Relationship of mango seedling diseases prevalence to the environmental factors

M.N. Islam[1], K.K. Poddar[2], Ismail Hossain[4], M.S.M. Chowdhury[1], AFM Jamal Uddin[3] and H. Mehraj[5]

1. Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
2. Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
3. Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
4. Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh
5. The United Graduate School of Agricultural Sciences, Ehime University, 3-5-7 Tarami, Matsumaya, Ehime 790-8556, Japan
Corresponding Author email: hmehraj02@yahoo.com

Paper Information	A B S T R A C T
  Citation 	Anthracnose, leaf spot and sooty mold of mango were studied to see their relation with temperature, relative humidity and rainfall. A positive correlation was observed between prevalence of anthracnose and leaf spot with temperature and relative humidity. Maximum prevalence of anthracnose and leaf spot was observed in October and minimum in January. Relative humidity showed a positive correlation with prevalence of leaf spot and prevalence of sooty mould of mango. The prevalence of leaf spot and sooty mould was in October and no prevalence observed in January. Thus leaf spot is being reported as a new disease of mango seedlings in Bangladesh.

Key words: *Anthracnose, leaf spot, sooty mold, temperature, relative humidity and rainfall*

Introduction

Success of an orchard depends on the quality of the planting material. Mango (Mangifera indica L.) is a delicious fruit with enriched vitamins, minerals and nutrients which frequently grown in Bangladesh. It is called the king of fruits. Despite some mango diseases that can be handled effectively the conditions for high quality yield of mango (Usman et al., 2003). The climate of Bangladesh is luxuriant for the growth and reproduction of large number of plant pathogens which cause hundreds of different diseases of crops (Fakir, 2001). Plant diseases play a major role in reducing yields of horticultural crops in the tropics (Ploetz et al., 1998; Mariau, 2001). Effects of temperature, rainfall and relative humidity on disease prevalence have been focused by many researchers worldwide (Chowdhury and Hossain, 2011; Pinkerton et al., 1998; MacHardy et al., 2001; Mondal and Timmer, 2002). Based on understanding the disease epidemiology, effective control measures could be developed and implemented (Hopkins and McQuilken, 2000). Identification of the relationship between the mango seedling diseases with the environmental factor may be useful for the grower to mange the mango seedling diseases. Regression analysis is a statistical tool for the investigation of relationships between variables. The aim of current study to search the relationship of mango seedling diseases with the environmental factor.

Materials And Methods

The experiment was carried out in eight nurseries of Dhaka (Green orchid nursery, Agargaon and Barisal nursery, Savar), Gazipur (Gazipur nursery and Laxmipur nursery), Barisal (Sarchina nursery and Riyad nursery) and Khagrachari (Hill Research Center, Khagrachari and Ramghar nursery, Ramghar) during July 2010 to April 2012 to study the seedling diseases of mango. Altogether eight surveys were made in July 2010; October 2010; January 2011; April 2011; July 2011; October 2011; January 2012; April 2012; respectively. 30 randomly sleeted 2 years mango seedlings for counting diseased leaves and disease free leaves and moreover five leaves/plant were randomly selected to determine the disease severity. Disease incidence and disease severity were determined by the following formulas (Rai and Mamatha, 2005).

Disease incidence (%) = (No. of diseased leaves ÷ No. of total leaves) × 100
Disease severity (%) = (Area of leaf tissue infected ÷ Total leaf area) × 100

Meteorological data of the experimental period were collected from Meteorological Department, Agargaon, Dhaka, Bangladesh.

Results

Effect of different weather factors on the incidence and severity of anthracnose of Mango seedling

The maximum incidence (60.28% and 66.79%) and severity (50.5% and 55.13%) of anthracnose disease were recorded in October, for both three years; when average temperature, relative humidity and rainfall were 28.63°C, 80.2%, 7.13 cm and 29.5°C, 81.50%, 5.95 cm, respectively. On the other hand, minimum incidence (24.3% and 25.5%) and severity (17.39% and 16.14%) were recorded in January for both the years; having average temperature, relative humidity and rainfall 16.88°C, 73.80%, 0.52cm and 18.46°C, 76.0%, 0.60 cm respectively (Figure 1a and 1b).
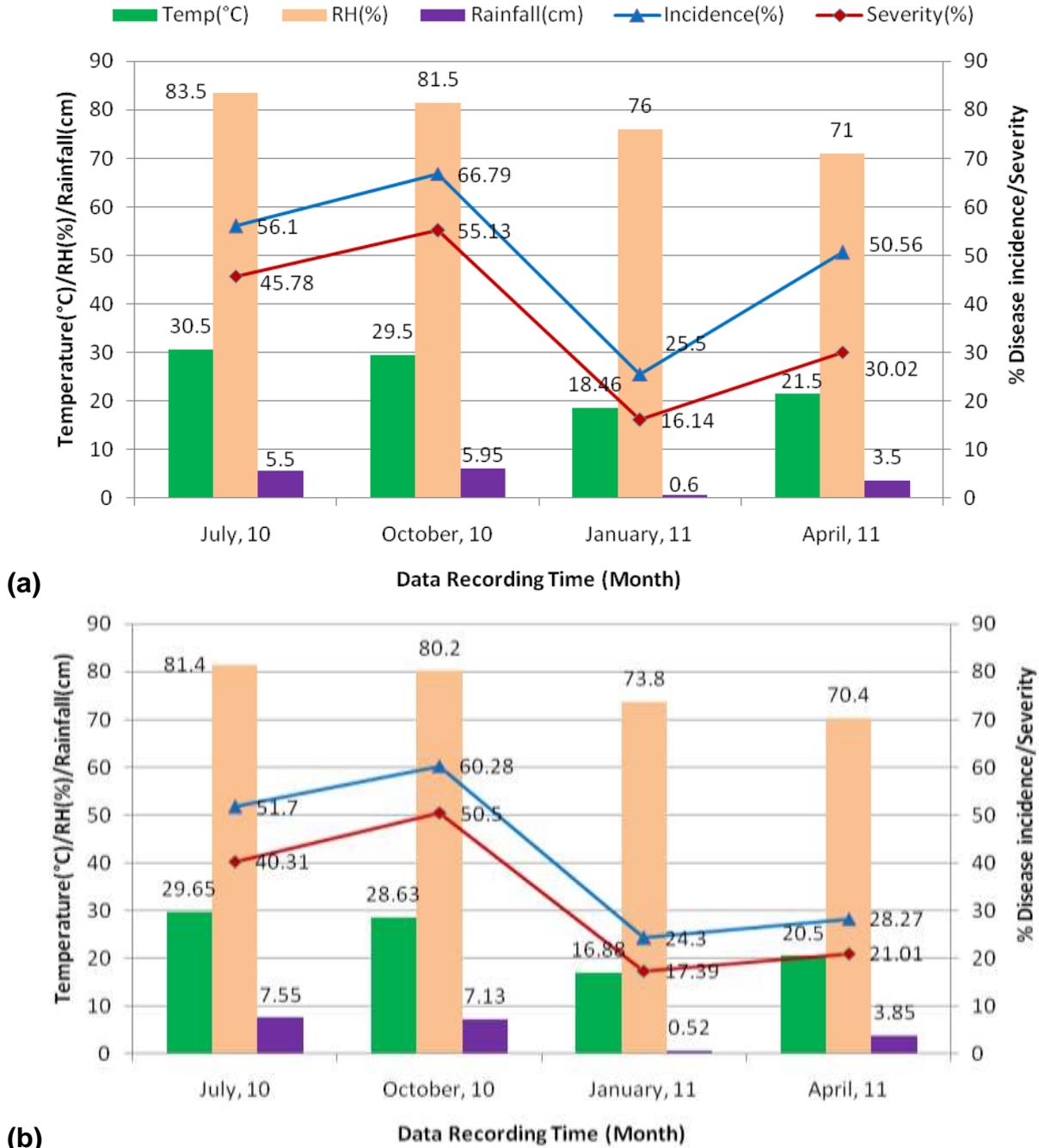

(a)

(b)

Figure 1. Effect of different weather factors on the incidence and severity of anthracnose of Mango seedling during (a) July, 2010 to April, 2011 and (b) July, 2011 to April, 2012

Relation between anthracnose disease incidence and severity of mango seedlings with temperature

The relationship between anthracnose incidence and temperature was significant and the R^2 value was 0.910 and

0.736 while the relationship between severity and temperature was significant and the R^2 value was 0.874 and 0.900 (Figure 2).
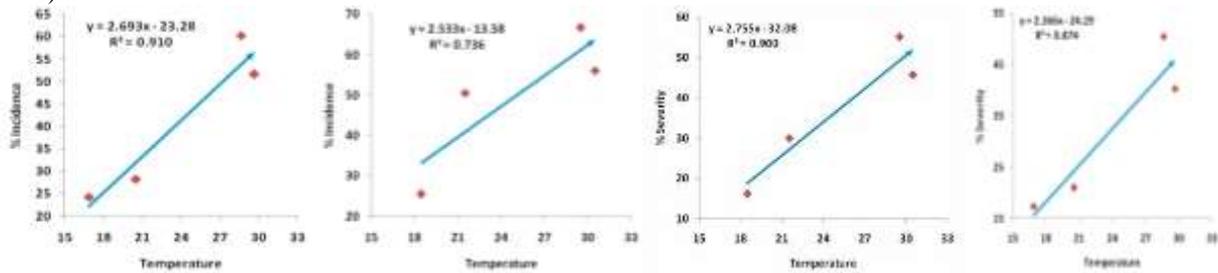

Figure 2. Linear regression of temperature on incidence and severity of anthracnose of mango with temperature during July, 2010 to April, 2012

Relation between anthracnose disease incidence and severity of mango seedlings with relative humidity

A significant negative correlation between anthracnose incidence and severity with relative humidity were observed for both the years. R^2 value for the relationship between incidences with relative humidity was 0.797 and 0.215 whereas between severity with relative humidity was 0.759 and 0.481 (Figure 3).
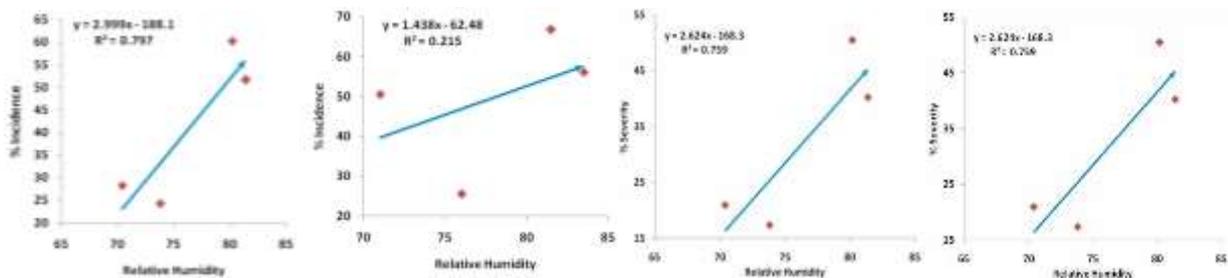

Figure 3. Linear regression of relative humidity on incidence and severity of anthracnose of mango with relative humidity during July, 2010 to April, 2012

Relation between anthracnose disease incidence and severity of mango seedlings with rainfall

A significant positive correlation between anthracnose incidence and severity with rainfall were observed for both the years. R^2 value for the relationship between incidences with rainfall was 0.835 and 0.951 whereas between severity with rainfall was 0.804 and 0.952 (Figure 4).
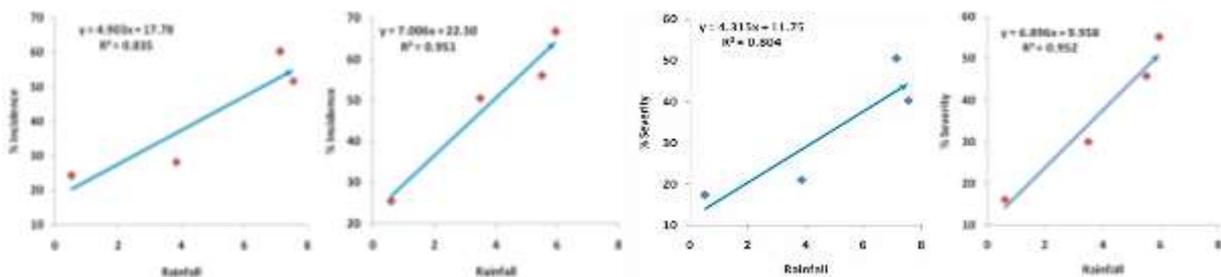

Figure 4. Linear regression of incidence and severity on incidence of anthracnose of mango with rainfall during July, 2010 to April, 2012

Effect of weather factors on the incidence and severity of leaf spot disease of mango seedling

In different growing seasons of mango seedlings, the maximum incidence (62.40% and 65.84%) and severity (54.72% and 56.21%) of leaf spot disease were recorded in October for both years when average temperature, relative humidity and rainfall were 28.63^0C, 80.2%, 7.13 cm and 29.50^0C, 81.50%, 5.95 cm respectively. On the other hand, minimum incidence (26.76% and 31.28%) and severity (19.12% and 21.81%) were recorded in April 11 and January, 11; having average temperature, relative humidity and rainfall 20.50^0C, 70.40%, 3.85 cm and 21.50^0C, 71.00%, 3.50 cm respectively (Figure 5a and 5b).
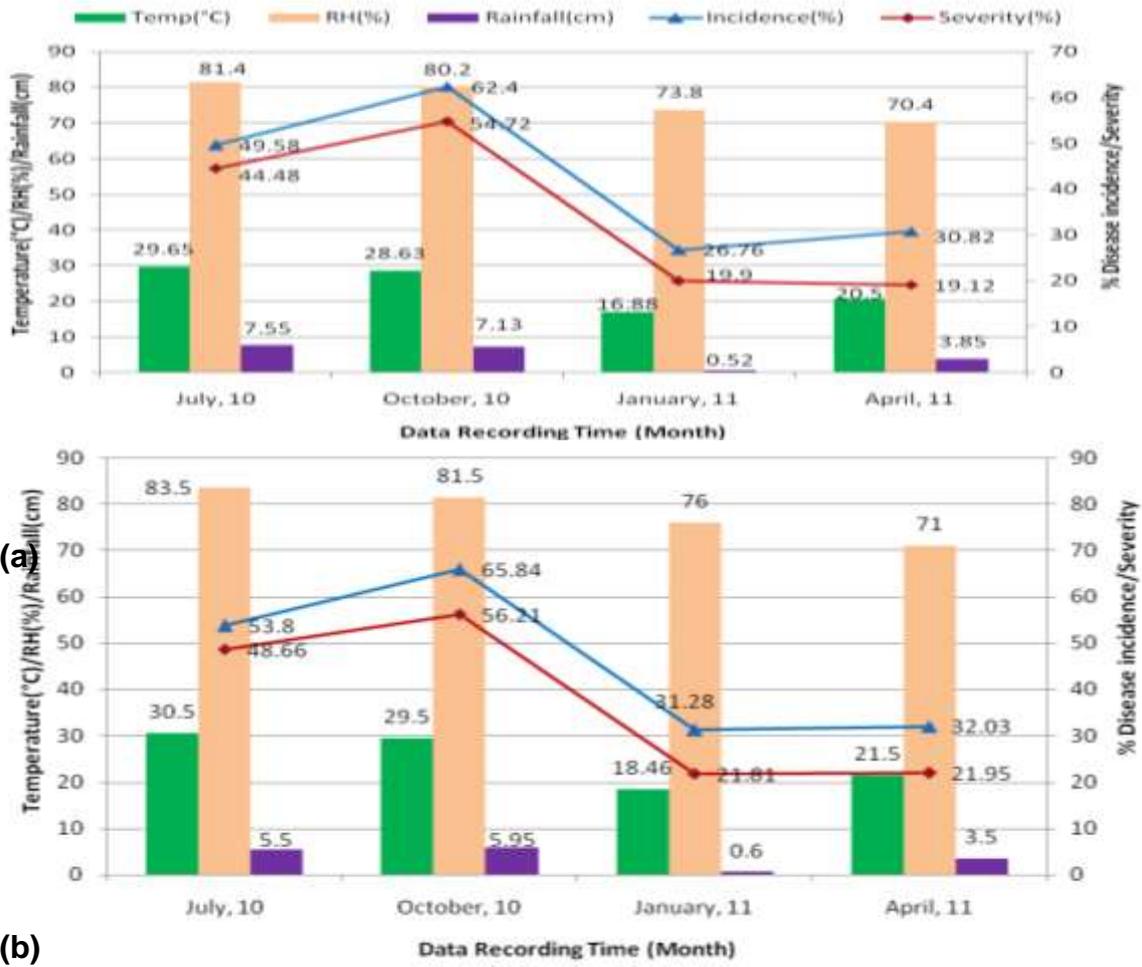
Figure 5. Effect of different weather factors on the incidence and severity of leaf spot of mango seedling during (a) July, 2010 to April, 2011 and (b) July, 2011 to April, 2012

Relation between leaf spot disease incidence and severity of mango seedlings with temperature

A significant positive correlation between leaf spot incidence and severity with temperature were observed for both the years. R^2 value for the relationship between incidences with temperature was 0.841 and 0.841 whereas between severity with temperature was 0.850 and 0.901 (Figure 6).
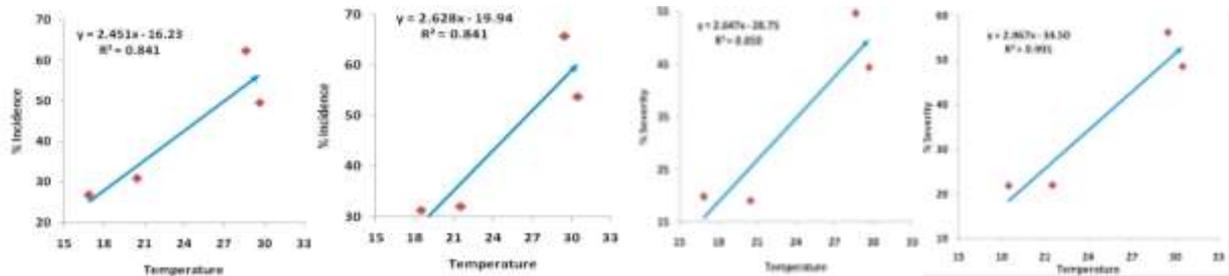

Figure 6. Linear regression of incidence and severity on incidence of leaf spot with temperature of mango during July, 2010 to April, 2012

Relation between leaf spot disease incidence and severity of mango seedlings with relative humidity

A significant positive correlation between leaf spot disease incidence as well as severity and relative humidity were observed for both the years. R^2 value for the relationship between incidences with relative humidity was 0.722 and 0.694 whereas between severity with relative humidity was 0.838 and 0.776 (Figure 7).
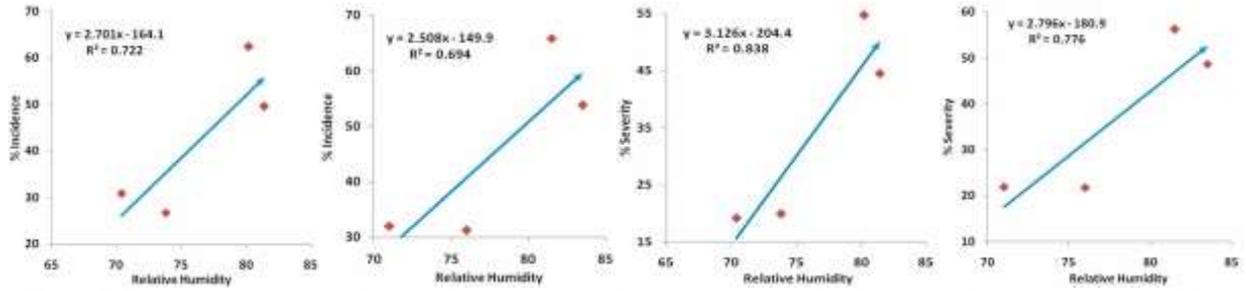
Figure 7. Linear regression of incidence and severity on incidence of leaf spot with relative humidity of mango during July, 2010 to April, 2012

Relation between leaf spot disease incidence and severity of mango seedlings with rainfall

A significant positive correlation between leaf spot disease incidence as well as severity and rainfall were observed for both the years. R^2 value for the relationship between incidences with rainfall was 0.778 and 0.746 whereas between severity with rainfall was 0.745 and 0.760 (Figure 8).
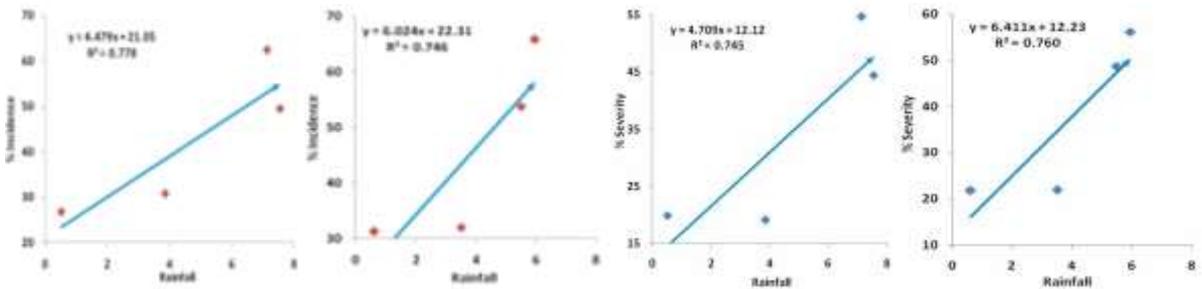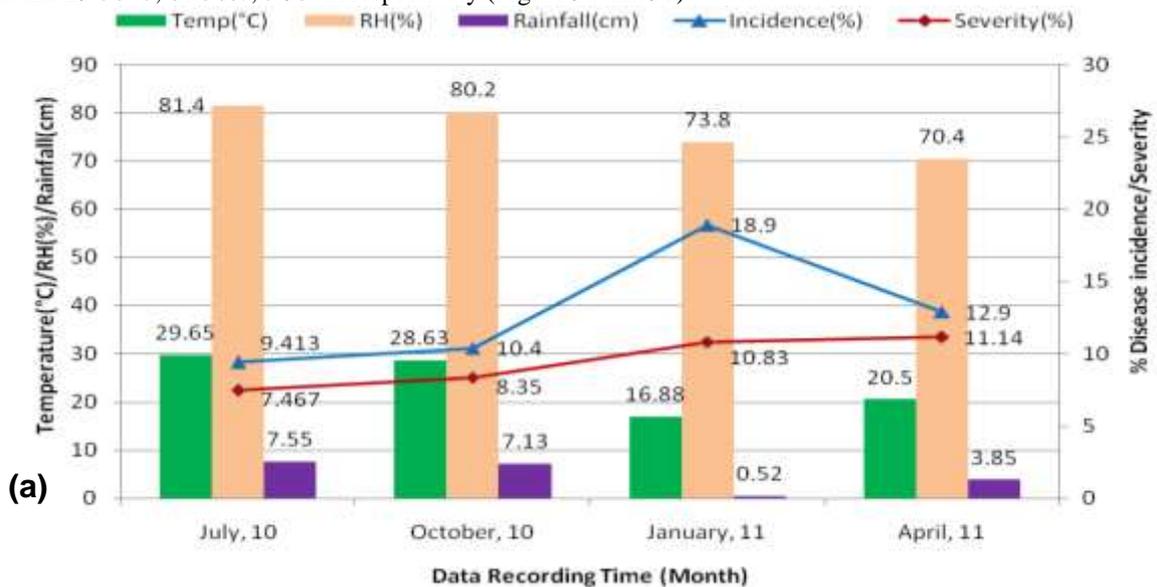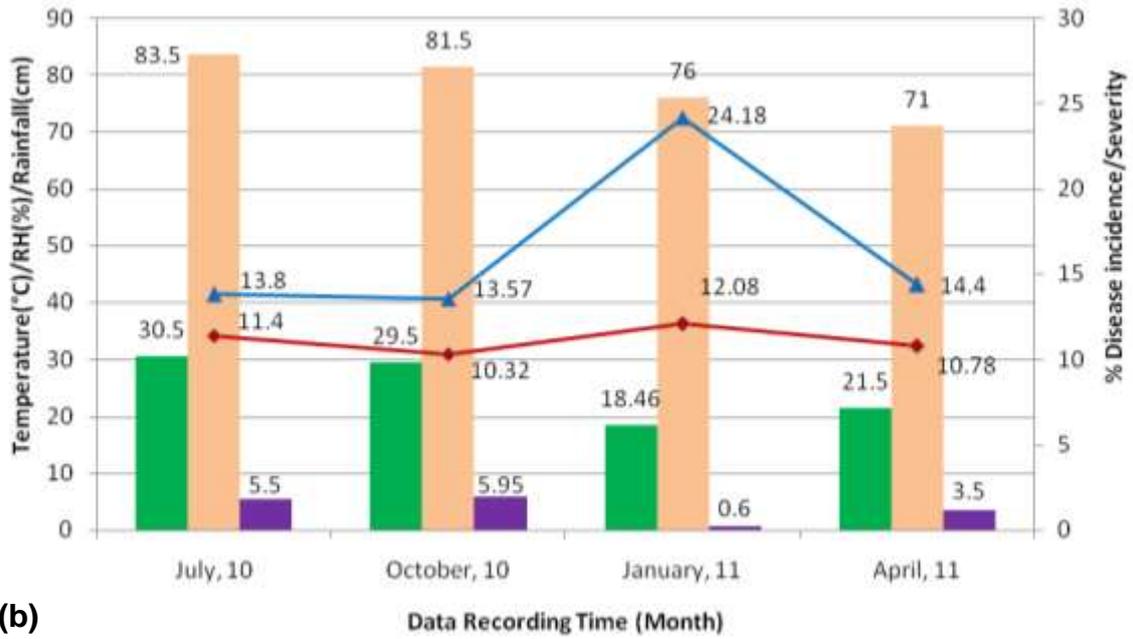

Figure 8. Linear regression of incidence and severity on incidence of leaf spot with rainfall of mango during July, 2010 to April, 2012

Effect of weather components on the incidence and severity of sooty mould of mango seedling

In different growing seasons of mango seedlings, the highest incidence (18.90%) and (24.18%) and the highest severity (11.14%) and (12.08%) of sooty mould disease were recorded in January, for both the years when average temperature, relative humidity and rainfall were 16.88°C, 73.80%, 0.52cm, and 18.46°C, 76%, 0.6cm respectively. On the other hand, lowest incidence (9.413%) and (13.57%) and the lowest severity (7.467%) and (10.32%) were recorded in July in 2010-2011 and in October in 2011-2012; having average temperature, relative humidity and rainfall 29.65°C, 81.40%, 7.55 cm and 29.50°C, 81.50%, 5.95cm respectively (Figure 9a and 9b).

(b)

Data Recording Time (Month)

Figure 9. Effect of different weather factors on the incidence and severity of sooty mold of mango seedling during (a) July, 2010 to April, 2011 and (b) July, 2011 to April, 2012

Relation between sooty mold disease incidence and severity of mango seedlings with temperature

      A significant positive correlation between sooty mold incidence and severity with temperature were observed for both the years. R^2 value for the relationship between incidences with temperature was 0.865 and 0.601 whereas between severity with temperature was 0.891 and 0.276 (Figure 10).
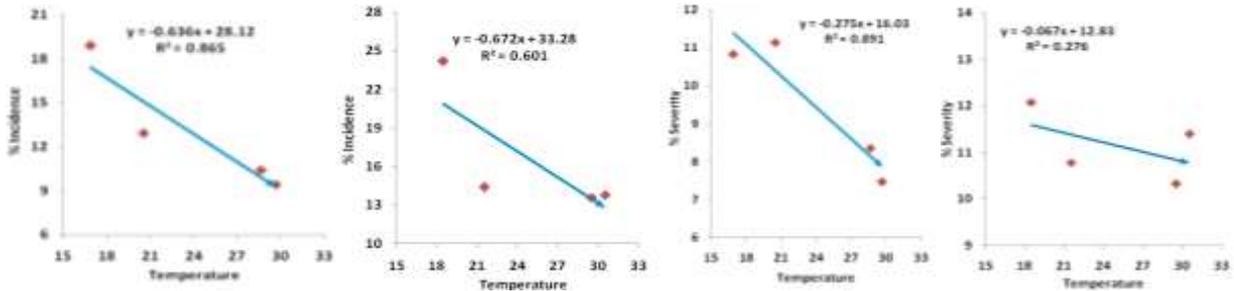

Figure 10. Linear regression of incidence and severity on incidence of sooty mold with temperature of mango during July, 2010 to April, 2012

Relation between sooty mold disease incidence and severity of mango seedlings with relative humidity

      A significant negative correlation between sooty mold incidence and severity with relative humidity were observed for both the years. R^2 value for the relationship between incidences with relative humidity was 0.040 and 0.087 whereas between severity with relative humidity was 0.951 and 0.003 (Figure 11).
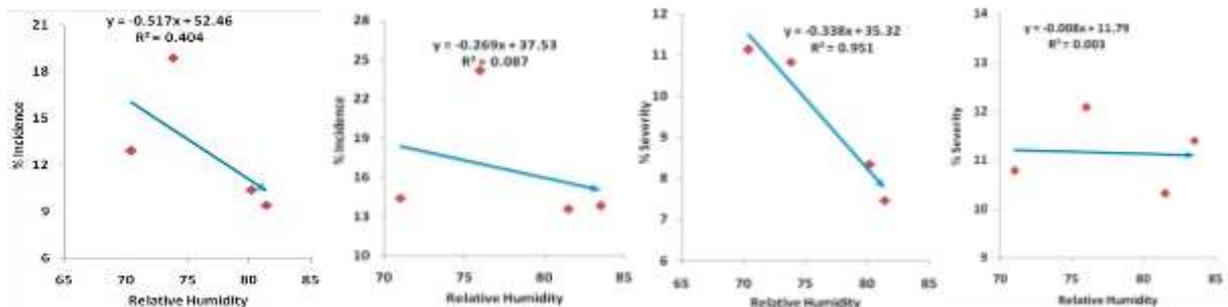

Figure 11. Linear regression of incidence and severity on incidence of sooty mold with relative humidity of mango during July, 2010 to April, 2012

142

Relation between sooty mold disease incidence and severity of mango seedlings with rainfall

A significant positive correlation between sooty mold incidence and severity with rainfall were observed for both the years. R^2 value for the relationship between incidences with rainfall was 0.963 and 0.859 whereas between severity with rainfall was 0.756 and 0.571 (Figure 12).
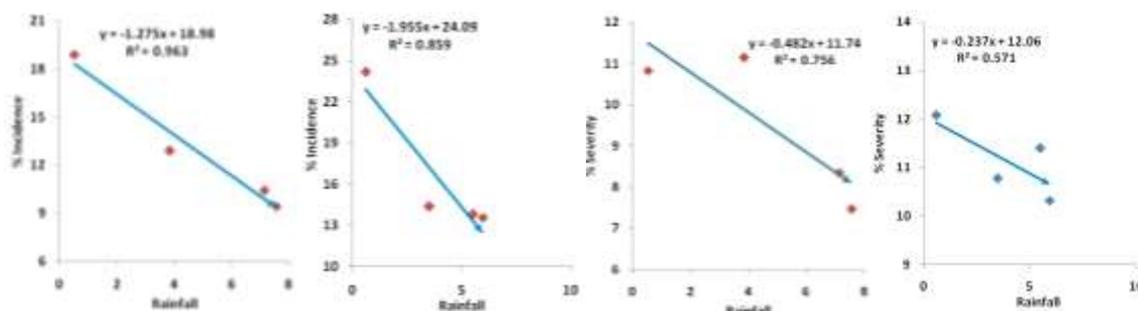

Figure 12. Linear regression of incidence and severity on incidence of sooty mold with rainfall of mango during July, 2010 to April, 2012

The average temperature, relative humidity and rainfall of each month during the experimental period have been recorded and presented in Table 1.

Table 1. Average temperature, relative humidity and rainfall of Dhaka, Gazipur, Barisal and Khagrachari from July, 2010 to April, 2012

Month	Temperature	Relative humidity	Rainfall
July, 2010	29.65	81.4	7.55
October, 2010	28.63	80.2	7.13
January, 2011	16.88	73.8	0.52
April, 2011	20.5	70.43	3.85
July, 2011	30.5	83.5	5.5
October, 2011	29.5	81.5	5.95
January, 2012	18.46	76	0.6
April, 2012	21.5	71	3.5

Discussion

Diseases were recorded eight particular times during the period of two years survey from July, 2010 to April, 2012 in this study. Prevalence (incidence and severity) of mango anthracnose and leaf spot were found to be increased in the month of April and July while the disease decreased in the month of January and October. Regression analysis of prevalence of anthracnose and leaf spot disease along with generalized environmental parameters revealed that this increase and decrease were due the effect of temperature, relative humidity and rainfall. A positive correlation was observed between prevalence of leaf spot with temperature, relative humidity and rainfall. With the increase of temperature, relative humidity and rainfall both the incidence and severity increased significantly. Mango leaf spot was found to build up during the first week of June with the onset of rains while highest incidence of mango leaf spot was on the second week of September and the diseases showed a positive correlation with temperatures, relative humidity and rain and hence the period from July to September was identified as the most conducive for the development of mango leaf spot. Mango leaf spot occurs primarily in tropical and sub-tropical climates where considerable rainfall accompanies warm temperatures but it can also occur in drier climates (Ploetz et al., 1994). Maximum prevalence of anthracnose in mango was observed in the month of July and April and minimum in the month of January and October. A positive correlation was found between prevalence of anthracnose with temperature, relative humidity and rainfall. With the increase of temperature, relative humidity and rainfall both the incidence and severity increased significantly i.e., anthracnose was negligible in colder season than that of warmer seasons. Anthracnose prevails in the regions where temperature and humidity remains low (Meah and Khan, 1987). Humidity and rainfall played more important role in the development of anthracnose than by temperature (Chowdhury et al., 2011). The prevalence of sooty mould of mango was recorded in the months July and October but no disease was found in the month of January and April. A positive correlation was observed between prevalence of sooty mould with temperature, relative humidity and rainfall. The present study also supported by the results of others previous study (Misra, 2001; Colon et al., 2002; Awasthi et al., 2005; Tiwari et al., 2006; Sarkar, 2008; Chowdhury et al., 2011).

Conclusion

The occurrence of seedling disease in nursery revealed that all diseases studied are related to the temperature, relative humidity and rainfall. Other parameters of epidemiology viz. leaf wetness period, vapor presser deficit, sunshine hour and microclimate should be critically evaluated. Formation, germination and development of inoculums in different

pathosystem should also be critically studied for each host-pathogen system to find out the most appropriate time to combat the disease at minimum effort.

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