Research in
AGRICULTURE, LIVESTOCK and FISHERIES
ISSN : P-2409-0603, E-2409-9325
An Open Access Peer Reviewed Journal

Open Access **Res. Agric. Livest. Fish.**
Research Article **Vol. 3, No. 2, August 2016: 279-286**

POST-HARVEST FACTORS AFFECTING QUALITY AND SHELF LIFE OF MANGO CV. AMROPALI

Sherajum Monira, M. Abdur Rahim, MAB Khalil Rahad and M. Ashraful Islam*

Department of Horticulture, Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

***Corresponding author:** M. Ashraful Islam; E-mail: ashrafulmi@bau.edu.bd

ARTICLE INFOABSTRACT

Received
18.06.2016

Accepted
14.08.2016

Online
17 August 2016

Key words
Aloe vera, Chitosan, Mango, Postharvest, Quality, Shelf life

A study was conducted to investigate the effect of some postharvest treatments on shelf life and quality of mango. Experiment was conducted at the BAU Germplasm centre, Department of Horticulture, Bangladesh Agricultural University, Mymensingh during May to July, 2013. Two treatments viz. Aloe vera and Chitosan solution were used for this study. The experiment was laid out in Completely Randomized Design (CRD) to observe the post-harvest performance of mango with three replications. The fruits were divided into three grades eg. large, medium and small for the convenience of the experiment. In each group mango were treated with Aloe vera gel and Chitosan solution in three different concentrations of 0.5%, 1% and 1.5%. Amropali cultivar had the highest shelf life (7days) at 1.5% Aloe vera gel treatment to the large size mangoes at room temperature compare to other sizes and treatments. Nearly, similar effect was obtained from 1.5% Aloe vera gel to the medium size fruits than other treatments. 1.5% Chitosan showed the second best result in case of shelf life extension followed by 1% Chitosan solution.

To cite this article: Monira S, MA Rahim, MABK Rahad and MA Islam, 2016. Post-harvest factors affecting quality and shelf life of mango cv. amropali. Res. Agric. Livest. Fish.,3 (2): 279-286.

INTRODUCTION

Mango (*Mangifera indica* L.) is a delicious, nutritionally superior and one of the most valuable fruit. Mango is a common fruit throughout the world. Mango, often referred to as the king of tropical fruits, is an important fruit crop cultivated in the tropical regions (Boghrma *et al.,* 2000). There are so many mango varieties in our country in different areas, available in the season (May to July). Mango is grown in almost all districts of Bangladesh, but it is commercially cultivated in the greater districts of Rajshahi, Dinajpur, Rangpur, Kushtia and Jessore. Amropali was an exotic variety from India, although now it has been registered in our country but its commercial production is still poor than other local varieties. Amropali is usually smaller in size but total production is more than other common varieties. Main problems of commercial production of mango are irregular bearing, poor bearing, lower quality of fruits and small duration of market availability. Total production of mango is 992296 metric tons with an average yield of 36.14 tons per hectare in our country (BBS, 2014). Now, main concern is to increase shelf life, maintain better quality. However, a considerable proportion of mango fruit is spoiled each year due to lack of proper storage and marketing infrastructures. Herianus*et al.* (2003) observed the ripening process in mature green mango takes within 9–12 days or 12–14 days after harvest (Manzano*et al*. 1997) with good flavor, texture and color characteristic at ambient conditions at 25^{o}C. In Bangladesh, postharvest loss of mango in supply chain is about 27 %. Hence, adequate measures should be taken to prolong shelf life of mangoes. Proper storage is essential for extending the consumption period of fruits, regulating their supply to the market and also for transportation to long distances. The mature green fruits can be kept at room temperature for about 4 to10 days depending upon the variety (Carrillo *et al.* 2000). Molla*et al. (*2010) also reported that the post-harvest losses of mango in Bangladesh are 51.88% (including agro–food sector) while it is only 5–25% in developed countries (Kader and Mitcham, 2008). Shelf life of fruits could be extended by pre cooling, chemical treatments, low temperature, different botanical extracts and so on. Different botanical extracts were found as to extend the shelf life of Mango (Shindem *et al*., 2009). The use of Aloe vera gel has drawn interest in the food industry. Aloe vera coating is found to prevent loss of moisture and firmness, control respiration rate and development and maturation, delay oxidative browning, and reduce microorganism proliferation in fruits such as sweet cherry, table grapes and nectarines (Arowora *et al.,* 2013). In experiment, we used two botanical extracts Aloe vera gel and chitosan on different sizes of Mango cv. Amropali. Mango was collected with different pre -harvest treated plants which were graded according to the size (Monira *et al.,* 2015). Our main objectives of the experiment were to observe the performance of shelf life and quality of different size mangoes influenced by different botanical extracts.

MATERIALS AND METHODS

Experimental materials

The experiment was carried out at BAU Germplasm Centre (GPC) under the Fruit Tree Improvement Program (FTIP) during May to July, 2013. The two factor experiment was laid out in Complete Randomized Design (CRD) with three replications. Aloe vera gel was obtained from Aloe vera plant collection of BAU Germplasm Centre (GPC) field. Fruits of uniform size, free from visual blemishes and diseases were employed in this work. Mangoes were randomly divided into 3 grades according to their size, small, medium and large fruits. The mangoes were then treated with Aloe vera gel and Chitosan dilutions, prepared with distilled water, (0.5%, 1.0%and 1.5%).

Effect of fruit size and Post–harvest treatments on shelf life of mango

Two factor experiments were laid out in a Complete Randomized Design (CRD) with three replications.

Factor A (Size of fruit)

1. L =Large size fruit
2. M= Medium size fruit
3. S =Small size fruit

Factor B (Coating Material)

1. Aloe vera gel solutions: 0.5% , 1% and 1.5%
2. Chitosan powder solutions: 0.5% , 1% and 1.5%

So, the treatment combinations were 3x3x3x3=54. Fruits were dipped in solution for 2-3 seconds and then placed on card board boxes with tagging. The main benefits of edible active coatings are to maintain the quality and extend shelf-life of fresh fruits and prevent microbial spoilage.

Storing at Atmospheric conditions of store room

The temperature and relative humidity of the storage room were recorded daily during the study period with a digital thermo hygrometer (THERMO, TFA, and Germany). The minimum and maximum temperatures during the study period of the storage room were 10.54 to 33.07^{o}C, respectively. The minimum and maximum relative humidity was 66.4 % and 84.5%, respectively.

Aloe vera gel coating

Aloe veragel was obtained from BAU Germplasm Centre (GPC) field. Fruits of uniform size, free from visual blemishes and diseases were employed in this work. The mangoes were then treated with Aloe veragel dilutions, prepared with distilled water @ (0.5%, 1.0% and 1. 5 %) by dipping for 2-3 seconds. After letting dry, mangoes were placed on card board boxes with tagging. The boxes were stored in room temperature.

Chitosan coating

Chitosan powder is a biological product obtained from grind shell of Arthopoda family. It was imported from Malaysia, as an experimental material, first time used in that experiment in order to identify its potential in maintaining quality and extending shelf-life of fresh fruits through preventing microbial spoilage.

Maturity stage

The mangoes used for the experiment were harvested at maturity stage therefore; the fruits were soon start developing color within few days.

Total soluble solids (% Brix)

Total soluble solids (TSS) content of mango pulp was estimated using Abbe's Refract meter. A drop of mango juice squeezed from the fruit pulp was placed on the prism of the refract meter, and TSS was recorded at % Brix from direct reading of the instrument.

Weight loss

Weight loss was determined considering the fresh weight at harvest using a balance with an accuracy of 0.01 g. Weight loss was calculated from the weight of each mango measured initially before storages and after 3, 6 and 9 days of storage. Firmness was measured visually.

Percent weight loss

The weight loss of mango fruits was determined by using the following equation.

$$\text{Weight loss of fruits} = \frac{\text{Initial weight(g)} - \text{Final weight(g)}}{\text{Initial weight}} \times 100$$

The weight losses were recorded periodically during the storage period.

Disease–pest incidence

Disease and pest incidences of collected fruits were calculated using the following equation

$$= \frac{\text{No.of infected fruits in eachreplication}}{\text{Total no of fruits in each replication}} \times 100$$

The disease–pest incidence was recorded periodically during the storage period.

Shelf life

Shelf life of mango fruits as influenced by different coating substances and temperature of the storage room that was calculated by counting the number of days required to ripen fully with retained optimum marketing and eating qualities.

Collection of data

To assess the effect of different types of solution and physiochemical changes of mango fruits during storage was collected at two days interval during storage period. The shelf life, color development, weight loss or gain (%), rotting (%) were studied during the entire storage period. All the characteristics were recorded until 9th days of storage. Weight loss was determined considering the fresh weight at harvest using a balance with an accuracy of 0.01 g. Weight loss was then calculated from the weight of each mango measured initially before storages and after 3, 6 and 9 days of storage. Firmness was measured visually. Disease–pest incidence was recorded periodically during the storage period.

Statistical analysis

The collected data on various parameters were statistically analyzed using MSTAT statistical package. The means for all the treatments were calculated and analysis of variances (ANOVA) for all parameters was performed by F–test. The significance of difference between the pairs of means was compared by least significant difference (LSD) test at the 1% and 5% levels of probability (Gomez and Gomez, 1984).

RESULT

Quality and shelf life of mango fruits as affected by size and post-harvest treatment

Effect of post-harvest treatments on shelf life, no. of diseased fruits (%), no. of infected fruits (%) and weight loss (%)

Shelf life of mango varied significantly as treated with biological extract at room temperature. Amropali cultivar showed maximum shelf life (5.89days) when it was treated with Aloe vera gel, with comparatively the lowest disease and insect infestations. The extension of shelf life of fruits was one of the major concerns. Results revealed that the largest shelf life (5.89 days) of mango fruits was recorded from the 1.5% Aloe vera gel treated fruits (T_4) with the lowest disease (33.33%) and insect infestations (33.33%). This was followed by 1.5% Chitosan treated (T_7) fruits (5.22 days). The shortest shelf life (3.00days) was observed from the control (T_1), 0.5% Aloe vera (T_2) and 0.5% Chitosan (T_5) treated fruits, with comparatively higher disease and pest incidences. Among other chemical treated fruits, treatment T_3 (1.0% Aloe vera) and T_6 (1.0%Chitosan) were statistically similar regarding this parameter (4.78 and 3.67 days, respectively), with relatively higher disease and pest infestations that was statistically significant at 1%level.

Post-harvest treatments showed effects on total weight loss. Amropali lost the lowest weight 9.61%in T_4 (1.5% Aloe vera) and the highest 13.27% in T_1 (control) at 3rd day of storage. At 9th day of storage the highest weight loss was 15.97% in T_1 (Control) and the lowest weight loss was10.69% in T_4 1.5 % Aloe vera gel treatment. Among the treatments 1.5% Aloe vera gel coating was found to be the best in terms of weight loss followed by 1.5% Chitosan, 1.0% Aloe vera and 1.0 % Chitosan during the storage under room condition.

Effect of size on shelf life, no. of disease fruit (%), no. of infected fruit (%) and weight loss (%)

According to the size of the treatment shelf life, disease and pest infestation show significant difference. Control fruits were distinguished into three size grades eg. Large, medium and small. Here, the large fruits showed the highest shelf life with comparatively lower disease and pest incidences. Shelf life of mango was intensively related with the size of the fruits. Large size fruit showed greater shelf life (4.33days) with the lowest disease (47.62%) and pest (42.87%) incidences on the other hand, the lowest shelf life was found in Small fruits with the highest disease and pest infestations. According to the size of the fruits, weight loss also varied significantly.

Table1. Main effect of post-harvest treatment on shelf life, no. of diseased fruits (%), no. of infected fruits (%) and weight loss (%).

Treatment	Shelf life (Days)	No. of Diseased fruits (%)	No. of Infected Fruits (%)	Weight loss (%) at DAS		
				3	6	9
T_1	3.00	92.59	81.48	13.27	15.13	15.97
T_2	3.00	59.26	55.56	12.28	13.57	14.17
T_3	4.78	40.74	40.74	10.19	11.46	12.39
T_4	5.89	33.33	33.33	9.61	10.09	10.69
T_5	3.00	77.78	66.67	12.81	14.19	14.93
T_6	3.67	55.55	44.44	11.89	12.51	12.96
T_7	5.22	40.74	37.04	9.84	10.68	11.53
LSD (0.05)	0.29	4.03	58.13	0.19	0.16	0.22
LSD(0.01)	0.39	5.38	77.72	0.26	0.21	0.29
Level of significance	**	**	**	**	**	**

T_1-=Control, T_2=0.5% Aloe vera, T_3=1.0% Aloe vera, T_4=1.5% Aloe vera, T_5=0.5% Chitosan, T_6 =1.0% Chitosan, T_7 =1.5% Chitosan
**=Significant at 1.0% level, DAS = days after storage

Table 2. Main effect of grade/size on shelf life, no. of disease fruit (%), no. of infected fruit (%) & weight loss (%)

Grade/size	Shelf life(Days)	No. of Diseased fruits (%)	No. of Infected fruits (%)	Weight loss (%) at different DAS		
				3	6	9
L	4.33	47.62	42.86	10.51	11.49	12.22
M	4.14	55.56	44.44	11.25	12.31	13.12
S	3.86	68.25	66.67	12.47	13.76	14.36
LSD(0.05)	0.190	2.634	38.037	0.129	0.104	0.142
LSD(0.01)	0.254	3.524	50.892	0.173	0.140	0.190
Level of significance	**	**	**	**	**	**

Here, L= Large, M= Medium, S= Small,DAS = days after storage; **=Significant at 1.0%level

At 3rd day of storage the highest weight loss was found in small fruits (12.47%) and the lowest weight loss in large size fruits 10.51%. On the other hand, at 9th day of storage the highest weight loss (14.36%) was in small size and (12.22%) in large size fruits. Therefore large fruit was found to be the best for storage in respect of weight loss prevention.

Combined effect of size and postharvest treatment on shelf life, no. of diseased fruits (%) and no. of infected fruits (%) and weight loss (%)

The combined effect of chemical treatment at different concentrations and sizes of the fruits had significant effect on shelf life and disease-pest incidence at room temperature. It appears from the table that, Larger fruits of Amropali with the concentration of 1.5% Aloe vera (LT_4) at room temperature, extended maximum shelf life (7.00days) along with the lowest disease and pest incidences. The combined effect of size and post-harvest treatments on weight loss was statistically significant. At 3rd day of storage the highest weight loss (14.80%) in ST_1 and the lowest (8.85%) in LT_4 were observed. On the other hand, at 9th day of storage the highest weight loss (17.22%) in $ST^1$and lowest weight loss (9.97%) in LT^4 were found. Therefore

1.5% Aloe vera gel treatment was found to be the most suitable treatments in respect of reducing weight loss. That was followed by (MT_4) Medium fruits with 1.5% Aloe vera gel treatment (6.33days). Which were statistically similar with LT_7 (5.67days) Large at 1.5% Chitosan in this respect. Among other combinations, control treated fruits, (ST_1), (LT_1), (LT_2), (LT_5), (MT_2), (MT_5), (ST_2), (MT_1) and (ST_5) had the shorter shelf life (3 days) which was also statistically significant at 1% level of probability.

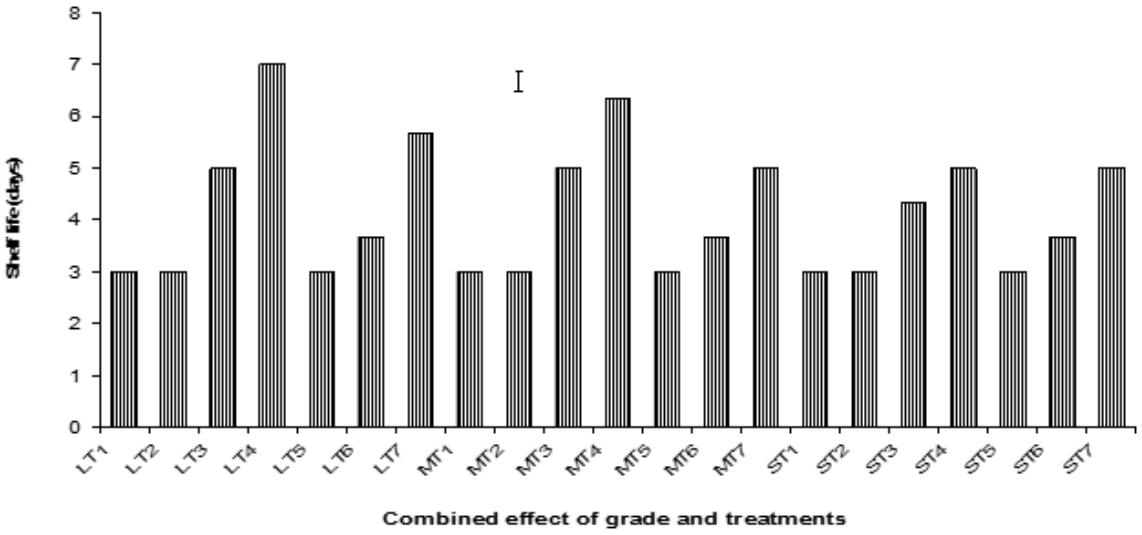

Figure 1. Combined effect of size and postharvest treatment on shelf life. Vertical bar represents 1% level of probability.

Here,
S= Small, M= Medium, L= Large,
T_1-=Control, T_2=0.5% Aloe vera, T_3=1.0% Aloe vera, T_4=1.5%, Aloevera,
T_5=0.5% Chitosan, T_6 =1.0% Chitosan, T_7 =1.5% Chitosan

DISCUSSION

Quality and shelf life of mango fruits from Control treated plants as affected by size and post-harvest treatment

Shelf life extension with different coating materials under room temperature in respect of size of fruits and treatment concentration had significant variation. Highest shelf life (7.00 days) found with Aloe vera gel treatment compared with Chitosan and no coating Control treatment. With the concentration of Aloe vera and Chitosan, shelf life and disease-pest incidence of fruits vary significantly. 1.5% Aloe vera gel treatment was best followed by 1.5% Chitosan. Disease and pest incidence also changes accordingly. Among the other treatments, 1.0% Aloe vera and 1.0% Chitosan was statistically similar. Size of fruits determines the shelf life and post-harvest quality. Large size fruit performed better than medium (7.00days) and small (6.33days) size fruits. As proper size-shape development is necessary for better post-harvest performance in respect of shelf life and disease-pest incidence. Weight loss is an important index of ripening. With the advancement of ripening and conversion of starch to sugar weight decreases. Singh *et al.* (2000) showed the behavior of mango (*Mangiferaindica*) cv. Langra and reported that the treatment of neem oil (10%) showed the minimum physiological weight loss when compared to other treatments and controls. Popy*et al*, (2013) found the similar result in Amropali treating with neem and garlic extract.

Ochiki*et al.,* (2014) stated that mango is a highly perishable fruit and high post-harvest losses occur in Africa. In order to address this problem, 4 concentrations of Aloe vera gel (AG) (0, 25, 50 and 75%) and chitosan (1%) were tested at two temperature levels (room temperature 15-22°C and 13°C) to determine their effect on the postharvest life of mango (var. Ngowe'). The experimental design was a 5 by 2 factorial

experiment embedded in a complete randomized design with three replications. It was found that at both temperatures 50 and 75% Aloe vera concentrations significantly increased the shelf life and decrease in titrable acidity. Fruit color and ascorbic acid were also maintained for longer periods in these treatments. Findings of this study demonstrate the potential of using Aloe vera gel at 50% as a coating for improved postharvest shelf life and maintaining quality of mango fruits hence reduced postharvest losses. Hossain et al, (2001) studied the physio-chemical composition of three varieties of mango. The best fruit weight was lowest (221.33 gram) in Amarpali but the variety of Bishawanath had the maximum fresh weight (256.0 gram) and keeping quality (8.75 days). The maximum keeping quality was in Amarpali (12.5 days) mango fruit. The TSS (23.50 percent), total sugar (26.85 percent) and pH of pulp (6. 0) were highest in Amarpali, but Bishawanath indicated highest Vitamin C (14.20 mg /100g) and acidity (titrable) (0.87 %). Amarpali fruit was better in respect of al l characters as compared to other varieties.

Molla*et al,* (2011) studied the postharvest changes in mango and stated that color and quality of mango was very better in treated fruits compared to non-treated fruits. Leaf extract has better performance in case of shelf life extension. Shinde*et al*, (2009) studied the influence of various plant extract treatments to increase the shelf life and to minimize the postharvest losses in mango. Among the fruits treated with different plant extracts and wrapping materials, 10 per cent neem oil has been proved to be most effective in slow increase of TSS and slow decrease of ascorbic acid and acidity during storage. Adetunji *et al*, (2008) reported that the *Aloe vera*extracts possess antimicrobial activity against bacterial pathogens. Dang *et al*, (2008) reported that, *Aloe vera*gel is widely used as edible coating of fruits and vegetables. Edible coatings have various favorable effects on fruits such as imparting a glossy appearance and better color, retarding weight loss, or prolonging storage/shelf life by preventing microbial spoilage. In view of the fact that there were not much recent reports on the utilization of *Aloe vera*in extending the shelf life of fruits therefore, this study was conducted to fulfill the gap by evaluating the effects of *Aloe vera*gel coatings on quality and storability of fruit. Further, the same experiment can be repeated to observe the performance of different varieties of mango.

REFERENCES

1. Arowora ST, 2013. Functional foods: an adventure in food formulation. Food Australia, 53: 428- 432.
2. BBS, 2014. All Crop Summary 2009–10. *Year* Book of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics. Statistics Division, Ministry of Planning, Government of the People Republic of Bangladesh. Agriculture Census/All_Crops_summary_09–10.
3. Boghrma V, RS Sharma and D Puravankara, 2000. Effect of antioxidant principles isolated from mango *(Mangiferaindica*L) seed kernels on oxidative stability of buffalo ghee (butter fat). Journal of Science & Food Agriculture, 80*:* 522–526.
4. Carrillo LA, F Ramirez–Bustamante, JB Valdez–Torres, R Rojas–Villegas and EM Yahia, 2000. Ripening and quality changes in mango fruit as affected by coating with an edible film. Journal of Food Quality 23: pp.479–486.
5. Dang, Z Singh and EE Shinny, 2008. Edible coatings influence fruit ripening, quality and aroma biosynthesis in mango fruit*.* Journal of Agriculture and Food Chemistry.56: pp. 1361-1370.
6. Gomez KA and AA Gomez, 1984. Statistical Procedure for Agricultural Research (2nd edition). Willey. International Science of Publication. pp. 28–192.
7. Hossain KH*,* 2001. Policy for Postharvest Loss Reduction of fruits and Vegetables and Socio–Economic Uplift of the Stakeholders.P.188. Research Project Funded by United SAID and EC, and Jointly implemented by FAO and FPM of the Ministry of Food and Disaster Management (MoFDM).
8. Herianus JD, LZ Singh and SC Tan, 2003. Aroma volatiles production during fruit ripening of 'Kensington Pride' mango*.* Postharvest Biotechnology*, 27*: 323 –336.
9. Kader A and B Mitcham, 2008. Optimum Procedures for Ripening Mangoes. In: Fruit Ripening and Ethylene Management: 47-48.University of California.Postharvest Technology Research and Information Center Publication Series number 9:766-897
10. Manzano JE, Y Perez and E Rojas, 1997. Coating waxes on Haden mango fruits (*Mangiferaindica*L.) cultivar for export*.* ActaHorculture455: 738-746.

11. Molla MM, MN Islam, MA Muqit, KA Ara and MAH Talukder, 2011. Increasing Shelf Life andMaintaining Quality of Mango by Postharvest Treatments and Packaging Technique. Journal ofOrnamental Horticultural Plants, 1: 73-84.
12. Molla MM, MN Islam, TAA Nasrin and MR Karim, 2010. Survey on postharvest practices and losses of mango in selected areas of Bangladesh. Postharvest Management of Horticultural Crops, Annual report, Horticultural Research Centre, Bangladesh Agricultural Research Institute, Gazipur–1701. P.64
13. Monira S, MA Rahim and MA Islam, 2015. Pre-harvest factors affecting yield, quality and shelf life of Mango cv. Amropali. Research in Agriculture, Livestock and Fisheries, 2: 279-286.
14. Ochiki S, G M Robert and W J Ngwela, 2014. Effect of Aloe vera gel coating on postharvest quality and shelf life of mango (Mangifera*indica* L.) fruits Var. 'Ngowe' Department of Crops, Horticulture and Soils Sciences, Egerton University
15. Popy B, 2013. Effect of different chemicals on yield, quality and shelf life of different varieties of mango. MS thesis of Bangladesh Agricultural University, Mymensingh
16. Shindem GS, RR Viradia, SA Patil and DK Kakade, 2009. Effect of post-harvest treatments of natural plant extract and wrapping material on storage behavior of mango (cv. KESAR). International Journal of Agricultural Science, 5: 420-423.
17. Singh DK, S Ram and S Ram, 2000. Effect of paclobutazol application on fruits. Journal of Horticultural Science, 70: 28–59