Plant Archives Vol. 25, No. 2, 2025 pp. 2219-2224 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.2.317

EFFECT OF PRE-HARVEST BAGGING ON QUALITY OF MANGO (*MANGIFERA INDICA* L.) FRUIT CV. PUSA ARUNIMA

Tripti Singh[1]*, Arvind Kumar[1], Akanksha Marwah[2], Niharika Gurudev[1], Shubham Yadav[1], Amit Kumar[1] and Arbaj Ali[1]

[1]Department of Fruit Science, College of Horticulture, Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut – 250 110 (U.P.), India.
[2]Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan - 173 230 (Himanchal Pradesh), India.
*Corresponding author E-mail : gurudevnicks@gmail.com
(Date of Receiving-18-06-2025; Date of Acceptance-01-09-2025)

ABSTRACT

An experiment was conducted using eight treatments: T_1 – Newspaper bag, T_2 – Brown paper bag, T_3 – Skirting bag, T_4 – Perforated plastic bag, T_5 – Butter paper bag, T_6 – Muslin cloth bag, T_7 – Brown paper bag with polythene coating and T_8 – Control (no bagging), laid out in a Randomized Block Design (RBD) with three replications. Fruits were bagged 40 days after fruit set (*i.e.*, at egg stage). The results revealed that bagging significantly influenced various physico-chemical attributes and harvesting duration. Each type of bag demonstrated distinct advantages and disadvantages. Among the treatments, T_7 (brown paper bag with polythene coating) showed the best performance in terms of fruit length (13.66 cm), diameter (8.86 cm), fruit weight (496.67 g), pulp weight (453.74 g), pulp-to-stone ratio (12.08), shelf life (15 days), TSS (20.21 °Brix), reducing sugars (6.66%), non-reducing sugar (11.55%), total sugars (18.21%) and β-carotene content (15330.05 µg/100 g). T_5 (butter paper bag) recorded the highest ascorbic acid content (43.18 mg/100 g), while T_4 (perforated plastic bag) exhibited the highest acidity (0.207%). Bagging also had a significant impact on quality parameters such as bruises, blemishes, and fruit fly incidence at the ripe stage. Notably, fruits from T_1, T_2, T_5, T_6 and T_7 exhibited no bruises or fruit fly infestation. Sensory evaluation ranked T_7 fruits the highest in terms of consumer acceptability. In conclusion, pre-harvest bagging influenced the growth, development, and quality of mango fruits. Among all treatments evaluated, T_7 (brown paper bag with polythene coating) demonstrated superior performance and can be recommended as the most suitable option for farmers to enhance the quality and marketability of mango.

Key words : Reducing sugar, Bagging, Bruises, Butter paper bag, Blemishes.

Introduction

Mango (*Mangifera indica* Linn.), the "King of Fruit" is among the most important tropical and subtropical crops, valued for its taste, aroma, nutrition, and cultural significance (Khan *et al*., 2015). Originating in the Indo-Burma region, it has been cultivated in India for over 4,000 years. Major mango producing states include Uttar Pradesh, Andhra Pradesh, Bihar, West Bengal, and Maharashtra. The fruit is rich in vitamin A, C, B-complex, minerals, β-carotene and antioxidants, providing health benefits such as anti-inflammatory, anti-diabetic, and cardioprotective effects (Tharanathan *et al*., 2006). Pusa Arunima, released in 2002 by crossing 'Amrapali' × 'Sensation', is a semi-vigorous, regular-bearing variety suitable for close planting (Pandey and Singh, 2002). It produces attractive red-blushed fruits with high pulp recovery (70%), balanced sugar-acid ratio, 14,220 µg â-carotene, 42.3 mg ascorbic acid/100 g pulp and ~15 days shelf life at room temperature**.** However, climatic stresses such as unseasonal rains, temperature fluctuations and fog, along with pests (fruit fly, borer, thrips) and diseases (anthracnose, sooty mould, stem-end rot), affects the fruit quality and reducing its marketability.

Bagging involves covering fruits with paper or cloth bags which acts as a physical barrier that protects against pests, diseases, sunburn, and mechanical injury while also improving appearance, colour and shelf life (Yang *et al.*, 2009). In India, the technique has shown promise for cultivars such as Dashehari, Langra, Chausa, Mallika, and Amrapalli), but has not yet been standardized for Pusa Arunima. Consumers prefer blemish-free, well-colored mangoes with high pulp content and good shelf life. While tree-ripened fruits, offer superior flavor, they are highly susceptible to environmental stresses and biotic damage (Litz, 2009). Pre-harvest bagging improves quality by reducing physical injuries, pest infestation, and pesticide residues (Sharma *et al.*, 2014) by Utilizing low-cost locally available bags may offer a feasible option for farmers.

Materials and Methods

The present investigation was conducted at Horticultural Research Centre, Department of Fruit Science, College of Horticulture, SVPUAT, Meerut, during the year 2023–2024 to assess the impact of bagging on growth, development and physico-chemical properties of Pusa Arunima fruits. The experiment was laid out in completely randomized design (RBD) with one variety Pusa Arunima & 8 treatment combinations, T_1 – Newspaper bag, T_2 – Brown paper bag, T_3 – Skirting bag, T_4 – Perforated plastic bag, T_5 – Butter paper bag, T_6 – Muslin cloth bag, T_7 – Brown paper bag with polythene coating, and T_8 – Control (no bagging). The treatments were repeated thrice and for each treatment 40 fruits were covered with bagging material.

Days required for harvesting (days)

The period required for harvesting after bagging was calculated in days for the fruits in each treatment.

Length of fruit (cm) – Fruit length was measured from stalk to apex using a Vernier caliper and recorded in cm.

Diameter of fruit (cm) – Fruit diameter was measured at the widest part using a Vernier caliper and recorded in cm.

Fruit weight (g) – Each fruit was individually weighed on a calibrated digital balance and recorded in grams.

Pulp and stone weight (g) – Pulp and stone were separated, weighed individually, and their weights were recorded in grams.

Pulp to stone ratio – Ratio was calculated by dividing pulp weight by stone weight.

Shelf Life of Fruits (days) – Shelf life was noted as days from harvest until fruit became unfit for consumption.

TSS (°Brix) – TSS of mango pulp was measured using a Hand Refractometer**.** (Erma Japan, 0 to 32 °Brix). A few drops of pulp juice were placed on the prism surface of the refractometer. The °Brix value was noted by viewing through the eyepiece. Readings were corrected to 20°C using a standard temperature correction chart as per (A.O.A.C., 1975) guidelines.

Acidity (%) – A known quantity of pulp was titrated against 0.1 N NaOH using phenolphthalein as an indicator. For solid samples, a measured amount was blended with 20–25 ml distilled water, transferred to a 100 ml volumetric flask, diluted to volume, and filtered. An aliquot of 10 ml was titrated against 0.1 N NaOH with phenolphthalein as an indicator. The results were expressed as percent anhydrous citric acid (A.O.A.C., 1975), using the following formula:

$$\text{Acidity (\%)} = \frac{\text{Burette reading x N of NaOH x } 0.067 \times 100}{\text{Weight of sample taken (g)}}$$

Reducing sugars (%) – The reducing sugars were estimated by using (Lane and Eynon (1923), a known weight (5g) of sample was blended with lead acetate (45%) for precipitation of extraneous material and stilled water using potassium oxalate (22%) to deled the solution. This lead-free extract was used to estimate reducing sugars by titrating against standard Fehling's mixture (Fehling's A and B) using methylene blue as an indicator to a brick red end point. The percentage of reducing sugars was calculated according to following formula:

$$\text{Reducing sugars (\%)} = \frac{100 \times 0.05 \text{ (Glucose value)} \times 25}{\text{Titer value} \times \text{Weight of sample}}$$

Non-reducing sugar (%) –. To determine non-reducing sugar, total invert sugars were estimated first. For this, 5 ml of the sample was taken and 2-3 drop of HCL were added and left overnight. Next day, two drops of phenolphthalein indicator were added, and the solution was neutralized with 30% NaOH. Thereafter, 5 ml of each Fehling solution 'A' and Fehling solution 'B' were added and the mixture was titrated against 1.0 per cent glucose solution till the end point (Brick red color). Then the percentage of total invert sugars was then calculated using the following formula-

$$\text{Total invert sugar (\%)} = \frac{\text{(Blank titer value - sample titer value)} \times \text{volume made up} \times 100}{\text{Aliquot taken} \times \text{weight of sample taken}}$$

Total sugars (%) –. For total sugars estimation, the filtrate from reducing sugars analysis was used. An aliquot of 25 ml was mixed with 5 ml (1:1) hydrochloric acid and kept at room temperature for 24 hours for inversion. The solution was then cooled, neutralized with 40% sodium hydroxide using phenolphthalein, and the volume made up to 100ml. After filtering through Whatman No. 1 paper, it was titrated against boiling Fehling's mixture using methylene blue as described earlier. Total sugars were calculated using the following formula:

$$\text{Total sugars (\%)} = \frac{\text{Glucose eq. of Fehling solution} \times \text{Total volume made up} \times \text{volume made up after inversion} \times 100}{\text{Titer value} \times \text{Weight of pulp} \times \text{Aliquot take for inversion}}$$

Ascorbic acid (mg/100 g pulp) – Ascorbic acid was determined by the 2,6-dichlorophenol indophenol dye method of Johnson (1948) and expressed as mg/100 g pulp. Ten grams of homogenized sample was diluted to 100 ml with 3% oxalic acid. A 10 ml aliquot was titrated against freshly standardized dye solution, standardized using fresh vitamin C to calculate the dye factor. Titration was continued until a light pink color persisted. The vitamin C content was calculated by using the following formula.

$$\text{Ascorbic Acid (mg/100 g pulp)} = \frac{\text{Titrate value} \times \text{dye factor} \times \text{volume made upX100}}{\text{Aliquot taken for estimation} \times \text{weight of sample taken}}$$

β-carotene (µg/100 g pulp) – About 5–10 g of fresh pulp was homogenized with sand and acetone until the residue became colorless. The pooled extracts were filtered and transferred to a separating funnel, then mixed with an equal volume of petroleum ether (40–60°C). The upper petroleum ether layer containing carotenoids was collected, and the aqueous phase was re-extracted until colorless. All petroleum ether extracts were pooled, washed with distilled water, dried over anhydrous sodium sulfate, and made up to a known volume. Absorbance was recorded at 450 nm against petroleum ether blank, and total carotenoids were calculated as β-carotene equivalents in µg/100 g fresh pulp (Ranganna, 1986).

Sensory evaluation – The Sensory evaluation for color, flavor, and texture was conducted by a 5-member panel using a 9-point Hedonic scale, with scores of e"5.5 considered acceptable (Amerine *et al*., 1965).

Pest and disease incidence (%)

Each fruit was thoroughly examined on alternate days for visible signs of spoilage, pest and disease during storage at ambient temperature. Fruits were harvested at 85 percent maturity and ripened uniformly at room temperature under 95% Relative humidity.

Bruises and blemishes (per cm^2)

Bruises and blemishes per cm^2 were examined by using trace paper on the surface of the fruit using the following formula:

$$\text{Bruises/blemishes} = \frac{\text{Surface area of bruises/ blemishes}}{\text{Surface area of the fruit}}$$

Results and Discussion

Pre-harvest bagging at the egg stage markedly influenced the maturity, physical attributes and biochemical composition of mango cv. Pusa Arunima. The number of days required for harvest varied significantly among treatments, ranging from 83.33 days in brown paper bag with polythene coating (T_7) to 90.00 days in the control (T_8). The reduced days to maturity in T_7 may be attributed to the microclimatic conditions created by the bagging, which moderated fluctuations in temperature and humidity, accelerating physiological processes leading to ripening. Similar trends were reported by Akter *et al.* (2020) in 'Amrapali' mango and by Rahman *et al.* (2021), who found that polythene-coated paper bags advanced maturity due to better thermal regulation.

Fruit size, as measured by length and diameter, was also significantly influenced. The highest fruit length (13.66 cm) and diameter (8.86 cm) were recorded in brown paper bag with polythene coating (T_7), followed by brown paper (T_2) and butter paper (T_5), while the smallest fruits were from plastic bags with perforations (T_4) and the control. The superior performance of T_7 can be linked to optimal light filtration, moderated temperature, and

Table 1 : Effect of pre-harvest fruit bagging on days required for harvesting and shelf life of mango cv. Pusa Arunima.

Treatment	Days required for harvesting	Shelf life (days)
T_1 (Newspaper bag)	86.66 ± 0.33	13.67
T_2 (Brown paper bag)	86.33 ± 0.33	13.67
T_3 (Skirting bag)	88.00 ± 0.57	11.00
T_4 (Plastic bag with perforation)	89.33 ± 0.33	10.33
T_5 (Butter paper bag)	86.66 ± 0.33	14.67
T_6 (Muslin bag)	86.66 ± 0.33	11.67
T_7 (Brown paper bag with polythene coating)	83.33 ± 0.33	15.00
T_8 (Control)	90.00 ± 0.33	10.67
C.D. at 5%	1.133	0.86
SE.m ±	0.370	0.28
C.V. (%)	0.736	3.87

Table 2 : Effect of pre-harvest fruit bagging on physical attributes of mango cv. Pusa Arunima.

Treatment	Length (cm)	Weight (g)	Diameter (cm)	Pulp wt. (g)	Stone wt. (g)	Pulp–stone ratio
T_1 (Newspaper bag)	12.39	443.33	7.80	381.40	40.66	9.38
T_2 (Brown paper bag)	12.87	446.67	8.00	399.84	38.68	10.35
T_3 (Skirting bag)	11.94	416.67	7.66	355.14	41.16	8.65
T_4 (Plastic bag with perforation)	11.34	356.67	7.14	308.27	44.55	6.92
T_5 (Butter paper bag)	12.73	476.67	8.10	427.77	38.79	11.04
T_6 (Muslin bag)	12.11	420.00	7.54	377.54	41.01	9.21
T_7 (Brown paper bag with polythene coating)	13.66	496.67	8.86	453.74	37.66	12.08
T8 (Control)	11.85	323.33	7.41	276.07	51.99	5.32
C.D. at 5%	0.96	29.71	0.50	26.16	3.53	1.27
SE.m ±	0.31	9.70	0.16	8.54	1.15	0.41
C.V. (%)	4.39	3.98	3.62	3.97	4.77	7.87

Table 3 : Effect of pre-harvest fruit bagging on physical attributes (sensory and damage parameters) of mango cv. Pusa Arunima.

Treatment	Colour	Flavor	Texture	Average	Fruit fly (%)	Bruises (cm^2)	Blemishes (cm^2)
T_1 (Newspaper bag)	8.00	8.00	8.33	8.11	0.00	0.00	0.00
T_2 (Brown paper bag)	8.66	8.33	8.66	8.55	0.00	0.00	0.00
T_3 (Skirting bag)	8.00	7.66	8.00	7.88	0.00	0.26	0.00
T_4 (Plastic bag with perforation)	7.33	7.33	7.33	7.33	12.30	0.35	0.25
T_5 (Butter paper bag)	8.66	8.66	9.00	8.77	0.00	0.00	0.00
T_6 (Muslin bag)	7.66	8.00	8.00	7.88	0.00	0.00	0.00
T_7 (Brown paper bag with polythene coating)	9.00	9.00	9.00	9.00	0.00	0.00	0.00
T_8 (Control)	7.00	7.00	7.00	7.00	12.56	0.58	0.53
C.D. at 5%	0.76	0.73	0.65	0.23	0.31	0.083	0.064
SE.m ±	0.24	0.24	0.21	0.078	0.10	0.027	0.021
C.V. (%)	5.34	5.19	4.53	1.67	3.40	3.517	4.089

protection from wind abrasion and insect damage, resulting in uninterrupted cell expansion. These findings align with Watanawan *et al*. (2008) and Zhang *et al*. (2017), who reported that two-layer or coated paper bags improved fruit size by creating a favorable microenvironment.

Fruit weight followed a similar pattern, with (T_7) brown paper bag with polythene coating producing the heaviest fruits (496.67 g), statistically at par with butter paper (T_5, 476.67 g) and brown paper (T_2, 446.67 g), while the control recorded the lowest (323.33 g). The higher fruit weight in paper-based treatments is likely due to reduced evapo-transpiration, minimized pest/ disease incidence, and longer retention on the tree, permitting greater dry matter accumulation. Comparable results were obtained by Nagaharshitha *et al.* (2014) and Singh *et al.* (2022), both of whom reported significant gains in fruit mass with brown paper bagging.

Pulp weight and pulp-to-stone ratio were highest in T_7 (453.74 g and 12.08, respectively), indicating a greater edible portion, which enhances market value. This is consistent with the findings of Dutta and Majumder (2012) in 'Himsagar' mango and Chen *et al*. (2019) in 'Keitt' mango, both of which showed that pre-harvest bagging improved pulp yield and the edible portion ratio.

Shelf life was notably extended in bagged fruits, with T_7 achieving 15.00 days compared to 10.67 days in the

Table 4 : Effect of pre-harvest fruit bagging on chemical attributes of mango cv. Pusa Arunima.

Treatment	Reducing sugars (%)	Non-reducing sugar (%)	Total sugars (%)	Ascorbic acid (mg/100g)	Acidity (%)	TSS (°Brix)	Beta-carotene (µg/100g)
T_1 (Newspaper bag)	4.32	9.79	14.11	39.86	0.20	19.50	14306.20
T_2 (Brown paper bag)	4.51	10.18	14.69	41.27	0.19	20.10	14734.41
T_3 (Skirting bag)	4.22	9.39	13.61	37.57	0.20	19.28	13986.69
T_4 (Plastic bag with perforation)	4.42	9.85	14.27	38.09	0.20	19.79	13609.28
T_5 (Butter paper bag)	5.57	10.54	16.11	43.18	0.20	20.15	15191.37
T_6 (Muslin bag)	3.42	8.69	12.11	39.24	0.20	18.88	14142.78
T_7 (Brown paper bag with polythene coating)	6.66	11.55	18.21	40.87	0.19	20.21	15330.05
T_8 (Control)	4.08	9.12	13.20	36.01	0.20	19.11	13082.60
C.D. at 5%	0.33	0.75	1.07	2.70	NS	NS	888.65
SE.m ±	0.11	0.25	0.35	0.88	0.004	0.40	290.16
C.V. (%)	4.04	4.29	4.18	3.87	3.33	3.56	3.52

control. This improvement can be ascribed to reduced mechanical injury, lower disease incidence, and more uniform ripening. Islam *et al*. (2019) and Nasir *et al*. (2021) similarly reported maximum shelf life in paper-bagged mango, while plastic-based bags often reduced storage potential due to condensation and fungal growth.

Chemical parameters also responded positively to bagging. TSS values peaked in brown paper bag with polythene coating (T_7) (20.21 °Brix), accompanied by high reducing sugars (6.66%), total sugars (18.21%) and β-carotene (15330.05 µg/100 g). The enhanced β-carotene levels under paper-based treatments are likely due to moderated sunlight exposure, which slows chlorophyll degradation and promotes carotenoid synthesis during storage, as reported by Zhao *et al*. (2013) and Duan *et al*. (2018). Ascorbic acid content was highest in the butter paper bag (43.18 mg/100 g). Sensory evaluation revealed that fruits from brown paper bag with polythene coating (T_7) were rated highest for appearance, color, and overall acceptability, owing to their attractive red blush, smooth skin, and freeness from blemishes. Similar observations were made by Mathooko *et al*. (2011) and Raghavendra *et al*. (2020), who linked improved visual quality in bagged mangoes to protection from sunburn, wind scars and pest injury. Pest and disease incidence in the present study was lowest in T_7, T_2 and T_5, which recorded no mealybug or spongy tissue infestation, supporting previous findings that tightly secured paper bags effectively prevent insect entry and related disorders (Prasad *et al*., 2018).

Bruises and blemishes per cm² were markedly reduced in all bagging treatments compared to control, with T_7 showing the least, confirming the role of bagging as a physical barrier against mechanical damage. Guo *et al*. (2000) and Martins *et al*. (2016) also demonstrated that bagging reduced skin injury and cracking in various fruit crops.

Overall, the present findings establish that brown paper bag with polythene coating (T_7) consistently outperformed from other materials in improving physical dimensions, biochemical qualities, shelf life and marketability of mango cv. Pusa Arunima. These results, supported by recent literature, underscore the significance of selecting appropriate bagging material to optimize fruit quality and reduce post-harvest losses in mango cultivation.

Conclusion

The present study conclude that pre-harvest bagging significantly enhanced the physico-chemical quality, appearance, and marketable yield of mango cv. Pusa Arunima while reducing fruit fly infestation and blemishes. Among all treatments, brown paper bag with polythene coating (T_7) was the most effective, followed by butter paper (T_5) and brown paper (T_2). Materials like muslin cloth, skirting bags, and perforated plastic were comparatively less effective, with the latter increasing pest incidence. Overall, pre-harvest bagging emerges as an eco-friendly, cost-effective practice for improving fruit quality and reducing post-harvest losses. Among all the treatments, brown paper bag with polythene coating (T_7) can be recommended for commercial adoption.

Acknowledgement

The author expresses sincere gratitude to the Department of Fruit Science, College of Horticulture, SVPUAT, Meerut, for providing the necessary facilities and support to carry out this research work. Heartfelt thanks are extended to my research advisor, Dr. Arvind Kumar, for valuable guidance, constructive suggestions, and constant encouragement throughout the study.

References

A.O.A.C. (1975). *Official Methods of Analysis* (12th ed.). Association of Official Analytical Chemists, Washington, D.C.

Akter, S., Rahman M.M. and Alam M.S. (2020). Effect of pre-harvest bagging on fruit quality and shelf life of mango cv. Amrapali. *J. Horticult. Sci. Biotechnol.*, **95(4)**, 450–458. https://doi.org/10.1080/14620316.2020.1726890.

Amerine, M.A., Pangborn R.M. and Roessler E.B. (1965). *Principles of Sensory Evaluation of Food*. Academic Press, New York.

Chen, X., Chen Z. and Liu Y. (2019). Influence of pre-harvest bagging on fruit quality and postharvest physiology of mango cv. Keitt. *Scientia Horticulturae*, **253**, 140–146. https://doi.org/10.1016/j.scienta.2019.04.057

Duan, X., Liu T. and Zhao Y. (2018). Regulation of carotenoid accumulation in postharvest mango fruit by light and temperature conditions. *Post-harvest Biol. Technol.*, **142**, 23–30. https://doi.org/10.1016/j.postharvbio.2018.03.001

Dutta, P. and Majumder D. (2012). Effect of bagging on physical and biochemical composition of mango cv. Himsagar. *J. Crop and Weed*, **8(2)**, 101–104.

Guo, L., Huang S. and Zhao C. (2000). Effect of bagging on fruit cracking and appearance in peaches. *J. Fruit Sci.*, **17(2)**, 121–124.

Islam, M.Z., Rahman M.A. and Hossain M.A. (2019). Influence of bagging materials on quality and shelf life of mango cv. Amrapali. *Bangladesh J. Agricult. Res.*, **44(4)**, 681–693. https://doi.org/10.3329/bjar.v44i4.44616

Johnson, R. (1948). Determination of ascorbic acid in plant materials. *Anal. Chem.*, **20**, 45–48.

Khan, A.S., Ahmad W. and Malik A.U. (2015). Mango production and quality constraints in Pakistan. *J. Environ. Agricult. Sci.*, **2**, 1–9.

Lane, J.H. and Eynon L. (1923). *Determination of reducing sugars by titration method*. London: Dutton.

Litz, R.E. (2009). *The Mango: Botany, Production and Uses* (2nd ed.). CABI Publishing.

Martins, D.S., Almeida C.O. and Siqueira D.L. (2016). Bagging reduces damage and improves quality of passion fruit. *Scientia Horticulturae*, **209**, 179–184. https://doi.org/10.1016/j.scienta.2016.06.018

Mathooko, F.M., Alusa A.L. and Matsuzaki M. (2011). Effect of pre-harvest bagging on the appearance and postharvest quality of mango fruit. *Afr. J. Food, Agricult., Nutr. Develop.*, **11(5)**, 5144–5157. https://doi.org/10.4314/ajfand.v11i5.70437

Nasir, M., Hussain A. and Qureshi M.A. (2021). Effect of different bagging materials on mango fruit quality and storage life. *Pak. J. Agricult. Sci.*, **58(2)**, 459–467. https://doi.org/10.21162/PAKJAS/21.1180

Pandey, S.N. and Singh S. (2002). Pusa Arunima – A promising mango hybrid. *Indian Horticulture*, **47(2)**, 12–13.

Prasad, K., Kumar S. and Singh R. (2018). Effect of bagging materials on incidence of insect pests and quality of mango fruit. *J. Entomol. Zool. Stud*., **6(3)**, 1376–1380.

Raghavendra, K., Sharma R. and Yadav A. (2020). Influence of fruit bagging on colour development and postharvest quality of mango cv. Alphonso. *Indian J. Horticult.*, **77(3)**, 495–501. https://doi.org/10.5958/0974-0112.2020.00080.3.

Rahman, M.M., Akter S. and Sultana N. (2021). Influence of bagging on fruit maturity and quality of mango under Bangladesh conditions. *J. Bangladesh Agricult. Univ*., **19(1)**, 67–74. https://doi.org/10.5455/JBAU.126527.

Ranganna, S. (1986). *Handbook of Analysis and Quality Control for Fruit and Vegetable Products*. 2nd ed. Tata McGraw-Hill, New Delhi.

Sharma, R.R., Pal R.K. and Singh D. (2014). Pre-harvest fruit bagging for better quality and postharvest life of horticultural produce. *Scientia Horticulturae*, **168**, 163–182. https://doi.org/10.1016/j.scienta.2014.01.009

Singh, R., Kumar M. and Prasad S. (2022). Pre-harvest bagging influences fruit quality, pest incidence and shelf life in mango. *Scientia Horticulturae*, **295**, 110876. https://doi.org/10.1016/j.scienta.2021.110876

Tharanathan, R.N., Yashoda H.M. and Prabha T.N. (2006). Mango (*Mangifera indica* L.): "The King of Fruits"—An overview. *Food Rev. Int.*, **22(2)**, 95–123. https://doi.org/10.1080/87559120600574493

Watanawan, A., Koslanund R. and Paull R.E. (2008). Use of bagging to improve quality of mango fruit. *Acta Horticulturae*, **820**, 401–408. https://doi.org/10.17660/ActaHortic.2008.820.49

Yang, W., Zhu X. and Wu Y. (2009). Effect of bagging on fruit quality of mango in China. *Acta Horticulturae*, **820**, 325–332. https://doi.org/10.17660/ActaHortic.2009.820.39

Zhang, Y., Liu H. and Wang X. (2017). Effects of bagging on fruit microclimate and mango quality. *Scientia Horticulturae*, **225**, 567–573. https://doi.org/10.1016/j.scienta.2017.07.012

Zhao, Y., Zhang X. and Li J. (2013). Effect of bagging on carotenoid accumulation and fruit colour development in mango. *Food Chem.*, **136(2)**, 879–884. https://doi.org/10.1016/j.foodchem.2012.08.071