EFFICACY OF FUNGICIDES IN CONTROLLING LEAF BLIGHT OF WHEAT CAUSED BY *Bipolaris sorokiniana*

MD. SHAH ZAMAL

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

June, 2006

EFFICACY OF FUNGICIDES IN CONTROLLING LEAF BLIGHT OF WHEAT CAUSED BY *Bipolaris sorokiniana*

By

REGISTRATION NO. 25201 / 00327

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, 2006

Approved by:

Dr. F. M. Aminuzzaman	**Nazneen Sultana**
Assistant Professor	**Assistant Professor**
Department of Plant Pathology	**Department of Plant Pathology**
Supervisor	**Co - Supervisor**

Dr. Md. Rafiqul Islam
Associate Professor
Chairman
Examination committee

Sher-e-Bangla Agricultural University

Sher-e-Bangla Nagar, Dhaka – 1207
PABX: 9110351 & 9144270-79

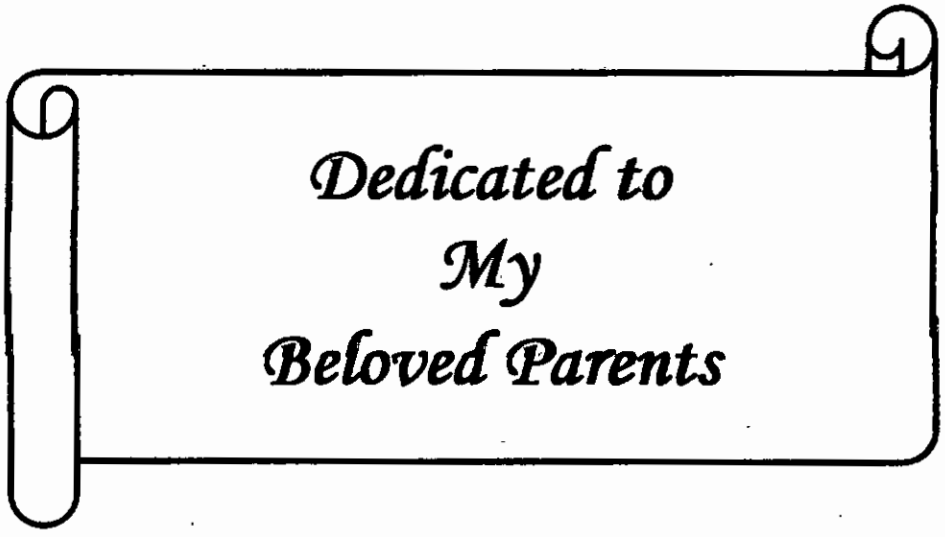
CERTIFICATE

This is to certify that the thesis entitled "**EFFICACY OF FUNGICIDES IN CONTROLLING LEAF BLIGHT OF WHEAT CAUSED BY *Bipolaris sorokiniana***" 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 **Md. Shah Zamal, Registration No. 25201 / 00327,** under my supervision and guidance. No part of this thesis has been submitted for any other degree in any other institutions.

I further certify that any help or sources of information, received during the course of this investigation have been duly acknowledged.

Dated: 30.08.06
Dhaka, Bangladesh

Dr. F. M. Aminuzzaman
Supervisor


Dedicated to
My
Beloved Parents

ACKNOWLEDGMENT

All praises to almighty "Allah" Who enabled the author to complete the research work and thesis writing leading to Master of Science (MS) in Plant Pathology. The author expresses his grateful respect and wishes, whole hearted gratitude and appreciation to his benevolent teacher and supervisor Dr. F. M. Aminuzzaman, Assistant Professor, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka for his invaluable suggestions, constructed criticism, proper guidance and helpful comments through out the study. He took keen interest and intellectually guided the author to develop the conceptual framework of the study. He took much pain to edit the thesis thoroughly and gave valuable suggestions for its improvement. His scholastic supervision and constant inspiration brought this thesis up to its present standard.

The author expresses his deepest sense of gratitude, indebtedness and sincere appreciation to his co-supervisor Nazneen Sultana, Assistant Professor, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka for her valuable advice, constant inspiration and helpful suggestions.

Cordial thanks and honors to Dr. Md. Rafiqul Islam, Associated Professor and Chairman, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, for his helpful comments and providing necessary facilities during the period of the research work.

The author also expresses his cordial thanks and gratefulness to all other respected teachers of the Department of Plant Pathology, Sher-e-Bangla Agricultural University, for their valuable advices, suggestions and constructive criticism.

The author is grateful to the office staffs of the Department of Plant Pathology and Farm Division at SAU, for their cooperation, encouragement and help to complete the research work.

The author extends his heartiest thanks and special gratefulness to his friends, Md. Akhlas Hossain Sarker, Md. Abu Sadat, Md. Aminur Islam, Md. Ziaul Haque, Md. Sakil Mahmud Khan, Nazmun Naher Tonu, Lutfun Naher Laila, Md. Abdul Alim, Md. Safiul Alam, Yakub Ali and many other well wishers for their inspiration, encouragement, help and active co-operation for carrying out the present study.

The authors also convey his special thanks to Md. Ashraful Islam (Pintu) and Md. Sarwar Mursed (Shohel) for their generous help to analyses data and for taking photographs for the research work.

The author recalls his late friend Pervez Rana and prays to almighty Allah for the peace of his departed souls.

Finally, the author is highly indebted to his beloved parents, brother and sister for their sacrifices and inspirations to pursue education from beginning to the completion.

The Author

EFFICACY OF FUNGICIDES IN CONTROLLING LEAF BLIGHT OF WHEAT CAUSED BY *Bipolaris sorokiniana*

by

MD. SHAH ZAMAL

ABSTRACT

An experiment was carried out to determine the comparative efficacy of Vitavax-200 as seed treating chemical; Tilt-250 EC, Bavistin and Pencozeb as foliar spray in controlling leaf blight of wheat caused by *Bipolaris sorokiniana* under field conditions. The single effect of Vitavax-200, Tilt-250 EC, Bavistin and Pencozeb were found less effective than that of combined effect of Vitavax-200 with Tilt-250 EC, Vitavax-200 with Pencozeb and Vitavax-200 with Bavistin. The effect of seed treatment with Vitavax- 200 followed by subsequent three foliar sprays with Tilt-250 EC (T_8) has been found significantly more effective than the other single and combined effects in reducing leaf blight severity of wheat. Maximum grain yield 4.05 t/ha was found under the treatment T_8 (Vitavax-200 with three sprays of Tilt-250 EC) which increased grain yield by 44.64% over untreated control. The treatment T_7 resulted statistically similar effect to that of treatment T_8 (Vitavax-200 with two sprays of Tilt-250 EC) in reducing leaf blight severity and increasing grain yield of wheat over control.

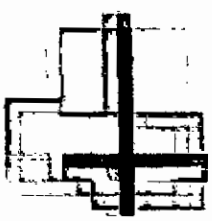
CONTENTS

CONTENTS (Contd.)

LIST OF TABLES

LIST OF PLATES

LIST OF APPENDICES



Chapter 1
Introduction

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops and main staple food all over the world. About two third of the world's population used wheat as staple food (Majumder, 1991). Dubin and Ginkel (1991) reported that the largest area of wheat cultivation in the warmer climates exists in the South-East Asia including Bangladesh, India and Nepal. It is the second most important grain crop in Bangladesh that plays a vital role in the national economy by reducing the volume of import of cereals (Razzaque *et al.*, 1992). Besides of human nutrition, wheat and straw are also used as animal feed. Wheat straw is used as fuel and as well as straw shade for the poor farmers of Bangladesh. Though the crop introduced in Bangladesh former East Pakistan in 1967 but its popularity increased after 1975. Now it is a raising crop over the country and well accepted by the farmers. Wheat cultivation has increased manifolds to meet up the food shortage in the country. In spite of its importance, the yield of the crop in our country is low in comparison to the other countries of the world, where average yield estimated 2.69 t/ha (FAO, 1997). Though the area, production and yield of wheat have been increasing dramatically during the last decade, but still it is too low (2.2 t/ha) in comparison to the developed countries like Japan, France, Germany and UK producing 3.76, 7.12, 7.28, and 8.00 t/ha, respectively (FAO, 2000). About 706.86 thousand hectares of land in Bangladesh is covered by wheat cultivation with the annual production of 1570 thousand tons (BBS, 2005).

All the growth stages of wheat are prone to the attack of numerous diseases which play a major role among the various factors responsible for reducing the

yield (Rashid, 1996). It suffers from as many as 200 diseases of which leaf blight caused by *Bipolaris sorokiniana* is the most destructive one.

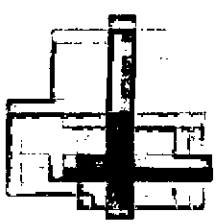
Bipolaris sorokiniana, Teleomorph *Cochliobolus sativus* (Ito & Kuribayashi) Drechs, exdustur, (Syn. *Helminthosporium sativum* pamm. King and Blakke) is a highly virulent pathogen of wheat. It is a major pathogen of wheat in temperate regions of the world also. It causes leaf blotch, leaf spot, leaf blight, foot rot, seedling blight, discolored grain, black point and impaired grain filling. The leaf blight disease is considered to be a threat to the wheat cultivation all over the world (Duveiller and Gilchrist, 1994). In Bangladesh the disease is also considered as highly devastating (Hossain and Azad, 1992). The yield loss due to leaf blight /blotch disease in the country has been reported to be 20% in var. Sonalika, where as 14% and 8% in Akbar and Kanchan, respectively (Razzaque and Hossain, 1991). In farmers field the yield loss is estimated to be 14.97% (Alam *et al.*, 1995), where as 29% yield reduction was estimated during 1991- 1992 in Kanchan (Alam *et al.*, 1994). In case of severe attack it may result even 100% yield loss (Hossain and Azad, 1994). Efforts for controlling the disease through different measures have been made by many workers (Nene and Saxena, 1971; Pidoplichko and Andreeva, 1980; BARI, 1984; Meisner *et al.*, 1994; Hossain and Azad, 1992; Wildermutt *et al.*, 1992; Malaker *et al.*, 1994; Dewey and Albrechtsen, 1997). The most expectable method for controlling the disease is cultivation of resistant variety, but not a single wheat cultivar in the country is found to be resistant (Hossain and Azad, 1992). It can also be control by the application of fungicides. Many workers followed the use of different chemicals against the disease and Tilt-250 EC had been proved effective (Anonymous, 1989). Foliar spray with Tilt-250 EC has been practiced in controlling the disease under field condition (Meyer, L., 1990; Bockus *et al.*, 1992; Anonymous, 1993 and Malaker *et al.*, 1994). Efficacy of 0.1% Propiconazole (Tilt-250 EC) to control leaf blight of wheat

much better than the 0.025% Mancozeb (Pencozeb) and 0.1% Carbendazim (Bavistin) 50 WP (Patil *et al.*, 2002). The three sprays of Tilt-250 EC were as good as four sprays in respect of yield, grain weight and disease severity (Singh *et al.* 1995). Foliar spray of Tilt-250 EC (0.1%) was found more effective than seed treatment with Vitavax-200 in controlling leaf blight of wheat (Rahman, 1998; Rahman *et al.*, 1999 and 2001).

However considering the above facts the researcher has transfer a piece of research work on the efficacy of fungicides in controlling leaf blight (*Bipolaris sorokiniana*) of wheat with the following objectives-

1. To evaluate the efficacy of fungicides in controlling leaf blight (*Bipolaris sorokiniana*) of wheat.

2. To determine the effect of fungicide on yield and some yield contributing characters.



Chapter 2
Review of literature

2. REVIEW OF LITERATURE

Leaf blight of wheat caused by *Bipolaris sorokiniana* a very common and destructive disease in Bangladesh. To control the disease, several management programmed has been practiced. Literature on chemical control for the management of leaf blight of wheat is presented in this chapter.

2.1. Seed treatment with Vitavax-200

Ram (1992) reported that seed treatment with Vitavax-200 gave excellent control of *Bipolaris sorokiniana* by reducing seed borne infection.

Meisner *et al.* (1994) found that seed dressing with Vitavax-200 decreased soil borne pathogen population and seedling infection caused by *Bipolaris sorokiniana.*

Leaf blight of wheat caused by *Bipolaris sorokiniana* is the major disease constraint of wheat production. An integrated approach is required to control the disease as regards to reduce the fungal inoculums by using seed with low level of infection. Seed treatment, spraying appropriate fungicide and other agronomical practices are the important approaches. (Duveiller and Gilchrist, 1994)

Dang and Tyagi (1997) found that seed treatment with Vitavax-200 before sowing usually increased the germination percentage of wheat.

Dewey and Albrechtsen (1997) reported that Vitavax-200 treated seed significantly increased number of grain per spikelet, number of spikelet per spike and ultimately increased the yield.

Rahman *et al.* (1999) reported the effect of seed treatment with Vitavax-200 (Carbendazim + Thiram) at 4 g/kg, foliar spray with Garlic extracts, foliar spray with Tilt-250 EC 0.1%, seed treatment with Vitavax-200 + Garlic extracts, foliar spray and seed treatment with Vitavax-200 + Tilt-250 EC against leaf blight of wheat caused by *Bipolaris sorokiniana* (*Cochliobolus sativus*). They observed a significant effect incase of reduction of leaf blight severity and increased yield were observed with seed treatment with Vitavax combining with foliar spray of Tilt-250 EC.

Rahman *et al.* (2001) found that *Bipolaris* leaf blight (caused by *Bipolaris sorokiniana*) of wheat can be controlled by using Vitavax-200 (0.4%) and Tilt - 250 EC (0.1%) but their combined effect of (Vitavax-200 + Tilt-250 EC) showed better control than the single one.

2. 2. Foliar spray of fungicides

Foliar spray of Tilt-250 EC (Propiconazole) significantly decreased the pathogen population and percent blighted leaf area compared to nons-prayed control (Jones, 1983; Peltonen and Karjalainen, 1992; BARI, 1992a).

Three times spraying with Tilt-250 EC at maximum tillering stage, 50% flowering stage and milk ripening stage were reported to control leaf blight caused by *Bipolaris sorokiniana* (Jones, 1983; BARI. 1990 and BARI 1992b).

Das (1988) sprayed sonalika wheat with 9 test fungicides at the initial appearance of disease at approximately 2-month-old plants where subsequently sprayed twice at 10-12 days intervals. Disease intensity was recorded 10 days after the final spraying Pencozeb gave the best control of *Bipolaris sorokiniana.*

Dithane M-45 (Mancozeb) (0.2%), Rovral, (0.2%), Tilt-250 EC (0.1%) and G-698 (0.2%) were evaluated for controlling leaf blight. Three spraying was done at an interval of 15 days. Both Rovral and Tilt-250 EC were highly effective to control the disease (Anonymous, 1989).

Ashok *et al.* (1989) followed economical spray schedule for the management of leaf blight / blotch of wheat in the field and he found that the most effective and economical control was Mancozeb 3-sprays applied at 10 days intervals followed by 3-sprays at 15 days intervals with Mancozeb.

Entz *et al.* (1990) conducted an experiment to determine the effect of foliar fungicides on grain yield, grain size and seed size in wheat. Tilt-250 EC was applied at 125 ai/ha. Tilt-250 EC reduced the disease, significantly increased grain yield and the number of grains. Under low levels of infection, Tilt-250 EC rarely increased grain yield, but frequently increased the number of large grain.

Experiments were conducted to assess the yield loss due to *Bipolaris* leaf blight at three locations with four sprays of Tilt @ 1.25% at an interval of 15 days commencing from 1st appearance of disease symptoms. It has been reported that sprays reduced the percent of leaf blight and the percent loss in grain yield estimated as 25% (Anonymous, 1992a).

Tilt application (3 times) with seed treatment had lower yield loss than the other application. Tilt application at post anthesis increased yield by 17% which significantly differed from that of booting stage. Three applications of Tilt with or without seed treatment were similar to post anthesis application (Anonymous, 1992b).

Bockus *et al.* (1992) found that the application of Tilt-250 EC as foliar spray showed increased grain yield, 1000 grain weight and large seed as a subsequent higher grain yield in comparison to non-sprayed plots.

Peltonen and Karjalainen (1992) observed that application of Tilt increased grain yield. They also found that Tilt significantly increased nitrogen uptake, grain weight and protein quality in a good growing season but in a cold and wet weather Tilt did not increase yield or quality of cultivars.

Tilt-250 EC @ 1.25% was sprayed at an interval of 15 days commencing from first appearance of disease symptoms at three wheat locations and reduced the leaf blight disease and loss in grain yield. The average yield loss was 24%. The 1000-grain weight of non-sprayed and appeared plots varied from 39.6 to 42.59 g and 43.3 to 47.39 g respectively (Anonymous, 1993).

Malaker *et al.* (1994) observed the severity of disease at four locations under conditions of natural infection by *Helminthosporium sativum* (*Cochliobolus sativas*). Tilt-250 EC was effective against *Helminthosporium* leaf blight (HLB) and disease severity where significantly differed from 3.04 to 3.44 for sprayed and non-sprayed plots, respectively.

Mondal *et al.* (1994) evaluated four commercial fungicides to evaluate their efficacy in controlling *Bipolaris* leaf blight of wheat under natural epiphytotic conditions during 1991-1992 and 1992-1993. Among them, Tilt-250 EC (0.05%) was the most effective and profitable one, which controlled the disease significantly producing the highest grain, yields with maximum gross margin. The disease severity was also reduced by Dithane M-45 (0.2%) and Pencozeb

(0.15%) and gave profitable yield while application of Rovral (0.2%) was round uneconomic offering the lowest gross margin.

Goulart *et al.* (1995) evaluated the effect of fungicides spraying on above ground part of wheat on the incidence of *Bipolaris sorokiniana* (*Cochliobolus sativus*). The best disease control was obtained with 3 applications, when wheat was sprayed with tebuconazole, propiconazole and flutriatol.

Singh and Chauhan (1995) studied the efficacy of Dithane M-45 (0.25% and 0.30%), Tilt (0.025% and 0.05%) and Topsin-M (0.05% and 0.1%) against *Helminthosporium* leaf blight of wheat in-vitro and in-vivo. Tilt (500ppm) provided significant control the pathogen. Tilt (0.05%) provided significant control as foliar application in the field after 3-sprays at 10 days interval, with a cost benefit ratio of 1:2.69.

Singh *et al.* (1995) used four fungicides namely Mancozeb, Tilt-250 EC, Topsin-M and Rhilex to manage the foliar blight of wheat. Among the four tested fungicides, maximum yield, grain weight and minimum disease were found with 4 spraying of Tilt (500 ml/ha) starting at disease initiation following by 3 spraying of Tilt. The 3 sprays of Tilt was good as four sprays in respect of yield, grain weight and disease severity. Second effective fungicides was Mancozeb (2.5kg/ha) with four sprays at disease initiation.

Khan and Ityas (1996) applied Tilt (Propiconazole) and Folicur (Tebuconazole) at growth stage 10.1 (heading) and 10.5 (anthesis) on FSD-85, LU-26 and pak-81 in the spraying of 1996 to determine their effect on *Drechslera sorokiniana* (*Cochliobolus sativas*) in wheat. A single application of either Tilt or Folicur gave significant reduction of spot blotch development.

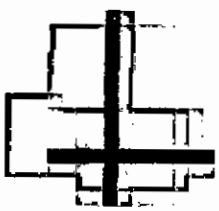
Kabir (1997) carried out an experiment on integrated control of leaf blotch under field conditions. Out of the inputs of integrated disease management program, two applications of fungicide (Tilt-250 EC) were more effective to control leaf blotch of wheat.

Rahman (1998) carried out an experiment on foliar spray in controlling *Bipolaris* leaf blight of wheat and found Tilt-250 EC (0.1%) more effective as foliar spray than the effect of seed treatment with Vitavax-200. The maximum percent disease index (PDI) of 58.25% was observed in control plots. The PDI value was reduced to 21.75% when Tilt was sprayed for six times.

Kabir and Hossain (2000) showed that the effect of different combinations of nutrients, irrigation and fungicides on controlled *Bipolaris* leaf blight caused by *Bipolaris sorokiniana* in wheat cv. Kanchan. Treatments with nutrient + irrigation + Tilt (twice) reduced or controlled the disease and increased yield.

Rashid *et al.* (2001) reported that Tilt-250 EC (Propiconazole) is a good fungicide in controlling leaf blight of wheat

Patil *et al.* (2002) reported that the efficiency of 0.1% Propiconazole (Tilt) 250 EC & 25% EC, 0.1% Haxaconazole 25% EC, 0.05% Tridemorph 200 WC, 0.1% Carbendazim 50 WP (Bavistin), 0.1% Triadimefon, 0.0025% Mancozeb (Pencozeb), 0.020% Chlorothalonil, 0.3% Copper oxychloride 50 WP and 0.03% Nimbicidin in controlling leaf blight of wheat. The incidence of the disease was not observed in plant sprayed with 0.1% Propiconazole (Tilt) and increased the yield and biomass.



Chapter 3
Materials and methods

3. MATERIALS AND METHODS

3.1. Experimental site

The experiment was conducted in the farm of Sher-e-Bangla Agricultural University, Dhaka, under natural conditions.

3.2. Experimental period

The experiment was carried out during the period from November, 2005 to April 2006.

3.3. Soil type

The soil of the experimental field belongs to the Tejgaon series under the Agro Ecological Zone, Madhupur Tract (AEZ-28) and the General soil type is Shallow Red brown terrace Soils. Details of the soil characteristics are shown in Appendix I.

3.4. Climate

The experimental area was under the sub-tropical climate characterized by comparatively high rainfall, humidity, temperature with relatively long day length during the period from April to September and scanty rainfall, low humidity, low temperature and short day length during the period from October to march (Anonymous, 1960).

3.5. Crop

Wheat (*Triticum aestivum* L.) cv. Kanchan was collected from a farmer of Sirajgonj district and used in this study.

3.6. Treatments

There were ten different treatments which were as follows-

T_1= Untreated control

T_2 = Seed treatment with Vitavax-200 (0.4%)

T_3 = Single spray of Tilt-250 EC (0.1%)

T_4 = Single spray of Pencozeb 80 WP (0.2%)

T_5 = Single spray of Bavistin 50 WP (0.1%)

T_6 = Seed treatment with Vitavax-200 (0.4%) + single spray of Tilt-250 EC (0.1%)

T_7 = Seed treatment with Vitavax-200(0.4%) + two sprays of Tilt-250 EC (0.1%)

T_8 = Seed treatment with Vitavax-200(0.4%) + three sprays of Tilt-250 EC (0.1%)

T_9 = Seed treatment with Vitavax-200 (0.4%) + single spray of Pencozeb (0.2%)

T_{10}= Seed treatment with Vitavax-200 (0.4%) + single spray of Bavistin (0.1%)

3.7. Design of experiment

The experiment was laid out in Randomized Complete Block Design (RCBD) comprising three replications for each treatment. Block to block and plot to plot distance was one meter and one meter respectively. The unit plot size was 2m x 1m.

3.8. Land preparation

The land was thoroughly prepared by ploughing and cross ploughing with a power tiller followed by laddering. The clods were broken and the soils were leveled until the desired tilth was obtained for sowing the wheat seeds. During land preparations weeds and stubbles of the previous crops were collected and removed from the field.

3.9. Manure and fertilizer application

Manure and fertilizer were applied as per recommendation of BARI (2005). The following doses fertilizer and manure were applied to the plots for wheat cultivation-

Fertilizer and Manure	Dose/ha
Urea	220 kg
TSP	180 kg
MP	50 kg
Gypsum	120 kg
Cow dung	10 tons

Two third of Urea, all the TSP, MP, and Gypsum were used at the time of final land preparation. Remaining one-third Urea was applied as splits at growth stage of 25 days after sowing.

3.10. Sowing of seed

Seeds were sown in line on 2nd December 2005 at the rate of 120 kg /ha. After placing the seeds in the furrows, the furrows were covered by soil. For the treatments T_2, T_6, T_7, T_9, and T_{10} seeds were treated by Vitavax-200 (0.4%) prior to sowing in the field.

3.11. Intercultural operation

3.11.1. Irrigation

The field plots were irrigated three times. First irrigation was done at 21 days after sowing; Second irrigation was done at 60 days after sowing and third irrigation was done at 76 days after sowing.

3.11.2. Weeding

Weeds growing out in the plot during the growing period of the crop. First weeding was done at 25 days after sowing and another at 60 days after sowing.

3.12. Preparation of fungicidal spray solution

The fungicidal solutions were prepared by mixing with required amount of fungicides with tube well water to get 0.1% solution for Tilt-250 EC and Bavistin, 0.2% for Pencozeb. Specification of fungicides used in this study is presented in table 1.

Table 1. Specification of fungicides

Common name (Trade name)	Chemical name	Active ingredient	Dose used (%)
Tilt-250 EC	1-[2-(2,4-Diclorophenyl-4-prophyl-1,3-Dioxalene-2-el-methyl) 1h, 1,2,4-triozole]	Propiconazole	0.1
Bavistin	Methyl-1H-Benzemidazole-2-Phynyl Carbamate	Carbendazim	0.1
Pencozeb	Manganese ethylene bisdio-thiocarbamate plus zinc	Mancozeb	0.2
Vitavax-200	5,6-dihydro-2-N-phynyl-1-oxathin-3-carboxamide	Triazimidazole	0.4

3.13. Application of spray solution

All sprays solution (fungicides) was sprayed with compressed sprayer. Sprays were done for three times 30 days after sowing, 45 days after sowing and 60 days after sowing. The first spraying was done at 30 days after sowing for all the foliar fungicides tested. The second spray of Tilt-250 EC (T_7 and T_8) was done at 45 days after sowing. The third spray of Tilt-250 EC (T_8) was performed at 60 days after sowing. Every time the fungicide was freshly prepared prior to application and the spray tank was thoroughly cleaned before filling with new spray materials. Special attention was given to complete coverage of the growing plants with the fungicides. Adequate precaution was taken to avoid drifting of spray materials from one plot to the neighboring ones.

3.14. Recording of disease severity

The data were recorded for disease reaction in four growth stages of the plant namely panicle initiation stage, flowering stage, milking stage and hard dough stage. Twenty-five plants per plot (5 plants per row) were selected for collection of data on percent Leaf area diseased (% LAD). LAD of flag leaf, second leaf (2^{nd} from the top) and 3^{rd} leaf (3^{rd} from the top) were counted. The grading of the leaves were done followed 0-5 rating scale (Plate 1) as used by Hossain and Azad (1992) and the CIMMYT method (Gilchrist, 1984) as shown bellow (Plate 1)

3.15. Harvesting of crop

The crop was harvested on 1^{st} April, 2006 at full ripening stage. The twenty-five selected tagged plants of each plot were harvested separately. The crop was harvested by cutting the plants just at the soil level and bundled separately. The bundles were threshed mechanically by hand and individual bundles of straw were weighted and recorded.

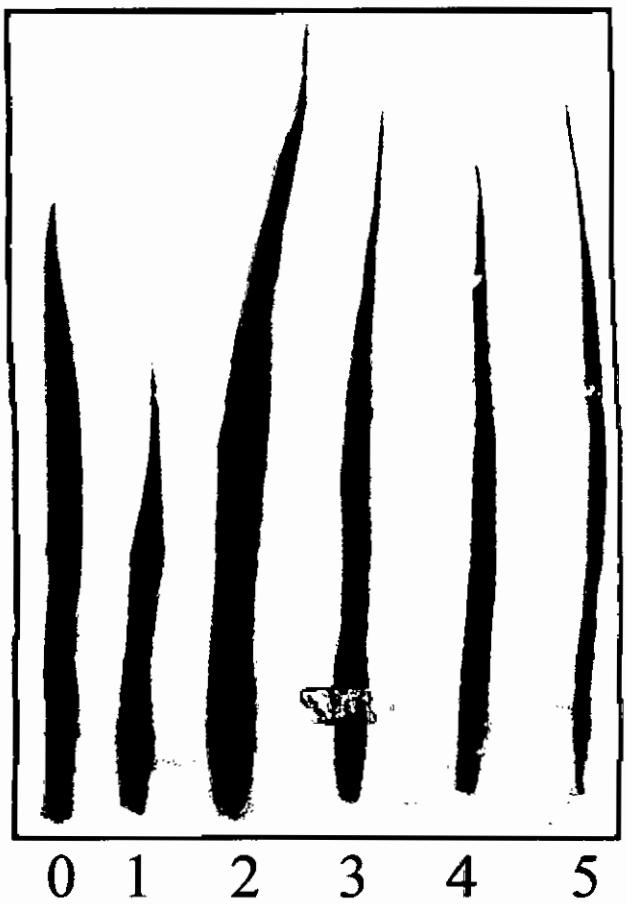


Plate 1. Disease severity grade on 0 - 5 scale

0 = free from infection

1 = few minute lesions on leaves

2 = black lesion with number of distinct chlorotic halos covering < 10% of the leaf area

3 = typical lesions surrounded by distinct chlorotic halos covering 10 – 50% of the leaf area

4 = severe lesion on leaves with ample necrotic zones, drying over a part of the leaf, covering > 50% of the leaf area and

5 = severe infection of the leaf, spike, infected to the some extent

3.16. Recording data on yield parameters

Data were recorded on the following parameters –

i. Plant height (cm)
ii. Ear length (cm)
iii. Distance between the point of flag leaf initiation and base of the ear (cm)
iv. Number of spikelets/ear
v. Number of healthy spikelets/ear
vi. Number of diseased spikelets/ear
vii. Number of grains/ear
viii. Number of healthy grains /ear
ix. Number of diseased grains /ear
x. Weight of grains /ear (g)
xi. Weight of healthy grains /ear (g)
xii. Weight of diseased grains/ear (g)
xiii. 1000-grains weight (g)
xiv. Grains yield (kg/plot)
xv. Grains yield (t/ha)
xvi. Straw yield (kg/plot)
xvii. Straw yield (t/ha)

3.17. Statistical Analysis

Data collected on different parameters were subjected to statistical analysis and tested according to Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

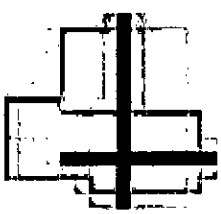
3.18. Pathogen isolation and identification

The collected diseased leaves were cut into pieces (0.5 cm) and surface sterilized with $HgCl_2$ (1: 1000) for 30 seconds. Then the cut pieces were washed in sterilized water thrice and were placed on to PDA in petridish. The petridish containing leaf pieces were placed in an incubator at 22-24^{0}C for 7 days. The organism was isolated by hyphal tip culture method and then purified (Plate 3). Temporarily, PDA plates were used to preserve the pathogen. Later, the pathogen was grown on PDA at 22-24^{0}C under Near Ultra-Violet ray for a week. Pathogen was then transferred to PDA and maintain as pure culture for future study.

Plate 2. Infected plants showing leaf spot caused by *Bipolaris sorokiniana*

Plate 3. Pure culture of *Bipolaris sorokiniana*

Plate 4. Conidiophores and conidia of *Bipolaris sorokiniana* (X 400).



Chapter 4
Results

4. RESULTS

4.1. Efficacy of fungicides in controlling leaf blight (*Bipolaris sorokiniana*) of wheat at panicle initiation stage

Leaf blight disease caused by *Bipolaris sorokiniana* was observed in all the plots (Plate 5) and recorded at four different stages of plant growth. The leaf blight severity at panicle initiation stage varied significantly in respect of different chemical used. Significantly the highest disease severity (Plate 5) was recorded under the treatment T_1 (control) against where as fungicides were not applied. Significantly the lowest disease severity (Plate6) in flag leaf, second leaf and third leaf were found under the treatment T_8 (Vitavax-200 with three sprays Tilt-250 EC). Regarding average disease severity of flag leaf, second leaf and third leaf, it was found that seed treatment with Vitavax-200 with three spraying with Tilt-250 EC significantly reduced leaf blight severity than that of non-treated control.

4.2. Efficacy of fungicides in controlling leaf blight (*Bipolaris sorokiniana*) of wheat at flowering stage

The leaf blight severity at flowering stage varied significantly in respect of different chemical used. Significantly the highest disease severity was recorded under the treatment T_1 (control) where fungicides were not applied. Significantly lowest disease severity in flag leaf, second leaf and third leaf were found under the treatment T_8 (Vitavax-200 with three sprays Tilt-250 EC) followed by T_7 (Vitavax-200 with two sprays Tilt-250 EC). Regarding average disease severity of flag leaf, second leaf and third leaf, it was found that seed treatment with Vitavax-200 with three spraying with Tilt-250 EC significantly reduced leaf blight severity than that of non-treated control.

Table 2. Efficacy fungicides in controlling leaf blight (*Bipolaris sorokiniana)* of wheat at panicle initiation stage

Treatments	Flag leaf	2nd leaf	3rd leaf	Average
T_1	0.13 a	0.16 a	0.24a	0.18s a
T_2	0.04 b	0.10 a-d	0.16 bc	0.10 b-d
T_3	0.04 b	0.09 b-e	0.14 bc	0.09 b-d
T_4	0.07 b	0.13 ab	0.17 b	0.12 ab
T_5	0.06 b	0.12 a-c	0.17 b	0.11 bc
T_6	0.04 b	0.06 c-e	0.14 bc	0.08 b-d
T_7	0. 02 b	0.05 de	0.12 bc	0.06 cd
T_8	0.01 b	0.04 e	0.10 c	0.05 d
T_9	0.05 b	0.08 b-e	0.13 bc	0.08 b-d
T_{10}	0.05 b	0.09 b-e	0.13 bc	0.09 b-d
LSD	0.054	0.058	0.058	0.058

T_1 = Untreated control

T_2 = Seed treatment with Vitavax-200 (0.4%)

T_3 = Single spray of Tilt-250 EC (0.1%)

T_4 = Single spray of Pencozeb 80 WP (0.2%)

T_5 = Single spray of Bavistin 50 WP (0.1%)

T_6 = Seed treatment with Vitavax-200 (0.4%) + Single spray of Tilt-250 EC (0.1%)

T_7 = Seed treatment with Vitavax-200 (0.4%) + two sprays of Tilt-250 EC (0.1%)

T_8 = Seed treatment with Vitavax-200 (0.4%) + three sprays of Tilt-250 EC (0.1%)

T_9 = Seed treatment with Vitavax-200 (0.4%) + Single spray of Pencozeb (0.2%)

T_{10}=Seed treatment with Vitavax-200 (0.4%) + Single spray of Bavistin (0.1%)

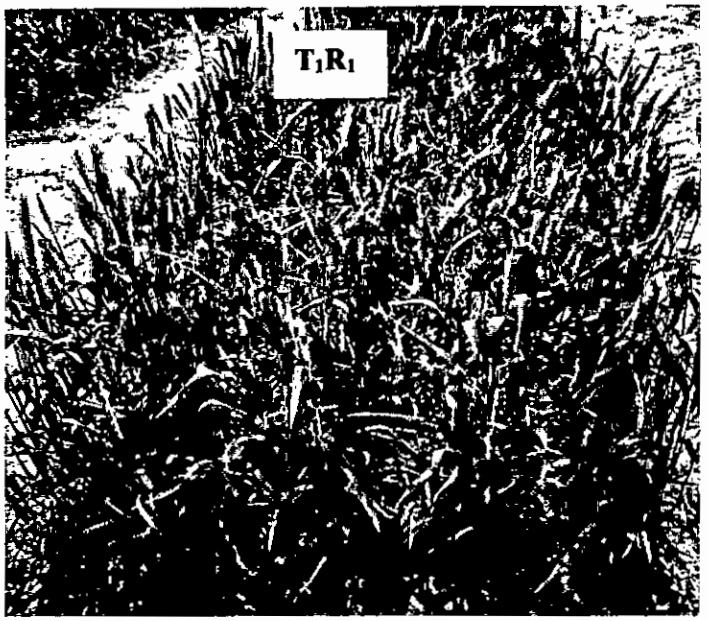


Plate 5. Leaf blight severity in control plot

Plate 6. Healthy plants under seed treatment with Vitavax-200 and three sprays of Tilt-250 EC (T_8)

Table 3. Efficacy of fungicides in controlling leaf blight (*Bipolaris sorokiniana)* of wheat at flowering stage

Treatments	Flag leaf	2nd leaf	3rd leaf	Average
T_1	0.21a	0.24 a	0.42 a	0.29 a
T_2	0.13 b	0.17 b	0.26 bc	0.19 b
T_3	0.13 b	0.17 b	0.26 bc	0.19 b
T_4	0.13 b	0.14 bc	0.29 b	0.19 b
T_5	0.13 b	0.16 bc	0.29 b	0.19 b
T_6	0.09 bc	0.12 b-d	0.24 b-d	0.15 bc
T_7	0.06 c	0.10 cd	0.18 cd	0.12 c
T_8	0.05 c	0.09 d	0.17 d	0.10 c
T_9	0.10 bc	0.13 b-d	0.22 b-d	0.15 bc
T_{10}	0.10 bc	0.13 b-d	0.24 b-d	0.16 bc
LSD	0.054	0.058	0.076	0.058

T_1 = Untreated control

T_2 = Seed treatment with Vitavax-200 (0.4%)

T_3 = Single spray of Tilt-250 EC (0.1%)

T_4 = Single spray of Pencozeb 80 WP (0.2%)

T_5 = Single spray of Bavistin 50 WP (0.1%)

T_6 = Seed treatment with Vitavax-200 (0.4%) + single spray of Tilt-250 EC (0.1%)

T_7 = Seed treatment with Vitavax-200 (0.4%) + two sprays of Tilt-250 EC (0.1%)

T_8 = Seed treatment with Vitavax-200 (0.4%) + three sprays of Tilt-250 EC (0.1%)

T_9 = Seed treatment with Vitavax-200 (0.4%) + single spray of Pencozeb (0.2%)

T_{10} = Seed treatment with Vitavax-200 (0.4%) + single spray of Bavistin (0.1%)

4.3. Efficacy of fungicides in controlling leaf blight (*Bipolaris sorokiniana)* of wheat at milking stage

The leaf blight severity at milking stage varied significantly in respect of different chemical used. Significantly the highest disease severity is recorded under the treatment T_1 (control) where as fungicides were not applied. Significantly the lowest disease severity in flag leaf, second leaf and third leaf were found under the treatment T_8 (Vitavax-200 with three sprays of Tilt-250 EC). Regarding average disease severity of flag leaf, second leaf and third leaf it was found that seed treatment with Vitavax-200 with three times spraying with Tilt-250 EC significantly reduced leaf blight severity than that of non-treated control.

4.4. Efficacy of fungicides in controlling leaf blight (*Bipolaris sorokiniana)* of wheat at hard dough stage

The leaf blight severity at hard dough stage varied significantly in respect of different chemical used. Significantly the highest disease severity is recorded under the treatment T_1 (control) where as fungicides were not applied. Significantly the lowest disease severity in flag leaf, second leaf and third leaf were found under the treatment T_8 (Vitavax-200 with three sprays Tilt-250 EC). Regarding average disease severity of flag leaf, second leaf and third leaf it was found that seed treatment with Vitavax-200 with three times spraying with Tilt-250 EC significantly reduced leaf blight severity than that of non-treated control.

Table 4. Efficacy of fungicides in controlling leaf blight (*Bipolaris sorokiniana)* of wheat at milking stage

Treatments	Flag leaf	2nd leaf	3rd leaf	Average
T_1	0.28 a	0.66 a	0.94 a	0.62 a
T_2	0.17 bc	0.56 ab	0.68 bc	0.47 b
T_3	0.18 bc	0.54 a-c	0.70 b	0.47 b
T_4	0.20 b	0.58 ab	0.66 bc	0.48 b
T_5	0.20 b	0.61 ab	0.65 bc	0.48 b
T_6	0.13 cd	0.42 c-e	0.46 c-e	0.33 c-e
T_7	0.10 d	0.39 de	0.38 de	0.29 de
T_8	0.09 d	0.38 e	0.35 e	0.28 e
T_9	0.13 cd	0.51 b-d	0.58 b-d	0.40 b-d
T_{10}	0.13 cd	0.52 b-d	0.59 b-d	0.41 bc
LSD	0.054	0.12	0.21	0.11

T_1= Untreated control

T_2 = Seed treatment with Vitavax-200 (0.4%)

T_3 = Single spray of Tilt-250 EC (0.1%)

T_4 = Single spray of Pencozeb 80 WP (0.2%)

T_5 = Single spray of Bavistin 50 WP (0.1%)

T_6 = Seed treatment with Vitavax-200 (0.4%) + single spray of Tilt-250 EC (0.1%)

T_7 = Seed treatment with Vitavax-200 (0.4%) + two sprays of Tilt-250 EC (0.1%)

T_8 = Seed treatment with Vitavax-200 (0.4%) + three sprays of Tilt-250 EC (0.1%)

T_9 = Seed treatment with Vitavax-200 (0.4%) + single spray of Pencozeb (0.2%)

T_{10} = Seed treatment with Vitavax-200 (0.4%) + Single spray of Bavistin (0.1%)

Table 5. Efficacy of fungicides in controlling leaf blight (*Bipolaris sorokiniana)* of wheat at hard dough stage

Treatments	Flag leaf	2nd leaf	3rd leaf	Average
T_1	0.81 a	0.88 a	1.86 a	1.18 a
T_2	0.58 c	0.65 bc	1.69 ab	0.97 bc
T_3	0.59 bc	0.66 bc	1.62 a-c	0.95 bc
T_4	0.67 ab	0.69 bc	1.68 ab	1.01 b
T_5	0.53 b-d	0.73 b	1.72 ab	0.99 b
T_6	0.22 e	0.57 c-e	1.42 b-d	0.73 de
T_7	0.20 e	0.50 de	1.28 cd	0.66 ef
T_8	0.16 e	0.44 e	1.12 d	0.57 f
T_9	0.46 cd	0.60 b-d	1.52 a-c	0.86 cd
T_{10}	0.46 d	0.62 b-d	1.62 a-c	0.88 bc
LSD	0.14	0.13	0.32	0.13

T_1 = Untreated control

T_2 = Seed treatment with Vitavax-200 (0.4%)

T_3 = Single spray of Tilt-250 EC (0.1%)

T_4 = Single spray of Pencozeb 80 WP (0.2%)

T_5 = Single spray of Bavistin 50 WP (0.1%)

T_6 = Seed treatment with Vitavax-200 (0.4%) + single spray of Tilt-250 EC (0.1%)

T_7 = Seed treatment with Vitavax-200 (0.4%) + two sprays of Tilt-250 EC (0.1%)

T_8 = Seed treatment with Vitavax-200 (0.4%) + three sprays of Tilt-250 EC (0.1%)

T_9 = Seed treatment with Vitavax-200 (0.4%) + single spray of Pencozeb (0.2%)

T_{10} = Seed treatment with Vitavax-200 (0.4%) + single spray of Bavistin (0.1%)

4.5. Effect of fungicides on plant growth and spikelet formation of wheat

The effect of seed treatments and foliar spray on plant height, ear length, distance between flag leaf initiation and base of the ear, number of spikelets/ear, number of healthy spikelets/ear, and number of diseased spikelets /ear were shown in table 6. It was observed that all the treatments showed significant effect. Plant height varied from 79.95 to 87.82 cm. The highest plant height was observed in T_8 (Seed treatment with Vitavax -200 + three sprays of Tilt-250 EC) followed by T_6, T_7, T_9 and T_{10}. The lowest plant height was recorded in control plot T_1 (Untreated control).

It was observed that the treatments showed significant effect on ear length. The ear length under different treatments ranged from 13.62 to 15.76. The highest ear length observed in T_8 followed by T_7. The lowest ear length was recorded in control plot (T_1). Statistically no significant variation was found in T_2, T_5, T_9 and T_{10}. In case of distance between flag leaf initiation and base of the ear, the treatments showed significant effect. The distance between flag leaf initiation and base of the ear differed from 11.36 to 14.86cm.where the highest distance observed in T_8 followed by T_2, T_3, T_6, T_7, T_9, and T_{10}. The lowest distance was recoded in control plot (T_1). The number of spikelets per ear varied significantly among the treatments. The number of spikelets per ear varied from 18.72 to 20.70. The highest numbers of spikelets were observed in T_8 followed by T_6, T_7 and T_9. The lowest number of spikelets recorded in control plot. Statistically no significant difference found among the T_2, T_3, T_4 and T_5. regarding the number of spikelets/ear.

The number of healthy spikelets per ear differed significantly among the treatments and ranged from 12.76 to 18.21. The highest number of healthy

Table. 6. Effect of fungicides on plant growth and spikelets formation of wheat

Treatments	Plant height (cm)	Ear length (cm)	Distance between the flag leaf initiation and base the ear(cm)	Number of Spikelets/ ear	Number of healthy spikelets/ ear	Number of diseased spikelets / ear
T_1	79.96 d	13.63 d	11.36 c	18.72 d	12.76 e	5.96 a
T_2	83.13 b-d	14.73 c	13.98 ab	18.92 cd	14.55 d	4.37 b
T_3	82.21 cd	14.93 bc	13.05a-c	18.85 cd	14.85 cd	4.00 b
T_4	82.58 cd	14.96 bc	12.30 bc	19.02 cd	14.48 d	4.54 ab
T_5	80.12 d	14.57 c	13.34a-c	18.90 cd	14.71 d	4.29 b
T_6	85.74a-c	14.98 bc	14.40 ab	20.01 a-c	16.43 bc	3.58 b
T_7	86.92ab	15.66 ab	14.60 a	20.31 ab	16.85 ab	3.46 b
T_8	87.82 a	15.76 a	14.86 a	20.70a	18.21 a	3.17 b
T_9	85.01 a-c	14.88 c	14.14 ab	19.09a-d	15.23 b-d	3.87 b
T_{10}	84.02a-d	14.81 c	14.09 ab	19.69b-d	15.96 b-d	3.73 b
LSD	3.86	0.76	1.94	1.12	1.71	1.42

T_1 = Untreated control

T_2 = Seed treatment with Vitavax-200 (0.4%)

T_3 = Single spray of Tilt-250 EC (0.1%)

T_4 = Single spray of Pencozeb 80 WP (0.2%)

T_5 = Single spray of Bavistin 50 WP (0.1%)

T_6 = Seed treatment with Vitavax-200 (0.4%) + single spray of Tilt-250 EC (0.1%)

T_7 = Seed treatment with Vitavax-200 (0.4%) + two sprays of Tilt-250 EC (0.1%)

T_8 = Seed treatment with Vitavax-200 (0.4%) + three sprays of Tilt-250 EC (0.1%)

T_9 = Seed treatment with Vitavax-200 (0.4%) + single spray of Pencozeb (0.2%)

T_{10} = Seed treatment with Vitavax-200 (0.4%) + single spray of Bavistin (0.1%)

spikelets/ear was observed in T_8 and lowest number of healthy spikelets was observed in T_1. No significant variation was found among the treatments T_2, T_4 and T_5. Like wise, the treatments T_9 and T_{10} were statistically similar regarding number of healthy spikelets/ear. Through the number of diseased spikelets/ear under different treatments ranged from 3.16 to 5.96. The highest number of diseased spikelets recorded in T_1 followed by T_4. The lowest numbers of diseased spikelets were recorded in T_8. Significant difference among the T_2, T_3, T_5, T_6, T_7, T_8, T_9 and T_{10} was found regarding the diseased spikelets/ear.

4.6. Effect of seed treatment and foliar spray of fungicides on grain formation and grain weight of wheat

The effect of seed treatments and foliar spray on total number grains/ear, number of healthy grains/ear, number of disease grains/ear, weight of grains/ear, healthy grains weight/ear & weight of diseased grains/ear were presented in Table-7. It was observed that all the treatments showed significant effect except weight of disease grain/ear. Number grains/ear varied from 43.56 to 49.29. The highest plant height was observed in T_8 (Seed treatment with Vitavax -200 + three sprays of Tilt-250 EC) followed by T_7 (Seed treatment with Vitavax -200 + two sprays of Tilt-250 EC) and the lowest plant height was recorded in control plot T_1.

It was observed that the treatments had significant effect on number of healthy grains/ear. Number of healthy grains/ear under different treatments ranged from 41.68 to 47.58. The highest number of healthy grains/ear in T_8. The lowest number of healthy grains/ear was recorded in control plot (T_1). In case of number of diseased grains/ear treatments showed significant effect. Number of diseased grains/ear differed from 1.71 to 2.88cm, where the highest

number of diseased grains/ear observed in T_8 followed by T_7. The lowest distance between flag leaf initiation and base of the ear was recorded in control plot (T_1). The weight of grains/ear varied significantly among the treatments. The weight of grains/ear varied from 34.45 to 40.95g. The highest weight of grains/ear was observed in T_8. The lowest weight of grains/ear recorded in control plot. Statistically no significant difference found among the T_2, T_3, T_9 and T_{10}, regarding the number of spikelets/ear.

The weight of healthy grains/ear differed significantly among the treatments and ranged from 35.45 to 41.95g. The highest weight of healthy grains/ear was observed in T_8 and the lowest weight of healthy grains/ear was observed in T_1. No significant variation was found among the treatments T_2, T_3 T_4, T_9 and T_{10} in respect of the weight of the healthy grains/ear. The weight of diseased grains/ear did not differ significantly among the treatments. Though the weight of diseased grains/ear under different treatments ranged from 0.04 to 0.09g. The highest weight of diseased grains/ear recorded in T_1. The lowest weights of diseased grains/ear were recorded in T_8.

Table. 7. Effect of seed treatment and foliar spray of fungicides on grain formation and grain weight of wheat

Treat-ments	Number of grains/ ear	Number of healthy grains/ ear	Number of Diseased grains/ ear	Weight of grains/ ear(gm)	Weight of healthy grains/ ear(gm)	Weight of disease grains/ ear(gm)
T_1	41.26 d	41.68 d	2.88 a	34.45 d	35.45 c	0.09
T_2	43.6 b-d	43.6 b-d	2.26 a-c	37.09 a-d	36.87 bc	0.07
T_3	43.01 cd	43.61 b-d	2.34 a-c	37.40 a-d	36.31 bc	0.07
T_4	42.59 cd	42.03 cd	2.46 a-c	36.31 b-d	36.73 bc	0.07
T_5	43.61 b-d	42.93 cd	2.70 a-c	35.92 cd	35.92 c	0.09
T_6	45.47 bc	45.61 a-c	1.98 bc	38.72 a-c	38.73 a-c	0.08
T_7	47.20 ab	47.12 ab	1.86 c	40.15 ab	40.15 ab	0.06
T_8	49.58 a	47.58 a	1.71 c	40.95 a	41.95 a	0.04
T_9	43.73 b-d	43.73 b-d	2.24 a-c	37.87 a-d	38.09 bc	0.07
T_{10}	45.37 bc	44.37a-d	1.92 bc	37.63 a-d	36.96 bc	0.07
LSD	**3.45**	**3.69**	**0.53**	**4.04**	**3.51**	**NS**

T_1=Untreated control

T_2= Seed treatment with Vitavax-200 (0.4%)

T_3= Single spray of Tilt-250 EC (0.1%)

T_4= Single spray of Pencozeb 80 WP (0.2%)

T_5= Single spray of Bavistin 50 WP (0.1%)

T_6= Seed treatment with Vitavax-200 (0.4%) + single spray of Tilt-250 EC (0.1%)

T_7= Seed treatment with Vitavax-200 (0.4%) + two sprays of Tilt-250 EC (0.1%)

T_8= Seed treatment with Vitavax-200 (0.4%) + three sprays of Tilt-250 EC (0.1%)

T_9= Seed treatment with Vitavax-200 (0.4%) + single spray of Pencozeb (0.2%)

T_{10}= Seed treatment with Vitavax-200 (0.4%) + single spray of Bavistin (0.1%)

4.7. Effect of seed treatment and foliar spray of fungicides on 1000-seed weight and yield of wheat

The yield performances of wheat under different treatments have been presented in table-8. There were no significant differences among the treatments in terms of 1000-seeds weight (gm). The 1000-seeds weight ranged from 32.43 to 37.91g. It has been observed that the treatments differed significantly from one to another in respect of the straw yield and grain yield. The lowest straw yield observed in T_1 and the highest straw yield was in T_8 followed by T_7. Statistically no significant difference observed among the T_2, T_3, T_6, T_9 and T_{10}. Considering the grain yield/plot and grain yield t/ha, it was found that the highest grain yield/plot (809.82 g/plot) and grain yield (4.05 t/ha) was observed in T_8 followed by T_7. The treatment T_8 (Seed treatment with Vitavax-200(0.4%) + three sprays of Tilt- 250 EC) increased 44.64% grain yield over untreated control while T_7 (Seed treatment with Vitavax-200(0.4%) + two sprays of Tilt-250 EC) increased 42.86% higher yield over control. The lowest grain yield /plot (559.88g or 2.80 t/ha) was recorded in control plot (T_1), statistically no significant differences were observed among the T_3, T_6, T_9 and T_{10} regarding grain yield.

Table 8. Effect of seed treatment and foliar spray on 1000-seed weight (g), straw yield and grain yield of wheat

Treatments	1000-seed weight(g)	Straw yield (kg/plot)	Grain yield /plot(g)	Grain yield (t/ha)	% grain yield increased over control
T_1	32.43	1.80 d	559.88 d	2.80 f	-
T_2	33.38	2.14 a-c	721.46 bc	3.61 de	28.93
T_3	32.18	2.17 a-c	767.45 a-c	3.70 c-e	32.14
T_4	33.33	2.06 bc	722.47 bc	3.61 de	28.93
T_5	33.32	2.01 cd	705.80 c	3.53 e	26.07
T_6	34.59	2.18 a-c	784.30 a-c	3.92 a-c	40.00
T_7	35.55	2.30 ab	800.16 ab	4.00 ab	42.46
T_8	35.91	2.37 a	809.82 a	4.05 a	44.64
T_9	33.69	2.13 a-c	751.29 a-c	3.76 b-e	34.29
T_{10}	33.89	2.18 a-c	738.94 a-c	3.86 a-d	37.14
LSD	NS	0.24	82.11	0.094	

T_1=Untreated control

T_2= Seed treatment with Vitavax-200 (0.4%)

T_3= Single spray of Tilt-250 EC (0.1%)

T_4= Single spray of Pencozeb 80 WP (0.2%)

T_5= Single spray of Bavistin 50 WP (0.1%)

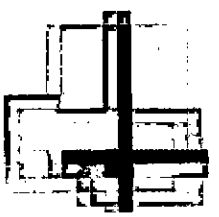
T_6= Seed treatment with Vitavax-200 (0.4%) + single spray of Tilt-250 EC (0.1%)

T_7= Seed treatment with Vitavax-200 (0.4%) + two sprays of Tilt-250 EC (0.1%)

T_8= Seed treatment with Vitavax-200 (0.4%) + three sprays of Tilt- 250 EC (0.1%)

T_9= Seed treatment with Vitavax-200 (0.4%) + single spray of Pencozeb (0.2%)

T_{10}= Seed treatment with Vitavax-200 (0.4%) + single spray of Bavistin (0.1%)



Chapter 5
Discussion

5. DISCUSSION

Leaf blight of wheat caused by *Bipolaris sorokiniana* is a serious concern all over the world as well as in Bangladesh. The present piece of work has been carried out to determine the efficacy of seed treatment and foliar spraying with fungicides in controlling leaf blight (*Bipolaris sorokiniana*) of wheat. The disease severity was recorded in four different growth stages viz. panicle initiation stage, flowering stage, milking stage, and hard dough stage. Statistically the highest disease severities were recorded in all the plant growth stages in the control plot (T_1). The disease severity decreased significantly with the increase the number of fungicidal spray. In the present study, seed treatment with Vitavax-200 along with three foliar sprays of Tilt- 250 EC gave excellent result in controlling leaf blight severity which was statistically similar to that of T_7 (Vitavax-200 + two sprays of Tilt-250 EC).Three sprays with Tilt-250 EC at maximum tillering stage, 50% flowering stage and milk ripening stage had been reported to control leaf blight caused by *Bipolaris sorokiniana* (Jones, 1983; Brahma and Asir 1989; BARI, 1990 and BARI, 1992a). Dey *et al.* (1992) found that single effect of seed treatment with Vitavax-200 significantly reduced the disease. Many workers reported that the seed treatment with Vitavax-200 gave excellent result in reducing seed borne (*Bipolaris sorokiniana*) infection (Sharma and Joshi, 1972; Katyal and Shrotriya, 1976; Hall *et al.*, 1978; Pidoplichko and Andreeva, 1980; BARI, 1984; Guldhe *et al.*, 1985; Korobova *et al.*, 1990; Lopes and Bueno, 1990; Mironova, 1991; Shugveov, 1991 and Ram, 1992). Peltonen and Karjalainen (1992) also found that the application only of Tilt-250 EC as foliar spray significantly decreased *Bipolaris* leaf blight severity. In Bangladesh, many researchers worked with Tilt-250 EC (0.1%) for controlling leaf blight of wheat

and found promising result (Anonymous, 1989). Mondal *et al.* (1994) evaluated four commercial fungicides for their efficacy to control leaf blight of wheat under natural condition. Among them Tilt-250 EC (0.05%) was found most effective. The disease severity was also reduced significantly by Tilt-250 EC, when sprayed @ 0.04% (Alam *et al.*, 1995). In the field experiment conducted by many researchers, it was found that application of Tilt-250 EC to wheat significantly decreased the pathogen population and %LAD, comparing to unsprayed plot (Jones, 1983; Brahma and Asir, 1989; Alikseeva *et al.*, 1990; Peltonen and Karjalainen, 1992 and BARI 1992b). In this study it has been found that the lower leaves were significantly more infected than the flag leaves which are supported by Rashid *et al.*, 1987. It was revealed that there was a trend of gradual decrease of disease severity with the increase of spray frequency of Tilt-250 EC. Almost similar finding was reported by Ashok *et al.* (1989) while working with fungicide Pencozeb. They followed economical spray scheduled for the management of the leaf blight of wheat in the field for a period over three years. The most effective and economic treatment was three sprays at ten days interval followed by three sprays of 15 days interval. The yield increased following the treatments where more than double of only a single spray. Singh and Singh (1971) observed that the leaf blight of wheat was effectively controlled by 6 applications of Mancozeb within corresponding increasing yield. In the study present Though Bavistin showed significant effect in controlling leaf blight of wheat over control, but it ranked after Tilt-250 EC and Pencozeb. Khan *et al.* (1985) observed that Bavistin could check the disease caused by *Bipolaris sorokiniana.* Among different concentration (0.075, 0.1 and 0.125%) 0.1% Tilt-250 EC were found better in controlling the disease (Brahma and Asir, 1989). In a field experiment conducted in BARI (1993), it was observed that Tilt-250 EC along with seed treatment with Vitavax-200 was very effective in controlling leaf blight of wheat under field

condition. Seed treatment with Vitavax-200 and three foliar sprays of Tilt-250 EC gave better result in respect of different parameters. The highest plant height, ear length, distance between the point of flag leaf initiation and base of the ear, number of spikelets/ear, number of healthy spikelets/ear and number of diseased spikelets/ear were found in T_8 (Seed treatment with Vitavax-200 and three sprays of Tilt-250 EC). There are many reports on the effect of seed treatment with Vitavax-200, which showed significant influence on tillering. Many workers found that Tilt-250 EC was effective in decreasing disease severity and increasing N_2 uptake efficacy as well as protein quality resulting in positive effect in vegetative growth such as stem elongation, increase the tiller number per plant (Barshehak *et al.*, 1991; Peltonen and Karjalainen, 1992 and Wildermutt *et al.*, 1992). The effect of fungicides on yield performance has been differed significantly from one another. The number of grains/ear ranged from 43.56 to 49.29. The maximum number of grains/ear was obtained by T_8 and the lowest was by T_1. Numbers of healthy grains/ear under all the treatments ranged from 40.68-47.58. The highest number of healthy grains/ear was obtained by T_8 and the lowest number of healthy grains/ear recorded in control plot. Number of diseased grains/ear for all the treatments ranged from 1.71 to 2.88, The highest number of diseased grains was recorded in T_1 and the lowest number of diseased grains was counted in T_8 and as well as in T_7. Weight of grains/ear and weight of healthy grains/ear under different treatments differed significantly. The highest weight of grains /ear and weight of healthy grains /ear observed in T_8. The lowest number of grains /ear and number of healthy grains/ear observed in the treatment T_1. 1000 grains weight for all the treatments did not differ significantly.

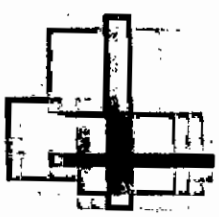
Singh *et al.* (1995) used four fungicides namely Mancozeb, Tilt-250 EC Topsin- M and Rhizolex to manage the foliar blight of wheat. Among the four

tested fungicides maximum yield, grain weight and minimum disease were found with four sprayings of Tilt-250 EC (500 ml/ha) stating at disease initiation following by spraying o0f Tilt-250 EC. The three sprays of Tilt-250 EC was a good as four sprays in respect of yield, grain weight and disease severity. Second effective fungicide was Mancozeb (2.5 kg/ha) with four sprays at disease initiation.

The seed treatment and fungicidal spray with Tilt-250 EC revealed profound effect on the straw yield of wheat. It has been found that the straw yield significantly increased with the spray frequency. The present finding therefore ascertains not only the grains yield per plot but also desired yield of straw, which is very cosmopolitan to our poor farmers. The yield of wheat profoundly varied from one treatment to another, ranging from 2.80 to 4.05 t /ha. The highest yield was recorded in T_8, which was 44.64% higher over control. The second highest yield (4.00 t/ha) was observed in plot of T_7, which was 42.46% higher over the control. Mondal *et al.* (1994) evaluated that Tilt was the most effective producing the highest grain yield with maximum gross margin. Truong *et al.* (1993) reported that Pencozeb with 5 weekly spraying from 29 days after sowing until soft dough stage significantly increased yield over control. Anonymous, (1990) obtained highest grain yield by 6 times application of Tilt, but the present study revealed that only two sprays of Tilt-250 EC yielded 4. 05 t/ha, which is 93% higher over national yield of wheat (2.05 t/ha) of Bangladesh (Anonymous, 1998). According to Kabir (1997), the application of Tilt-250 EC twice spraying in the field was more effective to control leaf blight of wheat caused by *Bipolaris sorokiniana.* In the present study seed treatment with Vitavax-200 increased grain yield by 28.93% over untreated control.

Singh and Saksena (1985); Dewey and Albrechtsen (1997) stated that only Vitavax-200 treated seed showed better result on some yield contributing characters and ultimately increased yield. The application of Tilt-250 EC as foliar spray showed increased yield (BARI, 1990; Malaker *et al.*, 1994). BARI, (1993) indicated that the combined use of seed treatment with Vitavax-200 and Tilt-250 EC was very effective in controlling leaf blight of wheat under field condition.

The present study indicated that the combination of Vitavax-200 (as seed treatment) and Tilt-250 EC (as foliar spray at three times) was better in controlling leaf blight of wheat caused by *Bipolaris sorokiniana* compared to the single effect of Vitavax, Tilt-250 EC, Pencozeb and Bavistin.



Chapter 6
Summary and Conclusion

6. SUMMARY AND CONCLUSION

Wheat (*Triticum aestivum* L.) is the second most important cereal crop in Bangladesh. Wheat plant suffers from many diseases of which leaf blight disease is a common and devastating disease considering grain quality and grain yield.

The present research work was conducted in the farm of Sher-e-Bangla Agricultural University, Dhaka during the period from November 2005 to April 2006, to investigate the efficacy of fungicides in controlling leaf blight of wheat caused by *Bipolaris sorokiniana*. There were 10 treatments namely T_1 = Untreated control, T_2 = Seed treatment with Vitavax-200 (0.4%), T_3 = Single spray of Tilt-250 EC (0.1%), T_4 = Single spray of Pencozeb 80 WP (0.2%), T_5 = Single spray of Bavistin 50 WP, T_6 = Seed treatment with Vitavax-200 (0.4%) + single spray of Tilt-250 EC (0.1%), T_7 = Seed treatment with Vitavax-200 (0.4%) + two sprays of Tilt-250 EC (0.1%), T_8 = Seed treatment with Vitavax-200 (0.4%) + three sprays of Tilt-250 EC, T_9 = Seed treatment with Vitavax-200 (0.4%) + single spray of Pencozeb (0.2%) and T_{10} = Seed treatment with Vitavax-200 (0.4%) + single spray of Bavistin (0.1%). The leaf spot severity was recorded in 0-5 scale on the flag leaf, second leaf and third leaf in four growth stages of the plant namely panicle initiation stage, flowering stage, milking stage and hard dough stage. Disease severity grade was always found higher in the lower leaves than the flag leaf. Disease severity shows the significant effect of spray frequency. All the stages, the higher disease severity grade was found in control plot and the lowest disease severity was found under the treatment T_8 (seed treatment with Vitavax-200 + three sprays of Tilt-250 EC), which was statistically similar to the treatment T_7 (Vitavax-200 + twice sprays of Tilt-250 EC).

Maximum plant height, Ear length, Distance between flag leaf initiation and base of the ear, Number of spikelets/ear, Number of healthy spikelets/ear and minimum number of diseased spikelets/ear of wheat obtained under the treatment T_8. 1000-grain weight was found insignificant among the treatments. In case of straw yield and grain yield, all the treatments varied significantly. Maximum grain yield (4.05 t/ha), which was 44.64% increased over control was recorded under the treatment T_8 which was statistically similar to the treatment T_7 (4.00 t/ha).The present findings indicate that the combination effect of seed treatment with Vitavax-200 and foliar spray with Tilt-250 EC (three times or two times) had significant effect on the control of leaf blight severity. Spray frequency of Tilt-250 EC at three times and two times resulted statistically similar effect in respect of leaf blight severity and yield of wheat. Thus, the seed treatment with Vitavax-200 + two sprays of Tilt-250 EC will be economic in controlling the disease. Spraying Bavistin and Pencozeb was less effective than spraying with Tilt-250 EC in controlling the disease.

REFERENCES

Alam, K. B.; Shaheed, M. A; Ahmed, A. U. and Malaker, P. K. (1994). *Bipolaris* leaf Blight (Spot Blotch) of wheat in Bangladesh in D. A. Saunders and G. P. Hattel, Eds. Wheat in Heat Stressed Environments. Irrigated, Dry Area and Rice-Wheat farming systems. Mexico, D. F. CIMMYT.pp.339-342.

Alam, K. B.; Malaker, R. K.; Shaheed, M. A.; Ahmed, M. U.; Ahmed, F. and Haque, M. S. (1995). Yield loss assessment of wheat due to *Bipolaris* leaf Blight in Bangladesh. *Bangladesh J. Pl. Path.* **11(1 & 2)**:35-37.

Alikseeva, T. P.; Pavlova, T. V. and Izmalkova, A. G. (1990). The effect of Tilt-250 EC on population structure of brown rust pathogen of wheat. Zashchita-Restenii-Moskva.1990.No. 9.pp.18-19.

Anonymous, (1960). Soil survey reports of Sadar division the district of Mymensingh. Agril. Chem. Bull.6.

Anonymous, (1989). Chemical control of *Bipolaris* leaf blight of wheat. Ann. Rept. BARI, Joydebpur, Gazipur. p.28.

Anonymous, (1990). Yield loss assessment in wheat due to leaf blight. Ann. Rept. For the year 1989-1990. Bangladesh Agril. Res. Ins., Joydebpur, Gazipur. pp.30-31.

Anonymous, (1992a). Assessment of yield loss due to foliar pathogens. Ann. Rept. For the year 1991-92 BARI, Joydebpur, Gazipur.p.21

Anonymous, (1992b). Assessment of yield loss of wheat due to leaf blight disease at farmer's field. Annual for the year 1991-92. BARI,

Joydebpur, Gazipur. pp.45-46.

Anonymous, (1993). Assignment of yield loss of wheat due to *Bipolaris* leaf blight at farmer's field. Ann. Rept.1992-93 BARI, Gazipur.p.46.

Anonymous, (1998). Krishi Diary. Krishi Tattha Santha, Khamerbari. Dhaka.

Ashok, M.; Patel, N. M.; Patel, D. B.; Patel. J. R.; Jadan, B. S. and Mishra, A. (1989). Economical spray schedule for the management of the blight of wheat. Pestology. **13(8)**:22-25.

Barshehak, T.; Korts, M.; Barszezak, T. and Kore, M. (1991). Yield of spring wheat treated with Tilt-250 EC fungicide depending on rates, dates and methods of urea application: Izvcstiya Timcryazcvskoi-scl.Skokhozyais tyennoi-Akademii (Poland) No.4.186, 11 ref.

BARI, (1984). Control of seed borne disease of wheat by fungicides. Ann. Rept. 1983-84, BARI, Gazipur.pp.7-18.

BARI, (1990). Yield loss assessment in wheat due to leaf blight Ann. Rept. 1989-1990 BARI, Gazipur.p.30.

BARI, (1992a). Assessment of yield loss of wheat due to foliar pathogen. Ann. Rept. 1992-1993, BARI, Gazipur.p.16.

BARI, (1992b). Assessment of yield loss of wheat due to leaf blight disease at farmer's field. Ann. Rept. of BARI, Gazipur.p.45.

BARI, (1993). Effect of fungicides in controlling seed borne disease of wheat. Ann. Rept. (1992-93). Bangladesh Agril. Res. Ins. Gazipur.p.18.

BARI, (2005). Lovejonok poddotete Gome Uppadanei Upaiy (the profit way of wheat cultivation) Booklet, wheat Res. Subcentre Nashipur, Dinajpur.

BBS (Bangladesh Bureau of Statistics), (2005). Monthly Statistical Bulletin, Bangladesh. Statistics Division. Ministry of Planning. Government of the Peoples Republic of Bangladesh. Dhaka.p. 57.

Bockus, W. W.; Devis, M. A. and Shroyer, J. P. (1992). Effect of foliar fungicides application on seed size of winter wheat. *J. Appl. Seed Prod.* (USA). **10**:1-6.

Brahma, R. N. and Asir, R. (1989). Control of stem rust of of wheat with Tilt. *Indian Phytopath.* 1989. **42(4)**:568-569.

Dang, J. K. and Tyagi, R. C. (1997).chemical control of leaf spot of wheat by Vitavax. Pesticides.7:19-30.

Das, S. R. (1988). Control of leaf spot/leaf blight of wheat through fungicides. *Indian. J. of Pl. Protection.* 1988, **16(2)**: 273-275.

Dey, T. K.; Chowdhury, N.; Ayub, A. and Goswami, B. K. (1992). Black point of wheat occurrence, effect of fungicidal seed treatment on germination and quality characters. *Bangladesh J. Bot.* **21(1)**:27-32.

Dewey, W. G. and Albrechtsen, R. S. (1997). Effect of seed treatment with three systemic fungicides on yield and stand of wheat and barley. Pl. Dis. Rept. **61 (12)**:1057-1060.

Dubin, H. J. and Ginkel, M. V. (1991). The status of wheat disease and disease research in warmer areas. In: Wheat for the nontraditional, warmer areas, Ed. By Saunders, D. A., Mexico, D. F. CIMMYT, pp.125-145.

Duveiller, E. and Gilchrist, L. (1994). Production constraints due to *Bipolaris sorokiana* in wheat: current situation and future prospects. Wheat in heat stressed environments: Irrigated, dry areas and rice wheat farming systems. Mexico DF (Mexico).CIMMYT.pp.343-352.

Entz, M. H.; Berg. C. G. J.; Van Den; Lafond, G. P.; Stobbe, E. H.; Rossnagel, B. G. and Austenson, H. M. (1990). Effect of late-season fungicide application on grain yield and seed size distribution in wheat and barley. *Canadian J of Pl. Science*. 1990, **70(3)**:699-706.

FAO, (1997). Production year book. Food and Agricultural Organization of the United Nations, Italy. Rome. p.62.

FAO, (2000). Production Year book. Food and Agricultural Organization of the United Nations, Italy, Rome. p.62.

Gilchrist, L. I. (1984). CIMMYT Methods for screening wheat for *Helminthosporium sativum* Resistance. In: wheat for more tropical environment- A proceedings of the international symposium Sept. pp. 24-28.

Goulart, A. C. P., Paiva, A. de F. and Andrade, P. I. M. 1995. Effect of fungicides spraying on above ground parts of wheat and incidence of *Bipolaris sorokinianal* and *Pyricularia grisea* associated with seeds. Fitapathologia, Brasilera.**20(4)**:628-632.

Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedures for Agricultural Research, Intl. John Wily and Sons, New York, Chick ester, Brisbane, Toronto, Singapore. p.643.

Guldhe, S. M.; Raut, J. G. and Wangikar, P. D. (1985). Control of loose smut infection in wheat by phygical and chemical methods of seed treatment. *PKV. Res. J.* **9 (1)**:56-58.

Hall, D. H.; Teviotdale, L. and Paulus, A. C. (1978). Chemical control of seed borne disease of wheat and barley. California Agril. **32**:14-15.

Hossain, I. and A. K. Azad. (1992). Reaction of wheat to *Helminthosporium sativum* in Bangladesh. Hereditas. **116:**203-205.

Hossain, I. and Azad, A. K. (1994). Bipolaris sorokiniana its reaction and effect on the yield of wheat Prog. Agric. **5(2)**:63-69.

Jones, R. W. (1983). Effect of broad spectrum systemic cereal fungicide Tilt on disease growth and productivity of lennox winter wheat. Ann. Rept. Res. Station Kentville, Nova Scatia 1982-83.pp.56-60.

Kabir, M. S. (1997). Integrated control of loose smut of wheat caused by *Bipolaris sorokiniana* MS thesis, Dept. Pl. Path. BAU. Mymensingh.

Kabir, M. S. and Hossain, I. (2000). Integrated management of *Bipolaris* leaf blight of wheat. *Bangladesh. J. of Pl. Path.* **16**(1-2):9-12.

Katyal, B. R. and Shrotriya, G. C. (1976). Effective control of loose smut of wheat Pesticides **10(12)**:46-47.

Khan, A. R.; Adhiwary S. K. and M. A. Howlider. (1985). Evaluation of fungicides against wheat leaf spot fungus *Drechslera sorokiniana. Bangladesh J. Pl. Path.* **1(1)**:29-32.

Khan, M. A. and Ityas, M. B. (1996). Effect of foliar applied on wheat varieties infected by *Puccinia recondita sp. Tritici* and *Drechslera sorokiniana*. Sultania. **1(1)**:7-11.

Korobora, L. W.; Chukine, Toropova, E. Y. and Kuznetsova, T. T. (1990). The effect of seed treatment at various level of infection with *Bipolaris sorokiniana* (sacc). Shoemaker on biogenicss-vestinik-set, Stokhozyaestvenno Nauki No. 1.pp.10-15.

Lopes, M. E. B. M. and Bueno, J. T. (1990). Preliminary studies on detection of *Pyricularia sp.* in wheat seed and the effect of seed treatment by fungicides under laboratory conditions. Summa Phytology **16(2)**:166-173.

Majumder, M. (1991). Crops of eastern Indian. West Bengal Text Book Board. Arg. Manson (8^{th} floor).6/A, Raja Subodh Mallik square, Calcutta.p.85.

Malaker, P. K.; Shah, N. K.; Rahman, M. M.; Hossain, A. B. S.; Haque, M. I. and Kabir, K. H. (1994). Yield loss assessment of wheat due to *Helminthosporium* leaf blight of farmer field. *Bangladesh J. Sc. and Industrial Res.* **29 (4)**:49-57.

Meisner, C. A., Badaruddin, M. Sunders, D. A. and Alam, K. B. (1994). Seed treatment as a means of increase wheat yield in worm areas in D. A. Saunders and G. P. Hettel eds. 1994. Wheat in heat stressed environments: Irrigated dry area and rice wheat farming system. CIMMYT. Mexico DF. pp.365-366.

Meyer, L. (1990). On the occurrence of *Bipolaris sorokiniana* (sacc) Subram. Et Jain as a foot rot pathogen in winter wheat. Archiv-fur-phytopathogenic and pflanzenschutz. **26(2)**:125-130.

Mironova, G. V. (1991). The effectiveness of spring wheat seed treatment. Nauchno Teakhnicheskii Bull. No. 5:20-24.

Mondal, N. A.; Assaduzzaman, S. M. Malaker, P. K.; Rouf, M. A. and Haque, M. I. (1994). Evaluation of fungicides against *Bipolaris sorokiniana* leaf blight of wheat (*Triticum aestivum*). Ann. Of Bangladesh Agric. **4(1)**:37-40.

Nene, Y. I. and Saxena, S. C. (1971). Present status of research on fungicidal control of wheat rusts and loose smut in India, Second Int. Symp, IARI, New Delhi, India **10**:83.

Patil, V. S.; Kulkarni, S. and Kalappanavar, I. K. (2002). Field evaluation of fungicides/plant products against leaf blight of wheat. *J. of Maharashtra Agril. Universities*. **27(3)**:313-314.

Peltonen, J. and Karjalainen, R. (1992). Effects of fungicides spray on foliar diseases, yield and quality of spring wheat in Finland.

Pidoplichko, K. M. and Andreeva, V. I. (1980). The effectiveness of fungicide seed protectants with systemic and complex action against root rots of winter wheat in laboratory and pot experiments. Zakhist Ropslin. No. **27**:102-108.

Rahman, M. A. (1998). Study on the effect of seed treatments and foliar spray in controlling Bipolaris leaf blight of wheat. MS Thesis. Dept. Pl. Path. BAU, Mymensingh.

Rahman, M. A.; Rashid,A. Q. M. B. and Islam, M. A. (1999). Effect of seed treatment and foliar spray on the yield of wheat as affected by *Bipolaris* leaf blight. *Bangladesh J. of Pl. Path.***15 (1-2)**:17-19.

Rahman, M. A.; Rashid, A. Q. M. R. and Islam, M. A. (2001). Control of *Bipolaris* leaf blight of wheat through seed dressing chemical. Seed Res. **29(1)**:121-123.

Ram, B. (1992). Evaluation of three seed treatment method for protection of wheat against loose smut. Test of Agro-chemicals and cultivars no.13:36-37.

Rashid, A. Q. M. B; Meah, M. B. and Jalaluddin, M. (1987). Effect of leaf blight caused by *Drechlera sorokiniana* (sacc.) Subram and Jain on some yield components of wheat. Crop protects. **6 (4)**:256-260.

Rashid, A. Q. M. B. (1996). *Bipolaris sorokiniana* in wheat seeds of Bangladesh. PhD thesis. Dept. Pl. Path. BAU, Mymensingh.

Rashid, A. Q. M. B.; Kakoli-Sarker and Khalaquzzaman, K. M. (2001). Control of *Bipolaris* leaf blight of wheat with foliar spray of Tilt-250 EC. *Bangladesh J. of Pl. Path.* **17**(1-2):45-47.

Razzaque, M. A. and A. B. S. Hossain. (1991). The wheat development program in Bangladesh "Wheat for the non traditional warm areas" edited by D.A. Saunders. Proc. Int. Conf held in July 29 to Aug 3, 1990 in Foz. Dolguacu Brazil CIMMYT. pp.44-54.

Razzaque, M. A.; M. A. Suffin and M. Badruddin.(1992). Wheat in the national economy in Bangladesh. In advances in the crop science, proceeding of the first biennial Conf. of the crop Sc. Society of Bangladesh held during 18-20 January, 1992. pp.13-25.

Sharma, R. C. and Joshi, L. M. (1972). Controlling the hill bunt, Indian Fmg. **22**:31-32.

Shugveov, I. M. (1991). The effectiveness of systemic seed treatments in control of *Helminthosporium* root rot of spring wheat Northern Kazakhstan. Vsesoylesni Nau chno-usledo-vatel skiy nau cknykh tredov. pp.38-45.

Singh, D. V. and Singh, V. K. (1971). Control of leaf blight of wheat with fungicides. **24**:694-697.

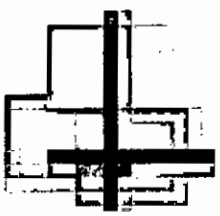
Singh. D. V. and Saksena, R. K. (1985). Chemical control of root rot and leaf blight of wheat caused by *Drechlera sorokiniana* and search for service of resistance. *Indian. J. Pl. Path.* **3**(1):89-93.

Singh, V. A. and Chauhan, S. K. S. (1995). Efficacy of fungicides in-vitro and in-vivo against leaf blight of wheat. *Indian J. Mycole. Pl. Path.* **25**(land):111.

Singh, R. V.; Singh, A. K.; Singh, D.; Singh, S. P. and Choudhary, V. P. (1995). Management of foliar blight of wheat through chemicals. *Indian J. Mycol. Pl. Path.* **25**: (**1** and **2**):113.

Truong, L. R.; Rinen, I. N. and Castro, A. A. (1993). Yield loss assessment in wheat due to Helminthosporium leaf spot under farmer's field condition. Twenty fourth annual scientific meeting of the pest management council of the Philippines. Inc. College, Laguna (Philippines).p.66.

Wildermutt. G. B.; Mcnamara, R. B. and Tinline, R. D. (1992). Assessment of yield loss caused by common rot in wheat cultivar in Queensland (*B. sorokiniana*). *Australian J. of Agril. Res.* (Australia) **43 (1)**: 43-58.



Appendices

APPENDICES

Appendix I. Morphological, physical and chemical characteristics of initial soil (0-15 cm depth)

pH		6.0
Particle-size analysis of soil		
	sand	30.65
	silt	18.19
	clay	31.16
Textural Class		Silty Clay
Total N (%)		0.078
Organic matter (%)		0.88
Phosphorous (%)		0.0015
Potassium (%)		0.0053
Sulphur (%)		0.0017

Appendix II. Monthly average of Temperature, Relative humidity, Total Rainfall and sunshine hour of the experiment site during the period from November 2005 to February 2006

Year	Month	Air temperature (^{0}c)			Relative humidity (%)	Rainfall (mm)	Sunshine (hr)
		Maximum	Minimum	Mean			
2005	November	29.5	18.6	24.0	69.5	0.0	233.2
	December	26.9	16.2	21.5	70.6	0.0	210.5
2006	January	24.5	13.9	19.2	68.5	4.0	194.1
	February	28.9	18.0	23.4	61.0	3.0	221.5

Source: Bangladesh Meteorological Department (Climate division), Agargaon, Dhaka- 1212.

Appendix III. Analysis of variance of the data on disease severity at panicle initiation and flowering stage of wheat

Sources of variation	Degree of freedom	Mean square					
		Disease severity at Panicle initiation Stage			Disease severity at Flowering Stage		
		Flag leaf	2nd leaf	3rd leaf	Flag leaf	2nd leaf	3rd leaf
Replication	2	0.00	0.005	0.004	0.002	0.003	0.002
Treatment	9	0.003**	0.004**	0.004**	0.006**	0.005**	0.015**
Error	18	0.001	0.001	0.001	0.001	0.001	0.002

** Significant at 1% level of significance

* Significant at 5% level of significance

Appendix IV. Analysis of variance of the data on disease severity at milky and hard dough stage of wheat

Sources of variation	Degree of freedom	Mean square					
		Disease severity at Milking Stage			Disease severity at Hard dough Stage		
		Flag leaf	2nd leaf	3rd leaf	Flag leaf	2nd leaf	3rd leaf
Replication	2	0.001	0.15	0.013	0.014	0.012	0.008
Treatment	9	0.009**	0.026**	0.090**	0.140**	0.045**	0.149**
Error	18	0.001	0.005	0.015	0.007	0.006	0.035

** Significant at 1% level of significance

* Significant at 5% level of significance

Appendix V. Analysis of variance of the data on yield contributing character of wheat

Sources of variation	Degree of freedom	Mean square					
		No. of grains/ear	No. of healthy grains/ear	No. of disease grains/ear	Wt. of grains/ear(g)	Wt. of healthy grains/ear(g)	Wt. of disease grains/ear(g)
Replication	2	0.141	0.395	0.032	0.082	0.257	0.000
Treatment	9	17.738**	11.834*	0.427NS	11.243NS	12.525*	0.000NS
Error	18	4.055	4.008	0.202	4.803	4.195	0.000

** Significant at 5% level of significance

* Significant at 1% level of significance

Appendix VI. Analysis of variance of the data on yield contributing character and yield of wheat

Sources of variation	Degree of freedom	Mean square			
		1000 –grains weight (g)	Straw yield (t/ha)	Grain yield (kg/plot)	Grain yield (t/ha)
Replication	2	5.223	0.007	0.0001	0.003
Treatment	9	8.589**	0.900**	1.291**	0.552**
Error	18	1.455	0.002	0.115	0.048

** Significant at 1% level of significance

* Significant at 5% level of significance