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CODEN (Chemical Abstract Services, USA): IJASKD

Vol-3(1) March, 2015

Research Article

WEATHER IMPACT ON NURSERY DISEASES OF MANGO SAPLINGS IN BANGLADESH

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Abstract

The study was carried out during the period of July 2010 to April 2012 to find out the effect of weather prevalence of seedling diseases of mango in different areas of Bangladesh. The locations were Mymensingh Dinajpur, Rajshahi and Khagrachari. Altogether 12 nurseries in four districts of Bangladesh were surveyed and mango seedling diseases were recorded. Incidence and severity of important seedling diseases of has been studied under different geographical locations (viz. Mymensingh, Dinajpur, Rajshahi and Khagrachari) of Bangladesh. The effects of temperature, rainfall, and relative humidity on the incidence and severity of noted diseases were observed the aforesaid locations of Bangladesh. The studied diseases were anthracnose, leaf spot, red rust, powdery mildew, scab, bacterial leaf blight and malformation of mango seedlings. The graphs of weather parameters and incidence and severity of diseases were performed to determine the relationship between different components of climatic factor and seedling diseases of mango.

Keywords: Mango seedling; Weather; Epidemiology; Anthracnose; Pathosystem

Introduction

Mango (*Mangifera indica* L.) belonging to the family Anacardiaceae is one of the most important, popular and delicious fruits grown throughout the tropics and sub-tropics of the world including Bangladesh. Mango has been cultivated for more than 4000 years ago (Candole, 1984). It was originated in the region of Eastern Indo-Bangladesh, Myanmar, Malaysia or Thailand (Salunkhe and Desai, 1984). It is being cultivated commercially in a number of countries of the world such as India, Pakistan, Mexico, Brazil, Haiti and Philippines. Mango is also grown in Indonesia, Java, Thailand, Bangladesh, Srilanka and Northwest Australia. The mango is considered as a popular fruit in our country. It is widely grown all over Bangladesh with the quality mangoes solely concentrated in the north-western areas especially greater Rajshahi, Dinajpur and Rangpur (Karim, 1985). Mango ranks third among the tropical fruits grown in the world. In Bangladesh mango ranks second fruit in terms of area and third in terms of production (Kobra *et al.*, 2012). Bangladesh produced 945059 metric tons of mango in 30666 ha of mango orchard during the period of 2011-12 (BBS, 2013). Mango has got a unique position in respect of nutritional quality, taste, consumers' preference etc. among the 50 kinds of fruits grown in Bangladesh (Ahmed *et al.*, 1995). It is a rich source of vitamins, minerals and total soluble solids (Pramanik, 1995). It is also a source of carbohydrate as ripe mango pulp contains 16.9% carbohydrate (Salunkhe and Desai, 1984). The minimum dietary requirement of fruit/day/head is 85g, whereas our availability is only 30-35 g, which is much lower than recommended daily allowance (Siddique and Scanlan, 1995).

The demand of mango is increasing day by day with growing population and decline in production results in scarcity every year. Disease is a major cause for lower production of mango in Bangladesh (Meah and Khan, 1987). Nursery diseases of mango are reported to be attacked with as many as 8 different diseases in Bangladesh (Suchana, 2008). The major diseases are anthracnose, bacterial leaf spot, bacterial leaf blight, powdery mildew, die-back, rust, malformation and scab. Nursery diseases are an important consideration for mango production. But seedling diseases are one of the important problems in the tropics.

The climate of Bangladesh is characterized by high temperatures, heavy rainfall, and often excessive humidity with fairly marked seasonal variations (Anonymous, 1995). The features of temperatures regime observed the highest temperatures prevail from March to May; June was transitional period and an equable temperature prevails

from July to September; a fall in temperature observed from October to the end of December and coolest period prevailed January to February. The main rainy period begins with the coming of tropical monsoon. About 80% of the annual rainfall occurred in the monsoon period, which lasts from late May to mid-October. The monsoon ends in mid-October. March and April are the least humid months and the months of June to October prevails over 80% relative humidity and from November to February it is around 75%. The climate of Bangladesh harbors plant pathogens and provides luxuriant environment for the growth and reproduction of large number of plant pathogens which cause hundreds of different diseases of crops (Fakir, 2001). Determining the effect of temperature, rainfall and relative humidity on the formation, release and germination of inoculums in different pathosystems have been focused by many researchers worldwide Pinkerton *et al.* 1998; MacHardy *et al.* 2001; Mondal & Timmer, 2002; Chowdhury, 2009). Since diseases pose a potential threat to seedlings of fruit species by causing enormous loss in plant quality and disruption of production schedules. Therefore, it is imperative to investigate nurseries to get information on the identify and epidemiology of the pathogen that cause diseases. Considering the above facts and points, the present research program has been designed to investigate the effects of temperature, rainfall and humidity on the nursery diseases of mango seedlings in the country.

Materials and Methods

The study was conducted during the period of July 2010 to April 2012. Major growing areas of mango were identified and selected on the basis of growing areas and production of mango. The locations were Mymensingh Dinajpur, Rajshahi and Khagrachari. Altogether 12 nurseries in four districts of Bangladesh were surveyed and mango seedling diseases were recorded. Four visits were made in the selected 12 nurseries during the growing season on one to two years old seedlings over a period of one year. On the basis of the climatic variations, four disease recording times were selected to see the effect of weather variations on the incidence and severity of seedling diseases of mango. The data collection dates was 1st week of July, October, January and April for the each year. In each nursery 30 tagged seedlings were considered for disease incidence and severity.

Disease incidence (foliar disease) was assessed as percentage of plants infected with at least one leaf spot or visible symptom. Assessment of incidence and severity of the diseases of mango seedlings was calculated by the following formula:

Percent Disease Incidence (PDI) was calculated using the formula of Rai and Mamatha (2005):

Percent Disease Incidence (PDI)

$$= \frac{\text{Number of diseased leaves on each plant}}{\text{Number of total leaves on each plant}} \times 100$$

Estimates of disease severity per plant was expressed as the mean disease severity of 10 leaves per plant. Disease severity was calculated using the formula of Johnston (2000.):

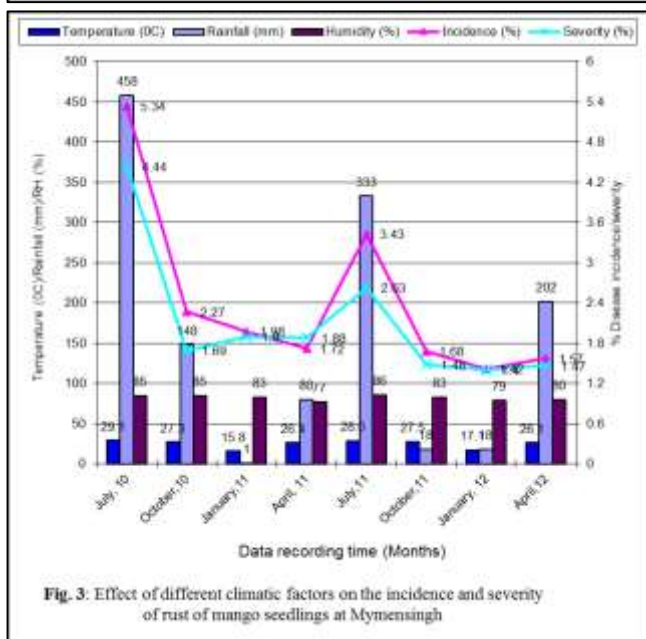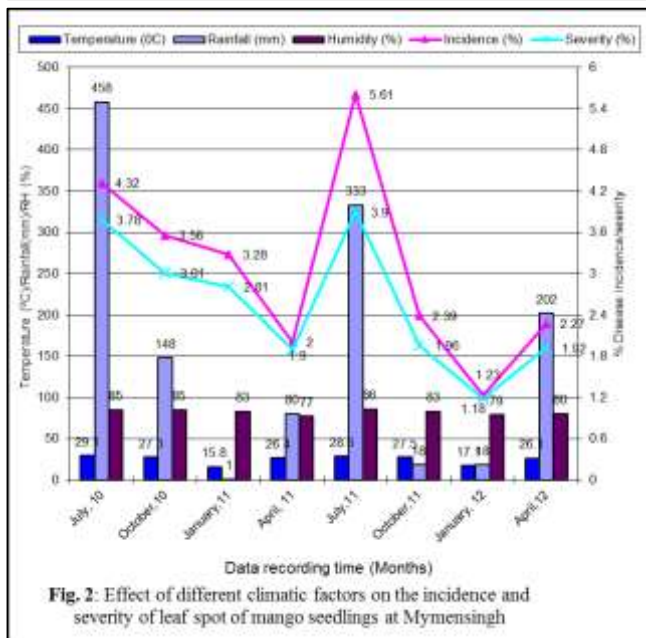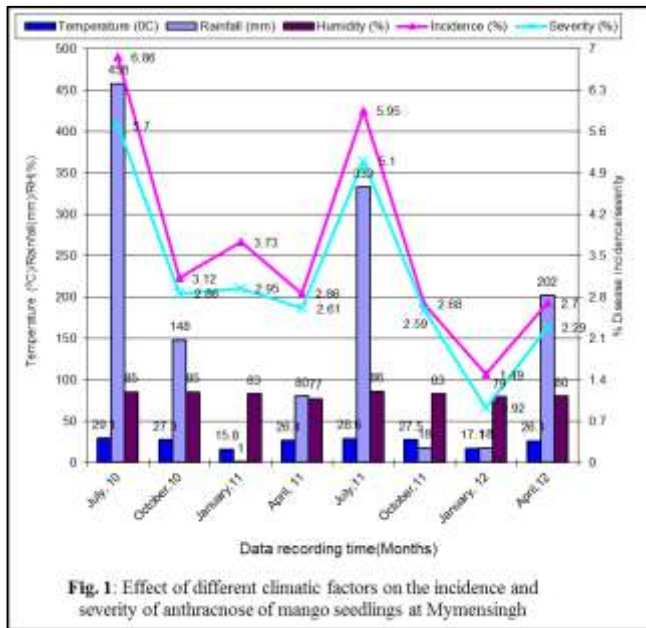Percent disease severity (PDS)

$$= \frac{\text{Area of leaf tissue infected by disease}}{\text{Total area of leaf}} \times 100$$

Moreover, monitoring disease environment relation to epidemiological aspects of mango seedlings in Bangladesh. Meteorological data on air temperature, relative humidity (RH) and rainfall were collected from weather stations of the respective locations throughout the study period from July 2010 to April 2012. The data were calculated for monthly mean of minimum and maximum temperature, mean of minimum and maximum relative humidity and mean of minimum and maximum rainfall of the respective locations.
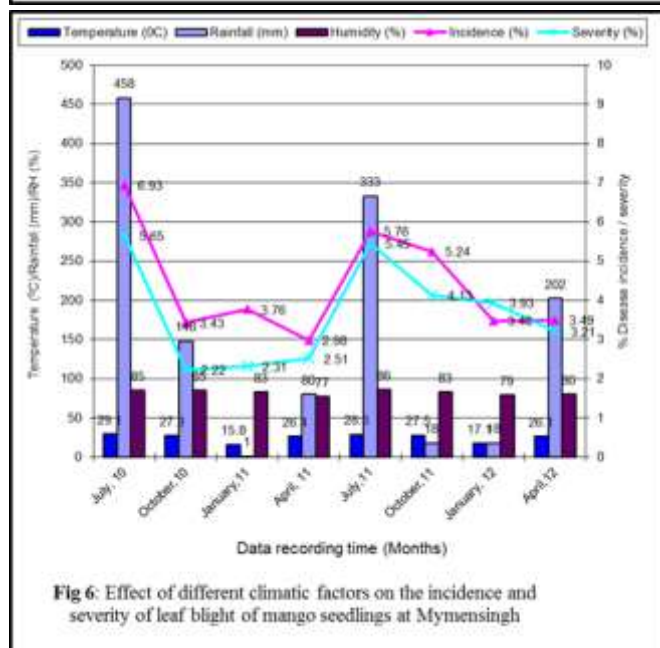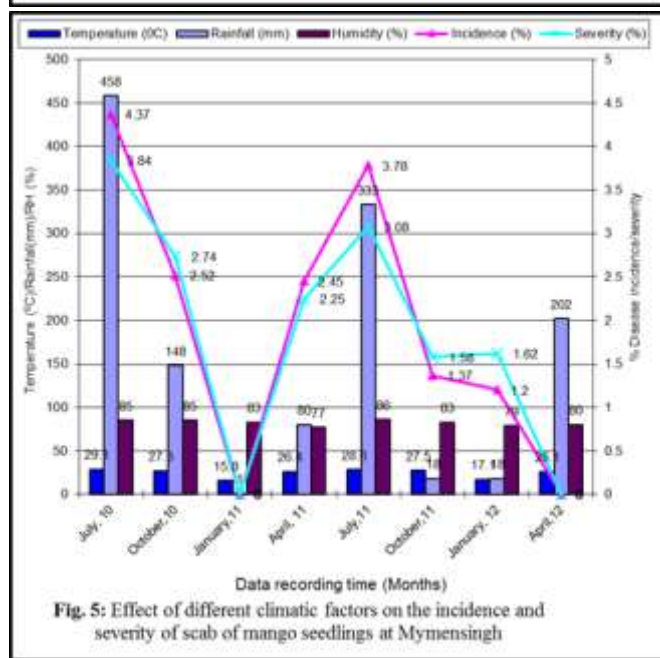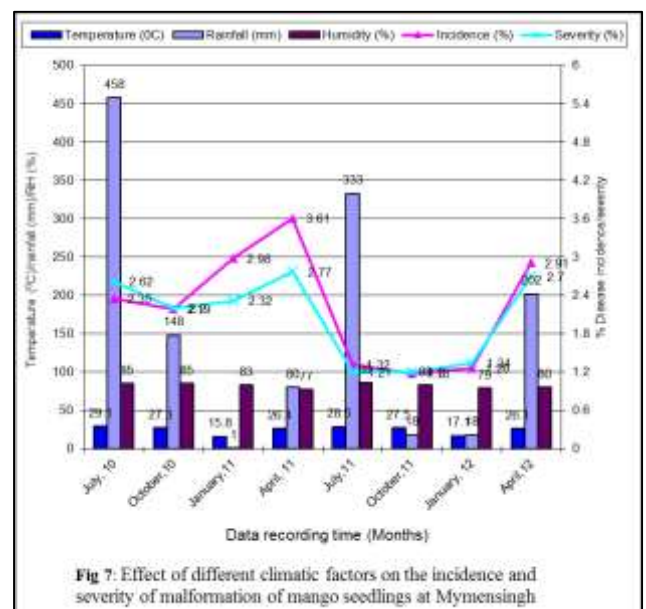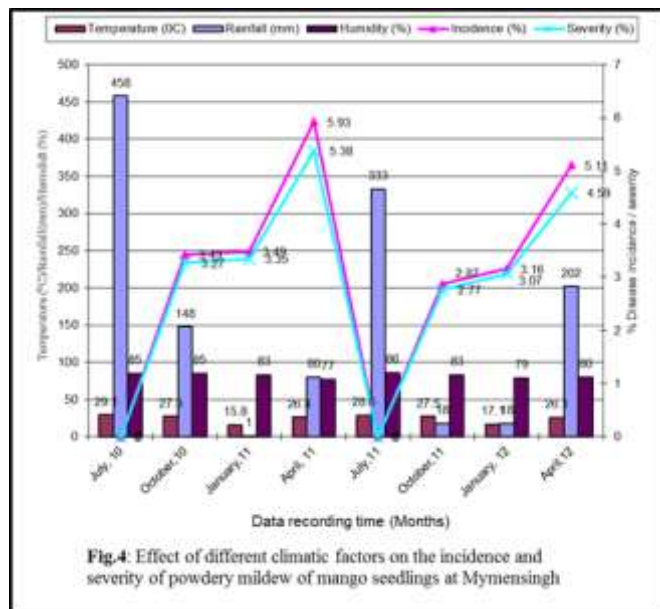
Results and Discussion

Incidence and severity of important seedling diseases of has been studied under different geographical locations (viz. Mymensingh, Dinajpur, Rajshahi and Khagrachari) of Bangladesh. The effects of temperature, rainfall, and relative humidity on the incidence and severity of noted diseases were observed the aforesaid locations of Bangladesh. The studied diseases were anthracnose, leaf spot, red rust, powdery mildew, scab, bacterial leaf blight and malformation of mango seedlings. The graphs of weather parameters and incidence and severity of diseases were performed to determine the relationship between different components of climatic factor and seedling diseases of mango. Determining the effects of temperature, rainfall and relative humidity on the incidence and severity of disease in different pathosystems had been focused by many researchers worldwide (Pinkerton *et al.*, 1998; MacHardy *et al.*, 2001; Mondal & Timmer, 2002; Chowdhury, 2009).

In Mymensingh, incidence and severity of anthracnose of mango seedling diseases was high in July, 2010 when temperature, rainfall and relative humidity all were high by 29.1 °C, 458 mm and 85 %, respectively and minimum incidence and severity of anthracnose was recorded in January, 2012 (Fig.1). Similar prevalence of anthracnose was also observed and reported by Ekbote *et al.*, (2001). In addition to this the spores of causal organism C. gloeosporioides must have free water to germinate, abundance of moisture (>97%) to release from acervuli and rain splash for spread observed by Ploetz *et al.*, (1994).

Fig. 1: Effect of different climatic factors on the incidence and severity of anthracnose of mango seedlings at Mymensingh

Fig. 2: Effect of different climatic factors on the incidence and severity of leaf spot of mango seedlings at Mymensingh

Fig. 3: Effect of different climatic factors on the incidence and severity of rust of mango seedlings at Mymensingh

Dickman and Alvarez (1983) observed that the pathogen *C. gloeosporioides* was inactivated in extreme temperatures (<18 or > 25 ºC), dry weather a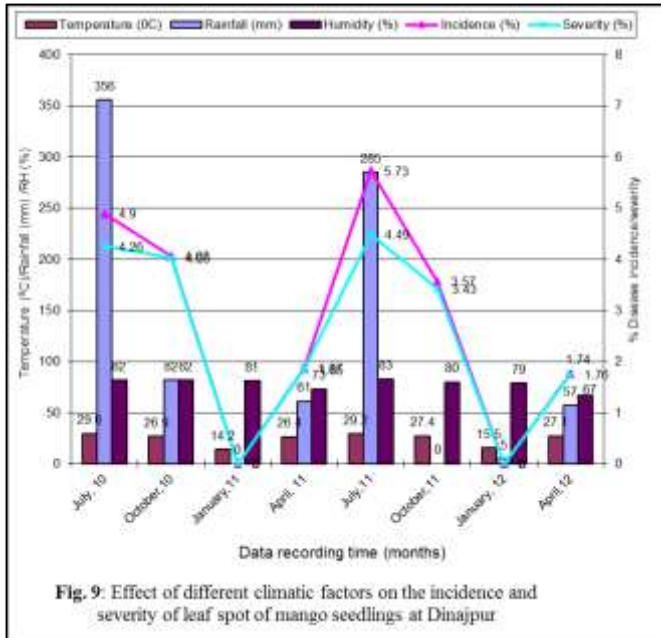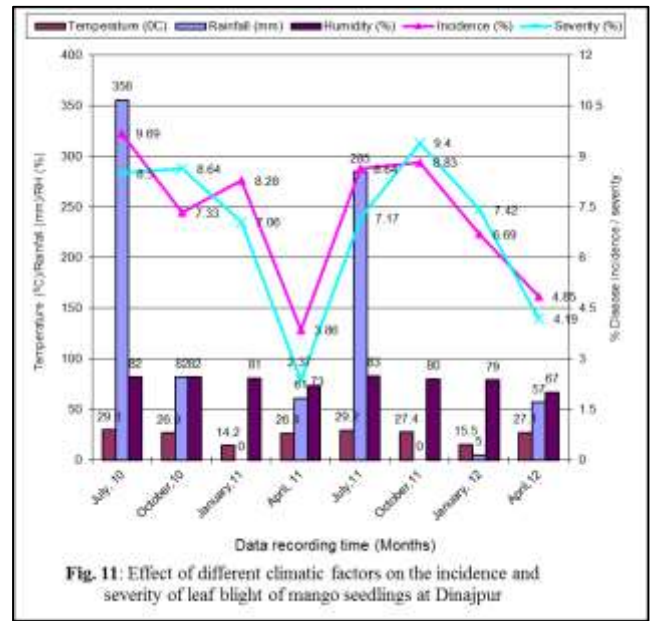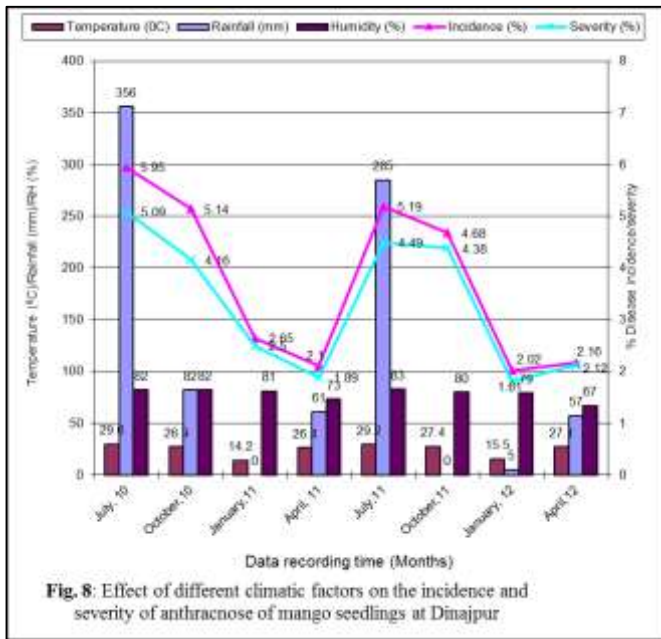nd sunlight. This may be the lowest prevalence of the disease in the January. Incidence and severity of leaf spot of mango seedling disease was high in July, 2011 when temperature, rainfall and relative humidity all were high by 28.6 ºC, 333 mm and 86 %, respectively and minimum incidence and severity of leaf spot was recorded in January, 2012 (Fig. 2). The growth and development of *Alternaria alternata* might be influenced by temperature and relative humidity. This finding is strongly supported by Ploetz *et al.,* (1994) who stated that a minimum of 350 hr of relative humidity over 80% was needed for leaf spot disease development. The highest prevalence of red rust of mango seedling (5.34 % and 4.44%, respectively) during the period of July, 2010 at temperature, rainfall and relative humidity by 29.1 ºC, 458 mm and 85 %, respectively while minimum incidence and severity of red rust was recorded in January, 2012 at temperature, rainfall and relative humidity by 17.1 ºC, 18 mm and 79 %, respectively (Fig. 3). The findings of the present study corroborate with the incidence and severity of red rust disease of mango seedlings reported by Ploetz *et al.* (1994). They observed that a wet and humid environment within the tree canopy was conducive for spread and establishment of alga (*Cephaleurous virescencs*). The total amount of rainfall is concentrated in the month of July to October and high relative humidity prevails in those months. Rainfall may spread out the superficially attached zoospores on the surface of leaves as a result high prevalence of red rust was observed in the month of July. Powdery mildew, incidence and severity varied from July 2010 to April 2012 and that ranged from 0.00-5.93 % and 0.00-5.38 %, respectively. The highest incidence and severity were recorded during the months of April 2011 at temperature, rainfall and relative humidity of 26.4 ºC, 80 mm and 77 % and no disease incidence and severity were observed in the month of July 2010 at temperature, rainfall and relative humidity of 29.1 ºC, 458 mm and 85 %, respectively (Fig. 4). Similar results were observed in consecutive years. The result is in accordance with the findings of Chowdhury (2009). He reported that the highest incidence and severity were recorded in April and no disease incidence and severity were observed in July and October. The highest incidence and severity of scab of mango seedling (4.37 and 3.84%) disease was high in July, 2010 when temperature, rainfall and relative humidity all were high by 29.1 ºC, 458 mm and 85 %, respectively and no incidence and severity of scab was recorded in January, 2011 and April, 2012 (Fig. 5). The highest prevalence of bacterial leaf blight of mango seedling disease was recorded (6.93 and 5.65 %) in July, 2010 at temperature, rainfall and relative humidity of 29.1ºC, 458 mm and 85 %, respectively and minimum incidence and severity of bacterial leaf blight was recorded in April, 2011 at temperature, rainfall

Fig.4: Effect of different climatic factors on the incidence and severity of powdery mildew of mango seedlings at Mymensingh

Fig 7: Effect of different climatic factors on the incidence and severity of malformation of mango seedlings at Mymensingh

Fig. 5: Effect of different climatic factors on the incidence and severity of scab of mango seedlings at Mymensingh

Fig 6: Effect of different climatic factors on the incidence and severity of leaf blight of mango seedlings at Mymensingh

and humidity of 26.4 °C, 80 mm and 77% (Fig. 6). The highest incidence and severity of malformation of mango seedlings disease (3.61 and 2.77%) was recorded in April, 2011 at temperature, rainfall and relative humidity of 26.4 °C, 80 mm and 77 %, respectively and minimum incidence and severity of malformation was recorded in October, 2011 at temperature, rainfall and relative humidity of 27 °C, 18 mm and 83%, respectively (Fig. 7). In Dinajpur, the highest incidence and severity of anthracnose of mango seedling disease (5.95 and 5.09 %) were recorded in July, 2010 when temperature, rainfall and relative humidity were recorded by 29.6 °C, 356 mm and 82%, respectively (Fig. 8). The lowest incidence and severity of anthracnose (2.02 and 1.81%) were recorded in January, 2012 at temperature, rainfall and relative humidity were recorded by 15.5 °C, 05 mm and 82%, respectively This result is in accordance with the findings of Ekbote *et al.*, (2001), Ploetz *et al.*, (1994) and Dickman and Alvarez (1983). The highest incidence and severity of leaf spot of mango seedling disease (5.73 and 4.49%) were recorded in July, 2011 when temperature, rainfall and relative humidity were recorded by 29.2 °C, 285 mm and 83 %, respectively (Fig. 9). The lowest incidence and severity of leaf spot (1.76 and 1.74 %) were recorded in April, 2012 at temperature, rainfall and relative humidity were recorded by 27.1°C, 57 mm and 82%, respectively The finding is strongly supported by Ploetz *et al.*, (1994). The highest incidence and severity of red rust of mango seedling disease (4.25 and 3.56%) were recorded in July, 2010 when temperature, rainfall and relative humidity were recorded by 29.6 °C, 356 mm and 82%, respectively (Fig. 10). The lowest incidence and severity of red rust (1.24 and 1.36%) were recorded in January, 2012 at temperature, rainfall and relative humidity were recorded by 15.5 °C, 05 mm and 79%, respectively. The result of the present study corroborate with the findings of Ploetz *et al.*, (1994).

Fig. 8: Effect of different climatic factors on the incidence and severity of anthracnose of mango seedlings at Dinajpur

Fig. 9: Effect of different climatic factors on the incidence and severity of leaf spot of mango seedlings at Dinajpur

Fig. 10: Effect of different climatic factors on the incidence and severity of red rust of mango seedlings at Dinajpur

Fig. 11: Effect of different climatic factors on the incidence and severity of leaf blight of mango seedlings at Dinajpur

The highest prevalence of bacterial leaf blight of mango seedling disease (9.69 and 8.50 %) were recorded in July, 2010 when temperature, rainfall and relative humidity were recorded by 29.6 ℃, 356 mm and 82%, respectively (Fig.11). The lowest incidence and severity of bacterial leaf blight of mango (3.86 and 2.37%) were recorded in April, 2011 when temperature, rainfall and relative humidity were recorded by 26.4 ℃, 61 mm and 73%, respectively. The highest incidence and severity of malformation of mango seedling disease (5.19 and 4.42%) were recorded in April, 2011 when temperature, rainfall and relative humidity were recorded by 26.4 ℃, 61 mm and 73 %, respectively (**Fig. 12**). The lowest incidence and severity of malformation of mango (1.58 and 1.67 %) were recorded in July, 2011 when temperature, rainfall and relative humidity were recorded by 29.2 ℃, 285 mm and 83%, respectively.

In Rajshahi, the highest incidence and severity of anthracnose disease of mango seedlings (4.83 and 3.64%) were recorded in July, 2010 when temperature, rainfall, and relative humidity were recorded by 29.7 ℃, 94 mm and 83 %, respectively (Fig. 13). The lowest incidence and severity of anthracnose disease of mango seedlings (1.77 and 1.51 %) were recorded in January, 2012 when temperature, rainfall and relative humidity were recorded by 16.7 ℃, 06 mm and 79 %, respectively. This result is in accordance with the findings of Ekbote *et al.*, (2001), Ploetz *et al.*, (1994) and Dickman and Alvarez (1983). In Rajshahi, the highest incidence and severity of leaf spot disease of mango seedlings (4.56 and 3.42 %) were recorded in July, 2011 when temperature, rainfall, and relative humidity were recorded by 29.3 ℃, 144 mm and 85 %, respectively (Fig. 14). The lowest incidence and severity of anthracnose disease of mango seedlings (2.00 and 1.90 %) were recorded in April, 2011 when temperature, rainfall and relative humidity were recorded by 27.6 ℃, 94 mm and 72%, respectively. The finding is strongly supported by Ploetz *et al.*, (1994). The highest incidence and severity of

red rust disease of mango seedling in Rajshahi (2.19 and 1.85%) were recorded in October, 2010 when temperature, rainfall and relative humidity were recorded by 27.0 oC, 127 mm and 85%, respectively (Fig. 15). The lowest incidence and severity of red rust disease of mango seedlings (1.02 and 0.73 %) were recorded in April, 2012 when temperature, rainfall and relative humidity were recorded by 28.6 ºC, 123 mm 69%, respectively. The result of the present study corroborate with the findings of Ploetz *et al.*, (1994). The highest incidence and severity of bacterial leaf blight disease of mango seedlings (8.745 and 8.16 %) were recorded in October, 2010 when temperature, rainfall and relative humidity were recorded by 27oC, 127 mm and 85%, respectively (Fig. 16). The lowest incidence and severity of bacterial leaf blight disease of mango seedlings (4.47 and 3.92 %) were recorded in April, 2011 when temperature, rainfall and relative humidity were recorded by 27.6 ºC, 94 mm and 72 %, respectively.
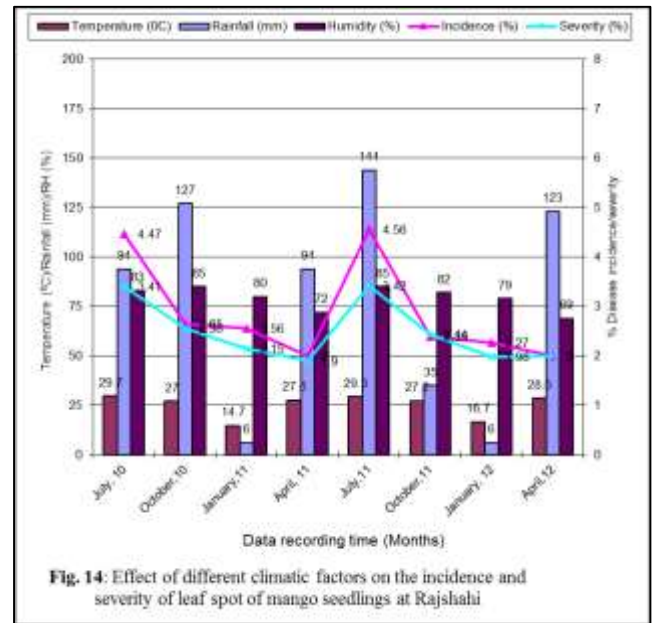

Fig. 14: Effect of different climatic factors on the incidence and severity of leaf spot of mango seedlings at Rajshahi
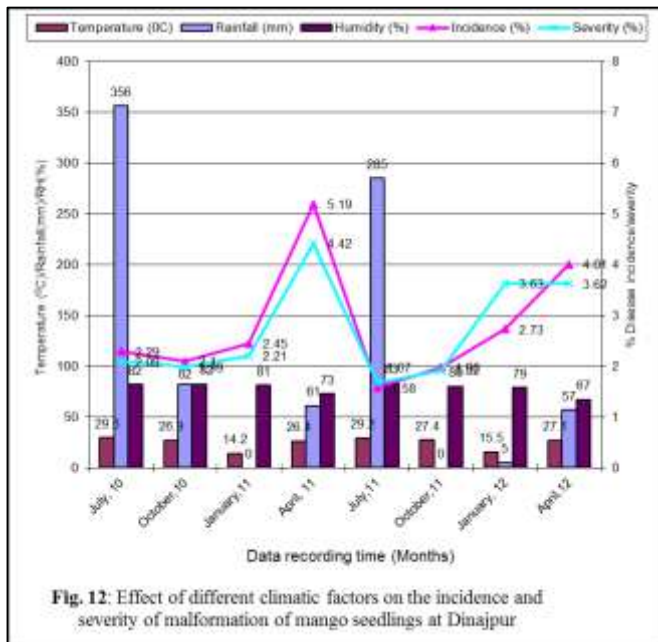

Fig. 12: Effect of different climatic factors on the incidence and severity of malformation of mango seedlings at Dinajpur
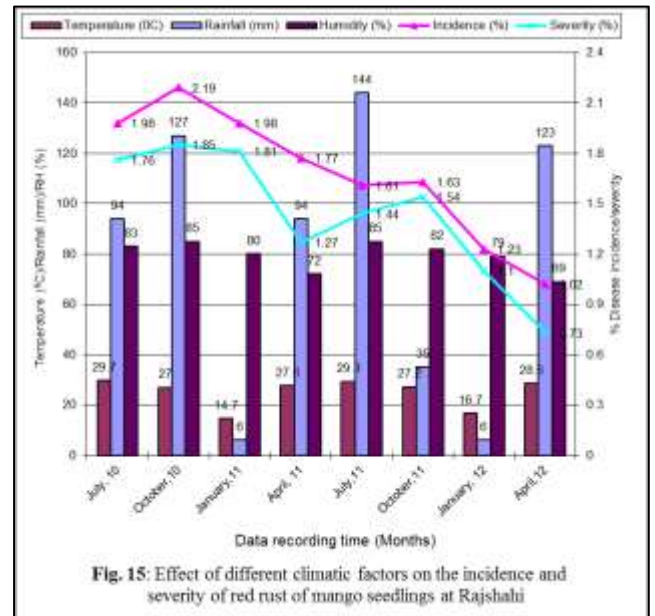

Fig. 15: Effect of different climatic factors on the incidence and severity of red rust of mango seedlings at Rajshahi
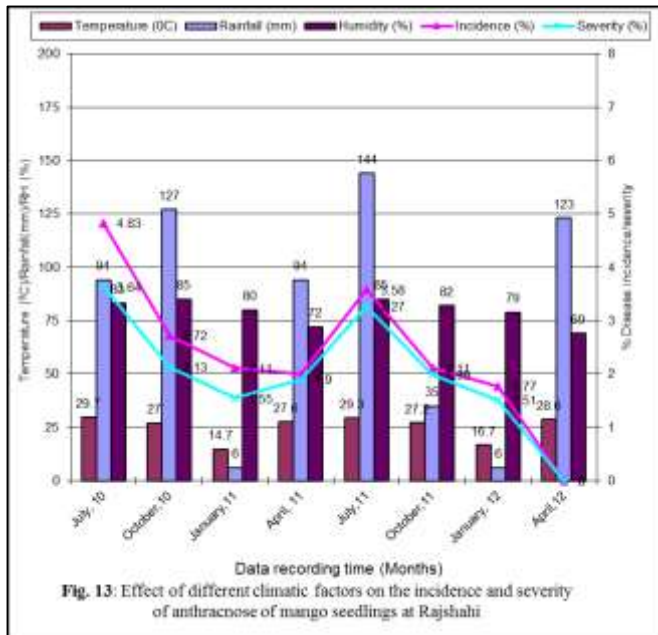
The highest incidence and severity of malformation disease of mango seedlings in Rajshahi (3.02 and 3.29%) were recorded in April, 2011 when temperature, rainfall and relative humidity were recorded by 27.6 ºC, 94 mm and 72%, respectively (Fig. 17). The lowest incidence and severity of malformation disease of mango (0.81 and 0.81 %) were recorded in July, 2011 when temperature, rainfall and relative humidity were recorded by 29.3 ºC, 144 mm and 85 %, respectively. In Khagrachari, the highest prevalence of anthracnose disease of mango seedlings was high (17.50 and 17.49 %) in July, 2010 at temperature, rainfall and relative humidity of 28.3 ºC, 304 mm and 84 %, respectively (Fig. 18). But minimum incidence and severity (8.25 and 7.99%) of anthracnose disease was recorded in April, 2011 at temperature, rainfall and relative humidity of 27.4oC, 78 mm and 72 %, respectively. This result is in accordance with the findings of Ekbote *et al.*, (2001).
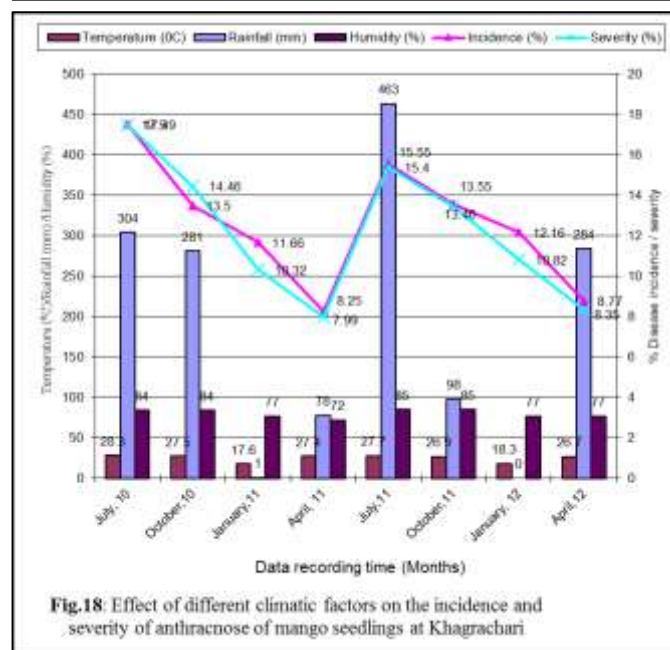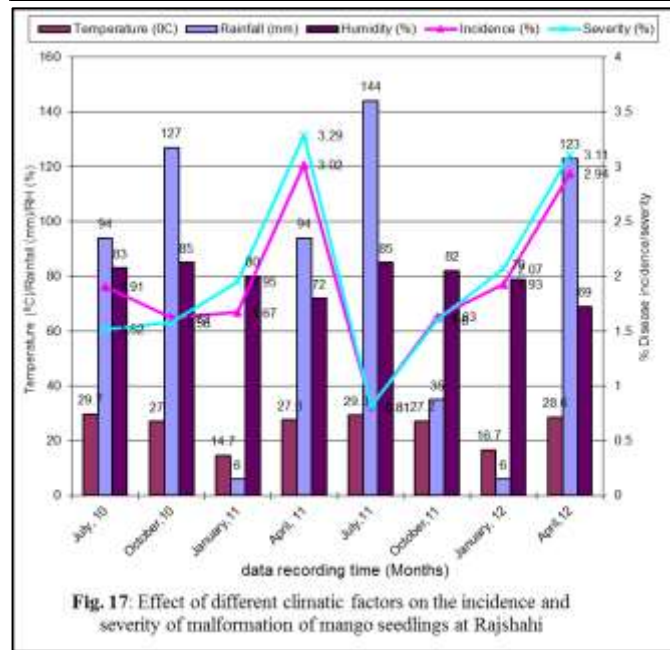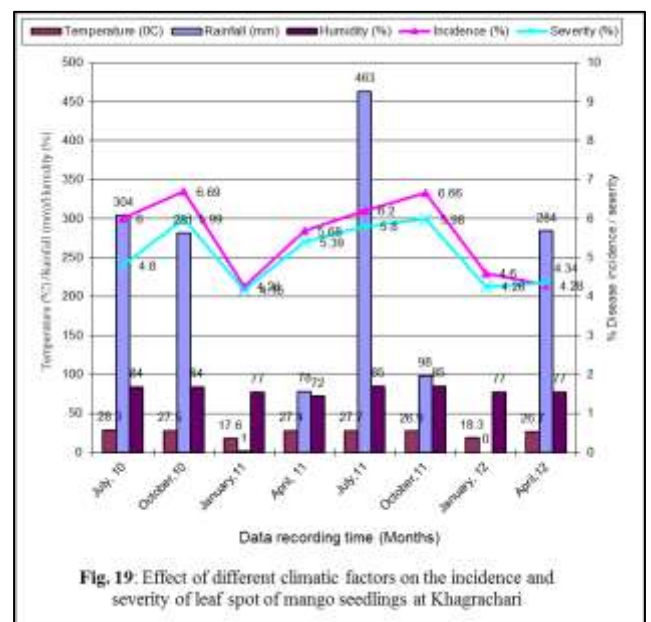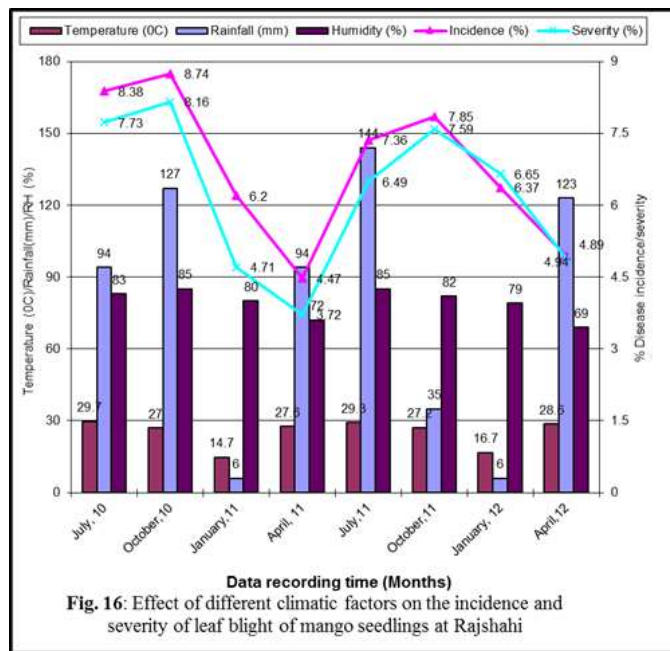

Fig. 13: Effect of different climatic factors on the incidence and severity of anthracnose of mango seedlings at Rajshahi

Fig. 16: Effect of different climatic factors on the incidence and severity of leaf blight of mango seedlings at Rajshahi

Fig. 17: Effect of different climatic factors on the incidence and severity of malformation of mango seedlings at Rajshahi

Fig.18: Effect of different climatic factors on the incidence and severity of anthracnose of mango seedlings at Khagrachari

Fig. 19: Effect of different climatic factors on the incidence and severity of leaf spot of mango seedlings at Khagrachari

Incidence and severity of leaf blight disease of mango seedlings was high (6.69 and 5.99 %) in October, 2010 when temperature, rainfall and relative humidity all were high by 27.5°C, 281 mm and 84%, respectively (Fig. 19). But minimum incidence and severity (4.26 and 4.16%) of leaf blight disease was recorded in January, 2011 at temperature, rainfall and relative humidity of 17.6 °C, 01 mm and 77%, respectively.

Conclusion

The weather parameters have profound effect on the occurrence of seedling diseases of mango and the effect differs significantly in different weather conditions. Critical study should be conducted on host-pathogen system to find out the most appropriate time to combat the disease at minimum effort. Further, other parameters of epidemiology viz. total amount of rainfall in the growing period, leaf wetness period, vapour presser deficit, sunshine hour, microclimate parameters including canopy temperature, relative humidity etc. should be critically evaluated to have better understanding of disease development.

Acknowledgement

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