STUDY ON SEEDLING DISEASES OF COCONUT (*Cocos nucifera* L.) IN SELECTED LOCATION OF BANGLADESH AND THEIR MANAGEMENT

SHAMS ANIKA

DEPARTMENT OF PLANT PATHOLOGY
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

JUNE, 2011

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BY
SHAMS ANIKA
REG. NO. : 05-01545

A Thesis
Submitted to the Faculty of Agriculture,
Sher-e-Bangla Agricultural University, Dhaka
in partial fulfillment of the requirements
for the degree

of

MASTER OF SCIENCE
IN
PLANT PATHOLOGY

SEMESTER: JANUARY-JUNE, 2011

APPROVED BY:

(Dr. M. Salahuddin M. Chowdhury)
Professor
Supervisor

(Abu Noman Faruq Ahmmed)
Assistant Professor
Co-Supervisor

(Associate Professor Nazneen Sultana)
Chairman
Examination Committee

Dr. M. Salahuddin M. Chowdhury
Professor
Department of Plant Pathology
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

Mob : + 8801713382588
E-mail : smc_1968@yahoo.com

CERTIFICATE

This is to certify that the thesis entitled, "**STUDY ON SEEDLING DISEASES OF COCONUT (*Cocos nucifera* L.) IN SELECTED LOCATION OF BANGLADESH AND THEIR MANAGEMENT**" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** in **PLANT PATHOLOGY**, embodies the result of a piece of bona fide research work carried out by **Shams Anika** Registration number: **05-01545** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated: 30.06.2011
Dhaka, Bangladesh

Dr. M. Salahuddin M. Chowdhury
Professor
Department of Plant Pathology
Sher-e-Bangla Agricultural University
Supervisor

Dedicated to
My
Beloved Parents

ACKNOWLEDGEMENT

The author deems it a much privilege to express her enormous sense of gratitude to the almighty Allah for there ever ending blessings for the successful completion of the research work.

The author feels proud to express her deep sense of gratitude, sincere appreciation and immense indebtedness to her supervisor Prof. Dr. M. Salahuddin M. Chowdhury, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, for her continuous guidance, co-operation, constructive criticism and helpful suggestions, valuable opinion in carrying out the research work and preparation of this thesis, without her intense co-operation this work would not have been possible.

The author feels proud to express her deepest respect, sincere appreciation and immense indebtedness to her co-supervisor Assistant Prof. Abu Noman Faruq Ahmmed, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, for her scholastic and continuous guidance, constructive criticism and valuable suggestions during the entire period of course and research work and preparation of this thesis.

The author expresses her sincere respect to Associate Professor and Chairman, Nazneen Sultana, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka for valuable suggestions and cooperation during the study period. The author also expresses her heartfelt thanks to all the teachers of the Department of Plant Pathology, SAU, for their valuable teaching, suggestions and encouragement during the period of the study.

The author expresses her sincere appreciation to her beloved father S.M. Shamsuddoha, mother Hazera Doha, her sister Shams Anamika, other members of the family, well wishers and friends for their inspiration, help and encouragement throughout the study.

The Author

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STUDY ON SEEDLING DISEASES OF COCONUT (*Cocos nucifera* L.) IN SELECTED LOCATION OF BANGLADESH AND THEIR MANAGEMENT

ABSTRACT

Seedlings diseases of coconut and the effect of weather parameters on the diseases were studied during 2010 to 2012 in different growing locations of Bangladesh with an effort to development a suitable disease management practice. Important plant pathogens *Pestalotia* sp., *Cercospora* sp., *Curvularia sp.* and *Phytophthora* sp. were detected and identified as causal agent of leaf spot and leaf blight diseases of coconut seedlings. Disease incidence and severity observed higher in Dhaka than Khulna in different nursery surveyed. Effect of weather parameters on incidence and severity of diseases were studied and significant variations were observed. The highest disease incidence (84.60%) and severity (33.74%) was recorded by the effect of *Pestalotia* sp. And the lowest disease incidence (2.25%) and severity (2.83%) was recorded by the effect of *Phytophthora* sp. Temperature, relative humidity and rainfall act as parameter in this study. The highest disease incidence and severity occurred in the month of April and July and the lowest in December. Effectiveness of four chemical fungicides viz. Cupravit 50 WP, Mancozeb, Dithane M-45 and Bavistin 50 WP were evaluated on coconut seedling diseases in the nursery. Among the treatments applied Cupravit 50 WP and Dithane M-45 showed better result than Mencozeb and Bavistin in controlling disease incidence and severity of leaf spot and leaf blighted diseases of coconut.

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LIST OF SYMBOLS AND ABBREVIATIONS

%	=	Percentage
et al.	=	and others
spp.	=	Species
J.	=	Journal
No.	=	Number
viz.	=	Namely
df.	=	Degrees of freedom
@	=	At the rate of
&	=	and
etc	=	Etcetera
PDA	=	Potato Dextrose Agar media
^{0}C	=	Degree Celsius
cm	=	Centimeter
BBS	=	Bangladesh Bureau of Statistics
Kg	=	Kilogram
CV%	=	Percentages of Co-efficient of Variance
LSD	=	Least Significant Difference
Sci.	=	Science
ANOVA	=	Analysis of variances
hr	=	Hour (s)
cv.	=	Cultivar (s)
T	=	Treatment
ft	=	feet (s)
pv.	=	pathovar
syn.	=	synonym
var.	=	variety
mm	=	milimiter
µm	=	micrometer
USA	=	United State of America

Chapter 1

Introduction

CHAPTER -I

INTRODUCTION

Coconut (*Cocos nucifera*) palms are found naturally in tropical coastal areas all around the world. Coconut is the archetypal smallholder crop of the coastal tropics (Persley, 1992). Coconut survive long voyages at sea because the fibre on the shell is thick, light and water tight, allowing the coconut to float, plus there a lot of food inside for the seed to feed. More than 1500 species in the palm family of plants (palmaceae), the coconut palm is the best known. A unique tree, with no really close relatives (it is the only member of the genus *Cocos)*, it is considered to be one of the most useful trees in the world. A recent study reported 360 contemporary uses for this tree, half of which were for food.

Coconut palms have been called the 'tree of life' because of the huge variety of uses. They are cultivated throughout the tropics for fibre and fuel, but are best known as a food. They are also the seventh most important vegetable oil crop in the world. Coconut cultivation in South Asia is manly confined to the southern and coastal areas. Coconut has grown on an estimated 11.6 Mha in 86 countries and 96% total world production comes from smallholdings. About 85% of the crop is produced in Asia and pacific region (Persley, 1992). Bangladesh produces a smaller amount of coconut which cannot fulfill our daily demand, though a great weather and soil support are present to produce a huge amount of coconut in Bangladesh.

Coconut fruit and its different edible parts is a great source of calorie, fat, carbohydrate, protein, minerals and vitamins. Coconut water provides eight percent of the daily value of vitamin C. It also contains four percent of the daily value for thiamine and three percent of the daily value for vitamin B_6. Coconut oil aids metabolism and provides stamina since your body burns the fats in the oil for energy. A serving of coconut meat contain a total of 180 calories. This provides nine percent of the daily value for calories, assuming the standard intake of 2,000 calories per day.

Although coconut water is popular refreshment during workouts, the water often carries a higher cost than other popular sports drinks. So that we need to increase coconut plantation. More production of healthy and disease free coconut seedlings can increase coconut production in our country.

Quantity and quality of coconut in this country is far below the world standard. There are several factors responsible for low yield and poor quality of coconut in Bangladesh. The climate of Bangladesh harbors plant pathogens and provide luxuriant environment for the growth and reproduction of large number of plant pathogens which causes hundreds of different diseases of crops (Fakir, 2001).

Healthy seedlings are prime need and basic raw material for establishment of plantation for the production of coconut. That's why seedling diseases are an important consideration for coconut production. Seedling is frequently affected by physical and physiological disorders as well as diseases caused by fungi, bacteria and viruses (Mittal and Mathur, 1990). Seed-borne pathogens affect nursery seedlings and reduce seedling vigor (Abdelmonem and Rasmi, 2003). So, seedling diseases of coconut are one of the important problems in the tropics. Although a huge number of nurseries are engaged in producing seedlings, they fail to produce quality seedlings due to lack of their knowledge about diseases. Seed after germination are liable to attack by different soil borne organisms. Even after emergence of the seedling, it could be attacked by different diseases which may produce distinct symptoms in the nursery bed or it may carry the organisms when it is transplanted in the orchard or any selected place. In severe cases, diseases cause mortality of many seedlings after plantation (Chowdhury, 2009). For this reasons, seedlings are to be reared up with proper care in order to avoid the diseases and to ensure quality and quantity production and increasing yield of coconut. Thus production of healthy seedlings ensures good plantation and save money, labor and energy of coconut gardener.

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Seedlings of coconut are affected by diseases mostly of fungal disease. Such as, leaf spot (Pestalotia leaf spot, Curvularia leaf spot, Alternaria leaf spot, Cercospora leaf spot), leaf blight (Phytophthora leaf blight, Cercospora leaf blight) and bud rot caused by *Phytophthora* sp., *Fusarium* sp. and *Curvularia* sp. To control and reduce the disease incidence and severity different types of fungicides were applied.

The existing technology of cultivation of palm crops in the country is in a stage that needs to be upgraded for successful coconut production in order to meet up the national demand. So, studies on the seedling disease of coconut and their management are the urgent need in the country.

Considering the above facts, the present research work is designed with the following objectives:

i) Survey on the prevalence of seedling disease of coconut in some selected nurseries of Dhaka and Khulna.
ii) To identify the pathogen(s) associated with the disease.
iii) To study the effect of temperature, relative humidity and rainfall on incidence and severity of nursery disease of coconut.
iv) To find out a suitable management strategies for controlling nursery disease of coconut.

Chapter 2

Review of literature

CHAPTER-II

REVIEW OF LITERATURE

Coconut is one of the important and nutritious fruit of Bangladesh. Almost all of the parts of the plant are used. Copra, the dried endosperm and the source of edible oil, is the main economic product world-wide. Coconut suffers from numerous diseases. Coconut plants are prone to the attack of many diseases at all stages of its growth. The diseases of coconut seedlings have been studied in Bangladesh to a limited content. In this chapter an attempt has been made to review the available literature about symptoms of nursery diseases of coconut, their causal organism, status of the diseases, epidemiology and management practices of these diseases.

Randless *et al.* (1999) showed that severely attack of *Phytophthora* sp on coconut leaves can caused the leaves totally damaged. A lateral necrosis of the petiole developed which caused the leaf to die and hanged from the canopy. The appearance of a normal apex and several yellowish leaves that hanged through green older leaves was characterstic of the Phytophthora leaf spot disease.

Ploetz *et al.* (1999) described the effect of fungicide on Cercospora leaf spot disease on coconut plant where Cu fungicide and Dithane M-45 represent the best result to control the leaf spot disease of coconut.

Simatupang (1999) reported that Curvularia leaf spot showed on younger coconut leaves produced black color spotted symptom on leaves and centered area partially black or whitish black color appeared. The spots were normally irregular in size and in severe condition whole leaf was spotted and visually no green area observed on the leaves.

Concibido-Manohar and Abad (1994) reported that the disease incidence of Phytophthora leaf spot on coconut was higher rate in humid and tempered area. The incidence gradually increased with the time and caused a great economic loss.

Franqueville *et al.(*1994) worked on the behavior of coconut tree with respect to Phytophthora were carried out in the Ivory Coast, Indonesia, and the Philippines. He showed *Phytophthora* sp. were perfomed for more than ten years for individual and systematic survey of mortality due to bud rot and premature nutfall.

Selvan *et al.* (1993) worked on the leaf spot diseases of coconut plant with some fungicide and observed the best controlling fungicide against leaf spot disease are Bavistin and Cu-fungicide rather and Tilt and other fungicide.

Schuiling *et al.* (1992) researched that the incidence and severity of leaf spot diseases of coconut differs significantly from region to region in Tanzania.

Joseph and Radha (1975) observed pink to reddish brown younger tissue and leaf necrosis on coconut seedlings due to the attack of *Phytophthora* sp. At the later stages the younger leaves often showed rotten area on the attacking portion of the *Phytophthora* pathogen.

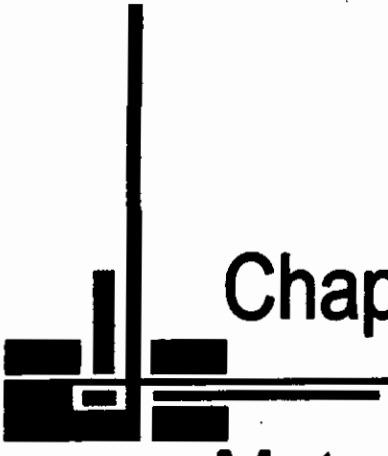
Papa Rao *et al.* (1975) reported that leaf blight causing pathogen *Pestalotia* on coconut leaves can be effectively reduced by applying Bordeaux mixture 1% or Fytolan 0.5% which were Cu containing fungicide.

Mordue and Holiday (1971) reported grey leaf blight on coconut leaves caused by *Pestalotia palmarum* produced small yellow to brown spots on leaflets and rachis that develop grey centers with dark brown borders as they enlarge.

Menon and Pandalai (1960) observed chlorosis and blighted symptom on the younger leaves of coconut plants caused by *Pestalotia* pathogen. At first spotted area shown on leaves which gradually turned on to blight.

Martinez (1954) showed the effect of Cu fungicide on Cercospora leaf spot on coconut reduce the disease incidence and severity at a greater rate. Cupravit and Bordeaux mixture showed the best result on the reduction of leaf spot on coconut leaves caused by *Cercospora* sp.

Menon and Nair (1952) showed the variation of incidence and severity of Phytophthora leaf spot disease of coconut from one location to another with temperature and humidity. Most of time disease occurred severely on humid area and in moderately high temperature.



Chapter 3

Materials and methods

CHAPTER III

MATERIALS AND METHODS

Three experiments were carried out throughout the study period in order to study the seedling diseases of coconut. The experiment was as follows:

i) Survey on the seedling diseases of coconut in some selected nurseries of Bangladesh.

ii) Identification of causal organisms of the seedling diseases of coconut.

iii) Epidemiological survey on the prevalence of seedling diseases of coconut.

iv) Evaluation of fungicides to manage seedling diseases of coconut.

3.1. Experiment I. Survey on the seedling diseases of coconut in some selected nurseries of Bangladesh

3.1.1. Location of survey area

Prevalence of diseases occurring on coconut seedlings raised in the selected nurseries was surveyed. The experiment was carried out in five nurseries of Dhaka and Khulna.

3.1.2. Selection of Nursery

The five nurseries of two districts were surveyed:

Name of District	Name of nursery
Dhaka	• Experimental field, SAU • Green orchid nursery, Agargaon
khulna	• Dalhia nursery, Khulna • New market nursery, New market • Bagan Bilash nursery, Joragate, khulna

3.1.3. Age and number of seedlings

The age and number of the seedlings included for the survey are presented in Table 1.

Table1. Age of the coconut seedlings and total number of seedlings in selected Five nurseries from July, 2010 to April, 2012

Nurseries	Age of the seedling (Years)	Number of seedlings (July, 2010-July, 2011)	Number of seedlings (October, 2010-October, 2011)	Number of seedlings (January, 2011- January, 2012)	Number of seedlings (April, 2011- April, 2011)
Experimental field, SAU	1	45	50	50	45
Green orchid nursery, Agargaon, Dhaka	1	70	75	75	80
Dalhia nursery, Khulna	1	80	80	80	80
New market nursery, Khulna	1	60	60	65	65
Joragate nursery, Khulna	1	85	80	80	85

3.1.4. Observation of the symptoms

Symptoms of the diseases were studied by visual observation. Sometimes hand lens was used for critical observation of the disease and sometimes a disease was identified based on matching the observed symptoms in the infected plants with the symptoms published in Ber and other coconut disease compendium.

3.2. Experiment II: Identification of causal organisms

3.2.1. Collection of diseased specimen

Diseased leaves were collected from the infected plants of different surveyed areas. The specimens were preserved in the laboratory following standard procedure until isolation was made.

3.2.2. Isolation of causal organisms was made by two methods as follows:

3.2.2.1. Moist blotter method

The pathogen associated with the diseased plant parts (leaves) were cut into several pieces by scissors and placed on the moist filter paper (Whatman no.1). Three pieces of filter paper were moistened by dipping in sterile water. The petridishes with the diseased specimens were incubated at 22±2°C under 12/12 alternating cycles of NUV and darkness in the incubation room of the Seed Pathology Lab (SPL) for three to five days. After incubation the plates were examined under stereomicroscope for primary identification of the organisms (fungi). The fungi were transferred to PDA plates for proper sporulation and purification.

3.2.2.2. Preparation of Potato Dextrose Agar (PDA) media

Two hundred grams peeled potato chips and 500 ml of water were boiled together for 15 minutes so that the potato tissues were softened. Then the prepared pulp was sieved through a muslin cloth; 20 g of agar and 500 ml of water were heated together and a solution was made. Then 17 g of dextrose was added to it and 1000 ml of potato dextrose medium was prepared.

3.2.2.3. Agar plate method

The diseased plant parts (leaves) were surface sterilized by dipping them in 0.001% $HgCl_2$ solution for 1.5 minutes and washed three times with sterile water and there after placed on PDA (Potato = 200g, Dextrose = 17g, Agar = 17 - 20g, Water = 1000ml) plates aseptically. The plates were incubated at 28°±1°C for several days and examined daily for any fungal growth.

3.3. Experiment III: Epidemiology of disease incidence and severity

3.3.1. Survey period

Altogether eight surveys were made during the period from July, 2010 to April, 2012 where first, second, third, fourth, fifth, sixth, seventh, and eighth surveys were made in July 2010, October 2010, January 2011, April 2011, July 2011, October 2011, January 2012, and April 2012 respectively.

3.3.2. Data collection during survey

During the survey in the nurseries, total numbers of coconut seedlings as well as number of diseased seedlings in the nurseries were recorded. Then 30 seedlings were randomly selected for counting diseased leaves and disease free leaves. Moreover, five leaves per plant were randomly selected to determine the disease severity.

3.3.3. Determination of disease incidence and disease severity

For calculation of incidence of disease every seedling was counted in the nursery and also counted the infected seedlings and then expressed in percentage. The disease incidence of coconut seedling was determined by the following formula (Rai and Mamatha, 2005):

$$\text{Percent plant infection} = \frac{\text{Number of diseased plants}}{\text{Number of total plants observed}} \times 100$$

Percent Disease severity (PDI) was determined by the following formula (Rai and Mamatha, 2005):

$$\text{Percent Disease Severity (Leaves)} = \frac{\text{Area of leaf tissue infected by disease}}{\text{Total leaf area of the plant}} \times 100$$

3.4. Experiment IV: Efficacy of fungicides in controlling the nursery diseases of coconut

3.4.1. Experimental sites

The research work was conducted to determine the effective fungicides in controlling the coconut diseases was carried out at Sher-e-Bangla Agricultural University, Dhaka-1207.

3.4.2. Experimental period

The experiment was carried out from July 2010 to April 2012.

3.4.3. Preparation of nursery soil

The substratum was prepared by mixing soil, sand and well decomposed cow dung in the proportion of 2:1:1 and sterilized with 5 ml formalin (40%) diluted with 20 ml water for 4 kg soil (Dashgupta,1988). The prepared soil was heaped in square block. Soil heap was covered by a polythene sheet for 48 hr to make the soil free from soil borne inocula. After 4 days of treatment the sterilized soil was prepared.

3.5. Meterological data collection

Meterologial data of the experimental period were collected from Meterological Department, Agargaon, Dhaka

3.6. Treatments:

For the management of nursery disease four different fungicides were evaluated. Four different fungicides were applied against different plant pathogens in the experiment. Normal tap water was used for controlled plot experiment. The fungicides were applied as foliar spray at 30 days interval. The different treatments used in the experiment are as follows:

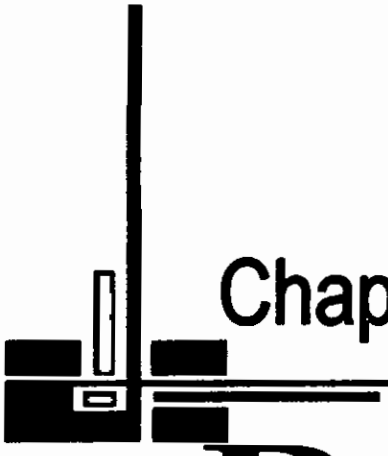
Treatments		Dose used
T_1	Bavistin 50 WP	0.2%
T_2	Mencozeb	.0.2%
T_3	Dithane M-45	0.2%
T_4	Cupravit 50 WP	0.2%
T_5	Untreated control	

3.7. Data collection

In experimental field coconut seedling were arranged in seven rows and five columns. The total number of seedling was thirty five.

3.8. Statistical analysis

Data on different parameters were analyzed in two factor randomized block design (RCBD) through computer software MSTAT-C (Anonymous 1989). Duncan's Multiple Range Test (DMRT) and Least Significant difference (LSD) test were performed to determine the level of significant differences and to separate the means within the parameters.



Chapter 4

Results

CHAPTER-IV

RESULTS

4.1. Survey on nursery diseases of coconut

Different fungal leaf spot and leaf blight diseases were recorded in the survey conducted in five nurseries of Dhaka and khulna districts.

4.2. Symptom of the diseases and identification of the pathogen

Leaf spot and blight of coconut

4.2.1. Pestalotia leaf spot and blight

The observed symptoms consist of sunken, dark brown colored, necrotic lesions. At the later of time, the small sunken lesions coalesce to form large necrotic patches and causes leaf blight.

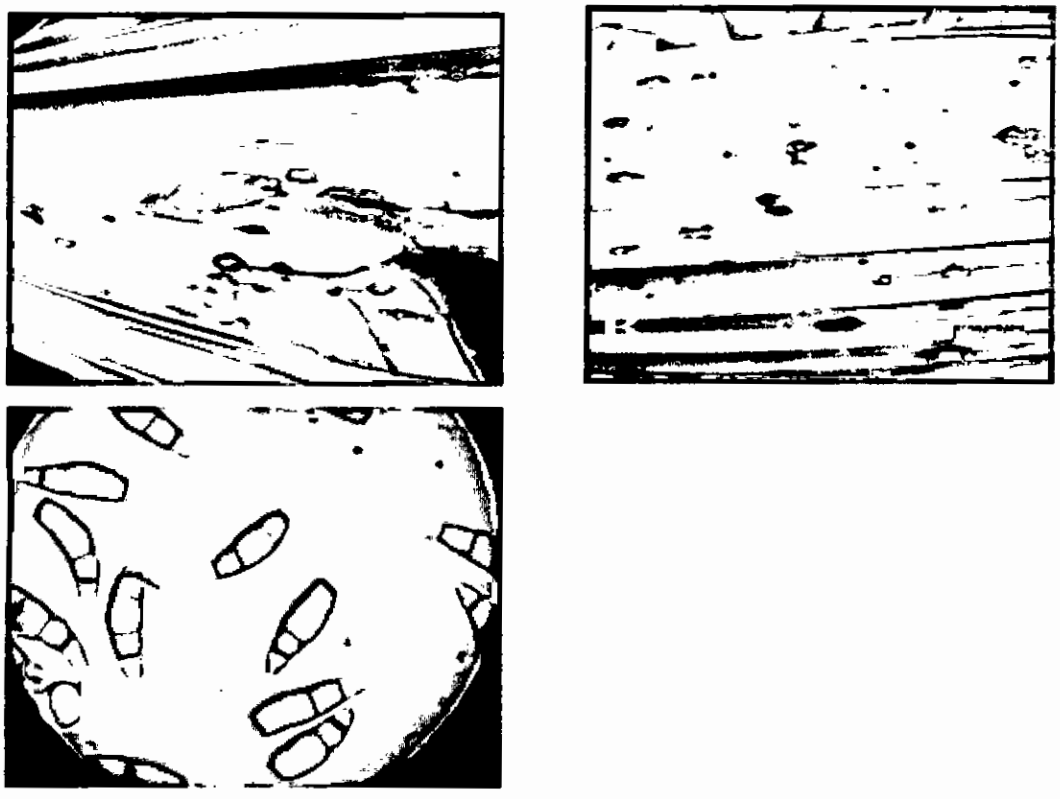


Plate 1: **A.** Pestalotia leaf blight and **B.** Leaf spot disease symptom on leaves of Coconut seedling. **C.** Conidia of *Pestalotia* sp.

4.2.2. Cercospora leaf spot

Dark black colour necrotic irregular lesions on the leaves of coconut seedling. In severe cases the entire leaf covered with black spots. The conidia of *Cercospora* sp. are slightly elongated and sickle shaped.

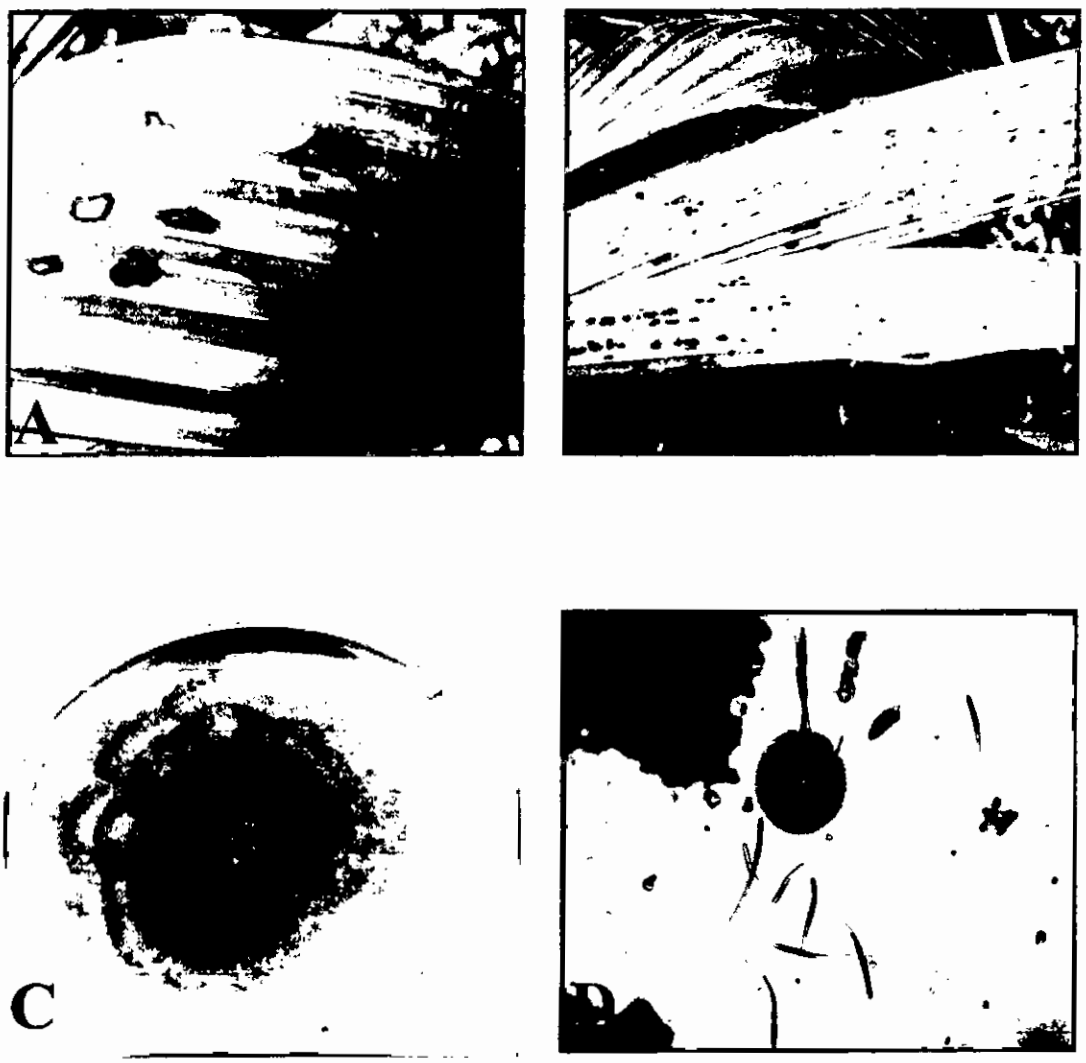


Plate 2: A. & B. Cercospora leaf spot disease symptom observed on young leaves of coconut plant. **C.** Culture of *Cercospora* sp. **D.** Conidia of *Cercospora* sp.

4.2.3. Curvularia leaf spot

The spots are irregular in size and the side of spots covered with black color rather than the middle portion. The conidia of *Curvularia* sp.are multi celled and pure culture normally black in color.

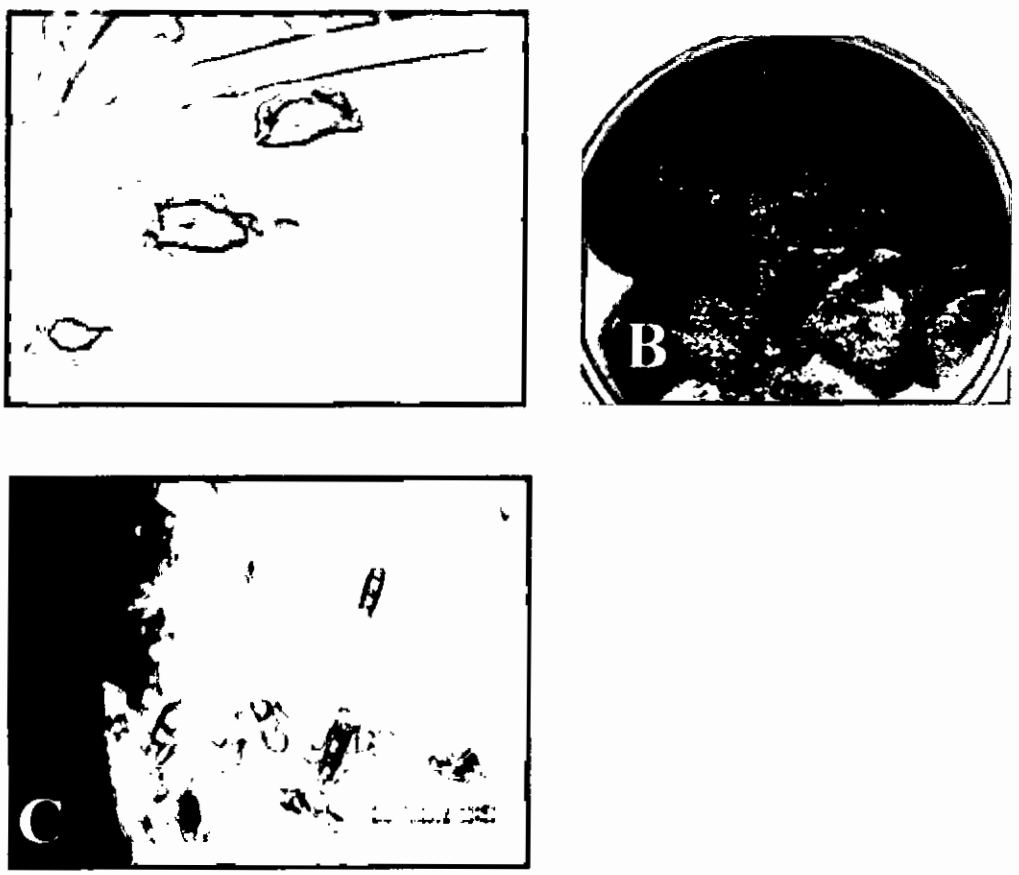


Plate 3: A. Curvularia leaf spot disease on coconut seedling leaves. **B.** Pure culture of *Curvularia* sp. isolated from diseased leaf of coconut. **C.** Conidia of *Curvularia* sp. under compound microscope .

4.2.4. Phytophthora leaf spot

Whitish sunken lesion with black margin observed on the coconut leaves due to Phytophthora leaf spot disease. It was not possible to make pure culture and no pathogen was identified for the lack of suitable specimen.

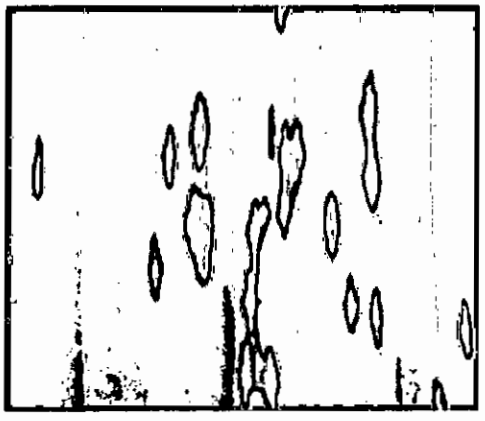


Plate 4: A. Phytophthora leaf spot disease showed on coconut leaves

4.3. Epidemiology of seedling diseases

4.3.1.1. Incidence and severity of Pestalotia leaf spot of coconut at different locations of Bangladesh from July, 2010 to April, 2012

Incidence of Pestalotia leaf spot of coconut varied from location to location and year to year that 61.78% in Khulna and 73.22% in Dhaka in 2010-2011 and 62.55% in Khulna and 70.67 % in Dhaka in 2011-2012 (Table 2). The highest incidence was recorded at Dhaka and the lowest was recorded at Khulna in both the years. The severity of Pestalotia leaf spot of coconut also varied from location to location and year to year that 22.69% in Khulna and 25.59 in Dhaka in 2010-2011 and 21.27% in Khulna and 25.36% in Dhaka in 2011-2012. The highest severity was recorded at Dhaka in 2010-2011 and the lowest was recorded Khulna 21.27% in 2011-20112 .

Table 2. Incidence and severity of Pestalotia leaf spot of coconut at different locations of Bangladesh from July, 2010 to April, 2012

Location	Pestalotia leaf spot			
	Incidence (%)		Severity (%)	
	2010-2011	2011-2012	2010-2011	2011-2012
Dhaka	73.22 a	70.67	25.59	25.36
Khulna	61.78 b	62.55	22.69	21.27
$LSD_{(p\geq0.05)}$	7.242	NS	NS	NS
CV%	4.68	5.44	7.85	9.08

4.3.1.2. Incidence and severity of Pestalotia leaf spot of coconut during July, 2010 to April, 2012

Incidence of Pestalotia of coconut varied from July, 2010 to April, 2012 and that ranged from 83.61-46.67% in 2010-2011 and 84.60-40.58% in 2011-2012 (Table 3). The highest incidence was recorded in July in 2010-2011 and April in 2011-2012 and the lowest was recorded in January both the years. The severity of Pestalotia of coconut also varied from year to year that ranged from 11.10-33.74% in 2010-2011 at 10.17-33.58% in 2011-2012. The highest severity was recorded in July in both the years, and the lowest was recorded in January in both the years.

Table 3. Incidence and severity of Pestalotia leaf spot of coconut during July, 2010 to April 2012

Time of data collection	Pestalotia leaf spot			
	Incidence (%)		Severity (%)	
	2010-2011	2011-2012	2010-2011	2011-2012
July	83.61 a	78.33 a	33.74 a	33.58 a
October	61.22 b	62.92 b	22.85 c	22.77 c
January	46.67 c	40.58 c	11.10 d	10.17 d
April	78.50 a	84.60 a	28.87 b	26.73 b
$LSD_{(p\geq0.05)}$	5.623	6.450	3.369	3.767
CV%	4.68	5.44	7.85	9.08

4.3.1.3. Incidence and severity of Pestalotia leaf spot of coconut during July, 2010 to April, 2012 of different experimental locations of Bangladesh.

Incidence of Pestalotia of coconut varied significantly from season to season as well as location to location and that ranged from 43.33-92.11% in 2010-2011 and 36.50-86.67% in 2011-2012 (Table 4). The highest (92.11% and 86.67%)

incidence of Pestalotia leaf spot of coconut recorded in the month of July, 2010 and April, 2011 at Dhaka, respectively. The lowest (43.33% and 36.50) incidence was observed in the month of January, for both the years at Khulna respectively. The severity of Pestalotia of coconut also varied significantly from season to season as well as location to location and that ranged from 9.66-35.20% in 2010-2011 and 10.00-35.00% in 2011-2012. The highest (35.20% and 35.00%) severity of Pestalotia of coconut observed in the month of July, 2010 and 2011 both at Dhaka while the lowest (9.667% and 10.00%) was recorded in the month of January for both the years at Khulna .

Table 4. Incidence and severity of Pestalotia leaf spot of coconut during July, 2010 to April, 2012 of different experimental locations of Bangladesh

Location	Data recording time(month)	Pestalotia leaf spot			
		Incidence(%)		Severity(%)	
		2010-2011	2011-2012	2010-2011	2011-2012
Dhaka.	July	92.11 a	86.33 a	35.20 a	35.00 a
	October	65.11 d	65.00 bc	24.07 de	25.00 c
	January	50.00 f	44.67 d	12.53 f	10.33 e
	April	85.67 b	86.67 a	30.54 bc	31.10 b
Khulna	July	75.11 c	70.33 b	32.28 ab	32.17 ab
	October	57.33 e	60.83 c	21.63 e	20.53 d
	January	43.33 g	36.50 e	9.667 f	10.00 e
	April	71.33 c	82.53 a	27.19 cd	22.37 cd
$LSD_{(p\geq0.05)}$		5.623	6.450	3.369	3.767
CV(%)		4.68	5.44	7.85	9.08

Each data represents the mean value of five nurseries.

4.3.1.4. Effect of different weather factors on the incidence and severity of Pestalotia leaf spot of coconut seedling during July, 2010 to April, 2012

In different growing seasons of coconut seedlings, the highest incidence (83.61% and 84.60%) and the highest severity (33.74% and 33.58%) of Pestalotia disease were recorded in July and April, in two years when average temperature, relative humidity and rainfall were 29.65°C, 81.40% and 7.55 cm, and 30.50°C, 83.50%, 5.50 cm, respectively. On the other hand, lowest incidence (46.67% and 40.58%) and the lowest severity (11.10% and 10.17%) were recorded in January, for both the years when average temperature, relative humidity and rainfall were 16.88°C, 73.80% and 0.52 cm, and 18.46°C, 76%, 0.60 cm, respectively (Fig.1&2).

Figure 1. Effect of different weather factors on the incidence and severity of Pestalotia leaf spot of coconut seedling during July, 2010 to April, 2011

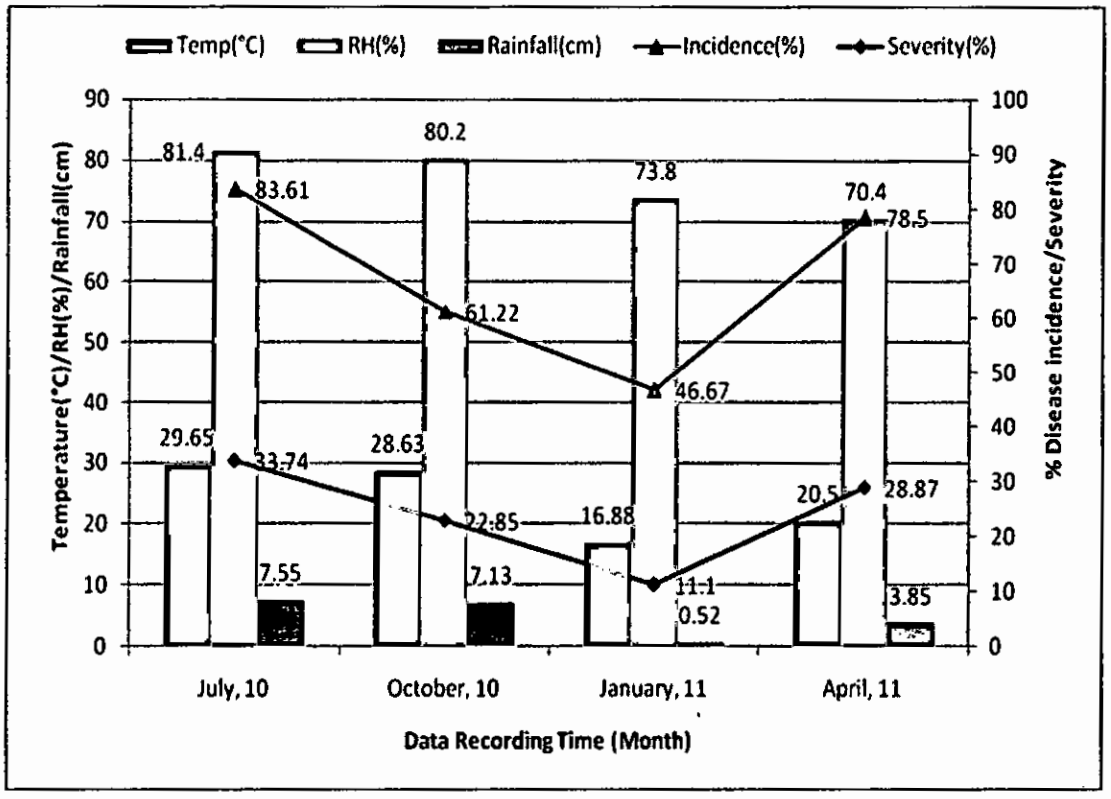
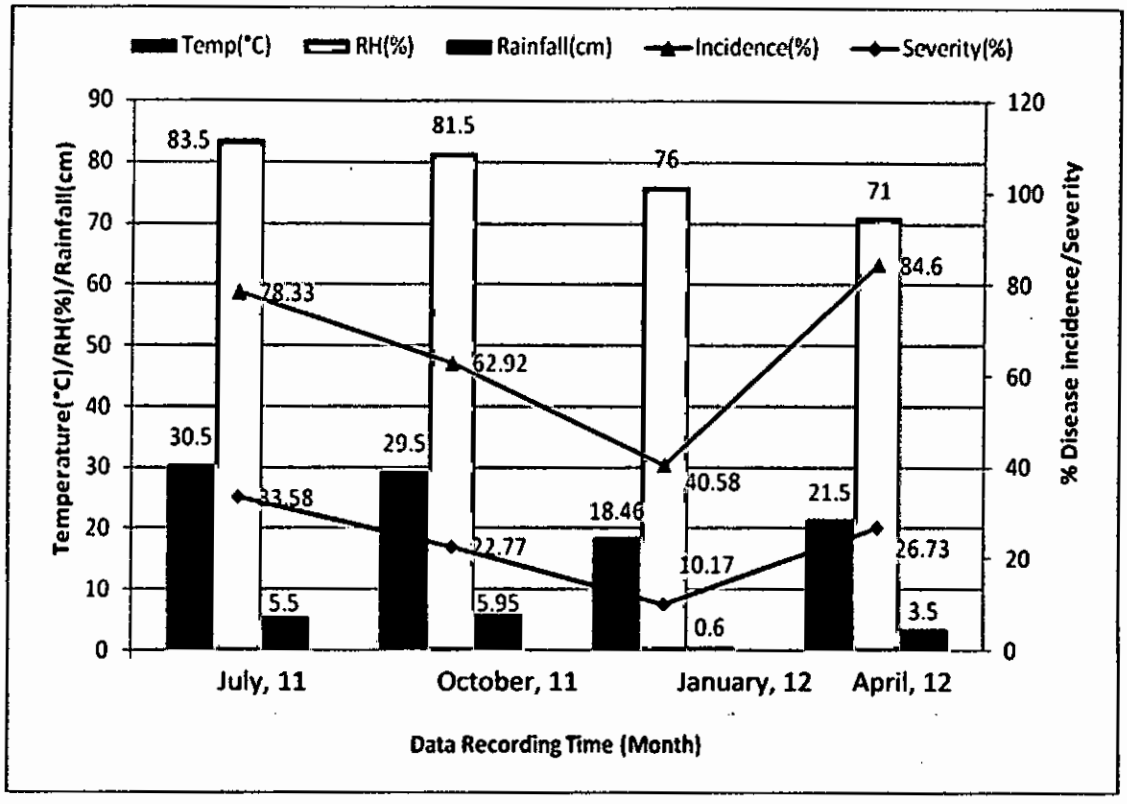


Figure 2. Effect of different weather factors on the incidence and severity of Pestalotia leaf spot of coconut seedling during July, 2011 to April, 2012



4.3.1.4.a. Relation between Pestalotia leaf spot disease incidence as well as severity of coconut seedlings with temperature.

A positive correlation between incidence and severity of Pestalotia disease with temperature were observed for both the years. The relationship between disease incidence and temperature could be expressed by the equation Y=1.477x+32.17, (R^2=0.297) and Y=1.470x+29.87, (R^2=0.197), where x=temperature and y=disease incidence. Here, the R^2 value indicates that the contribution of temperature to the incidence of Pestalotia leaf spot of coconut. On the other hand, the relationship between disease severity and temperature could be expressed by the equation Y=1.071x-1.478, (R^2=0.4666), and Y=1.213x−7.005 (R^2=0.535), where x=temperature and y=disease severity. Here, the R^2 value indicates that the contribution of temperature to the severity of Pestalotia of coconut.

Figure 3. Linear regression analysis of the effect of temperature on Incidence of Pestalotia leaf spot of coconut during July, 2010 to April, 2012

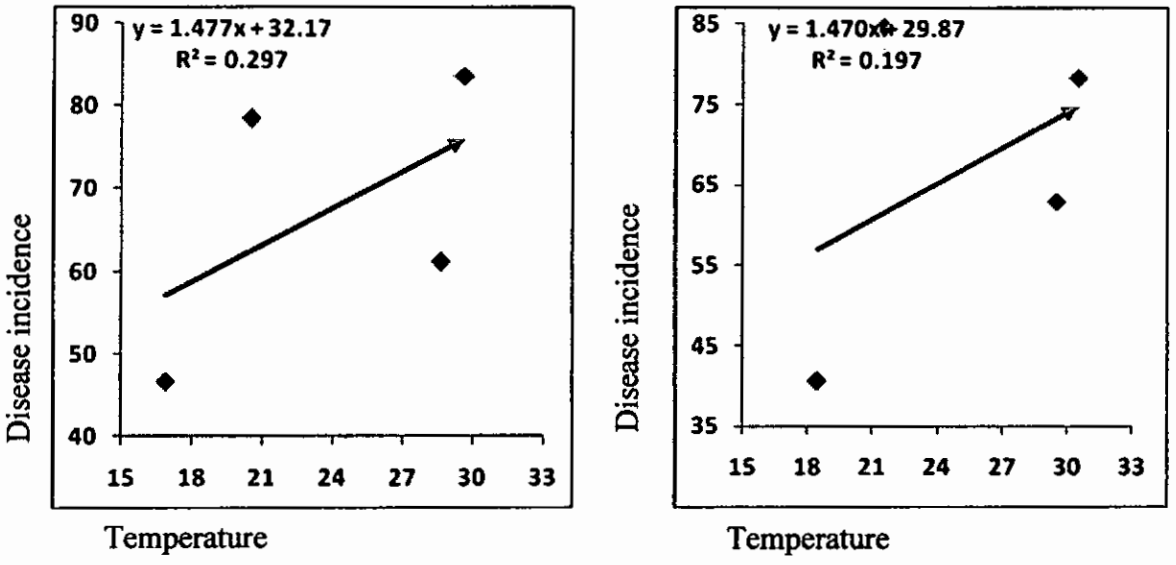
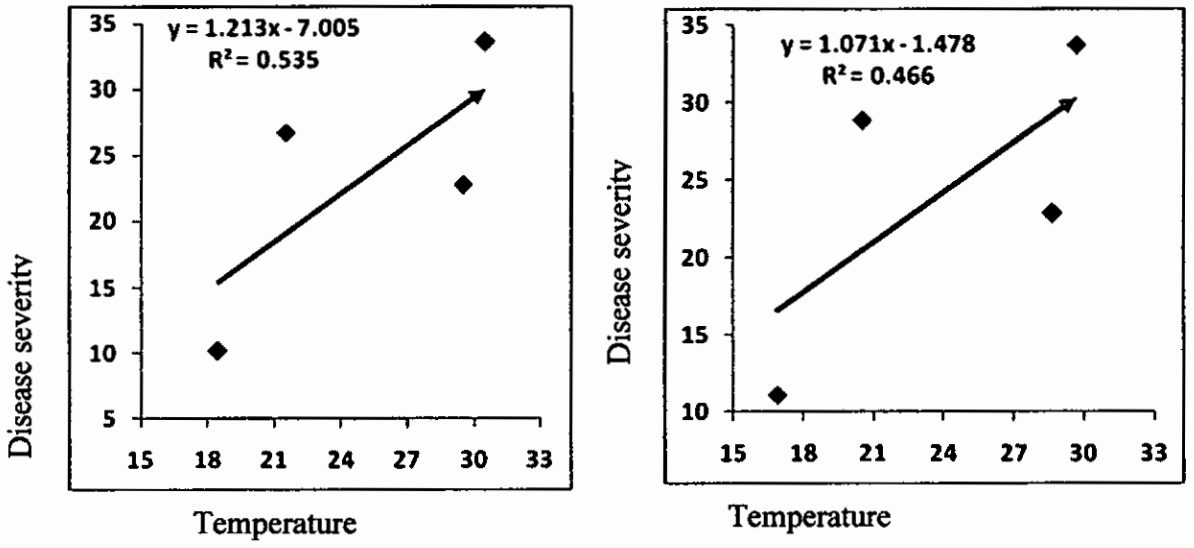


Figure 4. Linear regression analysis of the effect of temperature on severity of Pestalotia leaf spot of coconut during July, 2010 to April, 2012



4.3.1.4.b. Relation between Pestalotia leaf spot disease incidence as well as severity of coconut seedlings and relative humidity.

A positive correlation between incidence and severity of Pestalotia leaf spot disease with relative humidity were observed for both the years. The relationship between disease incidence and relative humidity could be expressed by the equation Y=0.545x+25.78, (R^2=0.028) and Y=0.233x+84.84, (R^2=0.004), where x=relative humidity and y=disease incidence. Here, the R^2

value indicates that the contribution of relative humidity to the incidence of Pestalotia of coconut. On the other hand, the relationship between disease severity and relative humidity could be expressed by the equation Y=0.591x–721.08, (R^2=0.100) and Y=0.596x–23.18, (R^2=0.117), where x=relative humidity and y=disease severity. Here, the R^2 value indicates that the contribution of relative humidity to the severity of Pestalotia of coconut.

Figure 5. Linear regression analysis of the effect of relative humidity on incidence of Pestalotia leaf spot of coconut during July, 2010 to April, 2012

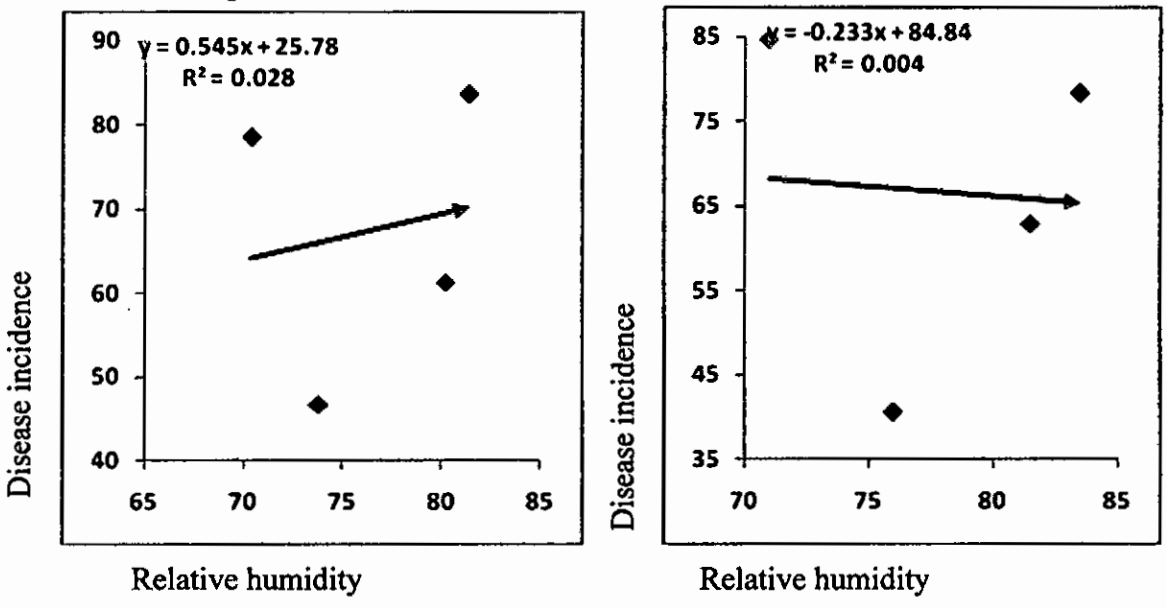
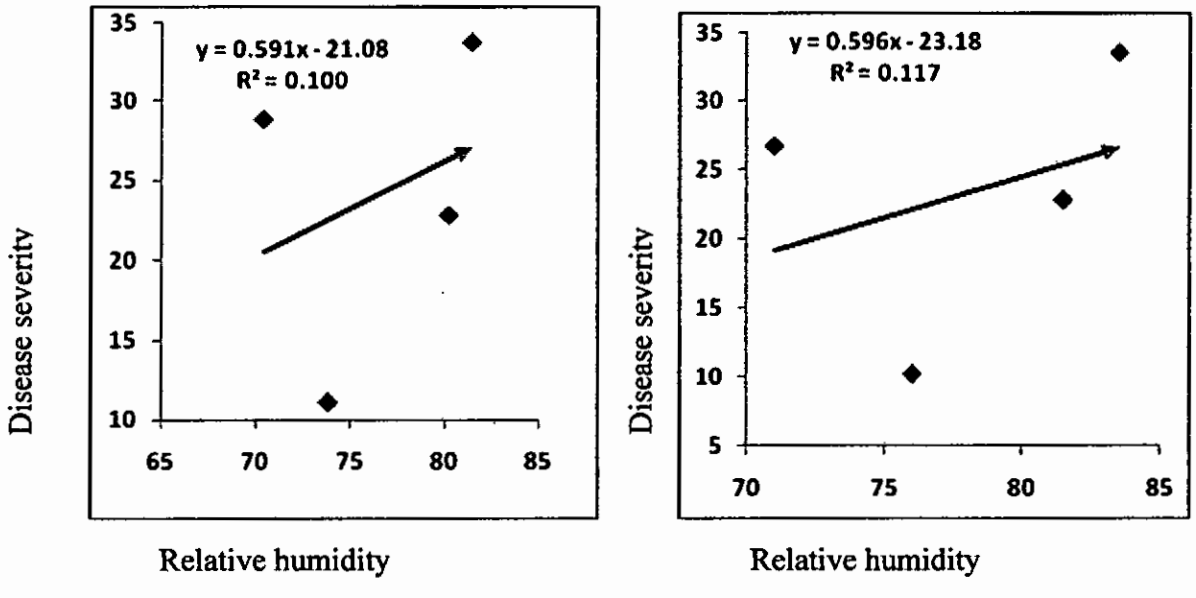


Figure 6. Linear regression analysis of the effect of relative humidity on severity of Pestalotia leaf spot of coconut during July, 2010 to April, 2012



4.3.1.4.c. Relation between Pestalotia leaf spot disease incidence as well as severity of coconut seedlings and rainfall.

A positive correlation between incidence and severity of Pestalotia leaf spot disease with rainfall were observed for both the years. The relationship between disease incidence and rainfall could be expressed by the equation Y=3.364x+51.47, (R^2=0.427) and Y=5.046x+46.98, (R^2=0.393), where x= rainfall and y=disease incidence. Here, the R^2 value indicates that the contribution of rainfall to the incidence of Pestalotia of coconut. On the other hand, the relationship between disease severity and rainfall could be expressed by the equation Y=2.319x+13.09, (R^2=0.605) and Y=3.218x+10.80, (R^2=0.635), where x=rainfall and y=disease severity. Here, the R^2 value indicates that the contribution of rainfall to the severity of Pestalotia of coconut.

Figure 7. Linear regression analysis of the effect of rainfall on incidence of Pestalotia leaf spot of coconut during July, 2010 to April, 2012

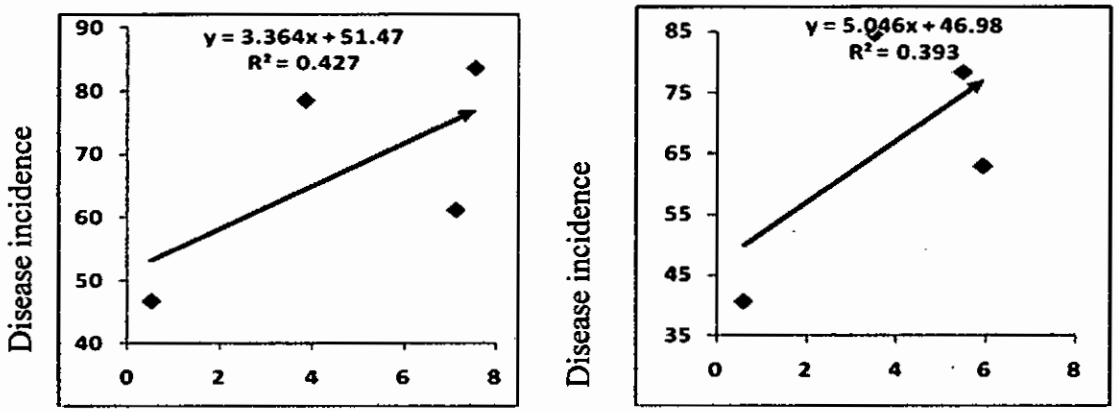
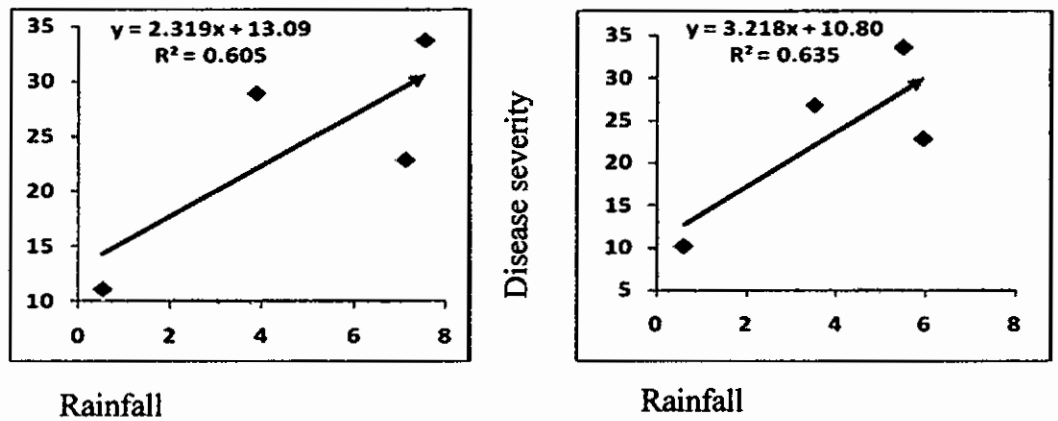


Figure 8. Linear regression analysis of the effect of rainfall on severity of Pestalotia leaf spot of coconut during July, 2010 to April, 2012



4.3.2.1. Incidence and severity of Cercospora leaf spot of coconut at different locations of Bangladesh from July, 2010 to April, 2012

Incidence of Cercospora leaf spot of coconut varied from location to location and year to year that ranged from 28.67-35.33% in 2010-2011 and 25.26-35.01% in 2011-2012 (Table 5). The highest incidence was recorded at Dhaka and the lowest was recorded at Khulna in both the years. The severity of Cercospora of coconut also varied from location to location and year to year that ranged from 15.53-17.67% in 2010-2011 and 14.47-17.50% in 2011-2012. The highest severity was recorded at Dhaka for both the years, and the lowest was recorded at Khulna in 2010-2011 and 2011-2012.

Table 5. Incidence and severity of Cercospora leaf spot of coconut at different locations of Bangladesh from July, 2010 to April, 2012

Location	Cercospora leaf spot			
	Incidence (%)		Severity (%)	
	2010-2011	2011-2012	2010-2011	2011-2012
Dhaka	35.33 a	35.01 a	17.67 a	17.50 a
Khulna	28.67 a	25.26 b	15.53 b	14.47 b
$LSD_{(p\geq 0.05)}$	9.03	7.018	1.774	1.898
CV%	9.46	8.53	3.58	6.88

4.3.2.2. Incidence and severity of Cercospora leaf spot of cococnut during July, 2010 to April, 2012

Incidence of Cercospora of coconut varied from July, 2010 to April, 2012 and that ranged from 11.17-41.67% in 2010-2011 and 10.60-41.68% (Table-6) in 2011-2012. The highest incidence was recorded in April, for 2010-2011 and 2011-2012. And the lowest was recorded in month of January, for both the years. The severity of Cercospora of coconut also varied from year to year that ranged from 7.667-23.43% in 2010-2011 and 8.6-21.17% in 2011-2012. The

highest severity was recorded in April, in 2010-2011 and 2011-2012. And the lowest was recorded in January for both the years.

Table 6. Incidence and severity of Cercospora leaf spot of coconut during July, 2010 to April, 2012

Time of data collection	Cercospora leaf spot			
	Incidence (%)		Severity (%)	
	2010-2011	2011-2012	2010-2011	2011-2012
July	35.33 b	39.08 a	21.45 b	20.17 a
October	28.67 c	29.17 b	13.87 c	14.00 b
January	11.17 d	10.60 c	7.66 d	8.60 c
April	41.67 a	41.68 a	23.43 a	21.17 a
$LSD_{(p\geq0.05)}$	4.917	4.573	1.057	1.955
CV%	9.46	8.53	3.58	6.88

4.3.2.3. Incidence and severity of Cercospora leaf spot of coconut during July, 2010 to April, 2012 of different experimental locations of Bangladesh

Incidence of Cercospora leaf spot of coconut varied significantly from season to season as well as location to location and that ranged from 10.00-50.00% in 2010-2011 and 9.033-52.83% in 2011-2012 (Table 7). The highest (50.00% and 52.83%) incidence of cercospora of coconut recorded in the month of April, for both the years, at Dhaka respectively. The lowest (10.00% and 9.033%) incidence was observed in the month of January, 2010-2011 and 2011-2012 at Khulna. The severity of cercospora of coconut also varied significantly from season to season as well as location to location and that ranged from 6.833-24.33% in 2010-2011 and 6.867-24.67% in 2011-2012. The highest (24.33and 24.67%) severity of Cercospora of coconut observed in the month of April, for both the years, at Dhaka while the lowest (6.833% and

6.867%) were recorded in the month of January, 2010-2011 and 2011-2012 in Khulna.

Table 7. Incidence and severity of Cercospora leaf spot of coconut during July, 2010 to April, 2012 of different experimental locations of Bangladesh

Location	Data recording time (month)	Cercospora leaf spot			
		Incidence(%)		Severity(%)	
		2010-2011	2011-2012	2010-2011	2011-2012
Dhaka.	July	40.33 b	42.20 b	22.60 b	21.33 b
	October	33.33 c	32.83 cd	15.27 d	13.67 d
	January	12.33 e	12.17 f	8.500 f	10.33 e
	April	50.00 a	52.83 a	24.33 a	24.67 a
Khulna	July	30.33 c	35.97 c	20.30 c	19.00 c
	October	24.00 d	25.50 e	12.47 e	14.33 d
	January	10.00 e	9.033 f	6.833 g	6.867 f
	April	33.33 c	30.53 d	22.53 b	17.67 c
$LSD_{(p\geq 0.05)}$		4.917	4.573	1.057	1.955
CV(%)		9.46	8.53	3.58	6.88

Each data represents the mean value of five nurseries.

4.3.2.4. Effect of weather components on the incidence and severity of Cercospora leaf spot disease of coconut seedling during July, 2010 to April 2012

In different growing seasons of coconut seedlings, the highest incidence (41.67% and 41.68%) and the highest severity (29.65% and 30.5%) of Cercospora leaf spot disease were recorded in April and in July for 2010-2011 and 2011-2012 respectively, where average temperature, relative humidity and

rainfall were 20.5°C, 70.4% and 3.85 cm, in April 2010-2011 and 21.5°C, 71%, 3.5 cm, in April 2011-2012. Again 29.65°C, 81.4% and 7.55 cm, in July,2010-2011 and 30.5°C, 83.5% and 5.5 cm in July 2011-2012 respectively. On the other hand, lowest incidence (11.17% and 10.6%) and the lowest severity (7.667% and 8.6%) were recorded in January, for both the years which average temperature, relative humidity and rainfall were 16.88°C, 73.8% and 0.52 cm, and 18.46°C, 76%, 0.6 cm, respectively (Fig. 9&10).

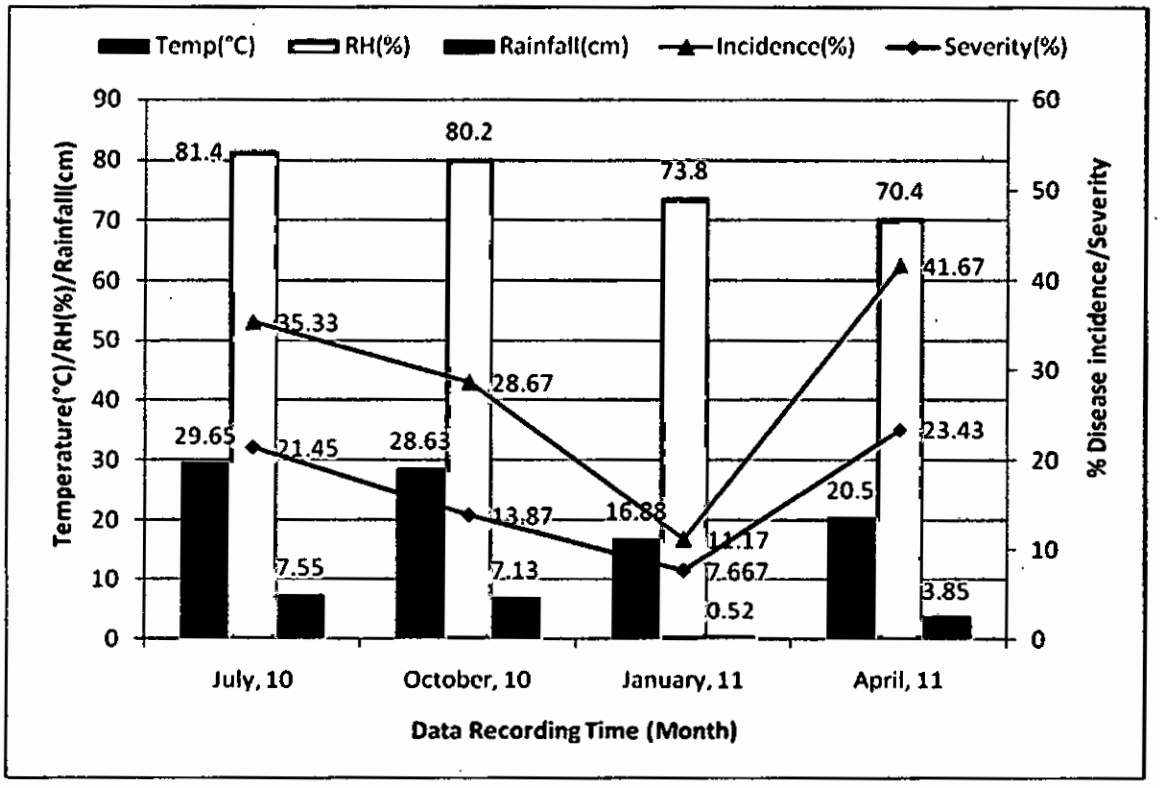


Fig 9. Effect of different weather factors on the incidence and severity of Cercospora leaf spot of coconut seedling

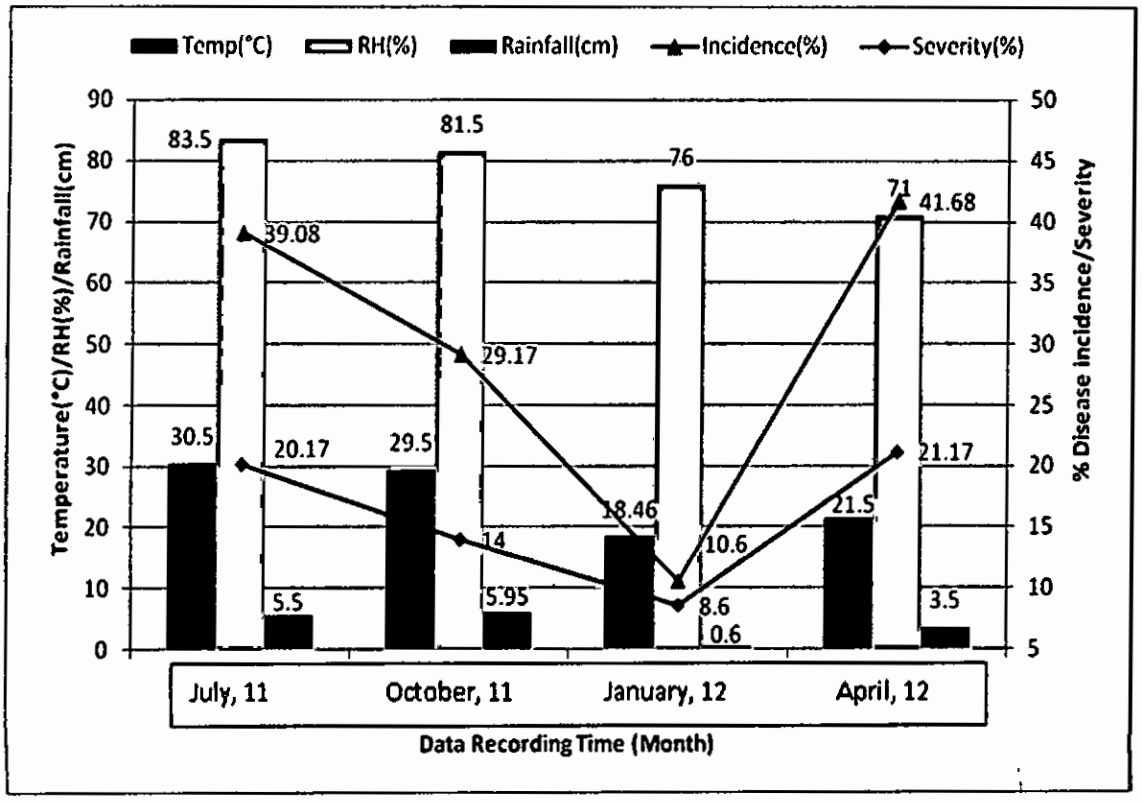


Figure 10. Effect of different weather factors on the incidence and severity of Cercospora leaf spot of coconut seedling during July, 2011 to April, 2012

4.3.2.4.a. Relation between Cercospora leaf spot disease incidence as well as severity of coconut seedlings and temperature.

A positive correlation between incidence and severity of Cercospora leaf spot disease with temperature were observed in 2010-2011 and 2011-2012. The relationship between disease incidence and temperature could be expressed by the equation $Y=1.005x+5.163$, ($R^2=0.226$) and $Y=1.252x-1.177$, ($R^2=0.278$), where x=temperature and y=disease incidence. Here, the R^2 value indicates that the contribution of temperature to the incidence of Cercospora of coconut.On the other hand, the relationship between disease severity and temperature could be expressed by the equation $Y=-0.468x+5.402$, ($R^2=0.162$), and $Y=0.419x+5.509$, ($R^2=0.162$), where x=temperature and y=disease severity. Here, the R^2 value indicates that the contribution of temperature to the severity of Cercospora of coconut seedling.

Figure 11. Linear regression analysis of the effect of temperature on incidence of Cercospora leaf spot of coconut during July, 2010 to April, 2012

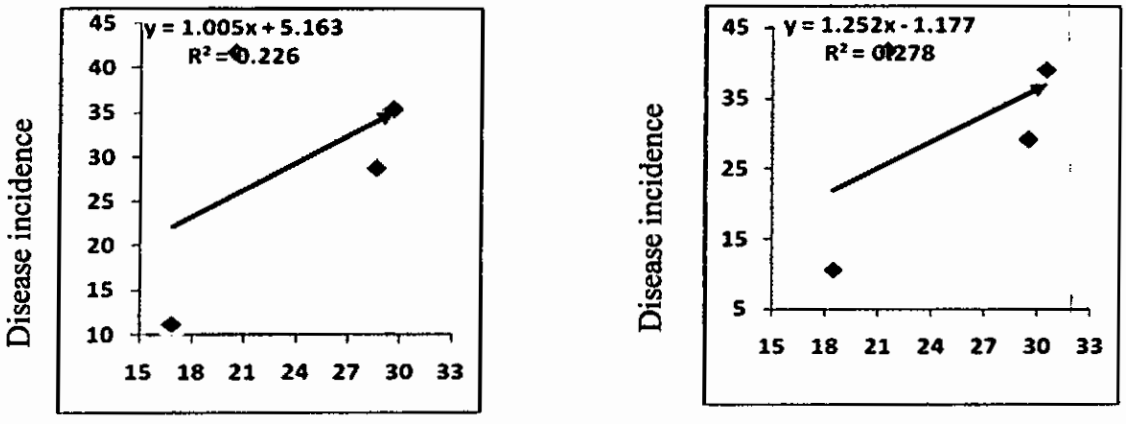
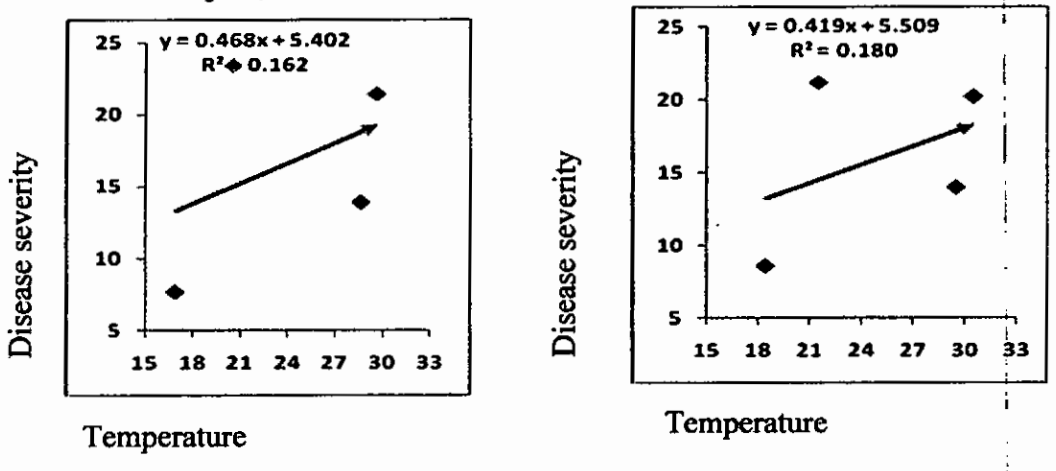


Figure 12. Linear regression analysis of the effect of temperature on severity of Cercospora leaf spot of coconut during July, 2010 to April, 2012



4.3.2.4.b. Relation between Cercospora leaf spot disease incidence as well as severity of Coconut seedlings and relative humidity.

A positive correlation between incidence of Cercospora leaf spot disease with relative humidity were observed in 2010-2011 and 2012. And negative correlations with severity of Cercospora disease were observed in 2010-2012. The relationship between disease incidence and relative humidity could be expressed by the equation Y=0.008x+28.56, (R^2=1E-05) and Y=0.042x+26.80, (R^2=0.000), where x= relative humidity and y=disease incidence. Here, the R^2 value indicates that the contribution of relative humidity to the incidence of

cercospora of coconut. On the other hand, the relationship between disease severity and relative humidity could be expressed by the equation Y=-0.047x+20.21, (R^2=0.001), and Y=-0.057x+20.44, (R^2=0.003), where x=relative humidity and y=disease severity. Here, the R^2 value indicates that the contribution of relative humidity to the severity of Cercospora of coconut.

Figure 13. Linear regression analysis of the effect of relative humidity on incidence of Cercospora leaf spot of coconut during July, 2010 to April, 2012

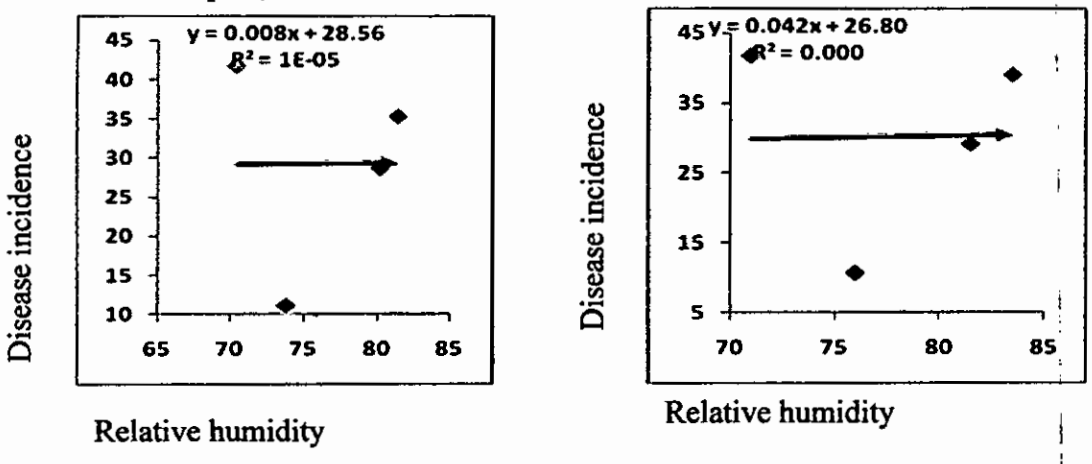
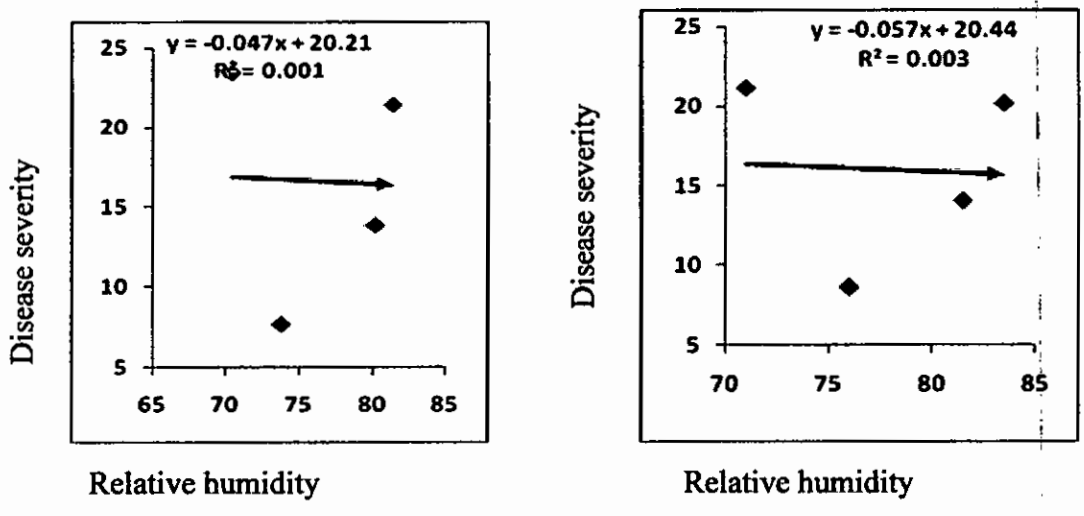


Figure 14. Linear regression analysis of the effect of relative humidity on severity of Cercospora leaf spot of coconut during July, 2010 to April, 2012



4.3.2.4.c. Relation between Cercospora leaf spot disease incidence as well as severity of coconut seedlings and rainfall.

A positive correlation between incidence and severity of Cercospora leaf spot disease with rainfall were observed in 2010-2011 and 2011-2012. Relationship

between disease incidence and rainfall expressed by the equation Y=2.513x+17.24, (R^2=0.392) and Y=4.052x+14.37, (R^2=0.490), where x= rainfall, y=disease incidence. Here, the R^2 value indicates that the contribution of rainfall to the incidence of Cercospora of coconut. On the other hand, the relationship between disease severity and rainfall could be expressed by the equation Y=1.202x+10.87, (R^2=0.295), Y=1.399x+10.54, (R^2=0.339), where x= rainfall and y=disease severity. Here, the R^2 value indicates that the contribution of rainfall to the severity of Cercospora of coconut.

Figure 15. Linear regression analysis of the effect of rainfall on incidence of Cercospora leaf spot of coconut during July, 2010 to April 2012

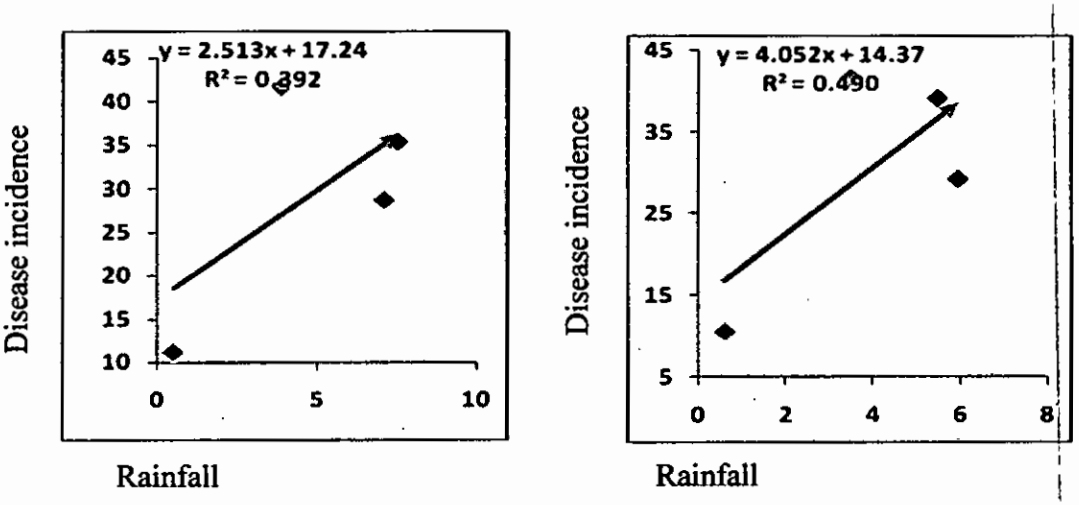
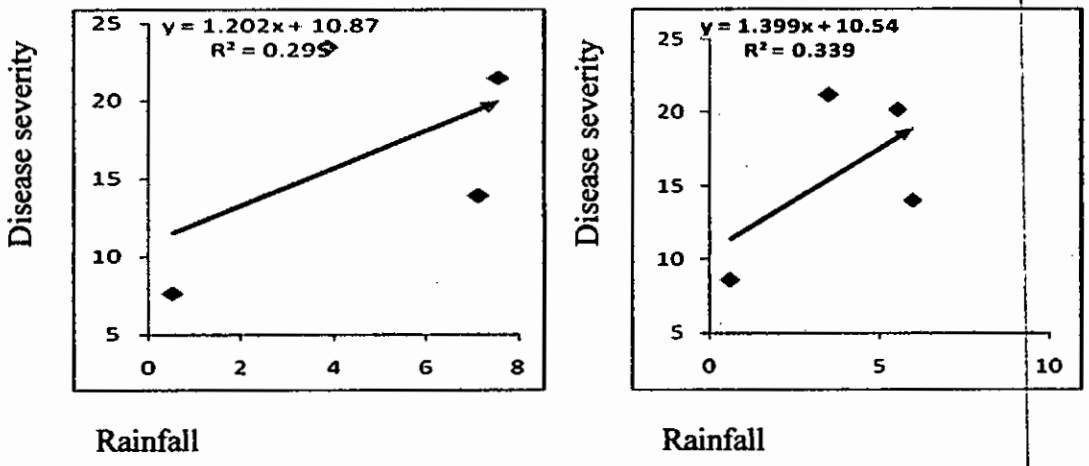


Figure 16. Linear regression analysis of the effect of rainfall on severity of Cercospora leaf spot of coconut during July, 2010 to April, 2012



4.3.3.1. Incidence and severity of Curvularia leaf spot of coconut at different locations of Bangladesh from July, 2010 to April, 2012

Incidence of Curvularia leaf spot of coconut varied from location to location and year to year that ranged from 8.350-9.217% in 2010-2011 and 8.125-9.175% in 2011-2012 (Table 8). The highest incidence (9.217and 9.175%) both was recorded at Dhaka in 2010-2011 and 2011-2012. The lowest incidence was recorded at Khulna in both the years. The severity of Curvularia leaf spot of coconut also varied from location to location and year to year that ranged from 7.675-6.233% in 2010-2011 and 7.183-6.492% in 2011-2012. The highest severity (7.675 and7.183%) was recorded at Dhaka in 2010-2011 and 2011-2012. The lowest severity was recorded at Khulna in 2010-2012.

Table 8. Incidence and severity of Curvularia leaf spot of coconut at different locations of Bangladesh from July, 2010 to April, 2012

Location	Curvularia leaf spot			
	Incidence (%)		Severity (%)	
	2010-2011	2011-2012	2010-2011	2011-2012
Dhaka	9.21	9.17 a	7.67 a	7.18 a
Khulna	8.35	8.12 b	6.23 b	6.49 b
$LSD_{(p\geq0.05)}$	NS	0.2222	0.4303	0.2484
CV%	2.95	3.17	1.36	1.91

Each data represents the mean value of five nurseries

4.3.3.2. Incidence and severity of Curvularia leaf spot of coconut during July, 2010 to April, 2012 in Bangladesh

Incidence of Curvularia leaf spot of coconut varied significantly from July, 2010 to April, 2012 and that ranged from 5.217-10.98% in 2010-2011 and 5.00-11.40% in 2011-2012. The highest incidence (10.98 was recorded in April

in2010-2011 and 11.40% was recorded in July in 2011-2012. And the lowest (5.217% and 5.00%) were observed in the month of January, for both the years (Table-9). The severity of Curvularia leaf spot of coconut, varied significantly from July, 2011 to April, 2012 and that ranged from 4.250-9.350% in 2010-2011 and 4.283-9.10% in 2011-2012. The highest severity (9.350% and 9.1%) were recorded in the month of April, for both the years. And the lowest (4.250% and 4.283%) were observed in the month of January, for both the years (Table-9).

Table 9. Incidence and severity of Curvularia leaf spot of coconut during July, 2010 to April, 2012 in Bangladesh

Time of data collection	Curvularia leaf spot			
	Incidence (%)		Severity (%)	
	2010-2011	2011-2012	2010-2011	2011-2012
July	10.75 a	11.40 a	9.23 a	8.35 b
October	8.18 b	7.80 c	4.98 b	5.61 c
January	5.21 c	5.00 d	4.25 c	4.28 d
April	10.98 a	10.40 b	9.35 a	9.10 a
$LSD_{(p\geq0.05)}$	0.4605	0.2105	0.3898	0.2320
CV%	2.95	3.17	1.36	1.91

Each data represents the mean value of five nurseries

4.3.3.3. Incidence and severity of Curvularia leaf spot of coconut during July, 2010 to April, 2012 of different experimental locations of Bangladesh.

Incidence of cercospora of coconut varied significantly from season to season as well as location to location and that ranged from 4.933-11.50% in 2010-2011 and 5.00-12.80% in 2011-2012. The highest incidence 11.50% was recorded in the month of July and April 2010-2011 at Dhaka and 12.80% was

recorded in July in 2011-2012 at Dhaka also. The lowest incidence (4.933% and 5.00%) were observed in the month of January, at Khulna . The severity of Curvularia leaf spot of coconut also varied significantly from season to season as well as location to location and that ranged from 4.00-10.70% in 2010-2011 and 4.267-10.00% in 2011-2012. The highest severity (10.70% and 10.00%) were observed in the month of July, 2010-2011 and 2011-2012 at Dhaka. while the lowest (4.00% and 4.267%) (Table-10) were recorded in the month of January, 2010-2012 at Khulna.

Table 10. Incidence and severity of Curvularia leaf spot of coconut during July, 2010 to April, 2012 of different experimental locations of Bangladesh

Location	Data recording time (month)	Curvularia leaf spot			
		Incidence (%)		Severity (%)	
		2010-2011	2011-2012	2010-2011	2011-2012
Dhaka.	July	11.50 a	12.80 a	10.00 b	8.70 b
	October	8.36 d	8.00 d	5.50 e	5.73 d
	January	5.50 e	5.00 f	4.50 f	4.30 f
	April	11.50 a	10.90 b	10.70 a	10.00 a
Khulna	July	10.00 c	10.00 c	8.46 c	8.00 c
	October	8.00 d	7.60 e	4.46 f	5.50 e
	January	4.93 f	5.00 f	4.00 g	4.26 f
	April	10.47 b	9.90 c	8.00 d	8.20 c
$LSD_{(p\geq0.05)}$		0.4605	0.2105	0.3898	0.2320
CV(%)		2.95	3.17	1.36	1.91

Each data represents the mean value of five nurseries.

4.3.3.4. Effect of weather components on the incidence and severity of Curvularia leaf spot of coconut seedling during July, 2010 to April, 2012

In different growing seasons of coconut seedlings, the highest incidence (10.98% and 11.4%) and the highest severity (9.35% and 9.10%) of Curvularia leaf spot disease were recorded in April 2010-2011 and July 2011-2012 which average temperature, relative humidity and rainfall were 20.5°C, 70.4% and 3.85 cm in April 2010-2011 and 30.5°C, 83.5%, 5.5 cm in 2011-2012 respectively. On the other hand, lowest incidence (5.22% and 5.00%) and the lowest severity (4.25% and 4.28%) were recorded in January, for both the years which average temperature, relative humidity and rainfall were 16.88°C, 73.80% and 0.52 cm, and 18.46°C, 76%, 0.60 cm, respectively (Fig.17&18).

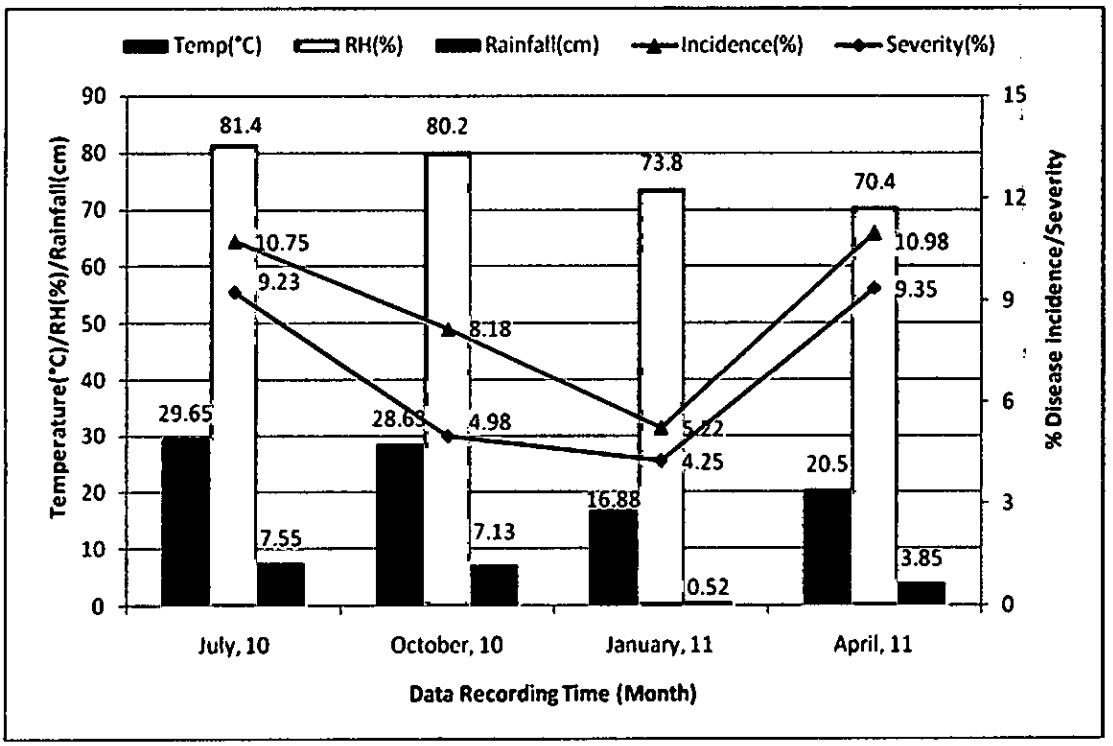


Figure 17. Effect of different weather factors on the incidence and severity of Curvularia leaf spot of coconut seedling during July, 2010 to April, 2011

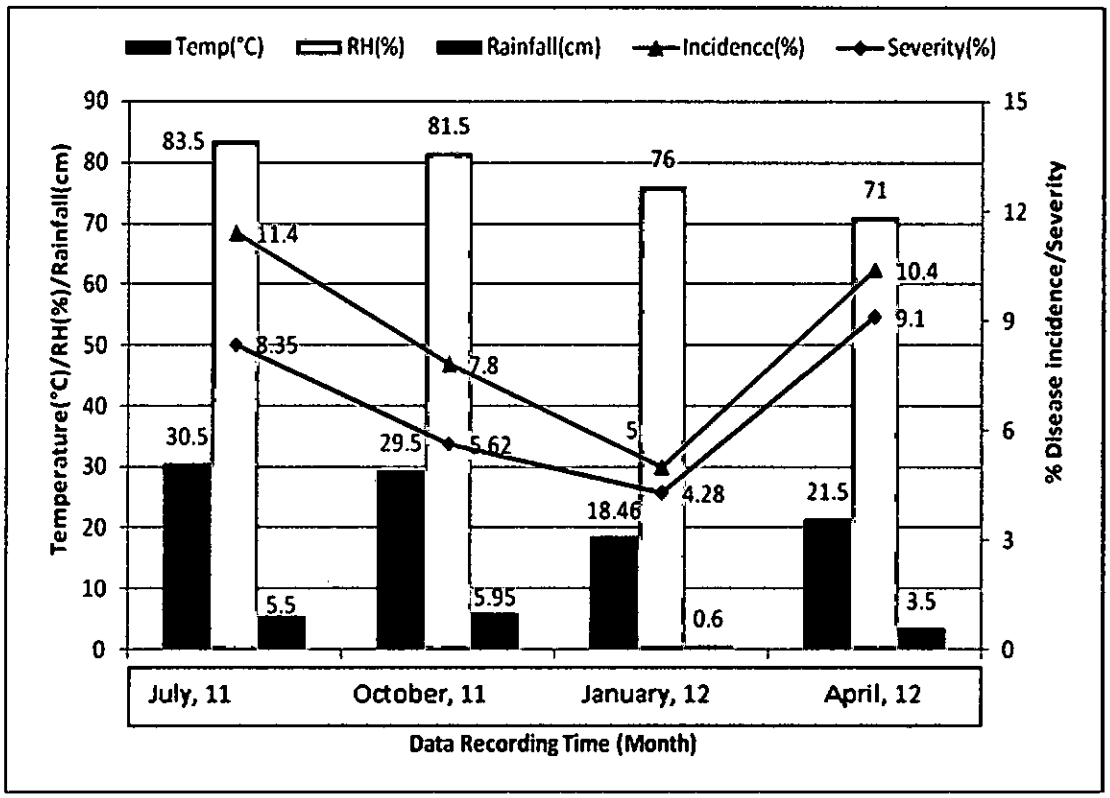


Figure 18. Effect of different weather factors on the incidence and severity of Curvularia leaf spot of coconut seedling during July, 2011 to April, 2012

4.3.3.4.a. Relation between Curvularia leaf spot disease incidence as well as severity of coconut seedlings and rainfall.

A positive correlation between incidence and severity of Curvularia leaf spot disease with temperature were observed for both the years. The relationship between disease incidence and temperature could be expressed by the equation $Y=0.223x+3.434$, ($R^2=0.267$) and $Y=0.275x+1.771$, ($R^2=0.324$), where x=temperature and y=disease incidence. Here, the R^2 value indicates that the contribution of temperature to the incidence of Curvularia leaf spot of coconut. On the other hand, the relationship between disease severity and temperature could be expressed by the equation $Y=0.125x+3.952$, ($R^2=0.082$), and $Y=0.110x+4.087$, ($R^2 = 0.082$), where x=temperature and y=disease severity. Here, the R^2 value indicates that the contribution of temperature to the severity of Curvularia leaf spot of coconut.

Figure 19. Linear regression analysis of the effect of temperature on incidence of Curvularia leaf spot of coconut during July, 2010 to April, 2011

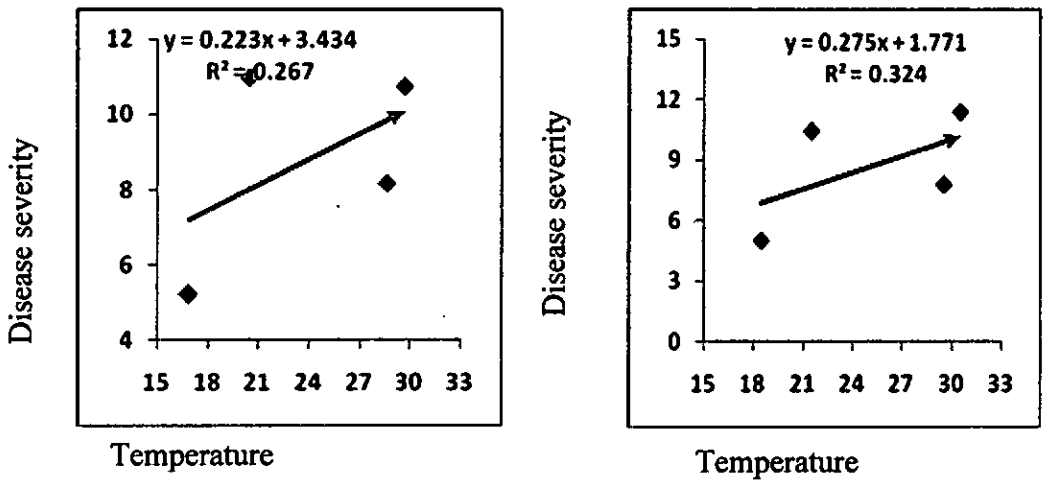
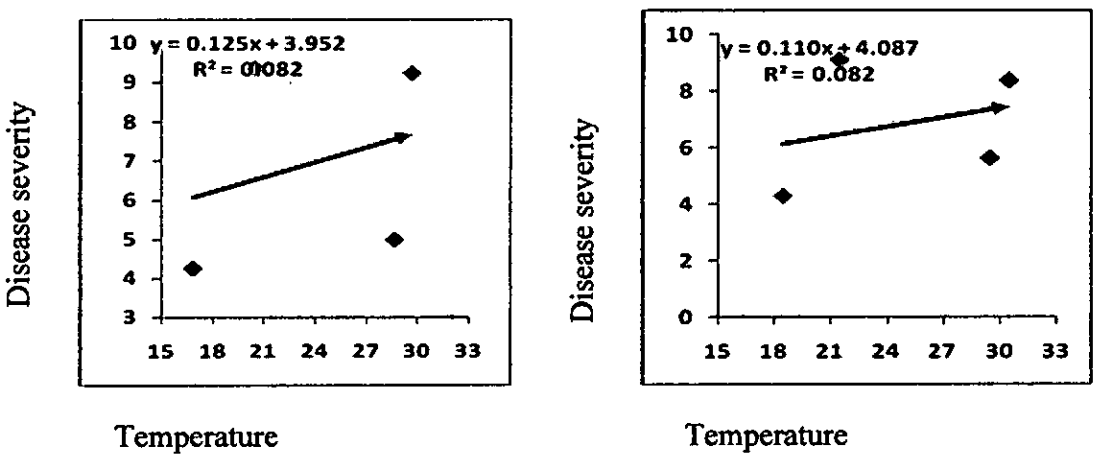


Figure 20. Linear regression analysis of the effect of temperature on severity of Curvularia leaf spot of coconut during July, 2010 to April, 2012



4.3.3.4.b. Relation between Curvularia leaf spot disease incidence as well as severity of coconut seedlings and relative humidity

A positive correlation between incidence and severity of Curvularia leaf spot disease with relative humidity were observed for both the years. The relationship between disease incidence and relative humidity could be expressed by the equation Y=0.044x+5.410, (R^2 = 0.007) and Y=0.075+2.769, (R^2=0.022), where x= relative humidity and y=disease incidence. Here, the R^2 value indicates that the contribution of relative humidity to the incidence of

Curvularia spot of coconut. On the other hand, the relationship between disease severity and relative humidity could be expressed by the equation Y=-0.042 x+10.17, (R^2=0.006), and Y=-0.07x+12.29, (R^2 = 0.030), where x= relative humidity and y=disease severity. Here, the R^2 value indicates that the contribution of relative humidity to the severity of Curvularia leaf spot of coconut.

Figure 21. Linear regression analysis of the effect of relative humidity on Incidence of Curvularia leaf spot of coconut during July, 2010 to April, 2011

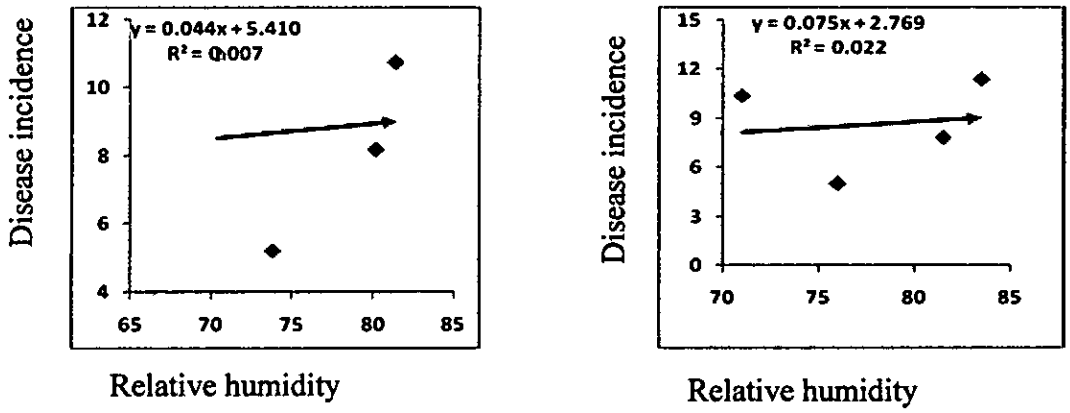
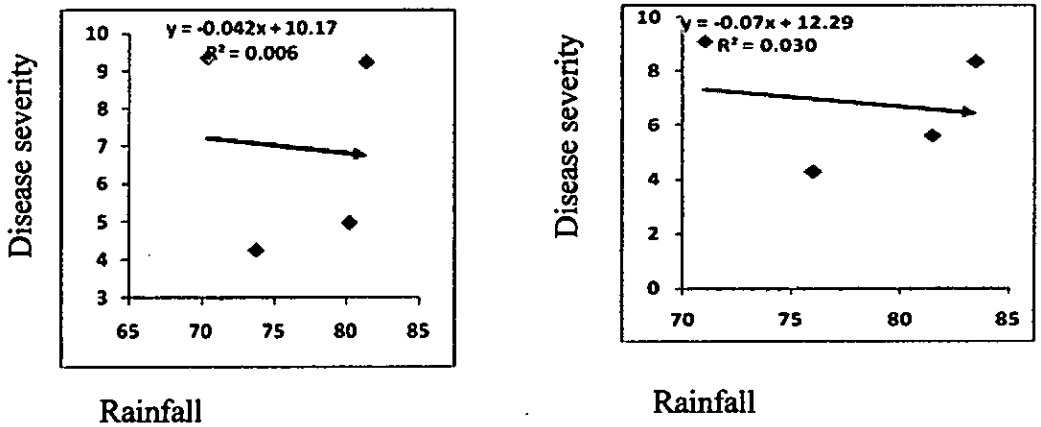


Figure22. Linear regression analysis of the effect of relative humidity on severity of Curvularia leaf spot of coconut during July, 2011 to April, 2012



4.3.3.4.c. Relation between Curvularia leaf spot disease incidence as well as severity of coconut seedlings and rainfall.

A positive correlation between incidence and severity of leaf spot disease with rainfall were observed for both the years. The relationship between disease incidence and rainfall could be expressed by the equation Y=0.533x+6.244,

(R^2=0.420) and Y=0.786x+5.593, (R^2=0.446), where x= rainfall and y=disease incidence. Here, the R^2 value indicates that the contribution of rainfall to the incidence of leaf blight of guava. On the other hand, the relationship between disease severity and rainfall could be expressed by the equation Y=0.340x+5.332, (R^2=0.168), and Y=0.417x+5.213, (R^2=0.201), (Fig: 23&24). where x=rainfall and y=disease severity. Here, the R^2 value indicates that the contribution of rainfall to the severity of Curvularia leaf spot of coconut.

Figure 23. Linear regression analysis of the effect of rainfall on incidence of Curvularia leaf spot of coconut during July, 2010 to April, 2012

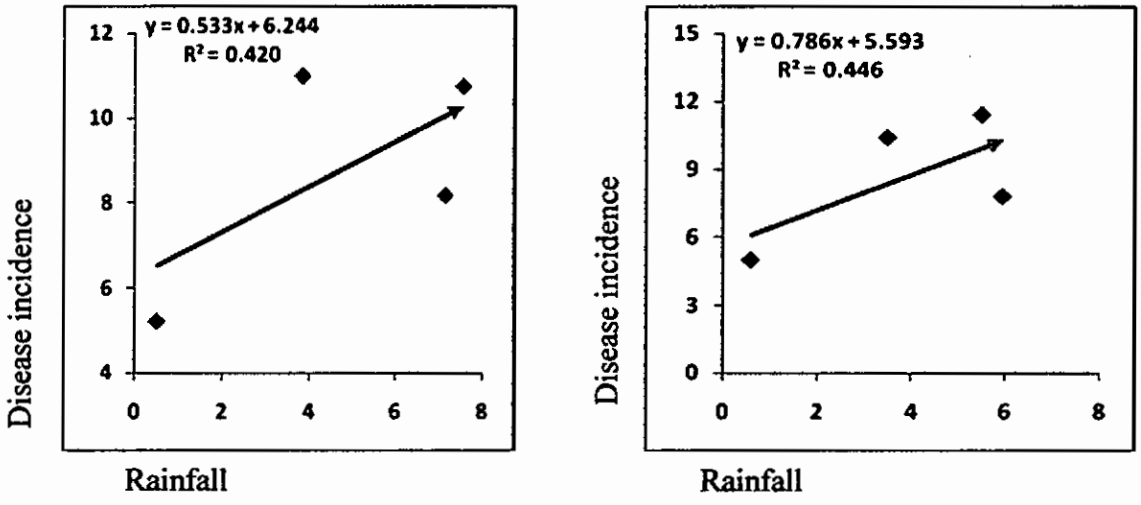
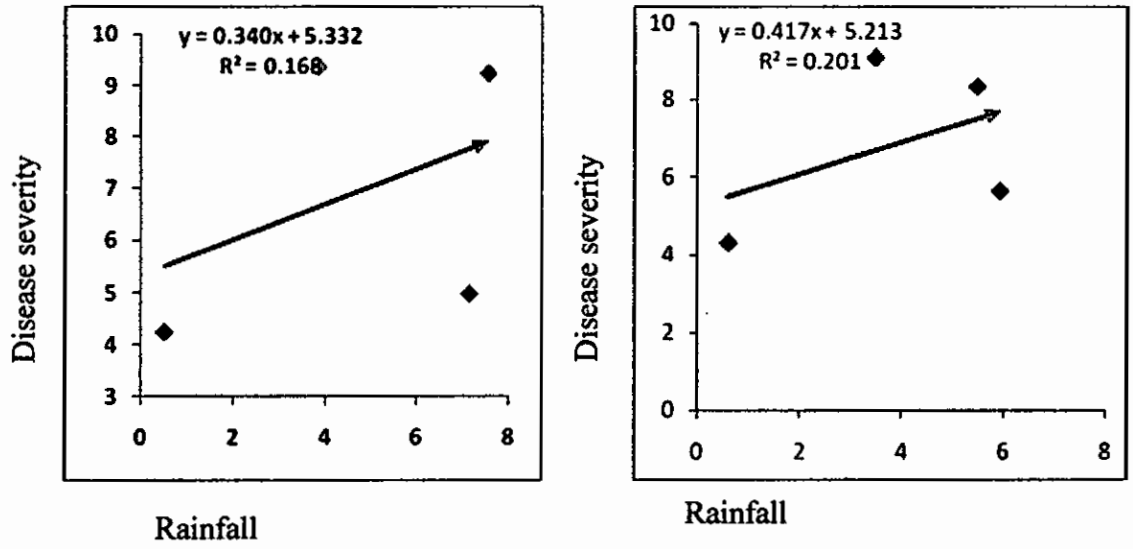


Figure 24. Linear regression analysis of the effect of rainfall on severity of Curvularia leaf spot of coconut during July, 2011 to April, 2012



4.3.4.1. Incidence and severity of Phytophthora leaf spot of coconut at different locations of Bangladesh from July, 2010 to April, 2012

Incidence of Phytophthora leaf spot of coconut varied from location to location and year to year that ranged from 12.21-16.33% in 2010-2011 and 10.95-15.93% in 2011-2012 (Table 11). The highest incidence (16.33and 15.93%) both was recorded at Dhaka in 2010-2011 and 2011-2012. The lowest incidence was recorded at Khulna in both the years. The severity of Phytophthora of coconut also varied from location to location and year to year that ranged from 4.925-5.950% in 2010-2011 and 5.450-6.433% in 2011-2012. The highest severity (5.950 and6.433%) was recorded at Dhaka in 2010-2011 and 2011-2012. The lowest severity was recorded at Khulna in 2010-2011 and 2011-2012 (Table-11).

Table 11. Incidence and severity of Phytophthora leaf spot of coconut at different locations of Bangladesh from July, 2010 to April, 2012

Location	Phytophthora leaf spot			
	Incidence (%)		Severity (%)	
	2010-2011	2011-2012	2010-2011	2011-2012
Dhaka	16.33 a	15.93 a	5.950 a	6.43 a
Khulna	12.21 a	10.95 b	4.925 a	5.45 b
$LSD_{(p\geq0.05)}$	4.850	2.208	2.367	0.1571
CV%	9.02	9.21	5.49	1.43

Each data represents the mean value of five nurseries

4.3.4.2. Incidence and severity of Phytophthora leaf spot of coconut during July, 2010 to April, 2012 in Bangladesh

Incidence of phytophthora leaf spot of coconut varied significantly from July, 2010 to April, 2012 and that ranged from 8.917-20.75 % in 2010-2011 and 8.583-17.45% in 2011-2012. The highest incidence (20.75% and 17.45%)

recorded in April for the both years. And the lowest (8.917% and 8.583%) (Table-11) were observed in the month of January, for both the years. The severity of curvularia of coconut, varied significantly from July, 2011 to April, 2012 and that ranged from 2.250-7.750% in 2010-2011 and 2.833-8.333% in 2011-2012. The highest severity (7.750% and 8.833%) were recorded in the month of April, for both the years. And the lowest (2.250% and 2.833%) were observed in the month of January, for both the years (Table-12).

Table 12. Incidence and severity of Phytophthora leaf spot of coconut during July, 2010 to April, 2012 in Bangladesh

Time of data collection	Phytophthora leaf spot			
	Incidence (%)		Severity (%)	
	2010-2011	2011-2012	2010-2011	2011-2012
July	15.25 b	15.40 b	7.250 a	7.85 b
October	12.17 c	12.32 c	4.50 b	4.75 c
January	8.91 d	8.58 d	2.25 c	2.83 d
April	20.75 a	17.45 a	7.75 a	8.33 a
$LSD_{(p\geq0.05)}$	2.801	1.312	0.9873	0.1488
CV%	9.02	9.21	5.49	1.43

Each data represents the mean value of five nurseries

4.3.4.3. Incidence and severity of Phytophthora leaf spot of coconut during July, 2010 to April, 2012 of different experimental locations of Bangladesh.

Incidence of cercospora of coconut varied significantly from season to season as well as location to location and that ranged from 8.833-22.50% in 2010-2011 and 8.367-21.20% in 2011-2012. The highest incidence 22.50% and 21.20% was recorded in the month of April at Dhaka in 2010-2012 at . The

lowest incidence 8.833 was observed in the month of January, at Khulna in 2010-2011 and 8.367 was observed in the month of January at Dhaka in 2011-2012. The severity of phytophthora of coconut also varied significantly from season to season as well as location to location and that ranged from 2.00-8.3% in 2010-2011 and 2.00-8.667% in 2011-2012. The highest severity (8.3% and 8.667%) were observed in the month of April, 2010-2011 and 2011-2012 at Dhaka. while the lowest 2% was recorded in the month of January, 2010-2011 and 2011-2012 at Khulna (Table-13) .

Table 13. Incidence and severity of Phytophthora leaf spot of coconut during July, 2011 to April, 2012 of different experimental locations of Bangladesh.

Location	Data recording time(month)	Phytophthora leaf spot			
		Incidence(%)		Severity(%)	
		2010-2011	2011-2012	2010-2011	2011-2012
Dhaka.	July	18.50 b	19.00 b	7.50 ab	7.90 bc
	October	15.33 c	15.13 c	5.50 c	5.50 d
	January	9.00 e	8.367 f	2.50 e	3.66 f
	April	22.50 a	21.20 a	8.30 a	8.66 a
Khulna	July	12.00 d	11.80 e	7.00 b	7.80 c
	October	9.00 e	9.500 f	3.50 d	4.00 e
	January	8.83 e	8.800 f	2.00 e	2.00 g
	April	19.00 b	13.70 d	7.20 b	8.00 b
$LSD_{(p\geq0.05)}$		2.801	1.312	0.9873	0.1488
CV(%)		9.02	9.21	5.49	1.43

Each data represents the mean value of five nurseries

4.3.4.4. Effect of weather components on the incidence and severity of Phytophthora leaf spot of coconut seedling during July, 2010 to April, 2012

In different growing seasons of coconut seedlings, the highest incidence (20.75% and 17.45%) and the highest severity (7.75% and 8.33%) (Table-13) of Phytophthora leaf spot disease were recorded in April, for both the years when average temperature, relative humidity and rainfall were 20.5°C, 70.4% and 3.85 cm, and 21.5°C, 71.00%, 3.5 cm, respectively. On the other hand, lowest incidence (8.917% and 8.583%) and the lowest severity (2.25% and 2.833%) were recorded in January, for both the years when average temperature, relative humidity and rainfall were 16.88°C, 73.80% and 0.52 cm, and 18.46°C, 76%, 0.60 cm, respectively (Fig. 25& 26).

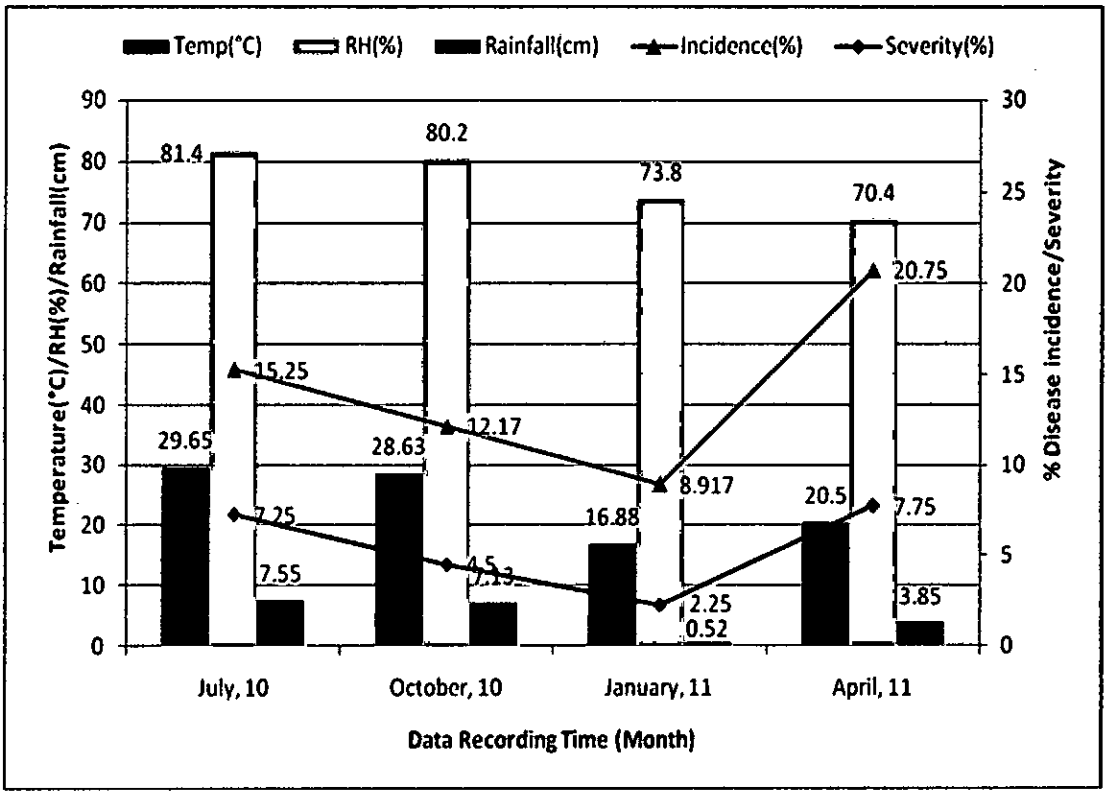


Figure 25. Effect of different weather factors on the incidence and severity of Phytophthora leaf spot of coconut seedling during July, 2010 to April, 2011

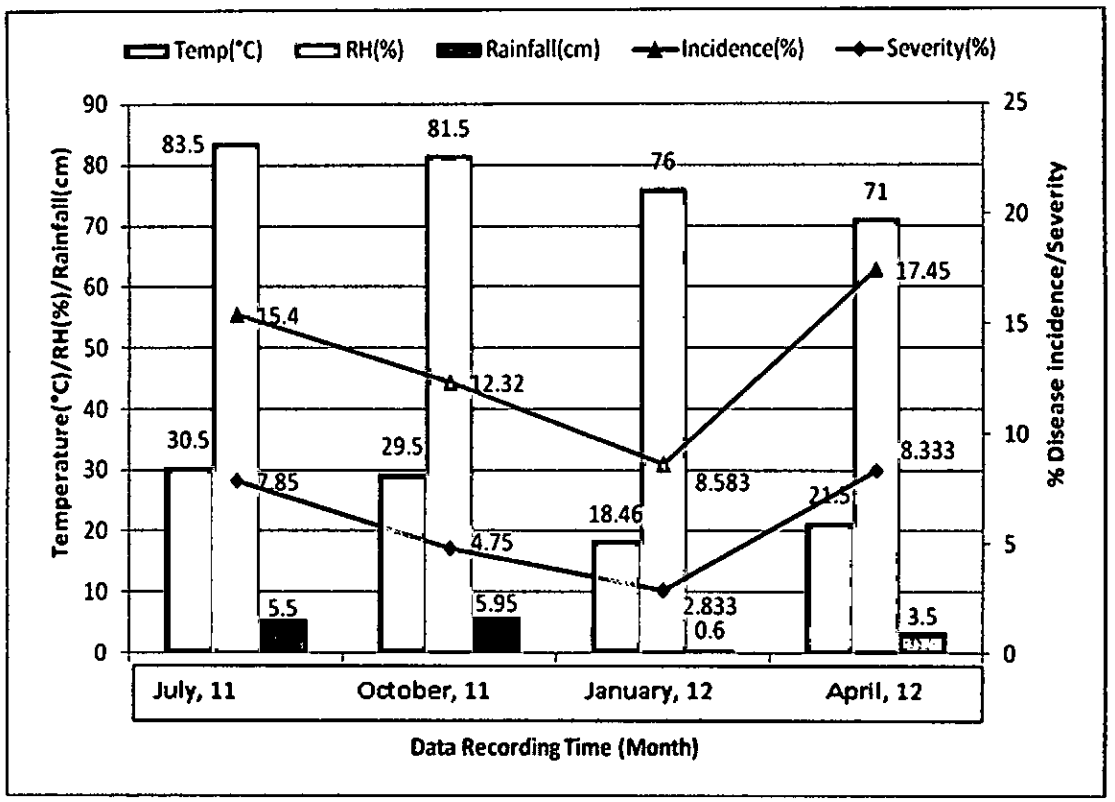


Figure 26. Effect of different weather factors on the incidence and severity of Phytophthora leaf spot of coconut seedling during July, 2011 to April, 2012

4.3.4.4.a. Relation between Phytophthora leaf spot disease incidence as well as severity of coconut seedlings and temperature.

A positive correlation between incidence and Phytophthora leaf spot of disease with temperature were observed for both the years. The relationship between disease incidence and temperature could be expressed by the equation $Y=0.096x+11.95$, ($R^2=0.014$) and $Y=0.222x+7.88$, ($R^2=0.116$), where x=temperature and y=disease incidence. Here, the R^2 value indicates that the contribution of temperature to the incidence of Phytophthora spot of coconut. On the other hand, the relationship between disease severity and temperature could be expressed by the equation $Y=0.176x+1.220$, ($R^2=0.183$), and $Y=0.162x+ 1.893$, ($R^2 = 0.135$), where x=temperature and y=disease severity. Here, the R^2 value indicates that the contribution of temperature to the severity of Phytophthora leaf spot of coconut.

Figure 27. Linear regression analysis of the effect of temperature on incidence of Phytophthora leaf spot of coconut during July, 2010 to April, 2011

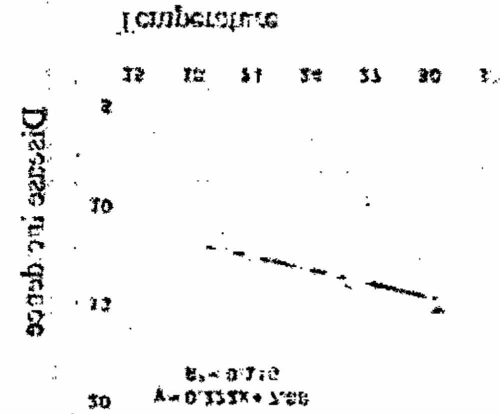
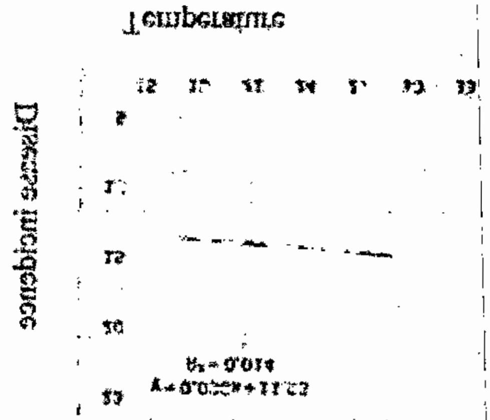
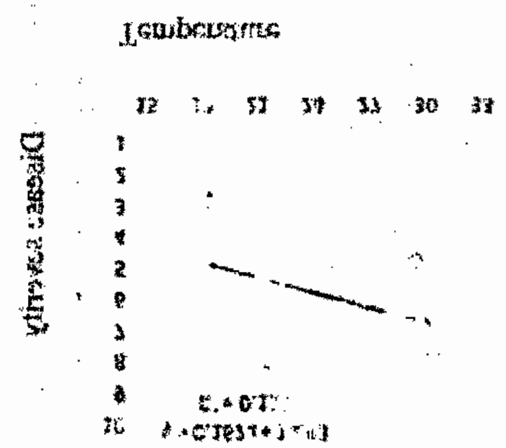
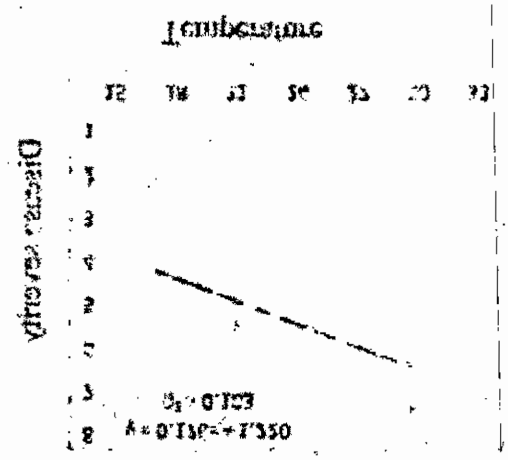



Figure 28. Linear regression analysis of the effect of temperature on severity of Phytophthora leaf spot of coconut during July, 2010 to April, 2012

4.3.4.4.b. Relation between Phytophthora leaf spot of coconut disease incidence as well as severity of coconut seedlings and relative humidity.

A positive correlation between incidence and severity of Phytophthora leaf spot disease with relative humidity were observed for both the years. The relationship between disease incidence and relative humidity could be expressed by the equation Y=-0.341x+40.35, (R^2 =0.125) and Y=-0.120x+22.82, (R^2=0.030), where x= relative humidity and y= disease incidence. Here, the R^2 value indicates that the contribution of relative humidity to the incidence of coconut. On the other hand, the relationship between disease severity and relative humidity could be expressed by the

equation Y=-0.001x+5.518, (R^2=5E-0.6), and Y=-0.043x+9.369, (R^2 = 0.009), where x= relative humidity and y=disease severity. Here, the R^2 value indicates that the contribution of relative humidity to the Phytophthora leaf spot of coconut.

Figure 29. Linear regression analysis of the effect of relative humidity on incidence of Phytophthora leaf spot of coconut during July, 2010 to April, 2012

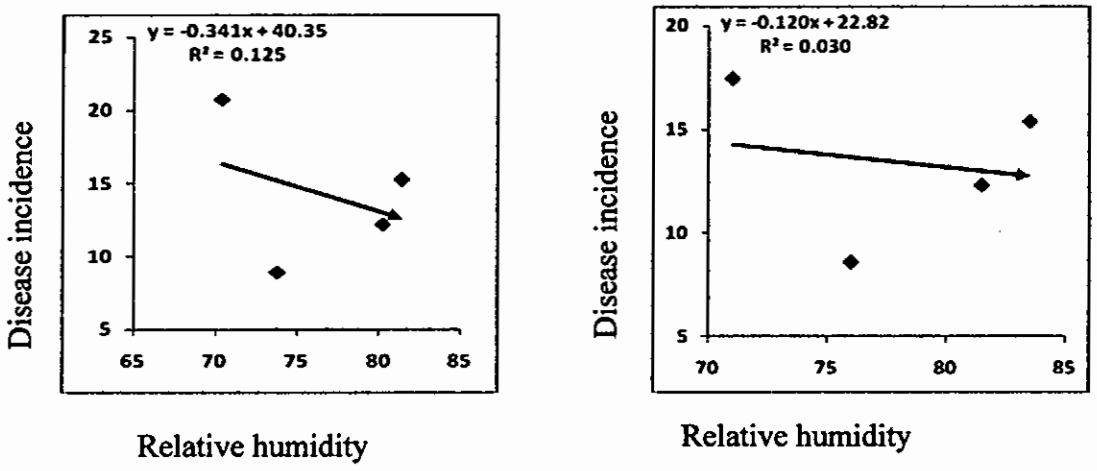
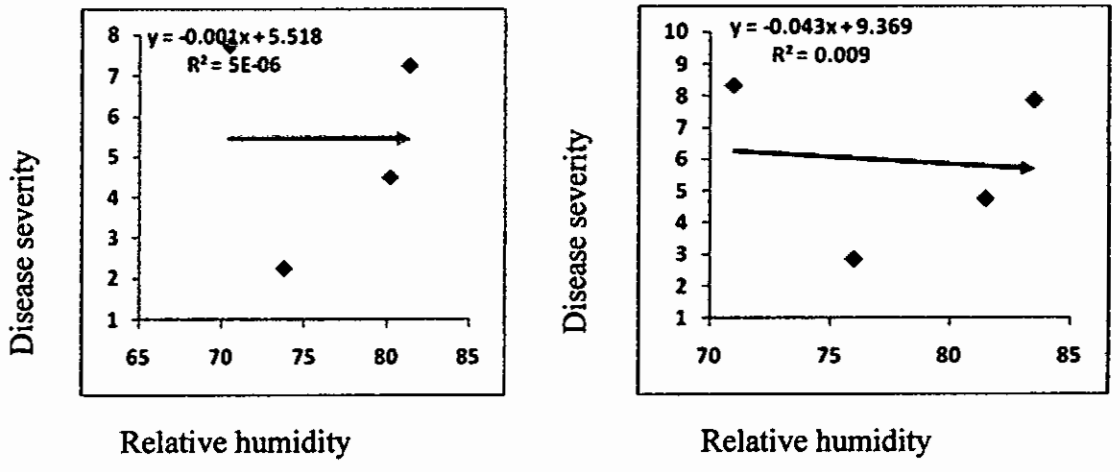


Figure 30. Linear regression analysis of the effect of relative humidity on severity of Phytophthora leaf spot of coconut during July, 2010 to April, 2012



4.3.4.4.c. Relation between Phytophthora leaf spot disease incidence as well as severity of coconut seedlings and rainfall.

A positive correlation between incidence and severity of Phytophthora leaf spot disease with rainfall were observed for both the years. The relationship

between disease incidence and rainfall could be expressed by the equation Y=0.452x+12.11, (R^2=0.086) and Y=-0.043x+9.369, (R^2=0.009), where x= rainfall and y=disease incidence. Here, the R^2 value indicates that the contribution of rainfall to the incidence of Phytophthora spot of coconut. On the other hand, the relationship between disease severity and rainfall could be expressed by the equation Y=0.442x+3.331, (R^2=0.320), and Y=0.857x+10.10, (R^2=0.292), where x=rainfall and y=disease severity. Here, the R^2 value indicates that the contribution of rainfall to the severity Phytophthora leaf spot of coconut.

Figure 31. Linear regression analysis of the effect of rainfall on incidence of Phytophthora leaf spot of coconut during July, 2010 to April, 2012

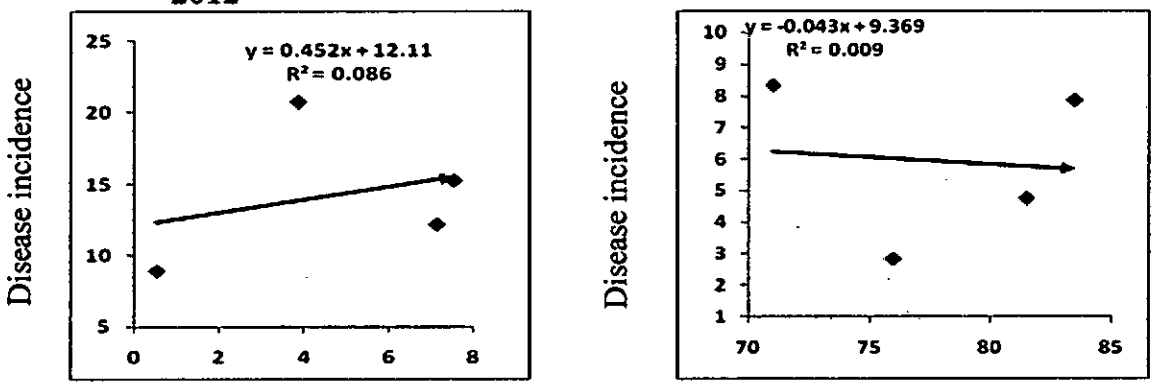
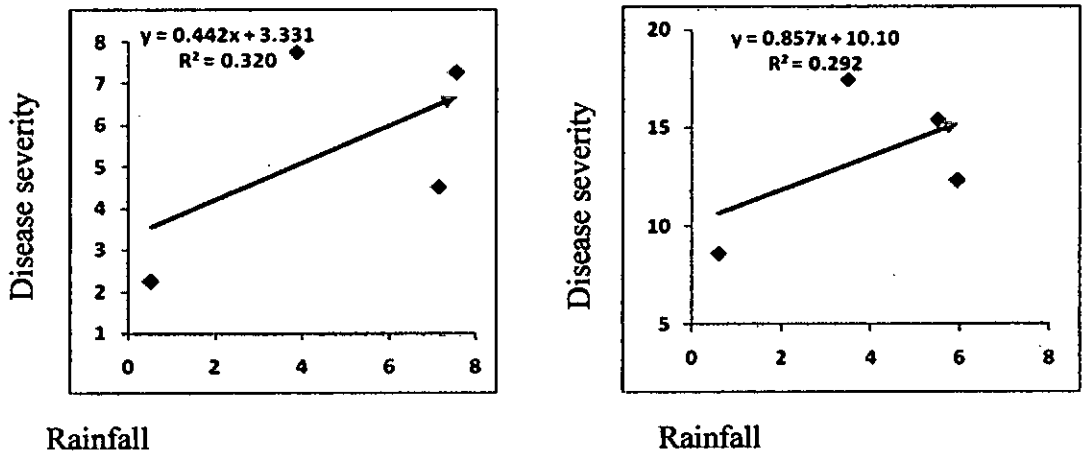


Figure 32. Linear regression analysis of the effect of rainfall on severity of Phytophthora leaf spot of coconut during July, 2010 to April, 2012



4.3.5. Average temperature, relative humidity and rainfall of Dhaka and Khulna from 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 the following table:

Table 14. Average temperature, relative humidity and rainfall of Dhaka, and Khulna from July, 2010 to April, 2012

Month	Average Temperature	Average Relative humidity	Average Rainfall
July, 2010	29.65	81.40	7.55
October, 2010	28.63	80.20	7.13
January, 2011	16.88	73.80	0.52
April, 2011	20.50	70.43	3.85
July, 2011	30.50	83.50	5.50
October, 2011	29.50	81.50	5.95
January, 2012	18.46	76.0	0.60
April, 2012	21.50	71.0	3.50

4.4. CONTROL OF DISEASES OF COCONUT SEEDLING APPLYING SOME FUNGICIDES

4.4.1.1. Effect of fungicides on the incidence of Pestalotia leaf spot disease of coconut

In all five treatments applied, disease incidence with of Pestalotia leaf spot follow a definite pattern of increase or decrease. Mean disease incidence ranged from 22.66% to 50.59 % the lowest incidence was observed in Dithane M-45 was application and highest in Untreated Control. The highest Percent reduction of Pestalotia leaf spot disease incidence over control was 55.21% caused by Dithane M-45 application and the lowest reduction of disease incidence over control was 17.85% by Mancozeb application (Table-15).

Table 15. Effect of different fungicides on the disease incidence of Pestalotia leaf spot disease of coconut

Treatment	% Disease Incidence													% Reduction over control
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Mean	
T_1	15.33c	25.20d	20.60 c	35.50 c	45.60c	41.83 d	50.20c	40.50c	40.5b	41.00b	32.50 c	24.50c	34.44 d	31.92
T_2	13.50c	29.67 c	30.50 b	55.60 a	51.20b	55.37 b	68.17a	55.27a	42.33b	35.50c	40.43 a	21.20d	41.56 b	17.85
T_3	8.233d	17.30 e	20.70 c	30.30d	29.00d	30.00e	30.00e	27.00d	24.37c	20.90d	17.77 d	16.40e	22.66 e	55.21
T_4	20.60b	30.50b	30.50 b	40.50b	45.50c	45.50 c	45.27d	43.83b	40.33b	32.83c	35.27 b	30.43b	36.76 c	27.34
T_5	30.33a	45.47a	45.30 a	55.63 a	60.27a	65.53a	65.43b	55.40a	50.60a	46.50a	41.50 a	45.17a	50.59 a	
LSD(0.05)	2.786	0.6468	0.7194	0.5424	1.219	1.558	1.017	1.384	2.287	2.997	2.287	1.597	0.6013	
CV%	2.19	1.16	1.29	0.66	1.40	1.74	1.04	1.66	3.05	4.50	3.63	3.08	0.86	

Data represent the mean value of 5 (five) replications

T_1= Cupravit was applied as foliar spray @ 0.2%

T_2= Mancozeb was applied as foliar spray @ 0.2%

T_3= Dithane M-45 was applied as foliar spray @ 0.2%

T_4 = Bavistin was applied as foliar spray @ 0.2%

T_5 = Untreated control

4.4.1.2. Effect of different fungicides on the incidence of Cercospora leaf spot disease of coconut.

Incidence of Cercospora leaf spot disease follow a definite pattern of increase or decrease. Mean disease incidence ranged from 25.69% to 37.96% and the lowest incidence was recorded in Dithane M-45 application and highest in Untreated Control. The highest Percent reduction of Cercospora spot disease incidence over control was 32.32% in Dithane M-45 application and the lowest reduction of disease incidence over control was 15.38% in Mancozeb application .

Table 16. Effect of different fungicides on the disease incidence of Cercospora leaf spot disease of coconut

Treatment	% Disease Incidence													% Reduction over control
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Mean	
T_1	14.33bc	24.67b	25.00c	28.00d	28.20b	32.50 b	46.90a	25.67d	25.60d	26.17c	19.33d	15.17d	25.96d	31.61
T_2	15.50 b	25.50b	30.37b	35.67b	37.77a	43.77 a	46.37a	32.10c	33.30b	35.70b	27.77b	21.63b	32.12 b	15.38
T_3	12.83bc	26.00b	26.40c	30.43c	27.70b	27.67c	31.17d	45.17a	24.13d	23.90d	18.27d	14.63d	25.69 d	32.32
T_4	11.77 c	23.00c	22.47d	35.17b	29.73b	30.07bc	34.28c	30.83c	30.23c	26.37c	24.97c	18.47c	26.45c	30.32
T_5	25.17 a	29.30a	34.37a	43.17a	40.83a	41.57a	44.23b	41.20b	39.90a	40.60a	41.50a	33.63a	37.96 a	
LSD(0.05)	2.847	1.510	1.514	2.420	3.345	3.884	1.613	2.042	2.346	1.426	2.569	1.958	0.4416	
CV%	9.50	3.12	2.90	3.73	5.41	5.88	2.11	3.10	4.07	2.48	5.17	5.02	0.79	

Data represent the mean value of 5 (five) replications

T_1= Bavistin was applied as foliar spray @ 0.2%

T_2= Mancozeb was applied as foliar spray @ 0.2%

T_3= Dithane M-45was applied as foliar spray @ 0.2%

T_4 = Cupravit was applied as foliar spray @ 0.2%

T_5 = Untreated control

4.4.1.3. Effect of fungicides on the incidence of Curvularia leaf spot disease of coconut.

In all the treatments applied, disease incidence of Curvularia leaf spot showed a specific pattern of increase or decrease. Mean disease incidence ranged from 15.91% to 32.81% and the lowest incidence was recorded in Bavistin application and highest in Untreated Control. The highest Percent reduction of Cercospora spot disease incidence over control was 54.53% in Bavistin application and the lowest reduction of disease incidence over control was 24.75% caused by Cupravit application .

Table 17. Effect of different fungicides on the disease incidence of Curvularia leaf spot disease of coconut

Treatment	% Disease Incidence													% Reduction over control
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Mean	
T_1	4.833 d	14.00 b	15.17 b	17.33 d	18.13 c	19.53 c	20.83 d	21.00c	13.87 d	15.23 c	12.50b	9.600 d	15.17 d	54.32
T_2	8.433 c	15.70 b	15.9 b	24.17c	24.60 b	20.00 c	25.17 c	23.47c	19.60 c	16.17 c	12.97 b	12.57c	18.23 c	45.11
T_3	4.033 d	10.97c	14.47 b	24.17c	21.27bc	11.03 d	22.77cd	23.13c	15.63 d	14.67 c	11.87b	7.233 e	15.10 d	54.53
T_4	11.77 b	23.20 a	23.67 a	31.30 b	24.33 b	26.43 b	30.43 b	34.07b	25.03 b	26.47 b	22.57 a	20.57 b	24.99 b	24.75
T_5	19.03 a	24.13 a	24.53 a	34.63 a	39.03 a	40.50 a	44.23 a	45.60a	41.00 a	34.00 a	25.50 a	26.37 a	33.21 a	
LSD(0.05)	1.484	2.150	1.796	3.132	3.433	1.090	3.160	4.991	2.913	1.703	3.208	2.161	0.8272	
CV%	8.19	6.49	5.08	6.32	7.16	2.46	5.85	9.00	6.72	4.25	9.98	7.52	2.06	

Data represent the mean value of 5 (five) replications

T_1= Bavistin was applied as foliar spray @ 0.2%

T_2= Mancozeb was applied as foliar spray @ 0.2%

T_3= Dithane M-45 was applied as foliar spray @ 0.2%

T_4 = Cupravit was applied as foliar spray @ 0.2%

T_5 = Untreated control.

4.4.1.4. Effect of fungicides on the incidence of Phytophthora leaf and blight disease of coconut.

In all five treatments applied, disease incidence of Phytophthora leaf spot and blight disease followed a specific pattern of increase or decrease. Mean disease incidence ranged from 15.91% to 33.21% the lowest incidence was made by Dithane M-45 application and highest in Untreated Control. The highest Percent reduction of Phytophthora leaf blight disease incidence over control 51.51% caused by Dithane M-45 application and the lowest reduction of disease incidence over control was 26.61% caused by Cupravit application (Table-18).

Table 18. Effect of fungicides practices on the disease incidence of Phytophthora leaf spot and blight disease of coconut

Treatment	% Disease Incidence													% Reduction over control
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Mean	
T_1	5.500d	15.53c	12.43d	21.37e	16.73d	16.47c	20.87c	22.13 c	18.87c	15.63 c	13.67 c	11.67 c	15.91d	51.51
T_2	9.200c	20.67b	15.50c	30.23c	24.40c	27.17b	26.63b	28.87 b	24.77b	22.13 b	23.00b	15.47 b	22.34 b	31.91
T_3	5.533d	12.97d	20.10b	24.27d	23.50c	20.90c	24.37bc	26.27bc	21.73bc	20.27b	14.70 c	14.57 b	19.10 c	41.79
T_4	13.50b	19.30b	21.90b	32.53b	30.37b	27.80b	27.03 b	30.07b	27.03 b	22.90b	21.13b	15.43b	24.08 b	26.61
T_5	24.33a	24.47a	31.30a	35.83a	34.23a	37.13a	40.93 a	37.60a	37.07 a	33.43a	32.87a	24.50 a	32.81a	
LSD (0.05)	1.744	1.815	2.040	1.503	2.255	5.382	5.033	6.310	5.525	3.638	3.707	1.749	1.895	
CV%	7.98	5.18	5.35	2.77	4.64	9.04	9.56	9.56	9.33	8.45	9.34	5.69	4.41	

Data represent the mean value of 5 (five) replications

T_1= Bavistin was applied as foliar spray @ 0.2%

T_2= Mancozeb was applied as foliar spray @ 0.2%

T_3= Dithane M-45 was applied as foliar spray @ 2%

T_4= Cupravit was applied as foliar spray @ 0.2%

T_5 = Untreated control

4.4.1.5. Effect of fungicides on the severity of Pestalotia leaf spot disease of coconut

Out of five treatments applied, disease severity of Pestalotia leaf spot disease showed a specific increase or decrease pattern. Mean disease severity ranged from 23.45% to 39.49% and the lowest severity was found in Bavistin application and highest in Untreated Control. The highest Percent reduction of Pestalotia leaf spot disease severity over control was 40.62% caused by Bavistin application and the lowest reduction of disease severity over control was 26.64% caused by Cupravit application (Table-19).

Table 19. Effect of fungicides practices on the disease severity of Pestalotia leaf spot disease of coconut

Treatment	% Disease Severity													% Reduction over control
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Mean	
T_1	9.533 c	20.43c	21.40c	30.23c	29.50c	26.63b	30.57b	30.80b	26.20c	22.30c	19.80c	14.00c	23.45c	40.62
T_2	12.20bc	24.23bc	24.67bc	37.57b	32.57bc	31.03b	33.50b	34.43b	30.47b	26.47b	24.17bc	18.67 bc	27.50 b	30.36
T_3	9.700 c	19.97c	20.27c	30.53c	29.30c	28.17b	29.63b	30.77b	25.70c	22.57c	20.10 c	18.63bc	23.78 c	39.78
T_4	14.63 b	25.40b	26.17b	37.17b	33.67b	33.87b	34.83b	34.63b	32.30b	28.73b	25.47 b	20.73 b	28.97 b	26.64
T_5	25.33 a	32.70a	38.60 a	44.53a	44.43 a	45.33a	46.87a	43.93a	41.10a	40.03a	36.70a	34.30 a	39.49a	
LSD(0.05)	3.734	4.305	4.329	3.137	3.834	7.192	5.874	4.991	3.534	3.063	4.846	5.517	2.829	
CV%	9.89	9.31	8.77	4.63	6.01	9.57	8.89	7.59	6.02	5.81	9.19	9.78	5.25	

Data represent the mean value of 5 (five) replications

T_1= Bavistin was applied as foliar spray @ 0.2%

T_2= Mancozeb was applied as foliar spray @ 0.2%

T_3= Dithane M-45 was applied in the soil as well as foliar spray @ 0.2%

T_4 = Cupravit was applied as foliar spray @ 0.2%

T_5 = Untreated control

4.4.1.6. Effect of fungicides on the severity of Cercospora leaf spot disease of coconut

Disease severity of Cercospora leaf spot disease showed a specific increase or decrease pattern in all the treatments. Mean disease severity ranged from 21.44% to 38.30% and the lowest severity was recorded in Bavistin and highest Untreated Control). The highest Percent reduction of Cercospora spot disease severity over control was 44.02% caused by Bavistin application and the lowest reduction of disease severity over control was 31.23% caused by Cupravit application (Table-20).

Table:20. Effect of fungicides practices on the disease severity of Cercospora leaf spot disease of coconut

Treatment	% Disease Severity													% Reduction over control
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Mean	
T_1	8.500 c	20.13bc	20.37b	28.63c	26.30d	25.23b	27.57c	28.23b	22.83c	20.43c	16.90 c	12.17 c	21.44 c	44.02
T_2	11.33bc	23.50 b	23.93 b	34.00b	31.13b	28.90b	30.77b	29.63b	29.00b	25.80b	22.83 b	17.50 bc	25.69b	32.92
T_3	8.400 c	17.70 c	20.10 b	28.73c	26.97cd	25.63b	27.83c	27.67b	23.47c	21.07c	20.23bc	17.07 bc	22.07c	42.38
T_4	11.77 b	23.30 b	23.50 b	34.00b	29.73bc	30.57b	32.67b	31.27b	28.77b	27.03b	24.97 b	18.47 b	26.34 b	31.23
T_5	24.83a	30.63a	37.03 a	43.50a	40.83a	41.57a	44.90a	43.20a	39.90a	40.60a	40.83a	31.80a	38.30a	
LSD(0.05)	2.934	4.358	4.775	4.377	2.815	6.070	3.363	8.105	3.541	2.155	4.740	5.904	1.743	
CV%	9.02	9.04	9.15	6.88	4.82	9.61	5.45	9.45	6.53	4.24	9.01	9.16	3.46	

Data represent the mean value of 5 (five) replications

T_1= Bavistin was applied as foliar spray @ 0.2%

T_2= Mancozeb was applied as foliar spray @ 0.2%

T_3= Dithane M-45 was applied in the soil as well as foliar spray @ 0.2%

T_4 = Cupravit was applied as foliar spray @ 0.2%

T_5 = Untreated control

4.4.1.7. Effect of fungicides on the severity of Curvularia leaf spot disease of coconut

Among the five fungicidal treatments applied, disease severity of Curvularia leaf spot disease showed a specific increase or decrease pattern. Mean disease severity ranged from 19.67 % to 35.94% and the lowest severity was recorded in Bavistin application and highest in Untreated Control. The highest Percent reduction of Curvularia leaf spot disease severity over control was 57.57% caused by Dithane M-45 application and the lowest reduction of disease severity over control was 26.91% caused by T_4 Cupravit application (Table-21).

Table 21. Effect of different fungicides on the disease severity of Curvularia leaf spot disease of coconut

Treatment	% Disease Severity													% Reduction over control
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Mean	
T_1	6.100 c	15.47c	18.47c	24.43 c	25.10c	21.70 c	25.07 b	26.40c	23.63d	18.77 d	16.40 c	14.47 d	19.67 c	45.27
T_2	11.60 b	21.57 b	19.43 c	35.40 b	29.93b	29.23 b	30.43 b	32.37 b	27.73 c	25.13bc	22.9 b	17.23 c	25.25 b	29.75
T_3	5.867c	13.83 c	18.30c	19.90 c	23.50c	20.90 c	24.37 b	26.27c	21.73 d	20.27cd	14.70 c	16.60 c	18.85 c	57.57
T_4	13.50 b	22.70 b	23.80 b	34.83 b	30.60b	31.63 b	29.10 b	32.53 b	31.43 b	27.13 b	23.80 b	20.00 b	26.76 b	26.91
T_5	24.83 a	28.30 a	34.93a	41.10 a	41.40a	38.20 a	44.77 a	40.30a	40.13a	35.43 a	35.43 a	26.40 a	35.94 a	
LSD(0.05)	3.293	4.343	3.876	5.382	3.295	3.855	6.2	4.129	3.645	4.888	4.879	1.038	2.381	
CV%	9.12	9.32	8.95	9.18	5.81	7.23	9.71	6.95	6.69	9.24	9.44	2.91	5.00	

Data represent the mean value of 5 (five) replications

T_1= Bavistin was applied as foliar spray @ 0.2%

T_2= Mancozeb was applied as foliar spray @ 0.2%

T_3= Dithane M-45 was applied in the soil as well as foliar spray @ 0.2%

T_4 = Cupravit was applied as foliar spray @ 0.2%

T_5 = Untreated control

4.4.1.8. Effect of fungicides on the severity of Phytophthora leaf spot and blight disease of coconut

In all the five treatments disease severity of Phytophthora leaf spot and leaf blight disease showed a specific increase or decrease pattern. Mean disease severity ranged from 13.99% to 32.8% and the lowest severity was made Dithane M-45 was application and highest in Untreated Control. The highest Percent reduction of Phytophthora leaf spot and blight disease severity over control was 57.4% caused by Dithane M-45 application and the lowest reduction of disease severity over control was 23.6% caused by Cupravit application (Table-22).

Table 22. Effect of different fungicides on the disease severity of Phytophthora leaf blight and leaf spot disease of coconut

Treatment	% Disease Severity													% Reduction over control
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Mean	
T_1	1.60 e	11.43 d	12.30c	16.77d	17.60 d	19.10d	18.50d	18.87b	21.60d	10.30 e	14.50 d	7.200d	14.15 d	56.91
T_2	5.50 c	14.30 c	15.50c	23.27c	22.20bc	20.40 c	24.63c	22.63b	22.20 c	17.60 c	16.40 c	13.20 c	18.15 c	44.73
T_3	3.10 d	9.800 e	11.60c	23.17c	20.00cd	14.60e	22.00cd	21.10b	14.47 e	12.60 d	9.833 e	5.600 e	13.99 d	57.4
T_4	8.90 b	21.70 b	25.50b	29.77b	23,90b	25.30b	30.30b	34.93a	29.10 b	26.80 b	24.50 b	20.10 b	25.07 b	23.66
T_5	24.6 a	25.60 a	31.87a	37.70a	39,97a	39.50 a	36.30a	35.87a	33.10 a	30.20 a	30.60 a	28.80 a	32.84 a	
LSD(0.05)	0.1975	0.9186	4.974	4.215	3.189	0.2063	4.030	5.006	0.2228	0.2063	0,1786	0.2063	0.7243	
CV%	1.20	2.95	9.65	8.57	6,85	0.46	8.12	9.97	0.49	0.57	0.49	0.73	2.06	

Data represent the mean value of 5 (five) replications

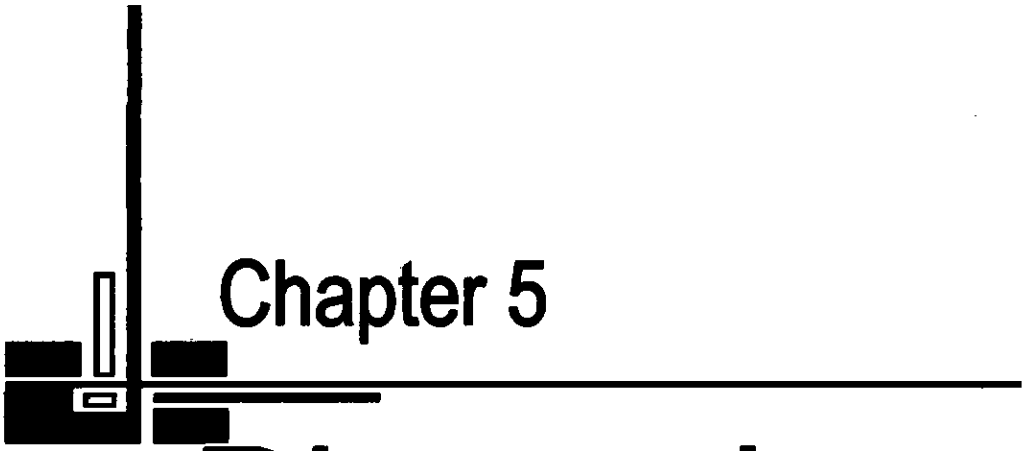
T_1= Bavistin was applied as foliar spray @ 0,2%

T_2= Mancozeb was applied as foliar spray @ 0.2%

T_3= Dithane M-45 was applied in the soil as well as foliar spray @ 0.2%

T_4 = Cupravit was applied as foliar spray @ 0.2%

T_5 = Untreated control



Chapter 5

Discussion

CHAPTER V

DISCUSSION

Coconut, one of the major fruit crops of Bangladesh, was surveyed during the research period of 2010-2012. The survey was designed to sutdy the nursery diseases of coconut and to observe the effect of temperature, relative humidity and rainfall on the occurrence of disease incidence and severity on seedling as well as their management practices with fungicides survey on five nurseries. The five nurseries were Green orchid nursery, Agargaon; Experimental field in Sher-E-Bangla Agricultural University in Dhaka; Dalhia nursery in Sonadanga; New market nursery in New Market and Bagan Bilash nursery in Joragate of Khulna district in Bangladesh. These diseases were recorded as a common disease in all the growing areas.The diseases were identified by observing the symptoms on the seedlings during survey and determination of presence of fungi was made either directly by preparation of slides and examined them under compound microscope or indirectly by isolation to agar culture following keys outline by Pathak (1980), Singh (1998), and Ploetz *et al.,* (1998).

Leaf spot of coconut fruit caused by *Pestalotia* sp., *Cercospora* sp., *Curvularia* sp. *and Phytophthora* sp. were isolated from spotted and blighted diseased leaf during survey period of different area of two districts of five nurseries. Radha and Shanta (1976) were also isolated *Pestalotia, Curvularia* and *Phytophthora* pathogens from leaf spot and blight diseases of coconut. Presence of *Pestalotia* in the coconut tree also reported by Koushik *et al.* (1972). In the present study, the diseases were recorded eight times during the period of twenty month survey from July, 2010 to April, 2012. During the survey of Pestalotia leaf spot of cooconut was found to increase with the increase of the temperature, relative humidity and rainfall. This positive correlation of Pestalotia leaf spot with high humidity, rainfall, and temperature is in agreement with the results of Koushik *et al.* (1972) who reported the leaf spot disease incidence have a positive relation with high humidity, rainfall and temperature.

The effects of temperature, rainfall and relative humidity on the incidence and severity of noted diseases of coconut in selected location were observed. The climate of Bangladesh is characterized by high temperature, heavy rainfall, and often excessive humidity with fairly marked seasonal variations (Anonymous, 1995). ANOVAs, correlation and linear regression analysis were performed to determine the relationship between different components of climatic factor (temperature, relative humidity and rainfall) and the incidence as well as severity of seedling disease of coconut. Gilligan (1986) observed that ANOVAs has been the fundamental method used by plant pathologist to determine the correlation between the prevalence and environmental parameters.

In this study, it was observed that the incidence and severity of leaf spot and leaf blight of coconut varied from location to location and year to year. Incidence and severity of Pestalotia leaf spot, Cercospora leaf spot, Curvularia leaf spot and Phytophthora leaf spot diseases of coconut varied from location to location and year to year. This finding was supported by Schuiling *et al.* (1992). He showed that the leaf spot disease incidence and severity of coconut palm tree differ significantly from region to region in Tanzania.

Disease incidence and severity of Phytophthora leaf blight of coconut also varied from location to location and year to year on the basis of different weather parameters viz. temperature, humidity, rainfall etc. Menon and Nair (1952) also noticed that leaf blight disease on coconut leaf caused by *Phytophthora* sp, highest disease incidence and severity observed in high temperate and humid region than in low temperate region in India.

Coconut seedlings are mainly affected by leaf spot, leaf blight and bud rot diseases. These diseases are cause by mainly fungi such as *Pestalotia* sp., *Cercosporsa* sp., *Curvularia* sp. and *Phytophthora* sp. To manage these pathogens and to control these diseases five fungicides were evaluated by applying four types of fungicides viz. T_1= Cupravit as foliar sparying @ 0.2%,

T_2= Mencozeb as foliar spraying @ 0.2%, T_3= Dithane M-45 as foliar spraying @ 0.2%, T_4= Bavistin as foliar spraying @ 0.2% and T_5= Untreated control on seedling diseases of coconut in the nursery. Significant effect of fungicidal spray in relation to incidence and severity and were observed. Percentage of mean disease incidence of *Pestalotia* leaf spot, *Cercospora* leaf spot, *Curvularia* leaf spot and *Phytophthora* leaf spot and blight shown different result by applying different fungicides. The lowest disease incidence (22.66%) was found by spraying Cupravit 50WP and Dithane M-45 for Pestalotia leaf spot of coconut. Similar studies conducted on coconut by Papa Rao *et al.* (1975) and showed that lowest incidence of *Pestalotia* sp observed in applying Cuparvit fungicide. The lowest disease incidence 25.69% in *Cercospora* leaf spot 19.10%, in Curvularia leaf spot 15.10% and in *Phytophthora* leaf spot observed by applying T_3 and T_1 (Dithane M-45 and Cupravit 50 WP). The highest mean disease incidence (50.59%, 37.96%, 32.81%, 32.21%) incidence above four diseases showed in T_5 (untreated control). Percentage reduction of disease incidence over control showed best in applying Dithane M-45 and Cupravit 50 WP than Mencozeb and Bavistin application in 2010-2012. Same result observed by Khalequzzaman *et al.* (1998), who conducted a research on effect of fungicide in controlling leaf spot of coconut.

The lowest disease severity was 23.45% in Pestalotia leaf spot on coconut seedlings. Similar result observed by Praveena and Kachapur (2002) on disease severity on coconut. Again the lowest disease severity was 21.44%, in Cercospora leaf spot, 18.85% in Curvularia leaf spot and 13.99% in Phytophthora showed by applying T_3 and T_1 (Dithane M-45 and Cupravit 50WP) @ 0.2%. The highest mean disease incidence (39.49%, 38.30%, 35.94%, 32.84%) above four diseases showed in T_5 (untreated control). Percentage reduction of disease incidence over control showed best result in applying Dithane M-45 and Cupravit 50 WP than Mencozeb and Bavistin application in both the year. Khalequzzaman *et al.* (1998) showed that Cupravit 50 WP and Dithane M-45 act best on controlling disease severity of leaf spot on coconut rather than Bavistin and other fungicides viz. Tilt-250 EC,

Mencozeb etc. Percentage reduction of disease incidence over control showed best result in applying Dithane M-45 and Cupravit 50 WP than Mencozeb and Bavistin application in 2010-2012. The disease incidence and severity gradually decrease from December to February and increases from March to August in both the year. This variation also reported by Menon and Nair (1952) that Cu fungicide applying on controlling leaf spot disease of coconut showed best result than other fungicide.

Chapter 6

Summary and conclusion

CHAPTER VI

SUMMARY AND CONCLUSION

Coconut (*Cocos nucifera* L.), is considered as the popular fruits of Bangladesh. Though, this crop is important for vitamins and minerals for the people of the country, but less emphasis has been given for of this crop improvement. The demand of this fruit is increasing day by day but the production in terms of area and yield is not satisfactory. Therefore, the present study has been designed to survey the nursery diseases of coconut in five nurseries in two selected districts; Dhaka and Khulna. In Dhaka two nurseries are Green orchid nursery in Agargaon and Experimental field in Sher-e-Bangla Agricultural University. And in Khulna, three nurseries are- Dahlia nursery in Sonadanga, New Market nursery in New Market and Bagan Bilash nursery in Joragate area of Khulna.

The incidence and severity of leaf spot and leaf blight of coconut varied from location to location. The highest incidence of leaf spot caused by *Pestalotia* sp., *Cercospora* sp., *Curvularia* sp. *and Phytophthora sp.* of coconut was recorded at Dhaka and lowest at Khulna in 2010-2012. The highest severity were recorded at Dhaka in 2010-2012. The lowest were recorded at Khulna in 2010-2012. The highest incidence and severity mainly observed in the month of April and July for both the years at Dhaka. And the lowest incidence and severity were recorded in January at Khulna 2010-2012. Prevalence of leaf spot and leaf blight of coconut varied from season to season. The highest incidence (83.61% and 84.60%) of Pestalotia leaf spot of coconut were recorded in April and July, and the lowest (46.67% and 40.58) were recorded in January, in both the years. The highest severity (33.74% and 33.58%) were recorded in April and July, in both the years, and the lowest (11.10% and 10.17%) were recorded in January, in both the years.

The highest incidence (41.67% and 41.68%) of Cercospora leaf spot of coconut were recorded in April and July, 2010-2012. The lowest incidence (11.17% and 10.6%) were recorded in month of January, in both the years. The highest

severity (29.65% and 30.5%) were recorded in April, 2010-2011, and July, in 2011-2012. And the lowest (7.667% and 8.6%) were recorded in January, in both the years.

The highest incidence (10.98% and 11.4%) of Curvularia leaf spot of coconut were recorded in April in 2010-2011 and July in 2011-2012. And the lowest (5.22% and 5.00%) were observed in January for both years. The highest severity (9.35% and 9.10%) were recorded in July, for both the years and the lowest (4.25% and 4.28%) were observed in the January, in both the years.

The highest incidence (20.75% and 17.45%) of Phytophthora leaf spot and blight of coconut were recorded in April in both the year. And the lowest (8.917% and 8.583%) were observed in January for both years. The highest severity (7.75% and 8.33%) were recorded in of April, for both the years and the lowest (2.25% and 2.833%) were observed in January, for both the years.

For control of disease causing fungus, different fungicide application were evaluated. Five treatments were applied. Among these Cupravit 50 WP and Dithane M-45 treatment showed best result against disease incidence and severity of leaf spot of coconut. Percentage of reduction of disease incidence and severity over control also shown good result in the applying of Cupravit and Dithane M-45 than Mancozeb and Bavistin.

Therefore, the present study on the occurrence of seedling disease of coconut in the nursery revealed that all the diseases studied were related to the temperature, relative humidity and rainfall. Other parameters of epidemiology viz. leaf wetness period, vapor presser deficit, sunshine hour, microclimatic parameters including canopy temperature, relative humidity etc, should be critically evaluated to have profound effects on over wintering formation, germination and development of inoculum in different pathosystem and these should 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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