Original Research Article

Influence of fruit bagging on the physical qualities and shelf life of mango cv. Alphonso under Ultra-High-Density Planting

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ABSTRACT

The present experiment was conducted to study the effect of preharvest fruit bagging on the physical parameters and shelf life of mango cv. Alphonso during 2023. Mango fruits were bagged 35 days after the fruit set with various types of bags *viz*: T_1: Brown paper bag; T_2: Double layered bag; T_3: Transparent bag; T_4: Non-woven bag; T_5: Butter paper bag; T_6: Control (no bagging). The experiment was conducted in Randomized Block Design (RBD) with six treatments and four replications. The result indicated that preharvest fruit bagging had a significant effect on physical parameters, shelf life and days required for harvest after bagging. Bagging with Double layered bag increased fruit retention (75.03%), fruit length (9.35cm), fruit weight (295.36g), pulp weight (228.30g), shelf life (18.5 days) and decreased physiological loss of weight (8.16%). Therefore, preharvest fruit bagging improved fruit retention, physical parameters and shelf life in mango cv. Alphonso.

Keywords: [Preharvest bagging, Fruit retention, Shelf life, Physiological loss of weight, Fruit firmness]

INTRODUCTION

Mango (*Mangifera indica* L.) is a well-known tropical fruit in Asia. In India, it is one of the most popular fruits for people of all ages because of its delicious taste. Currently, In India, mango orchards cover approximately 2350300 hectares of land and produce approximately 1288315 metric tonnes. Recently, there has been increasing popularity and demand for high-quality Indian mangoes in international markets. The major mango cultivars exported from India are 'Alphonso', 'Banganapalli', 'Kesar', 'Dashehari' and 'Totapuri'. Despite the growing demand and increasing area of mango, safe and high-quality mango production remains low. Mango trees are susceptible to a number of diseases. Every year, the targeted mango yield is reduced due to the outbreak of various mango diseases and insect-pest attacks. In traditional system of planting the canopy stature is too high and difficult for fruit bagging whereas in UHDP the stature is dwarf and easy for fruit bagging. Farmers are using higher doses of pesticides in their orchards to control these diseases, and the rate of increase in pesticide application is alarming. Fruit fly is a major pest of various mango varieties due to the favorable environment for the pest during fruit maturity**.** Sarker *et al.,* (2010) reported that a significant amount of mango fruits may be lost every year due to fruit fly infestation. In recent years, climatic irregularities such as sudden increase in temperature and relative humidity, as well as excessive rains, have been common. It had a negative impact on the external appearance of the fruit but also susceptible to pests such as mealybugs and physiological disorders such as spongy fruit

tissue, which added to the losses. The affected fruits fetch low market prices, and they are also rejected by processing industries. Several good agricultural practices are becoming increasingly popular around the world for preventing fruit losses caused by both biotic and abiotic factors. Among several such alternatives, the pre-harvest fruit bagging technique has been widely adopted that is consumer-friendly technique in several fruit crops to improve fruit appearance and also reducing the incidence of pest, disease, sunburn, bird damage, mechanical damage and pesticide residues on the fruits. Bagging also provides the estimated knowledge on the number of fruits per tree and also influences on fruit physical and quality parameters (Watanawan *et al.* 2008). With this background the current experiment was done to study the influence of fruit bagging on the physical qualities of mango cv. Alphonso under ultra-high-density plantation.

2. MATERIAL AND METHODS

Sixteen years old uniform-sized mango trees were selected in the farms of Jain Irrigation Systems Limited, located at Udumalpet, Tamil Nadu, India during March to July 2023. Bagging was done on each fruit individually at 35 days after fruit set. Small malformed and clustered fruits were thinned out and healthy fruits were kept for bagging. The current experiment was carried out in using Randomized Block Design (RBD) with six treatments replicated four times with a unit of 10 fruits per treatment per replication. The treatments were T_1: Single-layered brown paper bag; T_2: Double-layered bag; T_3: Transparent bag; T_4: White non-oven bag; T_5: Butter paper bag; T_6: Control (no bagging). Two holes were made at the bottom of T_3: Transparent bag for proper ventilation. While bagging the brown paper bags, transparent bags, butter paper bags, and non-oven bags were stapled properly and the double layered bag contains the wired wrap which can be used to fasten to the pedicel so that bag will not fall down as well as there will be no open space for insects or rain to enter. Fruits were harvested with stalk 3cm by using secateur. Fruits were harvested with 85% maturity. Immediately after harvest, the fruits were transported and analyzed for physical and sensory attributes that are directly related to fruit quality in the Department of Fruit Science laboratory of Tamil Nadu Agricultural University (TNAU). Observations such as fruit retention (percent) and the number of days needed to harvest the fruit after bagging were also recorded. Ten fruits per treatment per replication were selected for following observations.

2.1. FRUIT WEIGHT AND PULPWEIGHT (g)

Fruit was weighed individually in an automated weigh balance, and the average weight was given in grams per fruit. The pulp was measured by the same method

2.2. FRUIT LENGTH AND CIRCUMFERENCE (cm)

Length of the fruit from the stalk end to the apex of the fruit was measured using the digital vernier caliper scale. Average length expressed in centimeter (cm) and fruit circumference was calculated in centimeters by using a thread to measure it at the fruit's center (cm).

2.3. FRUIT FIRMNESS (N)

Ten fruits for each treatment were observed for fruit firmness. The firmness was estimated by adopting standard procedure (AOAC, 2005). The firmness was determined by hand-held digital penetrometer (Parisa technology, AGY-30, Mumbai). It is expressed in newton.

2.4 Physiological loss of weight (%)

The extent of physiological loss in weight was determined at 4 days interval till fruit get spoiled by weight basis and was expressed in percentage.

$$\text{Physiological loss in weight} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Final weight}} \; X\; 100$$

2.5. SENSORY ANALYSIS

The sensory evaluation of the fruits was done at the fully ripened stage using the 9-point Hedonic scale as given in (table-1) prepared on the basis of principles of organoleptic evaluation (Rangana, 1977) and evaluated by a panel of 10 judges. A batch of 10 fruits for each treatment were stored at ambient conditions (temperature; 25±1°C and RH 60±5%) and sensory analysis for peel colour and appearance, pulp, texture, taste, flavour and overall acceptance was done at fully ripen stage on an average of nine days after harvest (DAH).

Table-1 Sensory Scorecard

Characteristics	Colour andAppearance	Texture	Taste	Flavour	Overall acceptability
Like extremely	9	9	9	9	9
Like very much	8	8	8	8	8
Like moderately	7	7	7	7	7
Like slightly	6	6	6	6	6
Neither like nor dislike	5	5	5	5	5
Dislike slightly	4	4	4	4	4
Dislike moderately	3	3	3	3	3
Dislike very much	2	2	2	2	2
Dislike extremely	1	1	1	1	1

2.6. Shelf life of fruits (Days)

The end of shelf life in days was noted from the day of harvesting to fruits that got spoiled and unaccepted. It is expressed in days. The fruits with the maturity of 85 percent maturity were harvested. The end shelf life was noted until the fruits get spoiled.

3. Statistical Analysis

The statistical analysis was performed as per the ANOVA suggested by Panse and Sukhatme (1967). The P values of data were estimated by student's paired T-Test. SD was computed as per the procedure given by Rangaswamy (1995). All analysis were performed using R studio software version R4.3.1.

4. Result and Discussion

The statistically analysed data regarding fruit retention (table-2), physical parameters (table-3), shelf life (table-4), and sensory evaluation (fig.1) were given. In mango cv. Alphonso while comparing with all treatments T_2-Double layered bag has shown maximum fruit retention (75.03%) followed by the T_1-Brownpaper bag (71.95%) respectively which was significantly higher than other treatments. Whereas T_3-Transparent bag has shown the minimum fruit retention (64.62%) over control (66.07%). The harvesting was earlier in Transparent bag (62.00 days) followed by Double layered bag (63.00 days) and the harvest got delayed in brown paper bag (66 days). Similar observations delayed harvest were found on preharvest bagging on mango cv Alphonso when bagged with brown paper bag (Haldankar *et.al.*, 2015). The days required for harvest of the double-layered bag was at par with the non-woven bag. Fruit bagging changes the

microclimate like, temperature and relative humidity of the fruit within the bag which plays a crucial role in fruit growth and development (Sharma et al., 2014). The earliness of fruit harvesting in polythene bag has been reported in litchi and Fujii Supreme Apple (Debnath & Mitra,2006: Fallahi *et al*., 2001). Pre-harvest bagging of fruit with double layered and brown paper bag has enhanced the physical quality like length of the fruit and weight of the fruit, over control-non-bagged fruits and the variations were statistically significant. The fruits bagged with the double layered bag were significantly higher in fruit length (9.35cm) and fruit weight (295.36g). whereas the lowest fruit length (8.20cm) and fruit weight (257.78g) was observed in control-non bagged fruit. Similar observations showed that fruit bagging had positive influence on fruit weight and size over control fruits (Chonhenchob et al.,2011). Watanawan *et al.* (2008) observed that the highest fruit weight was found in the double-layer paper bag, followed by the brown paper bag when compared to control in mango cv. "Nam Dok Mai". The circumference of the fruit was not significantly affected by bagging whereas the highest fruit circumference was observed in the T_2-double-layer bag (22.86cm) and the lowest circumference was observed in control non bagged fruit (19.25cm). The Pulp weight of the fruit was significantly highest in Double layered bagged fruits (223.60g) and the lowest pulp weight was observed in control non-bagged fruits (201.77g). The pulp: stone ratio was also significantly higher in double layered bagged fruit (7.12). The double layered bag was at par with Transparent bag whereas the lowest pulp: stone ratio was observed in control-non bagged mango fruit (5.68). Preharvest fruit bagging also have significant difference on fruit firmness. The fruit firmness was significantly higher in T_2-Double layered bag (36.31N) followed by T_1-Brown paper bag (33.63N) and the lowest fruit firmness was observed in T_3-Transparent bag (27.84N). The enhanced fruit firmness has positively correlated with extending the shelf life of fruit. Usually, the fruit firmness gradually decreases during ripening process by breakdown of insoluble protopectin into soluble pectin. Preharvest fruit bagging maintains microclimate and also act as a physical barrier by interfering the transpiration rate of the fruit compared to unbagged fruit. Bagging also influences the calcium ion accumulation on the fruit. Islam *et al*. (2017) found that pre-harvest mango fruit bagging extended the shelf life of mango by delaying the ripening process. The fruits bagged with the T_2- Double layered bag have significantly higher shelf life (18.5 days) after harvest, whereas the lowest shelf-life (13.5 days) was observed in T_3- Transparent bag. Similar findings by (Jakhar *et al*. 2014) found that preharvest fruit bagging with polythene bag get early maturity and fruit get shrink and spoiled due to temperature and humidity inside the bag. The physiological loss in weight was significantly higher in T_3-Transparent bag (13.31%) with poor keeping quality and the lowest physiological loss in weight was in T_2-Double layered bag (8.16%) with good keeping quality. Similar observations were reported in mango cv. Sensation that weight loss was significantly higher in polythene bags than in control (shorter *et al.,* 1997). This might be due to the maintenance of fruit firmness, reduction of respiration and delay in senescence. Fruits bagged with treatment T_2-Double layered bag had significantly higher sensory score (9.02) for fruit colour which indicates class of "Like extremely" given in Fig.1. While comparing the sensory score of overall acceptability T_2-Double layered bag was the significantly highest score (8.87) indicating class of "Like very much". Whereas T_3 -Transparent bag got the lowest score (6.90) for overall acceptability which indicates class of "Like slightly".

Conclusion:

This study revealed that preharvest bagging at 35 days after fruit set with different bags altered fruit retention, physical parameters and shelf life in mango cv. Alphonso. Preharvest fruit bagging also modified, days required for harvesting after bagging. The T_2- Double layered bag and T_1- Brown paper bag was found to be the best to increase fruit retention, length of fruit, weight of the fruit, firmness of fruit, keeping quality of fruit and decreased physiological loss of weight. Therefore, among all the treatments

Double layered bag is suggested for mango growers of India for producing the highest fruit physical quality with an extended shelf life to obtain a profitable price in local and export markets.

Table 2. Effect of types of bags on fruit retention and days required for harvesting after bagging in mango fruit cv. Alphonso under UHDP (202

Treatments	Fruit retention (%)	Days required for harvesting after bagging
T1 (Brown paper bag)	71.95	66
T2 (Double layered bag)	75.03	63
T3 (Transparent bag)	64.62	62
T4 (Non-oven bag)	67.65	63.50
T5 (Butter paper bag)	68.79	65.50
T6 Control (no bagging)	66.07	68
Range	64.62 – 75.03	62 - 68
Mean	68.4345	64.70
S.Em ±	0.77	0.72
C.D. at 5%	2.34	2.19
P - Value	*0.97*	*0.4132895*

Table 3. Effect of types of bags on Physical parameters of mango cv. Alphonso under UHDP (2023)

Treatments	Length of fruit (cm)	Circumference of fruit (cm)	Weight (g)	Pulp weight (g)	Stone weight (g)	Pulp-to-stone ratio
T1 (Brown paper bag)	8.72	21.63	284.25	221.73	35.47	6.26
T2 (Double layered bag)	9.35	22.86	295.36	228.30	31.397	7.27
T3 (Transparent bag)	8.44	21.72	274.50	218.90	31.35	7.00
T4 (Non-oven bag)	8.64	20.87	260.26	213.75	33.07	6.48
T5 (Butter paper bag)	8.50	21.53	271.97	217.62	34.97	6.22
T6 Control (no bagging)	8.20	19.25	257.78	205.85	35.46	5.80
Range	8.20– 9.35	19.25 – 22.86	257.78– 295.36	205.85 – 228.30	31.35 – 35.47	5.80– 7.27
Mean	9.04	21.31	274.02	217.69	33.62	6.50
S.Em ±	0.35	0.68	4.20	3.44	0.85	0.17
C.D. at 5%	0.75	2.05	12.66	10.38	2.58	0.53
P - Value	*0.1967562*	*0.9499*	*0.6069911*	*0.007965*	*0.599584*	*0.6498270*

Table 4. Effect of types of bags on fruit firmness, shelf life and physiological loss of weight of mango cv. Alphonso under UHDP (2023)

Treatments	Fruit firmness	Shelf life	Physiological loss in

	(N)	(days)	weight (%)
T1 (Brown paper bag)	33.66	16	8.89
T2 (Double layered bag)	36.31	18.5	8.16
T3 (Transparent bag)	27.84	13.5	13.31
T4 (Non-woven bag)	33.51	15.5	9.79
T5 (Butter paper bag)	31.11	14.5	9.88
T6 Control (no bagging)	30.97	15	12.66
Range	27.84 – 36.31	13.5 – 18.5	8.16 – 13.31
Mean	32.23	15.4	10.45
S.Em ±	0.66	0.46	0.35
C.D. at 5%	1.99	1.39	1.05
P - Value	*0.8275*	*0.6943*	*0.5767*

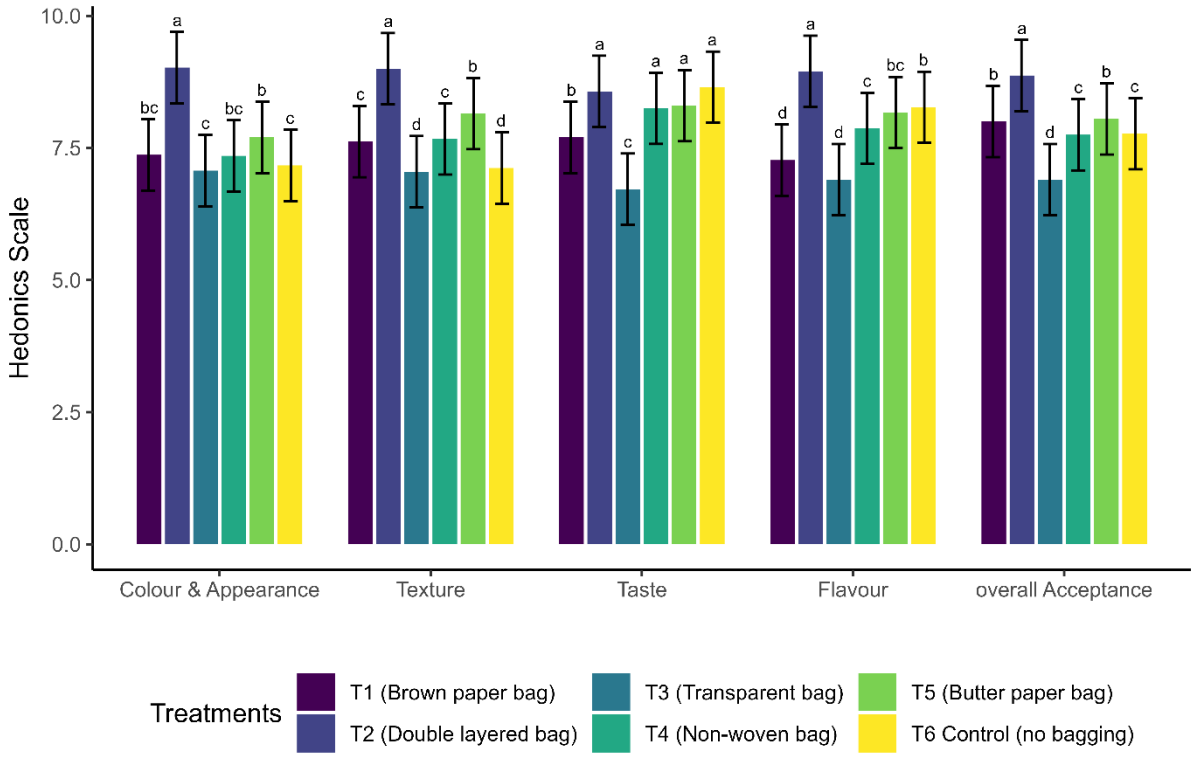

Fig-1. Effect of different types of bags on quality characteristics of mango cv. Alphonso under UHDP (2023)

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