EFFECT OF PHYSICAL AND CHEMICAL SEED TREATMENTS ON LEAF SPOT (*Bipolaris sorokiniana*) AND GRAIN YIELD OF WHEAT

MD. HUMAYUN KABIR

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

June 2006

EFFECT OF PHYSICAL AND CHEMICAL SEED TREATMENTS ON LEAF SPOT (*Bipolaris sorokiniana*) AND GRAIN YIELD OF WHEAT

By

MD. HUMAYUN KABIR
REGISTRATION NO 23956/00194

A thesis
Submitted to the Department of Plant Pathology
Sher-e-Bangla Agricultural University, Dhaka
In partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE (MS)
IN
PLANT PATHOLOGY

Semester: January - June 2006

Approved by:

Dr. F. M. Aminuzzaman
Assistant Professor
Supervisor

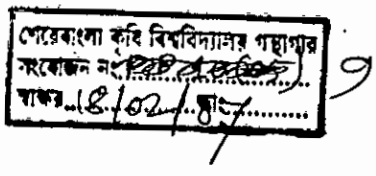
Dr. Md. Rafiqul Islam
Associate Professor
Co-supervisor

Dr. Md. Rafiqul Islam
Chairman
Examination Committee

CERTIFICATE

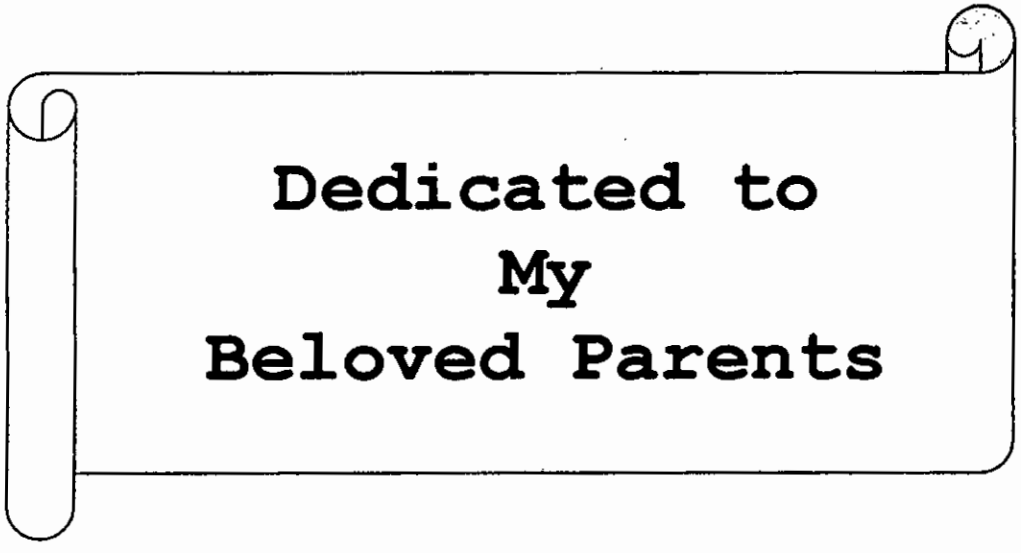
This is to certify that the thesis entitled "Effect of physical and chemical seed treatments on leaf spot (*Bipolaris sorokiniana*) and grain yield of wheat" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN PLANT PATHOLOGY,** embodies the result of a piece of bonafide research work carried out by **Md. Humayun Kabir, Registration No. 23956/00194** under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.

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



Dated: 30. 08. 06
Dhaka, Bangladesh

Dr. F. M. Aminuzzaman
Assistant Professor
Supervisor


Dedicated to
My
Beloved Parents

ACKNOWLEDGEMENTS

All praises, gratitude and thanks are due to the omniscient, Omnipresent and omnipotent Allah who enabled the author to complete this thesis successfully.

The author expresses his deepest sense of gratitude, sincere appreciation and immense indebtedness to his supervisor Dr. F. M. Aminuzzaman, Assistant Professor, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, for his guidance, constructive criticism and valuable suggestion in successful completion of the research work and preparation of this thesis. Profound gratitude is expressed to his honorable co-supervisor Dr. Md. Rafiqul Islam, Associate Professor and Chairman, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka for his scholastic guidance and constant inspiration throughout the research work and preparation of this thesis.The author is highly grateful to Assistant Prof. M. Salahuddin M. Chowdhury, for valuable suggestions and cooperation during the study period.The author also expresses his heartfelt thanks to all the teachers of Plant Pathology Department, SAU, for their valuable suggestions and encouragement during the period of the study.

Thanks are extended to his friends Md. Rashedul Islam, Arfan Ali, Abu Sayem Md. Tauhidul Islam, Md Afzal Hossain, Sohel Mahmud and other friends for their help and

inspiration. The author wishes to acknowledge his heartfelt indebtedness and profound respect to his father Md. Azhar Ali and mother Daulotan Nesha for their sacrifice, blessings, patience and encouragement and for his success.

The author expresses his sincere appreciation to his brother, sisters, relatives, well wishers and friends for their inspiration, help and encouragement throughout the study.

The Author

EFFECT OF PHYSICAL AND CHEMICAL SEED TREATMENTS ON LEAF SPOT (*Bipolaris sorokiniana*) AND GRAIN YIELD OF WHEAT

By

MD HUMAYUN KABIR

ABSTRACT

An experiment was conducted at the Farm of Sher-e-Bangla Agricultural University, Dhaka during the period from December 2005 to April 2006 to study the effect of physical and chemical seed treatments on leaf spot (*Bipolaris sorokiniana*) and grain yield of wheat.There were ten treatments viz. farmer's stored seed (T_1), apparently healthy seed (T_2), farmer's stored seed treated with Vitavax-200 @ 0.4% (T_3), apparently healthy seed treated with Vitavax-200 @ 0.4% (T_4), farmer's stored seed washed with water (T_5), apparently healthy seed washed with water (T_6), farmer's stored seed treated with brine solution @ 2% (T_7), apparently healthy seed treated with brine solution @ 2% (T_8), washed farmer's stored seed treated with brine solution @ 2% (T_9) and washed apparently healthy seed treated with brine solution @ 2% (T_{10}). The highest germination was counted 84.20% and 86.08% respectively at 10 and 15 DAS in the treatment T_4 and the lowest germination 49.84% and 55.54% at 10 and 15 DAS, respectively was recorded in the treatment T_1 that served as control. The lowest disease severity were recorded at panicle initiation stage, flowering stage, milking stage and hard dough stage under the treatment T_4, which were 0.06, 0.19, 0.36 and 0.84, respectively. On the other hand the highest disease severity were recorded at panicle initiation stage, flowering stage, milking stage and hard dough stage under the treatment T_1, which were 0.55, 1.21, 1.69 and 2.53, respectively. The highest grain yield (3.5 t/ha) was obtained in treatment T_4, which was 75% increased over control (T_1).

LIST OF ABBREVIATED TERMS

Full name	Abbreviation
Agro-Ecological Zone	AEZ
And others	*et al.*
Bangladesh Bureau of Statistics	BBS
Centimeter	cm
Degree Celsius	°C
Days after sowing	DAS
Etcetera	etc
Food and Agriculture Organization	FAO
Gram	g
Hour	hr
Kilogram	kg
Meter	m
Millimeter	mm
Month	mo
Murate of Potash	MP
Number	no.
Percent	%
Randomized Complete Block Design	RCBD
Sher-e-Bangla Agricultural University	SAU
Square meter	m^2
Triple Super Phosphate	TSP

CONTENTS

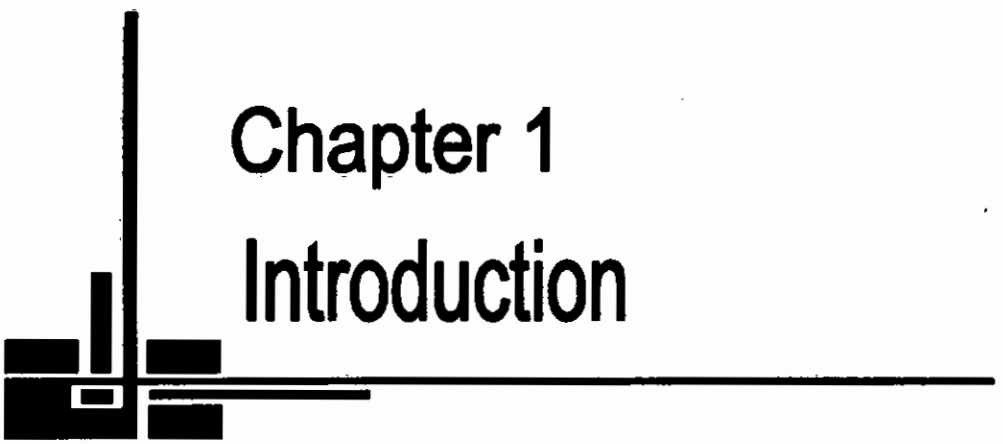
CONTENTS (contd.)

CONTENTS (contd.)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES



Chapter 1
Introduction

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the cereal crops in the world. 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. Though the crop has been introduced in 1961 in the country, its popularity has gained after 1975. Since initiation of HYV wheat expansion program in 1974, the area as well as yield has increased manifold (Ahmed and Meisner, 1996). Though the area, production and yield rate of wheat have been increasing dramatically during the last decade, the wheat yield in Bangladesh is too low (2.2 t/ ha) in comparison to the other countries of the world like Japan, France, Germany and UK producing 3.76, 7.12, 7.28, and 8.00 t/ha, respectively (FAO, 2000). About 642.1 thousand hectares of land was covered by wheat cultivation with the annual production of 1253 thousand tons (1.95 t/ha) in Bangladesh (BBS, 2005).

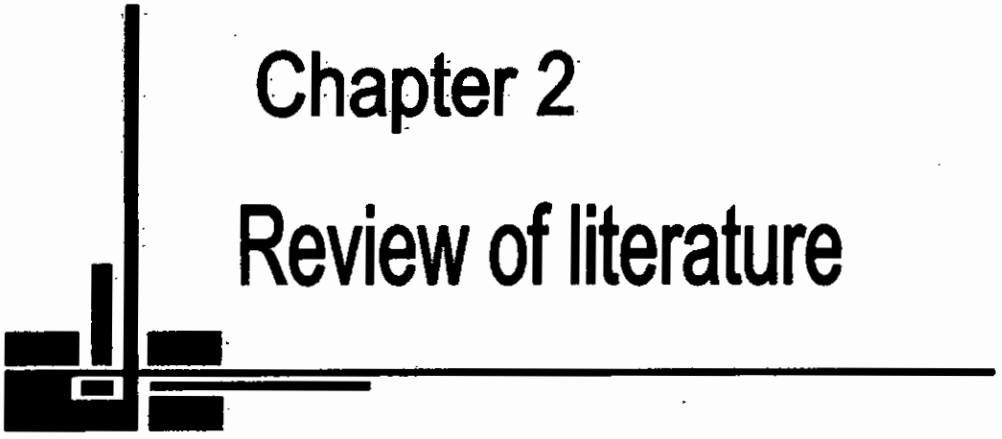
There are many constraints responsible for low yield of wheat in Bangladesh. Among the different factors that affect the production of wheat, use of unhealthy or diseased seeds is one of the major constraints. Government and semi government organizations supply only 22.8 % of the total wheat seed required during 1998-1999 (Motahar, 2000). These seeds are treated as quality seeds in Bangladesh. The rest 77.2 % of the seeds produced traditionally by the farmers with no or little care even for purity and germination and remain out of scope of certification. As a result, a huge crop loss is incurred every year in wheat due to seed diseases in the country. Seed borne disease causes enormous losses to our crop (Fakir, 1982). Seed carries large number of destructive pathogens. Wheat is

suffering from as many as 26 seed borne diseases (Fakir, 1999a). Various diseases not only common crop loss in the field but also deteriorate quality of seeds in storage and reduce germination (Christensen and Kaufmanns, 1965; Sachan and Agarwal, 1994). Fungi are the principle organisms among the various organisms associated with seeds in storage. Seed borne inocula of fungal pathogens may be in the form of dormant mycelia, pycnidia, acervuli, sporodochia and sclerotia. 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). Seed borne infections of fungal pathogens are important not only due to its association with the seeds that causes germination failure and attacks to the newly emerged seedlings or growing plants, but it also contaminate the soil by establishing its inocula permanently. Among the diseases, leaf spot/leaf blight/leaf blotch caused by *Bipolaris sorokiniana* (Sacc. In sork.) is considered to be a threat to wheat cultivation all over the world (Duveiller and Gilchrist, 1994). In Bangladesh, the disease is also considered as a common and devastating one (Hossain and Azad, 1992). In Bangladesh yield loss in wheat due to leaf blight/leaf spot/leaf blotch disease has been reported to be 20% in Sonalika, while 14% and 8% in Akbar and Kanchan, respectively (Razzaque and Hossain, 1991). In farmers field, the yield loss was estimated 14.97% (Alam *et al.*, 1995), where up to 29% yield reduction was estimated during 1991-1992 in 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. So, seed should be free from pathogens or diseases for better wheat production.

Easy and economic way of controlling seed borne diseases may be the use of clean, healthy looking and washed seeds. It may play an important role to minimize disease incidence and reducing entry of pathogens to the field. In a preliminary study, it has been found that, cleaning and washing farmer's seed reduces seedling diseases up to 53.87% over unclean farmer's seed (Hossain and Asad-ud-Doullah, 1998). Seed cleaning and washing are easy and practically feasible method for our poor farmer's (Hasan, 2000). This technique does not require much effort and it is free from chemical threat. It is an alternative method of avoiding seed treating chemicals and thus environment will be save from pollution. Now a day's scientists are giving more emphasis on sustainable technology for agriculture. It would be possible when ecologically sound, economically viable, culturally appropriate and socially acceptable technology will be adopted. Therefore, the present study has been undertaken with the following objectives:

1. To evaluate the effect of seed sorting, seed washing on the incidence of *Bipolaris sorokiniana* in wheat seeds.
2. To determine the effect of seed treatment with Vitavax-200 and brine solution on the incidence of *Bipolaris sorokiniana* in wheat seeds.
3. To evaluate the effect of seed sorting, seed washing and seed treatment with brine solution and Vitavax-200 on leaf spot severity (*Bipolaris sorokiniana*) of wheat.
4. To determine the effect of seed sorting, seed washing and seed treatment with brine solution and Vitavax-200 on grain yield of wheat.



Chapter 2

Review of literature

2. REVIEW OF LITERATURE

Seed borne pathogens are reported to cause spots or discoloration on the seed. Seed cleaning and washing may reduce number of seed borne pathogens associated with seed and thus improves the quality of seed. The experimental evidence regarding the benefit of seed cleaning, washing and treated with brine solution at home and abroad is rare and scanty. Therefore, attempt has been taken to collect relevant literature on this aspect, which are given below:

Hanson and christensen (1953) reported that the relation of discolored seed to germination and plant stand depend on some organism or organisms responsible for discoloration. If *Helminthosporium* caused it, there may be detrimental effects. They also found an almost similar trend of variation in germination of *Helminthosporium sativum* infected wheat seeds variety Kubanka collected from direct sources. They found the seed germination as 60% and 62% from the seeds having respectively 80% and 74% infection with *H. sativum*. Seed infected with *H. sativum* on the other hand, commonly germinated poorly and produced inferior stands with more seedling blight than clean seeds.

Bedi and Gill (1960) reported that a substantial loss in germination (11.0 to 37.3%) is associated with the spotted seeds. They found spotted seeds, which did not germinate was profusely covered with mycelium and the spore of *Helminthosporium oryzae*. Healthy seeds gave very high percentage

germination as 99% and remained free from any seedling mortality. In the case of naturally infected seed there was a loss of about 5% among the seedlings. They also found appreciable loss in weight with spotted seeds. It was found to vary from 40.58% to 29%.

Khanum *et al.* (1987) stated that black point is responsible for the germination failure of grains in the field. Visual observations indicated that natural infection of grains of the cultivars Lyp-73, Pai-73 and Pka-81 were 58%, 35% and 15%, respectively .The germination of healthy grains was 55-96.5% and that of diseased grains 34.5-71%.

Hossain and Asad-ud-Doullah (1998) reported that cleaning and washing of farmer's rice seeds reduced the seedling diseases up to 53.87% over the unclean farmer's seed. Use of healthy seedlings resulted 14.77% increase in grain yield over the unbiased use of normal seedlings from seedbed.

Rashid and Fakir (2000) reported that high quality healthy seeds are crying need of the day to assure sustainable good crops to the farmers who must be aware of the consequences of the crop losses with unhealthy seeds. With a view to obtain good harvest, the effectiveness of other inputs such as fertilizer, irrigation etc. influence largely the quality of seeds.

Fakir *et al.* (2000) found that seed cleaning had paramount importance for improvement of quality of rice seeds in the Seed Health Improvement Project under PETRRA. They separated out 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 matter) and abnormal seeds (spotted, discolored, deformed, shriveled, unfilled and half-seeds) by manual physical seed sorting. The least percentage of seed- borne pathogenic fungi were recorded on seed health analysis. Also, lesser number of dead/abnormal seedlings and higher percentage of normal seedling were obtained from best seeds in the germination test.

Hasan (2000) found that seed cleaning and washing with water increase of germination and vigour index by 8.33 and 31.10%, respectively in farmers rice seed (cv. BR11). Seed health test revealed that farmer's seeds yielded *Bipolaris oryzae*, *Fusarium moniliforme*, *Alternaria padwickii*, *Aspergillus niger*, *Aspergillus flavus* and *Penicillium* 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 for controlling seed–borne pathogens of rice. Seed cleaning and washing 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.

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 lunata*, *Nigrospora oryzae*, *Alternaria tenuis*, *Aspergillus* spp. and *Penicillium* spp. All the three seed treatment methods reduced all seed borne fungal infections. The best method was treatment with Vitavax-200, followed by manual seed sorting and flotation. Germination test following paper towel method showed that chemical treatment was the best in producing normal seedlings, 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 1000- seed weight. Grain yield was increased in manually sorted, flotation and Vitavax-200 treated seeds/ plots 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%, 16.45%, 23.39% and 26.6% grain yield, respectively over farmer'saved seeds of rice (BR11).

Gworgwor *et al.* (2002) conducted field trials in Nigeria during 1997 and 1998 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 0.5, 1.0, 1.5, and 2.0 M. were used. They

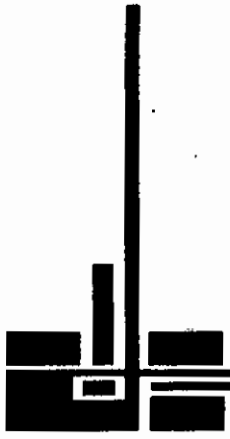
reported that the effect of brine treatments on plant establishment, growth and yield of sorghum under Striga infestation shows there that was a decrease in crop stands with increase in brine concentration, with the least value at 2.0 M brine treatment, which was damaging at this rate. Plant height and LAI of sorghum increased with increasing concentration of brine to a maximum at 1.5 M and declined at 2.0 M brine treatment. The 1.5M brine treatment produced the height grain yield.

Kabir (2003) reported that the germination test of farmer's seed treated with Vitavax-200 resulted 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 disease severity of brown spot, narrow brown spot, blast, sheath blight and sheath rot was the lowest in plots under farmer's seed treated with Vitavax-200, followed by soaked washed cleaned seed. The Vitavax-200 treated seed significantly resulted highest plant height, panicle length and 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%).

Siddique (2003) reported that the seeds remained on sieve showed better performance in respect of seed germination, seedling vigour and seed health in different wheat varieties (Kanchan, Akbar and Sourov). Seeds were cleaned by bamboo sieve having mesh size 2.25mm. Seeds were taken on bamboo sieve and manually shaken for different duration (two, four, six and eight minute). The seeds remained on sieve were considered as healthy seeds and those were dropped the sieve were consider as unhealthy seeds. Germination and seedling vigour increased with increasing duration of sieving. Seed cleaning by bamboo sieve reduced prevalence of pathogens. Infection percentage gradually decreased with increasing duration of sieving.

Uddin (2005) reported that seed borne pathogens were 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.



Chapter 3

Materials and Methods

3. MATERIALS AND METHODS

3.1. Laboratory experiment

The experiment was carried out in the Seed Pathology Laboratory, Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh.

3.1.1. Collection of seeds

Wheat seeds of Kanchan variety were collected from a farmer named Md. Nurul Islam of Village Mahiarpur, Thana Mithapukur, District Rangpur.

3.1.2. Preparation of the seed sample for different treatments

3.1.2.1. Sorting of apparently healthy seeds

Apparently healthy seeds were obtained by manual separation of seeds from the contaminants and abnormal seeds of the lot of original farmer stored seeds.

3.1.2.2. Seed washing

For washing, required amount of seeds were taken in conical flask and required amount of water was added into the seeds. The seeds were then stirred for 10 minutes with a magnetic stirrer. The excess water was removed. The washing was done both for farmer's stored seeds and apparently healthy seeds.

3.1.2.3. Seed treatment with brine solution

At first 2% brine solution was prepared by mixing 100 ml tape water with 2g edible salt (NaCl) and seeds were soaked in the solution for 15 minutes. After treating seeds the excess water was removed and the seeds were air dried in the laboratory prior to sowing.

3.1.2.4. Seed treatment with Vitavax-200

Seeds were taken in a beaker and 0.1g chemicals was added into 24g seeds. The chemical was mixed thoroughly by a stick. Both apparently healthy seeds and original farmers stored seeds were treated with Vitavax-200 @ 0.4%.

3.1.3. Seed health study of treated seed

Seed health study was done following the standard method of ISTA (1999). In this method, three layers of blotting paper (whatman filter paper no.1) soaked in water and were placed at the base of a 9 cm diameter plastic petridish and thereafter 25 seeds were placed on filter paper. The petridishes containing seeds were incubated at 20±2 ^{0}C under alternating cycles of 12 hours near ultraviolet (NUV) and darkness for 7 days. The incubated seeds were examined under stereo binocular microscope in order to record the incidence of *Bipolaris sorokiniana* that grew out of the seeds. For proper identification of fungi, temporary slides were also prepared from the fungal colony and examined

under compound microscope and fungi were identified (Malone and Muskett, 1964; Benoit and Mathur, 1970; Ellis, 1971 and Agarwal *et al.*, 1989).

3.2. Field experiment

3.2.1. Experimental site and experimental period

The experiment was conducted at Sher-e-Bangla Agricultural University Farm, Dhaka-1207 during the period from December 2005 to April 2006. The experimental field was located at $90^0 22'$ E longitudes and $23^0 41'$ 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

The soil of the experimental field belongs to the Tejgaon series under the Agro Ecological Zone, Madhupur Tract (AEZ-28) and the general soil type is Shallow, Red Brown, Terrace Soils. Details of the soil characteristics are shown in Table 1.

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

(Source:Bhuiyan, 2005)

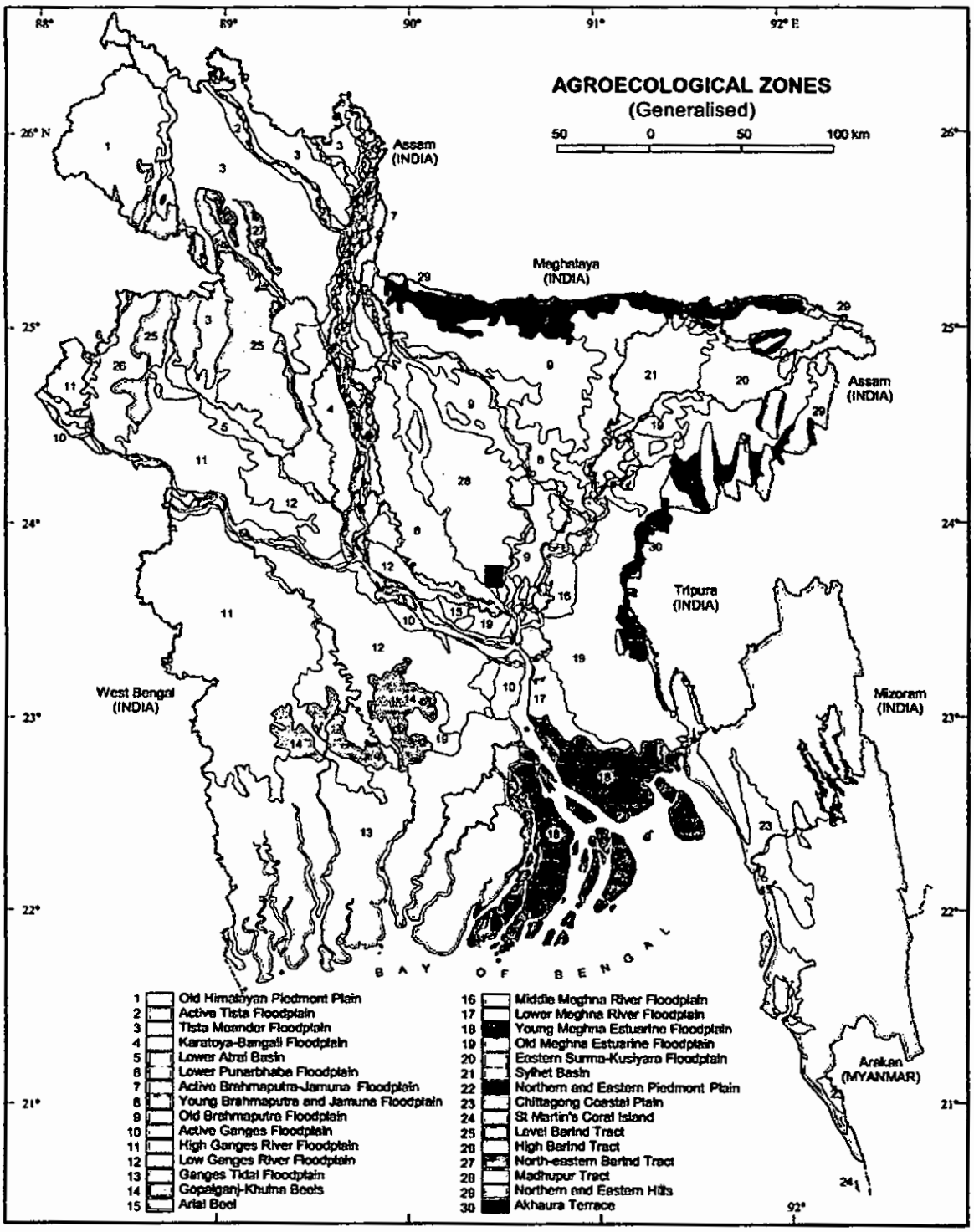


Fig. 1. Location of experimental field

3.2.3. Climate

The monthly mean of daily maximum, minimum and average temperature, relative humidity, monthly total rainfall (mm) and sunshine hours throughout the experimental period were collected from weather office, She-e- Bangla Nagar, Dhaka. The monthly weather report for the study period is shown in Table 2.

Table 2. Monthly average of temperature, relative humidity, total rainfall and sunshine hour of the experimental site during the period from December 2005 to April 2006

Year	Month	Air temperature (^{0}c)			Relative humidity (%)	Rainfall (mm)	Sunshine (hr)
		Maximum	Minimum	Mean			
2005	December	26.9	16.2	21.5	70.6	0.0	210.5
2006	January	24.5	13.9	19.2	68.5	4.0	194.1
	February	28.9	18.0	23.4	61.0	3.0	221.5
	March	32.14	22.39	27.27	66.67	0155	216.4
	April	34.44	24.23	29.34	67.66	0091	253.4

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

3.2.4 Layout of the experiment

The experiment was laid out in a Randomized Complete Block Design with three replications. The total number of plots was 30. The size of unit plot was 2m × 1m. The distance maintained between two plots was 50 cm and between blocks was 1.0 m.

3.2.5. Land preparation

A power tiller first opened the selected land on 1st December 2005; afterwards the land was ploughed and cross-ploughed several times followed by laddering to obtain 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 leveled and the experimental plot was partitioned into unit plots.

3.2.6. Treatments

There were ten treatments, which were as follows:

T_1 =Farmer's stored seed (control)
T_2 = Apparently healthy seed
T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%
T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%
T_5 = Farmer's stored seed washed with water
T_6 = Apparently healthy seed washed with water
T_7 = Farmer's stored seed treated with brine solution @ 2%
T_8 = Apparently healthy seed treated with brine solution @ 2%
T_9 = Washed farmer's stored seed treated with brine solution @ 2%
T_{10} = Washed apparently healthy seed treated with brine solution @ 2%

3.2.7. 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.

3.2.8. Collection of seeds

Wheat seeds of Kanchan variety were collected from a farmer, Md. Nurul Islam, Village Mahiarpur, Thana Mithapukur, district Rangpur.

3.2.9. Preparation of the seed sample for different treatments

Sorting of apparently healthy seeds, seed washing and seed treatment with brine solution and vitavax-200 were done following the method as described in laboratory experiment (3.1.2.).

3.2.10. Sowing of seeds

Wheat seeds were sown in the field on 10th December 2005 at the rate of 120 Kg/ha. The seeds were sown in lines at a depth of 5 cm and covered by soil with the help of hand. The distance between lines was 20 cm in every plot.

3.2.11. Intercultural operation and management practices

Intercultural operation like weeding, irrigation was done in order to maintain the normal hygienic condition of crop growth. Weeding was performed two times during the growing period of crop (one after 30 days and another 50 days of sowing). The experimental field was irrigated twice, first irrigation was done at 21 days after sowing and second irrigation was done at 60 days after sowing. Special care was taken to protect the crop from birds especially sowing and germination stages and at the ripening stage of the crop.

3.2.12. Isolation and identification of *Bipolaris sorokiniana.*

The collected diseased leaves were cut into pieces (0.5 cm) and surface sterilized with $HgCl_2$ (1: 1000) for 30 seconds. Then the cut pieces were washed in sterilized water thrice and were placed on to PDA in petridish. The petridish containing leaf pieces were placed in an incubator at 22-24^{0}C for 7days. The organism was isolated by hyphal tip culture method and then purified and identified following the key characteristics of pure culture of *Bipolaris sorokiniana* on PDA (Fig. 2.) and mycelia and conidia of *Bipolaris sorokiniana* (Fig. 3).

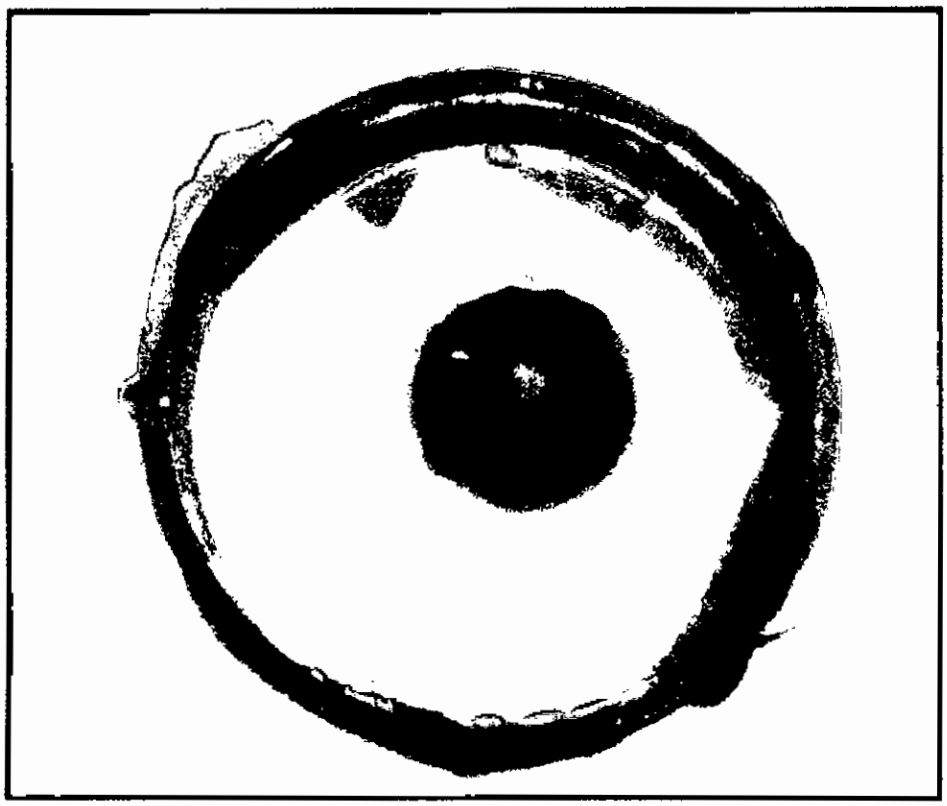


Fig. 2. Pure culture of *Bipolaris sorokiniana* on PDA

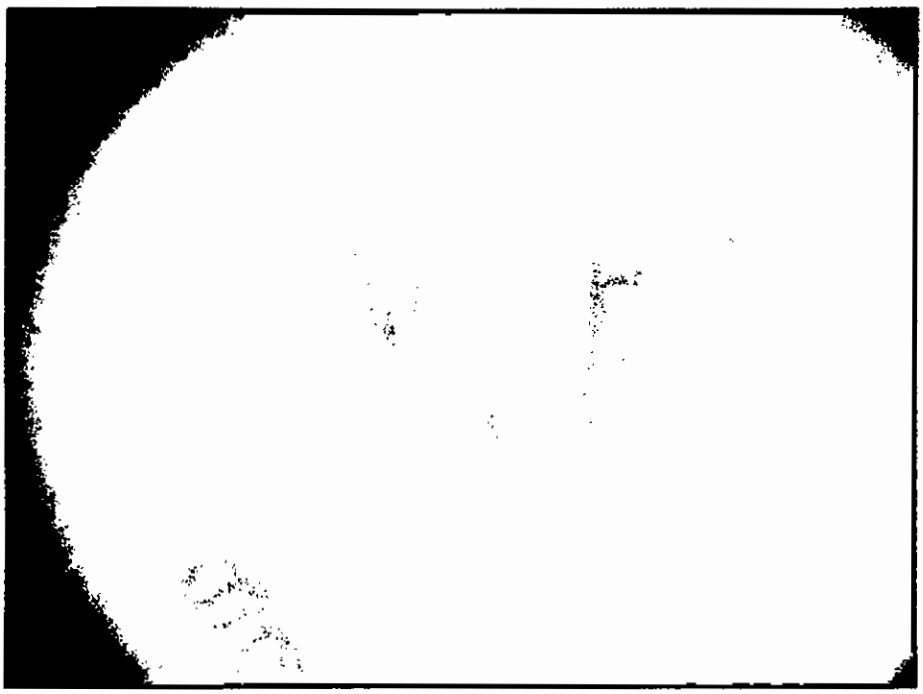


Fig. 3. Mycelia and conidia of *Bipolaris sorokiniana* (× 250)

3.2.13. Recording of leaf spot / leaf blight severity

Leaf spot severity of wheat was evaluated at four growth stages of plant viz. panicle initiation, flowering, milking, hard dough stage. The disease severity was recorded following rating scale as used by Hossain and Azad (1992) (Fig. 4) The rating scale is given below:

0 =No infection (Highly resistant)

1 = Few minute lesions on leaves (Resistant)

2 = Black lesion with no distinct chlorotic halos covering≤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 ≥ 50% of the leaf area (susceptible)

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

The rating of the disease reaction was done on the flag leaf, second leaf and 3rd leaf from the top of the plant. The randomly selected 25 plants/plot were tagged for rating the disease severity and mean value were determined to get rating score of the material of each treatment.

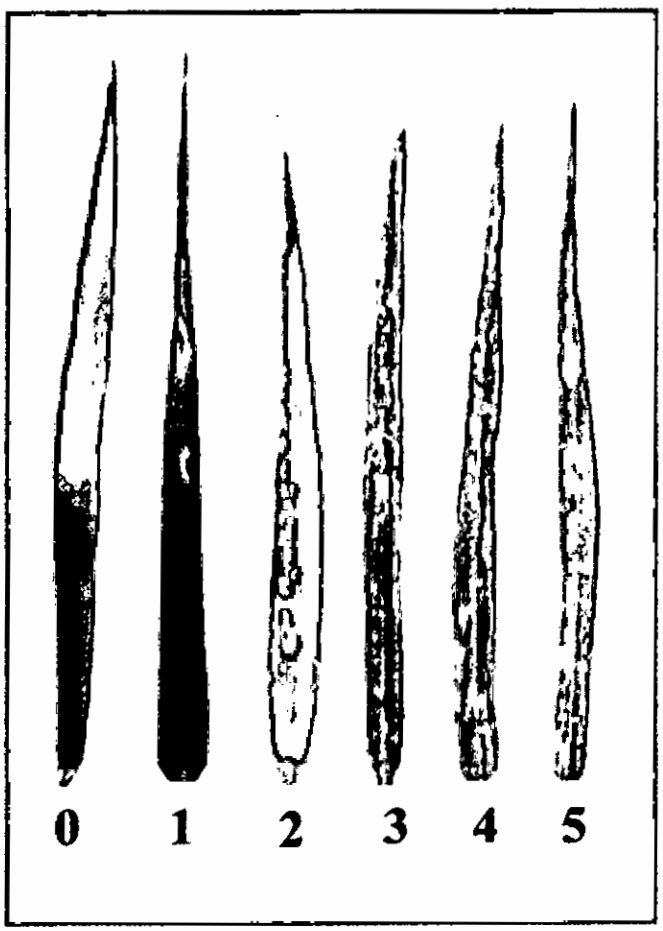


Fig. 4. 0-5 rating scale of leaf spot severity of wheat

3.2.14. Harvesting and recording growth and yield contributing characters

The crop was harvested at full ripening stage. The observations pertaining to the following parameters were recorded after harvesting from randomly selected and tagged 25 plants of each unit plot:

(i) Plant height (cm)

(ii) Distance between the point of flag leaf initiation and base of ear (cm)

(iii) Length 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) Weight of thousand seeds (g)

(xiv) Grain yield (Kg/plot)

(xv) Grain yield (t/ha)

(xvi) Straw yield (Kg/plot)

(xvii) Straw yield (t/ha))

3.2.15. Recording data on grading of seeds

The grading of seeds was done following the 0-5 rating scale (Fig. 5) of CIMMYT (Gilchrist, 1985). 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 grains are infected and

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

3.2.16. Statistical analysis

Data in respect of different growth and yield contributing characters were statistically analyzed and test of significance was done following DMRT (Duncan's New Multiple Range Test) and means were compared following LSD (Least Significance Difference).

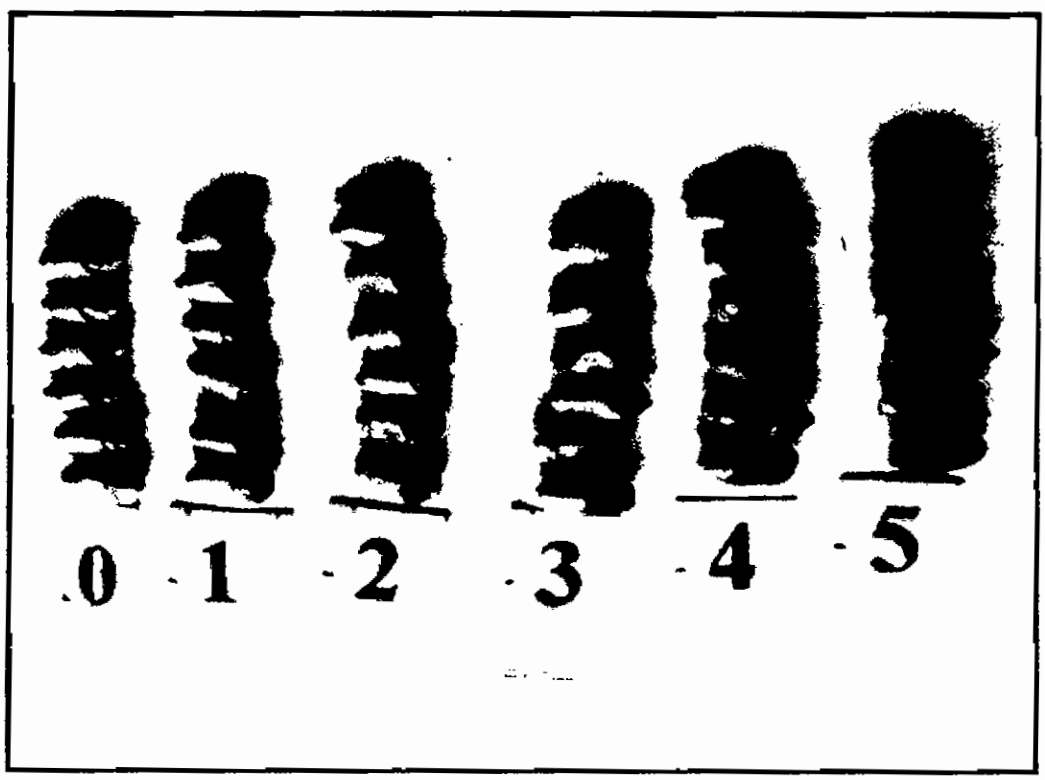
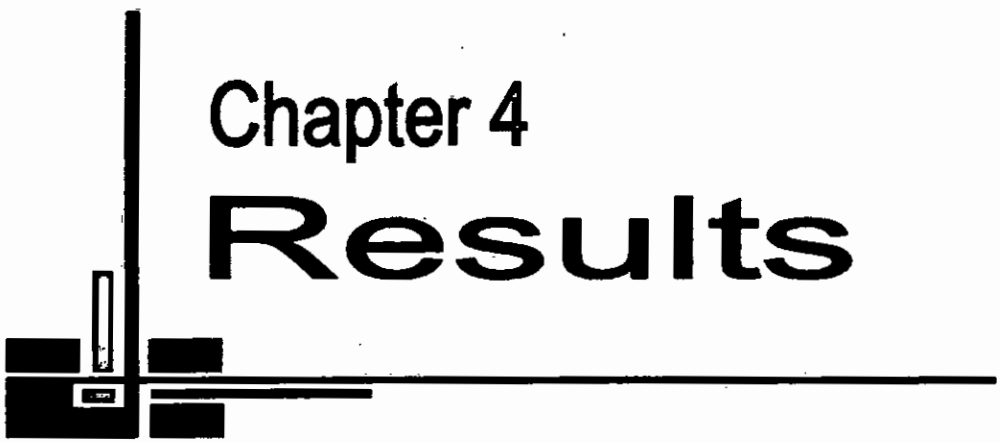


Fig. 5. Wheat seeds of different grades (0-5 scale)



Chapter 4
Results

4. RESULTS

The results of different quality of seed after application of seed treatment of wheat on the germination, disease severity, yield contributing character and yield have been presented in this chapter. The analysis of variance (ANOVA) of data on different parameters is given in appendix I to VI. The results have been presented under the following headings:

4.1. Laboratory experiment

4.1.1. Effect of seed treatments on germination of seeds

Significant variations were observed in percentage of seed germination (Table 3). The highest germination (97.10%) was counted in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%) and the lowest germination (82.57%) was counted in treatment T_1 (farmer's stored seed). The treatments T_2 (apparently healthy seed), T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%), T_6 (apparently healthy seed washed with water), T_8 (apparently healthy seed treated with brine solution @ 2%) and T_{10} (washed apparently healthy seed treated with brine solution @ 2%) were statistically similar in respect of seed germination but they differed significantly from T_1 (farmer's stored seed).

4.1.2. Effect of seed treatments on incidence of *Bipolaris sorokiniana* on seed surface by blotter method.

Different treatments differed significantly in respect to incidence of seed borne *Bipolaris sorokinian* that has shown in table 3. The highest incidence of *Bipolaris sorokiniana* was counted (17.40%) under the treatment T_1 (farmer's stored seed) and the lowest incidence was counted (3.70%) under the treatment T_{10} (washed apparently healthy seed treated with brine solution @ 2%). The treatment T_{10} reduced 78.63% incidence of *Bipolaris sorokiniana* over control T_1 (farmer's stored seed).

Table 3. Effect of seed treatments on germination and incidence of *Bipolaris sorokiniana* on wheat seeds by blotter method

Treatments	Germination (%)	*Bipolaris sorokiniana* on seed surface (%)	Decrease (%) of *Bipolaris sorokiniana* over control
T_1	82.57 b	17.40 a	--
T_2	96.23 a	8.20 c	52.87
T_3	83.83 b	5.43 de	68.69
T_4	97.10 a	4.13 ef	76.15
T_5	83.83 b	10.33 b	40.56
T_6	96.16 a	5.60 d	67.73
T_7	82.93 b	5.67 d	67.34
T_8	96.07a	4.07 ef	76.53
T_9	83.57 b	4.67 def	73.08
T_{10}	96.43 a	3.70 f	78.63
$LSD_{(0.01)}$	1.31	1.43	--

T_1 =Farmer's stored seed (control)
T_2 = Apparently healthy seed
T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%
T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%
T_5 = Farmer's stored seed washed with water
T_6 = Apparently healthy seed washed with water
T_7 = Farmer's stored seed treated with brine solution @ 2%
T_8 = Apparently healthy seed treated with brine solution @ 2%
T_9 = Washed farmer's stored seed treated with brine solution @ 2%
T_{10} = Washed apparently healthy seed treated with brine solution @ 2%

4.2. Field experiment

4.2.1. Effect of seed treatments on emergence and plant growth of wheat

The emergence of wheat seedling was counted at 10 and 15 days after sowing (DAS) of seeds. Significant variation in percentage of seed germination at 10 DAS and 15 DAS among the treatments were found and are shown in Table 4. The germination percentage varied from 49.84% to 84.20% at 10 DAS and 55.54% to 86.08% at 15 DAS among the treatments. The highest germination was counted 84.20% and 86.08% at 10 and 15 DAS respectively, under the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%) and this was statistically similar to the treatment T_3 (Farmer's stored seed treated with vitavax-200 @ 0.4%) where germination was counted 82.32% and 83.92% at 10 DAS and 15 DAS, respectively. On the other hand the lowest germination (49.84% and 55.54% at 10 and 15 DAS, respectively) was recorded in the treatment T_1 (farmer's stored seed).

Significant variation in plant height among the treatments was observed and has shown in Table 4. Plant height varied from 64.80 to 86.83 cm. The highest Plant height (86.83cm) was recorded under the treatment T_4 treatment (apparently healthy seed treated with vitavax-200 @ 0.4%), which was statistically identical to the treatment T_3 (farmer's stored seed treated with vitavax-200 @ 0.4%), T_8 (apparently healthy seed treated with brine solution @ 2%) and T_{10} (washed apparently healthy seed treated with brine solution @ 2%). On the other hand the lowest plant height (64.80 cm) was recorded in the treatment T_1 (farmer's stored

seed) that was statistically similar to the treatment T_5 (farmer's stored seed washed with water) and T_9 (Washed farmer's stored seed treated with brine solution @ 2%).

The spike length did not show any significant variation among the treatments (table 4). The spike length varies from 14.68 to 13.02 cm that was not statistically significant (Table 4). The highest spike length was found 14.68 cm in T_4 treatment (apparently healthy seed treated with vitavax-200 @ 0.4%). On the contrary, the lowest spike length (13.02 cm) was recorded in the treatment T_1 (farmer's stored seed). Chemically treated seed gave the maximum spike length that might be take place due to chemically treated seed could be free from seed borne pathogens which influence the development of wheat spike.

While considering the length between panicle initiation and point of spike, no significant variation was found among the treatments (Table 4). The highest distance between the point of flag leaf initiation and base of ear (14.68 cm) was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%) and the lowest distance between the point of flag leaf initiation and base of ear (13.20 cm) was recorded in the treatment T_1 (farmer's stored seed).

Table 4. Effect of seed Treatment on germination, plant height, spike length and distance between the point of flag leaf initiation and base of ear of wheat

Treatments	Germination (%)		Plant height (cm)	Spike length (cm)	Distance between the point of flag leaf initiation and base of ear (cm)
	10 DAS	15 DAS			
T_1	49.84 d	55.54 e	64.80 f	13.02	13.20
T_2	68.64 b	75.97 b	75.61 cd	14.06	14.07
T_3	82.32 a	83.92 a	83.62 ab	14.32	14.32
T_4	84.20 a	86.08 a	86.83 a	14.68	14.68
T_5	57.58 c	65.08 d	66.82 ef	13.32	13.72
T_6	72.50 b	76.21 b	79.72 bc	14.24	14.42
T_7	52.50 cd	56.28 e	72.48 de	13.56	13.76
T_8	71.51 b	74.20 bc	80.12 abc	14.04	14.12
T_9	54.21 cd	66.28 d	70.16 def	13.52	13.80
T_{10}	56.42 cd	68.21 cd	80.22 abc	13.75	14.32
$LSD_{(0.01)}$	6.22	6.95	6.32	NS	NS

- NS = Non significant

T_1 =Farmer's stored seed (control)

T_2 = Apparently healthy seed

T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%

T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%

T_5 = Farmer's stored seed washed with water

T_6 = Apparently healthy seed washed with water

T_7 = Farmer's stored seed treated with brine solution @ 2%

T_8 = Apparently healthy seed treated with brine solution @ 2%

T_9 = Washed farmer's stored seed treated with brine solution @ 2%

T_{10} = Washed apparently healthy seed treated with brine solution @ 2%

4.2.2. Effect of seed treatment on leaf spot severity of wheat at panicle initiation stage

Disease severity at panicle initiation stage was recorded on flag leaf, Penulpimate leaf and 3rd leaf of wheat and found to have statistically significant variations (Table 5). The lowest disease severities were recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%), which was 0.01, 0.04 and 0.12 at flag leaf, flag leaf-1 and flag leaf-2, respectively. On the other hand the highest disease severities were obtained under the treatment T_1, which was 0.15, 0.42 and 1.08 on flag leaf, Penulpimate leaf and 3rd leaf of wheat, respectively.

4.2.3. Effect of seed treatment on leaf spot severity of wheat at flowering stage

Disease severity at flowering stage was recorded on flag leaf, Penulpimate leaf and 3rd leaf of wheat and was found statistically significant variation (Table 6). The lowest disease severities were recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%), which was 0.04, 0.12 and 0.42 on flag leaf, Penulpimate leaf and 3rd leaf, respectively. On the other hand the highest disease severities 0.52, 1.03 and 2.09 were obtained under the treatment T_1 (farmer's stored seed) that was on flag leaf, Penulpimate leaf and 3rd leaf flag leaf, Penulpimate leaf and 3rd leaf, of wheat, respectively.

Table 5. Effect of seed treatment on leaf spot severity of wheat at panicle initiation stage

Treatments	Disease severity at panicle initiation stage			
	Flag leaf	Penulpimate leaf	3rd leaf	Average
T_1	0.15 a	0.42 a	1.08 a	0.55 a
T_2	0.07 cd	0.21 d	0.66 c	0.31 d
T_3	0.02 e	0.06 f	0.18 f	0.09 g
T_4	0.01 e	0.04 g	0.12 g	0.05 h
T_5	0.06 cd	0.18 e	0.54 d	0.26e
T_6	0.10 b	0.31 b	0.80 b	0.40 b
T_7	0.08 c	0.25 c	0.68 c	0.0.34 c
T_8	0.06 d	0.18 e	0.49 de	0.24 f
T_9	0. cd	0.21 d	0.65 c	0.31 d
T_{10}	0.06 d	0.17 e	0.48 e	0.24 f
$LSD_{(0.01)}$	0.02	0.01	0.05	0.02

T_1 =Farmer's stored seed (control)

T_2 = Apparently healthy seed

T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%

T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%

T_5 = Farmer's stored seed washed with water

T_6 = Apparently healthy seed washed with water

T_7 = Farmer's stored seed treated with brine solution @ 2%

T_8 = Apparently healthy seed treated with brine solution @ 2%

T_9 = Washed farmer's stored seed treated with brine solution @ 2%

T_{10} = Washed apparently healthy seed treated with brine solution @ 2%

Table 6. Effect of seed treatment on leaf spot severity of wheat at flowering stage

Treatments	Disease severity at flowering Stage			
	Flag leaf	Penulpimate leaf	3rd leaf	Average
T_1	0.52 a	1.03 a	2.09 a	1.21 a
T_2	0.16 c	0.60 c	1.28 cd	0.68 d
T_3	0.08 f	0.18 f	0.54 f	0.26 g
T_4	0.04 g	0.12 g	0.42 f	0.19 h
T_5	0.15 c	0.54 de	1.18 de	0.62 e
T_6	0.24 b	0.66 b	1.50 b	0.80 b
T_7	0.16 c	0.60 c	1.42 b	0.72 c
T_8	0.10 e	0.51 de	1.08 e	0.56 f
T_9	0.12 d	0.56 cd	1.40 bc	0.69 d
T_{10}	0.09 ef	0.49 e	1.06 e	0.54 f
$LSD_{(0.01)}$	0.02	0.05	0.12	0.02

T_1 =Farmer's stored seed (control)

T_2 = Apparently healthy seed

T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%

T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%

T_5 = Farmer's stored seed washed with water

T_6 = Apparently healthy seed washed with water

T_7 = Farmer's stored seed treated with brine solution @ 2%

T_8 = Apparently healthy seed treated with brine solution @ 2%

T_9 = Washed farmer's stored seed treated with brine solution @ 2%

T_{10} = Washed apparently healthy seed treated with brine solution @ 2%

4.2.4. Effect of seed treatment on leaf spot severity of wheat at milking stage

Statistically significant variation was found in disease severity at milking stage was recorded on flag leaf, Penulpimate leaf and 3rd leaf of wheat (Table 7). The lowest disease severity was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%), which was 0.08, 0.28 and 0.72 on flag leaf, flag leaf, Penulpimate leaf and 3rd leaf, respectively. On the other hand, the highest disease severity was obtained under the treatment T_1 (farmer's stored seed) that were 0.76, 1.50 and 2.82 on flag leaf, Penulpimate leaf and 3rd leaf of wheat, respectively.

4.2.5. Effect of seed treatment on leaf spot severity of wheat at hard dough stage

Disease severity at hard dough stage was recorded on flag leaf, Penulpimate leaf and 3rd leaf of wheat and was found statistically significant variation (Table 8). The lowest disease severity was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%), which were 0.28, 0.72 and 1.52 on flag leaf, Penulpimate leaf and 3rd leaf, respectively. On the other hand the highest disease severities 1.48, 2.56 and 3.54 were obtained under the treatment T_1 (farmer's stored seed) that was on flag leaf, Penulpimate leaf and 3rd leaf of wheat, respectively.

Table 7. Effect of seed treatment on leaf spot severity of wheat at milking stage

Treatments	Disease severity at milking stage			
	Flag leaf	Penulpimate leaf	3rd leaf	Average
T_1	0.76 a	1.50 a	2.82 a	1.69 a
T_2	0.38 e	0.88 d	1.96 cd	1.07 e
T_3	0.18 g	0.52 f	0.98 f	0.56 i
T_4	0.08 h	0.28 g	0.72 g	0.36 j
T_5	0.66 b	1.32 b	2.21 b	1.39 b
T_6	0.32 f	0.76 e	1.68 e	0.92 g
T_7	0.54 c	1.27 bc	2.10 bc	1.30 c
T_8	0.30 f	0.70 e	1.70 e	0.90 h
T_9	0.44 d	1.21 c	2.02 c	1.22 d
T_{10}	0.32 f	0.72 e	1.80 de	0.94 f
$LSD_{(0.01)}$	0.05	0.09	0.16	0.02

T_1 = Farmer's stored seed (control)

T_2 = Apparently healthy seed

T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%

T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%

T_5 = Farmer's stored seed washed with water

T_6 = Apparently healthy seed washed with water

T_7 = Farmer's stored seed treated with brine solution @ 2%

T_8 = Apparently healthy seed treated with brine solution @ 2%

T_9 = Washed farmer's stored seed treated with brine solution @ 2%

T_{10} = Washed apparently healthy seed treated with brine solution @ 2%

Table 8. Effect of seed treatment on leaf spot severity of wheat at hard dough stage

Treatments	Disease severity at hard dough Stage			
	Flag leaf	Penulpimate leaf	3rd leaf	Average
T_1	1.48 a	2.56 a	3.54 a	2.52 a
T_2	0.70 c	1.68 cd	2.50cd	1.62 e
T_3	0.44 f	0.88f	1.96 e	1.09 h
T_4	0.28 g	0.72f	1.52 f	0.84 i
T_5	1.04 b	2.06 b	3.10 b	2.06 b
T_6	0.62 d	1.48 de	2.40 d	1.50 f
T_7	0.75 c	1.82 c	2.80 bc	1.79 c
T_8	0.60 d	1.60 cd	2.38d	1.52 f
T_9	0.52 e	1.70 cd	2.86 bc	1.69 d
T_{10}	0.42 f	1.32 e	2.32 de	1.35 g
$LSD_{(0.01)}$	0.08	0.22	0.38	0.05

T_1 =Farmer's stored seed (control)

T_2 = Apparently healthy seed

T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%

T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%

T_5 = Farmer's stored seed washed with water

T_6 = Apparently healthy seed washed with water

T_7 = Farmer's stored seed treated with brine solution @ 2%

T_8 = Apparently healthy seed treated with brine solution @ 2%

T_9 = Washed farmer's stored seed treated with brine solution @ 2%

T_{10} = Washed apparently healthy seed treated with brine solution @ 2%

4.2.6. Effect of seed treatment on spikelet formation of wheat

Considering the number of spikelets/ear different seed treatments did not differ significantly (Table 9). The lowest number of spikelets/ear (19.17) was recorded in the treatment T_1 (farmer's stored seed). On the contrary the highest number of spikelets/ear (20.10) was recorded in the treatment T_8 (apparently healthy seed treated with brine solution @ 2%).

Considering the number of healthy spikelets/ear different seed treatments did not differ significantly. (Table 9). The lowest number of healthy spikelets/ear (17.96) was recorded in the treatment T_1 (farmer's stored seed). On the contrary the highest number of healthy spikelets/ear (20.04) was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%.

Considering the number of diseased spikelets/ear different seed treatments did differ significantly. (Table 9). The highest number of diseased spikelets/ear (1.21) was recorded at the treatment T_1 (farmer's stored seed). On the other hand the lowest number of diseased spikelets/ear (0.04) was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%.

Table 9. Effect of seed treatment on number of spikelets / ear, number of healthy spikelets / ear and number of diseased spikelets/ ear of wheat.

Treatments	Number of spikelets / ear	Number of healthy spikelets / ear	Number of diseased spikelets/ ear
T_1	19.17	17.96	1.21 a
T_2	19.64	19.40	0.24 de
T_3	19.96	19.84	0.12 f
T_4	20.08	20.04	0.04 g
T_5	19.23	18.65	0.58 b
T_6	19.78	19.56	0.22 de
T_7	19.18	18.82	0.36 c
T_8	20.10	19.92	0.18 ef
T_9	19.49	19.21	0.28 d
T_{10}	19.60	19.36	0.24 de
$LSD_{(0.01)}$	NS	NS	0.07

NS = Non significant
T_1 =Farmer's stored seed (control)
T_2 = Apparently healthy seed
T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%
T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%
T_5 = Farmer's stored seed washed with water
T_6 = Apparently healthy seed washed with water
T_7 = Farmer's stored seed treated with brine solution @ 2%
T_8 = Apparently healthy seed treated with brine solution @ 2%
T_9 = Washed farmer's stored seed treated with brine solution @ 2%
T_{10} = Washed apparently healthy seed treated with brine solution @ 2%

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

Number of grains/ear, number of healthy grains/ear and number of diseased grains/ear varied significantly in respect of different physical and chemical seed treatments. (Table 10).

Number of grains/ear ranged from 33.03 to 40.60 where the highest and lowest counts were made under the treatments T_4 (40.60) and T_1 (33.03) respectively. The treatments T_3, T_4, T_6 and T_8 resulted statistically similar effect in producing grains/ear. All the treatments differed significantly from the treatment T_1 (farmer's stored seed) in producing number of grains/ear.

Significant variations were recorded among the treatment under the present trial in number of healthy grains/ear (Table 10). The lowest number of healthy grains/ear (30.00) was recorded in the treatment T_1 (farmer's stored seed). On the other hand, the highest healthy grains/ear (40.32) was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%).

Significant variations were recorded among the treatment under the present trial in number of diseased grains/ear (Table 10). The highest diseased grains/ear (3.03) was recorded in the treatment T_1 (farmer's stored seed), which was closely followed by T_5 treatment (farmer's stored seed washed with water). On the other

hand the lowest diseased grains/ear (0.28) was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%) that was statistically identical to the treatment T_3 (farmer's stored seed treated with vitavax-200 @ 0.4%).

Considering the weight of healthy grains/ear there were no significant variations among the treatments (Table 10). But the lowest weight of healthy grain/ear (1.29 g) was recorded in the treatment T_1 (farmer's stored seed). On the other way the highest weight of healthy grains/ear (1.75 g) was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%).

Considerable variation was recorded among the treatments under the present piece of experiment in weight of diseased grains/ear (Table 10). The highest weight of diseased grains/ear (0.16 g) was recorded in the treatment T_1 (farmer's stored seed), which was closely followed by T_5 treatment (farmer's stored seed washed with water). On the other hand the lowest weight of diseased grains/ear (0.03 g) was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%) that was closely followed by T_3 (farmer's stored seed treated with vitavax-200 @ 0.4%). From the results it was observed that farmer's stored seed gave the highest weight of diseased grains/ear.

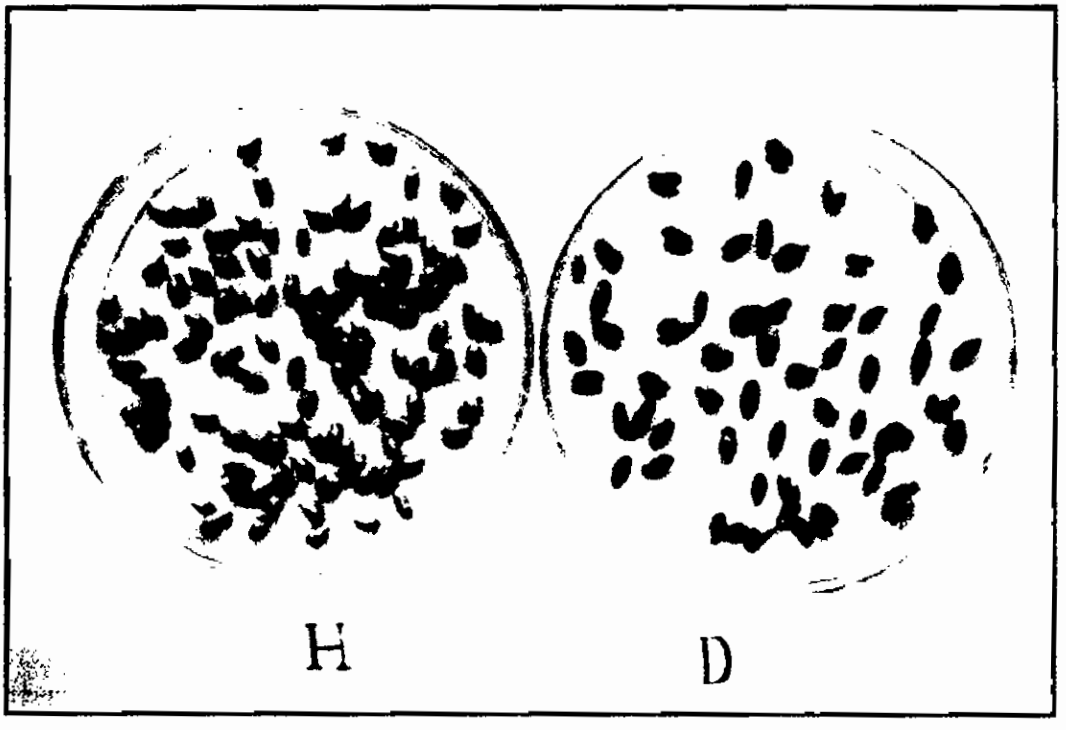


Fig. 12. Apparently healthy and diseased grains of wheat

Table 10. Effect of seed treatment on number of grains / ear, number of healthy grains / ear, number of diseased grains/ ear, weight of grains/ ear, weight of healthy grains/ ear and weight of diseased grains / ear 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	33.03 e	30.0 c	3.03 a	1.45	1.29	0.16 a
T_2	38.24 bc	37.04 ab	1.20 c	1.60	1.54	0.06 cd
T_3	39.75 ab	39.25 ab	0.51 f	1.67	1.63	0.04 ef
T_4	40.60 a	40.32 a	0.28 g	1.78	1.75	0.03 f
T_5	36.83 d	35.22 b	1.61 b	1.52	1.44	0.08 b
T_6	39.31ab	38.34 ab	0.97 de	1.65	1.55	0.06 cde
T_7	35.77 d	34.68 bc	1.09 cd	1.67	1.60	0.07 bc
T_8	39.34ab	38.52 ab	0.82 e	1.71	1.65	0.06 cd
T_9	36.87 bc	35.63 ab	1.24 c	1.65	1.58	0.07 bc
T_{10}	37.62 c	36.82ab	0.80 ef	1.73	1.68	0.05 de
$LSD_{(0.01)}$	1.52	5.08	0.18	NS	NS	0.02

NS = Non significant
T_1 =Farmer's stored seed (control)
T_2 = Apparently healthy seed
T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%
T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%
T_5 = Farmer's stored seed washed with water
T_6 = Apparently healthy seed washed with water
T_7 = Farmer's stored seed treated with brine solution @ 2%
T_8 = Apparently healthy seed treated with brine solution @ 2%
T_9 = Washed farmer's stored seed treated with brine solution @ 2%
T_{10} = Washed apparently healthy seed treated with brine solution @ 2%

4.2.8. Effect of seed treatment on number of grains/ear of different grades of wheat

A significant variation was recorded in consideration grade-0 seed under the scaling of 0-5 scale (Table 11). The highest grade-0 seeds were recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%) that were 40.32 while the lowest were recorded in the treatment T_1 (farmer's stored) that were 30.00. The highest grade-1 seed (0.80) was recorded in the treatment T_1 and the lowest (0.20) was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%), which was closely followed by T_3 (farmer's stored seed treated with vitavax-200 @ 0.4%) and T_8 (apparently healthy seed washed with brine solution @ 2%). In case of grade-2 grains/ear the highest counts (0.60) were recorded in the treatment T_1 (farmer's stored seed) and the lowest (0.00), which was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%). Considering grade-3 grains/ear it was found that the highest infected seed (0.40) was recorded in the treatment T_1 (farmer's stored seed) and the lowest infected seed (0.00) was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%). In grade-4 grains/ear the highest counts (0.30) was recorded in the treatment T_1 and the lowest (0.08) was recorded in the treatment T_3 (farmer's stored seed treated with vitavax-200 @ 0.4%). In case of grade-5 grains/ear the highest infected seed (0.93) was recorded in the treatment T_1 (farmer's stored seed). The lowest infected seed (0.00), which was

recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%) and also T_3 (farmer's stored seed treated with vitavax-200 @ 0.4%)

4.2.9. Effect of seed treatment on 1000- seed weight and yield of wheat

1000-seed weight did not differ significantly among the treatments under the present trail. (Table 12). The 1000-seed weight of wheat varied from 29.22 g to 36.17 g. where the highest weight of 1000- seed (36.17 g) was recorded in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%). On the contrary the lowest weight of 1000- seed (29.22 g) was recorded in the treatment T_1 (farmer's stored seed). From the above-mentioned result it was found that highest infected seed was recorded from farmers stored seed.

Considering the straw yield of wheat per hectare a significant variation was recorded among the treatments (Table 12). Straw yield under the treatment varied from 4.00 to 6.16 t/ha. The highest straw yield was recorded 6.16 t/ha in the treatment T_3 (farmer's stored seed treated with vitavax-200 @ 0.4%) that was statistically identical (6.00 t/ha) in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%). On the other hand the lowest straw yield (4.00 t/ha) was recorded in the treatment T_1 (farmer's stored seed) that was closely followed by T_2, T_8, T_9 and T_{10}.

A significant variation was recorded in grain yield of wheat per hectare under the experiment (Table 12). From this experiment grain yield of wheat varied from 2.00 to 3.50 t/ha. The highest grain yield was found 3.50 t/ha in treatment the T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%), which was statistically similar to the treatment T_3 (farmer's stored seed treated with vitavax-200 @ 0.4%). On the contrary the lowest grain yield (2.00 t/ha) was recorded in the treatment T_1 (farmer's stored seed). All the treatment differed significantly from T_1 (farmer's stored seed in respect of grain yield (t/ha). The treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%) resulted 75% increased yield over control.

Table 11. Effect of seed treatment on number of grains/ear of different grades of wheat

Treatments	Grading of seeds (0-5 scale)					
	0	1	2	3	4	5
T_1	30.00c	0.80a	0.60a	0.40b	0.30a	0.93a
T_2	37.04ab	0.60b	0.20d	0.00e	0.10b	0.30bc
T_3	39.25ab	0.40d	0.10e	0.00e	0.01c	0.00e
T_4	40.32a	0.20e	0.00f	0.00e	0.08b	0.00e
T_5	35.22b	0.45cd	0.40b	0.30c	0.12b	0.34b
T_6	38.34ab	0.52bc	0.12e	0.12d	0.00c	0.21cd
T_7	34.68bc	0.50bcd	0.20d	0.09a	0.00c	0.30bc
T_8	38.52ab	0.40d	0.20d	0.00e	0.00c	0.22cd
T_9	35.63ab	0.60b	0.32c	0.12d	0.00c	0.20cd
T_{10}	36.82ab	0.40d	0.10e	0.00e	0.12b	0.18d
$LSD_{(0.01)}$	5.08	0.10	0.06	0.05	0.05	0.10

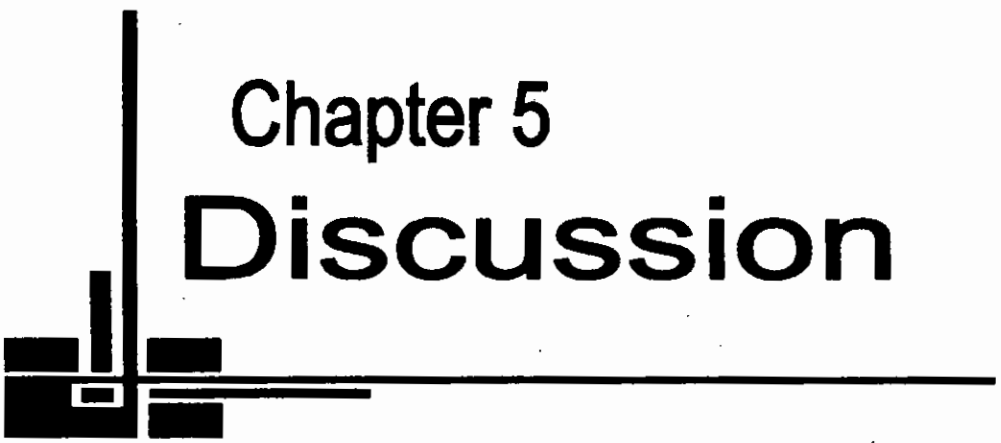
T_1 =Farmer's stored seed (control)
T_2 = Apparently healthy seed
T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%
T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%
T_5 = Farmer's stored seed washed with water
T_6 = Apparently healthy seed washed with water
T_7 = Farmer's stored seed treated with brine solution @ 2%
T_8 = Apparently healthy seed treated with brine solution @ 2%
T_9 = Washed farmer's stored seed treated with brine solution @ 2%
T_{10} = Washed apparently healthy seed treated with brine solution @ 2%

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

Table 12. Effect of seed treatment on 1000 seed weight and yield of wheat

Treatments	1000- seed weight (g)	Straw yield (t/ha)	Grain yield (t/ha)	% Grain yield increased over control
T_1	29.22	4.00 d	2.00 d	--
T_2	33.82	5.50 ab	3.00 b	50.00
T_3	35.24	6.16 a	3.41 a	70.50
T_4	36.17	6.00 a	3.50 a	75.00
T_5	31.26	4.70 c	2.50 c	25.00
T_6	34.32	5.90 ab	2.91 bc	45.50
T_7	32.08	5.25 bc	2.75 bc	37.50
T_8	33.80	5.70 ab	3.00 b	50.00
T_9	32.68	5.51 ab	2.72 bc	36.00
T_{10}	34.27	5.75 ab	2.95 b	47.50
$LSD_{(0.01)}$	NS	0.58	0.37	-

NS = Non significant
T_1 =Farmer's stored seed (control)
T_2 = Apparently healthy seed
T_3 = Farmer's stored seed treated with vitavax-200 @ 0.4%
T_4 = Apparently healthy seed treated with vitavax-200 @ 0.4%
T_5 = Farmer's stored seed washed with water
T_6 = Apparently healthy seed washed with water
T_7 = Farmer's stored seed treated with brine solution @ 2%
T_8 = Apparently healthy seed treated with brine solution @ 2%
T_9 = Washed farmer's stored seed treated with brine solution @ 2%
T_{10} = Washed apparently healthy seed treated with brine solution @ 2%



Chapter 5
Discussion

5. DISCUSSION

Different methods of seed treatment differed significantly in respect to incidence of seed borne *Bipolaris sorokiniana.* The highest incidence of *Bipolaris sorokiniana* was counted (17.40%) under the treatment T_1 (farmer's stored seed) and the lowest incidence was counted (3.70%) under the treatment T_{10} (washed apparently healthy seed treated with brine solution @ 2%). The treatment T_{10} reduced 78.63% incidence of *Bipolaris sorokiniana* over control T_1 (farmer's stored seed). 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 stored seed). The findings of the present study corroborates with the findings of Hasan (2000). In a similar type of experiment with rice, he reported that highest incidence of *Bipolaris oryzae* (3.5%) was found in discoloured and diseased seeds. He also reported that seeds became free from *Bipolaris oryzae* when washed with brine solution or seed cleaning followed by washing in normal water.

The highest germination was counted in the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%). While the lowest germination was recorded in the treatment T_1 (farmer's stored seed). It reveals that farmer's stored seed have the lowest germination percentage. This might be happened due to lack of proper storage facilities, germination inhibitory fungus or other microorganism. On the other hand chemically treated seed gave the highest germination percentage, which was due to destroying of germination inhibitory fungus or other microorganisms.

Seed cleaning (apparently healthy seed) followed by washing also gave higher germination percentage. This result indicates that pathogenic fungal associations with the seed and lack of proper storage facilities have profound effect on germination. The findings of the present study corroborates with the study of Hasan (2000). He reported that physically sorted seed (apparently healthy seeds) showed higher germination (75%) than farmer's stored seed. The findings of the present study also corroborates with the study of Uddin (2005) who observed that germination percentage was higher in physically sorted seeds over control (untreated seeds). Brine solution treated seed also exhibited comparatively lower germination percentage this might be due to formation of germination inhibitory substances. The findings of the present study corroborates with the study of Hasan (2000).

The highest plant height (86.83 cm) was observed in T_4 (apparently healthy seed treated with Vitavax-200 @ 0.4%) followed by T_3 (farmer's stored seeds treated with Vitavax-200 @ 0.4%), T_{10} (washed apparently healthy seed treated with brine solution @ 2%), apparently healthy seeds treated with brine solution @ 2% (T_8) and apparently healthy seeds washed with water (T_6). The findings of the present study keep in with the findings of Hasan (2000). He reported that the highest plant height (117.8cm) was observed in farmer's seed washed with brine solution (20%) followed by farmer's cleaned seed and farmer's cleaned and washed seed of rice (BR 11) at BAU farm.

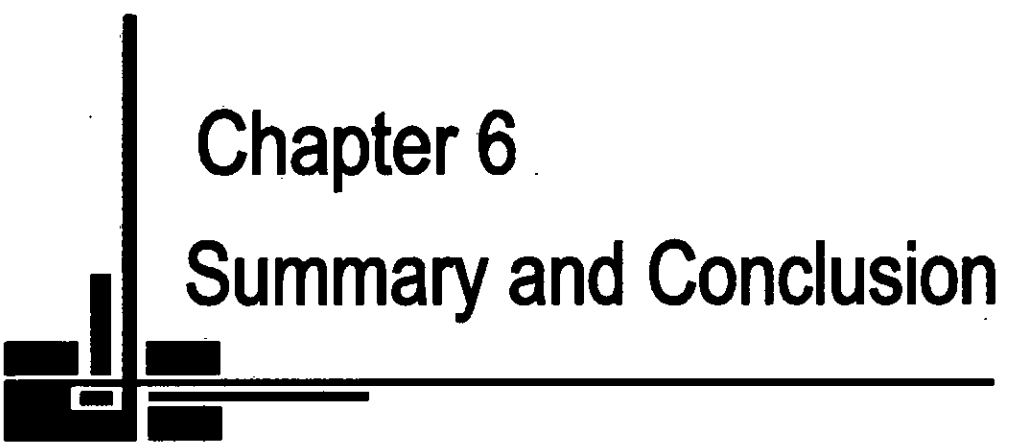
It was found that the farmer's stored seed (T_1) always resulted significantly highest leaf spot severity of wheat at panicle initiation stage, flowering stage, milking stage and hard dough stage, whereas the treatment T_4 (apparently healthy seed treated with vitavax-200 @ 0.4%) resulted minimum disease severity. All the treatments significantly reduced lower leaf spot severity over control (T_1). From the present study it has been found that apparently healthy seed treated with Vitavax-200, brine solution and washing in water resulted the lower disease severity. The findings of the present study are supported by Hasan (2000). He reported that seed cleaning and washing reduced the disease severity of rice over farmer's stored seed. The findings of the present study also corroborates with the

findings of Hossain and Asad-ud-Doullah (1998). They reported that cleaning and washing of farmer's stored seed of rice reduced the seedling diseases up to 53.87% over the unclean farmer's stored seed. Uddin (2005) found the highest reduction of fungal flora in case of chemical treatment followed by garlic extract, brine solution, hot water and physically sorted seed in lentil.

It was found that the farmer's stored seed (T_1) always resulted significantly the lowest number of grains/ear, healthy grains/ear and diseased grains/ear, whereas the treatment T_4 (apparently healthy seeds treated with Vitavax-200) resulted highest number of grains /ear (40.60) and healthy grains /ear (40.32) and the lowest diseased grains/ear (0.28) which was closely followed by farmer's stored seed treated with Vitavax-200 (T_3) and apparently healthy seeds treated with brine solution (T_8) and apparently healthy seeds washed with water (T_6). The findings of the present study supported by Hasan (2000). He reported that seed cleaning, washing and treated with brine solution increased number of grains /ear and healthy grains /ear of rice over farmer's stored seed. The findings of the present study also corroborates with the findings of Rahman *et al.* (2000). They reported that seed treated with Vitavax-200 and manually sorted seed produced the highest number of healthy seed.

Considering seed yield, it was observed that the highest grain yield (3.5 t/ha) was observed in T_4 (apparently healthy seeds treated with Vitavax-200) and the lowest grain yield (2.0 t/ha) was recorded in T_1 (farmer's stored seed). It was found that seed sorting, washing and seed treatment with brine solution and vitavax-200 increased grain yield over the control (T_1). It was observed that grain yield was increased by 50%, 70.50%, 75%, 25%, 45.50%, 37.50%, 50%, 36% and 47.50% for the treatments, apparently healthy seeds (T_2), farmer's stored seed treated with Vitavax-200 @ 0.4% (T_3), apparently healthy seeds treated with Vitavax-200 @ 0.4% (T_4), farmer's stored seed washed with water (T_5), apparently healthy seed washed with water (T_6), farmer's stored seed treated with brine solution @ 2% (T_7), apparently healthy seed treated with brine solution @ 2% (T_8), washed farmer's stored seed treated with brine solution @ 2% (T_9) and washed apparently healthy seed treated with brine solution @ 2% (T_{10}), respectively. The findings of the present study corroborates with the findings of Hasan (2000). He reported that grain yield of rice was increased by 24.39%, 23.18%, 32.93%, and 28.05% for the treatments, farmer's cleaned seed, farmer's seed washed with water, farmer's seed washed with brine solution (20% NaCl) and farmer's cleaned and washed with water, respectively. The findings of the present study also corroborates with the findings of Hossein (2002). He 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 stored seed of rice (cv. BR11).



Chapter 6
Summary and Conclusion

6. Summary and Conclusion

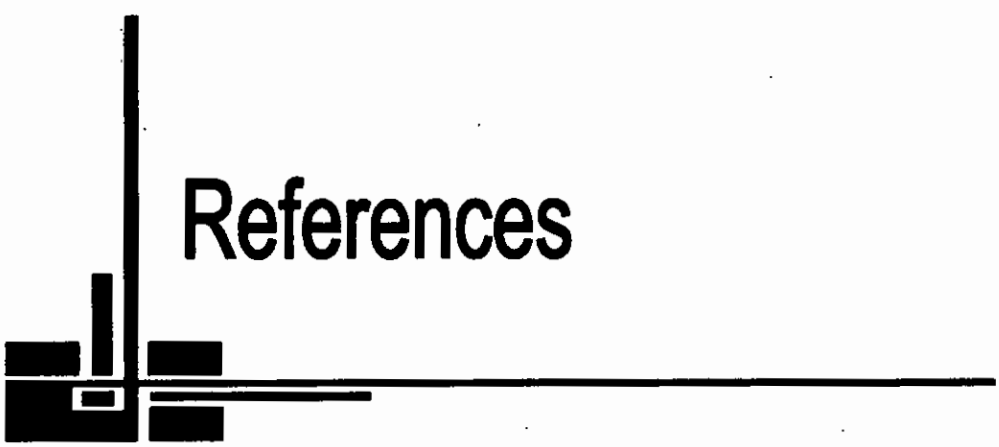
An experiment was conducted at the Farm of Sher-e-Bangla Agricultural University, Dhaka during the period from December 2005 to April 2006 to study the effect of physical and chemical seed treatments on leaf spot (*Bipolaris sorokiniana*) and grain yield of wheat. There were 10 methods viz. farmer's stored seed (T_1), apparently healthy seed (T_2), farmer's stored seed treated with Vitavax-200 @ 0.4% (T_3), apparently healthy seed treated with Vitavax-200 @ 0.4% (T_4), farmer's stored seed washed with water (T_5), apparently healthy seed washed with water (T_6), farmer's stored seed treated with brine solution @ 2% (T_7), apparently healthy seed treated with brine solution @ 2% (T_8), washed farmer's stored seed treated with brine solution @ 2% (T_9) and washed apparently healthy seed treated with brine solution @ 2% (T_{10}). including farmer's generally useable practices with the viewing of the objectives to identify the best pratice for farmers level cultivation of wheat cv. Kanchan. Data on emergence of seedlings yield and yield contributing characters and reatdisease severity at panicle initiation, flowering, milking and hard dough stages were studied. The data were statistically analyzed for find out the suitable practices for the farmers.

The emergence of wheat seedlings were counted at 10 and 15 DAS. The germination was varied from 49.84% to 84.20% at 10 DAS and 55.54% to 86.06%

at 15 DAS among the treatments which was applied on wheat seeds.The highest germination was counted 84.20% and 86.08% at 10 and 15 DAS in the treatment T_4 and the lowest germination 49.84% and 55.54% at 10 and15 DAS respectively was recorded in the treatment T_1.

The lowest disease severities were recorded in the treatment T_4, which was 0.01 0.04 and 0.12 at flag leaf, 2nd leaf and 3rd leaf, respectively and on the other hand the highest disease severities were obtained under the treatment T_1, which was 0.15, 0.42 and 1.08 on flag leaf, 2nd leaf and 3rd leaf at panicle initiation stage of wheat, respectively. The lowest disease severities were recorded in the treatment T_4, which was 0.04, 0.12 and 0.42 on flag leaf, 2nd leaf and 3rd leaf, respectively and on the other hand the highest disease severities 0.52, 1.03 and 2.09 were obtained under the treatment T_1, which was on flag leaf, 2nd leaf and 3rd leaf at flowering stage of wheat, respectively. The lowest disease severities were recorded in the treatment T_4, which was 0.08, 0.28 and 0.72 on flag leaf, 2nd leaf and 3rd leaf, respectively and on the other hand the highest disease severities 0.76, 1.50 and 2.82 were obtained under the treatment T_1, which was on flag leaf, 2nd leaf and 3rd leaf at milking stage of wheat, respectively. The lowest disease severities were recorded in the treatment T_4, which was 0.28, 0.72 and 1.52 on flag leaf, 2nd leaf and 3rd leaf, respectively and on the other hand the highest disease

Seed treatment with Vitavax-200 resulted maximum yield but it is costly and not environmentally sound for sustainable agriculture compared to other treatments used in the present study. From the findings of present study, it is well focused on the importance of seed sorting and washing for controlling seed borne pathogens of wheat. Seed sorting and washing techniques are easy, economic and will be accepted by the farmer's and they will save their money without purchasing costly seed treating chemicals. As a result, environment and as well as a whole the nation will be benefited. However, more investigations need to be carried out for the consecutive years in different Agro Ecological Zones of Bangladesh for its fitness.



References

REFERENCES

Ahmed, S. M. and Meisner, C. (1996). Wheat Research and Development in Bangladesh, 1st.ed. Published by Bangladesh. Australia Wheat Improvement Project and CIMMYT, Bangladesh. 20p.

Alam, K. B., Shaheed, M. A. Ahmed, A. U. and Malaker, P. K.(1994). Bipolaris leaf blight (spot blotch) of wheat in Bangladesh. Mexico, DF (Mexico), CIMMYT. 334-342pp.

Alam, K. B., Shaheed, M. U., Ahmed, F. and Haque, M. S. (1995). Yield loss assessment of wheat due to Bipolaris leaf blight in Bangladesh. Bangladesh J. Plant Pathology. 11 (1-2): 35-38.

Agarwal, P. C.; Mortensen, C. N. and Mathur, S. B. (1989). Seed-borne diseases and seed health testing of rice. Danish Govt. Inst. Seed Path. Copenhagen, Denmark. 14p.

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

Benoit, M. A. and Mathur, S. B. (1970). Identification of species of *Curvularia lunata* on rice seed. In: Proc. Int. Seed Test. Assoc. 35: 99-111.

Bedi, K. S. and Gill, H. S. (1960). Losses caused by brown leaf spot disease of rice in Panjab. Indian phytopathology 13 (20): 161-164.

Christensen, C. M. and Kaufmann, H. H. (1965). Deterioration of stored grains by fungi. Ann. Rev. Phytopath. 3: 69-81.

Bhuiyan, M. S. I. (2005). Effect of vermicompost and NPK on the growth, chemical composition and yield of wheat. M. S. Thesis, Department of Soil Science, Sher-e-Bangla Agricultural University. 18p.

Duveiller, E. and Gilchrist, L. (1994). Production constraints due to *Bipolaris sorokiniana* in wheat: Current situation and future prospects. In D. A. Saunders and G. P. Hettle ends. 1994. Wheat in Heat stressed Environments: Irrigated. Dry Areas and Rice-wheat Farming systems. DF. CIMMYT. 343-352pp.

Ellis, M. B. (1971). Dematiaceous Hypomycetes. CMI, Kew Surry, England. 507p.

Fakir, G. A. (1982). Annotated list of seed borne diseases in Bangladesh. Agriculture information service, Dhaka, Bangladesh.15p.

Fakir, G. A. (1999a). An Annotated list of seed borne disease in Bangladesh. Seed Pathology Laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh (in press). 52p.

Fakir, G. A. (2000). Estimation of yield loss of Major Crops of Bangladesh caused by diseases. Seed Pathology Centre Dept. of plant pathology, BAU, Mymensingh.

Fakir, G. A.; I. Hossain and Ahmad, M. U. (2000). Quality of farmers' saved rice seed in Bogra, Rajshahi and Rangpur sites of Bangladesh. Paper presented in the Review and planning workshop on rice seed health improvement for increasing yield and reducing pest pressure in Bangladesh, held on 25-26 Nov. 2000. Dhaka.

FAO. (2000). Production Yearbook. Food and Agriculture Organization of the United Nations, Italy, Rome, 62p.

Gilchrist, L. I. (1985). CIMMYT Methods for screening wheat for *Helminthosporium sativum* Resistance. In: wheat for more tropical environment-A proceedings of the international symposium Sept. 24-28. 1984. Mexico, D. F. Sponsored by: The united Nations Development Programme and CIMMYT. 149-151pp.

Gworgwor-NA, Huda-AI and Joshua-SD. (2002). Seed treatment of sorghum varieties with brine (NaCl) solution for control of *Striga hermonthica* in sorghum. Department of crop science, Faculty of Agriculture, University of Maiduguri, Borno state, Nigeria. Crop-Protection. 21: 10, 1005-10021; 24 ref.

Hanson, E. W. and Christinsen, J. J. (1953). The black Point Disease in the United State. Tech. Bull. 206, University of Minnesota.

Hasan, M. M. (2000). Effect of seed cleaning and washing on germination, disease incidence and yield of rice BR-11 (Mukta) M. S. Thesis, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh.

Hossain, I and Azad, A. K. (1992). Reaction of wheat to *Helminthosporium sativum* in Bangladesh. Hereditas 116 (1-2): 203-205.

Hossain, I. and Asad-ud-Doullah, M. (1998). Pilot projects Research. Paper presented at the DGISP Workshop ii "Future Strategies for research, Training and Development of Seed Pathology in Bangladesh" held on 10 December 1998 at BARC, Dhaka, Bangladesh.

Hossein, M. E. (2002). Effect of seed treatment on the incidence of seed borne fungal diseases, yield and seed quality of rice. M. S. thesis, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. 1-126pp.

ISTA. (1999). International Rules for Seed Testing. Seed Science and Technology, 27, Supplement, 333p.

Kabir, H. (2003). Effect of seed treatment on the incidence of fungal diseases, seed yield and seed quality of Boro rice. M. S. thesis, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. 50-70pp.

Khanum, M., Nigar, Y. and Khanzada, A. K. (1987). Effect of black point disease on the germination of wheat varieties. Pakistan Journal of Agicultureal Research 8(4): 467-473.

Krishi Projukti Hatboi (Handbook on Agro-technology), 3rd edition (reprint), Bangladesh Agricultural Research Institute, Gazipur 1701, Bangladesh. 10p.

Majumder, M. (1991). Crops of Eastern India. West Bengal stage Book Board. Arg. Mamson (8th floor). C/A, Raja Subodh Mallik square, Calcutta. 85p.

Malone, G. P. and Muskett, A. E. (1964). Seed borne fungi. Description of 77 fungus species. In: Proc. Int. Seed Test. Assoc. 29 (2): 180-183pp.

Motaher, M. (2000). Effect of different levels of black pointed seed on germination, seedling vigour, plant stand and seed quality of wheat. M. S. Thesis, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Rahman, A. J. M. M; Islam; M. A., Mia, T. (2000). Evaluation of cleaning methods to improve the quality of farmers' saved rice seed. Bangladesh J. Plant Pathology. 16 (1-2): 39-42.

Rashid, A. Q. M. B. and Fakir, G. A (1998). Seed- borne nature and transmission of Bipolaris sorokiniana in wheat. First national workshop on seed pathology. Progress and prospect of seed pathological reserch in Bangladesh. Department of Plant Pathology, Bangladesh Agricutural University, Mymensingh.

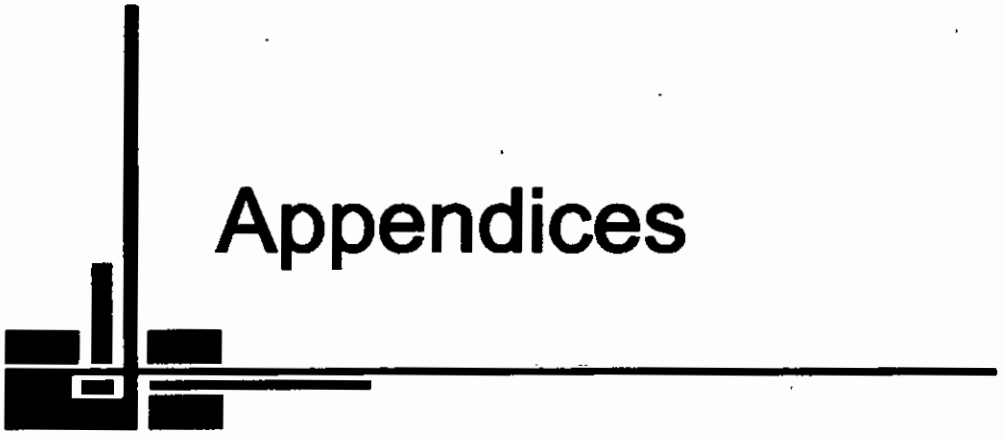
Rashid,A. Q. M. B. and Fakir, G. A. (2000). Impact of Seed health on Sustainable Crop Production in Bangladesh CO-operation, Yearly J. 24-36pp.

Razzaque, M. A. and Hossain, A. B. S. (1991). "Wheat for the non-traditional warm areas" edited by D. A. Saunders. Proc. International Conf. Held in July 29 to August 3, 1990 in foz do Iguacu, Brazil. CIMMYT. 44-54pp.

Sachan, I. P. and Agarwal,V. K. (1994). Effect of seed discolouration of rice on germination and seedling vigour. Seed Research 22 (1): 39-44.

Siddique, M. M. A. (2003). Effect of cleaning by sieving on germination and health of wheat seeds. M. S. thesis, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. 20-56pp.

Uddin, M. J. (2005). Effect of seed treatment on disease incidence of lentil. M. S. thesis, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. 45-54pp.



Appendices

APPENDICES

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

Sources of variation	Degree of freedom	Mean square				
		Germination (%)		Plant height (cm)	Spike length (cm)	Length between panicle initiation and point of spike (cm)
		10 DAS	15 DAS			
Replication	2	0.093	1.539	38.28	1.616	0.245
Treatment	9	470.54**	325.57**	160.09**	0.772	0.555
Error	18	13.168	16.40	13.58	2.389	1.992

DAS: Day After Sowing

** Significant at 1% level of significance

Appendix II. 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	Penulpimate leaf	3rd leaf	Flag leaf	Penulpimate leaf	3rd leaf
Replication	2	0.00	0.00	0.001	0.001	0.001	0.0001
Treatment	9	0.005**	0.037**	0.237**	0.056**	0.190**	0.685**
Error	18	0.0001	0.0001	0.001	0.0001	0.001	0.005

DAS: Day After Sowing
** Significant at 1% level of significance

df : Degrees of freedom

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

Sources of variation	Degree of freedom	Mean square					
		Disease severity at Milking Stage			Disease severity at Hard dough Stage		
		Flag leaf	Penulpimate leaf	3rd leaf	Flag leaf	Penulpimate leaf	3rd leaf
Replication	2	0.005	0.000	0.000	0.003	0.032	0.193
Treatment	9	0.131**	0.463**	1.079**	0.365**	0.860**	0.985**
Error	18	0.001	0.003	0.009	0.002	0.017	0.049

** Significant at 1% level of significance

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

Sources of variation	df	Mean square					
		Healthy spikelets/ ear	Diseased spikelets/ ear	Healthy grains/ear (No.)	Disease grains/ear (No.)	Healthy grains/ear (wt.)	Wt. of diseased grains/ear (g)
Replication	2	1.225	0.008	0.361	0.026	0.001	0.0001
Treatment	9	1.202	0.340**	69.09**	1.744**	0.052	0.004**
Error	18	0.993	0.002	10.05	0.011	0.047	0.0001

** Significant at 1% level of significance

df : Degrees of freedom

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

Sources of variation	df	Mean square				
		Healthy seeds/plant	Diseased seeds/plant	Straw yield (t/ha)	Grain yield (t/ha)	1000 seed weight (g)
Replication	2	7.726	0.007	0.0001	0.003	13.307
Treatment	9	25.967*	0.900**	1.291**	0.552**	12.399**
Error	18	7.572	0.002	0.115	0.048	7.695

* Significant at 5% level of significance
** Significant at 1% level of significance
df : Degrees of freedom

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

Sources of variation	Degree of freedom	Mean square				
		Grading of seeds (0-5 scale)				
		1	2	3	4	5
Replication	2	0.0001	0.000	0.001	0.0001	0.001
Treatment	9	0.077**	0.092**	0.060**	0.027**	0.202**
Error	18	0.003	0.001	0.001	0.0001	0.001

** 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.