chromosome number of $2n = 40$, is one of the India's most widely consumed tropical fruits, known as the "King of fruits" for its exceptional flavor and aroma (Yadav and Singh, 2017) [8]. India produces 20.92 million MT of mangoes from 2.33 million hectares (Anonymous, 2022-2023) [2]. The cultivar Banganapalli, a widely popular in South India, is commonly shipped to northern markets early in the growing season, often by the end of April, even before it reaches full maturity. However, its peak flavor is typically achieved later, in the latter part of May (Chadha, 1989) [5]. In South India, this variety is also referred to as Baneshan, while in the northern regions, it is known as Safeda. The fruits are characterized by their large size, with approximately 2 to 3 fruits per kilogram (Bose *et al.*, 2001) [4]. The area under mango is increasing day by day but safe and export quality mango production not increased accordingly. The target mango yield is reduced every year due to outbreak of different diseases and insect-pest attack. Because of the favorable environment during fruit maturity, the mango fruit fly is a major pest of different mango varieties. A considerable quantity of fruits may be lost due to the fruit fly infestation every year. In recent years, climatic aberrations such as a sudden increase in temperature and relative humidity, excessive rains especially during fruit development are often experienced. An attractive, strikingly bright, blemish-free skin and pest free fruits of this variety bring a premium rate in the market. The affected fruits gain little prices in the market and such fruits are also rejected by industry for processing. Several good agricultural practices are becoming popular throughout the world for preventing the losses of fruits caused by both biotic and abiotic factors.

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Among several such alternatives, the pre-harvest fruit bagging technique is an eco-friendly technique that has been adopted widely in several fruit crops to improve skin color in the same time, to reduce the incidence of diseases, insect pests, mechanical damages, sunburn of the skin and bird damages (Bayogan *et al.*, 2006) [3]. The study was undertaken to determine the profitability, gross return and net return and fruit sensory quality of mango using different bagging materials. The technology will open up a new door of exporting to a greater extent on the huge trees. The technology will open up a new door of exporting to various foreign markets. This even become essential for exporting to markets like the USA, China and Japan, where visually appealing fruits fetch premium prices. Organoleptic evaluation further supports, as bagged mangoes consistently show enhanced sensory attributes such as sweetness, texture, and overall taste compared to un-bagged fruits, making them more appealing to consumers and helping farmers achieve better returns on their investments. Additionally, the Banganapalli mango demonstrates reasonably consistent bearing, commercial making it a favored choice for the study (Sharma *et al.*, 2014) [7].

Materials & Methods

The present investigation was undertaken at Fruit Research Station, Sangareddy, Sri Konda Laxman Telangana Horticultural University, Telangana, during the period of 2023-24. The experimental design used was Randomized Block Design on seven years old Banganapalli trees with 5 x 5 m² spacing. A total of nine treatments with replicated thrice used for the study *viz.*, T₁-Newspaper bag, T₂-Reddish brown paper bag, T₃-Butter paper bag, T₄-Yellow paper bag, T₅-Muslin cloth bag, T₆-Polythene bag, T₇-Nylon bag, T₈-Non-woven bag and T₉-No bagging (control). For each treatment around 30 fruits bagged (10 fruits per replication) per tree when fruit attains 705 BBCH scale in Mango which was 60 days after fruit set and these bagged fruits were harvested when these fruits attain a stage of 809 BBCH scale. Uniformly grown fruits were selected for bagging. The sizes of the bags were 25 × 20 cm. Before bagging two perforations (≤ 4 mm diameter) was made for proper ventilation at the bottom of fruit bags. The particular bags were wrapped properly at the stalk of each fruit of respective treatments so that it would not fall down as well as there would not be open space. The observations of sensory evaluation and benefit cost ratio (profitability) were recorded in the following sub-heads.

Sensory attributes (9-point hedonic scale)

The Organoleptic or sensory evaluation of mango was carried out by a panel of 5 judges following a 9-point hedonic rating system for important characters like fruit appearance, colour development and taste as per the score (9-1) as described below. The average of all the above characters was calculated and expressed as overall acceptance or palatability. The attributes of 9 point hedonic are listed below.

1. Dislike extremely
2. Dislike very much
3. Dislike moderately
4. Dislike slightly
5. Neither like nor dislike
6. Like slightly
7. Like moderately
8. Like very much

9. Like extremely

Economics

Profit or net return is the difference between total revenue (gross return) *i.e.*, total value and the total cost. Total factor costs included all kinds of variable and fixed costs concerned with the production process. The benefit-cost ratio was calculated by the analysis of total cost, gross income and net income to draw the B: C ratio of individual treatment.

Total cost, Gross income and Net income

The total cost was calculated for each treatment by adding the value of each input *i.e.*, labour charges, cost of chemicals, etc. in each treatment during the experiment.

Gross income was calculated by multiplying the total yield per hectare with the selling price of produce.

Net income was calculated for each treatment by deducting the total cost from the gross income obtained in each treatment.

Benefit: Cost ratio

To assess the profitability level of mango based on bagging technology simple tabular form and Benefit Cost Ratio (BCR) was checked. BCR of mango was estimated by the ratio of gross return to variable cost and gross return to total cost. So, BCR was defined as (Afsar and Sultana, 2019) [1]:

The Benefit: cost ratio of the different treatments was calculated by dividing the net income by the respective cost of the treatment using the following formula:

$$\text{Benefit: cost ratio} = \frac{\text{Net income}}{\text{Total cost of cultivation}}$$

Result and Discussion

The commercial application of fruit bagging technology during the pre-harvest season protects mango from pest attack besides facilitating the farmers to get export quality fruits. When the bags are used substantially, use of harmful chemical insecticides and pesticides were reduced to a greater extent. A combination of descriptive and statistical techniques as demanded by the study was used to achieve the objectives and to get meaningful results.

Sensory attributes (9-point hedonic scale)

The data regarding the effect of pre-harvest fruit bagging on sensory attributes of mango cv. Banganapalli significantly differed and the obtained results were presented in the Table 1 and Fig 1. In mango cultivar Banganapalli, significant differences were observed with regarding sensory attributes across the various treatments. Among the various fruit bagging material used, non-woven bag recorded the highest sensory score for flavour, texture, taste and overall acceptability, with values of 8.33, 8.67, 8.67 and 8.33, respectively. In contrast, the fruits without any bag exhibited the lowest scores for flavour and texture, both recorded at 6.33. While, the polythene bag fruit resulted in lowest score for taste and overall acceptability, of 5.67 and 5.33, respectively. These findings highlight the superior sensory performance of mango fruits subjected to non-woven bag, reddish brown paper bag and the adverse effects of polythene bag on taste and overall consumer preference and acceptance.

Fruit bagging enhanced the overall acceptability of mangoes by enhancing their internal or external quality, taste and texture; additionally, the pre harvest fruit bagging protects from pest attack besides facilitating the farmers to get quality fruits

substantially, use of harmful chemical insecticides and pesticides reduced to a greater extent. Attitude score of the respondents on the potentiality of non-woven and reddish brown paper fruit bagging was obtained by adding together scores on all the 9 items in present which resulted in reduced blemishes and promoted taste, flavour, and texture of the fruit. It could also

be the result of the altered fruit growth microenvironment, which improves internal fruit quality in a number of ways. Sarker *et al.* (2009) [6] also reported that bagging improved the physical quality with best general appearance, organoleptic quality and consumer acceptability during storage.

Table 1: Effect of pre-harvest fruit bagging on sensory attributes of Mango cv. Banganapalli (9-point hedonic scale)

Treatments	Flavour	Texture	Taste	Overall acceptability
T ₁ -Newspaper bag	7.67 ^{abc}	8.00 ^{ab}	7.67 ^{abc}	8.00 ^{ab}
T ₂ -Reddish brown paper bag	8.00 ^{ab}	7.67 ^{abc}	8.33 ^{ab}	8.33 ^a
T ₃ -Butter paper bag	7.33 ^{abcd}	7.33 ^{abc}	8.00 ^{ab}	7.67 ^{ab}
T ₄ -Yellow paper bag	7.33 ^{abcd}	7.33 ^{abc}	7.33 ^{bc}	7.00 ^b
T ₅ -Muslin cloth bag	7.67 ^{abc}	6.67 ^{bc}	6.67 ^c	5.67 ^c
T ₆ -Polythene bag	6.67 ^{cd}	6.67 ^{bc}	5.67 ^d	5.33 ^c
T ₇ -Nylon bag	7.00 ^{bcd}	7.67 ^{abc}	7.33 ^{bc}	7.33 ^{ab}
T ₈ -Non-woven bag	8.33 ^a	8.67 ^a	8.67 ^a	8.33 ^a
T ₉ -No bagging (control)	6.33 ^d	6.33 ^c	6.67 ^c	7.33 ^{ab}
SE(m)	0.36	0.45	0.38	0.44
CD at 5%	1.09	1.36	1.13	1.31

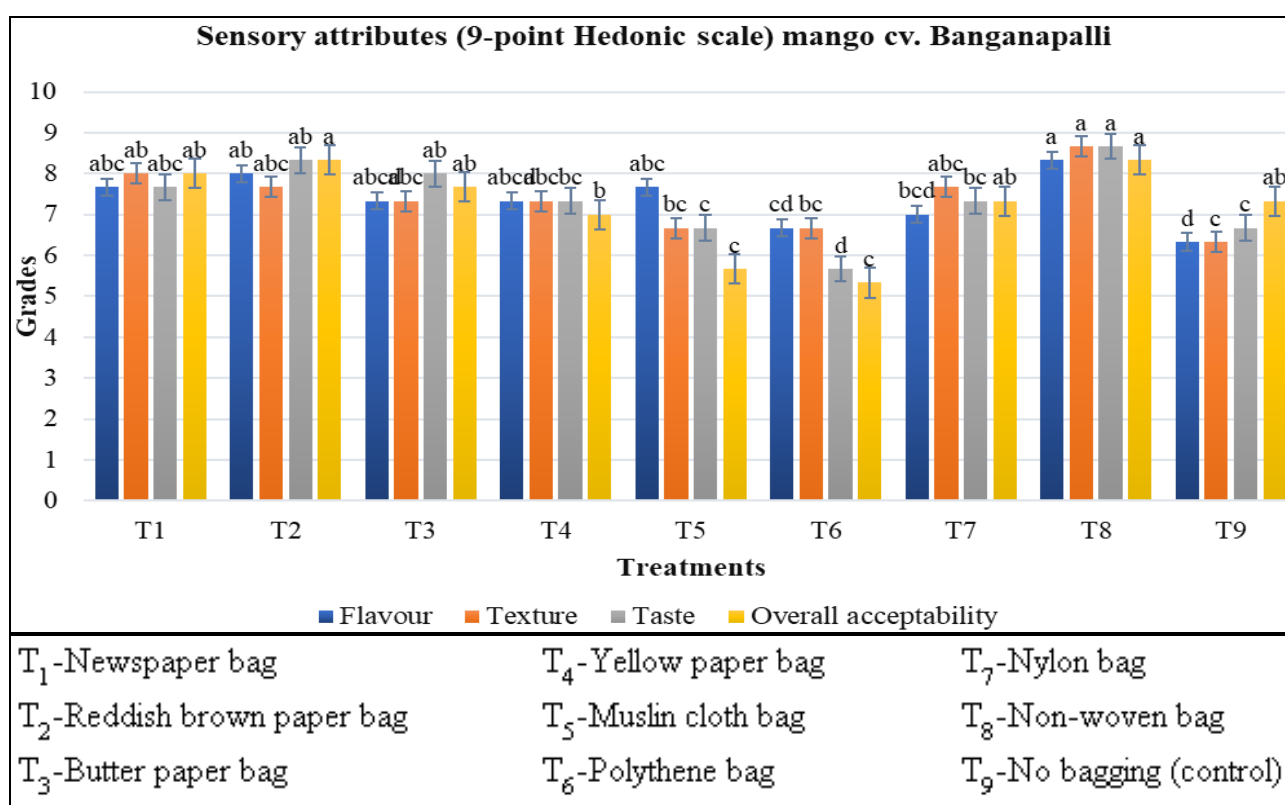


Fig 1: Effect of Pre-harvest fruit bagging on sensory attributes (9-point hedonic scale) of Mango cv. Banganapalli.

Table 2: Assessment of Pre-harvest fruit bagging on benefit-cost ratio of Mango cv. Banganapalli

Treatments	Treatment cost (₹)	Fixed cost (₹)	Total cost (₹)	Yield (t/ha)	Price/kg (₹)	Gross returns (₹)	Net returns (₹)	B:C ratio
T ₁	48,000	70,000	1,18,000	12.89	50.00	6,44,670	5,26,670	4.46
T ₂	58,000	70,000	1,28,000	12.67	60.00	7,60,404	6,32,404	4.94
T ₃	48,000	70,000	1,18,000	11.71	50.00	5,85,330	4,67,330	3.96
T ₄	58,000	70,000	1,28,000	9.51	55.00	5,23,237	3,95,237	3.09
T ₅	78,000	70,000	1,48,000	9.53	45.00	4,29,003	2,81,003	1.90
T ₆	38,000	70,000	1,08,000	8.47	45.00	3,81,303	2,73,303	2.53
T ₇	78,000	70,000	1,48,000	10.91	50.00	5,45,670	3,97,670	2.69
T ₈	73,000	70,000	1,43,000	13.47	60.00	8,07,996	6,64,996	4.65
T ₉	0.00	70,000	70,000	7.45	35.00	2,60,631	1,90,631	2.72

Benefit-cost ratio

The benefits-to-cost ratio exhibited varied results for the mango

cv. Banganapalli among the various bagging materials used. The Reddish brown paper bag had the highest B: C ratio (4.94),

followed by Non-woven bag (4.65) and the least in Muslin cloth bag (1.90) when compared to untreated control or no bagging. The average market price received was higher in reddish brown paper and non-woven bagging adopter at Rs. 60 per kg than no/un-bagged fruits Rs. 35 per kg and the per hectare average return of mango orchards in the study areas are depicted in Table 2. per kg). Per hectare average mango yield was found 7,450 kg without fruit bagging and gross return and net return was Rs. 2, 60,631 and Rs. 1, 90,631 respectively. The Bagging technology numerically increased the level of mango production per hectare which is 13,470 kg and gross return and net return was Rs. 8, 07,996 and Rs. 6, 64,996, respectively. This scenario led to higher returns in reddish brown fruits which were about Rs. 6, 64,996 and while the highest benefit-cost ratio 4.94 was recorded in reddish brown paper bag and it was followed by than Non-woven bag (4.65) and the non-bagged fruits showed lowest net returns of Rs. 1, 90,631. The improvement in fruit quality may be attributed to the environment that the bagging material provides inside the fruit, which is essential to fruit growth and development (Sharma *et al.*, 2014) [7]. The price of the reddish-brown bags was also acceptable given these kinds of returns. Higher cost benefit was the outcome of the fruits' increased market price due to their greater quality.

As we know that, fruit bagging increased the fruit shelf-life, pulp contain, color, texture, appearance, sweetness, price and also protect fruits from pest, fungal infections and diseases, mechanical damage, reduce spraying of insecticides, it can play a great role to obtain food safety and it is profitable also. Here the farmers those are practicing fruit bagging have high attitude and those are not practicing have low attitude towards fruit bagging. So, we can assume that possibility of use of fruit bagging will be increased in future.

Conclusion

Fruit bagging has emerged as a novel technology in practice, which is simple, grower friendly, safe and beneficial for the production of quality mangoes. It is easy and safe practice that protects fruit from diseases and insect pest's attacks, mechanical damage, sunburn of the skin, fruit cracking, agrochemical residues on the fruit and by the bird damage. In conclusion, pre-harvest fruit bagging significantly influenced the sensory attributes and economic returns of mango cv. Banganapalli. The non-woven bag demonstrated the highest sensory scores for flavor, texture, taste and overall acceptability, its effectiveness in enhancing fruit quality. Besides, the mango could be protected from all kinds of diseases and pests that will boost the volume of exportable mango. Additionally, the benefit-cost ratio analysis revealed that the reddish-brown paper bag achieved the highest profitability, along with the non-woven bag offering a favorable return on investment. These findings suggest that the choice of bagging material not only affects the sensory qualities of mangoes but also has a substantial impact on marketable value in high returns. The results of this study clearly demonstrate that it is advisable to use brown paper bag or Non-woven bag for getting golden yellow colored fruits. Apart from this, as the market price of the bagged mango is lucrative the growers can sell their produce at high price. Therefore, farmers might be used this technology for commercial mango cultivation to fulfill the demand of quality mango in country and abroad. This study reinforces the importance of selecting appropriate bagging materials to optimize both quality and profitability of mango cultivation.



Fig 2: Comparison treatments bagged fruits in Mango cv. Banganapalli

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