EFFICACY OF SELECTED FUNGICIDES IN CONTROLLING SOME FOLIAR DISEASES OF RICE

শেরেবাংলা কৃষি বিশ্ববিদ্যালয় গ্রন্থাগার
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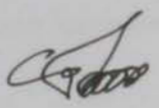

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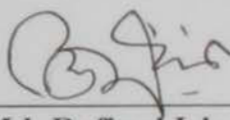

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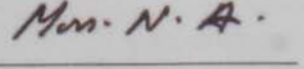

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This is to certify that the thesis entitled "**EFFICACY OF SELECTED FUNGICIDES IN CONTROLLING SOME FOLIAR DISEASES OF RICE**" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in PLANT PATHOLOGY,** embodies the results of a piece of bona fide research work carried out by **FATEH UN TULI, REGISTRATION NO. 27586 / 00741,** 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.

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Dedicated to
My
Beloved Parents

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ABSTRACT

Present investigation had been conducted to evaluate the efficacy of different fungicides against some foliar diseases of BRRI Dhan- 40, namely brown spot (*Bipolaris oryzae*), blast (*Pyricularia grisea*), narrow brown leaf spot (*Cercospora oryzae*) and sheath rot (*Sarocladium oryzae*) The experiment was conducted in the field Laboratory, Department of Plant Pathology of Sher-e-Bangla Agricultural University, Dhaka, during the period from July to November, 2006. Nine fungicides namely Knowin-50 WP @ 0.2%, Score-250 EC @ 0.1%, Controll-5 EC @ 0.1%, Proude-25EC @ 0.1%, Tilt-250 EC @ 0.2%, Folicure-250 EW @ 0.1%, Sunvit-50 WP @ 0.7%, Cupravit-50 WP @ 0.7% and Bordeaux Mixture ($CuSO_4$- 2.27 g: CuO-2.27 g: H_2O-1000 ml) were sprayed at maximum tillering stage of the crop. All the fungicides were effective in reducing the incidence of brown spot, blast, narrow brown spot and sheath rot at flowering, milking, dough and maturity stage compared to untreated control plots. The effect of Tilt-250 EC (Propiconazole) and Proude-25 EC (Propiconazole) were better than the other fungicides in controlling diseases with increasing yield and yield contributing characters. In case of maturity stage the highest disease severity of brown spot and sheath rot were found in control plot while lowest severity was found in Tilt-250EC sprayed plot. Again the highest severity of blast and narrow brown spot at maturity stage were found in control plot and the lowest severity were found in proud-25 EC treated plot. Significantly highest grain yield (4.75 t/ha) of rice BRRI Dhan-40 was obtained by spraying plots with Tilt-250EC which was 40.12% increased over untreated control.

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Chapter 1
Introduction

CHAPTER 1

INTRODUCTION

Rice is the most important cereal crop in Asia producing about 96% of the world rice production (IRRI, 2003). It is the most important staple food in Bangladesh. It also constitutes the staple food of 60% of the world population and important source of employment and income for rural people.

Rice covers more than 10.76 million of cropped area covering 80% arable land and accounts for 95% food grain production in Bangladesh (BBS, 2004). It provides about 71% of the total calories and 51% of the total protein in a typical diet in Bangladesh (Anon, 1998). Although rice is the staple food for people of Bangladesh, its yield (t/ha) is relatively very low in this country compared to those of other rice growing countries. In Bangladesh 10.76 million of cultivable land produces more than 25188 m. tons of rice in 2002-03 (BBS, 2004).

The average world yield of rice is 3.75 metric tons per hectare but the average yield of our country is only 1.98 metric tons per hectare (FAO, 2002; BBS, 2003). This result indicates that average per hectare production of rice in Bangladesh is extremely low compared to other rice growing countries of the world. By the end of 2010, the country will have to produce 25.8 million tons of food to feed an estimated population of 153 millions. (World Bank – UNDP, 1999). So there is no alternative to increase the yield of rice.

There are many causes of low yield of rice in Bangladesh of which diseases and pest play a major role (Fakir, 1982). Rice diseases, caused by different groups of microorganisms are grouped into virus, bacteria, fungi and nematodes. Thirty six fungal, twenty one viral, six nematode diseases are recorded in rice (Ou, 1985). Asia's hot and humid climate during the long and heavy monsoon season provide the most favorable agro ecological environment for rice cultivation as well as disease development.

About 31 diseases recorded so far to occur on rice in this country including 10 major diseases of rice (Miah *et al.*, 1985, shahajahan *et al.*, 1987). Among this diseases of rice blast (*Pyricularia grisea*), brown spot (*Bipolaris oryzae*), narrow brown spot (*Cercospora oryzae*), and sheath rot (*Sarocladium oryzae*) played profound role in reducing yield of rice.

Brown spot is a wide spread rice disease occurring in all rice growing countries of Asia, America and Africa and narrow brown leaf spot has also a worldwide distribution, except for Europe and occurs commonly (Anonymous, 1976). Sheath rot caused by *Sarocladium oryzae* is an economically important disease of rice causing severe yield loss all over the world (Rajappan *et al.*, 1997). Sing *et al.* (1994) observed that yield losses in 6 different cultivars under conditions of artificial inoculation in the field with *Sarocladium oryzae* varied from 1.7 to 54.7%. Blast disease of rice caused *by Pyricularia grisea* is the most important production constraint in modern rice cultivars in both the temperate and tropical rice-growing countries (Ou, 1985)

Deka *et al.* (1996) treated rice cv. Pankaj during 1991 and 1992 with propiconazole and other fungicide in field tests in Asam, India. The most effective disease control was obtained by spraying fungicide at the boot stage. The best management was reported by spraying mancozeb and propiconazole. Thangasamy and Rangaswamy (2001) tested fungicides namely carbendazim and mancozeb to control sheath rot caused by *Sarocladium oryzae* and they observed that carbendazim was good in controlling *Sarocladium oryzae.* Percich (1989) compared propiconazole with other fungicides for controlling brown spot of rice in a field experiment. They found that propiconazole gave the best control of brown spot of rice caused by *Bipolaris oryzae*.

Considering the above facts the present investigation was undertaken with the following objectives-

1) To determine the efficacy of fungicides in controlling brown spot (*Bipolaris oryzae*), blast (*Pyricularia grisea*) narrow brown leaf spot (*Cercospora oryzae*) and sheath rot (*Sarocladium oryzae*) of rice BRRI Dhan-40.
2) To evaluate the efficacy of fungicides on yield of rice BRRI Dhan-40.

Chapter 2
Review of literature

CHAPTER 2

REVIEW OF LITERATURE

Rice is one of the major crop in the world. It suffers from many diseases. The literatures on fungicidal management of brown spot, blast, narrow brown spot and sheath rot are accumulated in this chapter.

Kandhari *et al.* (2003) used benomyl, carbendazim, ediphenfos and hinosan and they reported that the combined treatments of carbendazim (0.05%) with the bio- control agent found best to control sheath rot disease of rice successfully.

Deka *et al.* (1996) treated rice cv. Pankaj during 1991 and 1992 with propiconazole and other fungicide in field tests in Asam, India. The most effective disease control was found by spraying propiconazole and mencozeb at the booting stage of the crop.

Dodan *et al.* (1996) used propiconconazole with carbendazin, mancozeb, edifenphos and trycyclazole to evaluate the efficacy of these fungi toxicants in controlling sheath rot of rice caused by *Sarocladum oryzae*. The fungicides were sprayed twice at the boot stage and 15 day later. Disease incidence and grain yield were recorded. Propiconazole and carbendazim significantly reduced disease incidence in all the seasons. The means of the pooled data for all the seasons revealed that Propiconazole was the most effective treatment, reducing sheath rot incidence by 46.5% with a corresponding yield increase of 8.7%.

Growth (1996) stated that blast caused by *Magnaporthe grisea* and sheath blight caused by *Rizoctonia solani* could greatly reduced the yield and quality of rice. He described the effectiveness of Tilt (propiconazole), Benlate (benomyl), Rovral (iprodione), Folicure (mencozeb) and quadris in disease control and on yield. Tilt reduced disease and increased grain yields up to 1400 pounds/acre and milling yield by 12%.

Moletti *et.al.* (1996) evaluated some fungicides (iprodione at 0.4 liters a.i/ha and propiconazole at 0.126 liters a.i/ha, applied once or twice at the beginning of brown spot development in drained and undrained field. Fungicide treatment reduced and/or delayed the infection of *Bipolaris oryzae* in both soil condition.

Sing *et al.* (1994) evaluated 7 fungicides in a field trial against *Pyricularia grisea* on the susceptible rice cv. Taraori Basrnati. Tritiyclazole and Propiconazole (both 0.1 %) were most effective in reducing neck blast and increasing yield.

Ahmad, M. (1992) reported that carbendazim, copper oxychloride and edifenphos were the most inhibitory to spore germination of *Pyricularia grisea.* Carbendazim was the best fungicide in the field followed by IRP, copper oxychloride and edifenphos, both in controlling leaf and neck blast and increasing grain yield.

Misra *et al.*, (1992) tested Validacin (200 ppm), 0.25% Vitavax, 0.25 % captan, 0.25% copper oxycloride and 0.25% carbendazim + thiram in the field to prevent discoloration of rice caused by seed-borne fungi. The fungicides were applied on panicles at the milk stage as pre-inoculation and post inoculation sprays and at 2 days intervals. None of the fungicides gave complete control of seed discoloration but partial control was achieved.

Balardin *et al.* (1992) stated that one or two spray of propiconazole, pyroquilor, mancozeb and IBP [iprobenfos] did not give effective control of the complex of fungi (*Drechslera, Phoma* and *Curvularia* spp.) causing glume spot of rice.

Grewal and kang (1991) reported that rice infection by *Sarocladium oryzae* was reduced most effectively by spraying with Bavistin (Carbendazim), Topsin Thiophanate-methyl, and Derosal (Carbendazim). The highest yield was obtained with carbendazim.

Suryadi *et al.* (1991) evaluated the effectiveness of several fungicides against sheath rot and sheath blight of rice. Spraying of fungicides were done at tillering stage before and after panicle initiation stages respectively. The degree of efficacy was evaluated by using the percentage reduction of disease severity and the yield in each treatment. Carbendazim was good in controlling rice sheath rot and Mancozeb was good in controlling rice sheath blight.

Sunder *et al.* (1991) reported that applications of carbendazim at disease initiation and booting stage proved more effective than the 2 corresponding sprays of isoprothiolane during the wet season of 1987 but in 1988, to sprays at rice sheath rot disease initiation and flowering were better than sprays at disease initiation and booting. Three sprays of either fungicide at disease initiation. boot and flowering stages were superior to spray in any of the combinations tested in reducing stem rot.

Percich (1989) compared different rates of application of propiconazole for controlling brown spot of wild rice (*Zizania palustris* cv. K-2). Plants were inoculated with conidial suspensions of *Bipolaris oryzae* . Propiconazole was applied at 124, 186 and 247 g a.i./ha at booting and heading and 247 and 308 g a.i./ha at boot only. Plants treated with 124 g a.i./ha twice or 308 g a.i./ha once did not have significant (P = 0.05) decreased disease severity or yield increases when compared with the nontreated control. Plants treated with either 186 or 247 g a.i./ha at booting and heading had av. significant yield increases of 54 and 87%, respectively. Only single application of propiconazole at 247 g a.i./ha resulted in a significant yield increase of 61% above the control. With the exception of the treatments at 124 and 308 g. a/i. /ha (phytotoxic), propiconazole reduced leaf infection by 80, 89 and 80% on the flag, F-1 and F-2 topmost leaves, respectively, when compared with the control.

Percich and Huot (1989) compared propiconazole and mancozeb for management of brown spot of rice and applied at 0.24 and 1.12 kg a.i./ha, respectively, to wild rice (*Zizania polustris*). Plants inoculated with *Bipolaris*

oryzae resulted higher disease severity and lower yields than gicide-treated non-inoculated controls. Inoculated plants receiving 1 application of Propiconazole plus 2 of mancozeb resulted 24% higher yields than inoculated plants receiving 1 application of propiconazole at either booting or heading stage. Propiconazole and mancozeb, individually or sequentially, resulted in significant (P = 0.05) increases of yield (38-120%) compared with the inoculated but non-treated controls.

Vidhyasekaran, *et al.* (1987) reported that sheath rot disease caused by *Sarocladium oryzae* was completely controlled by application of carbendazim (Bavistin) every 3 or 5 days. Captafol at 3, 5 or 10 days intervals or carbendazim (Bavistin) at 10 days intervals gave substantial protection. Fungicides sprayed at longer intervals were ineffective.

Murty (1986) tested fungicides viz hinosan (edifenphos), Bavistin (carbendazim) and Dithane M-45 (Mancozeb) in 1980 and 1992. He recorded significant reduction of sheath rot (*Sarocladium oryzae*) by spraying Bavistin (carbendazim) compared with untreated plots and other test chemicals.

Fabregat *et al.* (1985) reported that in field trials against *Pyricularia oryzae* Isoprothiolone at 0.8 and1.2 litre/ha a.i. gave good control and carbendazim at 1 kg/ha. a.i. ensured adequate protection of the foliage.

Chapter 3
Materials and methods

CHAPTER 3

MATERIALS AND METHODS

In this chapter the details of different materials used and methodology followed during the experimental period are described.

3. 1. Location and Site

The experiment was conducted in the Field of Sher-e-Bangla Agricultural University, Dhaka during the period from July to November 2006. The average temperature during the experimentation was 20-25° C. The common features of the field are given below:

Location	:	Sher-e-Bangla Agricultural University Farm, Dhaka.
Agro Ecological Zone	:	Madhupur Tract (AEZ-28).
Land Type	:	High land.
General Type	:	Deep Red Brown Terrace Soil.
Soil Series	:	Tejgaon.
Topography	:	Fairly level.
Depth Height	:	Above flood level.
Drainage Condition	:	Well drained.

3.2. Selection of the Variety

One high yielding rice variety, namely BRRI Dhan-40 was used as test crop. This variety was developed by Bangladesh Rice Research Institute (BRRI) and released by National Seed Board (NSB) in 2003 for Aman season. BRRI Dhan 40 was

developed from a cross between IRRI 4595-4-1-15 and BR 10 (Progoti) (BRRI 2003, Adhunik dhaner chash).

3.3. Collection of seed

3 kg seeds were collected from the BADC office at Dhaka for 360 sq. m. of land.

3.4. Sprouting of seed

Seeds were soaked in water in a basket for 24 hours. The seeds were then taken out of water and kept in gunny bags at room temperature for 72 hours for sprouting before sowing in seedbed.

3.5. Preparation of seedbed and sowing of seed

Seedbed was prepared by paddling the soil with the help of power tiller and harrow in the Field Laboratory, Department of Plant Pathology, Sher-e-Bangla Agricultural University,, Dhaka. As the land was rich in organic matters, therefore no manuring was done. 10 kg phosphate and 5 kg potash was applied to the seedbed. Sprouted seeds were sown in the wet seedbed on 23 June 2006. Seedlings were properly taken care of. Weeds were removed and irrigation was given in the seedbed as and when necessary.

3.6. Land Preparation

The land was prepared with the help of power tiller and harrow. The land was first opened on 16 July 2006 and ploughed. The final ploughing was performed with the help of power tiller followed by laddering in order to level the soil surface. Weeds and stubbles were removed from the land.

3.7. Fertilizer application

Fertilizers were applied as per recommendation of BRRI, 2004 (Adhunic Dhaner Chash,). The following doses of fertilizers were applied to the plots:

Fertilizers	Dose/ 360 m^2 (g)	Dose/ha (kg)
Urea (N_2)	1908	53.00
TSP (P_2O_5)	740	20.56
MP (K_20)	860	23.89
Gypsum (S)	490	13.61
Zinc Sulphate (Zn)	72	2.00

All fertilizers except 2/3 Urea were incorporated with soil during final land preparation. Rest of the Urea was applied in equal two installments at 30 and 45 days after transplanting.

3.8. Design of experiment

The experiment was carried out in a Randomized Complete Block Design (RCBD) with 3 replications. Each block comprised 10 unit plots and total number of unit plots were 30 (10 × 3). The unit plot size was 6 m^2. The distance maintained between plots was 1 m and between blocks was 1 m.

3.9. Transplanting of seedling

Thirty days old seedlings were uprooted from the seedbed very carefully and then transplanted on 23 July 2006 in the main field. In the field experiment, row to row spacing was maintained as 22 cm and that of hill was 15 cm. 2-3 seedlings were transplanted together in individual hill.

3.10. Intercultural operation

3.10.1. Weeding : Weeding was done once on 12 August 2006.

3.10.2. Irrigation : Irrigation was given in the field as and when necessary.

3.11. Treatments

There were ten treatments namely :

Treatments (Trade Name)	Concentration	Active Ingredient (A.I.)
T_1= Control (untreated)	-	-
T_2= Knowin-50 WP	0.2%	Carbendazim
T_3= Score-250 EC	0.1%	Difenoconzole
T_4= Controll-5 EC	0.1%	Hexaconazole
T_5= Proude-25 EC	0.1%	Propiconazole
T_6= Tilt-250 EC	0.2%	Propiconazole
T_7= Folicure-250 EW	0.1%	Mencozeb
T_8= Sunvit-50 WP	0.7%	Copper oxichloride
T_9= Cupravit-50 WP	0.7%	Copper oxichloride
T_{10}= Bordeaux mixture ($CuSO_4$- 2.27 g: CuO-2.27 g: H_2O-1000 ml)		

3.12. Preparation and application of chemicals

Chemicals were sprayed as solution into the experimental plot except the control plot. Each spray solution was prepared by mixing definite amount of chemicals with tap water. The whole surface of the plant was sprayed by the solution of the chemicals. In case of control plot water was sprayed only on the plants. The chemical spraying was done in maximum tillering stage of rice plant. Every time

the chemicals were freshly prepared prior to application and the spray tank was thoroughly cleaned before filling with the individual spray material. Special attention was given to complete coverage of the growing plants with the chemicals. Adequate precautions were taken to avoid tendency of spray materials from one plot to the neighboring ones.

3.13. Assessment of the disease severity in the field

Sixteen plants from each unit plot were randomly selected and tagged for grading the severity of diseases. The severity of four diseases viz. brown spot, blast, narrow brown leaf spot and sheath rot were recorded following IRRI recommended grading scale (Standard Evaluation System for Rice, 1980). The disease severity was recorded in the four growth stage of the plant namely flowering stage, milking stage, dough stage and maturity stage. The grades of different diseases are given below:

Brown spot (0-9 scale; affected leaf area)

0 = No incidence

1 = Less than 1 % leaf area affected

2=1-3% leaf area affected

3 =4-5 % leaf area affected

4=6-10% leaf area affected

5 = 11-15 % leaf area affected

Fig-1. Leaf showing brown spot symptoms

6=16-25% leaf area affected

7=26-50% leaf area affected

8=5I -75 % leaf area affected

9=76-100% leaf area affected

Blast (0-9 scale; affected leaf area)

0 = No incidence

1 = Less than 1 % leaf area affected

2=1-3% leaf area affected

3 =4-5 % leaf area affected

4=6-10% leaf area affected

5 = 11-15 % leaf area affected

6=16-25% leaf area affected

7=26-50% leaf area affected

8=5I -75 % leaf area affected

9=76-100% leaf area affected

Narrow brown leaf spot (0-9 scale; affected leaf area)

0 = No incidence

1 = Less than 1 % leaf area affected

3=1-5% leaf area affected

Fig-2. Leaf showing blast symptoms

Fig-3. Leaf showing narrow brown leaf spot symptoms

5=6-25% leaf area affected

7=26-50% leaf area affected

9=5I -100 % leaf area affected

Sheath rot (0 - 9 scale)

0 = No incidence

1 = Less than 1 % Sheath area affected

3=1-5% Sheath area affected

5=6-25% Sheath area affected

7=26-50% Sheath area affected

9=5I -100 % Sheath area affected

3.14. Harvesting and collection of data on yield and yield contributing parameters

The crop was harvested on 11 November 2006 at full ripening stage. Moreover 16 tagged plants of each unit plot were harvested separately. The data on the following yield contributing parameters were recorded:

- Plant height (cm)
- Panicle length (cm)
- Number of panicle /hill
- Number of grains/hill

Fig-4. Plant showing sheath rot symptom

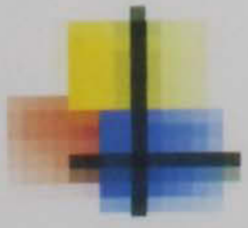
- Number of grains/panicle
- Weight of grains / hill (g)
- Weight of straw/hill (g)
- Weight of grains / panicle (g)
- Weight of thousand seeds (g)
- Weight of grain/plot (kg)
- Weight of straw/plot (kg)
- Grains yield (t/ha)
- Straw yield (t/ha)

3.15. Weather report

The data of monthly average temperature, relative humidity, rainfall and sunshine hours were collected from weather yard, Department of Environment, Agargoan, Sher-e-Bangla Nagar, Dhaka (Appendix 1).

3.16. Analysis of data

The data on different characters were subjected to statistical analysis using analysis of variance to find out the variation resulting from experimental treatments. Treatment means were compared by DMRT (Duncan's Multiple Range Test).



Chapter 4
Results

CHAPTER 4

RESULTS

4.1. Efficacy of fungicides in controlling brown spot of Rice cultivar BRRI Dhan-40

The efficacy of fungicides in controlling brown spot of rice (BRRI Dhan-40) at different growth stages was determined and the results are presented in Table1. The severity of brown spot was significant among the treatments at flowering stage and ranged from 0.00 to 0.48. The severity of brown spot and varied significantly at milking stage. The highest severity (1.13) was observed in T_1 (untreated control) and the lowest severity (0.00) was recorded in all fungicide treatment except Bordeaux mixture. The disease severity varied significantly at dough stage where the highest severity (1.58) was observed in untreated control and the lowest severity (0.00) was recorded in T_6 (Tilt-250 EC) and T_8 (Sunvit-50 WP). In case of maturity stage the highest disease severity (2.75) of brown spot was recorded in T_1 (untreated control), while lowest severity (0.00) was found in T_6 (Tilt-250 EC) which was statistically similar with all the fungicides.

Table 1. Efficacy of different fungicides on severity of brown spot of Rice (BRRI Dhan-40) at different growth stage

Treatments	Disease severity grade (0-9 scales)			
	Flowering stage	Milking stage	Dough stage	Maturity stage
T_1= Control (untreated)	0.48 a	1.13 a	1.58 a	2.75 a
T_2= Knowin-50 WP	0.00 b	0.00 b	0.08 b	0.83 b
T_3= Score-250 EC	0.00 b	0.00 b	0.17 b	0.35 b
T_4= Controll-5 EC	0.00 b	0.00 b	0.03 b	0.25 b
T_5= Proude-25 EC	0.00 b	0.00 b	0.00 b	0.17 b
T_6= Tilt-250 EC	0.00 b	0.00 b	0.00 b	0.00 b
T_7= Folicure-250 EW	0.00 b	0.00 b	0.07 b	0.13 b
T_8= Sunvit-50 WP	0.00 b	0.00 b	0.00 b	0.73 b
T_9= Cupravit-50 WP	0.00 b	0.00 b	0.25 b	0.32 b
T_{10}= Bordeaux mixture	0.03 b	0.06 b	0.55 b	0.70 b
LSD (P = 0.01)	0.0743	0.743	0.635	1.027
LSD (P = 0.05)				

4.2. Efficacy of fungicides in controlling blast of Rice cultivar BRRI Dhan-40

The efficacy of fungicides in controlling blast of rice (BRRI Dhan-40) at different growth stages are presented in Table 2. The severity of blast disease was significant in flowering, milking, dough and maturity stages in respect of different fungicide sprayed. The disease severity in flowering stage ranged from 0.00 to 0.47. The highest severity (0.47) was observed in T_1 (untreated control) and the lowest severity (0.00) was recorded in T_4 (Controll-5EC), T_5 (proude-25 EC), T_6 (Tilt-250 EC) and T_7 (Folicure-250 EW). The highest severity (0.90) in milking stage was recorded in T_1 (untreated control) and the lowest severity (0.00) was recorded in T_5 (proude-25 EC) and T_7 (Folicure-250 EW). In dough stage the highest severity (1.30) was recorded in T_1 (control) and the lowest severity (0.00) was recorded in T_5 (proude-25 EC). In case of maturity stage the severity of blast disease ranged from 0.17 to 2.10 where the highest severity (2.10) of blast disease was found in T_1 (untreated control), while lowest severity (0.17) was found in T_5 (proude-25 EC).

Table 2. Efficacy of different fungicides on severity of blast of rice (BRRI Dhan-40) at different growth stage

Treatments	Disease severity grade (0-9 scales)			
	Flowering stage	Milking stage	Dough stage	Maturity stage
T_1= Control (untreated)	0.47 a	0.90 a	1.30 a	2.10 a
T_2= Knowin-50 WP	0.11 b	0.13 b	0.22 b	0.78 b
T_3= Score-250 EC	0.18 b	0.18 b	0.33 b	0.97 b
T_4= Controll-5 EC	0.00 b	0.02 b	0.19 b	0.32 b
T_5= Proude-25 EC	0.00 b	0.00 b	0.00 b	0.17 b
T_6= Tilt-250 EC	0.00 b	0.02 b	0.38 b	0.57 b
T_7= Folicure-250 EW	0.00 b	0.00 b	0.02 b	0.27 b
T_8= Sunvit-50 WP	0.017 b	0.17 b	0.33 b	0.92 b
T_9= Cupravit-50 WP	0.10 b	0.37 b	0.55 b	0.70 b
T_{10}= Bordeaux mixture	0.10 b	0.17 b	0.53 b	1.33 ab
LSD (P = 0.01)	0.2575	0.3790	0.626	0.949

4.3. Efficacy of fungicides in controlling narrow brown leaf spot of Rice cultivar BRRI Dhan-40

The efficacy of different fungicides in controlling narrow brown leaf spot of BRRI Dhan-40 at flowering, milking, dough and maturity stage were recorded, and the result is presented in Table 3. The severity of narrow brown leaf spot was significant among the treatments at flowering stage and varied from 0.00. to 0.47 where the highest severity was found in T_1 (Control) and the lowest severity was found in T_4 (Controll-5EC), T_5 (proude-25 EC), T_6 (Tilt-250 EC), T_7 (Folicure-250 EW) and T_9 (Cupravit-50 WP). In case of milking stage narrow brown leaf spot severity differed significantly from one treatment to another, where the highest severity (1.10) was found in T_1 (untreated control) and the lowest (0.00) severity was found in T_7 (Folicure-250 EW) and T_9 (Cupravit-50 WP). The severity of the disease differed significantly at dough stage where the highest severity (2.07) was recorded in T_1 (untreated control) and the lowest (0.04) severity was recorded in T_5 (proude-25 EC) which was statistically similar with all other fungicides. The disease severity was also significant among the treatments at maturity stage, where the highest (5.06) and lowest (0.21) severities were recorded in T_1 (untreated control) and T_5 (proude-25 EC), respectively.

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Table 3. Efficacy of different fungicides on severity of narrow brown leaf spot of Rice (BRRI Dhan-40) at different growth stage

Treatments	Disease severity grade (0-9 scales)			
	Flowering stage	Milking stage	Dough stage	Maturity stage
T_1= Control (untreated)	0.47 a	1.10 a	2.07 a	5.06 a
T_2= Knowin-50 WP	0.02 b	0.02 b	0.05 b	1.18 cd
T_3= Score-250 EC	0.07 b	0.03 b	0.25 b	0.59 d
T_4= Controll-5 EC	0.00 b	0.02 b	0.05 b	1.52 cd
T_5= Proude-25 EC	0.00 b	0.02 b	0.04 b	0.21 d
T_6= Tilt-250 EC	0.00 b	0.02 b	0.05 b	0.37 d
T_7= Folicure-250 EW	0.00 b	0.00 b	0.12 b	0.95 cd
T_8= Sunvit-50 WP	0.18 b	0.20 b	0.38 b	1.63 cd
T_9= Cupravit-50 WP	0.00 b	0.00 b	0.35 b	2.23 bc
T_{10}= Bordeaux mixture	0.07 b	0.22 b	0.53 b	3.42 b
LSD (P = 0.01)	0.197	0.364	0.758	1.292

4.4. Efficacy of fungicides in controlling sheath rot of rice cultivar BRRI Dhan-40

The efficacy of fungicides in controlling sheath rot of rice (BRRI Dhan-40) at different growth stages was determined and the results are presented in Table 4. The severity grades of sheath rot were recorded at flowering, milking, dough and maturity stages. At flowering and milking stages the severity grade of sheath rot did not differ significantly though the highest severities of the disease were recorded in control (T_3) plot. But the severity of sheath rot varied significantly at dough stage. The highest severity (0.27) was recorded in T_1 (control) and the lowest severity (0.01) was recorded in T_6 (Tilt-50 EC) which was statistically similar with all the fungicides. In case of maturity stage the disease severity also varied significantly among the treatments. The highest severity (0.38) was recorded in T_1 (control), while the lowest severity (0.09) was found in T_6 (Tilt-50 EC).

Table 4. Effect of different fungicides on incidence of sheath rot of Rice (BRRI Dhan-40) at different growth stage

Treatments	Disease severity grade (0-9 scales)			
	Flowering stage	Milking stage	Dough stage	Maturity stage
T_1= Control (untreated)	0.04	0.14	0.27 a	3.38 a
T_2= Knowin-50 WP	0.01	0.03	0.11 b	0.19 b
T_3= Score-250 EC	0.06	0.08	0.14 b	0.15 b
T_4= Controll-5 EC	0.02	0.04	0.10 ab	0.13 b
T_5= Proude-25 EC	0.03	0.07	0.09 b	0.13 b
T_6= Tilt-250 EC	0.00	0.00	0.01 b	0.09 b
T_7= Folicure-250 EW	0.03	0.02	0.05 b	0.16 b
T_8= Sunvit-50 WP	0.02	0.04	0.05 b	0.22 b
T_9= Cupravit-50 WP	0.02	0.03	0.04 b	0.26 ab
T_{10}= Bordeaux mixture	0.00	0.00	0.11 b	0.27 ab
LSD (P = 0.05)	NS	NS	0.1329	0.1435

4.5.Effect of different fungicides on plant growth and yield contributing characters of rice cultivar BRRI Dhan-40

Data regarding the effect of different fungicides on plant height (cm), panicle length (cm), number of panicle /hill, number of grains/hill and number of grains/panicle of rice (BRRI Dhan-40) was recorded and tabulated results are shown in Table 5. The treatments showed significant differences in respect of plant height (cm). The highest plant height (114.2cm) was found in T_6 (Tilt-250 EC) which was statistically similar with T_3 (Score-250 EC) and T_4 (Controll-5 EC). The lowest plant height (104.1cm) was recorded in T_8 (Sunvit-50 WP) which was statistically similar with T_1, T_2 and T_{10}. The treatments also differed significantly in respect of panicle length (cm). The highest panicle length (10.66 cm) was recorded in T_9 (Cupravit-50 WP) that was significantly different from other treatments and the lowest panicle length (9.47) was recorded in T_1 (untreated control). The treatments did not show any significant effect on number of panicle /hill and number of grains/hill. Number of panicle /hill varied from 11.98 in T_{10} (Bordeaux mixture) to 13.90 in T_8 (sunvit-50 WP). Number of grains/hill varied from 834.52 in T_1 (Untreated control) to 1198.98 in T_5 (Proude-25 EC). But treatment showed significant difference in respect of number of grains/panicle which varied from 69.21 to 88.38, where the highest and lowest number of grains/ear was found in T_3 (Score-250 EC)and T_1 (Untreated Control), respectively.

Table 5. Efficacy of different fungicides on plant growth and yield contributing character of Rice (BRRI Dhan-40)

Treatments	Plant height (cm)	Panicle length (cm)	Number of panicle /hill	Number of grains/ hill	Number of grains /panicle
T_1= Control (untreated)	104.4 c	9.47 c	12.14	813.52	69.21 c
T_2= Knowin-50 WP	104.9 c	10.09 ab	12.83	1085.36	85.71 ab
T_3= Score-250 EC	110.7 a	10.03 abc	13.83	1193.73	88.38 a
T_4= Controll-5 EC	110.2 a	10.03 abc	14.26	1141.00	79.98 abc
T_5= Proude-25 EC	109.6 ab	10.37 ab	14.38	1198.94	83.39 ab
T_6= Tilt-250 EC	114.2 a	9.943 bc	14.19	1018.82	84.07 ab
T_7= Folicure-250 EW	104.7 bc	10.28 ab	13.37	1099.54	78.28 abc
T_8= Sunvit-50 WP	104.1 c	10.13 ab	13.90	1012.60	72.87 bc
T_9= Cupravit-50 WP	104.8 bc	10.66 a	13.40	935.43	76.68 abc
T_{10}= Bordeaux mixture	104.8 c	10.31 ab	11.98	990.68	82.23 abc
LSD (P = 0.01)	4.565	.5660	NS	NS	12.36

4.6. Efficacy of different fungicides on weight of grains of rice (BRRI Dhan-40)

Data regarding the effect of different fungicides on weight of grains / hill, weight of straw/hill, weight of grains / panicle and weight of thousand seeds of rice (BRRI Dhan-40) was recorded and results are shown in Table 6. The treatments showed significant differences in respect of weight of grains / hill. The highest weight of grains / hill (25.14 g) was found in T_5 (Proude-25 EC) and the lowest (20.01 g) was recorded in T_1 (Untreated control). But the treatments did not show any significant effect on weight of straw/hill and weight of grains / panicle. In case of weight of straw/hill the result varied from 101.45 g in T_8 (Sunvit-50 WP) to 114.58 gm in T_3 (Score-250 EC) and in case of weight of grains /panicle the result varied from 1.64 g in T_1 (Untreated control) to 1.93 g in T_9 (Bordeaux mixture). But the treatment showed significant difference in respect of weight of thousand seeds which varied from 20.42 g to 23.99 g. The highest weight of thousand seeds was found in T_5 (Proude-25 EC) which was statistically similar to T_2, T_4, T_6, T_7, T_8 and T_9. The lowest weight of thousand seeds was found in T_1 (Untreated Control).

Table 6. Effect of different fungicides on weight of grains of Rice (BRRI Dhan-40)

Treatments	Weight of grains / hill (g)	Weight of straw/hill (g)	Weight of grains / panicle (g)	Weight of thousand seeds (g)
T_1= Control (untreated)	20.01 c	102.14	1.64	20.42 b
T_2= Knowin-50 WP	21.61 bc	103.81	1.71	23.59 a
T_3= Score-250 EC	24.27 ab	114.58	1.77	22.36 ab
T_4= Controll-5 EC	24.15 ab	105.71	1.70	23.31 a
T_5= Proude-25 EC	25.14 a	106.17	1.75	23.99 a
T_6= Tilt-250 EC	23.84 ab	105.21	1.68	23.51 a
T_7= Folicure-250 EW	23.89 ab	106.25	1.70	22.88 a
T_8= Sunvit-50 WP	22.8 6 abc	101.45	1.65	23.17 a
T_9= Cupravit-50 WP	23.94 ab	105.21	1.80	22.49 a
T_{10}= Bordeaux mixture	23.18 ab	103.75	1.94	22.04 ab
LSD (P = 0.01)	2.853	NS	NS	1.908

4.7. Efficacy of different fungicides on yield of rice (BRRI Dhan-40)

The effect of different fungicides on grain yield (kg/plot), straw yield (kg/plot) and grain yield (t/ha) of rice (BRRI Dhan-40) was recorded and results are shown in Table 7. There was significant differences among the different treatments in respect of grain yield (kg/plot). The highest grain yield (2.85 kg/plot) was recorded in T_6 (Tilt-125 EC) and the lowest (2.28 kg/plot) was found in T_1 (Untreated control). The treatments also show significant effect on straw yield(kg/plot), where the highest straw yield (9.82kg/plot) was recorded in T_6 (Tilt-125 EC) and the lowest (6.85 kg/plot) was found in T_1 (Untreated control). The grain yield of rice (t/ha) differed significantly among the treatments, where the highest yield of 4.75 ton/ha was found in T_6 (Tilt-125 EC) which was statistically similar to T_8 (Sunvit- 50 WP) and the lowest yield of 3.39 ton/ha was found in T_1 (Untreated control). The treatment T_6 (Tilt-125 EC) increased 40.12 % grain yield over untreated control.

Table 7. Effect of different fungicides on yield of Rice (BRRI Dhan-40)

Treatments	Grain yield (kg/plot)	Straw yield (kg/plot)	Grain yield (t/ha)	Percent grain yield increased over untreated control
T_1= Control (untreated)	2.28 d	6.85 c	3.39 b	-
T_2= Knowin-50 WP	2.51 abcd	9.13 ab	4.19 ab	23.6
T_3= Score-250 EC	2.68 abc	9.07ab	4.47 ab	31.86
T_4= Controll-5 EC	2.37 cd	9.28ab	3.94 ab	16.23
T_5= Proude-25 EC	2.47 bcd	8.82 ab	4.11 ab	24.19
T_6= Tilt-250 EC	2.85 a	9.82 a	4.75 a	40.12
T_7= Folicure-250 EW	2.55 abcd	9.37 ab	4.24 ab	25.08
T_8= Sunvit-50 WP	2.78 ab	8.77 ab	4.64 a	36.88
T_9= Cupravit-50 WP	2.70 abc	8.65 ab	4.50 ab	32.75
T_{10}= Bordeaux mixture	2.56 abcd	8.145 bc	4.28 ab	26.26
LSD (P = 0.05)	0.302	1.422	0.9943	

Chapter 5
Discussion

CHAPTER 5
DISCUSSION

The present investigation has been conducted to evaluate the effect of different fungicides in controlling some foliar diseases of rice viz. brown spot, blast, narrow brown leaf spot and sheath rot with increasing the grain yield. The experiment was conducted under field condition during the period from July to November 2006. The selected chemicals were Knowin-50 WP (0.2%), Score-250 EC (0.1%), Controll-5 EC (0.1%), Proude-25 EC (0.1%), Tilt-250 EC (0.2%), Folicure-250 EW (0.1%), Sunvit-50 WP (0.7%), Cupravit-50 WP (0.7%) and Bordeaux mixture were sprayed at maximum tillering stage of the crop.

From this result it was observed that all the fungicides were effective in reducing the severity of brown spot at flowering, milking, dough and maturity stage compared to untreated plots. Percich (1989) reported that the application of Propiconazole decreased disease severity of brown spot in wild rice when compared with the non-treated control plot. Moletti *et al.* (1996) reported that fungicide treatment (Propiconazole at 0.126 liters a.i./ha) reduced and/or delayed the infection of *Bipolaris oryzae*. The effect of Bordeaux mixture was not so strong at flowering stage because the chemical showed its effect normally 10-12 days after application on plants. Schloesser (1997) reported that activation of inducing chemicals need 7 days after its application.

From this result it has been found that all the fungicides were effective in reducing the severity of narrow brown leaf spot at flowering, milking, dough and maturity stage compared to untreated control plots. Tilt-250 EC (Propiconazole) is more effective chemical to reduce the severity of narrow brown leaf spot compared to untreated control plot. T_5 (Proude-25 EC) was also effective chemical but this effect was not better than Tilt-250 EC. Though the severity of narrow brown leaf spot was gradually increased from flowering to maturity stage but the fungicidal treatments gave better results compared to untreated control plot of rice (BRRI Dhan-40). The effect of Tilt-250 EC in controlling narrow brown leaf spot was better than other treatments at maturity stages. Ahmed *et al.* (1988) tested propiconazole with other fungicides in a field experiment in Bangladesh for controlling some major diseases of rice and they found that propiconazole gave the best control of narrow brown leaf spot of rice caused by *Cercospora oryzae*.

Though the severity of blast increased with age of plant but the effect of Tilt 250 EC was better to decrease its severity. Fabregat *et al.* (1995) reported that Propiconazole at 0.8 and 1.2 litre/ha a.i. gave good control and carbzndazim at 1 kg/ha. a.i. ensured adequate protection of the foliage. Ram *et al.* (1994) evaluated 7 fungicides in a field trial against *Pyricularia oryzae* on the susceptible rice cv. Taraori Basrnati. Tricyclazole and propiconazole (both 0.1%) were the most effective in reducing neck blast and increasing yield. From the data it has been

found that propiconazoie was the most effective treatment in reducing blast incidence.

At flowering and milking stage no significant effect of fungicides was found in controlling sheath rot of rice. The effect of Tilt-250 EC (Propiconazole) was better compared to other fungicides. Though the disease increased with age of plant but the effect of Tilt 250 EC was better to decrease sheath rot severity. Dodan *et al.* (1996) reported the efficiency of propicoriazoie in controlling sheath rot of rice caused by *Sarocladium oryzae*. The fungicide was sprayed at the pre-flowering stage. Propiconazole significantly reduced disease in all the seasons. The means of the polled data for all the seasons revealed that propiconazoie was the most effective treatment, reducing sheath rot incidence by 46.5%. But in the present study Tilt was best for controlling sheath rot of rice BRRI Dhan-40.

Plant height, panicle length and number of grains/panicle varied significantly among the treatment used. The treatments T_6 (Tilt-250 EC), T_3 (Score-250 EC) and T_4 (Controll-5 EC) significantly increased plant height though Tilt-250 EC gave better result compared to others but T_8 (Sunvit-50 WP), T_2 (Knowin-50 WP) and T_{10} (Bordeaux mixture) did not show any marked effect on it. In case of panicle length fungicides had significant effect compared to untreated but Cupravit-50 WP showed best effect on panicle length. There was no significant effect of fungicides on number

of panicle /hill and number of grains/hill. In case of number of grains/ panicle Score-250 EC gave better result than the other fungicides.

From present study it has been observed that all the fungicides were effective except Knowin-50 WP to increase weight of grains per hill compared to untreated plot, but Proude-25 EC was more effective than other fungicides. In case of weight of straw per hill, weight of grain per panicle and wt. of straw per plot, fungicides gave no significant difference compared to untreated plot. But significant effect of fungicides were found on weight. of thousand seeds, Plot wise grain yield and Grain yield (ton/ha) of BRRI Dhan-40. From this result it was observed that all the fungicides were effective to increase weight of thousand seeds grain yield (ton/ha) Tilt-250 EC (Propiconazole) showed better result than the other fungicides. The treatment T_6 increased 40.12 % grain yield over untreated control.

From the present investigations it has been found that rice naturally got infected by brown spot, blast, narrow brown leaf spot and sheath rot that may be controlled by spraying different fungicides. Tilt-250 EC (Propiconazole) showed relatively good result against some major foliar diseases namely brown spot, blast, narrow brown leaf spot and sheath rot of rice (BRRI Dhan-40) and increased yield.

CHAPTER 6

SUMMARY AND CONCLUSION

Present investigation had been conducted to evaluate the efficacy of different fungicides against some foliar diseases of BRRI Dhan- 40, namely brown spot (*Bipolaris oryzae*), blast (*Pyricularia grisea*), narrow brown leaf spot (*Cercospora oryzae*) and sheath rot (*Sarocladium oryzae*) which cause serious damages in rice cultivation in world wide. BRRI Dhan-40 was grown in the Field of Sher-e-Bangla Agricultural University, Dhaka, during the period from July to November, 2006 with normal agronomic practices and were sprayed with different fungicides at maximum tillering stage. The fungicides are Knowin-50 WP @ 0.2%, Score-250 EC @ 0.1%, Controll-5 EC @ 0.1%, Proude-25 EC @ 0.1%, Tilt-250 EC @ 0.2%, Folicure-250 EW @ 0.1%, Sunvit-50 WP @ 0.7%, Cupravit-50 WP @ 0.7% and Bordeaux Mixture.

From this result it was observed that all the fungicides were effective in reducing the severity of brown spot at flowering, milking, dough and maturity stage compared to untreated control where Tilt-250 EC (Propiconazole) was more effective chemical to reduce the severity of brown spot compared to untreated control. T_5 (Proude-25 EC) was also effective chemical to reduce the disease significantly over untreated control.

It was also observed that all the fungicides were effective in reducing the severity of narrow brown leaf spot at flowering, milking, dough and maturity stage

compared to untreated control. Tilt-250 EC (Propiconazole) was more effective chemical to reduce the severity of narrow brown leaf spot compared to untreated control. T_5 (Proude-25 EC) was also effective chemical for controlling narrow brown leaf spot. All the fungicides significantly reduced the severity of blast of rice compared to untreated plot where Tilt-250 EC (Propiconazole) resulted best performance to control the disease. Similarly, the severity of sheath rot significantly reduced by spraying the fungicides over untreated control at dough and maturity stage where the efficacy of Tilt-250 EC in controlling the disease was comparatively higher over untreated control.

Plant height, panicle length and number of grains/panicle varied significantly among the treatment used. From this result it was observed that all the fungicides showed significant effect in reducing the diseases over control (untreated). The effect of Tilt-250 EC and Proude-25 EC were better than the other fungicides in controlling diseases with increasing yield and yield contributing characters. Tilt-250 EC increased grain yield of BRRI Dhan-40 by 40.12% over control (untreated).

More studies are required to find out the effect of fungicides with Tilt-250 EC and other fungicides in controlling disease of rice in different season with different variety and under different agro-ecological zones in the country.

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REFERENCES

Anonymous. (2004). Adhunic Dhaner Chash, Bangladesh Rice Research Institute, Gazipru. 10th edition. Pp: 10-11.

Anonymous. (2003). Adhunic Dhaner Chash, Bangladesh Rice Research Institute, Gazipru. 10th edition. Pp: 18.

Anonymous. (1998). Adhunic Dhaner Chash, Bangladesh Rice Research Institute,, Gazipru. 5th edition. p.6.

Anonymous. (1976). Pest Control in Rice. PANS Manual No.3. Centre for Overseas Pest Research London, W85SJ, UK. Pp. 51-65.

Ahmad M.(1992). Control rice blast by foliar fungicidal sprays. *Plant Disease Research* 7:24-32.

Ahamed, H.U; Shahjaham A.K.M. and Miah. S.A. (1988). Fungicides to control rice. *International Rice Research Newsletter* **13**(4):37-38.

BBS. (2004). Statistical pocketbook of Bangladesh Ministry of Planning Government of People Republic of Bangladesh. P.27.

BBS. (2003). Statistical pocketbook of Bangladesh Ministry of Planning Government of People Republic of Bangladesh. P.36.

Balardin, R.S., Facco M.J. and Muller S. (1992). Fungicides for the control of irrigated rice. Glum spots disease. *Ciencia Rural* **22**(3):267-270.

Deka, B.M.;. Ali, S.; and Chandra, K.C.; (1996). Management of Grain Discoloration of Rice. *Indian Journal of Mycology and Plant Pathology*. **26**(1):105-106.

Dodan, D.S.; Ram.S.; Sunder S.; and Singh R..(1996). Efficiency of fungitoxicants against sheath rot of rice. *Indian J. of Mycology and Plant Pathology*. **26**(3):283-284.

FAO. (2002). Rice Production in Philippijnes Year Book. Food and Agricultural Organization. United Nations. Italy. Rome. **51**:62-66.

Fabregat, J.M.; Barcelo, J.C.; and Martinez P.J.(1985). Fungicide Trials Against *Pyricularia* Disease of Rice. *Documentos-De-Ciencia-Y-Tecnica-De-La-Agricuultura*. **4**:25-40.

Fakir, G.A.(1982). Estimate of Crop Losses Due to Seed-borne Disease in Bangladesh. Department of Plant Pathology. BAU, Mymenshing.

Growth, D.E. (1996). Two new fungicides to control rice diseases. *Louisiana Agriculture* **39**(4):31-33.

Greewal, S.K. and Kang, M.S. (1991) Fungicidal control of *Fusarium* sheath rot of rice. *Plant Disease Research*. **6**(2): 75-77.

Haque, M.A..; Miah, M.A.T.; and. Islam, M.R (1992) Chemical Control of seed borne disease of rice. Bangladesh . *Journal of Plant Pathology* **8**(12) 13-16.

IRRI. (2003). Standard Evaluation System for rice. INGER. Genetic Resource Centre, IRRI, Manila, Phillippines. P.22.

IRRI. (1980). Standard Evaluation System for rice. International Rice Testing Program. Losbanos. Phillippines. Pp. 7-20.

Kandhari, J.; Gupta, R.L. and Sami, A.P. (2003). Efficacy to new organo phosphorus compound against sheath rot of rice. *Indian Phytopathology*. **63**(2):120-123.

Miah, S.A.; Shahjahan A.K.M., Hossain M.A. and Sharma, N.R.(1985). survey of rice desease in Bangladesh. *Trop. Pest management* **31**(3):208-213.

Moletti, M.; Giudici, M.L. and Villa, R. (1996). Rice akiochi-brownsp of diseade in ltaly; Agronomic and Chemical control. *Informatora Fitopat Logico*. **46**: 41-46.

Misra, A.K., Dharma, V. and Vir, D.(1992). Field Evaluation of fungicides against fungi causing discoloration of paddy seeds. *Indian Phytopathology* **45**: 49-54.

Murty, V.S.T. (1986). Studies on chemical control of sheath rot of rice. *Pesticides.* **20**(9):20-21.

Ou, S.H. (1985). Rice Diseases. Second Edition, CMI, Kew, Surrey, England. P. 38-41.

Percich, J.A. (1989). Comparison of Propiconazole rates for control of fungal brown spot of wild rice. *Plant Disease* **73**(7):588-589.

Percich, J.A. and Huot, C.M.(1989). Comparison of Propiconazole and mencozeb applied individually or sequentially for management of fungal brown spot of wild rice. *Plant disease*. **73**(3): 257-259.

Puat, G.B. and Raju, C.A (1998). Influence of time of inoculation on the development of rice sheath rot. *Media Penelitian-Sukamandi* (Indonesia) **10**: 32-37.

Rajappan, K. Mariappan, V.and Kareem, A. (1997). Effect of dried leaf extract of ipomoea on rice sheath rot pathogen and beneficial microorganisms. *Indian Phytopathology* **50**(3): 340-358.

Shukla, V.D.; Maiti, D. and Variar, M. (1993). Effect of combination of fungicide formulation on management of rice blast in rain fed upland. *Indian journal of agril. Sciences* **63**(6): 386-389.

Shahjahan. A.K.M.; Duve, T. and Bonman, J.M. (1987). Climate and rice diseases. In weather and rice. IRRI, Los Banon,Laquna, Philippines.pp. 125-128.

Schloesser, E. (1997). Systemic Activated Resistance a new dimension in plant protection; *Arab J. Pl. Prot.* **15**(2):147-149.

Singh, R Doden, D.S. and Singh, R. (1994). Comparative efficacy of some new fungicidal formulations against neck blast of paddy. *Indian J. Mycology and Plant Pathology* **24**(3): 236-237.

Sundar, S.; Dodan, D. S. Ahufa, S.C. and Singh, R. (1991). Spray schedule for control of rice stem rot. *Oryza* **28**: 421-423.

Suryadi, Y.; Kadir, S,. and Daradijat,A.A.(1991). Control of sheath rot and sheath blight of rice with fungicides. *Bulletin-perranian-Fakultals-pertanian universities-Islam-sunatera-utara medan* (Indonesia) **10**(3):13-17.

Thangasany, T.A. and Ranaswamy, M. (2001). Fungicide timing to control rice sheath rot. IRRN **14**(6):24.

Vidhyasekaran, P. and Lewin, H.D. (1987). Time of spraying to control sheath rot. *International Rice Research News Letter* **12**(6):21-22.

World Bank –UNDP. (1999).Bangladesh Population Projection, Dhaka.

Chapter 7
References

APPENDIX

Appendix 1. Monthly average temperature, relative humidity and total rainfall of the experimental site during the period from June to November 2006

Month	Air temperature (° C)		RH (%)	Total rainfall (mm)
	Maximum	Minimum		
June 06	33.40	26.80	91	279
July 06	31.52	25.35	88	233
August 06	28.25	24.55	82	165
September 06	26.20	24.15	73	117
October 06	26.70	21.13	89	41
November 06	22.00	20.15	87	00

Source : Dhaka metrological center

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