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# Effect of wrapping materials on post harvest diseases of mango

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**Abstract:** Incidence of post harvest diseases of mango as affected by different wrapping materials were studied in the laboratory of Plant Pathology Department and BAU Germplasm Centre, Department of Horticulture, Bangladesh Agricultural University, Mymensingh during May-August, 2004. Eight wrapping materials such as: i) perforated white polythene, ii) non-perforated white polythene, iii) Perforated black polythene, iv) non-perforated black polythene, v) white paper, vi) brown paper, vii) tissue paper and viii) newspaper were included in this study. Among the wrapping materials, perforated white polythene showed the best performance to reduce post harvest disease incidence in Amrapali and Fazli mango.
**Key word:** Wrapping materials, post harvest diseases

## Introduction

Mango (*Mangifera indica* L.) is one of the most popular and commercially important fruits in Bangladesh. Post harvest fungal diseases, is one of the main causes for extensive losses of mango. In Bangladesh, mango fruit suffers from many diseases. Mango is reported to be attacked by as many as 18 different diseases in Bangladesh (Meah and Khan, 1987). There are a number of fungi which attack mango at maturity after removal from the tree. These fungi cause infection during storage and transit. Among the mango diseases, anthracnose and stem-end rot appears to be the more prevalent (Sangchote, 1991). Anthracnose caused by *Colletotrichum gloeosporioides* is the most important field and post harvest diseases of mango and is associated with high rainfall and humidity (1990; Dodd *et al.,* 1992). Infection of anthracnose may occur after fruit set, and become severe during fruit ripening and the post harvest period (Muirhead and Grattidge, 1986). The highest disease incidence was observed in mango variety Aswina (37.16%) and Gootee (37.8%) in Nawabgonj district (Anonymous, 1990). Stem end rot caused by *Botryodiplodia theobromae* infects through the stem end and wounds on the fruit and become serious under a hot (28-32$^0$C) and humid (80-90% RH) condition (Meah and Khan, 1987). Singh and Chundawat (1991) from India reported that this disease can cause 25-30% loss in mango. Stem end rot and anthracnose are the major causes of post harvest losses of mango (Madan and Ullasa, 1991). To minimize losses due to diseases, several methods of disease control of mango have been developed but little informations are available on effect of wrapping materials to reduce incidence of post harvest diseases of mango. There is a great need to carryout research aiming to develop technologies for management of post harvest diseases of mango.

## Materials and Methods

The research was carried out in the laboratory of Plant Pathology Department and BAU Germplasm Centre, Fruit Tree Improvement Program, Bangladesh Agricultural University, Mymensingh during June-August, 2004. Two mango varieties (Amrapali and Fazli) were used for the experiment which was collected from BAU Germplasm Centre, Mymensingh and Fruit Research Centre, Rajshahi. The experiment was conducted in two factor Complete Randomized Design (CRD) with 3 replications. Each replication was consisting of 5 fruits. Two mango varieties namely Amrapali and Fazli were used. The harvested fruits were wrapped with perforated and non perforated white polythene, perforated and non perforated black polythene, white paper, brown paper, newspaper and tissue paper separately. Fruits after wrapping were stored at room temperature for observation and data collection. Following the method of Koolpluksee *et al.* (1993). Data on following parameters were collected:

**Disease incidence and severity**

Diseases were recorded on ripe fruits of mango during storage which was identified by visual symptoms. Number of lesions, average lesion size (cm) and percent fruit area diseased (%FAD) were recorded. Photographs were taken to use for elaboration. On the basis of visual symptoms of anthracnose and stem-end rot, diseased and healthy fruits were individually counted. Fifteen fruits were selected randomly. Total diseased portion of an individual fruit was considered as 100%. Thus, diseased area of an individual fruit was recorded on eye estimation from all the randomly selected fifteen fruits and the average value was calculated.

**Percent diseased fruit:** Percent diseased fruits were calculated on the basis of number of healthy and diseased fruits by the following formula:

$$\text{Diseased fruits (\%)} = \frac{Number\ of\ diseased\ fruits}{Total\ number\ of\ fruits} \times 100$$

**Percent fruit area diseased (FAD %)**

Fifteen infected fruits were selected randomly from each treatment. Percent fruit area diseased of the individual fruit was estimated by visual diagnosis method. The average of FAD% was then calculated.

## Results and Discussion

**Number of lesion**

The varieties exhibited highly significant effect in regards of number of lesion at different days of storage. Number of lesions were always highest in Amrapali at 5, 7, 9 and 11$^{th}$ days respectively than Fazli is presented in Table 1. The post harvest treatments showed highly significant variation in respect of number of lesions at all days of storage. Among the

treatments, perforated white polythene treatment gave the best result to reduce lesions number of mango. No lesions were found up to 7th days in this treatment after that it appeared at 9th days and it was increased up to11th days. The controlled fruits were failed to check lesions from the very beginning. In this treatment number of lesions were the highest at 5, 7, 9 and 11th days respectively, followed by fruits which were wrapped with white paper (Table 1)

**Lesion size**

Data regarding average lesion size (cm) have been presented in Table 1, which were found to be highly significantly affected by varieties. The table indicates that the higher lesion size was recorded in Fazli and lower lesion size was in Amrapali. The wrapping materials which were used as post harvest treatments in this experiment had marked influence on the lesion size of fruit and found to be statistically highly significant (Table 1). The longest lesion size was recorded in controlled fruits at 5, 7, 9 and 11th days respectively whereas the shortest lesion size was found in fruits which were kept in perforated white polythene.

**Table 1 Main effect of variety and post harvest treatments on no. of lesion and lesion size of mango**

| Variety | No. of lesion at | | | | Lesion size (cm) | | | |
|---|---|---|---|---|---|---|---|---|
| | 5 days | 7 days | 9 days | 11 days | 5 days | 7 days | 9 days | 11 days |
| $V_1$ (Amrapali) | 1.63 | 2.61 | 3.88 | 5.42 | 0.49 | 0.88 | 1.32 | 2.27 |
| $V_2$ (Fazli) | 0.56 | 1.01 | 1.59 | 2.47 | 1.07 | 1.67 | 2.90 | 4.12 |
| Level of significance | ** | ** | ** | ** | ** | ** | ** | ** |
| LSD 0.05 | 0.121 | 0.133 | 0.162 | 0.207 | 0.087 | 0.140 | 0.130 | 0.162 |
| Post harvest treatments | | | | | | | | |
| $T_1$ (Perforated white polythene) | 0.00e | 0.00h | 0.10i | 0.40i | 0.00f | 0.00g | 0.31g | 0.88g |
| $T_2$ (Non-Perforated white polythene ) | 0.00e | 0.36g | 0.73h | 1.26h | 0.00f | 0.39f | 0.78f | 1.25f |
| $T_3$(Perforated black polythene | 0.00e | 0.20gh | 1.19g | 1.99g | 0.00f | 0.17fg | 0.92f | 1.60e |
| $T_4$(Non-Perforated black polythene) | 0.86d | 1.53e | 2.36e | 3.50e | 0.41e | 0.69e | 1.41e | 2.75d |
| $T_5$(white paper) | 2.07b | 3.33b | 4.76b | 6.63b | 1.31bc | 2.67b | 3.11b | 4.36b |
| $T_6$ (Brown paper) | 1.99b | 2.79c | 4.16c | 5.86c | 1.48b | 1.82c | 3.10b | 3.77c |
| $T_7$ (Tissue paper) | 1.53c | 2.43d | 3.59d | 5.09d | 1.22c | 1.49d | 2.68c | 4.43b |
| $T_8$ (News paper ) | 0.66d | 1.13f | 1.96f | 3.00f | 0.77d | 1.19d | 1.74d | 2.82d |
| $T_9$ (control) | 2.79a | 4.53a | 5.79a | 7.80a | 1.87a | 3.12a | 5.01a | 6.98a |
| Level of significance | ** | ** | ** | ** | ** | ** | ** | ** |
| LSD 0.05 | 0.257 | 0.282 | 0.344 | 0.439 | 0.185 | 0.299 | 0.277 | 0.344 |
| CV (%) | 19.85 | 13.30 | 10.70 | 9.49 | 19.99 | 19.87 | 11.21 | 9.16 |

*Means followed by same letter in a column are not significantly different at 5% level by DMRT

**% Diseased fruit**

Among the varieties of mango investigated, highly significant variation was found in term of percent diseased fruit during storage. Percent diseased fruits were found higher in Fazli and lower in Amrapali at 5, 7, 9 and 11th days of storage (Table 2). The percent diseased fruits of mango wrapped with various wrapping materials obtained highly significant at different days after storage is shown in Table 2. At 5th days after wrapping, the maximum diseased fruits were recorded in control followed by brown paper whereas minimum diseased fruits were found in treatment non perforated black polythene. Among these treatments perforated white polythene, non-perforated white polythene and perforated black polythene did not show any diseased fruits (Table 2). Perforated white polythene bagged fruits inhibited fruit infection till 7th day of storage. During this period, the highest diseased fruits were found in control and the second highest diseased fruits were found in white paper bagged fruits. Perforated black polythene and non-perforated white polythene bagged fruits started to be infected at this day. The lowest diseased fruits were obtained in the treatment perforated black polythene, preceded by non-perforated white polythene bagged fruits. At 9th days, all treated fruits showed more or less infection. Considering this period maximum and minimum diseased fruits were recorded from the treatment control and perforated white polythene bagged fruits. After 11days of storage, diseased fruits were increased in all treatment due to infection. Untreated fruits had the highest diseased fruits. The second highest diseased fruits were observed in white paper and tissue paper wrapped fruits ranked 3rd which were showed statistically similar results. The lowest diseased fruits were recorded in perforated white polythene preceded by non-perforated white polythene which are presented in the Table 2.

**% Fruit Area Diseased (% FAD)**

In terms of fruit area diseased (% FAD), varietal effect was highly significant at 5, 7, 9 and 11th days of storage. Among the two varieties Fazli showed higher %FAD and Amrapali showed lower % FAD at 5, 7, 9 and 11th days respectively (Table 2). Statistically highly significant variation was found in different treatments on % FAD during throughout the storage period. At 5th day, the highest % FAD was recorded in control and lowest was found in non-perforated black polythene. % FAD was nil in perforated white polythene, non-perforated white polythene and perforated black polythene treatment. At 7th days, no % FAD was observed in perforated white

polythene treatment. Maximum and minimum % FAD was recorded in control and non-perforated white polythene treatment. At 9th days, control fruits showed the highest % FAD followed by in white paper whereas the lowest % FAD was in perforated white polythene preceded by non-perforated white polythene treatment. At 11th days maximum % FAD was found in control followed by white paper. On the other hand, minimum % FAD was recorded in perforated white polythene preceded by non-perforated white polythene and perforated black polythene (Table 2).

**Table 2 Main effects of Variety and wrapping materials on % diseased fruit and %fruit area diseased of mango**

| Variety | % Diseased Fruit at | | | | % Fruit area Diseased (%FAD) at | | | |
|---|---|---|---|---|---|---|---|---|
| | 5 days | 7 days | 9 days | 11 days | 5 days | 7 days | 9 days | 11 days |
| $V_1$ (Amrapali) | 12.59 | 22.96 | 34.07 | 48.88 | 1.42 | 2.50 | 4.05 | 10.85 |
| $V_2$ (Fazli) | 23.70 | 31.85 | 43.70 | 57.03 | 3.88 | 7.67 | 11.22 | 15.12 |
| Level of significance | ** | ** | ** | ** | ** | ** | ** | ** |
| LSD 0.05 | 1.867 | 0.695 | 2.066 | 1.715 | 0.628 | 0.840 | 0.744 | 1.289 |
| Post harvest treatments | | | | | | | | |
| $T_1$ (Perforated white polythene) | 0.00f | 0.00h | 3.33g | 10.00g | 0.00d | 0.00g | 0.43f | 1.47e |
| $T_2$ (Non-Perforated white polythene ) | 0.00f | 9.99f | 16.67f | 23.33f | 0.00d | 0.68e | 1.07e | 1.87e |
| $T_3$(Perforated black polythene | 0.00f | 3.33g | 16.66f | 36.67e | 0.00d | 0.33f | 1.23e | 2.60e |
| $T_4$(Non-Perforated black polythene) | 9.99e | 16.67e | 26.67e | 50.00d | 0.77c | 1.10e | 2.73d | 7.27d |
| $T_5$(white paper) | 30.00bc | 50.00b | 66.67ab | 76.67b | 4.39b | 9.79b | 13.20b | 22.23b |
| $T_6$ (Brown paper) | 33.33b | 46.67b | 60.00b | 66.67c | 4.90b | 8.43c | 11.86bc | 17.57c |
| $T_7$ (Tissue paper) | 26.67c | 36.66c | 50.00c | 73.33b | 4.23b | 7.83c | 11.96c | 18.43c |
| $T_8$ (News paper ) | 19.99d | 26.67d | 36.67d | 50.00d | 1.20c | 1.80d | 3.57d | 6.10d |
| $T_9$ (control) | 43.33a | 56.67a | 73.33a | 90.00a | 8.40a | 15.86a | 22.67a | 39.36a |
| Level of significance | ** | ** | ** | ** | ** | ** | ** | ** |
| LSD 0.05 | 3.963 | 2.512 | 4.386 | 3.641 | 1.333 | 1.783 | 1.579 | 2.736 |
| CV (%) | 16.44 | 4.44 | 10.12 | 6.62 | 16.06 | 14.93 | 9.99 | 12.58 |

*Means followed by same letter in a column are not significantly different at 5% level by DMRT

**Disease incidence of stem end rot (%)**

In case of post harvest treatments highly significant variation was observed in consideration of stem end rot of mango during storage. Maximum stem end rot disease was found in control fruits in where no treatments were applied. On the other hand, the fruits which were wrapped with perforated white polythene gave the best result to reduce stem end rot (Fig. 1). The interaction effect of variety and wrapping materials showed highly significant in respect of stem end rot of mango. The highest stem end rot of mango was occurred in Fazli with control and tissue paper. The lowest stem end rot was found in Amrapali with non-perforated white polythene. No stem end rot disease was noticed in Amrapali with perforated white polythene are shown in Table 3.

**Disease incidence of Anthracnose (%)**

Among the different post harvest treatment in respect of anthracnose (%) have shown highly significant (Table 3). The result indicated that fruits which were wrapped with white paper and which were untreated showed the highest anthracnose (%) infection. On the other hand lowest anthracnose (%) was recorded in perforated white polythene preceded by non-perforated white polythene, perforated black polythene and news paper treatment which were statistically identical (Fig. 1). The interaction between variety and wrapping materials was highly significant in terms of anthracnose (%) of mango during storage (Table 3). Anthracnose (%) was maximum in Amrapali with control followed by white paper and brown paper. On the other hand, variety Amrapali with perforated white polythene and variety Fazli with non-perforated white polythene bagged fruits showed minimum anthracnose (%) infection. From the data it was observed that variety Fazli with perforated white polythene inhibited anthracnose (%) infection completely.

**Incidence of other post harvest disease (%)**

There were highly significant differences among the treatments in respect of other post harvest disease. The fruits which were untreated found to be most affected by other post harvest disease followed by brown paper, and white paper. Minimum other disease affected fruits were found in perforated white polythene and non-perforated white polythene treatment (Fig. 1). The interaction effect of variety and wrapping materials was highly significant in respect of other post harvest diseases of mango. Other post harvest diseases were not found in Amrapali with perforated white polythene and non-perforated white polythene treatment. Whereas it was highest in Fazli with control and Tissue paper and lowest was found in perforated black polythene in Amrapali, perforated white polythene, non-perforated white polythene, perforated black polythene treatment (Table 3).

**Table 3 Interaction effect of variety and wrapping materials on disease incidence (%) of mango**

| Variety × Post harvest Treatment | | Disease Incidence (%) | | |
|---|---|---|---|---|
| | | Stem end rot (%) | Anthracnose (%) | Others (%) |
| $V_1$ (Amrapali) | $T_1$ (Perforated white polythene) | 0.00g | 6.66f | 0.00e |
| | $T_2$ (Non-Perforated white polythene ) | 6.66f | 13.33e | 0.00e |
| | $T_3$(Perforated black polythene | 13.33e | 13.33e | 6.66d |
| | $T_4$(Non-Perforated black polythene) | 13.33e | 26.66c | 13.33c |
| | $T_5$(white paper) | 20.00d | 33.33b | 20.00b |
| | $T_6$ (Brown paper) | 6.66f | 33.33b | 20.00b |
| | $T_7$ (Tissue paper) | 20.00d | 26.66c | 13.33c |
| | $T_8$ (News paper ) | 13.33e | 20.00d | 13.33c |
| | $T_9$ (control) | 26.66bc | 40.00a | 20.00b |
| $V_2$ (Fazli) | $T_1$ (perforated.white polythen) | 6.66f | 0.00g | 6.66d |
| | $T_2$ (Non-perforated white polythen) | 13.33e | 6.66f | 6.66d |
| | $T_3$ (perforated black polythen) | 20.00d | 13.33e | 6.66d |
| | $T_4$ (Non-perforated black polythen) | 20.00d | 13.33e | 13.33c |
| | $T_5$ (white paper) | 40.00a | 26.66c | 13.33c |
| | $T_6$ (Brown paper) | 33.33b | 20.00d | 20.00b |
| | $T_7$(Tissue paper) | 46.66a | 13.33e | 26.66a |
| | $T_8$ (News paper) | 26.66c | 13.33e | 13.33c |
| | $T_9$ (Control) | 46.66a | 20.00d | 26.66a |
| Level of significance | | ** | ** | ** |
| LSD at 0.05 | | 3.803 | 3.780 | 0.736 |
| CV(%) | | 8.97 | 9.32 | 4.24 |

*****Means followed by same letter in a column are not significantly different at 5% level by DMR

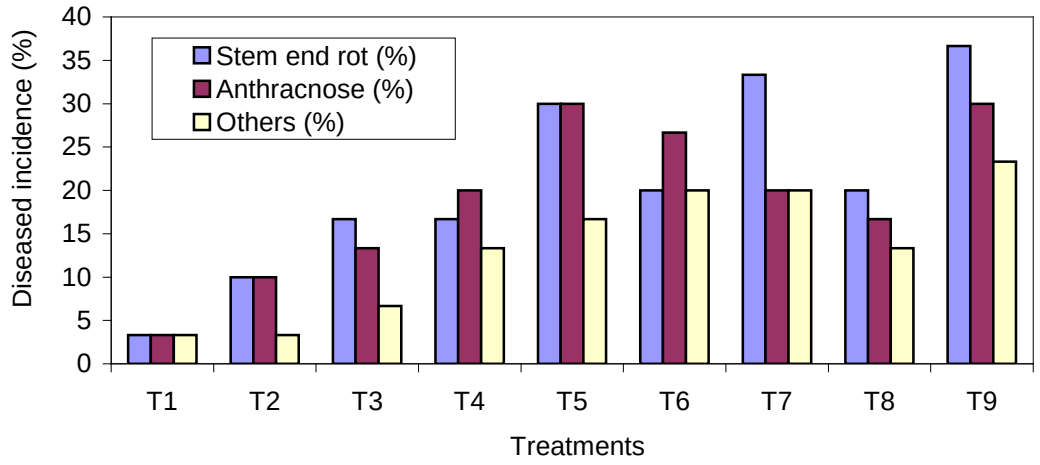


Fig. 1. Main effect of treatments on incidence of stem end rot, Anthracnose and other diseases of mango

T1 (perforated white polythen), T2 (Non- perforated white polythen), T3 ( perforated black polythen) T4 (Non- perforated black polythen), T5 (white paper), T6 (Brown paper), T7(Tissue paper) T8 (News paper), T9 (Control)

During the present studies, number of lesion and lesion size (cm) on fruit surface was recorded at 5, 7, 9 and 11 days of storage. Variety Amrapali showed the highest number of lesions at all days of storage whereas Fazli showed the lowest number of lesions. Incase of lesion size, maximum length of lesion was recorded in Fazli and minimum was in Amrapali. From the result it was found that % diseased fruit and % fruit area diseased (%FAD) was higher in Fazli than Amrapali. Incase of disease incidence the findings indicated that variety Fazli was more susceptible to stem end rot than Amrapali and Amrapali was more susceptible to anthracnose than Fazli. Other disease incidence showed higher in Fazli and lower in Amrapali. This difference might be due to genetical constituents. According to Quroshi and Meah (1991) the incidence of stem end rot was found higher in Aswina (16.25%) and Fazli (15.69%). They studied 9 most common varieties of mango; the highest disease incidence was in “Kohitor” (16.3%) and the lowest in “Lakkhanbhog” (6.4%). The result of the present study is differed with the result of Hossain (2003) who

observed higher incidence of anthracnose was in Fazli, Gootee and Gopalbhog were 11.6, 10.65%and 10.45%, respectively. Wrapping materials significantly influenced the disease development in mango fruits. Pathak (1995) observed that post harvest disease severity can be reduced by using wrapping materials. From the present study it was found that perforated white polythene bag wrapping caused maximum reduction in number of lesion, lesion size (cm), % diseased fruit and % fruit area diseased in both varieties of mango. The incidence of stem end rot and anthracnose was controlled successfully with perforated white polythene among other treatments over control. Mortuza *et al*. (2002) agreed with this finding who found polythene bag wrapping caused maximum reduction in incidence of anthracnose which was followed by newspaper and tissue paper. Perforated white polythene could enhance the resistance in mango fruits to post harvest diseases because of aeration that decreased the condensation inside of the package.

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