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Effects of different post-harvest treatments and varieties on disease incidence, severity and shelf life of Mango

Asma Anwari[1], Md. Harunor Rashid[1], Md. Mushfiqur Rahman[1], Abu Saleh Mohammad Yousuf Ali[1], Sanjida Akter[3], Md. Ariful Islam[1], Md. Kamrul Hassan[2]

[1]Bangladesh Agricultural Research Institute, Gazipur 1701, Bangladesh
[2]Bangladesh Agricultural University, Mymensingh 2202, Bangladesh
[3]Bangladesh Rice Research Institute, Bangladesh

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Corresponding Author

ASMY Ali
yousufr007@gmail.com

ABSTRACT

The present study was carried out at the Laboratory of the Department of Horticulture, Bangladesh Agricultural University, Mymensingh to find out the effects of variety and different postharvest treatments to extend shelf life and to reduce disease severity and incidence of mango. The two factor experiment was laid out in completely randomized design (CRD) with three replications. The factors taken for the experiments were (i) two varieties of mango, viz., V_1= Fazli and V_2= Aswina and (ii) seven postharvest treatments, viz., To = Control; T_1 = Wrapping with thin plastic film; T_2 = Paper wrapping and storage at 15^o C; T_3 = LDPE plastic bag with KMnO4; T_4 = LDPE plastic bag without KMnO4; T_5 = Hot water treatment (50^{o}C) for 5 minutes; T_6 = Low temperature storage (12^o C). The variety Fazli was more susceptible to postharvest diseases than Aswina. Higher disease severity (34.71%) was found in Fazli and it was lower (24.96%) in Aswina at the 12th day of storage. However, highly significant variations in respect of shelf life between two varieties and among different postharvest treatments were observed in the investigation. The longer shelf life (12.57 days) was recorded in Aswina than Fazli (10.14 days). Further, mango with low temperature storage (12 ^{o}C) appeared to be the best for extending shelf life. The longest shelf life (18.25 days) was observed in fruits of Aswina with low temperature (12^o C) treatment and the shortest shelf life (7.00 days) was observed in Fazli with control treatment.

INTRODUCTION

Mango (*Mangifera indica* L.), belongs to the family Anacardiaceae, is decidedly the most popular fruit among millions of people in the orient and is considered to be the best of all the indigenous fruits in Bangladesh. Mango is acknowledged as the king of fruits and one of the best fruits in the world market because of its great utility, excellent flavor, attractive fragrance, beautiful color, delicious taste and healthful value. Nutritionally, mango is highly important because it has medium calorific value and high nutritional values. The per capita fruit consumption in Bangladesh is far below the minimum requirement. The minimum dietary requirement of fruit/day/head is 85 g, whereas our availability is only 30-35 g, which is much lower than recommended daily requirement (Siddique and Scanlan, 1995). The nutritional content material of mangoes is motivated by cultivar, adulthood degree, storage conditions, and postharvest technology (Singh and Zaharah, 2015). On the other hand, scientist claim that a considerable portion of the world's total food supply and that 30 to 40 % at the crop produce harvested in the developing countries never reach to the consumer mainly because of pre and postharvest losses (Miller et al., 1986). As estimated by Lashley (1984), approximately 30 to 50% fruits go waste during postharvest handling, storage and ripening.

A huge quantity of nutritious fruits goes waste due to lack of proper postharvest handling and postharvest diseases. Anthacnose, caused by *Colletotrichum gloeosporiodes* Penz., and Sacc., is

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the major postharvest disease of mango (Dodd et al., 1997). *Alternaria alternata* and *Botryodiplodia* spp. the causal organisms of black spot disease and stem end rot, cause high losses and compromise storage life of the fruits (Prusky et al., 1997; Kobiler et al., 2001). The postharvest stem-end rots are caused by a number of fungi, including *Lasiodiplodia theobromae* (Pat.) Griffon and Maubl., *Dothiorella dominicana*, *D. mangiferae*, *Phomopsis mangiferae*, *Pestalotiopsis mangiferae*, *Nattrassia mangiferae* and *Cytosphaera mangiferae* (Johnson et al., 1993; Korsten et al., 1993). The magnitude of postharvest losses in fresh fruit was estimated to be 5 to 25% in developed countries and 20 to 50%in developing countries (Khader, 1985). According to Hassan (2010), the postharvest loss of mango in Bangladesh is 27.4%. There are number of fungi (*Colletotrium gloeosporoides. Botryodiplodia theobromae* etc.), those attack mango fruits at maturity, after collection from tree. These fungi cause infection during storage and transit, and losses sustained due to fungal infections during those periods are quite heavy. Singh (1960) reported from India that postharvest loss of fresh mango fruit due to microbial decay varies from 20-33%. The postharvest life of any fruit consists of ripening and senescence. The ripening and subsequent senescence are the sum total of a number of postharvest changes. Thus prolonging storage life of a fruit consists in slowing down the processes leading to ripening and if possible in stopping the changes that cause senescence after ripening. Therefore, a critical area of examination would be how to reduce these postharvest losses, diseases and to extend the shelf life of mango using different postharvest treatments.

MATERIALS AND METHODS

The experiments were carried out at the laboratories of the Department of Horticulture and Biochemistry, Bangladesh Agricultural University, Mymensingh. The experimental materials were mature hard fruits of two mango varieties, namely, Fazli and. Aswina. Mangoes used in the experiment were collected from the orchard of mango grower, Chapai Nawabgong on 14 August 2012. Maturity of mangoes was indicated when the shoulders were in line with the stem end and the color was olive green. Maturity was also judged by the grower's recommendation. Fazli is one of the most important and popular mango varieties in Bangladesh. It is liked both by sellers and consumers and occupies a prime market position because of its delicious taste, attractive shape, color and good keeping quality. Aswina is a late variety and available in the market when fruits of other varieties is not available. The two factor experiment was laid out in the completely randomized design with three replications of 6 fruits. A total of 252 fruits of more or less similar shape and size and free of visible disease symptoms were harvested. The skin adherences, dots and latex were cleaned by gently wiping the fruits with moist and clean towel. There were 7×2 treatments combinations. Each treatment combination comprised 18 fruits. The treated fruits were kept on brown papers that were previously placed on laboratory table at ambient condition. 252 fruits were randomly divided into 2 groups of 126. The fruits were critically examined one day later for the appearance of rot. The incidence of fruit rot was recorded after one day. The first count was made at the 3 days after storage. Diseases incidence means percentage of fruits infected with disease. This is measured by calculating the percentage of fruits infected in each replication of each treatment. The diseased fruits were identified symptomatically. The disease incidence was calculated as follow:

$$\text{Disease incidence (\%)} \frac{\text{Total number of fruits in each replication}}{\text{Number of infected fruits in each replication}} X\ 100$$

Disease severity represents the percent diseased portion of the infested mango fruit.

The percentage-of fruit skin diseased was recorded five times starting at the 3 days after storage. All the infected fruits were selected to determine percent fruit area infected. The percentage of fruit area diseased was measured based on eye estimation. Shelf life of mango fruits as influenced by variety & different postharvest storage treatments was calculated by counting the days required to ripe fully as to retaining, optimum marketing and eating qualities. The collected data on various parameters were statistically analyzed using MSTST C program. The means for all the treatments were calculated and analysis of variances (ANOVA) for all the 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 1984). The experiment consisted of seven postharvest treatments viz T_o: Control, T_1: Fruit wrapping with thin plastic film, T_2: Paper wrapping and store at 15°C, T_3: Fruit wrapping in LDPE bag containing KMnO4, T_4: Fruit wrapping in LDPE bag without KMnO4, T_5: Fruit treated with hot water at 50 °C for 5 minutes, T_6: Fruit store at 12 ° C. Data were recorded at an interval of 3 days during storage is influenced by different postharvest treatments & varieties.

RESULTS

Disease incidence

There was highly significant variation in the incidence of disease between two varieties on different dates of counting. No fruits were found diseased till the 3rd day of storage of fruits. The highest (14.55%, 50.78%, 73.00%) disease incidence levels were observed in Fazli than Aswina (11.11%, 41.26% and 66.66%) at 6th, 9th, 12th days storage (Table 1). Significant variation was found in respect of postharvest storage treatments of disease incidence during storage (Table 1). At the 12th day of storage, the highest (88.87%) infection was found in control fruits and the lowest (44.44%) disease incidence was observed in low temperature storage (12°C) treated fruits. The combined effects showed significant variation in terms of percent disease incidence of variety and postharvest treatments during storage. At 6thday of storage, the highest (33.33%) and lowest (0.00%) disease incidence were observed in Fazli with control treatment and Fazli with LDPE plastic bag with KMnO4 and Low temperature storage (12°C) treatment combination, respectively. At 9 and 12 days of storage, the highest (81.88% and 88.88%, respectively) and the lowest (21.22% and 43.44%, respectively) disease incidences were found in Fazli with control treatment and Aswina with low temperature storage (12°C) treatment combination (Table 2).

Disease severity

Significant variation was observed in respect of percentage of disease severity between two varieties at 3th, 6th, 9th and 12th days of storage. The higher disease severity level (34.71%) was found in Fazli and lower (24.96%) disease severity was observed in Aswina at 12th day of storage (Table 1). The disease severity ranged from 1.16% to 34.71% in Fazli and 0.45% to 24.96% in Aswina from 3rd to 12th days of storage, respectively. Different postharvest treatments used in present study showed significant variation in respect of percent disease severity. Disease severity of treated fruits was generally lower than untreated fruits. The higher disease severity (2.60%, 12.86%, 28.81% and 47.21%)) were observed in control treatment and lower disease severity (0.16%, 0.99%, 4.54% and 11.49%) in low temperature storage (12°C) followed by disease severity (0.27,% 2.27%, 8.05% and 20.88%) in LDPE plastic bag with KMnO4 treated fruits at 3th, 6th, 9th and 12th days of storage (Table 1). In combined effects of variety and postharvest treatments showed highly significant variation in terms of percent disease severity during storage. The higher disease severity (4.44%, 15.39%, 29.35% and 48.63%) was recorded in untreated Fazli and lower disease severity (0%, 0.57%, 2.87% and 7.07%) was observed in Aswina with low temperature storage (12 °C) at fruits at 3th, 6th, 9th and 12th days of storage (Table 2).

Shelf life

In the present investigation highly significant variation was observed on shelf life between the two varieties of mango. The shelf life of Aswina was longer (12.40 days) than that of Fazli (10.20 days) (Figure 1).

Table 1: Main effect of varieties and treatments on Disease incidence (%) and Disease Severity (%) of mango at different days after storage

Variety	Disease incidence(%) at different DAS				Disease Severity (%) at different DAS			
	6	9	12	15	3	6	9	12
Fazli	14.55	50.78	73.00	90.37	1.16	5.80	16.54	34.71
Aswina	11.11	41.26	66.66	76.68	0.45	3.47	9.53	24.96
$LSD_{0.05}$	0.074	0.337	0.703	0.412	0.080	0.089	0.101	0.166
$LSD_{0.01}$	0.101	0.457	0.954	0.559	0.108	0.121	0.138	0.226
Level of significance	**	**	**	**				
T_0	34.29	83.32	88.87	100.0	2.6	12.86	28.81	47.21
T_1	11.11	44.44	72.21	92.88	0.55	3.6	11.46	29.79
T_2	11.11	38.88	61.11	81.00	0.38	3.33	10.75	28.09
T_3	5.55	27.77	61.1	85.00	0.27	2.27	8.05	20.88
T_4	11.11	49.99	77.77	88.87	0.83	4.29	12.98	33.88
T_5	11.11	55.55	83.32	94.44	0.85	5.12	14.68	37.52
T_6	5.55	22.22	44.44	54.00	0.16	0.99	4.54	11.49
$LSD_{0.05}$	0.140	0.633	1.323	0.775	0.150	0.167	0.191	0.313
$LSD_{0.01}$	0.189	0.854	1.785	1.046	0.202	0.226	0.258	0.423
Level of significance	**	**	**	**				

** = Significant at 1% level of probability

T_0 = Control, T_1 = Wrapping with thin plastic film, T_2 = Paper wrapping and store at 15^oC, T_3 = Fruit wrapped in LDPE bag with $KMnO_4$, T_4 = Fruit wrapped in LDPE bagwithout$KMnO_4$, T_5 = Fruit treated with hot water at 50^o C, T_6 = Fruit store at 12^o C, DAS: Days after storage.]

Table 2: Combined effect of varieties and treatments on Disease incidence (%) and Disease Severity (%) of mango at different days after storage

Variety	Postharvest treatments	Disease incidence(%) at different DAS				Disease Severity (%) at different DAS			
Fazli		**6**	9	12	15	3	6	9	12
	T_0	33.33	81.88	88.88	100.0	4.44	15.39	29.35	48.63
	T_1	11.11	33.33	66.66	75.00	0.55	4.44	16.46	35.11
	T_2	11.11	33.33	55.55	77.00	0.55	4.33	15.32	34.50
	T_3	0.00	22.22	55.55	65.00	0.33	2.87	10.33	23.71
	T_4	11.11	44.44	77.77	88.88	1.11	5.47	18.44	40.44
	T_5	11.11	44.44	77.77	88.88	1.15	6.70	19.70	44.72
	T_6	0.00	22.22	44.44	50.00	0.00	1.42	6.22	15.91
Aswina	T_0	30.25	77.77	83.87	100.0	1.11	10.33	28.27	45.79
	T_1	11.11	55.55	77.77	77.77	0.55	2.77	6.47	24.47
	T_2	11.11	44.44	66.67	75.00	0.22	2.33	6.18	21.68
	T_3	11.11	33.33	66.66	75.00	0.00	1.67	5.78	18.05
	T_4	11.11	55.55	77.77	88.86	0.55	3.12	7.53	27.33
	T_5	11.11	66.66	88.87	100.0	0.77	3.54	9.66	30.33
	T_6	11.11	21.22	43.44	51.00	0.00	0.57	2.87	7.07
$LSD_{0.05}$		0.198	0.894	1.869	1.095	0.212	0.236	0.270	0.442
$LSD_{0.01}$		0.267	1.207	2.522	1.478	0.285	0.319	0.364	0.597
Level of significance		**	**	**	**	**	**	**	**

[** = Significant at 1% level of probability

T_0 = Control, T_1 = Wrapping with thin plastic film, T_2 = Paper wrapping and store at 15^o C, T_3 = Fruit wrapped in LDPE bag with $KMnO_4$, T_4 = Fruit wrapped in LDPE bag without $KMnO_4$, T_5 = Fruit treated with hot water at 50^o C, T_6 = Fruit store at 12^o C, DAS: Days after storage.]

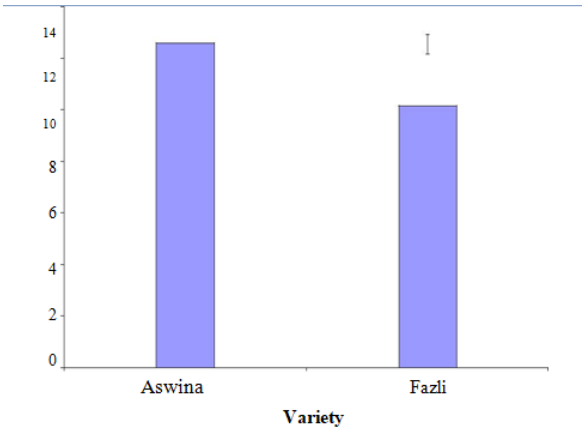
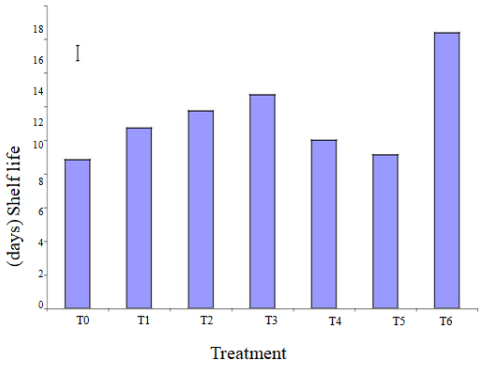


Figure 1: Effect of different varieties on shelf life of mango. The vertical bar represents LSD at 1% level of significance.

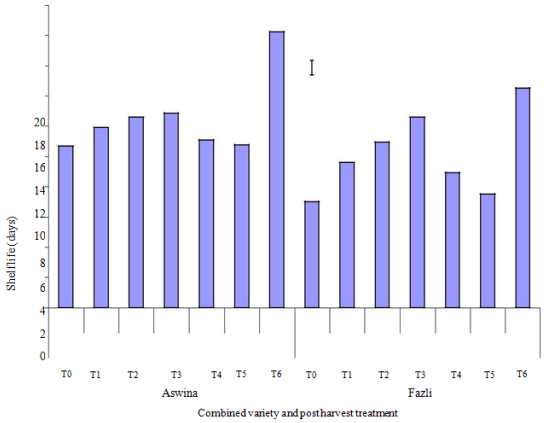


T_0 = Control, T_1 = Wrapping with thin plastic film, T_2 = Paper wrapping and store at 15^{o}C, T_3 = Fruit wrapped in LDPE bag with KMnO4, T_4 = Fruit wrapped in LDPE bag without KMnO4, T_5 = Fruit treated with hot water at 50^{o}C, T_6 = Fruit store at 12^{o}C.

Figure 2: Effect of different postharvest treatments on shelf life of mango. The vertical bar represents LSD at 1% level of significance.

Postharvest treatments exerted significant effects in extending shelf life of mango. The results of the study revealed that the shelf life of mango fruits ranged from 8.83 to 16.37 days. The longest shelf life (16.37 days) was found in mango stored at 12^{o}C and the shortest shelf life (8.83 days) was recorded in control (Figure 2). The shelf life of mango fruits could be extended by 1.90, 2.92, 3.93, 1.17, 0.39 and 7.54 days in wrapping with thin plastic film, paper wrapping & store at 15oC, LDPE bag with KMnO4, LDPE bag without KMnO4, hot water treatment (50^{o}C), and low temperature storage (12^{o}C) respectively over control treatment (8.83 days).

The combined effects of variety and postharvest treatments were significant in case of extending shelf life. The longest shelf life (18.25 days) was observed in fruits of variety Aswina with low temperature storage (12^{o}C) treatment followed in Fazli (14.50) days when held at low temperature storage (12^{o}C). The shortest shelf life (7.00 days) was observed in Fazli when held in control (Figure 3).



T_0 = Control, T_1 = Wrapping with thin plastic film, T_2 = Paper wrapping and store at 15^{o}C, T_3 = Fruit wrapped in LDPE bag with KMnO4, T_4 = Fruit wrapped in LDPE bag without KMnO4, T_5 = Fruit treated with hot water at 50^{o}C, T_6 = Fruit store at 12^{o}C.

Figure 3: Combined effect of different postharvest treatments and varieties on shelf life of mango. The vertical bar represents LSD at 1% level of significance.

DISCUSSIONS

This chapter comprises the discussion obtained from the present experiment. The data were recorded at 3 days interval after storage (DAS) on different characteristics of physical, chemical and microbial properties and also shelf life of mango. These results have been discussed and possible interpretations are given in this chapter.

The highest (88.87%) infection was found in control fruits and the lowest (44.44%) disease incidence was observed in low temperature storage (12°C) treated fruits. Feng et al. (1991) observed that controlled or modified atmosphere storage controlled postharvest diseases. Straten and Oosthuyse (1994) stated that polythene bag wrapping reduced disease incidence. The higher disease severity (48.63%) was recorded in untreated Fazli and lower disease severity (7.07%) was observed in Aswina with low temperature storage (12°C). Saaiman and Lonsdale (1994) stated that hot water + prochloraze was most effective to control anthracnose and soft brown rot of mango. The increase in percent disease severity observed in the present study is in support of the findings of Benitez (2006) and Nyanjage (1998). They stated that hot water treated fruits showed lower disease severity than untreated fruits. Mortuza (2002) stated that polythene bag wrapping caused maximum reduction incidence of anthracnose. Jagdish and Pathak (1992) found that postharvest disease severity can be reduced using wrapping materials. Yanashita et al. (1997) worked with mango fruit cv. `Keitt' and found lower loss of fruit packed in both heat shrinkable polythene film (D-955) arid a low density polythene film (LDPE) for 0 to 5 weeks at 20°C temperature' Bagging reduced postharvest diseases of mango and increased skin color at the ripe stage.

The longest shelf life (16.37 days) was recorded in low temperature storage (12°C) treatments and the shortest shelf life (8.83days) was recorded in control. The shelf life of mango fruits could be extended by 1.90, 2.92, 3.93, 1.17, 0.39 and 7.54 days in wrapping with thin plastic film, paper wrapping & store at normal refrigerator (15°C), LDPE plastic bag with KMnO4, LDPE plastic bag without KMnO4, hot water treatment (50°C), and low temperature storage (12°C) treatments, respectively over control treatment (8.83 days). Low temperature treatment increased the shelf life of fruits in the present study and this result was in agreement with the findings of Seymour *et al.* (1990) who found that physiological mature fruits could be stored up to 21 days at temperature of 12°C. The increase in shelf life due to low temperature was probably due to the reduction various physiological activities. Gofur et al. (1997) stated that the shelf life of mango fruit without applying any treatment was short because fruits exhibited a rapid rate of ripening. But the mango fruits treated with hot water at 52±2°C for 5 minutes containing 1% $CaC1_2$ delayed ripening by 5 to 8 days and their spoilage was reduced.

The combined effects showed significant variation in terms of percent disease incidence of variety and postharvest treatments during storage. The highest (33.33%) and lowest (0.00%) disease incidence were observed in Fazli with control treatment and Fazli with LDPE plastic bag with KMnO4 and Low temperature storage (12^0C) treatment combination, respectively. The combined effects of variety and postharvest treatments showed highly significant variation in terms of percent disease severity during storage. The highest disease severity was recorded in untreated Fazli and the lower disease severity was observed in Aswina with low temperature storage at 12^oC. A study on mango was carried out by Mortuza et al. (2002) where fruits were wrapped with polyethylene bag, newspaper or tissue paper and packed in wooden box, bamboo basket and hard paper carton. He observed that polyethylene bag wrapping caused maximum reduction in incidence of anthracnose (*Colletotrichum gloeosporioides*) which was followed by newspaper, arid tissue paper, polyethylene wrapping delayed ripening considerably. Fruits stored in polythene bags resulted in increased respiration and earlier fruits rotten (Martinez et al., 1997). The intensity of red colour decreased with the increasing duration of bagging (Hofman et al.; 1997). Noomhom and Tiasuwan (1995) reported that ripening of `Red' mangoes was delayed by using controlled atmosphere for two weeks compared to untreated mangoes. Mondal et al. (1995) noticed that shelf life of mango was 21 days by keeping mango fruits in poly bag. Agdish and Pathak (1992) conducted an experiment on mango and observed that postharvest disease severity can be reduced by using wrapping materials. They reported that rot significantly reduced 5 to 8 days after inoculation with *Botryodiplodia theobromadae, Aspergillusniger, Rhizopusarrhizus* and *Colletotrichurn* a result of wrapping the fruits in 0.002 cm thin plastic film. Molla et al. (2011) examined that the treated fruits performed less disease incidence compared to

without treated fruits. Non-treated fruits were attacked by the sunken black spots on the surface of the fruits as well as anthracnose (*Colletotrichum gloeosporioides*).

The combined effects of variety and postharvest treatments were significant in extending shelf life. The longest shelf life (18.25 days) was observed in fruits of variety Aswina with low temperature storage at 12^{o}C treatment followed in Fazli (14.50 days) when held at low temperature storage. The modified atmosphere storage of mango using polythene bag enhanced shelf life. Fruits could be stored up to 17 days at a temperature of 12°C. Increase in shelf life was probably due to the reduction of exchange of various gases (O2, CO2) from inner and outer atmosphere as well as slowing down the process leading to ripening by different postharvest treatments. The findings of the present study agree with the reposts of Cheema et al. (1939), Mukharjee (1956) and Singh (1960). They tried that various wrappers such as polythene, cellophone, tissue paper and parafilm tried to prolong the storage life of mangoes. The qualities of mango fruits were investigated by Srinivasa et al. (2002) on modified atmosphere packaging. On the other hand fruits stored in plastic film covered boxes showed an extension of shelf life up to 19 days and without any microbial growth and off flavor. Sanjay et al. (1998) worked on mango cv. `Amrapali' to evaluated the effect of perforated polythene wrapping and pre harvest application of calcium compounds on storage life of mango and found that the shelf life of fruit was enhanced by polythene wrapping, CaC12 (1.5%) and CaNO3 (1.5%). They noted that polythene wrapping was the most effective treatments for improving the storage life of mango. The shelf life of mango could be extended up to 5 days by hot water treatment and packed in corrugated fiber board carton compared to others. Hofman et al. (1999) observed that the effect of bagging of mango (*Mangifera indica* L.) fruit was evaluated in order to improve fruit quality of late maturing cultivars. Fruit calcium concentrations were reduced by bagging for 56 days or less in the 1994/1995 trial, but not by longer bagging times (82-131 days). In case of packaging technique, fruits packed in different packaging materials (like corrugated fiber board carton, plastic crate, perforate and non-perforated polyethylene bag) had the maximum shelf life, lower physiological loss in weight and less disease incidence than without package. Among the different packaging materials, fruits packed in corrugated fiber board carton had the maximum shelf life (13.02 days), lower physiological loss in weight (4.11%) and less disease incidence (1.12%) without excessive deterioration compared to others. Zainuri et al. (2001) this study investigated treatment of mango (*Mangifera indica* L.) fruit with 2 host deference promoting compounds for suppression of anthracnose disease (*Colletotrichum gloeosporioides*). Cultivar ‘Kensington Pride’ fruit were treated at concentrations of up to 1000 mg/L with either potassium phosphonate or salicylic. Kumar et al. (2011) Mango anthracnose, a major postharvest disease, induces huge losses in mangoes and threatens mango export and consumption. The effectiveness of hot water treatment as a postharvest disease control measure on Keitt cultivar of mango was assessed over a 21day storage period. Batches of fruits were subjected to various degrees of hot water treatments at temperatures 48^{o}C, 50^{o}C, 52^{o}C and control (tap water, 33^{o}C) for various durations (each treatment had different time duration of 5 and 10 minutes). Fruits were stored at room temperature (33^{o}C). Hot water treatments at 52^{o}C/10min, 52^{o}C/5min, 50^{o}C/10min and 50^{o}C/5min proved to be effective in controlling anthracnose disease on Keitt fruits after 7 days in storage, whereas the control showed the highest incidence. Mango fruits suffer from the appearance of red or green spots around the lenticels.

CONCLUSION

The results of the experiment revealed that different postharvest treatments under report had wide variations which were statistically significant. The disease incidence was higher (73.00%) in Fazli than Aswina (66.66%) at 12th day of storage. The higher disease severity (34.71%) was found in Fazli and lower (24.96%) in Aswina at 12th day of storage. Again, Fazli and Aswina exhibited significant variation in respect of shelf life. Aswina showed longer shelf life than Fazli. The shelf life of Aswina (12.57 days) was longer than Fazli (10.14 days). The disease severity and incidence of diseases were found to

be higher in control than other treatments. The postharvest treatments also had significant effects on shelf life. The longest shelf life (16.37 days) was noticed when fruits were kept in low temperature storage (12^{o}C) and the shortest shelf lives (8.83 days) are recorded in control.

The combined effects of variety with different postharvest treatments showed significant results of the parameters studied. Disease incidence and severity were found higher in Fazli under control treatment and lower in Aswina under low temperature storage (12^{o}C). Statistically significant difference in respect of shelf life was observed in the investigation. Fazli under control showed the shortest shelf life (7.00 days) and Aswina when kept in low temperature storage at 12^{o}C showed longest shelf life (14.50 days).From the above results it was found that the postharvest treatments caused significant effects on disease incidence and severity and shelf life of mango and others characteristics of postharvest characteristics. Low temperature storage at 12^{o}C gave the best result especially in relation to the reduction of disease incidence and severity compared to other treatments, and which ultimately resulted in prolonged shelf life of mango. Considering the above stated findings, further studies are suggested to examine the effects of other promising variety and postharvest treatments on shelf life and quality of mango grown in Bangladesh.

REFERENCES

Ashwani K and Dhawan SS (1995). Effects of postharvest treatments on the enhancement on ripening of mango fruit cv. Dashehari. Haryana Journal of Horticultural Science, 24(2): 105-115.

BBS (Bangladesh Bureau of Statistics) (2010). Yearbook of Agricultural statistics of Bangladesh. Bangladesh bureau of Statistics Division, Ministry of Planning, Government of People's Republic of Bangladesh.

BBS (Bangladesh Bureau of Statistics) 2011. Yearbook of Agricultural statistics of Bangladesh. Bangladesh Bureau of Statistics Division, Ministry of Planning, Government of People's Republic of Bangladesh.

BBS (Bangladesh Bureau of Statistics) (2006). Bangladesh Bureau of Statistics. Statistics Division, Ministry of planning, Government of people's Republics of Bangladesh, Dhaka. pp. 137.

Gomez KA and Gomez AA (1984). Statistical Procedures for Agricultural Research. Jhon Wiley and Sons. Inc. New York. 67-215.

Gomasta J, Islam MR, Sultana S and Alam A (2017). Post-harvest application of botanical extracts from the sunderbans for controlling disease and extending shelf life of mango (*Mangifera indica*). International Journal of Multidisciplinary Research and Development, 4(3): 220–223.

Hafiz M, Hossain M, and Karim M (2018). Physico-microbial investigation of mango (cv. Amrapali) under non-chemical preservation. Progressive Agriculture, 29(3): 221–232. https://doi.org/10.3329/pa.v29i3.40007.

Hassan MK (2000). Studies of postharvest Behavior of Bananas. MS Thesis, Department of Tropical Plant Science, School of Tropical Biology. James Cook University, Australia. 164.

Hassan MK (2006). Constitutive Alkenyl Resorcinol's & Resistance to Postharvest Diseases in Mango. Phd. Thesis, School of Agronomy & Horticulture, University of Queensland, Australia. 286.

Hassan MK, Dann EK, Coates LM, Hofman PJ and Irving DE (2010). Retention of the fruit peduncle at harvest retains sap and contributes to resistance against postharvest anthracnose disease in 'Kensington Pride', but not in 'R2E2', mango. Journal of Horticultural Science and Biotechnology (UK), 86(3): 261-266.

Hassan MK, Mondal MF and Hoque MS (1998). Studies on the storage behavior of mango. Bangladesh Journal of Agricultural Science, 25 (2): 311-318.

Khader SESA (1981). Effect of postharvest application of GA3 on postharvest behavior of mango fruits. Scientia Horticultura, 47 (3-4): 317-321.

Kumar A and Dhawan A (1995). Effect of postharvest treatments on the enhancement of ripening of mango (*Mangifera indica*) fruits cv. Dashehari. Haryana. Journal of Horticultural Science, 24(2): 109-115.

Laborem EG, Reys FJ and Rangel L (1992). Maturation in mangoes before low temperature storage. Fruits Paris, 47(3): 419-423.

Shrivarma RL and Thimmaraju KR (1989). Effect of pre-packaging and postharvest treatments on the storage behaviour of mango fruits cv. `Alphonso'. Acta Horticultura, 231: 664-670.

Srinivasa PC, Baskaran R, Ramesh MN, Prashanth KVH and Tharanthan RN (2002). Storage studies of mango packed using biodegradable chitosan film. European Food Research Technology, 215(6):504-508.