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# Effect of Various Factors on the Development of Leaf Spot Disease in Mulberry

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**Abstract**

Effect of various factors such as temperature, relative humidity, balanced fertilizer and plant spacing on the development of leaf spot disease in mulberry caused by *Cercospora moricola* was studied. High disease development was recorded in the month of August and September when outdoor temperature and relative humidity were 25-30 ºC and above 80%, respectively. Application of balanced fertilizer and plant spacing on this disease development was also studied and showed a distinct effect on severity of this disease. A balanced dose application of NPK fertilizer decreased disease severity to 6-8%. Balanced fertilizer application in the soil resulted lower infection by leaf pathogen in comparison with imbalanced fertilizer application in the soil. Disease development was also found to be high at close plant spacing (60 × 60) cm than distance spacing (90 × 90) cm.

**Key words**: *Cercospora moricola*, Environment, Leaf spot, Mulberry

## Introduction

Mulberry (*Morus* sp.) plant is an important plant in the economy because silk production depends on the nutritive quality of the leaves, which is hampered by pathogen attack. The most common disease found on mulberry are leaf spot, bacterial blight, leaf mosaic, powdery mildew, leaf-rust, stem canker, violet root-rot, white root-rot, root- knot and dwarfing (Reddy *et al*., 2009; Shree and Nataraj, 1993). These pathogens are the main obstacles causing considerable loss in yield and nutritive value of mulberry foliage. Feeding of the diseased leaves affects the health of the silkworm adversely and cocoon yield in terms of quality and quantity (Datta, 2010). The lack of regular and systematic studies on the leaf spot disease and epidemics is responsible for the loss in leaf yield (Ghoes *et al*., 2010).

The environmental factors that most seriously affect the initiation and development of infectious plant disease are temperature and humidity of the air, amount of rainfall, soil temperature, moisture and fertility. These factors affect disease development through their influence on the growth and susceptibility of the host, on the multiplication and activity of the pathogen or on the interaction of host and pathogen relates to the severity of symptom development (Agrios, 2005).

Mulberry is attacked by a number of diseases (Reddy *et al*., 2009; Sharma *et al*., 1993). Among them leaf spot disease due to *Cercospora moricola* Cooke is the most serious disease during the month of July to September in Bangladesh (Ghoes *et al*., 2010). Severe defoliation and most of the commercial varieties are reported to be susceptible to this disease (Sikder and Krisnaswami, 1980). Siddaramaiah and Hegde (1990) was found that, increase in the intensity of infection by *C. moricula* resulted in higher nitrogen and phosphorus but lower potash level in mulberry leaves. They also found that *Cercospora* infection induces changes in the biochemical constituents like amino acids, phenols and sugars which may affect the quality of mulberry leaves. The highest risk for infections occurs when the temperature range is 20-28 ºC and there from 36 to 72 hours of continuous environmental wetness (Nelson, 2008). Humidity increases the succulence of host plants and thus their susceptibility to certain pathogens, which affects the extents the severity of disease (Agrios, 2005).

Because of the adverse environmental conditions, *Cercospora* leaf spot diseases are invaded mulberry plantation. So, there is every necessary in rising healthy plantation for production of quality leaf. In Bangladesh, effects of fertilizer and plant spacing on the development of leaf spot of mulberry have not been studied. Considering the above points, the present study was undertaken to evaluate the effect of temperature and relative humidity of the air, application of balanced fertilizer and nitrogen fertilizer to the soil and plant spacing on the development of leaf spot disease in mulberry.

### Materials and Methods

In order to evaluate the effect of temperature and relative humidity (RH) on the development of leaf spot disease in mulberry, percentage of leaf infection and disease index were studied at one month interval during April to September of the year 2004 to 2006 (Table 1). Three low cut mulberry plots were selected for the study in three different locations of Bangladesh Sericulture Research and Training Institute, Rajshahi. From each plot 15 plants were

selected and disease incidence was studied. The plot size was (20 × 20) m and plant to plant spacing was 120 cm. Disease development in normal environmental conditions was studied.

To study the effect of balanced dose of NPK fertilizer on the leaf spot disease development, a three years old low cut mulberry varieties viz., BM-1, BM-2, BM-3 and BM-4 plot was selected. The plot size was (20 × 15) m with plant to plant and row spacing of 120 cm and 90 cm, respectively. The plot was divided into two parts and in the first part, balanced NPK fertilizer dose of 300:150:100 kg/ha was applied along with 15000 kg/ha of organic fertilizer. In the other part only 15000 kg/ha of organic fertilizer was applied. Both the parts were given other cultural practices when necessary. All the plants were pruned in a day. After 30 days of pruning conidial suspension of *C. moricola* was sprayed equally to all the plants and allow growing normally. After 30 days conidial spray, percentage of leaf infection and disease index (DI) were recorded (Table 2).

In order to study effect of plant spacing on the leaf spot disease development a high bush mulberry plot was raised with three different spacing (Table 3); in one plot plant to plant and row to row distance was 60 cm, in the second plot the distance were 60 and 90 cm, respectively. In the third plot the distance was 90 cm. Crown heights of all the plants under different spacing were maintained at 75 cm. Two and three years old selected high bush plant were used for this study. All the plants of three different spacing were pruned in a day. The plants were allowed to be naturally infected during the rainy months of June, July and August. After 80 days of pruning, disease development was studied.

In this study leaf infection (%), plant height, % of disease index (DI) and leaf yield of mulberry against leaf spot disease were studied. In all cases total numbers of diseased and healthy leaves were recorded in three long branches of each plant to calculate disease index (DI) according to grading method of Siddaramaiah *et al*. (1978).

**Grading method**

0 = No infection (Healthy)

I = 1-5%

II = 6-25%

III = 26-50%

IV = 51-75%

V = 76-100%

Disease severity in terms of Disease index (DI) was calculated by the formula:

$$DI = \frac{\text{Sum of numerical value x 100}}{\text{Total no. of leaves graded x maximum grading in 5}}$$

Where numerical values were obtained by multiplying the number of leaves with their respective grading. All the studied were made in the three replications and average results were calculated. The DI values were transferred into angular values and statistical analysis was completed using Microsoft Excel software. LSD was determined, whenever; the calculated 'F' values were significant at 5% level (Sendecor and Cochran, 1980).

## Result and Discussion

It was assumed that the climatic conditions which materially affect the time and severity of disease infection could be summarized in terms of temperature and humidity. The results on the effect of temperature and relative humidity on the development of leaf spot disease in mulberry are shown in Table 1.

**Table 1.** Effect of temperature and relative humidity on thedevelopment of leaf spot disease.

| Month | Average temperature (°C) | | | Average relative humidity (%) | | | Infection (%) | | | Disease index (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | | | | | | | | | | | |
| | 2004 | 2005 | 2006 | 2004 | 2005 | 2006 | 2004 | 2005 | 2006 | 2004 | 2005 | 2006 |
| April | 29.41 | 30.11 | 28.39 | 50.11 | 46.63 | 59.03 | 19.20 | 17.10 | 18.70 | 7.33 | 6.54 | 7.00 |
| May | 29.71 | 29.48 | 28.68 | 77.48 | 66.62 | 73.90 | 18.90 | 24.20 | 24.40 | 7.10 | 8.70 | 9.11 |
| June | 29.46 | 30.44 | 29.26 | 83.94 | 73.79 | 81.01 | 29.80 | 31.70 | 29.60 | 8.24 | 12.60 | 10.60 |
| July | 29.21 | 28.75 | 29.36 | 84.40 | 85.93 | 83.54 | 30.00 | 36.70 | 34.50 | 9.52 | 15.22 | 12.73 |
| Aug. | 29.54 | 29.4 | 29.31 | 85.38 | 82.40 | 86.43 | 44.50 | 42.10 | 41.20 | 18.30 | 17.40 | 16.50 |
| Sept. | 28.61 | 28.78 | 25.46 | 89.26 | 88.26 | 87.23 | 50.62 | 52.70 | 51.79 | 21.60 | 23.50 | 20.80 |

The results showed that temperature of 25 to 30 ºC and relative humidity above 80% were found to favour the development of the disease. Rapid development of disease was found during the months of June, July, August and September when average temperature and relative humidity were about 25-30ºC and 80% and above, respectively. Although the disease was found in April, its development was not as fast as it was found from June to September. Leaf spot disease was found to be serious when there was abundant moisture and frequent rains followed by warm and humid weather. It was reported that air relative humidity >95% or leaf wetness was required for *Cercospora* infection and subsequent lesion development in sugar beet (Wolf and Verreet, 2005). The effect of temperature and duration of wetness on infection of three peanut cultivars by *Cercospora arachidicola* was reported (Wu *et al.*, 1999). Alderman and Beute (Alderman and Beute, 1986) reported that conidia of *Cercospora* require a saturated atmosphere to germinate at optimum temperatures of 16 to 25 ºC. Germ tubes elongated at a relative humidity as low as 94.5%. This study suggested that temperature and relative humidity are the most important factors for *Cercospora* infection on mulberry leaves.

The results on effect of balanced fertilizer dose of 300 kg/ha, 150 kg/ha and 100 kg/ha of NPK with 15000 kg of fertilizer/ha of organic fertilizer on the leaf spot disease development in mulberry are shown in Table 2.

Table 2. Effect of balanced fertilizer on the development of leaf spot disease.

| Treatment | BM-1 | | BM-2 | | BM-3 | | BM-4 | |
|---|---|---|---|---|---|---|---|---|
| | Leaf infection (%) | Disease index (%) | Leaf infection (%) | Disease index (%) | Leaf infection (%) | Disease index (%) | Leaf infection (%) | Disease index (%) |
| NPK Organic fertilizer | 26.82 ± 0.537 | 7.69 ± 0.526 | 28.54 ± 0.687 | 7.77 ± 0.0366 | 29.82 ± 0.433 | 6.94 ± 0.397 | 25.36 ± 0.852 | 5.72 ± 0.473 |
| Nil Organic fertilizer | 37.12 ± 0.515 | 12.46 ± 0.325 | 32.6 ± 0.325 | 10.67 ± 0.32 | 36.57 ± 0.497 | 9.97 ± 0.412 | 33.12 ± 0.523 | 9.57 ± 0.08 |
| C.D. at 5% level | 2.982 | 1.903 | 3.031 | 2.376 | 3.886 | 2.316 | 3.886 | 1.952 |

This study showed that balanced fertilizer application was found to decrease disease infection and disease severity in all the four varieties BM-1, BM-2, BM-3 and BM-4 in comparison with the imbalanced fertilizer application. The importance of fertilizer application for both increased productivity and quality mulberry leaves has been well recognized. It was reported that application of nitrogen and phosphate fertilizer increased disease incidence and the decreased disease development with full NPK fertilizer application in the soil (Sharma, *et al*., 1993). The efficiency of photosynthesis of the chlorophyll molecules is higher than that of the healthy plants not supplied balanced fertilizer. NPK is important and vital for increased production of good quality mulberry leaves. It helps to reduce the breakdown of chlorophyll caused by infection. Leaf spot disease development under different plant spacing is shown in Table 3.

Table 3. Effect of plant spacing on the development of leaf spot disease due to *Cercospora moricola*

| Plant spacing (cm) | Leaf infection (%) | Disease index (%) | Leaf yield/plant (g) |
|---|---|---|---|
| 60 × 60 | 37.89 ± 0.242 | 11.03 ± 0.191 | 265.43 ± 0.654 |
| 0 × 90 | 33.9 ± 1.017 | 9.03 ± 0.22 | 290.3 ± 1.616 |
| 90 × 90 | 28.94 ± 0.691 | 7.99 ± 0.098 | 302.37 0.092 |
| C.D. at 50% level | 1.387 | 0.274 | 14.789 |

In this study wider plant spacing were found to decrease the leaf spot disease development as compared to that of the narrow spacing. Narrow plant spacing of 60 × 60 cm was found to increase the disease development up to 37.89% with lower leaf yield whereas wider plant spacing of 60 × 90 cm and 90 × 90 cm resulted 33.90 and 28.98% disease development with higher leaf yield, respectively. High disease severity was also recorded in the plants with narrow spacing which might be due to reduced temperature, air circulation and reduction of light in between the dense plant population. Closer plant spacing increased humidity and cuts light resulting in reduction of air circulation. It was reported that higher disease incidence under different agronomical practices: spacing, crown height and harvesting method (Sharma *et al*., 1993). They found significantly higher disease incidence in closer spacing (60 × 60 cm) in all the diseases they studied (leaf spot, powdery mildew and leaf rust). Agronomical trends like spacing fertilization and irrigation influence the disease incidence in various crops.

## Conclusions

The present study suggested that farmers can be forewarned about the possible development and spread of the leaf spot disease of mulberry so that proper management of the disease can be done. To increase the productivity of silk, information regarding importance of NPK and proper dose of organic fertilizer along with proper plant spacing are also important to manage the severity of the disease.

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