POTENTIALITY OF PLANT EXTRACT IN CONTROLLING LEAF BLIGHT *(Bipolaris sorokiniana)* OF WHEAT

MD. ALAUL ISLAM

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

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BY
MD. ALAUL ISLAM
Registration No. 00943

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Approved by:

(Dr. F. M. Aminuzzaman)	**(Dr. Md. Rafiqul Islam)**
Assistant Professor	**Professor**
Supervisor	**Co-supervisor**

(Professor Mrs. Nasim Akhtar)
Chairman
Examination Committee


Dedicated TO
MY
Beloved Parents

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BY

MD. Alaul Islam

ABSTRACT

Potentiality of plant extract in controlling leaf blight (*Bipolaris sorokiniana*) of wheat was carried out during the period from june, 2006 to March, 2007. The experiments were conducted in the Seed Health Laboratory, Department of Plant Pathology and in the farm of the Sher-e-Bangla Agricultural University, Dhaka. Primarily 24 plant species were evaluated for their antifungal activity against *B. sorokiniana* by an *invitro* test. Among them 13 species were found promising and selected for field evaluation against leaf blight disease. All the plant extracts reduced the incidence of *B. sorokiniana* over untreated control. The highest reduction was found in case of treating seeds with turmeric rhizome extract. Among the botanicals, durba leaf extract performed the highest percent of healthy seedlings. It has been observed that allamanda leaf extract showed the highest germination and highest vigor index in compare to control. Among the botanicals onion bulb extract treated seeds resulted lowest leaf blight severity in compare to untreated control. Seed treatment with onion bulb extract also showed the best result in producing higher number of spikelets/ear, number of grains/ear, weight of grain/panicle and weight of straw/panicle in compared to untreated control. The treatment T_2 (Onion bulb extract) and T_{11} (Allamanda leaf extract) resulted highest grain yield (3.92 g/plot) over untreated control.

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ABBREVIATIONS USED

AEZ	=	Agro-Ecological Zone
@	=	At the rate
Anon.	=	Anonymous
BARI	=	Bangladesh Agricultural Research Institute
BAU	=	Bangladesh Agricultural University
CIMMYT	=	International Maize and Wheat Improvement Center
cm	=	Centimeter
CT	=	Conventional tillage
cv.	=	Cultivar (s)
DAS	=	Days after sowing
DMRT	=	Duncan's Multiple Range Test
e.g.	=	Example
g	=	Gram
FAO	=	Food and Agriculture Organization
GY	=	Grain yield
ha	=	Hectare
HLB	=	*Helminthosporium* leaf blight
hr	=	Hour
i.e.	=	That is
K	=	Potassium
Kg	=	Kilogram
lb	=	Pound
LSD	=	Least significant difference
m	=	Meter
mm	=	Millimeter
MP	=	Muriate of potash

N	=	Nitrogen
NT	=	Not conventional tillage
P	=	Phosphorus
PDA	=	Potato Dextrose Agar
RCBD	=	Randomized Complete Block Design
S	=	Sulphur
SAU	=	Sher-e-Bangla Agricultural University
T	=	Treatment
t / ha	=	Ton per hectare
TSP	=	Triple Super Phosphate
UNDP	=	United Nation Development Program
wt.	=	Weight
w/v	=	weight/ volume
Zn	=	Zinc
^{0}C	=	Degree Centigrade
%	=	Percent

1. INTRODUCTION

Wheat (*Triticum* aestivum *L.*) is one of the most popular staple food in the world and the second most important cereal in Bangladesh. It has gained much popularity among the farmers of Bangladesh due to its higher nutritive value, ingredients of different food items and lower cost of production than that of rice. About 706.86 thousand hectares of land in Bangladesh is covered by wheat cultivation with the annual production of 1570 thousand tons (BBS, 2005). Wheat is well adapted crop in our native climate and can play a vital role in recovering our food deficit. Now it is cultivating through out the country and well accepted by the farmer. The average yield of wheat was 1.7 t ha^{-1} in our country which was lower in comparison to the developed countries of the world (FAO, 2005).

Wheat suffers from 26 seed-borne pathogens causing 14 seed-borne diseases (Fakir, 1999). Among them leaf blight and black point caused by *Bipolaris sorokiniana* has become a serious concern in Bangladesh. *B. sorokiniana* ,the causal agent of leaf blight, reduces. The yield of wheat by producing thinner stand with lower number, size and kernel weight. The effect of pathogen on crop yield and quality may vary considerably from year to year relating to changes in the environmental conditions. In Bangladesh yield loss of wheat due to leaf blight has been reported to be 20% in var. Sonalika, whereas 14% and 18% in Akbar and Kanchan, respectively (Razzaque and

Hossain, 1991). In farmer field, the yield loss was estimated to be 14.97% whereas 29% yield reduction was recorded during 1991-92 in Kanchan (Alam *et al.*, 1994). Some times the disease causes 100% yield loss of wheat.

In Bangladesh, the disease is being controlled by fungicides in the farmer field. Continuous use of chemicals has some adverse effect on our health and environment. Plant extracts is now being a suitable alternative of chemicals in controlling diseases. Islam et al. (2006) reported that Garlic extract and Bishkatali extract was found effective in reducing the incidence of *B. sorokiniana* as well as leaf blight severity in the field. Rahman et al. (2007) also reported that seed treatment with garlic clove extract and turmeric rhizome extract resulted remarkable reduction of leaf blight severity of wheat.

Considering the above facts, the present investigation was undertaken with the following objectives:

1. To determine the potentiality of plant extracts as seed treating agent in controlling seed-borne *B. sorokiniana* in laboratory.
2. To evaluate the effect of seed treatment with plant extracts on seedling vigor of wheat.
3. To determine the efficacy of seed treatment with plant extracts on leaf blight (*B. sorokiniana*) and yield of wheat.

2. REVIEW OF LITERATURE

Use of botanicals instead of chemical fungicides in controlling disease is one of the recent approaches for plant disease control. Literatures related to control of leaf blight of wheat caused by *Bipolaris sorokiniana* with plant extracts are presented in this chapter.

Alice and Rao (1987) evaluated the effect of garlic extract. They found promising effect of garlic extract in controlling *Drechslera oryzae*.

Ashrafuzzaman and Hossain (1992) evaluated Pudina (*Mentha viridis*) extract against *Bipolaris sorokiniana* and observed that the extract inhibited mycelial growth and spore germination. In the same work they also found that extract of *Ricinus communis* and *Leucas aspera* were inhibitory against mycelial growth and spore germination of *Bipolaris sorokiniana*.

Hossain and Schlosser (1993) observed that the possibility of using neem plant (*Azadirachta indica*) extract as a means of controlling *B. sorokiniana* of wheat. Neem seed extracts or cake was found effective against *B. sorokiniana.* The extract inhibited the growth of the fungus and also reduced its pathogenecity on wheat leaves. Germination rate of wheat seeds increased after treatment with extracts of neem seed and cake.

Hossain *et al.* (1993) conducted an experiment by using extracts of *Lawsonia alba*, *Ipomoea fistulosa*, *Allium sativum* and *Leucas aspera* against *Rhizoctonia solani* and *B. sorokiniana*. Among the test extract, *A. sativum* completely inhibited the mycelial growth of the fungi at dilution ratio of 1:4 (w/v).

Khan and Hossain (1993) observed that extracts of *Allium cepa, A. sativum*, *Datura stramonium*, *D. plumeiri*, *Lawsonia alba*, *Ricinus communis, Leomurus sibiricus* and *Metha viridis* completely inhibited spore germination of *B. sorokiniana* at 1:3 (w/v) dilution ratio.

Hossain *et al.* (1995) reported that extract of Mehedi (*Lawsonia alba*) was found to be effective against *B. sorokiniana*.

Bisht and Khulbe (1995) found promising effect of leaf extract of *Allium sativum* in controlling the mycelial growth of *Drechslera oryzae*.

Hossain *et al.* (1997) reported that the extract of *Allium sativum* and *Lawsonia alba* showed marked effect in controlling the spore germination and mycelial growth of *B. sorokiniana* and pathogenecity to wheat leaves and *Nigella sativa* showed positive antifugal activity in reducing the pathogenicity of *B. sorokiniana* of wheat leaves.

Hoassain *et al.* (2005) tested different botanicals viz. bishkatali, vatpata, garlic, gagra, bitter guard and neem against seed borne fungi of wheat. Seed treatment of wheat by crude extract and alcoholic extract both in undiluted and diluted form for 24 hours reduced the incidence of *B. sorokiniana, Alternaria tenuis, Curvularia lunata, Fusarium* spp and *Aspergillus* spp and increased seed germination.

Islam *et al*. (2006) evaluated eight plant extracts including Vitavax-200 against leaf spot (*B. sorokiniana*) of wheat. Among eight plant extracts, onion, garlic, kalijira, ginger, bishkatali and neem extract showed statistically similar grain yield as of seed treatment with Vitavax-200. Seed treatment with bishkatali extract increased 29.74% grain yield over untreated control.

Rahman *et al*. (2006) evaluated extracts of 33 plant species in *vitro* against *B. sorokiniana*. The extracts of kalijira, turmeric, ginger, garlic, onion, neem, allamanda, nayantara, mandar, naglingam and duranta showed good effect in controlling the mycelial growth of *B. sorokiniana*.

Rahman et al. (2007) evaluated 13 plant extracts in controlling leaf blight of wheat in the field. He found turmeric extract very promising against leaf blight (*B. sorokiniana*) of wheat with increasing grain yield.

3. MATERIALS AND METHODS

3.1. Laboratory experiment

The experiment was conducted at the Seed Pathology Laboratory of the Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh, during the period from june 2006 to September 2006.

3.1.1. Collection of seeds

About 10 kg seed sample of wheat cv. Kanchan was collected from Wheat Research Centre of Bangladesh Agricultural Research Institute (BARI). After collection, the seeds were kept in a plastic container with air tight lid and the container was stored in normal room temperature in Seed Pathology Laboratory of the Department of Plant Pathology, Sher-e-Bangla Agricultural University.

3.1.2. Collection of botanicals

Twenty four botanicals(Plate 1-6) were collected from different places of Dhaka. Garlic, ginger, kalizira, turmeric and onion were collected from the agargoan market, Tejgaon, Dhaka. Leaves of neem, allamanda, katamehedi, tulsi, naglingam, mander, eucalyptus, chita, noyantara, durba, bel, arjun, debderu, gandhaviduli, lemon, sajna, vat, mechania lata, dhonia were collected from Sher-e-Bangla Agricultural University campus.

Neem (*Azadirachta indica*)

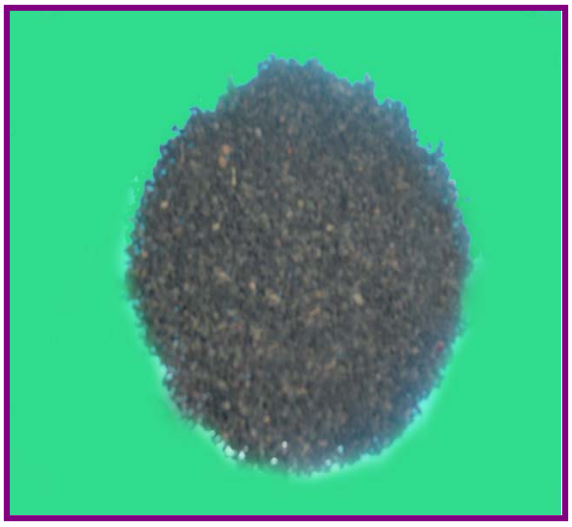
Allamanda (*Allamanda cathartica*)

Garlic (*Allium sativum*)

Onion (*Allium cepa*)

Plate 1: Botanicals used to test antifungal activity against *Bipolaris sorokiniana*

Turmeric (*Curcuma longa*)



Kalijira (*Nigella sativa*)

Katamehedi (*Lawsonia alba*)

Ginger (*Zingiber officinale*)

Plate 2: Botanicals used to test antifungal activity against *Bipolaris sorokiniana*

Tulsi (*Ocimum basilicum*)

Chita (*Pedilanthus tithymaloides*)

Naglingam (*Couroupita guianensis*)

Mandar (*Erythrina indica*)

Plate 3: Botanicals used to test antifungal activity against *Bipolaris sorokiniana*

Eucalyptus (*Eucalyptus calophylla*)

Bel (*Aegle marmelos*)

Durba (*Cynodon dactylon*)

Noyantara (*Vinca rosea*)

Plate 4: Botanicals used to test antifungal activity against *Bipolaris sorokiniana*

Arjun (*Terminalia arjuna*)

Gandhaviduli (*Ageratum conyzoides*)

Vat (*Glycosmis arborea*)

Debdaru (*Polyalthia longifolia*)

Plate 5: Botanicals used to test antifungal activity against *Bipolaris sorokiniana*

Dhonia (*Coriandrum sativum*)

Sajna (*Moringa oleifera*)

Mikania (*Mikania seandens*)

Lemon (*Citrus limon*)

Plate 6: Botanicals used to test antifungal activity against *Bipolaris sorokiniana*

The particulars of the botanicals used for the experiment are cited below

Common name	**English name**	**Scientific name**	**Plant parts used**
Neem	Margosa tree	*Azadirachta indica*	Leaf
Allamanda	Allamanda	*Allamanda cathartica*	Leaf
Garlic	Garlic	*Allium sativum*	Clove
Onion	Onion	*Allium cepa*	Bulb
Turmeric	Turmeric	*Curcuma longa*	Rhizome
Kalijira	Cumin black	*Nigella sativa*	Seed
Katamehedi	Henna	*Lawsonia alba*	Leaf
Ginger	Ginger	*Zingiber officinale*	Rhizome
Tulsi	Basil	*Ocimum basilicum*	Leaf
Naglingam	Cannon ball tree	*Couroupita guianensis*	Leaf
Mandar	Cortal tree	*Erythrina indica*	Leaf
Eucalyptus	Eucalyptus	*Eucalyptus calophylla*	Leaf
Chita	Jew Bush	*Pedilanthus tithymaloides*	Leaf
Noyantara	Periwinkle	*Vinca rosea*	Leaf
Durba	Bermuda grass	*Cynodon dactylon*	Leaf
Bel	Bel	*Aegle marmelos*	Leaf
Arjun	Arjun	*Terminalia arjuna*	Leaf
Debdaru	Mast tree	*Polyalthia longifolia*	Leaf
Gandhaviduli	Goat weed	*Ageratum conyzoides*	Leaf
Lemon	Lemon	*Citrus limon*	Leaf
Sajna	Drum stick	*Moringa oleifera*	Leaf
Dhonia	Coriander	*Coriandrum sativum*	Leaf and stem
Vat	Vat	*Glycosmis arborea*	Leaf
Mechania lata	Mikania	*Mikania seandens*	Leaf

3.1.3. Seed treatment

Seeds were treated by dipping separately in different extracts. For getting 1:2 (w/v) ratio, 100g plant parts was crashed in 200 ml of distilled water. The extracts were then filtered through cheese cloth. Plant extracts were then poured in different sterilized petridish. Then 400 hundred seeds were dipped in the solution for 30 minutes. The excess extract was then drained off. The treated seeds were then kept in blotting paper to remove excess moisture from seed surface.

3.1.4. Seed health and seedling vigor test

Seed health study was done by following blotter method (ISTA, 1996) and seedling infection and seedling vigor were determined following paper towel method (Warham, 1990). Vigor index was calculated by following formula:

Vigor index= (Mean of root length+ mean of shoot length) x %of seed germination

A. Blotter method

Incidence of seed-borne *B. sorokiniana* was recorded by using the blotter method of ISTA, 1996 (Plate 7). In this method 3 layers of blotter was soaked in sterilized water and placed at the bottom of the sterilized plastic petridish. Then extract treated 25 seeds were plated on the blotting paper (Whatman) in the petridishes maintaining equal distance and covered with the lid. The petridishes were incubated in an aircooled room at about 20^0 C temperatures for 7 days maintaining 12h/12h alternative cycle of NUV light and darkness in the

Laboratory. Time to time watering was done to keep the filter paper moist. After 7 days of incubation the seeds were observed under stereo-binocular microscope and data on percent germination and presence of seed-borne *B. sorokiniana* were recorded. 400 seeds were tested for each treatment maintaining three replications.

Plate 7: Seed health study through blotter method

B. Paper towel method

In this method, 50 treated seeds were paced on the wetted paper towels. Then the papers were rolled and kept in an air cooled room at about 20^0 C temperatures for 10 days maintaining 12h/12h alternative cycle of NUV light

and darkness in the Laboratory (Plate 8). Time to time watering was done to keep the paper towels moist. After 10 days, the paper towels were opened and data on percent germination, percent healthy and infected seedlings, length and weight of root and shoot and vigor index were recorded.

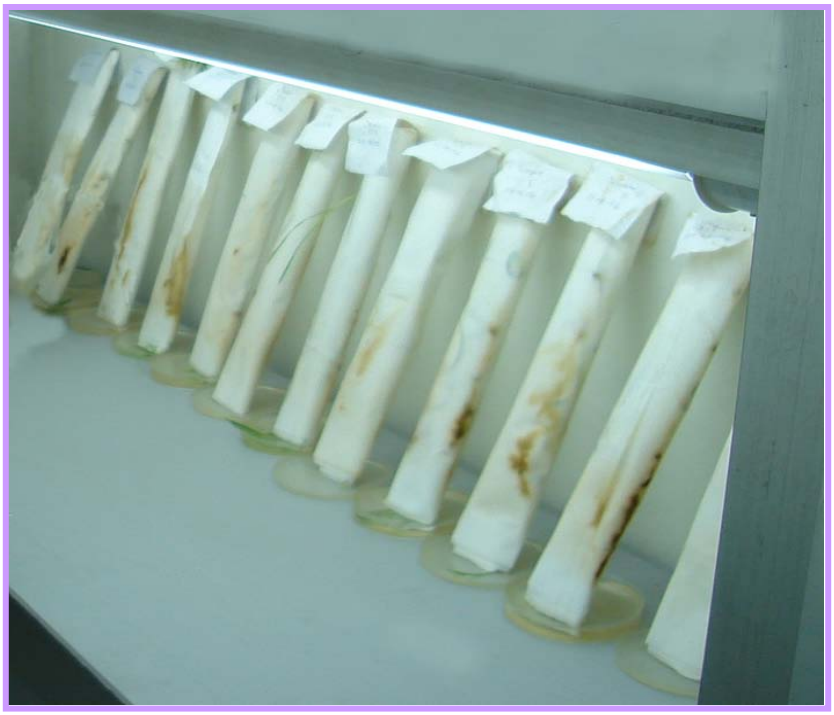


Plate 8: Determination of seed germination, seedling infection and Seedling vigor through paper towel method

3.2. Pot Experiment

3.2.1. Experimental site

The experiments were conducted in the net house, Department of Plant Pathology, Sher-e-Bangla Agricultural University,Dhaka, Bangladesh.

3.2. 2. Experimental period

The experiment was carried out during the period from November, 2006 to March, 2007.

3.2.3. Collection of soil

Soil was collected from Horticultural farm of Sher-e-Bangla Agricultural University. Surface soil of 6 inches depth was used for the experiment.

3.2.4. Preparation of soil

Soil, sand and cowdung were mixed in 2:1:1 ratio and kept for 15 days. Then each pot was filled up with the soil.

3.2.5. Seed samples used

Wheat *(Triticum aestivum* L.) seed sample of variety Kanchan was collected from Wheat Research Centre of BARI.

3.2.6. Design and layout of the experiment

The experiment was carried out in Completely Randomized Design (CRD) with three replications.

3.2.7. Treatments

Initialy twenty four plant species were evaluated against *B. sorokiniana* invitro and thirteen potential plant species were selected for experiment. So, including untreated control there were fourteen treatments for the pot experiment which were as follows:

T_1 = Control

T_2 = Onion bulb extract

T_3 = Garlic clove extract

T_4 = Neem leaf extract

T_5 = Naglingam twig extract

T_6 = Turmeric rhizome extract

T_7 = Mandar leaf extract

T_8 = Bel leaf extract

T_9 = Kalijira seed extract

T_{10} = Katamehedi leaf extract

T_{11} = Allamanda leaf extract

T_{12} = Ginger rhizome extract

T_{13} = Durba leaf extract

T_{14} = Eucalyptus leaf extract

3.2.8. Collection of botanicals and Preparation of extracts

The plant extracts were prepared using the method of Hoassain *et al*. (2005) as described in laboratory experiment (3.1.3.).

3.2.9. Seed treatment procedure

Seed treatment were done by dipping seed in different plant extracts for 30 minutes using the method of Hoassain *et al*. (2005) as described in laboratory experiment(3.1.3.).

3.2.10. Sowing of Seeds

The seeds were sown in the pot on 3rd November, 2006 at the rate of 70 seeds / pot. Seeds were placed at the depth of 5 cm in pot soil with the help of hand. Finally three seedlings/pot were allowed to grow for grain production.

3.2.11. Watering

Time to time watering was done to keep the soil moist.

3.2.12. Isolation and identification of *Bipolaris sorokiniana*

The diseased leaves were collected by using polythene bag and taken to the laboratory of the Department of Plant Pathology, Sher-e-Bangla Agricultural University, Dhaka. Then the diseased leaves were cut into small pieces (0.5 cm) and these were surfaced sterilized with Chlorox (1:1000) for one minute. Then the cut pieces were washed into sterilized water thrice and placed on a PDA media. The petridish containing leaves pieces (three pieces per plate) were

incubated at 25±1^{o} C for seven days. Then the organism grew freshly on to the culture and isolated by means of hyphal tip culture method aseptically and cultured again on another PDA plate to have pure culture. The pathogen was identified as *Bipolaris sorokiniana* (Plate 9 and Plate 10) following the key of Booth, 1971 and then preserved at 4^{o} C in the refrigerator for future use.

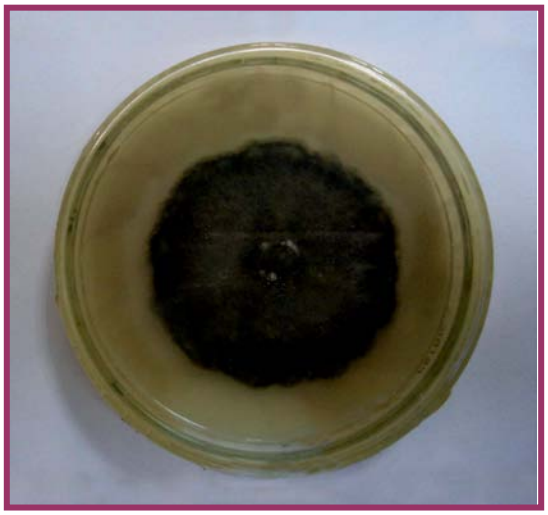


Plate 9. Pure culture of *Bipolaris sorokiniana* on PDA media

Plate 10. Conidia of *Bipolaris sorokiniana* (×250) under compound microscope

3.2.13. disease severity

Leaf blight severity was recorded from three selected plants per pot on flag leaf and penultimate leaf (2^{nd} leaf from top) from top of the plant. The data was recorded in flag leaf stage, booting stage, panicle ignition stage, flowering stage, milking stage and hard dough stage. The disease severity was recorded following 0-5 rating scale (Plate 11) as used by Hossain and Azad (1992) and the rating scale is given below:

0 = No infection

1 = Few minute lesion on leaves

2 = Black lesion with no distinct chlorotic halos covering≤ 10% of the leaf area

3= Typical lesions surround by distinct chlorotic halos covering 10-50% of leaf area

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

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

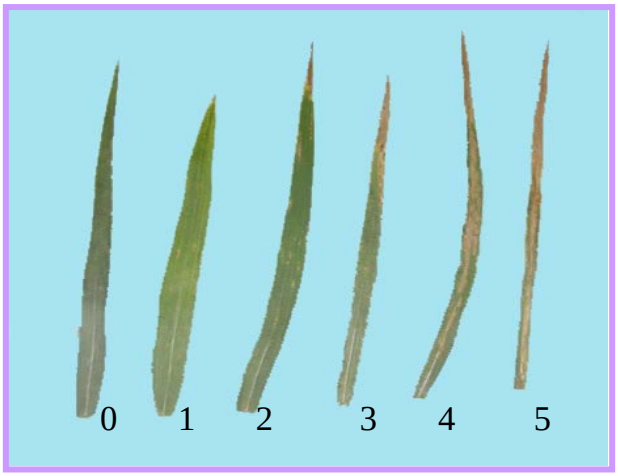


Plate 11. Leaf spot severity of wheat showing 0-5 rating scale (Hossain and Azad, 1992)

3.2.14. Harvesting and recording data on plant growth and yield attributes

The crop was harvested on 13th march, 2007 at full ripening stage. The data on the following parameters were recorded from the selected tagged plant of each pot:

I. Plant height (cm)

II. Ear length (cm)

III. Length between the point flag leaf initiation and base of ear (cm)

IV. Number of spikelets/ear

V. Number of grains/ear

VI. Weight of grains/panicle (g)

VII. Weight of straw/panicle (g)

VIII. Weight of grain/pot (g)

IX. Weight of straw/pot (g)

3.2.15. Statistical analysis

The collected data on different parameters were analyzed statistically. The means for all the treatments were compared by DMRT (Duncan's Multiple Range Test) according to Gomez and Gomez (1984). The significance of the difference among the means was calculated by LSD test (Least Significance Difference) also.

3.2.16. Weather report

The data on temperature, rainfall and humidity during experimental period were collected from the authority of Bangladesh Metrological Department, Agargoan, Dhaka and is presented in Appendix II.

4. RESULTS

`4.1. Laboratory experiment

4.1.1. Efficacy of plant extracts on germination of wheat seeds in the laboratory

Effects of different plant extract on germination of wheat seeds are shown in Table 1. Seed treatment with botanicals significantly increased seed germination over control. The highest germination (94.50%) was found in seeds treated with onion bulb extract and the lowest germination (75.00%) was found in control treatment. Neem leaf extract, turmeric rhizome extract and durba leaf extract increased remarkable seed germination over untreated control.

4.1.2. Efficacy of plant extract on the incidence of seed-borne *Bipolaris sorokiniana* on wheat seeds

Remarkable reduction in incidence of seed-borne *B. sorokiniana* was achieved by treating seeds with different plant extracts (Table 1). All the plant extracts reduced the incidence of *B. sorokiniana* over untreated control. Highest reduction in incidence of the fungus was found in case of treating seeds with durba leaf extract.

Table 1. Efficacy of plant extracts on germination and incidence of *Bipolaris sorokiniana* (Blotter method) of wheat

Treatments	%Gremination	Incidence of *Bipolaris sorokiniana*
T_1= Control	75.00e	35.00a
T_2 = Garlic clove extract	87.50a-d	5.00d-g
T_3 = Neem leaf extract	91.00ab	8.00c-g
T_4 = Turmeric rhizome extract	89.50a-c	3.00fg
T_5 = Kalijira seed extract	80.50b-e	4.50d-g
T_6 = Katamehedi leaf extract	88.50a-d	6.00c-g
T_7 = Allamanda leaf extract	90.00a-c	4.00d-g
T_8 = Ginger rhizome extract	85.00a-e	4.50d-g
T_9 = Onion bulb extract	94.50a	3.50e-g
T_{10} = Tulsi leaf extract	88.50a-d	5.50c-g
T_{11}= Chita leaf extract	87.50a-d	5.50c-g
T_{12}= Naglingam twig extract	87.50a-d	5.50c-g
T_{13}= Mandar leaf extract	88.00a-d	4.50d-g
T_{14}= Eucalyptus leaf extract	88.50a-d	4.00d-g
T_{15}= Bel leaf extract	87.50a-d	4.50d-g
T_{16}= Durba leaf extract	90.50a-c	2.50g
T_{17}= Nayantara leaf extract	87.00a-d	6.50c-g
T_{18}= Arjun leaf extract	85.00a-e	11.00c
T_{19}= Gandhaviduli leaf extract	82.50a-e	9.00c-f
T_{20} = Debdaru leaf extract	83.05a-e	16.50b
T_{21}= Vat leaf extract	84.00a-e	17.00b
T_{22}= Dhonia leaf and stem extract	78.50c-e	8.50c-g
T_{23}= Sajna leaf extract	77.00de	9.50c-e
T_{24}= Mechania lata leaf extract	85.50a-e	10.00cd
T_{25}= Lemon leaf extract	86.00a-e	9.50c-e
LSD(P=0.05)	9.741	4.962

4.1.3. Efficacy of plant extracts on germination and seedling infection of wheat at 10 days after sowing (Paper towel method)

Effect of plant extracts on germination and seedling infection of wheat was evaluated through paper towel method in vitro (Table 2). Treating seeds with plant extracts showed remarkable increase of germination of wheat seed. Highest seed germination (92.00%) was found in turmeric rhizome extract (92.00%) and Ginger rhizome extract followed by naglingam twig extract (91.00%); garlic clove extract (89.50 %) and onion bulb extract (89.50%). The lowest germination(72.00%) was recorded in control treatment. Among 24 botanicals, seed treatment with durba leaf extract produced the highest percent of healthy seedlings (94.00%) whereas the lowest (63.00%) was obtained in untreated control. Lastly % infected seedling showed lowest (6.00%) in durba leaf extract, whereas the highest (37%) performed in untreated control.

Table 2. Efficacy of plant extracts on germination and seedling infection of wheat at 10 days after sowing (Paper towel method)

Treatments	%Germination	%Healthy seedlings	% infected seedlings
T_1= Control	72.00f	63.00g	37.00a
T_2 = Garlic clove extract	89.50ab	89.00c-e	11.00c-e
T_3 = Neem leaf extract	85.00a-d	86.75e-f	13.25bc
T_4 = Turmeric rhizome extract	92.00a	89.50c-e	10.50c-f
T_5 = Kalijira seed extract	73.00ef	84.50f	15.50b
T_6 = Katamehedi leaf extract	84.00a-d	87.50ef	12.50bc
T_7 = Allamanda leaf extract	83.50b-d	87.50ef	12.50bc
T_8 = Ginger rhizome extract	92.00a	90.25b-e	9.75c-f
T_9 = Onion bulb extract	89.50ab	93.25ab	6.75fg
T_{10} = Tulsi leaf extract	78.50d-f	89.00c-e	11.00c-e
T_{11}= Chita leaf extract	79.50d-f	86.75ef	13.25bc
T_{12}= Naglingam twig extract	91.00ab	90.50b-e	9.50c-g
T_{13}= Mandar leaf extract	81.00cd	89.75b-e	10.25c-f
T_{14}= Eucalyptus leaf extract	78.50d-f	90.00b-e	10.00c-f
T_{15}= Bel leaf extract	89.00a-c	91.75a-d	8.25d-g
T_{16}= Durba leaf extract	90.50ab	94.00a	6.00g
T_{17}= Nayantara leaf extract	84.00a-d	89.50c-e	10.50c-f
T_{18}= Arjun leaf extract	81.50cd	89.50c-e	10.50c-f
T_{19}= Gandhaviduli leaf extract	79.00d-f	88.00d-f	12.00b-d
T_{20} = Debdaru leaf extract	80.50de	90.00b-e	10.00c-f
T_{21}= Vat leaf extract	81.50cd	88.75c-e	11.25c-e
T_{22}= Dhonia leaf and stem extract	81.50cd	90.50b-e	9.50c-g
T_{23}= Sajna leaf extract	79.75d-f	90.25b-e	9.75c-f
T_{24}= Mechania lata leaf extract	80.50de	89.50c-e	10.50c-f
T_{25}= Lemon leaf extract	85.50a-d	92.00a-c	8.00e-g
LSD(P=0.05)	6.799	3.141	3.141

4.1.4. Efficacy of plant extracts on shoot length, root length, shoot weight, root weight and vigor index of wheat at 10 days after sowing (Paper towel method)

Significant variation was obtained in length and weight of root and shoot of wheat when seeds were treated with different plant extracts (Table 3). The highest shoot length (8.90 cm) was showed in seed treatment with durba leaf extract which was significantly similar to onion bulb extract (8.77 cm). and garlic clove extract (8.20cm), onion bulb extract showed the second highest shoot length of wheat plant whereas tulsi leaf extract showed the lowest (6.30 cm) shoot length. The neem leaf extract resulted the highest length of root (7.22 cm) which was statistically similar to garlic clove extract (7.12 cm) and durba leaf extract (7.05 cm). Onion bulb extract gave the highest shoot weight (4.77 g) which was statistically similar to durba leaf extract (4.70 g) and bel leaf extract (4.60 g) where the lowest shoot weight was found in untreated control (3.25 g). Onion bulb extract (2.42 g) showed the best performance in case of root weight of wheat whereas untreated control (1.40 g) showed the lowest performance which was statistically similar to kalijira seed extract (1.47 g).

Seed treatment with durba leaf extract focus the highest vigor index (1442.0) which was similar to garlic clove extract (1370.0) and the lowest vigor index was obtained in untreated control (709.5).

Table 3. Efficacy of plant extracts on shoot length, root length, shoot weight, root weight and Vigor index of wheat at 10 days after sowing (Paper towel method)

Treatments	Shoot length (cm)	Root length (cm)	Shoot weight (g)	Root weight (g)	Vigor index
T_1= Control	6.57e-g	4.42f	3.25i	1.40i	709.5j
T_2 = Garlic clove extract	8.20ab	7.12a	3.68f-h	1.87gh	1370.0a
T_3 = Neem leaf extract	7.52bc	7.22a	3.75d-h	1.82h	1252.0b
T_4 = Turmeric rhizome extract	7.27c-f	5.90bc	3.70e-h	2.12c-e	1228.0bc
T_5 = Kalijira seed extract	7.00c-g	5.77c	3.45hi	1.47i	933.5g-i
T_6 = Katamehedi leaf extract	7.17c-f	5.00d-f	3.57h	1.82h	1023.0d-h
T_7 = Allamanda leaf extract	7.37c-e	6.10bc	3.67gh	1.87gh	1125.0cd
T_8 = Ginger rhizome extract	7.25c-f	6.12bc	4.30b	2.30ab	1231.0bc
T_9 = Onion bulb extract	8.77a	6.05bc	4.77a	2.42a	1328.0ab
T_{10} = Tulsi leaf extract	6.30g	6.32bc	4.07b-d	2.12c-e	975.3e-i
T_{11}= Chita leaf extract	6.75c-g	4.90d-f	4.02b-e	2.07d-f	927.0g-i
T_{12}= Naglingam twig extract	7.15c-f	4.60d-f	4.20bc	2.30ab	1070.0d-f
T_{13}= Mandar leaf extract	7.05c-g	6.47b	4.05b-d	1.82h	1095.0de
T_{14}= Eucalyptus leaf extract	7.15c-f	5.20d	4.02b-e	1.92f-h	967.9f-i
T_{15}= Bel leaf extract	7.45cd	5.10de	4.60a	2.27a-c	1117.0cd
T_{16}= Durba leaf extract	8.90a	7.05a	4.70a	2.35ab	1442.0a
T_{17}= Nayantara leaf extract	6.55e-g	5.00d-f	4.22bc	2.30ab	970.6f-h
T_{18}= Arjun leaf extract	6.47fg	4.45f	4.15bc	2.07d-f	889.5i
T_{19}= Gandhaviduli leaf extract	6.57e-g	5.00d-f	4.00b-f	2.02d-g	913.9hi
T_{20} = Debdaru leaf extract	6.75c-g	4.62d-f	4.01bc	2.10d-f	916.5hi
T_{21}= Vat leaf extract	6.82c-g	4.50ef	4.20bc	2.05d-f	924.1g-i
T_{22}= Dhonia leaf and stem extract	6.60e-g	4.85d-f	4.02b-e	2.07d-f	934.8gh
T_{23}= Sajna leaf extract	6.60e-g	4.75d-f	3.95c-g	2.02d-g	895.5hi
T_{24}= Mechania lata leaf extract	6.65d-g	4.70d-f	3.90c-g	1.95e-h	911.8h
T_{25}= Lemon leaf extract	7.30c-f	4.95d-f	4.17bc	2.20b-d	1047.0d-f
LSD(P=0.05)	0.6915	0.5289	0.2817	0.1543	109.9

4.2. Pot experiment

4.2.1. Effect of seed treatment with plant extracts on germination and vigor index of wheat at 15 days after sowing

Effects of seed treatment with different plant extracts on germination and vigor index of wheat in pot are shown in Table 4. Allamanda leaf extract showed the highest germination (80.47%) followed by bel leaf extract (77.62 %) and the lowest germination (52.85%) was counted in control treatment.

The highest shoot length (21.46 cm) was found in seed treatment with neem leaf extract whereas control gave the lowest shoot length (17.33). Treating seeds with neem leaf extract resulted the highest length of root (4.16 cm) and the lowest root length (2.82 cm) was obtained in untreated control.

Neem leaf extract gave the highest seedling weight (0.94 g) which was statistically similar to eucalyptus leaf extract (0.82 g) and bel leaf extract (0.81 g) where the lowest shoot weight was found in untreated control (0.55 g). In case of vigor index, seed treatment with allamanda leaf extract showed the highest vigor index (1944) and the lowest vigor index was obtained in untreated control (1065).

Table 4. Effect of seed treatment with plant extracts on germination and vigor index of wheat at 15 days after sowing in pot

Treatments	% Germination	Shoot length (cm)	Root length (cm)	Seedling weight (g)	Vigor index
T_1= Control	52.85e	17.33b	2.827c	0.546f	1065c
T_2 = Onion bulb extract	73.81a-c	18.78ab	3.733ab	0.633c-f	1665ab
T_3 = Garlic clove extract	70.47a-d	18.85ab	3.540a-c	0.606c-f	1580ab
T_4 = Neem leaf extract	68.57b-d	21.46a	4.167a	0.940a	1753ab
T_5= Naglingam twig extract	68.57b-d	17.80ab	3.460a-c	0.593d-f	1456b
T_6 = Turmeric rhizome extract	73.33a-c	17.93ab	3.947ab	0.580ef	1601ab
T_7= Mandar leaf extract	61.90d	20.19ab	3.327bc	0.740b-d	1459b
T_8= Bel leaf extract	77.62ab	18.53ab	3.953ab	0.813ab	1745ab
T_9 = Kalijira seed extract	63.80cd	20.97ab	3.613ab	0.633c-f	1555ab
T_{10} = Katamehedi leaf extract	73.33a-c	19.07ab	3.573ab	0.686b-f	1656ab
T_{11}= Allamanda leaf extract	80.47a	19.87ab	3.993ab	0.753bc	1944a
T_{12}= Ginger rhizome extract	67.61b-d	19.95ab	3.707ab	0.640c-f	1597ab
T_{13}= Durba leaf extract	70.00b-d	19.45ab	3.833ab	0.726b-e	1630ab
T_{14}= Eucalyptus leaf extract	70.00b-d	20.56ab	3.733ab	0.826ab	1700ab
LSD(P=0.05)	9.03	3.121	0.6606	0.1296	341.5

4.2.2. Effect of seed treatment with plant extracts on leaf blight (*Bipolaris sorokiniana*) severity of wheat at different growth stage

Leaf blight severity differed significantly among the different treatments at flag leaf, booting, panicle initiation stage (Table 5). In flag leaf stage, the lowest disease severity (0.33) was found in onion bulb extract. On the other hand, the highest disease severity (1.55) was found in Control.

In booting stage, the disease severity ranged from 0.99 to 2.00 where the lowest disease severity (0.99) was observed in neem leaf extract and eucalyptus leaf extract, and the highest disease severity (2.00) was recorded in untreated control.

In panicle initiation stage, durba leaf extract and eucalyptus leaf extract resulted the lowest disease severity (1.11) where the highest disease severity (3.22) was found in untreated control.

Table 5. Effect of seed treatment with plant extracts on leaf blight severity of wheat (0-5 Scale) at flag leaf, booting and panicle initiation stage in pot

Treatments	Flag leaf stage	Booting stage	Panicle initiation stage
T_1= Control	1.55a	2.00a	3.22a
T_2 = Onion bulb extract	0.33d	1.00e	1.22fg
T_3 = Garlic clove extract	1.00bc	1.22c-e	1.55c-f
T_4 = Neem leaf extract	0.73c	0.99e	1.33e-g
T_5= Naglingam twig extract	0.99bc	1.33c-e	1.55c-f
T_6 = Turmeric rhizome extract	0.66cd	1.44b-d	1.44d-g
T_7= Mandar leaf extract	1.22b	1.77ab	1.88bc
T_8= Bel leaf extract	1.00bc	1.33c-e	1.66b-e
T_9 = Kalijira seed extract	0.88bc	1.55bc	2.00b
T_{10} = Katamehedi leaf extract	0.88bc	1.44b-d	1.77b-d
T_{11}= Allamanda leaf extract	0.88bc	1.44b-d	1.77b-d
T_{12}= Ginger rhizome extract	0.66cd	1.11de	1.33e-g
T_{13}= Durba leaf extract	0.77c	1.00e	1.11g
T_{14}= Eucalyptus leaf extract	0.88bc	0.99e	1.11g
LSD(P=0.05)	0.3260	0.3740	0.3428

4.2.3. Effect of seed treatment with plant extracts on leaf blight (Bipolaris sorokiniana) severity of wheat at different growth stage

Leaf blight severity differed significantly in flowering, milking and hard dough stage (Table 6). In flowering stage, the lowest disease severity (1.22) was observed in durba leaf extract and the highest disease severity (4.55) was recorded in control treatment. Seed treatment with onion bulb extract showed the lowest disease severity at milking and hard dough stage. Control treatment gave the highest severity in both the stages. Other botanicals significantly reduced the leaf blight severity over untreated control.

Table 6. Effect of seed treatment with plant extracts on leaf blight severity of wheat (0-5 Scale) at flowering, milking and hard dough stage in pot

Treatments	Flowering stage	Milking stage	Hard dough stage
T_1= Control	4.55a	4.66a	4.66a
T_2 = Onion bulb extract	1.55c-e	1.66c	2.00e
T_3 = Garlic clove extract	1.55c-e	2.66bc	3.21b-d
T_4 = Neem leaf extract	1.66c-e	2.77b	2.88cd
T_5= Naglingam twig extract	1.66c-e	3.00b	3.33b-d
T_6 = Turmeric rhizome extract	1.66c-e	2.22bc	2.66de
T_7= Mandar leaf extract	2.22b	3.11b	3.33b-d
T_8= Bel leaf extract	1.77b-d	2.55bc	2.88cd
T_9 = Kalijira seed extract	2.00bc	2.66bc	2.77de
T_{10} = Katamehedi leaf extract	2.00bc	2.77b	2.99cd
T_{11}= Allamanda leaf extract	2.22b	2.99b	3.10b-d
T_{12}= Ginger rhizome extract	1.44de	2.49bc	2.72de
T_{13}= Durba leaf extract	1.22e	2.72b	3.83b
T_{14}= Eucalyptus leaf extract	1.55c-e	2.77b	3.66bc
LSD(P=0.05)	0.4457	0.8929	0.7664

4.2.4. Efficacy of seed treatment with plant extracts on plant growth and number of spikelets/ear of wheat

Plant height, ear length, length between the point of flag leaf initiation and base of ear, number of spikelets/ ear differed significantly in respect of seed treatment with different plant extracts (Table 7)

The highest plant height was observed in onion bulb extract 78.10 cm where as the lowest plant height (65.73 cm) was recorded in control. Neem leaf extract showed the second highest plant height (76.27cm) which was statistically similar to treatment T_{13}, $T_{6,}$ and $T_{14.}$ The length of ear ranged from 12.87 to 14.10 cm where the highest ear length was found in durba leaf extract and the lowest ear length was found in control treatment.

The length between the point of the flag leaf initiation and the base of ear ranged from 13.20 to 14.50 cm where the highest and the lowest lengths were observed under onion bulb extract and control treatment, respectively.

The number of spikelets/ear ranged from 14.33 to 20.67 where the highest was recorded in onion bulb extract and allamanda leaf extract, and the lowest was in untreated control.

Table 7. Effect of seed treatment with plant extracts on plant growth and grain formation of wheat in pot.

Treatments	Plant height (cm)	Length between the point of flag leaf initiation and base of ear (cm)	Ear length (cm)	No. of spikelets/ ear
T_1= Control	65.73g	13.20g	12.87h	14.33g
T_2 = Onion bulb extract	78.10a	14.50a	13.80bc	20.67a
T_3 = Garlic clove extract	73.90c	13.90c	13.50 de	17.67bc
T_4 = Neem leaf extract	76.27b	13.67de	13. 20fg	16.67c-f
T_5= Naglingam twig extract	71.62de	13.80cd	13.17fg	16.00d-f
T_6 = Turmeric rhizome extract	75.13b	13.97bc	13.60cd	17.33b-d
T_7= Mandar leaf extract	73.57c	13.57ef	13.10g	15.67e-g
T_8= Bel leaf extract	72.30d	13.90c	13.90ab	18.67b
T_9 = Kalijira seed extract	68.87f	13.40f	13.40d-f	15.33fg
T_{10} = Katamehedi leaf extract	70.93e	13.63de	13.33e-g	15.67e-g
T_{11}= Allamanda leaf extract	71.60de	13.53ef	13.13g	20.67a
T_{12}= Ginger rhizome extract	73.43c	14.10b	13.13g	16.67c-f
T_{13}= Durba leaf extract	76.23b	13.90c	14.10a	17.00c-f
T_{14}= Eucalyptus leaf extract	75.43b	13.53ef	13.47de	18.00bc
LSD(P=0.05)	1.094	0.1754	0.2181	1.316

4.2.5. Efficacy of seed treatment with plant extract on grain formation and yield of wheat

In case of number of grains/ear, the lowest (24.00g) and the highest (32.33g) counts were made under the control treatment and onion bulb extract, respectively. The weight of grains/ear ranged from 1.08 to 1.30g where the highest (1.30g) and lowest (1.08g) weight of grains/ear was recorded under the treatments onion bulb extract and control treatment respectively.

The effect of seed treatment with botanicals on grain and straw yield differed significantly (Table 8). The grain yield/pot ranged from 3.26 to 3.92 g. The highest weight of grain/pot was recorded in onion bulb extract and allamanda leaf extract (3.92 g). The lowest weight of grain (3.26 g) was recorded in the control treatment. In case of straw yield, among the botanicals the highest (8.00 g) and lowest (6.65 g) straw yield was obtained from onion bulb extract and control treatment, respectively.

Table 8. Effect of seed treatment with plant extracts on grain and straw yield of wheat in pot.

Treatments	No. of grains/ ear	Weight of grain/ ear (g)	Weight of grain/ pot (g)	Weight of straw/ pot (g)
T_1= Control	24.00g	1.08g	3.26g	6.65g
T_2 = Onion bulb extract	32.33a	1.30a	3.92a	8.00a
T_3 = Garlic clove extract	29.33cd	1.19b-e	3.59b-e	7.34cd
T_4 = Neem leaf extract	28.00de	1.17c-e	3.53c-e	7.24c-e
T_5= Naglingam twig extract	29.00cd	1.19b-e	3.58b-e	7.33cd
T_6 = Turmeric rhizome extract	25.67fg	1.11fg	3.33fg	6.86fg
T_7= Mandar leaf extract	30.33bc	1.24b	3.74b	7.69ab
T_8= Bel leaf extract	29.00cd	1.21b-d	3.63b-d	7.39b-d
T_9 = Kalijira seed extract	26.33ef	1.15d-f	3.45d-f	7.06d-f
T_{10} = Katamehedi leaf extract	25.67fg	1.14e-g	3.42e-g	6.98ef
T_{11}= Allamanda leaf extract	31.67ab	1.30a	3.92a	7.99a
T_{12}= Ginger rhizome extract	26.67ef	1.19b-e	3.57b-e	7.26c-e
T_{13}= Durba leaf extract	28.00de	1.20b-d	3.61b-d	7.47bc
T_{14}= Eucalyptus leaf extract	29.33cd	1.22bc	3.66bc	7.49bc
LSD(P=0.05)	1.788	1.087	0.1587	0.3038

5. DISCUSSION

5.1. Laboratory experiment

In the present study the highest germination was recorded in seeds of treated with onion bulb extract and the lowest germination was found in control. Neem leaf extract, turmeric rhizome extract and durba leaf extract increased seed germination over untreated control. Significant reduction in incidence of seed-borne *Bipolaris sorokiniana* was achieved by treating seeds with different plant extracts. All the plant extracts reduced the incidence of *Bipolaris sorokiniana* over untreated control. The highest reduction was found in case of treating seeds with turmeric rhizome extract. Plant extracts showed significantly higher germination of wheat seed between paper towels and also produced higher number of healthy seedlings over control. Turmeric rhizome extract and Ginger rhizome extract gave the highest germination followed by naglingam twig extract, garlic clove extract, and onion bulb extract. Among 24 botanicals, durba leaf extract treated seeds produced the highest percent of healthy seedlings whereas the lowest number of healthy seedlings was obtained in untreated control. Onion bulb extract showed the highest shoot length, shoot weight, root weight; garlic clove extract, neem leaf extract showed the highest root length whereas

control showed the lowest performance in each case. In case of vigor index, seed treatment with durba leaf extract focus the highest vigor index which was similar to garlic clove extract and the lowest vigor index was obtained in untreated control.

The present findings were well supported by the reports of Alice and Rao (1987); Hoassain *et al.* (2005); Khan and Kumar (1992); Hossain and Schlosser (1993); Hossain *et al*. (1997) and Islam *et al.* (2006). Hossain and Schlosser (1993) reported that germination rate of wheat seeds increased after treatment with extract of neem seed and Cake. Hossain *et al*. (1997) found that the plant extract of *Allium sativum* and *Lawsonia alba* showed significant effect in controlling the spore germination and mycelial growth of *Bipolaris sorokiniana.* Hoassain *et al.* (2005) reported that neem extract reduced the incidence of *Bipolaris sorokiniana* significantly and increased seed germination. He also found that out of six plant extracts, neem extract was proved superior followed by garlic, bishkatali and vatpata. Alice and Rao, (1987) evaluated plant extracts against seed-borne infection of fungus and found increased germinability of the treated seeds. Khan and Kumar (1992) also observed the antifungal activity of leaf extract of neem (*Azadirachta indica*) with different dilutions against seed mycoflora of wheat. They recorded remarkable reduction of seed mycoflora and increased

seed germination of treated seeds. Islam *et al.* (2006) reported that the highest seed germination was recorded under the onion bulb extract followed by neem extract, onion extract and ginger rhizome extract. Considering the incidence of seed yielding *Bipolaris sorokiniana,* it has been found that the treatment biskatali extract resulted the highest reduction in incidence of *Bipolaris sorokiniana* on wheat seeds.

5.2. Pot experiment

Efficacy of seed treatment with plant extracts in controlling leaf blight (*Bipolaris sorokiniana*) of wheat var. Kanchan was studied with a pot experiment. Extracts of thirteen plants were selected by invitro for seed treatment to find out its antifungal activity against leaf blight *Bipolaris sorokiniana*. From the present study it is evident that the treatments showed significant effect in respect of germination, vigor index and disease severity (0-5 scale) of wheat on flag leaf and penultimate leaf at flag leaf, booting, panicle initiation, flowering, milking and hard dough stages. It has been observed that allamanda leaf extract showed the highest germination among thirteen botanicals. The highest shoot length was found in seed treatment with neem leaf extract. In case of root length, neem leaf extract also

performed the highest length of root. For seedling weight, neem leaf extract gave the highest seedling weight. In case of vigor index, seed treatment with allamanda leaf extract showed the highest vigor index. It has been found that seed treatment with onion bulb extract, neem leaf extract, eucalyptus leaf extract and durba leaf extract resulted remarkable reduction of leaf spot severity over untreated control in all the growth stages of wheat. The antifungal activity of botanicals as seed treating agent have been reported by many scientists such as (Alice and Rao 1987; Rovesti *et al.,* 1992; Hossain and Schlosser 1993; Khan and Hossain, 1993; Arun *et al.* 1995; Bisht and Khulbe, 1995; Hossain *et al.* 1997). The finding of the present study is also supported by Rahman *et al.* (2007) who found a remarkable reduction of leaf blight severity of wheat by seed treating with garlic clove extract and turmeric rhizome extract. Hossain and Schlosser (1993) observed the potential use of neem *(Azadirachta indica*) extract as a means of controlling *Bipolaris sorokiniana* of wheat. They also reported that the neem extract inhibited the growth of *Bipolaris sorokiniana* in wheat seeds and reduced its pathogenecity on wheat leaves. Hossain *et al.* (1993) evaluated that extracts of *Lawsonia alba*, *Ipomoea fistulosa*, *Allium sativum* and *Leucas aspera*

against *Rhizoctonia solani* and *Bipolaris sorokiniana* where *A. sativum* completely inhibited the mycelial growth at dilution ratio of 1:4 (w/v). Hossain *et al.* (1997) also reported that the extracts of *Allium sativum* and *Lawsonia alba* showed remarkable effect in reducing the mycelial growth of *Bipolaris sorokiniana* and its pathogenicity to wheat leaves. Khan and Hossain (1993) observed that extracts of *Allium cepa*, *A. sativum* , *Datura stramonium*, *D. plumeiri*, *Lawsonia alba*, *Ricinus communis*, *Leomurus sibiricus* and *Mentha viridis* completely inhibited spore germination of *B. sorokiniana* at 1:3 (w/v) dilution ratio. Hossain *et al.* (1995) further reported that extract of *Lawsonia alba* was found to be effective against *Bipolaris sorokiniana.* Bisht and Khulbe (1995) studied the efficacy of leaf extract of *Allium sativum* in controlling the growth of *Drechslera oryzae* and reported that *Allium* sativum significantly reduced the mycelial growth compared to control.

In the present experiment, it has been found that seed treatment with plant extracts showed a significant effect on plant height, ear length, length between the point of flag leaf initiation and base of ear, number of spikelets/ ear, number of grains/ear, weight of grains/ear. The highest plant height was observed in the seed treated with onion bulb extract where as the lowest

plant height was recorded in untreated control. The highest weight of grain/pot (3.92 g) was recorded in seed treatment with onion bulb extract and seed treatment with allamanda leaf extract whereas the lowest weight weight of grain (3.26) was recorded in the control treatment. The similar results were also found by Islam *et al.* (2006) and Rahman *et al*. (2007) who reported that seed treated with garlic clove extract performed the highest plant height. Among thirteen botanicals seed treatment with onion bulb extract showed the best result in producing higher number of spikelets/ear, number of grains/ear, weight of grain/ear. The findings of the present study corroborates with the findings of Rahman (1998) who reported that the extracts of *Cymbopogon citratus, Lawsonia alba*, *Nigella sativa*, and *Allium sativum* significantly increased number of grains/ear and healthy grains/ear over untreated control. Islam *et al.* (2006) also agreed with present study. They reported that garlic, ginger, bishkatali and neem extract resulted statistically similar effect as of seed treatment with Vitavax-200 regarding number of grains/ear and number of healthy grains/ear.

From the above findings of the study it is well exposed that plant extracts have promising antifungal effect against leaf blight (*Bipolaris sorokiniana).* The findings of the study have ventilated an opportunity to control leaf blight of wheat with increasing yield by using plant extracts. However, more research work is necessary to find out more potential plant extracts against leaf blight (*Bipolaris sorokiniana*) of wheat.

6. SUMMARY AND CONCLUSION

Wheat (*Triticum aestivum* L.) is the second most important cereal crop next to rice in Bangladesh. Leaf blight caused by *Bipolaris sorokiniana* is a limiting factor of wheat production in Bangladesh. The fungus reduces the yield and quality of seeds. The research programme were undertaken to study the efficacy of some selected plant extracts against leaf blight (*Bipolaris sorokiniana*) of wheat.

In the present study, 24 botanical extracts were tested for their efficacy in controlling *Bipolaris sorokiniana.* All the tested botanicals significantly increased the seed germination of wheat in vitro. Significant reduction in incidence of seed-borne *Bipolaris sorokiniana* was achieved by treating seeds with different plant extracts. All the plant extracts reduced the incidence of *Bipolaris sorokiniana* over untreated control. The highest reduction was found in case of treating seeds with turmeric rhizome extract. Among 24 botanicals, durba leaf extract performed the highest percent of healthy seedlings. Onion bulb extract showed the highest shoot length, shoot weight, root weight; garlic clove extract, neem leaf extract showed the highest root length. In case of vigor index, seed treatment with durba leaf extract focuses the highest vigor index. Among 24 botanicals 13 species were selected for pot experiment to evaluate their potency against leaf blight (*Bipolaris sorokiniana).* The treatments

showed significant effect in respect of germination, vigor index and disease severity (0-5 scale) of wheat at flag leaf, booting, panicle initiation, flowering, milking and hard dough stages. It has been observed that allamanda leaf extract showed the highest germination among thirteen botanicals. The highest shoot length was found in seed treatment with neem leaf extract. In case of root length, neem leaf extract also performed the highest length of root. For seedling weight, neem leaf extract gave the highest seedling weight. In case of vigor index, seed treatment with allamanda leaf extract showed the highest vigor index. It has been found that seed treatment with onion bulb extract, neem leaf extract, eucalyptus leaf extract and durba leaf extract resulted remarkable reduction of leaf blight severity over untreated control in all the growth stages of wheat.

From the present study it was observed that the number of spikelets/ear, number of grains/ear and weight of grain/ear were increased by seed treatment with plant extracts. Among thirteen botanicals seed treatment with onion bulb extract significantly increased number of spikelets/ear, number of grains/ear, weight of grain/ear. The treatment T_2 (onion bulb extract) and T_{11} (allamanda leaf extract) resulted significantly higher yield (3.92 g/pot) over untreated control.

The findings of this study indicate that there is good prospect of using plant extracts for controlling leaf blight of wheat. But further study is

necessary to evaluate their efficacy in different AEZ against leaf blight (*Bipolaris sorokiniana).*

7. REFERENCES

Alam, K. B., Malaker, P. K., Shaheed, M. A., Ahmed, M. U., Ahmed, F. and Haque, M. S. 1994. Yield loss assessment of wheat due to *Bipolaris* leaf blight in Bangladesh. Bangladesh J. Pl. Path. **11(1-2):** 35-37.

Alice, D. and Rao, A. V. 1987. Antifungal effect of plant extracts on *Drechslera oryzae* in rice. Res. News Letter. **12(2):** 28.

Arun, A., Rekha, C. and Chitra, A. 1995. Effect of Alicia and extracts of Garlic and Bigononia on two fungi. Indian J. Mycol. and Plant Path. **25(3)**: 316-318.

Ashrafuzzaman, H. and Hossain, I. 1992. Antifungal activity of crude extracts of plants against *Rhizoctonia solani* and *Bipolaris sorokiniana*. Proc, BAU. Res. Prog. **6**: 188-192.

BBS (Bangladesh Bureau of Statistics). 2005 monthly statistical bulletin, Bangladesh.statistics Division. Ministry of Planing. Government of the peoples Republic of Bangladesh. Dhaka. p. 57.

Bisht, G. S. and Khulbe, R. D. 1995. Efficacy of leaf extracts of certain indigenous plant against brown leaf spot pathogen of rice. Indian Phytopath. **48(4)**: 480-482.

Booth, C. 1971. The genus *Fusarium*. Commonwealth Mycol. Inst. Kew, Surry, England. 231p.

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

FAO. 2005. Production Yearbook. Food and Agriculture Organization of the United Nations, Italy, Rome, 73p.

Gomez, K. A. and Gomez, A. A. 1984. Statistical procedures for Agricultural Research. 2nd ed., Intl. Rice Res. Inst.,John Willey and sons, New York, Chichester, Brisbane, Toronto, Sigapore. pp. 187-240.

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

Hossain, I. and Schlosser, E. 1993. Control of *Bipolaris sorokiniana* in wheat with Neem extracts. Bangladesh J. Mycrobial. 10(1): 39-42.

Hossain, I., Ashrafuzzaman, H. and Khan, M. H. H. 1993. Biocontrol of *Rhizoctonia solani.* BAU Res. Prog**. 7:**264-269.

Hossain, I., Ashrafuzzaman, H. Khan, M. H. H. and Mahamud, H. 1995. Effect of plant extracts on the incidence of seed-borne fungi of wheat. J. of Agric. and Rural Dev. **3(1 and 2).** 39-43.

Hossain, I., Mahamud, H. and Ashrafuzzaman, H. 1997. Effect of plant extracts on fungi (*Bipolaris sorokiniana* and *Bipolaris solani*) and okra Mosaic disease. Ecoprint **4(1):**35-42.

Hoassain. M. M., Khalequzzaman, K. M., Aminuzzaman, F. M., Mollah, M. R. A. and Rahman, G. M. M. 2005. Effect of plant extract on the incidence of seed-borne fungi of wheat. J. of Agric. and Rural Dev. **3(1 and 2).** 39-43.

Islam, M. A., Aminuzzaman, F. M., Islam, M. R. and Zamal, M. S. 2006. Seed treatment with plant extract and Vitavax-200 in controlling leaf spot (*Bipolaris sorokiniana*) with increasing grain yield of wheat. Int. J. of Sustain. Agril. Tech. **2(8):** 15-20.

ISTA, 1996. Iternational Rules of Testing Association. Proc. Int. Seed Test. Assoc. 180 p.

Khan, M. H. H. and Hossain, I. 1993. Antifungal activity of crude plant extracts against *Bipolaris sorokiniana*. Paper presented 5th Biennial conference. Bangladesh phytopathological society, 27-28 June-1993. BAU, Mymensingh. 10p.

Khan, M.I and Kumar, R. 1992. Antifungal activity of leaf extracts neem on seed mycoflora of wheat. Indian J. Seed Abs. **15(7):** 299.

Rahman, M. A. 1998. Study on the effect of seed treatment and foliar spray in controlling *Bipolaris* leaf blight of wheat. M.S.Thesis. Department of Plant Pathology. BAU, Mymensingh, Bangladesh.

Rahman, M. M., Aminuzzaman, F. M. and Islam, M. R. 2007. Efficacy of plant extracts in controlling leaf blight (*Bipolaris sorokiniana*) with increasing yield of wheat. Int. J. Sustain. Agril. Tech. **3(6): 22-27**.

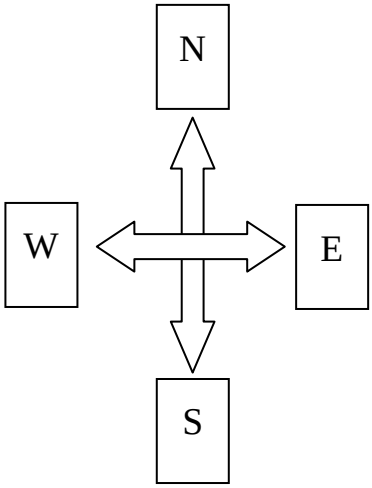
Rahman, M. M., Islam, M. A., Aminuzzaman, F. M. and Islam, M. R. 2006. Antifungal activity of indigenous plant extracts against *Bipolaris sorokiniana*. J. Agric. Educ. Technol. **9(1&2): 101-106**.

Razzaque, M. A. and Hossain A. B. S. 1991. The wheat development programme in Bangladesh "Wheat for the nontraditional warm areas" edited by D.A. Saunders. Proc. Intl.Conf. held in July 29 to Aug. 3, 1990 in Foz dolguacu Brazil CIMMYT. P p. 44-54.

Rovesti, L., Marco, D. S. and Tancald, D. 1992. Effect of Neem Kernel extract on some phytopathogenic fungi under green house conditions. Zeitschrift-fure-pflanjenk Yankhitenund-pftanjen schutj (Germany, F. R.) **V-99 (3) P**. 293-296.

Warham, E. J. 1990. Effect of *Telletia indica* infection on viability, germination and vigor of wheat seed. Plant Disease, 74: 130-135.

T_1R_1	T_1R_2	T_1R_3
T_2R_1	T_2R_2	T_2R_3
T_3R_1	T_3R_2	T_3R_3
T_4R_1	T_4R_2	T_4R_3
T_5R_1	T_5R_2	T_5R_3
T_6R_1	T_6R_2	T_6R_3
T_7R_1	T_7R_2	T_7R_3
T_8R_1	T_8R_2	T_8R_3
T_9R_1	T_9R_2	T_9R_3
$T_{10}R_1$	$T_{10}R_2$	$T_{10}R_3$
$T_{11}R_1$	$T_{11}R_2$	$T_{11}R_3$
$T_{12}R_1$	$T_{12}R_2$	$T_{12}R_3$
$T_{13}R_1$	$T_{13}R_2$	$T_{13}R_3$
$T_{14}R_1$	$T_{14}R_2$	$T_{14}R_3$



Appendix I. Layout of the pot experiment

Appendix II. Monthly average of Temperature, Relative humidity, Total Rainfall and Sunshine hour of the experimental site during the period from November 2006 to April 2007

Year	Month	Air temperature (^{0}c)			Relative humidity (%)	Rain fall (mm)	Sun shine (hr)
		Maximum	Minimum	Mean			
2006	November	29.5	19.4	24.05	68.0	0.0	230.5
	December	26.0	16.5	21.5	70.5	0.0	213.5
2007	January	24.6	13.5	19.05	67.5	3.0	192.5
	February	28.4	17.8	22.95	61.5	4.0	220.5
	March	32.1	22.2	27.55	66.7	0155	214.5
	April	34.2	24.8	29.65	67.5	0091	251.2

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