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An overview of post-harvest diseases of Mango in Chapai-Nawabganj district, Bangladesh

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Abstract

The purpose of this study was to evaluate the post-harvest diseases that now affect mangoes throughout their whole cultivation period in the upazilas of Shibganj, Bholahat, and Nawabganj in the district of Chapainawabganj. Between May and July of 2021, 120 mango producers were chosen at random and interviewed using structured questionnaires. Data were gathered regarding the farmers' educational background, land cultivation, contact with the extension office, chemical usage frequency and kind, awareness of post-harvest diseases, and attitudes toward these diseases and their treatment. Out of the 120 mango growers, 2.5 percent were illiterate followed by primary education (47.5%), secondary education (42.5%) and higher education (7.5%). Around 95 percent of the respondents had very limited contact with the extension workers. Education, farm size and extension contact of the respondents had positive and significant relationship ($r = 0.302^{**}$, 0.372^{**} and 0.422^{**} , respectively) with their knowledge on post-harvest diseases. Khirshapat, Bombay, Langra, Guti, Lakhnaw, Ashina, Fazli and Ammrupali are popularly cultivated mango varieties among which Bombay, Langra and Fazli were found highly susceptible to different post-harvest diseases. Anthracnose, Stem end rot, Aspergillus rot, Soft rot, Alternaria rot, Rhizopus rot, Fusarium rot, Blue mould are commonly found post-harvest diseases of mango. In different stages of mango production, three, five, and even more applications of twelve insecticides and fungicides under various brand names were most frequently applied. The most significant finding was that just 10% of respondents knew a great deal about post-harvest illnesses in mangoes and how to handle them, compared to 42.5% of respondents who knew very little. Farmers are highly dependent on chemicals for pest management. Most of the farmers and merchants showed positive attitude toward management of post-harvest diseases of mango.

Keywords: Mango, post-harvest diseases, management, knowledge, attitude

Introduction

The mango (*Mangifera indica* L.), known as the "king of fruits" due to its exceptional flavor, high nutritional content, and general eating qualities, is one of the most significant and well-liked fruits in Bangladesh. (Lebaka *et al.*, 2021) [12]. It is eaten in several forms, such as a vibrant fruit, dried, preserved, or processed into pickles, chutneys, purees, and juices. (Ali, *et al.*, 2019 and Hussain *et al.*, 2021) [3, 10]. Ripe mangoes are used to make ice cream, confections, and bakery goods in addition to being consumed as a fresh fruit, typically for dessert. Numerous minerals and phytochemicals can be found in mangos. Fruit pulp is a rich source of carotenoids, vitamin C, provitamin A, and other polyphenols. (Dessalegn *et al.*, 2014) [6]. The primary mango types grown in Bangladesh are BARI Aam 2, BARI Aam 3, and BARI Aam 4, as well as Fazli, Gopalbhog, Khirshapat, and Langra. (Sultana *et al.*, 2018 and Akther *et al.*, 2020) [17, 1]. These table types are meant to be consumed as cut, mature fruit. Dal or curry are typically enhanced in flavor and scent by the use of unripe mangoes. (FAO, 2011 and Alam, 2011) [7, 2]. In Bangladesh, the leading mango growing districts are Chapainawabganj, Rajshahi, Rangpur, Dinajpur and Kushtia. These are in high demand on the market and have significant commercial value. The districts of Rajshahi and Chapainawabganj are home to over 500 varieties of sweet, edible mangos. An estimated 85% of the population in the aforementioned districts depend on mango farming and related businesses, either directly or indirectly. (Rahman, 2018) [13]. In Bangladesh, Chapainawabganj is referred to as "The capital of the mango." Fazli, Langda, Gopalbhog, Himsagar, Khirshapat, Ashhwina, Khisanbhog, Kuapahadi, Lata, Foria, Bombai, Kohitoor, Laksmanbhog, Mohanbhog, Misribhog, and other well-known kinds are among those grown in the Chapainawabganj district. (Kobra *et al.*, 2012 and Hasan *et al.*, 2014) [11, 9]. Chapainawabganj District spans 1702.56 square kilometers and is situated between latitudes

24°25' and 24°58' north and longitudes 88°01' and 88°30' east. On 44,430 hectares of land, Chapainawabganj alone produces around 152,285 MT of mangoes. In the Chapainawabganj district, the primary mango-producing regions are Shibganj, Bholahat, and Gomastapur Upazilla. The Chapainawabganj district's economy is dominated by the seasonal cash crop known as mango. Mango sales drive this district's economy during the summer. Every year, a significant portion of the produced produce is harmed as a result of an inadequate postharvest management system. Numerous post-harvest illnesses, careless harvesting, rough handling, inadequate packaging, and poor transportation circumstances could all be to blame for these losses. Mango production and the marketing chain are significantly impacted by several pests and illnesses (Rony *et al.*, 2022) [14]. Most of the post-harvest losses of mangos occur by different types of pathogens which have infected before or after harvesting of fruits. Most of the mango growers of Chapainawabganj district are not well aware about the post-harvest diseases of mango. The present study is designed to overview the post-harvest diseases of mango, susceptible mango varieties, different management practices undertaken by the respondents in the study area. The study also finds out sociodemographic characters of the mango growers and the relationship between their knowledge on post-harvest diseases with their sociodemographic characters. Therefore, the objective of the present research were

- To identify different sociodemographic characteristics of the mango growers.
- To identify different post-harvest diseases of mango in Chapainawabganj district.
- To identify Knowledge level of the respondent on post-harvest diseases.
- To find out the correlation between the selected characteristics of the respondents with their knowledge on post-harvest diseases.

Research Methodology

The study was carried out in the three main upazillas in Chapainawabganj district - Sibganj, Bholahat, and Chapainawabganj Sadar upazila. The coordinates of Chapai Nawabganj are latitude 24'22 to latitude 24'57 and longitude 87'23 to 88'23. The previous Rajshahi Zillah included Chapainawabganj as one of its subdivisions. The phrase "Capital of Mango" refers to Chapainawabganj. In this district, the production of mangoes dominates the economy. The primary data were collected in a field survey by direct interview with farmers who was related mango production in the study area. In the first stage, random sampling technique was used in selecting the sample of the study. A pre structured questionnaire was prepared for collecting the data from the respondents from May, 2021 to July, 2021. For measuring the knowledge level of the respondent, rating scale was used. Response was taken from the respondent related to different post-harvest diseases. They were asked

20 different questions related to post-harvest diseases. On the basis of their answer their score was calculated and their knowledge level was categorized in three categories *viz.* low level of knowledge, medium level of knowledge and high level of knowledge. In order to get answers from the responders, each practice was presented as a question. "One" was awarded for the right answer and "zero" for the incorrect one. Compiling the results of all knowledge items allowed for the computation of each respondent's overall score. Each respondent could receive a maximum score of 120 or a minimum score of zero. Based on the total scores obtained, the knowledge index was worked out as follows:

$$\text{Knowledge index} = \frac{\text{No of correct responses}}{\text{Total no. of knowledge items}} \times 100$$

Respondents were then, categorized into three groups of knowledge level based on mean and SD. The knowledge level was categorized by following technique of Gupta *et al.*, 2017 [8].

Disease affected mangoes were collected from the merchant level especially from Arotadar and wholesale market. Then the diseases were identified in the lab. From each of the upazila 40 disease affected mangoes were collected. Therefore, from three upazila a total of 120 post-harvest disease affected mango were collected from the wholesale market. Then their disease type was identified in the lab. The susceptibleness of different mango varieties to post-harvest diseases was ranked ordered on the basis of the response of the mango growers. They were asked to rank the mango varieties on the basis of susceptibleness to post harvest diseases. Then their cultivated varieties were ranked. Statistical package for social science (SPSS) and Microsoft Excel program were used for analyzing the data.

Result and Discussion

Sociodemographic characteristics of the respondents

Data was collected from the respondents on some selected characteristics *viz.* sex, religion, age, education, farm size, income source and extension contact. The results on the selected characteristics with the farmers are presented in Table 1. In the study area all the mango growers were male and they directly involved in mango production. The sole mango production business is carried out by the male member of the family. Among the respondents, 82.5 percent were married and 17.5percent were unmarried. The major religious status of the farmers was Islam which is 97.5 percent and only 2.5 percent of them were Hindu. None another religious person was found. On the basis of age farmers were categories into three categories *viz.* young, middle and old aged. Majority of the respondents were found middle aged (67.5%) followed by young aged (20%) and old aged (12.5%).

Table 1: Distribution of the respondents according to their different sociodemographic characteristics.

Variable of the respondents	Measuring unit	Categories	Frequency (%)
Sex	Scale score	Male	100
		Female	0
Marital Status	Scale score	Married	82.5
		Unmarried	17.5
Religion	Scale score	Islam	97.5
		Hindu	2.5
Age	Actual year	Young (up to35)	20
		Middle (36-50)	67.5
		Old (above50)	12.5
Education	Year of schooling	Illiterate (0)	2.5
		Primary Level (Class1-5)	47.5
		Secondary Level (Class6-10)	42.5
		Tertiary Level (Above Secondary Level)	7.5
Farm size	Bigha	Small	60
		Medium	35
		Large	5
Income source	Scale score	Only mango cultivation	7.5
		Mango + Others	92.5
Extension contacts	Scale score	Yes	5
		No	55
		Partially	40

After examining the age groups of farmers, it was discovered that neither young nor old farmers were interested in managing post-harvest diseases. This was likely due to the fact that the former were unwilling to take a chance or implement management measures after mangos were harvested, and the latter were ignorant of these issues. It's the laborious procedures, they contend. In contrast, middle-aged farmers are better at managing post-harvest diseases in mango crops because they have a thorough understanding of the post-harvest losses brought on by these diseases. Primary education made up the majority of responses (47.5%), followed by secondary education (42.5%) and higher education (7.5%). Only 2.5 percent of those surveyed lacked literacy. That the majority of mango producers had a college degree is encouraging. Therefore, there is a great opportunity to share with farmers advanced agricultural knowledge about mango production. By offering appropriate training, it is possible to reduce the knowledge gap on post-harvest diseases. The majority of farmers (60%) had tiny farms with 0.13–1.33 hectares of

land, followed by medium-sized farms (35%). Only 5% of the was utilized for cultivation by 60% of mango growers, with 30% using 1.47-2.67 ha and 5% using more than 2.67 ha. Because of land fragmentation, there are more small farmers in the study area than large farmers. Just 5% of growers reported having interaction with extensions, compared to 55% who reported having no contact and 40% who reported having some contact. It is regrettable that so few farmers were able to effectively communicate with agriculture extension agents. The role of extension agents is essential to the growth of agriculture. Extension personnel can provide farmers with new knowledge and strategies for managing mangoes after harvest.

Different cultivated varieties

Most of the farmer prefer mix cultivation of mango where more than two varieties are cultivated in a single orchard. Most popular variety found in the study area was Khirshapat (97.5%) popularly known as Himsagor.

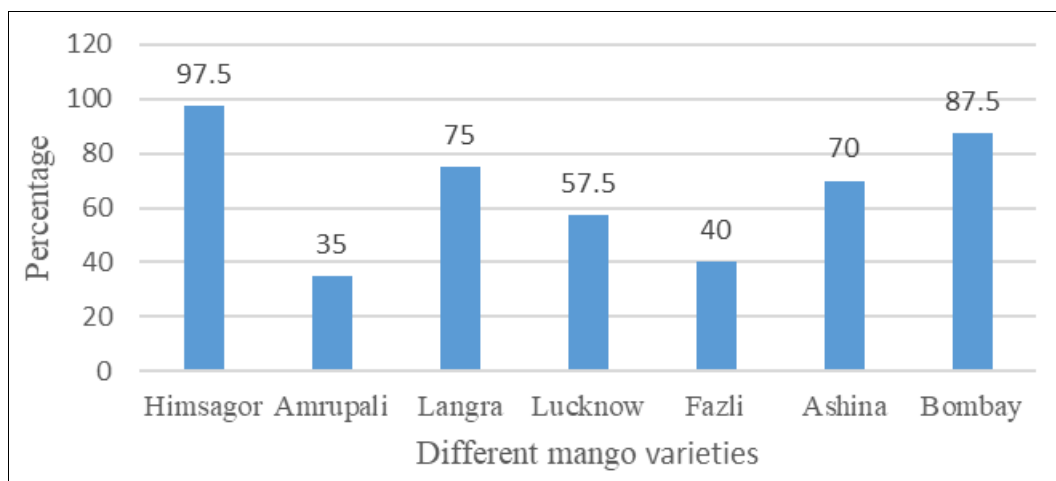


Fig 1: Different mango variety cultivated by the respondents

The next popular variety was found Bombay (87.5%) followed by Langra (75%), Ashina (70%), Fazli (40%) and

Amrupali (35%). Figure 1. Represent different varieties commercially cultivated by the

respondent of the study area. Those variety have high demand in the market as they are preferred by the respondents.

Different disease of mango.

In figure 2, we can see that anthracnose (32.5%) was the

mostly affected disease among the cultivated varieties. In the immature stage the pathogen are remains in latent condition, it doesn't show any symptom at early stage of mango fruits but when the mangos are harvest and keep for storage then it shows symptom widely.

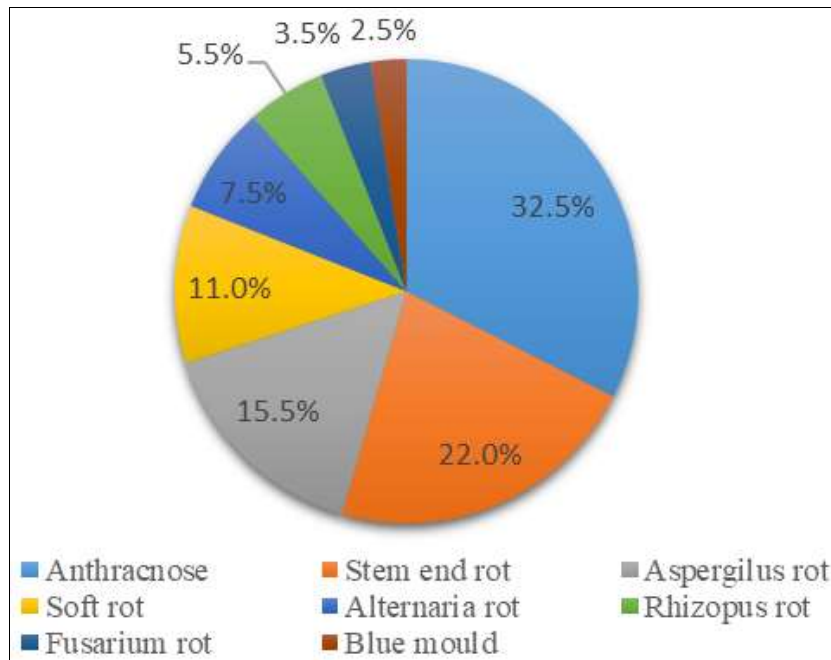


Fig 2: Different post-harvest disease of mango in the study area

Another cause is the disease symptom are affected all the parts of mango such as leaf, flower, tender shoots and foliage are easily affected. Second largest disease of mango was found stem end rot about 22 percent. Following harvest, as the fruit ripens, a dark rot appears from the stem end. A dark brown to black rot starts as a dark brown ring at one end of the stem and spreads to the other. The water-conducting tissues get dark streaks due to the decay. These fungus grow into the fruit stem before it is harvested and are found naturally on the branches of the mango tree. Bark and twig litter can also infect fruit that is left on the ground to be packaged at that time. The next major post-harvest disease of mango was found aspergillus rot (15.5%) followed by soft rot (11%), alternaria rot (7.5%), rhizopus rot (5.5%),

fusarium rot (3.5%) and blue mould (2.5%).

Susceptible varieties of mangoes

Some mango varieties were found more susceptible to different post-harvest disease than others. Response was taken from the mango grower about the susceptiblness of their cultivated mango varieties.

They were asked to rank their cultivated mango varieties on the basis of susceptiblness. According to their opinion Bomby was the most susceptible variety of mango. A total of 95 percent farmer identified the Bomby as most susceptible variety. The self-life of this variety was found very low.

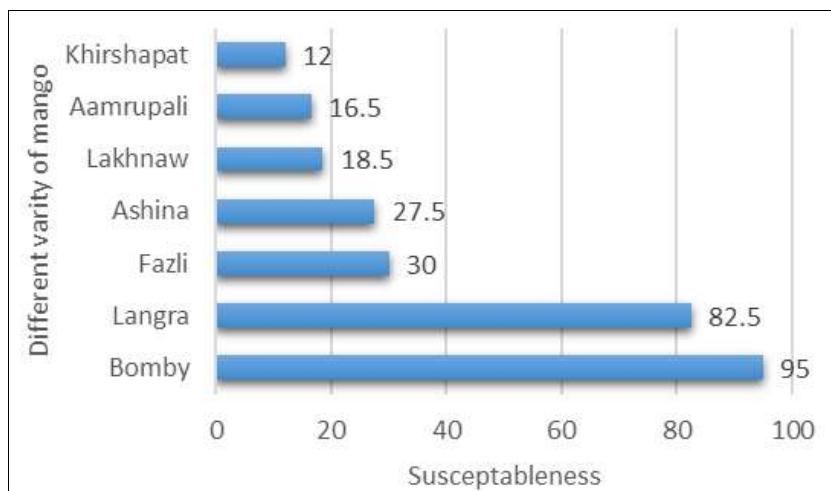


Fig 3: Rank of different cultivated mango varieties on the basis of susceptiblness

If some mangoes start rotting then it spread quickly in post-harvest situation. The second susceptible variety was identified Langra by the respondents. 82.5 percent mango growers identified it as most susceptible variety. Other susceptible varieties are Fazli (30%), Ashina (27.5%), Lakhnaw (18.5) and Amrupali (16.5%) identified by the respondents. Only 12 percent of the respondents identify Khirshapat, popularly known as Himsagar as a susceptible variety. So according to the susceptibleness the most susceptible variety was Bombay and least susceptible variety was Khirshapat.

Knowledge level of the respondents on post-harvest diseases: Farmers of the study area were asked a total of twenty questions to measure their knowledge level on post-harvest diseases. They were asked question related to different pre-harvest factors, chemical factors, climatic factors, nutritional factors, management practices, intercultural operations, mango bagging techniques, post-

harvest practices, handling of fruits, packaging, storage, transportation of fruits and post-harvest management of fruits. When their response was satisfactory then they were given marks one and if not satisfactory then they were given marks zero. Following that, a total score was determined for each farmer, and the sum of their scores allowed for the classification of their knowledge level into three groups: low, medium, and high.

Data of figure 4 represent the categorization of the respondents according to their knowledge level on post-harvest diseases of mango. According to the study, the majority of respondents (47.5%) knew a medium amount of post-harvest illnesses of mangos, followed by low knowledge (42.5%) and high knowledge (10.0%). As most of the respondents' knowledge level was low or medium, the chance of post-harvest losses was high. Related research also revealed that most of the post-harvest loss of mango occurs due to the lack of knowledge on post-harvest diseases.

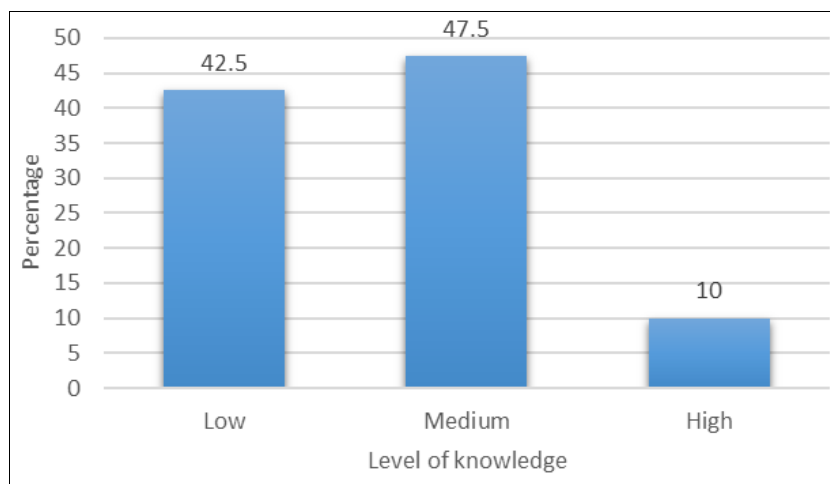


Fig 4: Distribution of the respondents according to their knowledge on post-harvest diseases

Relationship between the selected characteristics of the respondents with their knowledge on post-harvest diseases of mango: The correlation coefficient was calculated to investigate the associations between the respondents' chosen attributes and their understanding of post-harvest illnesses affecting mangoes. In the mango industry, post-harvest illnesses are the main source of financial harm. Most of the farmers of the study area had low to medium level of knowledge on post-harvest diseases of mango. Data of Table 2 represent the co-efficient of correlation of education, farm size and extension contact was found positive and significant at 1 percent level of probability ($r=0.302^{**}$, 0.372^{**} and 0.422^{**}).

Table 2: Relationship between the selected characteristics of the respondents with their knowledge on post-harvest diseases of mango

	Co-efficient of correlation (r)
Age	-0.058 ^{NS}
Education	0.302 ^{**}
Income	0.177 ^{NS}
Farm size	0.372 ^{**}
Extension contacts	0.422 ^{**}

Significant at 0.01 level of probability NS= Non significant

It indicates that education, farm size and extension contact

of the respondents had positive and significant relationship with their knowledge on post-harvest diseases. So much emphasis can be given on extension contact for training on different post-harvest technology of mango. On the other hand, age and income of the respondents had nonsignificant relationship with their knowledge on post-harvest diseases of mango.

Measures taken for controlling post-harvest diseases of mango by the respondents

There are mainly two factors which influence post-harvest diseases of mango viz. pre harvest factors and other is post-harvest factors. Some pre-harvest factors are application of different nutrients and chemicals, disease infestation, different management practices, irrigation etc. Some post-harvest factors which influence on post-harvest diseases are harvesting process, storage, packaging, transportation etc. (Santhosh *et al.*, 2021) ^[15]. Most of the farmers of study area use different types of pesticides and fungicides for controlling diseases. Twelve insecticides and twenty-three fungicides under different trade names were most usually applied at 3, 5, and even more than ten times in the stages of before flower bud initiation, mango blossoming, marble size mango, and ultimately until ripening. Trade name of some pesticide and fungicides are Rimill, Rajpid, Mancozeb, Agrotin, Ozeb, Sufi, Rajzol, Rilayance, Dithane, Bavistin,

Secure, Biron, Topsin-M used by the farmers. Chemical pesticides are available in the market and very easy to use. That's why the respondents prefer chemicals for controlling diseases of mango (Uddin *et al.*, 2019) [18]. The respondents also know about mango bagging technique. About 97.5 percent farmers knows about mango bagging technique. Only 2.5 percent respondents showed negligible attitude towards the technique. So, it can be said that majority of the farmers have heard about mango bagging technique or

found it helpful. Mango bagging technique is an eco-friendly method for protecting mangoes from diseases and pests. It boosts the production of export quality mangoes and ensures protection of mangoes from scratches and scars, making the fruits spotless and free from post-harvest disease and loss due to it. This strategy is gaining favor among mango growers in the neighborhood as a viable alternative to chemical pesticides.

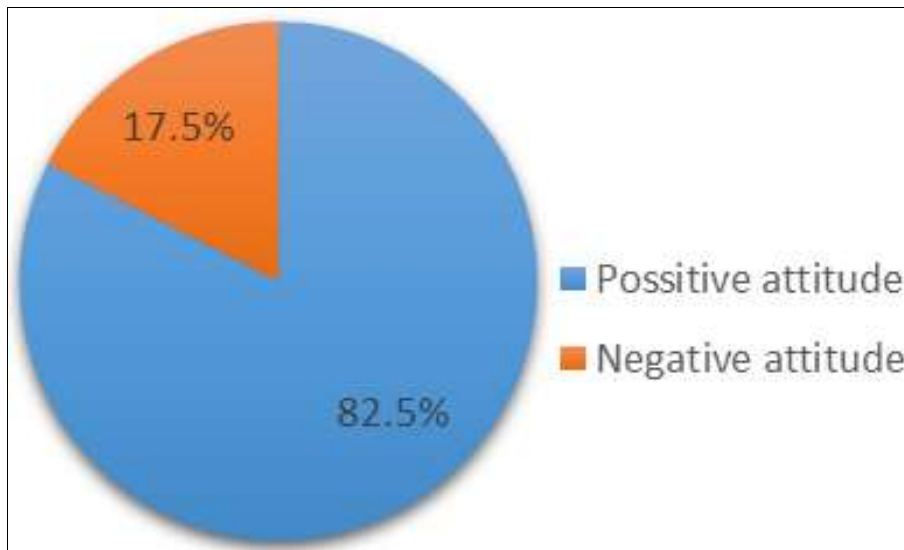


Fig 6: Attitude of respondents toward fruit bagging technique

During the data collection time most of the farmers are strongly agreed to accept bagging technique, because this technique helps to protect the mangos from different types of diseases. That's why, in this graph we can see 82.5 percent of the correspondent farmers found this technique is helpful and only 17.5 percent respondents showed negative attitude towards mango bagging technique.

Data presented in Table 3 shows how merchants manage mangoes during storage time. The majority of them (90%) keep the spot well ventilated and dry (85%) to prevent different fungal growth and rotting diseases.

Table 3: Different techniques practiced by the respondents for better post-harvest storage.

Different measures taken by the respondents	Percentage
Keep the floor dry	85
Maintained temperature	62
Well ventilation	90
Use of chemical solution	60
Others	40

A total of 62 percent follow maintained temperature, 60 percent take help of different chemical solution and only 40 follows other methods like cleaning outer surface of mango, use proper packaging technique etc. to keep mangoes unaffected from different post-harvest diseases.

Mangoes cannot be stored for a long time but it needs to be stored for business purpose. Merchant stores their mangoes for 1-7 days during the storage time the mangoes are infected by different type of pathogen due to wet floor and

poor ventilation system of the storage site. The merchants expressed that if the site is kept well ventilated through using fan and the keep the floor dry by using straw and gunny bag then the pathogen will not affect the mangoes and the mangoes will be in good condition.

Attitude of the respondents towards post-harvest diseases of mango and their management

Result presented in table 4, showing attitude of the respondent on different post-harvest disease of mango and their management. Majority of respondent (55%) strongly agree on necessity of knowing post-harvest disease management method followed by agree (37.5%), disagree (7.5%). Chi-square value (13.85*) showed significance difference among theme, indicating strongly agree to necessity of knowing post-harvest disease management method. On the statement "Damage/ Loss occurs due to post-harvest disease", majority of respondent (62.5%) agree loss due to post-harvest disease followed by strongly agree (30%), strongly disagree (1%), disagree (2). Chi-square value (37.4*) showed significance difference among theme, indicating agree on loss due to post-harvest disease. Chemical application is important for quickly managed post-harvest diseases of mango. On this statement majority of respondent (47.5%) strongly agree, chemicals quickly managed post-harvest diseases of mango followed by agree (37.5%), strongly disagree (2.5%), disagree (10%). Chi-square value (35.5*) showed significance difference among theme, indicating strongly agree on chemicals use quickly managed post-harvest diseases of mango.

Table 4: Attitude of the respondent on different post-harvest disease of mango and their management

	Statements	SA	A	N	DA	SDA	Chi-Square value
1	It is necessary to know post-harvest disease management technique/ method	55	37.5	0	7.5	0	13.85*
2	Damage/ Loss occurs due to post-harvest disease	30	62.5	0	2	1	37.40*
3	Chemical application is important for quickly managed post-harvest diseases of mango	47.5	37.5	0	10	2.5	35.50*
4	Chemical use has negative impact on health	25	60	0	2.5	0	30.20*
5	Post-harvest management technique is costly	37.5	47.5		15	0	6.65*
6	Post-harvest disease management increase profit	22.5	62.5	7.5	0	7.5	32.40*
7	Quality (Color/ Test/ Flavor) hampered after chemical use	55	55	5		0	.400*
8	Governmental support is need to control the post-harvest diseases of mango is important	0	5	5	23	17.5	22.80*
9	Manage of post-harvest disease, you will save the product(mango)	7.5	70	0	15.5	7.5	43.80*
10	Use chemical for post-harvest management, will increase shelf life of mango.	45	35	2.5	12.5	5	28.75*

SA=Strongly Agree, A= Agreed, N= Neutral, DA= Disagree, SDA= Strongly Disagree

In case of using chemicals has negative impact on health, majority of respondent (60%) agree, use chemicals has negative impact on health followed by strongly agree (25%), disagree (2.5%). Chi-square value (30.2*) showed significance difference among theme, indicating negative impact on health to use chemicals to manage post-harvest disease of mango. In the statement "Post-harvest disease management technique is costly", Majority of respondent (47.5%) agree, costly to manage post-harvest disease of mango followed by strongly agree (37.5%), disagree (15%). Chi-square value (6.65*) showed significance difference among theme, indicating high cost to manage post-harvest disease of mango. In case of "Post-harvest disease management increase profit", majority of respondent (62.5%) agree post-harvest disease management provide good returns followed by strongly agree (22.5), strongly disagree (7.5%), neutral (7.5%). Chi-square value (32.4*) showed significance difference among theme, indicating the importance of managing post-harvest disease for economic profit. Quality (Color/ Test/ Flavor) hampered after chemical use. On the statement majority of respondent (55%) strongly agree and agree followed by neutral (5%). Chi-square value (0.40%) showed significance difference among theme, indicating mango quality is hampered by using chemicals and PGR. On the statement "Governmental support is need to control the post-harvest diseases of mango is important", majority of respondent (23%) disagree with governmental support is available for managing post-harvest disease of mango followed by strongly disagree (17.5%), agree (5%), neutral (5%). Chi-square value (22.8*) showed significance difference among theme, indicating that there is lack of governmental support to management of post-harvest disease of mango. Manage of post-harvest disease, you will save the product (mango). On the statement majority of respondent (70%) agree to manage post-harvest disease will save the mango followed by disagree (15.5%) strongly agree (7.5%), strongly disagree (7.5%). Chi-square value (43.8*) showed significance difference among theme, indicating proper management of post-harvest disease of mango which will save the mango. If you are used chemical for post-harvest management, you will increase the mango shelf life. Majority of respondent (45%) strongly agree with the statement "use chemical for post-harvest management, will increase shelf life of mango followed by agree (35%), disagree (12.5%), strongly

disagree (5%), neutral (2.5%). Chi-square value (28.5*) showed significance difference among theme, indicating use of chemicals & hormones for post-harvest management will increase shelf life of mango during storage.

Conclusion

The aim of present study was to overview different post-harvest diseases of mango in Chapainawabganj district on the basis of response from the mango growers. The knowledge level, attitude towards post-harvest diseases and measures taken for controlling post-harvest diseases was also explored in the study. Chapainawabganj is called the "Capital of Mango" as the economic activity of the district largely depends on mango production. In Bangladesh about one third of the fruits and vegetables are being wasted due to post harvest losses and one of the major causes of post-harvest loss is infestation of different post-harvest diseases. Hot and humid climate is favorable for different pathogen to grow in post-harvest stage of mango. Poor orchard management conditions can also contribute to pathogen attacks, such as poor cleanliness, a lack of disease management in the form of pruning, the presence of dead fallen leaves, and so on. Under these conditions, fungal pathogens thrive and damage healthy trees. Environmental elements such as temperature, humidity, and rainfall have a substantial impact on the onset of fungal illnesses since fungal pathogens thrive in moist and warm environments. Due to the lack of proper management of post-harvest diseases a large amount of mango lost its quality or being wasted. Our study revealed that different types of pre-harvest and post-harvest diseases are prevalent in the study area. It was found that mango growers had very limited concern about different post-harvest diseases and their knowledge level on post-harvest diseases were not up to the mark. Very limited and retroactive activities are practiced by the mango growers as well as by the merchants. Though the mango growers do not take necessary steps for controlling different post-harvest diseases of mango but they feel that it is very important for better economic growth. Majority of the respondents showed positive attitude toward management of post-harvest diseases. It indicates that if we can increase the knowledge level of the mango growers on different post-harvest diseases of mango and their management, they will willingly accept it. We think our findings will help the policy makers to take decision for the

development of mango production in Chapainawabganj district as well as in Bangladesh.

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