ECO-FRIENDLY MANAGEMENT OF LEAF BLIGHT(*Bipolaris sorokiniana*) OF WHEAT

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ECO-FRIENDLY MANAGEMENT OF LEAF BLIGHT (*Bipolaris sorokiniana*) OF WHEAT

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CERTIFICATE

This is to certify that the thesis entitled **"ECO-FRIENDLY MANAGEMENT OF LEAF BLIGHT (*Bipolaris sorokiniana*) OF WHEAT"** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfilment 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 **ROMANA ZAMAN, Registration No. 03-01206,** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Dated : 30.06.2008

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ABSTRACT

The experiment was carried out to determine the effect of different eco-friendly treatments against management of leaf blight (*Bipolaris sorokiniana*) of wheat during the period from December-2007 to March-2008 at the farm of Sher-e-Bangla Agricultural University. Twelve treatments were explored in this experiment namely farmer's saved seed (T_1), apparently healthy seed (T_2), farmer's saved seed treated with brine solution (T_3), apparently healthy seed treated with brine solution (T_4), sun drying of farmer's saved seed (T_5), sun drying of apparently healthy seed (T_6), hot water treatment of farmer's saved seed (T_7), hot water treatment of apparently healthy seed (T_8), polythene solarization of farmer's saved seed (T_9), polythene solarization of apparently healthy seed (T_{10}), farmer's saved seed treated with Bavistin 50WP (T_{11}) and apparently healthy seed treated with Bavistin 50WP (T_{12}). The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. The highest reduction of incidence of seed-borne *Bipolaris sorokiniana* was recorded in treatment T_{12}. Among the eco-friendly treatments the highest reduction of incidence of *Bipolaris sorokiniana* as well as leaf infection and yield was found in treatment T_8 which was closely related to T_{11}. Among the rest of the seed treatments, T_6 gave good result in reducing leaf infection, increasing seed germination as well as seed yield. Treatment T_4 and T_{10} also increased seed germination, seed yield and reduced the leaf infection in field condition. Farmer's saved seeds treated with hot water, polythene solarization, brine solution and apparently healthy seeds showed moderate performances regarding over control (T_1).

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LIST OF ABBREVIATED TERMS

ABBREVIATIONS	FULL NAME
AEZ	= Agro- ecological Zone
Anon.	=Anonymous
BARI	= Bangladesh Agricultural Research Institute
BAU	=Bangladesh Agricultural University
BARC	= Bangladesh Agricultural Research Council
BBS	= Bangladesh Bureau of Statistics
CIMMYT	=International Maize and Wheat Improvement Centre
cv.	=Cultivar(s)
DMRT	=Duncan's Multiple Range Test
DAS	= Days After Sowing
e.g.	=For example
et al.	=And others
etc.	=Etcetera

FAO	=Food and Agriculture Organization
g	=Gram
i.e.	=That is
ISTA	=International Seed Testing Agency
IRRI	=International Rice Research Institute
Kg	=Kilogram
LSD	=Least Significant Difference
PDA	=Potato Dextrose Agar
RCBD	= Randomized Complete Block Design
SAU	= Sher-e-Bangla Agricultural University
SRDI	= Soil Resources Development Institute
t/ha	= Tone per hectare
%	= Percentage
@	= At the rate
°C	=Degree Centrigrade

CHAPTER-1

INTRODUCTION

INTRODUCTION

Wheat (*Triticum aestivum L.)* is one of the most important cereal crops all over the world in respect of human nutrition. About two third of the world population use wheat as staple food (Majumder, 1991). It is the second most important cereal crop next to rice in Bangladesh and most of the people meet their carbohydrate requirement from wheat. Though the crop has been introduced in 1961 in the country, its popularity has gained after 1975. Despite the area, production and yield rate of wheat have been increasing dramatically during the last decade, the wheat yield in Bangladesh is too low (1.85 t/ha) in comparison to the other countries of the world like India ,Iran, China, Pakistan and Brazil producing 78, 19, 112.5, 21 and 5.20 m. tons, respectively in 2008 (FAO, 2008). About 399 thousand hectares of land was covered by wheat cultivation with the annual production of 737 m. tons (1.85t/ha) in Bangladesh (BBS, 2008).

There are many constraints lowering the yield of wheat in Bangladesh. Among the different factors that affect the production of wheat, use of unhealthy or diseased seeds is one of the major constraints. Government and semi government organizations able to supply only 22.8% of the total wheat seed required during 1998-1999 (Motahar, 2000). The rest of 77.2% of the seeds prouduced traditionally by the farmer's with no or little care even for the purity and germination and remain out of scope of certification. As a result, a huge crop loss is incurred every year due to seed diseases of wheat in the country. In the 21th century, there is no alternative to use of high quality of seeds to attain sustainability in food production.

The production of wheat has undergone a historic revolution in many developing countries of Asia and Africa where the crop is grown under different environmental conditions ranging from humid to arid, subtropical to temperate and sea level to an altitude of 3000 meters (Sarri and Wilcoxon, 1974). Wheat plants at all growth stages prone to the attack of numerous diseases. The crop is known to suffer from as many as 200 diseases of which the most important and damaging ones are seed borne (USDA, 1960). Seed borne infections of fungal pathogens are important not only due to the association with the seeds that cause germination failure, and / or causing disease to the newly emerged seedlings or growing plants but also contaminate the soil by establishing its inocula permanently. Wheat suffers from as many as 26 seed borne pathogens causing 14 seed borne diseases. Among them leaf blight / spot and black point caused by *Bipolaris sorokiniana* has become a serious concern in the recent years in Bangladesh (Azhar *et al.*,1972; Fakir, 1988).

The yield loss in wheat due to leaf blight / spot disease in the farmer's field in our country have been reported to be 14.97% (Alam *et al.*, 1995). In case of severe attack, it may result 100% yield loss (Hossain and Azad, 1994). A rough estimate shows that an annual crop loss (including storage loss) of TK.1400 millions is occurred due to seed borne diseases in Bangladesh (Fakir, 2000). The leaf blight disease is considered to be a threat to the wheat cultivation all over the world (Duveiller and Gilchrist, 1994). The yield loss in wheat due to leaf blight / leaf spot / leaf blotch disease has been reported to be 20% in Sonalika, whereas 14% and 8% in Akbar and Kanchan ,respectively (Razzaque and Hossain, 1995).In farmer's field, 29% yield reduction

was estimated during 1991-1992 in cv. Kanchan (Alam *et al.*, 1994). Rashid and Fakir (1998) estimated yield reduction of wheat due to *Bipolaris sorokiniana* as high as 57.6% and 64.5% in cvs. Kanchan and Sonalika, respectively at maximum disease incidence. In case of severe attack the disease may result even 100% yield loss (Hossain and Azad, 1994).

In controlling leaf blight disease, several approaches have been practiced, such as use of resistant variety, cultural control, chemical control, biological control and use of plant extract etc. Cultivation of resistant variety is the most acceptable method for controlling this disease. But none of the wheat varieties in the country is found resistant against this disease (Hossain and Azad, 1992).

The most acceptable method for controlling this disease is sowing of pathogen free seeds. Therefore along with routine seed health testing, seed treatment before sowing is necessary. Treatment of seed with seed-dressing fungicides was found to improve germination and decrease infection of seedling growth from the black pointed seeds. Indiscriminate use of chemicals are creating health hazard and environmental pollution. Use of alternate methods instead of seed treating chemicals is of great concern now a days to save our environment.

Therefore, it is judicious to explore less expensive, less risky non-chemical components to treat seeds for freedom of the seed-borne pathogens. In this perspect, seed treatment with hot water, solar heat, polythene solarization and brine solution could be use to control seed borne fungal pathogens.

Considering the above facts, the present investigation has been taken to evaluate the efficacy of some selected eco-friendly treatments on leaf blight (*Bipolaris sorokiniana)* and grain yield of wheat with the following objectives:

1. To evaluate the effect of some selected eco-friendly treatments on seed germination and incidence of *Bipolaris sorokiniana* in the laboratory .

2. To determine the effect of some selected eco-friendly treatments on leaf blight (*Bipolaris sorokiniana)* and yield of wheat in field condition.

CHAPTER-2

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Leaf blight of wheat caused by *Bipolaris sorokiniana* is a very common devastating disease in Bangladesh. Seed treatment may reduce number of seed borne pathogens associated with seeds. To control the disease, several management programmes have been practiced. Literatures on chemical control and some eco-friendly approaches like seed treatment with hot water, brine solution, sun drying and polythene solarization for the management of leaf blight of wheat are presented in this chapter.

2.1. Eco-friendly treatment

2.1.1. Sorting of apparently healthy seed

Kalknnavar *et al.* (1989) graded wheat seeds into 4 categories based on length (a) 2.782.39mm (b) 2.38-1.97mm (c) 1.98-2.37mm and (d) 1.58-1.97 mm. Percent germination in seeds of (a) and (b) grades were similar and higher than grade (c) and (d). Percent germination was higher in the heavy seeds than in light seeds. Root length and seedling dry weight decreased with the decreasing of seed size. Heavy seeds were superior to light seeds in seedling dry weight and vigor index.

Hossain and Doullah (1998) reported that seed cleaning and seed washing of farmer's seed reduced the seedling disease and increased yield up to 53.87% and 14.77%, respectively over the unclean farmers saved seed.

Mia *et al.* (2000) reported that rice seed treated with Vitavax-200 showed the best performance followed by manual seed sorting against *Bipolaris oryzae*. Significant reduction of brown spot and

seedlings with lesion in coleoptile was noted in Vitavax-200 treated seed and manually sorted seed. Seed cleaning also increased the number of tiller and effective tiller/hill significantly.

Hasan (2000) found that seed cleaning and washing with water increased of germination and vigor index by 8.33% and 31.1%, respectively in farmer's rice seed (cv.BR11). Seed health test revealed that farmer's seeds yielded *Bipolaris oryzae,Fusarium moniliforma, Alternaria padwikii, Aspergillus niger, and Aspergillus flavus* spp. by 1.5%, 13.5%, 1.3%, 0.5% and 0.5%, respectively, over the best seeds. Seed cleaning followed by washing with water also increased 24.63% grain yield over farmer's seeds. He emphasized the importance of seed cleaning and washing that reduced incidence of foliar diseases in the field and increased seed yield by 35.13% over the use of normal farmer's seed of rice.

Fakir (2000) found that seed cleaning had paramount importance for improvement of quality rice seeds. They separated the best or clean apparently healthy seeds from the original farmer's stored rice seeds through elimination of seed contaminants (weed seeds, insects, varietal mixture, seeds of other crops, germinated seeds, smutted seeds and inert matter) and abnormal seeds (spotted, discolored, deformed, shriveled, unfilled and half filled seeds) by physical sorting. The least percentage of seed-borne pathogenic fungi was recorded on seed health analysis. Also lesser number of dead / abnormal seedling and higher percentage of normal seedlings were obtained from best seeds in the germination tests.

Rahman *et al.* (2000) carried out an experiment to improve seed quality by seed cleaning (manual sorting and flotation in water) in four seed

samples of rice cv. BR11. The seed borne fungi associated with the treated and untreated seeds were *Bipolaris oryzae, Trichoconis padwickii, Curvularia lunanta, Nigrospora oryzae, Alternaria tenuis, Aspergillus* spp. and *Penicillium* spp. All the seed treatment methods reduced all seed borne fungal infections. The best method was treatment with Vitavax-200 followed by manual sorting and flotation method. Vitavax-200 treated seeds and manually sorted seed produced the highest number of tillers / hill, percentage of healthy seeds and increased 1000-seed weight. Grain yield was increased in manually sorted, flotation and Vitavax-200 treated seed by 30.5%, 13.5% and 27.3%, respectively.

Hossien (2002) reported that farmer's clean seed, washed farmer's seed, washed clean seed and seed treated with Vitavax-200 increased 16.62%, 16.454%, 23.39% and 26.6% grain yield, respectively over farmer's saved seeds of rice (BR 11).

2.1.2 Seed Treatment with brine solution

Gworgwor *et al.* (2002) carried out field trials in Nigeria during 1997 and 1998 in wet seasons to determine the effect of seed treatment of different sorghum cultivars with brine solution (NaCl) on striga hermonthicam in sorghum. Different concentration of brine at o.5%, 1.0M, 1.5 M and 2.0 M were used. They reported that the effect of brine solution on establishment, growth and yield of sorghum under striga infestation shows that there was a decrease in crop stands with increase in brine concentration, with the least value at 2.0 M brine treatment. The 1.0 M brine treatment produced the highest grain yield.

Uddin (2005) stated that seed borne pathogens significantly reduced by treating seeds with chemical (Vitavax-200) followed by garlic extract, brine solution, hot water and physically sorted seeds in Lentil. The highest reduction of seed borne fungal flora were observed in case of chemical treatment followed by garlic extract, brine solution, hot water and physically sorted seeds. In the field condition, germination percentage was higher in physically sorted seeds.

Kabir (2006) conducted an experiment to control leaf blight of wheat where chemical and different physical seed treatments were used and the treatments were differed significantly. Among the different seed treatments, apparently healthy seed treated with Vitavax-200 @ 0.4% followed by apparently healthy seed treated with brine solution @ 2% washed apparently healthy seed treated with brine solution @ 2% was found to be the best in reducing leaf infection, increased seed germination and seed yield.

2.1.3 Seed treatment by solar heat

Guldhe *et al.* (1985) tested a physical methods against *Ustilago tritici* (*U. nuda*) associated with wheat seeds collected from infected field. They found that modified solar heat treatment was the best and gave only 46.9% control.

Mohinder *et al.* (1994) conducted a field experiment at Hisar, India, to study the efficacy of solar heat treatment for controlling loose smut of wheat caused by *Ustilago tritici* (*U. segetum* var *tritici*). The disease was completely controlled by solar heat. Jahan (1996) demonstrated that solar heat treatment of jute seed effectively inhibited seed-borne fungi.

Mahfuzul (1997) reported solar heat treatment as an effective method in reducing seed-borne infection of chilli compared to control.

Haque (1997) conducted an experiment to evaluate the solar heat treatment for 3 hours to control major seed-borne fungal pathogens of chilli. He found solar heat treatment significantly inhibited the growth of all the major seed-borne fungi in chilli seeds as compared to the control. Treated seed yielded 3.75%, 4.25%, 6.25% and 8.50% of *Alternaria tenuis, Colletotrichum capsici, Curvularia lunata* and *Fusarium* spp., respectively. In the control treatment, infection percentages were 14.0%, 12.75%, 12.00%, 20.25% for *A. tenuis, C. capsici, C. lunata and Fusarium* spp., respectively.

Fakir and Jahan (1998) carried out an experiment to control seed-borne fungal pathogens of jute by seed treatment with solar heat. Solar heat treatment effectively reduced 91.3% seed-borne infections and increased 9.0% seed germination.

Zobaer (2006) carried out an experiment to control leaf blight of wheat where different physical seed treatments were used and the treatments were differed significantly. Among the different seed treatments, solar heat treatment of apparently healthy seeds was found to be the best in reducing leaf infection, increased seed germination and seed yield. Apparently healthy seed treated with water increased seed germination, seed yield and also reduced the leaf infection.

2.1.4 Seed treatment with hot water

Prabhu and Prasada (1970) controlled alternaria leaf blight of wheat caused by *Alternaria triticina* by soaking seed in water at 52 to 54°C for 10 min. The lowest dead seeds (9.9%) recorded at temperature 51-52°C, which was lower than dead seeds (12.8%) at control condition. Increase in temperature above 51- 52°C, there observed a continuous significant increase in dead seeds indicating the negative effect of heat against viability of seeds. The highest dead seeds (53.6%) recorded at temperature 58-59°C.

Daniels (1983) observed that *Fusarium moniliforme* was eliminated from corn seeds when it was treated at 60°C for 5 min. According to him the seeds remained viable and neither the seeds nor aseptically germinated seedlings yielded the pathogen when plated on komaga agar.

Singh (1983) reported the method of hot water treatment as soaking of eggplant seeds in water at 20 - 30°C for 4-6 hr then dipping in water at 49°C for 2 min, followed by drying before planting. There are chances of reduction in germination if there is an increase in either temperature or duration of soaking of the seed. Because of the inherent problems in the method and in general the fact that only smaller quantities of seed can be treated.

According to IRRI (1983), *Bipolaris oryzae* caused brown spot of rice as a seed transmitted fungus effectively controlled by the hot water seed treatment at 53-54°C for 10-12 minutes. This treatment controlled primary infection at the seedling stages. Presoaking the seed in cold

water for 8 hours increased effectivity of the treatment.

Strandberg and White (1989) studied the tolerance of carrot seeds to heat treatments in order to eradicate seed borne pathogens. They observed that germination and emergence of seedlings from seeds treated in hot water at 35, 40, 45 and 55°C from 4-20 min were not affected, but seeds treated at 60°C for 8 min or more were affected adversely. Prolonged treatment and the higher temperatures were particularly effective in reducing populations of seed borne *Alternaria dauci.*

Jindal *et al.*(1991) reported that hot water treatment of bean seeds at 52°C for 10 min was found most effective for controlling *Xanthomonas campestris* pv. *phaseoli* .

According to Zhang *et al.* (1992), seed transmitted *Phytophthora boehmeriae,* the pathogen of ball rot of cotton was killed by exposure to 55°C for 5 min seed treatment with hot water.

Hadojo (1993) stated that ratoon stunting and chlorotic streak of sugarcane were controlled by treating setts in hot water at 52°C for 20 min or at 50°C for 2 hrs.

Winter *et al.* (1996) found that hot water treatment of barley seeds at 52° C for 5 or 10 minutes was partially effective against seed borne *Drechslera teres* and *Helminthosporium sativum.* However, hot water treatment at 52° C for 10 min sometimes reduced germination and field emergence but the effect was less with 5 min treatment.

Khaleduzzaman (1996) studied hot water treatment of wheat seeds at 49°C, 52°C, 55°C and 61°C, respectively for 5 and 10 min in controlling seed borne infection. Hot water treatment at 52°C-55°C for 10 min gave the highest control of *Alternaria tenuis, Aspergillus flavus, Aspergillus niger, Bipolaris sorokiniana, Curvularia luanata, Fusarium* spp. and *Penecillium* spp. and increased seed germination.

Ranganna *et al.* (1998) stated that hot water treatment at 57.5°C for 20-30 min for controlling storage pathogen like *Fusariun solani and Erwinia carotovora* was effectively done for potatoes.

Lurie *et al.* (1998) studied a pre-storage dry heat treatment and a hot water dip at 30°C for 48 to 72 h and 50 to 53°C for 2 to 3 min, respectively for reducing storage rots on capsicum bell peppers and tomatoes. Under these conditions *in vitro* germination and growth of *Alternaria alternata* and *Botrytis cinerea* were weakened or prevented.

Fallik *et al.* (1999) stated that hot water treatment qualified sweet pepper in storage condition after treating with 55±1°C for 12±2S. This treatment significantly improved the general appearance of the fruits, reduced decay and maintained fruit firmness. The respiration rate of rinsed and cleaned fruits was significantly lower than that of untreated fruits during storage and shelf-life simulation.

Hermansen *et al.* (1999) studied the effect of hot water treatments of carrot seeds on seed-borne fungi, germination, emergence and yield treatment at 44°C to 59°C for 20 min was employed for controlling seed-borne pathogen *Alternaria dauci.* Hot water treatment of carrot seeds at 44, 49 and 54°C generally improved germination of infected seeds and

reduced the incidence of *Alternaria dauci*. They recommended hot water treatment as an alternative to fungicide to eradicate seed-borne pathogens in carrots in organic farming system.

Karunaratne (1999) reported that the effect of hot water treatments (different temperature, time combination) of tomatoes, cucumbers and *Momordica charantia* (55°C for 1 min), *Capsicum annuum* (Chillis), carrots (50°C for 1 min), *Phaseolus vulgaris* (50°C for 30S) and okras (52°C for 30S) on the shelf life of each commodity at room temperature, (27±3°C) and relative humidity (65±5%). No disease symptom was developed from the treated seeds.

Satvinder and Kahur (2000) reviewed some physical techniques such as dry heat, hot water, solar heat, washing, radiation, microwave treatment, ultrasonic waves and forced air circulation for the management of plant disease including post harvest disease.

Nega *et al.* (2000) stated that five important vegetable crops (carrot, cabbage, parsley lamb's lettuce) and their most important seed-borne pathogens (*Alternaria* spp., *Phoma* spp., *Septoria* spp., *Xanthomonas* spp., *Peronspora valerianellae*) have been investigated in laboratory with hot water treatments at 40°C & 50°C to 55°C for 10 to 30 min, in some cases to 60 min and found no infected seeds from those vegetables. Seed-borne pathogens could be reduced without significant losses of germination by hot water treatments at 50°C for 20 to 30 min up to 53°C for 10 to 30 min.

Winter *et al.* (2001) stated that the incidence of common bunt *(Tilletia caries)* in winter wheat was strongly reduced by a seed

treatment with skim milk powder and warm water. The combined seed treatment with warm water at 45°C for 2 hours and skim milk powder (160 g / litre water) controlled the seed-borne infection of *Tilletia caries* (common bunt), *Garlachia nivalis*, (Snowmould), *Fusarium graminearum* and *Septoria nodorum* (damping off) in winter wheat.

Muniz (2001) stated that the dry heat treatment on the control of seed transmitted pathogens and its effects on the viability of tomato seeds treated at 70°C for 12 days eradicated fungi associated with tomato seeds. But in hot water treatment at 50°C for 30 minutes under laboratory research the associated fungi in tomato seeds were eradicated.

Sadek *et al.* (2001) stated that hot water treatment at 10°C for 10 minutes with potassium permanganate (1%) or copper sulfate (1%) application effectively controlled the pathogen in infected seeds of tomato, tobacco, cowpea, bean and pepper. By this treatment irregular necrotic spots were controlled effectively.

Fallik *et al.* (2002) studied the effectiveness of a short pre-storage hot water rinsing and brushing on resistance to decay development and chilling injury on pink tomato cv. 189 fruit that were kept for 15 days at 5 or 12° C plus three days at 22°C. He suggested the alternative method of a very short (15S) HWRB (Hot Water Rinsing & Brushing) at 52°C for desirable tomatoes. This treatment extended storability well over three weeks at 5°C by minimizing CI (Chilling Injury) and enhancing resistance against pathogen during storage.

Jiskani (2002) reported that the brown spot or blight of rice is a much more wide spread and a common disease in almost all rice growing area of the world. He prescribed that brown spot or blight of rice caused by *Helminthosporium oryzae* effectively controlled by hot water seed treatment at 54° C for 10 minutes.

Willium Nesmith (2003) at Ohio State University found hot water treatment effective against the major seed borne diseases of vegetables. He found effective temperature of 122°F (49.95°C) for 25 min for brussels sprouts, cabbage, eggplant, tomato and spinach; 122°F (49.95°C) for 20 min for broccoli, cauliflower, chinese cabbage, carrot, kale, kohlrabi and turnips; 122°F (49.95°C) for 1-5 min for mustard and radish; 125°F (51.6°C) for 30 min for peppers and 118°F (47.73°C) for 30 min for lettuce and celery.

Saila Yesmin (2007) carried out an experiment to control leaf blight of wheat where different seed treatments and foliar fungicides were used and the treatments were differed significantly. Among the different seed treatments hot water treatment of apparently healthy seeds was found to be the best in reducing leaf blight infection, increased seed germination and seed yield.

2.1.5. Seed treatment with chemicals

Mironova (1991) tested nine seed treating chemicals in controlling seed borne infection of *Bipolaris sorokiniana* and *Fusarium* spp. where Vitavax was the most effective in reducing seed borne infection of these pathogens.

Dey *et al.* (1992) reported the efficacy of certain seed treating chemical against *Drechslera* spp., *Alternaria* spp. and *Fusarium oxysporum* detected in black pointed wheat seeds. They observed that Vitavax-200 showed the best performance in controlling the above organisms followed by Tecto M and Bayten 10 DS.

Hyder-Ali and Fakir (1993) conducted an experiment by treating seed with Dithane M-45, Granosan M, Homai 80 WP, Panoctine CG/450, Vitavax-200 and Vitavax-300 to control seed borne fungi of wheat. They observed that all the fungicides reduced seed borne infection of *Alternaria tenuis, Aspergillus flavus, Bipolaris sorokiniana, Curvularia lunata* and *Fusarium semitectum* but complete control of *A. tenuis, B. sorokiniana, C. lunata* and *F. semitectum* were obtained by Vitavax-200,Vitavax-300 and Panoctine CG/450 when used @ of 0.5% of seed weight. Vitavax-200 and Dithane M-45 increased germination of seeds.

Gaur (2003) evaluated twenty one fungicides combined with hot water treatment in the field against seed borne inoculums of *Ascochyta rabiei* in chickpea. Four-hour seed dip in 0.2% thiabendazole solution significantly controlled seed-borne infection of *A. rabiei* with no deleterious effect on germination (88.6%). This treatment gave minimum number of diseased plant (2.9%) at flowering stages.

Kabir (2003) reported that the germination test of farmer's seed treated with Vitavax-200 resulted the highest percentage of germination, followed by soaked washed clean seed. Seedling emergence in seedbed was significantly higher (21.35%) in soaked washed cleaned seed than all other treatment (untreated farmer's seed, cleaned seed, washed farmer's seed, soaked washed farmer's seed, washed clean seed, and chemical

treatment of farmer's seed with Vitavax-200). The Vitavax-200 treated seed significantly resulted the highest plant height, panicle length and seed yield (5.88 tons/ha), which was 18.07% higher over the use of untreated farmer's seed; while soaked washed cleaned seed and washed cleaned seed gave 16.47%, 14.86% increased seed yield, respectively. Maximum numbers of apparently healthy seeds were obtained by using farmer's seed treated with Vitavax-200 (76.24%) followed by soaked washed cleaned seed (70.47%) over untreated farmer's seed (57.69%).

Uddin (2005) reported that seed borne pathogens were significantly reduced by treating seeds with Vitavax-200 followed by garlic extract, brine solution, hot water and physically sorted seeds in Lentil. The highest reduction of seed borne fungal flora were observed in case of Vitavax-200 followed by garlic extract, brine solution, hot water and physically sorted seeds. In the field condition, germination percentage was higher in physically sorted seeds.

Islam (2005) reported that phomopsis blight and fruit rot of egg plant could be contribute by seed treatment with Bavistin 50WP increasing germination.

CHAPTER-3

MATERIALS AND METHODS

MATERIALS AND METHODS

This chapter represents a short description about the experimental site, soil, climate, design, treatments, cultural operations, collection and preparation of plant samples and statistical analysis followed in the conduction of the experiment.

3.1. Laboratory experiment

The experiment was conducted in the Seed Health Laboratory, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, during the period from September 2007 to November 2007.

3.1.1. Treatments

There were twelve treatments namely:

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50WP

T_{12}= Apparently healthy seed treated Bavistin 50WP

3.1.2. Collection of seeds

Wheat seeds of Kanchan variety were collected from a farmer named Mahmudul Haque of Village: Raja Rampur, Thana: Fulbari, District Dinajpur.

3.1.3. Preparation of the seed sample for different treatments

3.1.3.1. Sorting of apparently healthy seeds

Apparently healthy seeds were obtained by manual separation of seeds from the contamination and abnormal seeds of the lot of original farmer stored seeds (Plate-1).

3.1.3.2. Seed treatment with brine solution

At first 2% brine solution was prepared by mixing 100 ml tap water with 2g edible salt (NaCl) and seeds were soaked in the solution for 1 hour. After treating seeds the excess water was removed and the seeds were air dried in the laboratory prior to sowing.

3.1.3.3. Seed treatment by sun drying

Apparently healthy and farmer's saved seeds were sun dried for 15 hours before sowing.

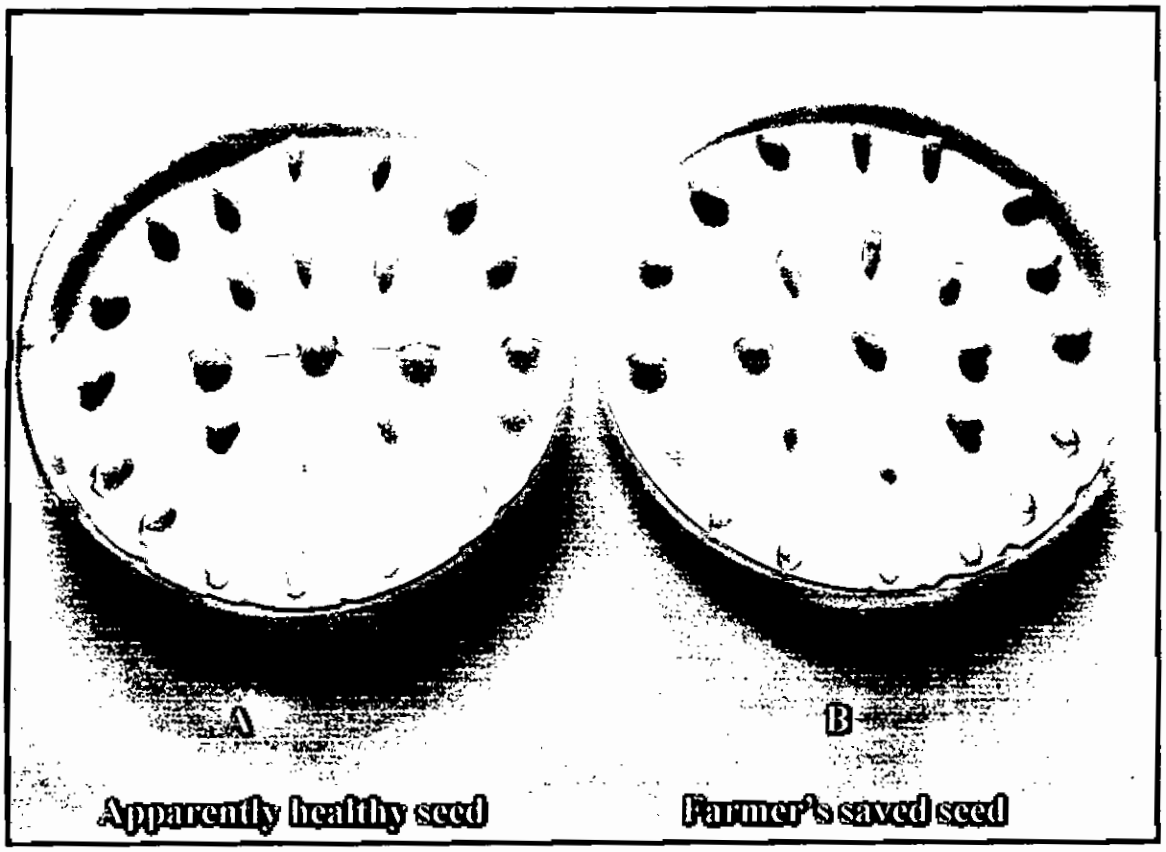

Plate 1: Apparently healthy seed and Farmer's saved seed

3.1.3.4. Seed treatment by polythene solarization

Apparently healthy and farmer's saved seeds were covered by transparent polyethylene paper and sun dried for 15 hours before sowing.

3.1.3.5. Seed treatment with hot water

Apparently healthy and farmer's saved seeds were treated with hot water at 52-56^{0}C for 20 minutes. After treating seeds the excess water was removed and the seeds were air dried in the laboratory prior to sowing.

3.1.3.6. Seed treatment with Bavistin 50 WP

Seeds were taken in a beaker and the specific amount of chemical was added into the seeds. The chemical was mixed thoroughly by a stick. Both apparently healthy seeds and original farmers saved seeds were treated with Bavistin 50 WP (0.3%)

3.1.3.7. Seed health study

Health status of the treated and untreated seeds was done following ISTA rules (ISTA, 1999). In this method 3 layers of blotter were soaked in sterilized water and placed at the bottom of the glass petridish. Then 25 seeds were set up on the blotting paper in a petridish maintaining equal distance and covered with lid. Seeds thus plated were incubated in an air cooled room at about 20^{0}C temperature for 7 days in Seed Pathology Laboratory, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka. After 7 days of incubation the seeds were observed for the presence of seed-borne *Bipolaris sorokiniana* fungi under stereo binocular microscope (Plate-2). Germination of the seeds was also recorded.

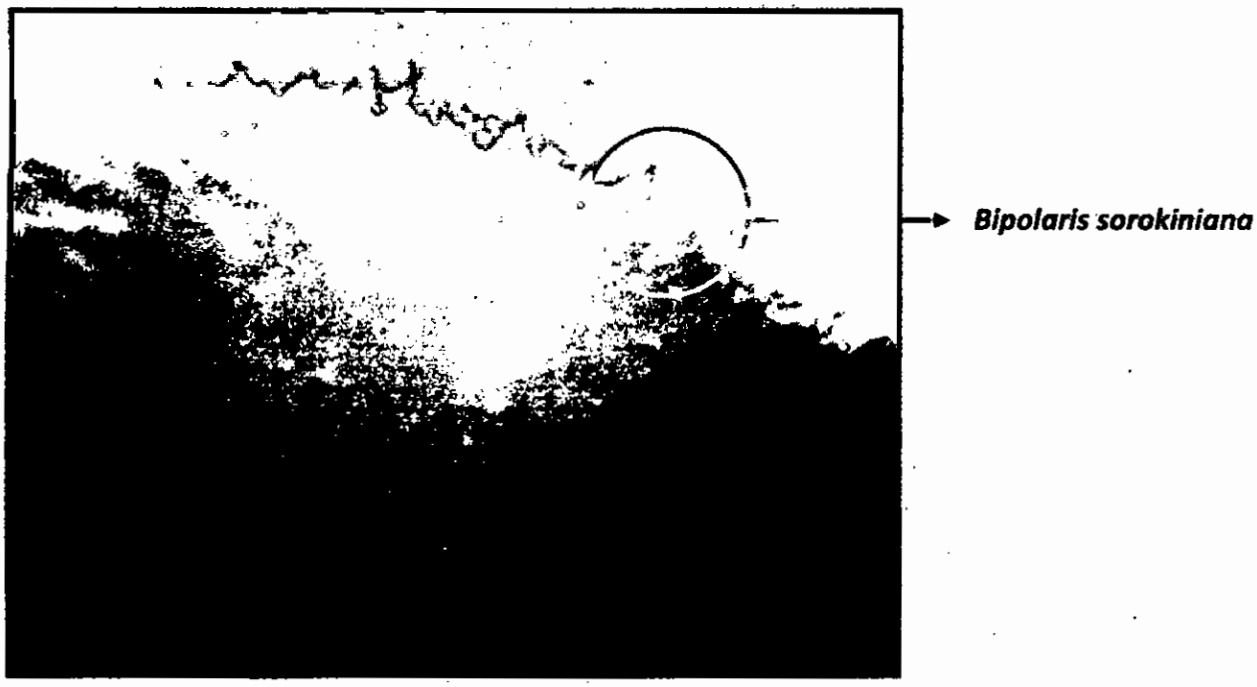

Plate 2: *Bipolaris sorokiniana* incubated on wheat seed under stereomicroscope(45x)

3.2. Field experiment

3.2.1. Experiment site and experimental period

The experiment was conducted at Sher-e-Bangla Agricultural University Farm, Dhaka-1207 during the period from December, 2007 to April 2008. The experimental field was located at 90°22′ E longitudes and 23°41′ N latitude at an altitude of 8.6 meters above the sea level. The following map shows the specific area of experimental site (Fig.1.)

3.2.2. Soil properties

Soil properties of the Experimental site were as follows:

Agro-ecological region: Madhupur Tract (AEZ -28)

Land Type	: Medium high land
General soil type	: Non-Calcareous Dark gray floodplain soil
Soil series	: Tejgaon
Topography	: Up land
Elevation	: 8.45
Location	: SAU Farm, Dhaka
Field level	: Above flood level
Drainage	: Fairly good
Firmness	: Compact to friable when dry

The soil of experimental site was analyzed in Soil Resource Development Institute (SRDI), Dhaka and details of the soil characteristics are shown in Table -1.

Table 1. Morphological, physical and chemical characteristics of soil of experimental field (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
Phosphorus (%)	0.0015
Potassium (%)	0.0053
Sulphur (%)	0.0017

(source: Bhuiyan, 2005)

Doses of fertilizer were used considering existing nutrient of the field soil mentioned below as BARC fertilizer recommendation guide:

Fertilizer	Doses
Cow dung	10 tons /ha
Urea	220 Kg /ha
TSP	180 Kg /ha
MP	50 Kg /ha
Gypsum	120 Kg

3.2.3. Treatments

There were twelve treatments as described in the laboratory experiment (3.1.2).

There will be twelve treatments namely:

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50WP

T_{12}= Apparently healthy seed treated Bavistin 50WP

3.2.4. Design of experiment

The experiment was laid out in Randomized Complete Block Design (RBCD) compromising three replications for each treatment. Each block was divided into 12 unit plots in which treatments were applied at random and there were 36 unit plots in the experiment. The size of the each plot was 2.4m x 4m and each plot was separated by 0.75 m wide drain and the distance between the blocks were 1.0 m (Plate- 3).

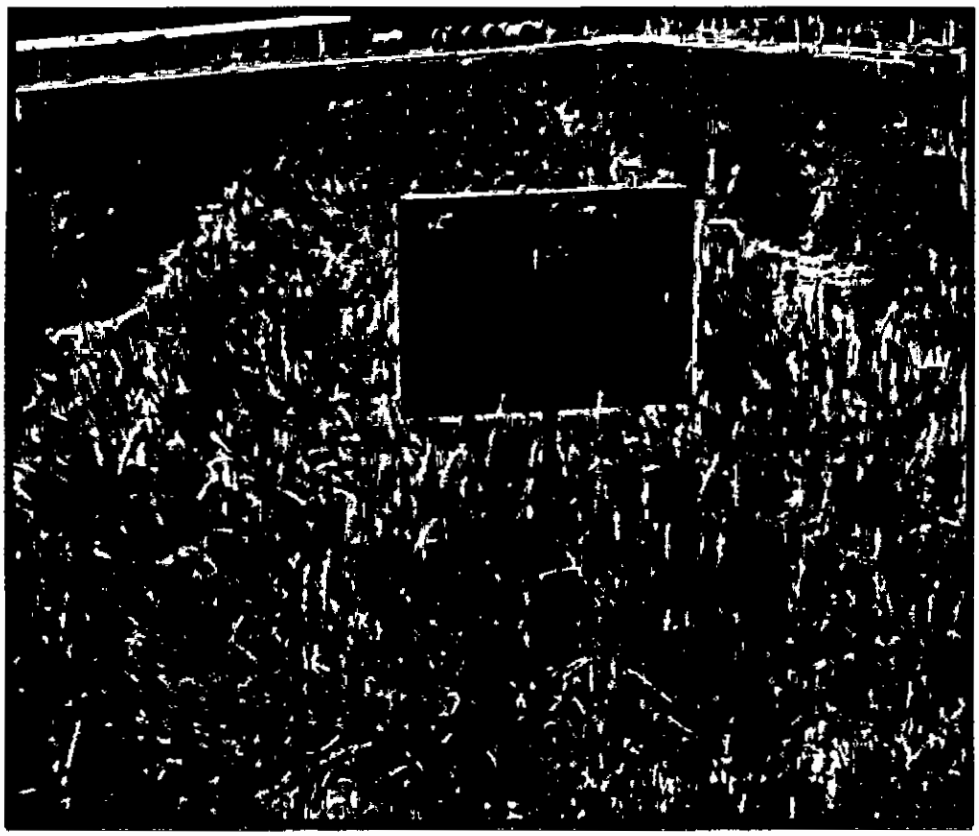

Plate 3: Experimental site of Sher-e-Bangla Agricultural University

3.2.5. Land preparation

The experimental field was thoroughly ploughed and cleaned prior to seed sowing and application of fertilizers and manure in the field. The experimental field was well prepared by ploughing followed by laddering to have a good tilth. Weeds and stubbles were removed, and large clods were broken into smaller pieces to obtain a desirable tilth of soil for sowing of seeds. Finally, the land was levelled and the experimental plot was partitioned into unit plots.

3.2.6. Application of fertilizers

The field was fertilized at the rate of 220 Kg urea, 180 Kg TSP, 50 Kg MP, 120 Kg Gypsum and 10 tons cow dung per hectare (Krishi Projukti Hatboi, 2005). Two third of urea, full dose of TSP, MP, Gypsum and cow dung were applied at the time of final land preparation. Remaining one third of urea was applied at 21 days after seed sowing.

3.2.7. Preparation of seed sample for different treatments

Sorting of apparently healthy seeds, seed treated with brine solution, sun drying, polythene solarization, hot water, Bavistin 50WP were done following the method as described in laboratory experiment (3.1.2).

3.2.8. Sowing of seeds

Wheat seeds were sown in the field on 5th December 2007 at the rate of 120 Kg\ha. The seeds were sown in broadcast method and covered by soil with the help of hand.

3.2.9. Intercultural operation

Irrigation was done once after 25 days and another after 45 days of sowing. Irrigation was generally followed weeding of the crops. Weeding was performed twice during the growing period of the crop for better soil aeration and conservation of soil moisture. The common weeds were *Cynodon dactylon* L. (Durba grass), *Cyperus rotundus* L. (Mutha) and *Chenopodium album* L. (Bathua). Weeding was done carefully keeping the delicate young plants undisturbed.

3.2.10. Plant protection activities

Special care was taken for 12 days after sowing to protect the crop from birds especially at sowing and germination stages and ripening stage of the crop.

3.2.11. Tagging for data collection

Randomly thirty plants were selected from each plot and tagged. So, 30 plants /plot were tagged for rating and mean values were determined to get rating score of the material of each treatment.

3.2.12. Evaluation of leaf blight severity

Leaf blight severity of 1st leaf and 2nd leaf was recorded in five growth stages of plant viz. flag leaf stage, panicle initiation stage, flowering stage and hard dough stage (plate-4). The severity of leaf blight disease was

recorded following 0-5 grade (plate-5) (Hossain and Azad, 1992). The grades are as follows:

0= No infection (Highly resistant)

1= Few minute lesions on leaves (Resistant)

2= Black lesion with no distinct chlorotic halos covering $\leq$10% of the leaf area (Moderately resistant).

3= Typical lesions surrounded by distinct chlorotic halos covering 10-50 % of the leaf area (Moderately susceptible).

4= Severe lesions on leaves with ample necrotic zones drying over part of the leaf, covering $\geq$50 % of the leaf area (Susceptible).

5= Severe infection, drying of the leaf spike infected to some extend (Highly susceptible).

3.2.13. Recording data on number of spike/m^2

Data on number of spike/m^2 was taken at the time of ripening stage.

3.2.14. Harvesting

The crop was harvested at full ripening stage on 30 March 2008.

Plate 4: Symptoms of Leaf blight of wheat

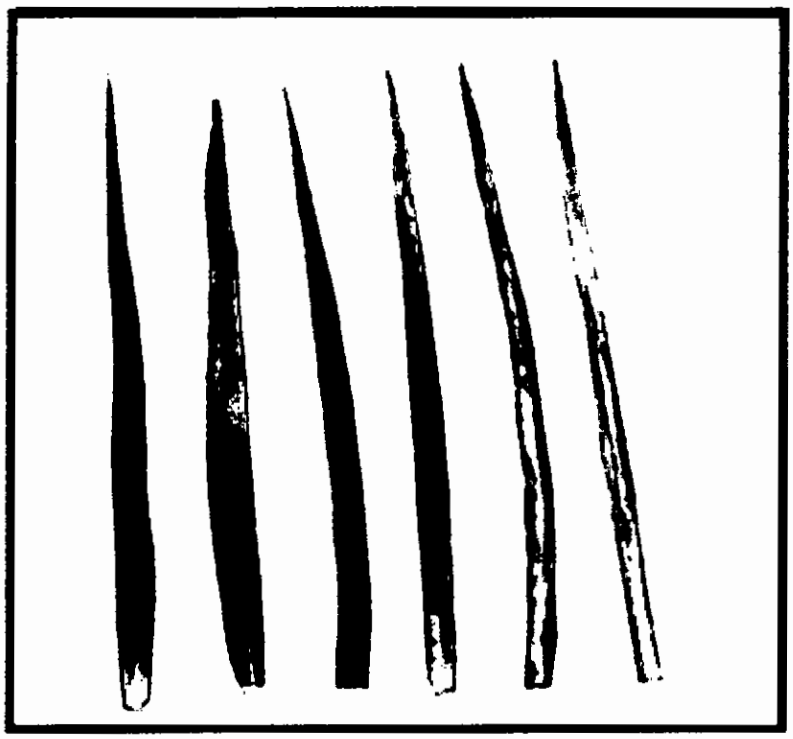

Plate 5: Different grading (0-5) of leaf blight severity of wheat

3.2.15. Isolation and identification of pathogen

Isolation and identification of pathogen were made by two ways-

a. By direct inspection

b. By inoculating sample tissue on PDA medium

(a) By direct observation

The diseased leaves of wheat plants were collected and kept in polythene bags and tagged. The samples were then taken to the laboratory. Then slides were prepared from the diseased samples, observed under microscope and the pathogen was identified according to CMI description.

(b) By growing on PDA medium

The diseased leaves were collected and were taken to the laboratory. The leaves were then cut into small pieces (about 0.5 cm) with diseased portion and surface sterilized with $HgCl_2$ solution (0.01%) for 30 second. The cut pieces were then washed in water at three times and were placed onto PDA medium in petridish. The plates were then incubated at 25 ± 1^0C for 7 days. Later the pathogen was purified using hyphal tip culture method and grown on PDA media at 25 ± 1^0C for 2 weeks and identified as *Bipolaris sorokiniana* with the help of relevant literature (CMI Description).

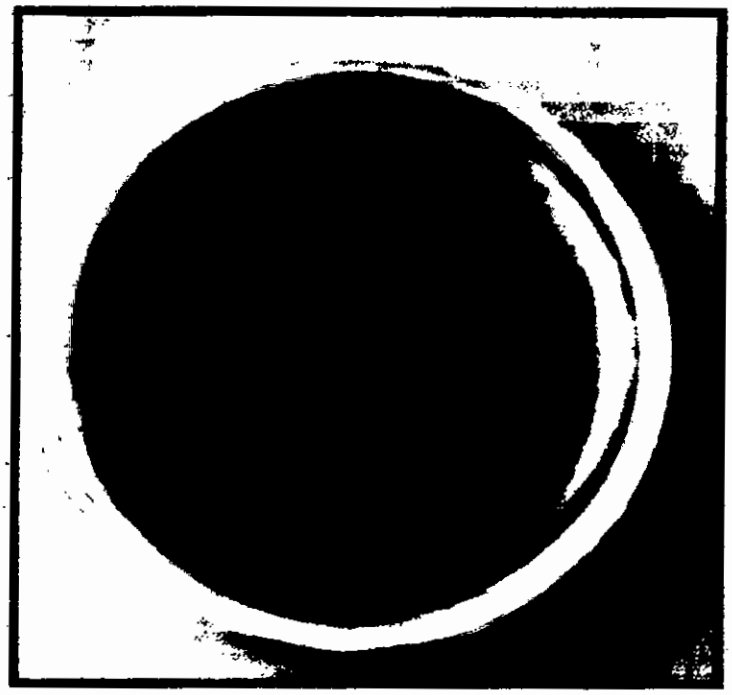

Plate 6: Pure culture of Bipolaris sorokiniana

Plate 7: Conidia of Bipolaris sorokiniana was observed under compound microscope (X100)

3.2.16. Collection of data on yield and contributing characters

Data on plant growth and yield contributing characters were recorded from the randomly selected 30 tagged plants of each unit plot on the following parameters.

i. Plant height (cm)
ii. Length of ear (cm)
iii. Length between the point of flag leaf initiation and base of 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 grain weight (g)
xiv. Grading of seeds /ear (0-5)
xv. Grain yield /plot (Kg)
xvi. Grain yield (t /ha)
xvii. Straw yield /plot (Kg)
xviii. Straw yield (t /ha)

3.2.17. Grading of seeds

The grading of seeds was done following the 0-5 rating scale(plate-8). The rating scale is as follows:

0= Free from infection

1= Only embryo blackish

2= Embryo and its adjacent area slightly infected

3= Embryo and less than ¼ of grains are discolored

4= Embryo and ½ of grain are infected

5= Grains are shrivelled, almost completely discolored or more than ½ of grains were discolored.

3.2.18. Analysis of data

The data on various parameters were analyzed using analysis of variance to find out variation obtained from different treatments. Treatment means were compared by DMRT (Duncan's Multiple Range Test).

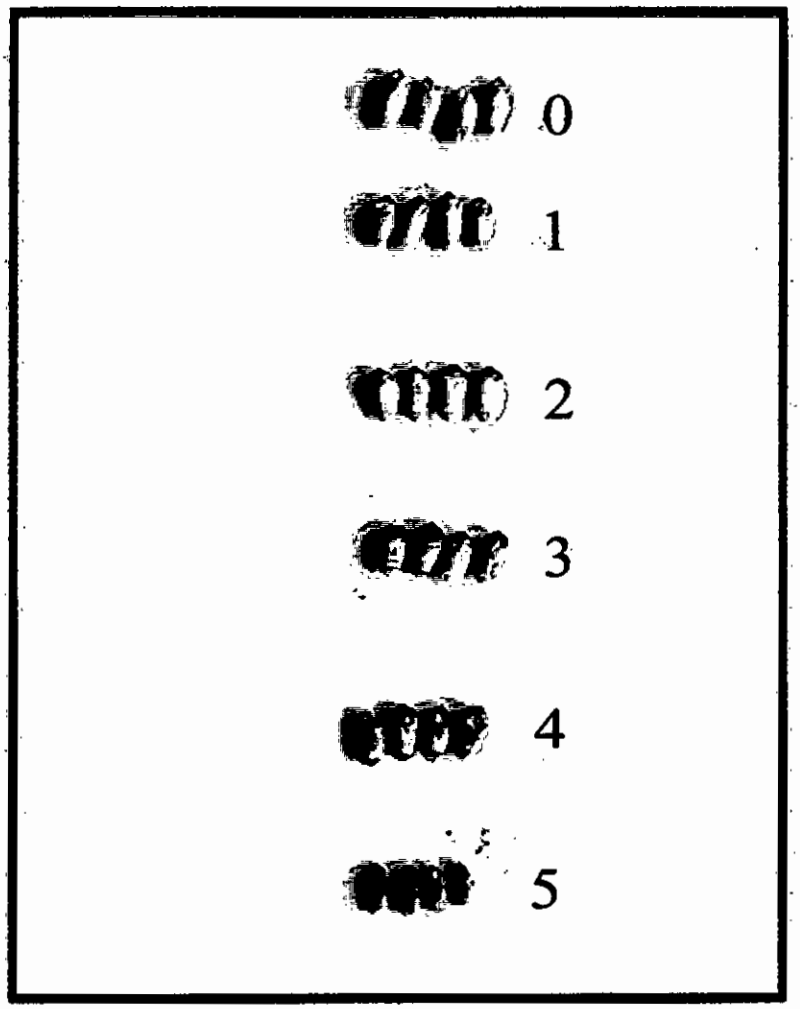

Plate 8: Different grading of (0-5) of wheat seeds

CHAPTER-4

RESULTS

RESULTS

4.1. Laboratory experiment

In laboratory experiment under *in vitro* condition, results on the effect of chemicals and some selected eco-friendly seed treatments in controlling seed borne infection of *Bipolaris sorokiniana* and seed germination was presented in Table-2. Significant variation was found in percentage of seed germination among the treatments. The highest (98.20%) seed germination was counted in the treatment T_{12} (apparently healthy seeds treated with Bavistin 50 WP) which was significantly higher than all other treatment (90.67%). The lowest seed germination (76.57%) was counted in farmer's saved seed (T_1). Among the other treatments methods, T_{11}(farmer's saved seed treated with Bavistin (50 WP) gave 87.39% seed germination which was followed by T_{10} (85.59%), T_7 (85.58%) and T_6 (84.83%).So, it is observed that the prevalence of *Bipolaris sorokiniana* varied significantly depending on the different seed treatment methods.

The incidence of *Bipolaris sorokiniana* was counted the heighest in untreated seeds (24.40%) which differed significantly from all other treatments. Among all the treatments, T_{12} (apparently healthy seed treated with Bavistin 50 WP) yielded the lowest prevalence (2.20%) of *Bipolaris sorokiniana* which was 90.73% less than untreated ones control (T_1)

Table 2. Effect of eco-friendly seed treatments on seed germination and seed yielding *Bipolrais sorokiniana* of wheat in the laboratory.

Treatments	% Germination	% Incidence of *Bipolaris sorokiniana*	% Incidence decreased over control
T_1	76.57 j	24.40 a	-------
T_2	82.53 h	8.26 b	66.15
T_3	81.23 i	7.67 c	68.56
T_4	84.23 f	5.98 de	75.49
T_5	83.47 g	7.31 c	70.00
T_6	84.83 e	5.68 e	77.13
T_7	85.58 d	6.40 d	73.77
T_8	90.67 b	5.02 f	79.43
T_9	81.44 i	7.36 c	69.84
T_{10}	85.59 d	5.68 e	76.72
T_{11}	87.39 c	5.11 f	79.05
T_{12}	98.20 a	2.26 h	90.73
LSD(0.01)	0.38	0.55	----

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated with Bavistin 50 WP

which was closely related to treatment T_{11} (5.11%) which was statistically similar with treatment T_8 (5.02%). Incidence of *Bipolaris sorokiniana* was also reduced over treatment T_1 when farmer's seed as well as physically sorted seeds were treated with brine solution, sun drying, hot water and polythene solarization.

Apparently healthy seeds obtained by manual seed sorting reduced 66.15% incidence of *Bipolaris sorokiniana* over untreated control. Apparently healthy seed, brine solution and polythene solarized seeds also gave good results in reducing the incidence of *Bipolaris sorokiniana* in comparison to control.

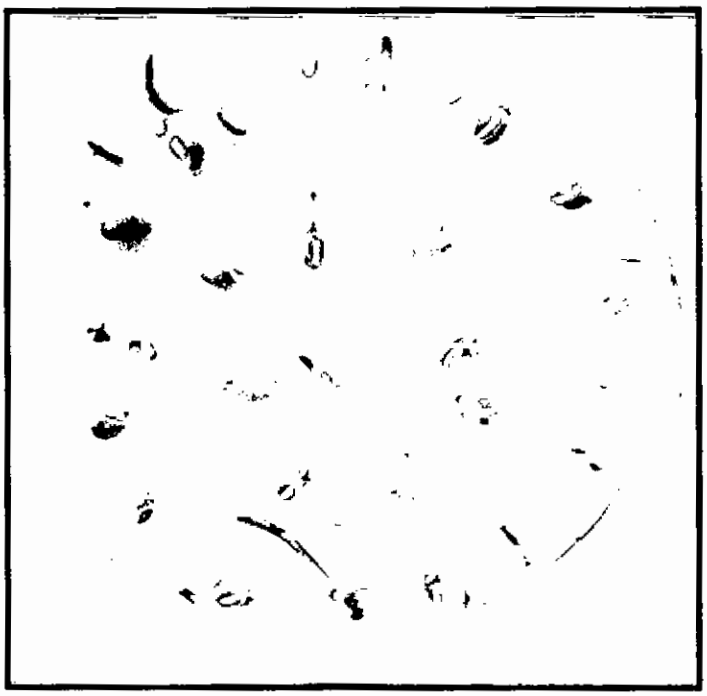

Plate 9: Apparently healthy seed (T_{12}) treated with Bavistin 50 WP in blotter method

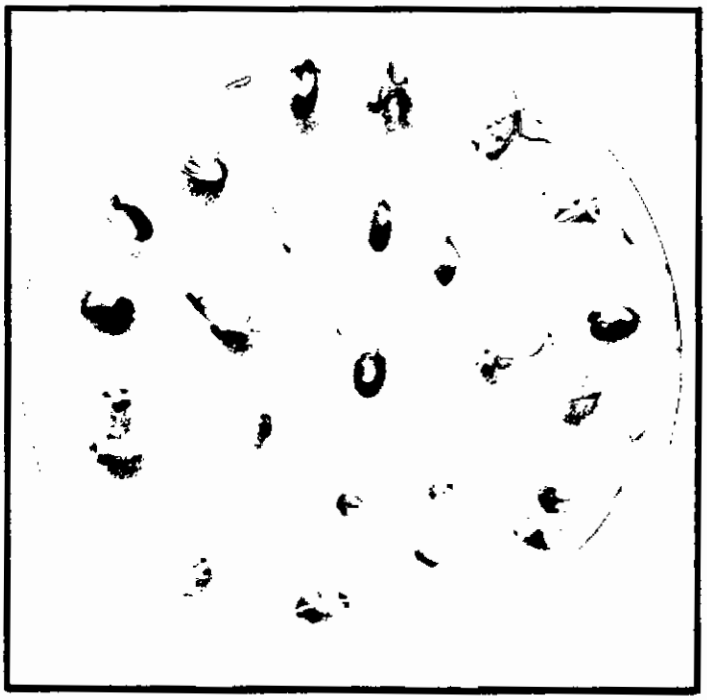

Plate 10: Farmers saved seed (T_1) in blotter method

4.2. Field experiment

4.2.1. Effect of eco-friendly seed treatments on seedling emergence and plant growth of wheat

Germination of wheat seedling was counted at 10 and 15 days after sowing (DAS) of seeds. Significant difference was found among all the treatments on seed germination compared to control (Table-3). The results showed that the highest germination was recorded 84.89% and 88.95% at 10 and 15 DAS, respectively in the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP). The second highest seed germination (80.90% and 85.59%) were recorded in case of treatment T_{11} (farmer's saved seed treated with Bavistin 50 WP) at 10 DAS and 15 DAS, respectively. Among the other eco-friendly seed treatments, T_8 (apparently healthy seed treated with hot water) gave the highest 84.23% germination followed by T_6, T_7, T_{10} and T_2.

Table 3. Effect of eco-friendly seed treatment on germination, plant height, spike length and length between panicle initiation and tip of spike of wheat.

Treatments	% Germination		Plant height (cm)	Spike length (cm)	Distance between the point of flag leaf initiation and base of ear (cm)
	10DAS	15DAS			
T_1	49.42 j	59.27 j	78.48 i	13.32	13.25
T_2	68.39 f	74.91 e	81.23 gh	14.01	14.00
T_3	53.92 i	60.48 i	80.60 gh	13.56	13.30
T_4	55.90 h	66.63 g	84.62 h	13.68	13.67
T_5	64.59 g	69.19 f	82.60 fg	13.67	13.73
T_6	71.89 h	76.28 d	86.55 bc	13.74	14.86
T_7	69.67 e	75.09 d	85.40 cd	13.75	14.31
T_8	79.49 c	84.23 c	87.95 ab	14.40	14.98
T_9	55.58 h	61.19 h	83.45 ef	13.54	13.86
T_{10}	64.59 g	75.98 e	84.60 de	13.89	13.87
T_{11}	80.98 b	85.59 b	88.50 b	14.03	14.29
T_{12}	84.89 a	88.95 a	89.32 a	14.93	14.99
LSD(0.01)	0.38	0.39	0.38	NS	NS

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated with Bavistin 50 WP

Plant height varied from 78.48 to 89.32 cm among the treatments. The highest plant height (89.32 cm) was recorded under the treatment T_{12} (apparently healthy seeds treated with Bavistin 50 WP) which was statistically identical with the treatment T_{11} (farmer's saved seed treated with Bavistin 50 WP) that showed 88.97 cm plant height. On the other hand the lowest plant height (78.48 cm) was recorded in the treatment T_1 (farmer's saved seed). The results showed that the plant height of treatments T_8 (87.95 cm) was close to that of treatment T_6 (86.55 cm), T_7 (85.40 cm), T_{10} (84.60 cm), T_9 (83.45 cm) , T_4 (82.60 cm),T_9 (83.45 cm) and T_2 (80.60 cm).The spike length did not show any significant variation among the treatments . However, the highest and the lowest spike length was obtained under the treatments T_{12} (14.93 cm) and T_1 (13.32 cm), respectively. Bavistin 50 WP treated seed gave the maximum spike length . The distance between the point of flag leaf initiation and the base of ear revealed insignificant regarding the treatments.

4.2.2. Effect of eco-friendly seed treatment on leaf blight severity of wheat at panicle initiation stage

Disease severity of wheat at panicle initiation stage on flag leaf, penultimate leaf slightly varied significantly and ranged from 0.00 to 0.20 in flag leaf and 0.02 to 0.30 in penultimate leaf. The lowest disease severity was found in the treatment T_{12} (apparently healthy seed treated Bavistin 50 WP), which was 0.00 and 0.02, respectively for flag leaf and penultimate leaf. On the contrary the highest disease severity was recorded under the treatment T_1(farmer's saved seed) which was 0.20 and 0.30, respectively for the flag leaf and penultimate leaf. The average

disease severity of flag leaf and penultimate leaf, ranged from 0.01 to 0.25 where the highest and lowest disease severity was recorded under the treatments T_1 and T_{12}, respectively. Among the eco-friendly seed treatments, T_{12} (apparently healthy seed treated with hot water) gave good results which was closely related to treatment T_{11} (farmer's saved seed treated with Bavistin 50 WP). The treatments T_6, T_7, T_5, T_{10}, T_4 also significantly reduced leaf blight severity over untreated control (Table-3). Moreover, manually sorted apparently healthy seeds (T_2) significantly reduced leaf blight severity over untreated control (Farmer's saved seed, T_1).

4.2.3. Effect of eco-friendly seed treatment on leaf blight severity of wheat at flowering stage

Disease severity of wheat at flowering stage on flag leaf, and penultimate leaf varied significantly and ranged from 0.0 to 0.30 and 0.06 to 0.50. respectively. The lowest disease severity was found in the treatment T_{12} (apparently healthy seed treated Bavistin 50 WP), which were 0.02 and 0.06, respectively. On the contrary the highest disease severity was recorded under the treatment T_1 (farmer's saved seed) which was 0.30 and 0.50, respectively. The average disease severity of flag leaf and penultimate leaf, ranged from 0.06 to 0.50 where the highest and the lowest disease severity was recorded under the treatments T_1 (0.50) and T_{12} (0.06), respectively. Rest of the treatments also significantly reduced leaf blight severity over untreated control (Table-5). Moreover, hot water and sundried treated apparently healthy seeds significantly reduced leaf blight severity over untreated control T_1 (farmer's saved seed,) .

Table 4. Effect of eco-friendly seed treatment on leaf blight severity of wheat at panicle initiation stage.

Treatments	Disease severity at panicle initiation		
	Flag leaf	Penultimate leaf	Average
T_1	0.20 a	0.30 a	0.25 a
T_2	015 ab	0.20 b	0.18 ab
T_3	0.12 bc	0.14 bc	0.13 bc
T_4	0.10 bcd	0.10 cde	0.10 bcd
T_5	0.08 cde	0.12 cd	0.11 bcd
T_6	0.06 de	0.10 cde	0.11 bcd
T_7	0.05 def	0.10 cde	0.08 bcd
T_8	0.03 ef	0.08 cde	0.04 cd
T_9	0.10 bcd	0.14 bc	0.12 bc
T_{10}	0.08 cde	0.10 cde	0.10 bcd
T_{11}	0.02 ef	0.04 de	0.03 cd
T_{12}	0.00 f	0.02 e	0.01 d
LSD(0.01)	0.054	0.073	0.093

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated with Bavistin 50 WP

Table 5. Effect of eco-friendly seed treatment on leaf blight severity of wheat at flowering stage.

Treatments	Disease severity at flowering stage		
	Flag leaf	Penultimate leaf	Average
T_1	0.30 a	0.50 a	0.40 a
T_2	0.20 b	0.25 b	0.23 b
T_3	0.15 bc	0.18 bc	0.22 b
T_4	0.12 cd	0.16 cd	0.14 cd
T_5	0.14 c	0.18 bc	0.16 bc
T_6	0.08 def	0.12 cde	0.10 cde
T_7	0.10 cde	0.14 cde	0.11 cde
T_8	0.06 efg	0.10 cde	0.08 cde
T_9	0.15 bc	0.16 cd	0.15 bc
T_{10}	0.10 cde	0.12 cde	0.11 cde
T_{11}	0.05 fg	0.08 de	0.06de
T_{12}	0.02 g	0.06 e	0.03 e
LSD(0.01)	0.054	0.073	0.076

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated with Bavistin 50 WP

4.2.4. Effect of eco-friendly seed treatment on leaf blight severity of wheat at milking stage

The effect on disease severity of wheat at milking stage on flag leaf and penultimate leaf sharply varied among the treatments and ranged from 0.07 to 0.74 in flag leaf and 1.63 to 0.11, in penultimate leaf, respectively (Table-7). The average disease severity of flag leaf and penultimate leaf ranged from 0.10 to 1.21 where the highest and lowest disease severity was recorded under the treatments T_1 (1.21) and T_{12} (0.10), respectively. The second lowest severity was recorded in treatment T_{11} (0.14) followed by T_8, T_6, T_{10}, and T_9,

4.2.5. Effect of eco-friendly seed treatment on leaf blight severity of wheat at hard dough stage

A sharp and significant differences on disease severity of wheat at hard dough stage on flag leaf, and penultimate leaf were observed owing to the different treatments that ranged from 0.17 to 1.52 in flag leaf and 0.58 to 2.35 in penultimate leaf. The treatments showed promising effect in reducing disease severity over control. The average disease severity of flag leaf and penultimate leaf ranged from 0.37 to 1.99 where the highest and lowest disease severity was recorded under the treatments T_1 and T_{12},

Table 6. Effect of eco-friendly seed treatment on leaf blight severity of wheat at milking stage.

Treatments	Disease severity at milking stage		
	Flag leaf	Penultimate leaf	Average
T_1	0.74 a	1.63 a	1.21 a
T_2	0.55 b	1.30 b	0.90 b
T_3	0.28 c	1.25 bc	0.76 c
T_4	0.20 c	1.18 c	0.72 c
T_5	0.16 de	0.95 d	0.55 e
T_6	0.09 ef	0.80 e	0.45 fg
T_7	0.15 def	0.60 g	0.38 h
T_8	0.08 ef	0.68 f	0.38 h
T_9	0.22 cd	0.65 fg	0.44 gh
T_{10}	0.15 def	0.70 f	0.42 gh
T_{11}	0.12 ef	0.15 h	0.14 i
T_{12}	0.07 f	0.11 h	0.10 i
LSD(0.01)	0.072	0.073	0.73

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated with Bavistin 50 WP

Table 7. Effect of eco-friendly seed treatment on leaf blight severity of wheat at hard dough stage.

Treatments	Disease severity at hard dough stage		
	Flag leaf	Penultimate leaf	Average
T_1	1.52 a	2.35 a	1.99 a
T_2	1.00 b	1.88 e	1.44 b
T_3	0.78 c	1.80 cd	1.29 c
T_4	0.75 cd	1.82 bc	1.24 cd
T_5	0.60 e	1.58 f	1.08 e
T_6	0.58 e	1.57 f	1.06 e
T_7	0.60 e	1.52 f	0.95 f
T_8	0.50 f	1.40 g	0.89 f
T_9	0.74 cd	1.73 de	1.29 d
T_{10}	0.70 d	1.66 e	1.18 d
T_{11}	0.21 g	0.72 h	0.47 g
T_{12}	0.17 g	0.58 i	0.37 h
LSD(0.01)	0.073	0.073	0.073

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated with Bavistin 50 WP

respectively (Table-7). The treatments T_{11}, T_8, T_7, T_6, and T_{10} also significantly reduced leaf blight severity over untreated control (T_1).

Moreover, hot water and sundried treated apparently healthy seeds significantly reduced leaf blight severity over untreated control (Farmer's saved seed, T_1).

4.2.6. Effect of eco-friendly seed treatments on number of tillers/ plant and number of spikelets /ear, number of healthy spikelets /ear and number of diseased spikelets /ear of wheat.

The number of tillers/plant the effects were differed significantly among the treatments (Table-8). The lowest number (6.01) of tillers/plant was recorded in T_1 treatment (farmer's saved seed) which was statistically similar to that of T_3 treatment (6.37). The highest number of tillers/plant (8.90) was recorded in the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP,0.3%) followed by T_8, T_{11}, T_6, T_7, T_5 and T_{10}.

Result obtained from number of spikelets /ear indicated that there were significant differences among the treatment (Table-8). Treatment T_{12} scored the maximum healthy spikelets (28.63) that was followed by treatment T_3 (26.52) whereas control gave minimum number of spikelets /ear (20.29). Among the rest of the seed treatments T_8 (apparently healthy seed treated with hot water) gave maximum count of spikelets/ear which was 25.40.

Table 8. Effect of eco-friendly seed treatment on number of tillers /plant, number of spikelets /ear, number of healthy spikelets /ear and number of diseased spikelets /ear of wheat.

Treatments	Number of tillers /plant	Number of spikelets /ear	Number of healthy spikelets /ear	Number of diseased spikelets /ear
T_1	6.01 g	21.42 h	19.11 i	1.63 a
T_2	7.12 de	22.03 fg	21.01 g	0.80 c
T_3	6.54 f	20.29 i	19.65 h	1.10 b
T_4	6.37 fg	21.95 g	21.55 f	0.55 d
T_5	6.38 fg	22.44 e	22.04 e	0.30 def
T_6	7.70 bc	23.72 d	23.45 d	0.20 ef
T_7	7.46 cd	23.68 d	23.38 d	0.25 ef
T_8	7.98 b	25.40 c	25.20 c	0.15 ef
T_9	6.52 f	21.26 h	20.75 g	0.40 de
T_{10}	6.95 e	22.39 ef	21.98 e	0.35 de
T_{11}	8.08 b	26.52 b	26.20 b	0.15 ef
T_{12}	8.90 a	28.63 a	28.52 a	0.05 f
LSD(0.01)	0.38	0.39	0.40	0.233

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated with Bavistin 50 WP

In case of number of health spikelets /ear, the effect of different treatments differed significantly. The highest number of healthy spikelets /ear was recorded (28.52) in case of treatment T_{12} (apparently healthy seeds treated with Bavistin 50 WP) followed by T_{11} (farmer's saved seed treated with Bavistin 50 WP) and T_{10} (apparently healthy seed treated with hot water). The lowest number of healthy spikelets /ear was recorded (19.11) in case of T_1 (farmers saved seed). Considering the number of diseased spikelets /ear different seed treatments did not differ significantly (Table-8).However, the highest number of diseased spikelets /ear (1.63) was recorded at the treatment T_1 (farmer's saved seed). On the other hand the lowest number of diseased spikelets /ear (0.05) was recorded at the treatment T_{12} (apparently healthy seed treated with Bavistin 50WP, 0.3%) followed by T_{11}, T_8, T_6, T_7, T_5, and T_{10} respectively.

4.2.7. Effect of seed eco-friendly treatments on grain formation and grain weight of wheat

In case of different eco-friendly and chemical seed treatment, number of grains/ear, number of healthy grains/ear, number of diseased grains/ear varied significantly (Table-9). The lowest number of grains/ear (31.18) was recorded under the treatment T_1 (farmer's saved seed). On the other hand the highest number of grains/ear (38.32) was recorded in the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP).

Table 9. Effect of eco-friendly seed treatments on grain formation and weight of grains of wheat.

Treatments	Number of grains/ear	Number of healthy grains/ear	Number of diseased grains/ear	Weight of grains/ear (g)	Weight of healthy grains/ear(g)	Weight of diseased grains/ear (g)
T_1	31.18 h	29.60 i	3.27 a	1.35 g	1.20 g	0.15 a
T_2	31.93g	30.10 h	1.25 b	1.45fg	1.30 f	0.06 bcd
T_3	31.35 h	29.87 hi	2.05 b	1.39 fg	1.25 fg	0.10 ab
T_4	32.12 fg	30.98 fg	1.14 b	1.48 ef	1.40 e	0.07 bc
T_5	32.37 f	33.20 e	0.83 cde	1.58 de	1.44 de	0.08 bc
T_6	34.94 d	33.89 d	1.05 bc	1.63 cd	1.50 cd	0.06 bcd
T_7	34.33 e	33.29 e	1.04 bc	1.67 bcd	1.55 bc	0.04 bcd
T_8	35.77 c	35.07 c	0.70 cd	1.75 ab	1.59 b	0.02 cd
T_9	32.23 fg	30.73 g	1.50 b	1.40 fg	1.40 e	0.05 bcd
T_{10}	34.49e	31.22 f	1.58 b	1.60 cd	1.48 d	0.07 bcd
T_{11}	37.05b	36.50 b	0.55 d	1.70 abc	1.60 b	0.02 cd
T_{12}	38.32a	38.03 a	0.29 d	1.80 a	1.70 a	0.01 d
LSD(0.01)	0.39	0.41	0.21	0.107	0.057	0.054

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated with Bavistin 50 WP

From these results it was observed that farmer's saved seed gave the lowest number of grain and chemically treated seed gave the highest number of grains. Though apparently healthy seeds (T_2) and farmer's saved seed (T_1) produced statistically similar number of grains/ear but the result differed significantly when apparently healthy seeds treated with hot water (T_8).

A significant variation was recorded among the treatment under the present trial considering number of healthy grains/ear (Table-9). The lowest number of healthy grains/ear (29.60) was recorded in the treatment T_1 (farmer's saved seed). On the other hand the highest number of grain healthy (38.03) was recorded in the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP) which was followed by T_{11}, T_8, T_6. From these results it was observed that Farmer's saved seed gave the lowest healthy grain in wheat and eco-friendly treated seeds, like hot water treated seeds and sun drying gave the highest number of healthy grains.

A significant variation was also recorded among the treatment under the present trial in number of diseased grain (Table-9). The highest number of diseased grains /ear (3.27) was recorded under the treatment T_1 (farmer's saved seed) and the lowest number of diseased grain (0.29) was recorded in the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP). From these results it was observed that farmer's saved

seed gave the highest diseased grains/ear of wheat. On the other hand eco-friendly measures, like hot water treated seeds and sun drying gave the minimum number of diseased grains.

Considering weight of grains/ear there were slightly significant variations found among the different methods of seed treatments (Table-9). However, the minimum weight of grains (1.35 g) was recorded in the treatment T_1 (farmer's saved seed) and the maximum weight of grains (1.80g) was recorded in the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP).

In case of healthy grains /ear there were slightly significant variations found among the different methods of seed treatments (Table-9).However, the minimum weight of healthy grains (1.20 g) was recorded in the treatment T_1 (farmer's saved seed) and the maximum weight of grains (1.70 g) was recorded in the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP).

In case of weight diseased grains /ear there were also less significant variations among the different methods of seed treatments (Table-9). But the maximum weight of diseased of grains/ear (.15 g) was recorded in the treatment T_1 (farmer's saved seed) and the minimum weight of diseased grains/ear (0.01g) was recorded in the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP).

4.2.8. Effect of eco-friendly seed treatments on the formation of grains of different grades of wheat

It was found that grading of seeds (0-5 scale) of wheat varied significantly among the treatments (Table-10). The highest number of grains under grade-0, was recorded in T_{12} (apparently healthy seed treated with Bavistin 50 WP, @ 0.3%), which was 37.99, followed by T_{11}, T_8, T_6, T_7, and T_{10} and the lowest was recorded in T_1 (farmer's saved seed), which was 28.30. The highest number of grade-1 grains/ear (0.90) was recorded in T_1 treatment and the lowest number of grade-1 grains/ear (0.24) was recorded in T_{12} treatment (apparently healthy treated with Bavistin 50 WP), which was followed by T_{11}, T_8, and T_6.

Considering grade-2 grains/ear the number of grains ranged from 0.03 to 0.71 where the highest and lowest counts were made under the treatments T_1 (0.71) and T_{12} (0.03), respectively.

Table 10. Effect of eco-friendly seed treatments on the formation different grades of wheat cv. Kanchan.

Treatments	Grading of seeds (0-5 scale)					
	0	1	2	3	4	5
T_1	28.31 g	0.90 a	0.713 a	0.41 a	0.22 bc	0.63 a
T_2	30.62 f	0.50 bc	0.22 de	0.15 c	0.11 de	0.33 b
T_3	30.06 f	0.53 b	0.19 de	0.17 c	0.09 de	0.31 b
T_4	30.92 f	0.45 c	0.15 ef	0.20 c	0.10 de	0.30 b
T_5	31.22ef	0.15 g	0.55 b	0.30 b	0.05 de	0.10 bc
T_6	33.89cd	0.20 fg	0.35 c	0.40 a	0.10 de	0.00 c
T_7	33.39 d	0.30 de	0.25 cde	0.30 b	0.05 cd	0.04 c
T_8	35.12bc	0.20 fg	0.30 cd	0.15 c	0.10 a	0.00 c
T_9	30.83 f	0.30 de	0.30 cd	0.40 a	0.50 cd	0.10 bc
T_{10}	32.76de	0.20 fg	0.24 cde	0.30 b	0.15 b	0.10 bc
T_{11}	36.26b	0.35 d	0.08 fg	0.04 d	0.30 de	0.02 c
T_{12}	37.99 a	0.24 ef	0.03 g	0.00 d	0.06 e	0.00 c
LSD(0.01)	38.33	0.073	0.11	0.089	0.10	0.23

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated with Bavistin 50 WP

In case of grade-3 grains/ear the number of grains ranged from 0.00 to 0.41 where the highest and lowest counts were made under the treatments T_1 (0.41) and T_{12} (0.00), respectively.

Considering grade-4 grains /ear it was found that the highest number of grains (0.22) was recorded in T_1 treatment and the lowest counts (0.06) was recorded in T_{12}.

In case of grade-5 grains (shrivelled and completely discolored) the number of grains differed significantly among the treatments. The highest number of grade-5 grains (0.63) was recorded in T_1 treatment (farmer's saved seed). No/least grade- 5 grains were observed in T_{12} treatment (apparently healthy seed treated with Bavistin 50 WP) which was followed by T_8, T_6 and also close to T_{11} (farmer's saved seed treated with Bavistin 50 WP).

4.2.9. Effect of eco-friendly seed treatments on 1000 grain weight and yield of wheat cv. Kanchan.

Effect of seed treatments on thousand seeds weight and yield of wheat cv. Kanchan is presented in Table-11. Thousand seed weight differed significantly where the highest (37.52) and lowest (32.12) thousand seeds weight were recorded under the treatments T_{12} and T_1, respectively. .

Table 11. Effect of eco-friendly seed treatment on 1000 seed weight and yield of wheat.

Treatments	1000 seeds Weight(g)	Straw yield (t/ha)	Grain yield (t/ha)	% Grain yield increased over control
T_1	32.12 h	4.50 e	2.20 h	------
T_2	33.98 f	4.73 de	2.60 h	11.36
T_3	32.86 g	4.60 e	2.40 i	18.18
T_4	34.04 e	4.65 de	2.90 f	38.12
T_5	34.49 d	5.38 bc	3.27 e	48.64
T_6	35.25 d	5.45 bc	3.60 cd	59.09
T_7	35.01 d	5.40 bc	3.50 d	63.64
T_8	36.20 c	5.59 b	3.70 c	72.73
T_9	34.50 e	5.07 cd	2.77 fg	25.91
T_{10}	34.61 e	5.20 bc	3.00 f	36.36
T_{11}	36.85 b	6.15 b	3.80 b	68.18
T_{12}	37.52 a	6.45 a	4.00 a	81.81
LSD(0.01)	0.37	0.41	0.15	-------

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated with Bavistin 50 WP

Among eco-friendly seed treatments methods T_8 (apparently healthy seed treated with hot) showed the promising result which was 36.20 g followed by T_6 , T_7 and T_{10}.

Considering the straw yield of wheat a significant variation was recorded among the treatments. Straw yield under the treatments varied from 6.45 to 4.50 t/ha. The highest straw yield was recorded 6.45 t/ha in T_{11} treatment (farmer's saved Bavistin 50 WP treated seed),which was closely related (6.15 t/ha) to the treatment T_{11} (farmer's saved seed treated with Bavistin 50 WP). On the other hand the lowest straw yield (4.50 t/ha) was recorded in the treatment T_1 (farmer's saved seed) that was closely followed by T_3, T_2, T_4 and T_5 treatment.

Grain yield varied from 2.20 to 4.00 t/ha. Among the treatments the highest grain yield was found 4.00 t/ha in T_{12} treatment (apparently healthy seed treated Bavistin 50 WP) followed by treatment T_{11} ,T_8, T_6, and T_7 . On the contrary the lowest grain yield (2.20t/ha) was recorded in the treatment T_1 (farmer's saved seed) which followed by T_2, T_3, T_9. The treatments T_{12} resulted maximum 81.81% increased grain yield over untreated control. Among the eco-friendly seed treatments apparently healthy seeds treated with hot water gave the highest result that was 72.73% increase of grain yield over untreated control (farmer's saved seed).

CHAPTER-5

DISCUSSION

DISCUSSION

In this experiment different kind of eco-friendly seed treatments were used for controlling leaf blight of wheat. The effect of seed sorting, sun drying, brine solution, seed treatment with hot water, polythene solarization and Bavistin 50 WP (0.3%) on germination, disease incidence as well as on yield of wheat cv. Kanchan was studied. There were twelve treatments in the study namely farmer's saved seed (T_1), apparently healthy seed (T_2), farmer's saved seed treated with brine solution (T_3), apparently healthy seed treated with brine solution(T_4), sun drying of farmer's saved seed (T_5), sun drying of apparently healthy seed (T_6), hot water treatment of farmer's saved seed (T_7), hot water treatment of apparently healthy seed (T_8), polythene solarization of farmer's saved seed (T_9), polythene solarization of apparently healthy seed (T_{10}), farmer's saved seed treated seed with Bavistin 50 WP (T_{11}) and apparently healthy seed treated with Bavistin 50 WP(0.3%) (T_{12}).

From the present study it has been found that all treatments had positive response in decreasing the incidence of *Bipolaris sorokiniana* over control T_1 (farmer's saved seed). In case of *in vitro* test, the lowest seed germination was recorded (76.57%) in the treatment T_1 (farmer's saved seed) where the highest germination was counted (98.20%) under the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP)

which is closely followed by the treatment T_{11} (apparently farmer's saved seed treated with Bavistin 50 WP). The present findings corroborate with the findings of Islam, 2005. who reported that phomopsis blight and fruit rot of egg plant could be controlled by seed treatment with Bavistin 50 WP increasing germination.

The highest incidence of *Bipolaris sorokiniana* (24.40%) was recorded under the treatment T_1 (farmer's saved seed) and the lowest incidence (2.26%) was recorded under the treatment T_{12} (apparently healthy seed treated with Bavistin 50wp). The treatment T_{12} reduced 90.73% incidence of *Bipolaris sorokiniana* over control (farmer's saved seed). Moreover, untreated farmer's saved seed treated with Bavistin 50 WP reduced 79.05% disease incidence over control (T_1). Most of the researcher found Vitavax-200 either most effective or controlled completely the seed borne infections of damaging pathogens of wheat. Mironova (1991) found that Vitavax-200 was most effective in reducing seed borne infection of *Bipolaris sorokiniana* and *Fusarium* spp. Similar reduction of seed borne *Drechslera sp. (syn Bipolaris sorokiniana)* with Vitavax-200 was also reported by Dey *et al.*, (1992).

The rest of the treatments were also performed good in comparison to untreated farmer's saved seed (T_1). From eco-friendly treated seeds, the treatment T_8 (apparently healthy seed treated with hot water) reduced 79.43% disease incidence over control (T_1).The results of the present study corroborates with the findings of Hasan

(2000). In a similar type of experiment with rice, he found the highest incidence (3.5%) of *Bipolaris sorokiniana* in discolored and diseased seeds. These findings are also supported by Zobaer (2006). He counted highest seed germination and lowest incidence of *Bipolaris sorokiniana* in apparently healthy seed treated with vitavax-200 followed by sun drying of apparently healthy seed and apparently healthy seed treated with hot water.

From the results it was observed that the highest germination was counted 84.89% and 88.95% at 10 and 15 DAS in the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP) followed by the treatment T_{11} (farmer's saved seed treated with Bavistin 50 WP). On the contrary the lowest germination was 49.42% and 59.27% at 10 and 15 DAS, respectively recorded in the treatment T_1 (farmer's saved seed). From this result it was observed that farmer's saved seed had the lowest germination percentage, this would have been due to lack of proper storage facilities, germination inhibitory fungus or other microorganism. On the other hand eco-friendly treated seeds as well as chemically treated seeds gave the highest germination percentage, which was the result of destroying *Bipolaris sorokiniana* or other microorganisms.

Among eco-friendly seed treatments, apparently healthy seeds treated with hot water gave the highest germination percentage 79.49% and 84.23% at 10 and 15 DAS, respectively. Saila Yesmin (2007) found the highest germination in hot water seed treatment followed by farmer's

saved seed treated with hot water over control. The findings of the present study corroborates with the findings of Fakir and Jahan (1998), Nega *et al.* (2000) and Uddin (2005). Fakir and Jahan (1998) reported that solar heat treatment increased 9.0% seed germination. Hot water treatment of wheat seeds at 52°C for 20 min increased seed germination by 68.76% and 74.90% at 10 and 15 DAS, respectively that was statistically similar to that of the treatment T_7 (Hot water treatment of farmer's saved seed) and T_2 (apparently healthy seeds). Uddin (2005) reported that germination percentage was higher in physically sorted lentil seeds over control (untreated seeds).

It was also recorded that the minimum plant height was found in the treatment T_1 (78.48 cm) and the highest plant height was found in the treatment T_{12} (89.32 cm) and it was closely followed by treatment T_{11}, T_8, T_7, T_{10} and T_9.

The leaf blight severity of wheat was found that the first onset of infection & preliminary disease development was more or less similar for all the treatments but in different growth stages the disease severity appeared to be distinct in comparison to control. It has been found that the farmer's saved seed always performed highest average disease severity at panicle initiation (0.25%) flowering (0.40%), milking (1.21%) and hard dough (1.99%) stage, where as the treatment T_{12} (apparently healthy seed treated with Bavistin 50 WP) resulted minimum disease

severity at all growth stages and it was closely followed by the treatment T_{11} (farmer's saved seed treated with Bavistin 50 WP). The findings of the present study corroborates with the study of Willium Nesmith (2003) who found that hot water treatment was effective against the major seed borne diseases of vegetables. He found effective temperature of 12°F (49.95°C) for 25 min for brussels sprouts, cabbage, eggplant, tomato, and spinach. Hyder-Ali and Fakir (1993) observed that Vitavax-200 completely controlled seed borne infection of *A. tennis, Bipolaris sorokiniana, C. lunata* and *F. semitectum* when the seeds were treated with higher doze of chemical @ 0.5% seed weight.

It was found that apparently healthy seeds treated with hot water T_{12} at 52-56°C for 20 minutes reduced greatly the leaf blight severity over control (T_1). The findings of the present study corroborates with the study of Prabhu and Prasada (1970) who reported the elimination of *Alternaria triticina* at 52-54°C for 10 min while seed borne infection of loose smut was eliminated at 55.5°C for 10 minutes. (Bever, 1951; Bedi ,1957; and Dean, 1969).

It was found that sundrying of physically sorted seeds also reduced the leaf blight severity at all growth stages of wheat. The possible explanation of decrease of this (*Bipolaris sorokiniana*) fungi may be that the seeds dried for long time, firstly the temperature acted upon the fungal propagules lying on the surface of the seeds as contaminants and with the increasing

of temperature it penetrated within the seed and killed the fungal parts embedded deeper in the seeds. So the present findings indicated that seed-borne fungi (*Bipolaris sorokiniana*) significantly inhibited by solar heat treatment. These results agreed with the report of Fakir and Jahan (1998), Mohindar *et al.* (1994) and Guldhe *et al.* (1985).

According to Fakir and Jahan (1998), solar heat was most effective against major seed-borne pathogens of jute and reduced 91.3% infections. It has been reported that solar heats completely eradicate the loose smut pathogens of wheat (Mohindar *et al.*, 1994; Guldhe *et al.*, 1985).

It was found that apparently healthy seeds reduced the leaf blight severity in panicle initiation (0.18%), flowering (0.23%), milking (0.90%) and hard dough (1.44%) stage in comparison to control (T_1). The findings are in agreement with Hossain and Doullah (1998), who found cleaning and seed washing of farmer's seed reduced the seedling disease and increased yield up to 53.87% and 14.77% respectively over the unclean farmers saved seed. Kabir (2006) reported that apparently healthy seeds treated with Vitavax-200 @ 0.4% followed by apparently healthy seed treated with brine solution @ 2% was found to be the best in reducing leaf infection, increased seed germination and seed yield.

It was observed that the the treatment T_{12} (apparently healthy seeds treated with Bavistin 50 WP) resulted the highest number of grains /ear (38.32) and healthy grains /ear (38.03) and the lowest diseased grains /ear (0.29) which was closely followed by farmer's saved seed treated with Bavistin 50 WP (T_{11}), hot water treatetd apparently healthy seeds (T_8) and

sun dried apparently healthy seeds (T_6). Farmer's saved seed (T_1) always resulted significantly the lowest number of grains /ear (31.18), healthy grains /ear (29.60) and diseased grains /ear (1.58). Rahman *et al.* (2000) reported that seed treatment with Vitavax-200 and manually sorted seeds produced the highest number of healthy grains.

Regarding seed yield, significant increase in grain yield was obtained in all the treatments over control (T_1). The highest grain yield (4 ton/ha) was recorded in the treatment T_{12} (apparently healthy seeds treated with Bavistin 50 WP) and it was similar to that of treatment T_{11}. Among the eco-friendly seed treatments apparently healthy seed treated with hot water (T_8) gave the highest yield that was 3.60 t/ha and followed by T_6, T_7 and T_5. The lowest yield (2.20t /ha) was recorded in the treatment T_1 (farmer's saved seed). It was observed that grain yield was increased 11.36%, 18.18%, 25.91%, 36.36%, 38.12%, 48.64%, 59.09%, 63.64%, 68.18% for the treatments T_2, T_3, T_9, T_{10}, T_4, T_5 and T_{11}, respectively. Hossein (2002) reported that farmer's clean seed, washed farmer's seed, washed clean seed and seed treated with Vitavax-200 increased grain yield by 16.62%, 16.45%, 23.39% and 26.60%, respectively over farmer's saved seed of rice (cv. BR11).

CHAPTER-6

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

The research work was undertaken in the farm of Sher-e-Bangla Agricultural University, Dhaka, during the period of December 2007 to March, 2008 to find out the effect of some eco-friendly treatment on leaf blight severity as well as yield of wheat. The experiment was laid out in Randomized Complete Block Design with three replications. Variety of wheat Kanchan was used. Farmer's saved seed (T_1), apparently healthy seed (T_2), farmer's saved seed treated with brine solution (T_3), apparently healthy seed treated with brine solution (T_4), sun drying of farmer's saved seed (T_5), sun drying of apparently healthy seed (T_6), hot water treatment of farmer's saved seed (T_7), hot water treatment of apparently healthy seed (T_8), polythene solarization of farmer's saved seed (T_9), polythene solarization of apparently healthy seed (T_{10}), farmer's saved seed treated with Bavistin 50 WP (T_{11}) apparently healthy seed treated with Bavistin 50 WP (T_{12}) were used to explore the possibility of controlling the leaf blight disease of wheat.

The observations were made on the effect of eco-friendly seed treatments on percent of seed germination, percent of seed infection, percent of leaf blight severity, seed yield, yield contributing characters and thousand seed weight. Before sowing of seeds, percent of seed germination and seed infection were investigated.

Under *in vitro* test, the highest germination (98.20%) was noted in T_{12} (apparently healthy seed treated with Bavistin 50 WP (0.3%) which was followed by that of T_8 (apparently healthy seed treated with hot water (90.67%), where the lowest germination was observed in control T_1 (76.57%) treatment. On the other hand, sun drying of wheat seed, polythene solarized seeds, brine solution treated seeds and apparently healthy seeds also gave the good performance over control (T_1).

The lowest seed infection by *Bipolaris sorokiniana* was recorded in treatment T_{12} followed by T_{11}. On the other hand, among the eco-friendly seed treatment, apparently healthy seed treated with hot water gave the lowest seed infection followed by sun drying of apparently healthy seed, polythene solarized apparently healthy seeds and apparently healthy seed treated with brine solution and apparently healthy seeds. The highest percent seed infection was noted in farmer's saved seed (T_1).

The lowest percent leaf infection was observed in case of Bavistin 50WP treated seed which was followed by hot water treated, sun drying, polythene solarization, brine solution treated seeds and apparently healthy seeds. The highest percent of leaf infection was recorded in control (T_1). Among the eco-friendly treatments under this experiment were also differed in respect of seed yield in comparison to control. The seed yield was recorded highest in apparently healthy Bavistin

50WP treated seed, followed by hot water treated, sun dried, polythene solarized, brine solution seeds and apparently healthy seeds. The lowest seed yield was observed in control treatment (T_1).

However, considering the overall results of chemicals and other eco-friendly treatments in controlling leaf blight disease of wheat, Bavistin 50WP was found best followed by other treatments. Seed treatment with the above chemical not only reduced the seed borne infections but also increased germination of seeds, it also decreased leaf blight severity and increased seed yield.

Among the eco-friendly seed treatments, results of the experiment revealed that hot water treatment of apparently healthy seeds 52°-56°C for 20 minutes gave the highest control of leaf blight disease and increased seed yield followed by sun drying of apparently healthy seeds for 15 hours. Uses of apparently healthy seed also performed better than untreated control. The rest of the treatments have some remarkable effect in controlling the disease.

In view of the above findings, it can be concluded that apparently healthy seeds treated with Bavistin 50 WP revealed to be effective for controlling leaf blight of wheat among the treatments employed in the experiments. It was also observed that uses of apparently healthy seed, brine solution, sundried and hot water treated can be reduced leaf blight disease and increased seed yield. However, these findings need to be further studied and evaluated in different AEZ with more eco-friendly treatments to reduce environmental pollution.

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APPENDICES

APPENDICES

Appendix I. Monthly average temperature, relative humidity, total rainfall and Sunshine (hour) of the experimental site during the period from November 2007 to April 2008

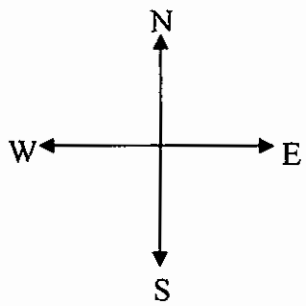
Year	Month	*Air temperature (^{0}C)		*Relative Humidity (%)	*Total rainfall (mm)	*Sunshine (hr)
		Maximum	Minimum			
2007	November	31.8	16.8	67	111	5.7
	December	28.2	11.3	63	0	5.5
2008	January	29.0	10.5	61.5	23	5.6
	February	30.6	10.8	54.5	56	5.8
	March	34.6	16.5	61.5	45	5.8
	April	36.9	19.6	59.5	91	8.3

*Monthly average

Source: Bangladesh Meteorological Department (Climate division), Agargaon, Dhaka - 1207

Appendix II : Field layout of the experiment in the Randomized Complete Block Design (RCBD)

T_3R_1	$T_{10}R_2$	T_1R_3
T_8R_1	T_7R_2	$T_{12}R_3$
T_1R_1	$T_{12}R_2$	T_3R_3
$T_{10}R_1$	T_9R_2	T_6R_3
T_5R_1	T_8R_2	T_5R_3
$T_{12}R_1$	$T_{11}R_2$	T_8R_3
T_7R_1	T_6R_2	T_7R_3
T_4R_1	T_5R_2	T_4R_3
T_9R_1	T_4R_2	T_9R_3
T_2R_1	T_1R_2	T_2R_3
$T_{11}R_3$	T_2R_2	$T_{11}R_3$
T_6R_1	T_3R_2	$T_{10}R_3$



Plot size : 4m x2.4 m
Spacing between plot : 0.75 cm
Spacing between replication : 1 m

The treatments are as follows :

T_1= Farmer's saved seed

T_2= Apparently healthy seed

T_3= Farmer's saved seed treated with brine solution

T_4= Apparently healthy seed treated with brine solution

T_5= Sun drying of farmer's saved seed

T_6= Sun drying of apparently healthy seed

T_7= Farmer's saved seed treated with hot water

T_8= Apparently healthy seed treated with hot water

T_9= Polythene solarization of farmer's saved seed

T_{10}= Polythene solarization of apparently healthy seed

T_{11}= Farmer's saved seed treated with Bavistin 50 WP

T_{12}= Apparently healthy seed treated Bavistin 50 WP

R_1 =Replication

R_2 = Replication

R_3 = Replication

Appendix III. Analysis of variance of the data on seed germination and yield of *Bipolaris sorokiniana* of wheat in blotter method

Sources of variation	df	Mean square	
		%Germination	*%Bipolaris sorokiniana*
Replication	2	0.028	0.028
Treatment	11	87.146**	96.343**
Error	22	0.028	0.028

** Significant at 1% level of significance

df : Degrees of freedom

Appendix IV. Analysis of variance of the data on seed germination and yield contributing characters of wheat

Sources of variation	df	Mean square				
		% Germination		Plant height(cm)	Spike length (cm)	Distance between the point of flag leaf initiation and base of ear (cm)
		10DAS	15DAS			
Replication	2	0.027	0.029	0.011	0.083	0.026
Treatment	11	358.60**	276.322**	33.551**	0.563	0.974**
Error	22	0.027	0.029	0.405	0.027	0.026

DAS: Day After Sowing

* df : Degrees of freedom

* Significant at 1% level of significance

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

Sources of variation	df	Mean square					
		Disease severity at Panicle initiation stage			Disease severity at Flowering stage		
		Flag leaf	Penultimate leaf	Mean	Flag leaf	Penultimate leaf	Mean
Replication	2	0.001	0.001	0.004	0.001	0.001	0.041
Treatment	11	0.01**	0.016**	0.013**	0.017**	0.623**	0.009**
Error	22	0.001	0.001	0.003	0.001	0.001	0.040

** Significant at 1% level of significance

df : Degrees of freedom

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

Sources of variation	df	Mean square					
		Disease severity at Milking stage			Disease severity at Hard dough stage		
		Flag leaf	Penultimate leaf	Mean	Flag leaf	Penultimate leaf	Mean
2	0.001	0.001	0.001	0.001	0.001	0.001	0.001
11	0.007**	0.025**	0.013**	0.372**	0.703**	0.520**	0.520
22	0.001	0.001	0.001	0.001	0.001	0.001	0.001

** Significant at 1% level of significance

df : Degrees of freedom

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

Sources of variation	df	Mean square			
		Number of tillers/plant	Number of spikelets/ear	Number of healthy spikelets/ear	No. of diseased spikelets/ear
Replication	3	0.027	0.029	0.030	0.027
Treatments	11	2.270**	17.800**	23.054**	1.439**
Error	22	0.027	0.029	0.030	0.027

** Significant at 1% level of significance

df : Degrees of freedom

Appendix VIII. Analysis of variance of the data on yield contributing

Sources of variation	df	Mean square					
		Number of grains/ear	Number of healthy grains/ear	Number of diseased grains/ear	Weight of grains/ear (g)	Weight of healthy grains/ear(g)	Weight o diseased grains/ea (g)
Replication	3	0.028	0.031	0.031	0.001	0.002	0.004
Treatments	11	16.526**	22.879**	1.310**	0.068**	0.068**	0.004**
Error	22	0.028	0.031	0.031	0.004	0.001	0.003

** Significant at 1% level of significance

df : Degrees of freedom

Appendix IX. Analysis of variance of the data on grading of wheat seed

Sources of variation	df	Mean square					
		Grading of seeds(0-5 scale)					
		0	1	2	3	4	5
Replication	3	0.0531	0.001	0.000	0.001	0.000	0.000
Treatments	11	24.972**	0.134**	0.109**	0.057**	0.053**	0.112**
Error	22	0.031	0.001	0.000	0.001	0.000	0.000

** Significant at 1% level of significance

1 = only embryo blackish

2 = embryo and its adjacent area slightly infected

3 = embryo and less than ¼ of grains are discolored

4 = embryo and ½ of grains are infected and

5 = grains are shriveled, almost completely discolored or more than ½ of grains discolored.

Appendix X. Analysis of variance of the data on yield of wheat seed

Sources of variation	df	Mean square		
		1000 seeds wt(g)	Straw yield (t/ha)	Grain yield (t/ha)
Replication	3	0.026	0.031	0.004
Treatments	11	0.152**	1.116**	0.751 **
Error	22	0.026	0.031	0.004

** Significant at 1% level of significance
df : Degrees of freedom