

Original Article

# Prevalence of fungi associated with Bipolaris leaf blight (BpLB) of different wheat varieties in Bangladesh

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**ABSTRACT:** Thirty five fungal species, representing 20 genera were found to be associated with BpLB infected leaves of twenty one wheat varieties, collected from eight districts (Dhaka, Gazipur, Dinajpur, Joypurhat, Pabna, Sirajgonj, Kushtia and Chuadanga) of Bangladesh. The most predominant fungi, in order of prevalence, were *Alternaria alternata*, *Bipolaris sorokiniana*, *Cladosporium cladosporioides*, *Curvularia lunata*, and *Fusarium semitectum*. The fungi varied in prevalence with respect to location, cultivar and year. Among the 35 fungi, association of *Bipolaris cynodontis* with wheat is a new record.

**KEYWORDS:** Bipolaris leaf blight, Prevalence of fungi, Wheat varieties, Bangladesh.

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## INTRODUCTION

Bangladesh is an over populated country and the growth rate of population is high. Keeping pace with the increasing population and from the point of their future food security, sustained increase of wheat production is well understood. Wheat grains are highly nutritive as they are rich in energy, carbohydrates, dietary fibre, fat, protein, thiamine, riboflavin, niacin, pantothenic acid, vitamin B<sub>6</sub>, folate, calcium, iron, magnesium, phosphorus, potassium, zinc and manganese<sup>1</sup>. Due to the high nutritive value, wheat grains are eaten in various forms (mainly roti/chapati). The average yield of wheat in Bangladesh is lower in comparison to other countries. During 2016-17, total wheat production was 1.335 million tons from 0.435 million hectares of land. The country needs 5.5 million tons wheat, 80% of which are imported every year<sup>2</sup>. Diseases play an important role in lowering wheat

yield in the country. Wheat is attacked by at least 20 different diseases in Bangladesh<sup>3,4</sup>, of which five are considered as major diseases, they are Bipolaris leaf blight- BpLB (*Bipolaris sorokiniana*), leaf rust (*Puccinia recondita*), seedling blight (*Bipolaris sorokiniana*), foot and root rot (*Sclerotium rolfsii* Tode) and black point [*B. sorokiniana*, *Alternaria alternata* (Fr) Keissler, *Curvularia lunata* (Wakker) Boedijn and species of *Fusarium* Link]. Sadat and Choi<sup>5</sup> reported wheat blast caused by *Pyricularia graminis-tritici* and *P. oryzae* from Bangladesh. The warmer parts of the world like Latin America, Africa, Asia, South-Asia etc. are mainly affected by *Bipolaris sorokiniana* (Sacc.) Shoemaker, teleomorph, *Cochliobolus sativus* (Ito and Kurib.) Drechsler ex Dastur, a notorious fungal pathogen<sup>6</sup>. This fungus act as a causal agent for various diseases like head blight, seedling blight, foliar blight/spot blotch, common root

rot and black point of wheat, barley, other small cereal grains and grasses<sup>7,8</sup>. Among all the diseases, caused by the pathogen leaf blight of wheat is considered as one of the most important diseases in those mega environment which is characterized by high temperature (coolest month greater than 17°C) and high humidity<sup>9</sup>. During past two decades, substantial economic loss in wheat production has occurred due to the severity of leaf blight, affecting the livelihood of millions of small-scale farmers. The widely applied rice-wheat cropping system of South-Asia provides favorable environment for the survival and multiplication of foliar blight pathogens because rice serves as a host for the leaf blight fungi and rice stubble plays its role as a substrate for the fungi after rice harvest<sup>10</sup>. On an average, a South-Asian country loses 20% of crop yield through leaf blight<sup>10</sup>. Yield loss was estimated to be 15% in Bangladesh<sup>11</sup>, 18-22% in India<sup>12</sup>. In recent years, leaf blight disease, caused by *Bipolaris sorokiniana* (Sacc.) Shoemaker, syn. *Drechslera sorokiniana* (Sacc.) Subram. & Jain, syn. *Helminthosporium sativum*, teleomorph *Cochliobolus sativus* (Ito & Kurib.) has emerged as serious concern for cultivation of wheat in Bangladesh. Present investigation was undertaken to find out the fungi associated with BpLB infected wheat leaves and to detect the prevalence of fungi with selected wheat leaves in different districts and different years.

## MATERIALS AND METHODS

### Collection of sample

BpLB infected wheat leaves of 21 wheat varieties were collected from different locations of eight districts (Dhaka, Gazipur, Dinajpur, Joypurhat, Pabna, Sirajgonj, Kushtia and Chuadanga) in Bangladesh (Table 1). Leaf samples were collected from Bangladesh Agriculture Research Institute (BARI), research fields of Gazipur and Dinajpur districts and also from the farmers' fields of the districts. Samples were collected during grain filling stage (from last week of February to 1<sup>st</sup> week of April) during the tenure of 2010 to 2013. At least 10-15 pieces of BpLB infected wheat leaves of each variety were collected and placed in clean brown paper bag, labeled properly and preserved at 4°C in refrigerator for subsequent studies. Total 121 samples of different varieties were collected and examined from different locations (Table 1).

### Isolation of fungi

The fungi were isolated from the samples following "Tissue planting method" on PDA (Potato Dextrose Agar) medium<sup>13</sup>. Infected leaf samples were washed thrice with sterilized water within a beaker. From infected leaves 2<sup>2</sup> mm inocula were prepared and placed in sterilized Petri plates then sterilized in 10% Chlorox for 2 minute and again washed in sterilized

water thrice. After washing they were placed on PDA medium at 5 pieces per Petri plate and incubated for 7 days at 25±2°C. Fungi grew from the diseased leaves were transferred to separate PDA plates and PDA slants for further studies and preservation.

### Identification of fungi

Detail morphological studies of the fungal isolates were made in order to determine their identification. Morphological colony features were recorded on PDA medium for each fungal specimen. The microscopic structural features of the specimens were drawn with aid of Camera Lucida and measurement unit was micro meter. Microphotographs were taken with Nycon digital camera. Then isolated fungi were identified based on following standard literatures<sup>14-20</sup>. Prevalence (%) of fungi in specimens was also recorded.

## RESULTS AND DISCUSSION

Thirty five fungal species, representing 20 genera were found to be associated with BpLB infected leaves of twenty one wheat varieties in Bangladesh. The most predominant fungi, in order of prevalence, were *Bipolaris sorokiniana* (Sacc.) Shoem., *Alternaria alternata* (Fr.) Keissler, *Curvularia lunata* (Wakker) Boedijn, *Cladosporium cladosporioides* de Vries and *Fusarium semitectum* Berk. & Rav. . Other fungi were *Alternaria tritricina* Prasada & Prabhu, *Arthrinium Kunze* ex Fr., *Aspergillus flavus* Link, *A. fumigatus* Fresen., *A. niger* Van Tiegh., *A. terreus* Thom., a species of *Aspergillus* Link, *Bipolaris cynodontis* (Marig.) Shoem., *B. oryzae* (Breda De Hann) Shoem., *B. tetramera* (Mckinney) Shoem., *B. victoriae* (Meehan & Murphy) Shoem., *Bispora antenata* (Pers.) Mason, *Cheatomium globosum* Kunze ex Fr., a species of *Chaetophoma* Cooke, a species of *Coniothyrium* Corda, *Curvularia affinis* Boedijn, *C. pallescens* Boedijn, *Drechslera dematioidea* (Bub. & Wrob.) Subram. & Jain, *D. hawaiiensis* (Bugnicourt) ex M.B. Ellis; Subram. & Jain, *Epicoccum purpurascens* Ehrneb. ex Schlecht, a species of *Eurotium*., *Fusarium moniliforme* Sheldon, *Fusarium nivale* Ces., *Nigrospora oryzae* Berk. & Br., *N. sacchari* (Speg.) Mason, *Penicillium digitatum* (Fr.) Sacc., *Pestalotiopsis guepinii* (Desm.) Stay., *Rhizopus stolonifer* (Ehrenb.:Fr.) Vuill, *Syncephalastrum* Schroet and *Trichoderma viride* Pers. (Table 2).

Among the 35 fungi, seven fungal species were obtained from almost eight districts. These were *Alternaria alternata*, *Aspergillus flavus*, *A. niger*, *Bipolaris sorokiniana*, *Cladosporium cladosporioides*, *Curvularia lunata* and *Fusarium semitectum*. Also there were some fungi, which prevail in only one district. Such as, *Aspergillus* sp., *Bipolaris oryzae*, *B. victoriae* and *Eurotium* sp. from Gazipur district, *Bispora antenata*, *Pestalotiopsis guepinii*, *Coniothyrium* sp. and *Syncephalastrum* sp. from Joypurhat district, *Chaetophoma* sp. from Pabna district and *Cheatomium globosum* from Chuadanga district (Table 2).

From Dhaka district eight fungal species were isolated, the frequency percentage of *Bipolaris sorokiniana* was highest (43.13) and the frequency percentage of *Alternaria trititica* was lowest (2.78). From Gazipur district the highest number of fungi (23) were isolated, frequency percentage of *Bipolaris sorokiniana* was highest (51.49) and the frequency percentage of *Trichoderma viride* was lowest (2.24) respectively. Twenty two fungi were isolated from Dinajpur district, the frequency percentage of *Alternaria alternata* was highest 44.93 and the lowest frequency percentage of *Fusarium moniliforme* was 2.77. From Joypurhat district total 14 fungi were isolated, frequency percentage of *Bipolaris sorokiniana* the highest (53.55) and frequency percentage of *Alternaria trititica* was lowest (1.32). Fourteen fungal species were isolated from Pabna district, the lowest frequency percentage of *Curvularia pallescens* was 1.77 and the highest frequency percentage of *Bipolaris sorokiniana* was 36.52 respectively. From Sirajgonj district, total isolated fungi were nine. The highest frequency percentage of *Bipolaris sorokiniana* was 35.37 and the lowest frequency percentage of *Aspergillus niger* was 5.26. From Kushtia district fifteen fungi were isolated, the highest frequency percentages of *A. flavus*, *A. fumigatus* and *Penicillium digitatum* was 33.34 and the

lowest frequency percentage of *Alternaria trititica* was 2.32. From Chuadanga district, total seventeen fungi were isolated from BpLB symptom of wheat varieties. The highest frequency percentage of *Curvularia lunata* was 24.99 and the lowest frequency percentage of *Nigrospora sacchari* was 3.15 (Table 2). The most predominant fungi, in order of prevalence, were *Alternaria alternata*, *Bipolaris sorokiniana*, *Cladosporium cladosporioides*, *Curvularia lunata* and *Fusarium semitectum*. The fungi varied in prevalence with respect to location, cultivar and year. Among eight districts, frequency percentage of *Alternaria alternata* was highest in Dinajpur district (44.93) and lowest in Joypurhat district (5.71), frequency percentage of *Bipolaris sorokiniana* was highest in Joypurhat district 53.55 and lowest in Kushtia district was 6.67. Frequency percentage of *Cladosporium cladosporioides* was highest in Gazipur district (35.05) and it was lowest in Dinajpur district (7.5). Frequency percentage of *Curvularia lunata* was highest in Gazipur district (32.98) and it was lowest in Kushtia district (5.0). Frequency percentage of *Fusarium semitectum* was highest in Gazipur district (25.41) and it was lowest in Dhaka district (12.08) (Table 2 and Fig.1).

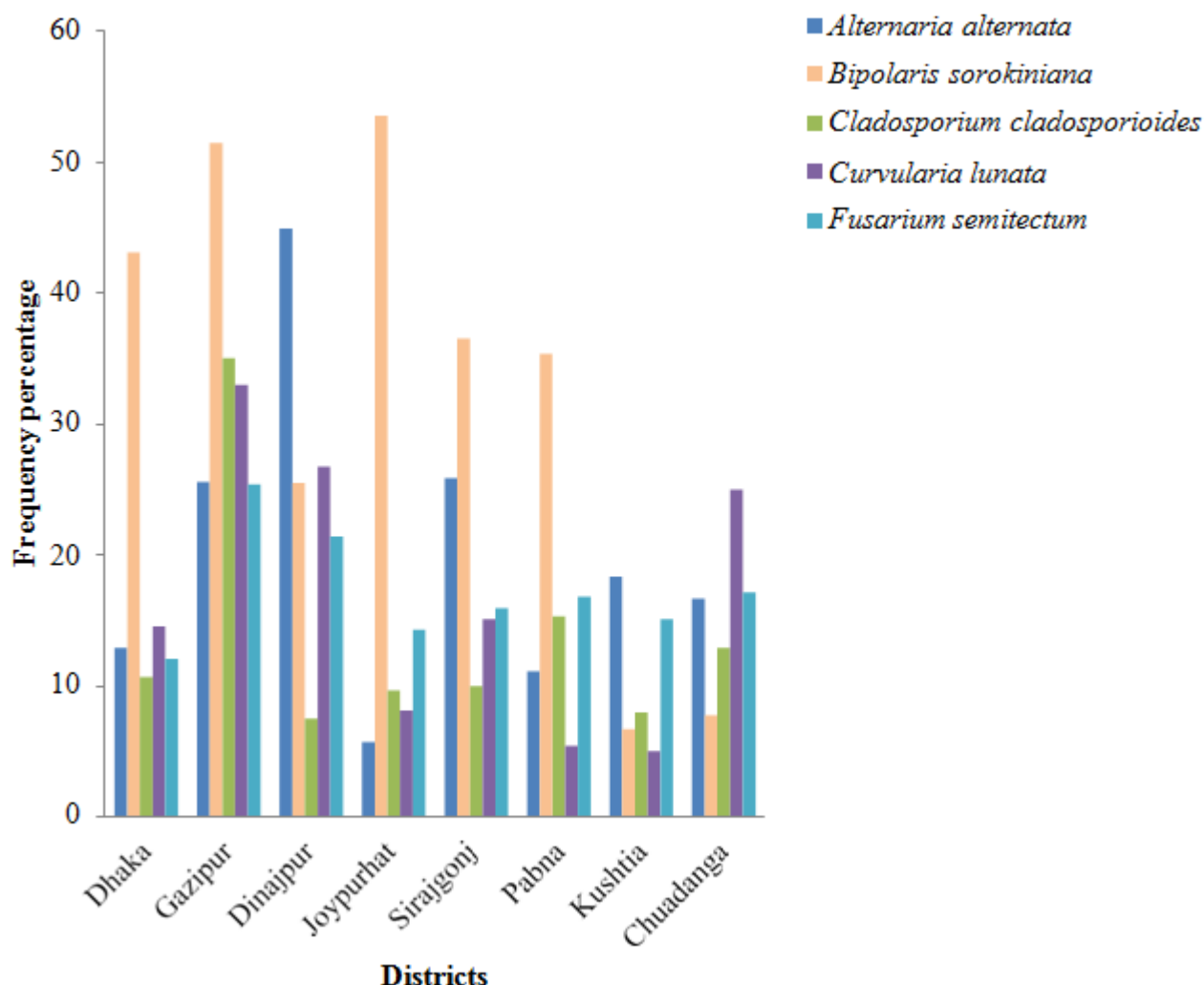
**Table 1.** Collection of BpLB infected leaf samples in Bangladesh.

| Division | District  | Upazilla  | Village/Area           | No. of samples       | Variety  | Date of Collection                                   |
|----------|-----------|-----------|------------------------|----------------------|--|--|
| Dhaka    | Dhaka     | DU        | Carzon Hall            | 10                   | BARI GOM-25, BARI GOM-26, Kanchan  | 25-02-2013   |
|          | Gazipur   | Joydebpur | BARI                   | 15 + 05+<br>10+05=35 | Aghrani, Akber, Ananda, Balaka, Barkat, Bijoy, Kalyansona, Kanchan, Kheri, Protiva, Shatabdi, Seri-82, Sonora-64, Inia-66, Sonalika,         | 20-03-2010<br>15-03-2011<br>23-03-2012<br>09-03-2013 |
| Rangpur  | Dinajpur  | BARI      | WRC                    | 15+10=25             | Ananda, Aghrani, Balaka, BARI GOM-25, BARI GOM-26, Bijoy, Ciano-79, Gaurab, Kalyansona, Kanchan, Prodip, Protiva, Saurav, Shatabdi, Sonalika | 27-02-2011<br>05-03-2012                             |
|          | Joypurhat | Sadar     | Vutiapara<br>Doripara  | 10                   | Bijoy, Prodip, Shatabdi, Saurav  | 04-04-2013   |
| Rajshahi | Pabna     | Bera      | Kazir Hat              | 10                   | Bijoy, Shatabdi, Saurav  | 23-03-2012   |
|          |           |           | Kashinathpur           |                      |  |  |
|          |           | Sujanagar | Matighara              |                      |  |  |
|          |           |           | Vatikaya               |                      |  |  |
|          | Sirajgonj | Sadar     | Binoypur<br>Vennabari  | 10                   | Bijoy, Prodip, Shatabdi, Saurav  | 03-04-2012   |
| Khulna   | Kushtia   | Veramara  | Farakpur<br>Khemirdiar | 15                   | Bijoy, Shatabdi, Prodip  | 12-03-2012   |
|          |           | Mirpur    | Kodalipara             |                      |  |  |
|          | Chuadanga | Sadar     | Farmpara               | 06                   | Bijoy, Shatabdi, Saurav  | 22-03-2012   |
| 4        | 8         | 10        | 15                     | 121                  | 21   | 2010-2013  |

**Table 2.** Prevalence of fungi associated with BpLB infected wheat leaves in eight districts of Bangladesh.

| Sl. No. | Species name                        | Dhaka | Gazipur | Dinajpur | Joypurhat | Pabna | Sirajgonj | Kushtia | Chuadanga |
|---------|-------------------------------------|-------|---------|----------|-----------|-------|-----------|---------|-----------|
| 1       | <i>Alternaria alternata</i>         | 12.90 | 25.56   | 44.93    | 5.71      | 25.87 | 11.12     | 18.34   | 16.66     |
| 2       | <i>Alternaria trititica</i>         | 2.78  | 4.96    | 10.28    | 1.32      | 5.34  | –         | 2.32    | 3.34      |
| 3       | <i>Arthirinium</i> sp.              | –     | 7.50    | –        | 6.67      | –     | –         | –       | –         |
| 4       | <i>Aspergillus flavus</i>           | 10.98 | 14.32   | 12.78    | 14.29     | 20.24 | 8.19      | 33.34   | 12.49     |
| 5       | <i>Aspergillus fumigatus</i>        | –     | 11.29   | 8.34     | 14.29     | 33.33 | –         | 33.34   | 16.66     |
| 6       | <i>Aspergillus niger</i>            | 10.98 | 19.81   | 10.83    | 15.71     | 12.61 | 5.26      | 23.34   | 5.35      |
| 7       | <i>Aspergillus terreus</i>          | –     | 10.0    | 13.34    | –         | –     | –         | 26.67   | –         |
| 8       | <i>Aspergillus</i> sp.              | –     | 6.67    | –        | –         | –     | –         | –       | –         |
| 9       | <i>Bipolaris cynodontis</i>         | –     | 4.76    | –        | 5.33      | –     | –         | –       | –         |
| 10      | <i>Bipolaris oryzae</i>             | –     | 2.86    | –        | –         | –     | –         | –       | –         |
| 11      | <i>Bipolaris sorokiniana</i>        | 43.13 | 51.49   | 25.49    | 53.55     | 36.52 | 35.37     | 6.67    | 7.78      |
| 12      | <i>Bipolaris tetramera</i>          | –     | 7.69    | 5.44     | 6.78      | –     | 6.59      | 6.85    | –         |
| 13      | <i>Bipolaris victoriae</i>          | –     | 3.34    | –        | –         | –     | –         | –       | –         |
| 14      | <i>Bispora antenata</i>             | –     | –       | 2.86     | –         | –     | –         | –       | –         |
| 15      | <i>Chaetomium globosum</i>          | –     | –       | –        | –         | –     | –         | –       | 3.57      |
| 16      | <i>Chaetophoma</i> sp.              | –     | –       | –        | –         | 3.34  | –         | –       | –         |
| 17      | <i>Cladosporium cladosporioides</i> | 10.67 | 35.05   | 7.50     | 9.67      | 10.0  | 15.33     | 7.99    | 12.89     |
| 18      | <i>Coniothyrium</i> sp.             | –     | –       | 6.67     | –         | –     | –         | –       | –         |
| 19      | <i>Curvularia affinis</i>           | –     | –       | 2.96     | –         | –     | –         | –       | 3.26      |
| 20      | <i>Curvularia lunata</i>            | 14.55 | 32.98   | 26.72    | 8.09      | 15.08 | 5.41      | 5.00    | 24.99     |
| 21      | <i>Curvularia pallescens</i>        | –     | 4.16    | –        | –         | 1.77  | –         | 3.34    | –         |
| 22      | <i>Drechslera dematioidea</i>       | –     | –       | –        | 1.43      | –     | –         | –       | –         |
| 23      | <i>Drechslera hawaiiensis</i>       | –     | 14.86   | 15.78    | –         | –     | –         | 9.38    | –         |
| 24      | <i>Epicoccum purpurascens</i>       | –     | –       | 6.67     | –         | –     | –         | –       | 10.71     |
| 25      | <i>Eurotium</i> sp.                 | –     | 6.67    | –        | –         | –     | –         | –       | –         |
| 26      | <i>Fusarium moniliforme</i>         | –     | –       | 2.77     | –         | –     | –         | –       | 3.17      |
| 27      | <i>Fusarium nivale</i>              | –     | 3.34    | –        | –         | 5.45  | –         | –       | –         |
| 28      | <i>Fusarium semitectum</i>          | 12.08 | 25.41   | 21.39    | 14.28     | 15.95 | 16.8      | 15.1    | 17.14     |
| 29      | <i>Nigrospora oryzae</i>            | –     | 11.11   | 14.52    | –         | 7.14  | –         | –       | 5.99      |
| 30      | <i>Nigrospora sacchari</i>          | –     | –       | 2.96     | –         | –     | –         | –       | 3.15      |
| 31      | <i>Penicillium digitatum</i>        | –     | 5.83    | 6.67     | –         | –     | 8.34      | 33.34   | 10.71     |
| 32      | <i>Pestalotiopsis guepinii</i>      | –     | –       | 18.33    | –         | –     | –         | –       | –         |
| 33      | <i>Rhizopus stolonifer</i>          | –     | –       | –        | 2.86      | 28.57 | –         | –       | 14.28     |
| 34      | <i>Syncephalastrum</i> sp.          | –     | –       | 3.57     | –         | –     | –         | –       | –         |
| 35      | <i>Trichoderma viride</i>           | –     | 2.24    | –        | –         | –     | –         | 5.71    | –         |

‘–’= No fungal growth



**Fig.1.** Prevalence of *Alternaria alternata*, *Bipolaris sorokiniana*, *Cladosporium cladosporioides*, *Curvularia lunata* and *Fusarium semitectum* in eight districts of Bangladesh.

Table 3 shows the frequency percentages of thirty five fungal species during the year 2010 to 2013 (2009-10, 2010-11, 2011-12 and 2012-13). In year 2009-10, total twenty fungal species were obtained; among them the highest frequency percentage of *Curvularia lunata* was 36.67 and lowest frequency percentage of *Trichoderma viride* was 2.24. Total twenty three fungal isolates were obtained in the year 2010-11; the highest and the lowest frequency percentage were *Alternaria alternata* (40.56) and *Fusarium moniliforme* (2.77). In year 2011-12, total twenty two fungi were obtained, among them the highest frequency percentage was *Bipolaris sorokiniana* 28.32 and the lowest *Curvularia pallescens* 2.55. Total twenty one fungi were isolated in the year 2012-13; the highest and the lowest frequency percentage were *Bipolaris sorokiniana* (40.83) and *Alternaria*

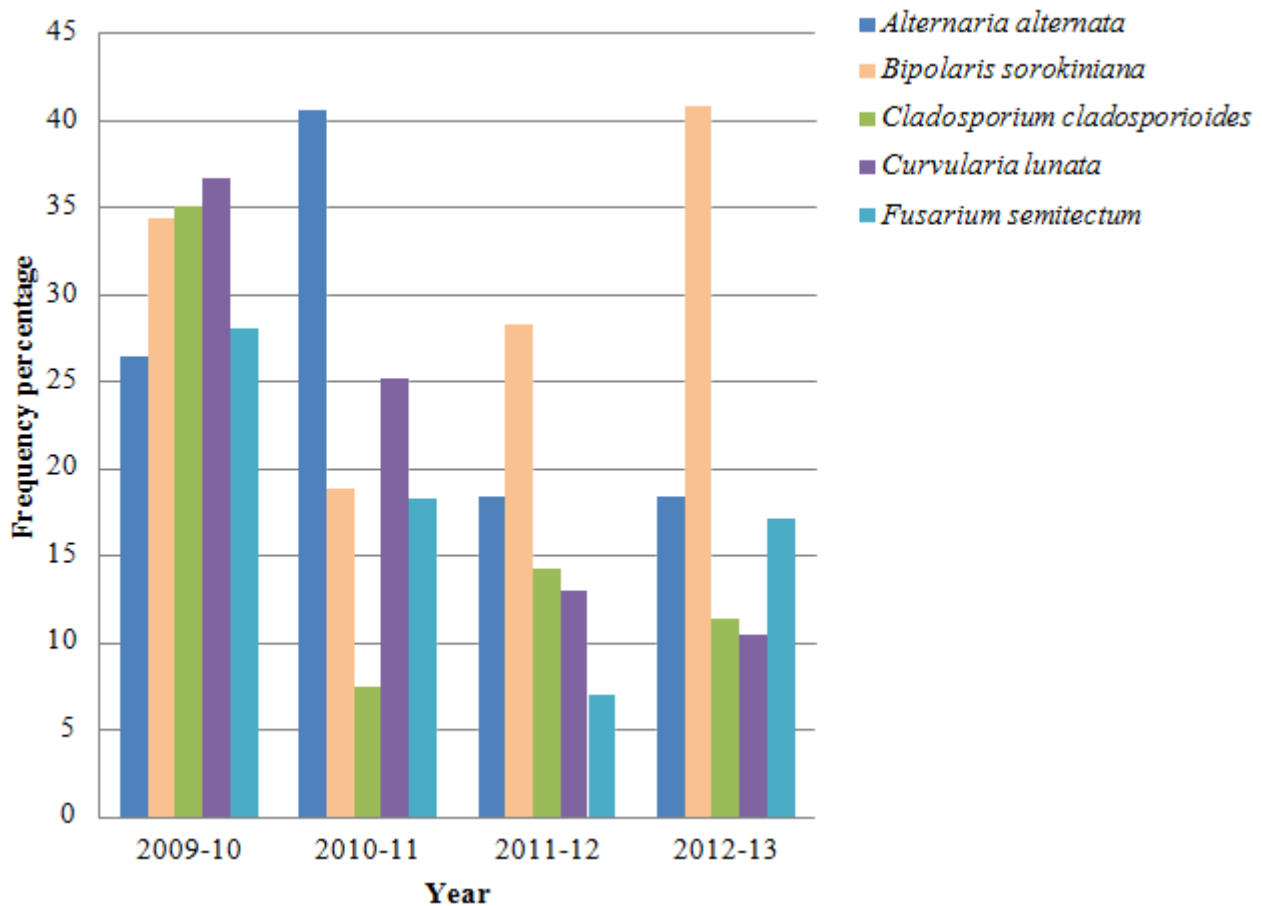
*triticina* (1.32). Frequency percentage of five predominant fungi, *Alternaria alternata*, *Bipolaris sorokiniana*, *Cladosporium cladosporioides*, *Curvularia lunata* and *Fusarium semitectum* were shown in the year 2010 to 2013. Frequency percentage of *Alternaria alternata* was highest in the year 2010-11 (40.56) and lowest in the year 2012-13 (18.37), *Bipolaris sorokiniana* was highest in the year 2012-13 (40.83%) and lowest in the year 2010-11 (18.92%), *Cladosporium cladosporioides* was highest in the year 2009-10 (35.05%) and lowest in the year 2010-11 (7.5%), *Curvularia lunata* was highest in the year 2009-10 (36.67%) and lowest in the year 2012-13 (10.46%) and *Fusarium semitectum* was highest in the year 2009-10 (28.04%) and lowest in the year 2011-12 (7.11%) (Table 3 and Fig. 2).



**Table 3.** Prevalence of fungi in Year 2010 to 2013 from BpLB infected wheat leaves in Bangladesh.

| Sl. No. | Fungal species                      | Year<br>2009-10 | Year<br>2010-11 | Year<br>2011-12 | Year<br>2012-13 |
|---------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
| 1       | <i>Alternaria alternata</i>         | 26.42           | 40.56           | 18.43           | 18.37           |
| 2       | <i>Alternaria triticina</i>         | 4.96            | 6.53            | 3.67            | 1.32            |
| 3       | <i>Arthrinium</i> sp.               | –               | 8.34            | –               | 6.67            |
| 4       | <i>Aspergillus flavus</i>           | 15.09           | 10.83           | 16.66           | 14.28           |
| 5       | <i>Aspergillus fumigatus</i>        | 13.33           | 7.28            | 27.14           | 16.02           |
| 6       | <i>Aspergillus niger</i>            | 20.44           | 12.0            | 10.07           | 11.02           |
| 7       | <i>Aspergillus terreus</i>          | 10.0            | 13.34           | 26.67           | 4.17            |
| 8       | <i>Aspergillus</i> sp.              | 6.67            | –               | –               | –               |
| 9       | <i>Bipolaris cynodontis</i>         | 4.76            | –               | –               | 5.33            |
| 10      | <i>Bipolaris oryzae</i>             | 2.86            | –               | –               | –               |
| 11      | <i>Bipolaris sorokiniana</i>        | 34.44           | 18.92           | 28.32           | 40.83           |
| 12      | <i>Bipolaris tetramera</i>          | 6.67            | 5.12            | 5.78            | 4.78            |
| 13      | <i>Bipolaris victoriae</i>          | –               | –               | –               | 3.33            |
| 14      | <i>Bispora antenata</i>             | –               | 2.86            | –               | –               |
| 15      | <i>Chaetomium globosum</i>          | –               | –               | 3.57            | –               |
| 16      | <i>Chaetophoma</i> sp.              | –               | –               | 3.34            | –               |
| 17      | <i>Cladosporium cladosporioides</i> | 35.05           | 7.50            | 14.28           | 11.42           |
| 18      | <i>Coniothyrium</i> sp.             | –               | 6.67            | –               | –               |
| 19      | <i>Curvularia affinis</i>           | –               | 2.96            | 3.26            | –               |
| 20      | <i>Curvularia lunata</i>            | 36.67           | 25.21           | 12.98           | 10.46           |
| 21      | <i>Curvularia pallescens</i>        | 4.16            | –               | 2.55            | –               |
| 22      | <i>Drechslera dematioidea</i>       | –               | –               | –               | 1.43            |
| 23      | <i>Drechslera hawaiiensis</i>       | 14.86           | 15.78           | –               | 9.38            |
| 24      | <i>Epicoccum purpurascens</i>       | –               | 6.67            | 10.71           | –               |
| 25      | <i>Eurotium</i> sp.                 | –               | –               | –               | 6.67            |
| 26      | <i>Fusarium moniliforme</i>         | –               | 2.77            | –               | 3.17            |
| 27      | <i>Fusarium nivale</i>              | 3.34            | –               | 5.45            | –               |
| 28      | <i>Fusarium semitectum</i>          | 28.04           | 18.35           | 7.11            | 17.19           |
| 29      | <i>Nigrospora oryzae</i>            | 13.33           | 14.52           | 7.14            | 6.67            |
| 30      | <i>Nigrospora sacchari</i>          | –               | 2.96            | 3.15            | –               |
| 31      | <i>Penicillium digitatum</i>        | 6.67            | 6.11            | 15.18           | 10.0            |
| 32      | <i>Pestalotiopsis guepinii</i>      | –               | 18.33           | –               | –               |
| 33      | <i>Rhizopus stolonifer</i>          | –               | –               | 21.42           | 2.86            |
| 34      | <i>Syncephalastrum</i> sp.          | –               | 3.57            | –               | –               |
| 35      | <i>Trichoderma viride</i>           | 2.24            | –               | 5.71            | –               |

‘–’= No fungal growth



**Fig. 2.** Prevalence of *Alternaria alternata*, *Bipolaris sorokiniana*, *Cladosporium cladosporioides*, *Curvularia lunata* and *Fusarium semitectum* in Year 2010 to 2013 from BpLB infected wheat leaves in Bangladesh.

Besides the above mentioned fungi, *Aspergillus flavus* and *A. niger* were isolated from all the eight districts and year studies. Among thirty five fungal species highest frequency percentage was noticed in *Bipolaris sorokiniana* in Joypurhat district (53.55) and the lowest count was (1.43) in *Drechslera dematioidea* of same district (Table 2).

Total twenty one wheat varieties or genotypes were collected from wheat research station of Gazipur and

Dinajpur districts and also from farmers' fields of eight districts.

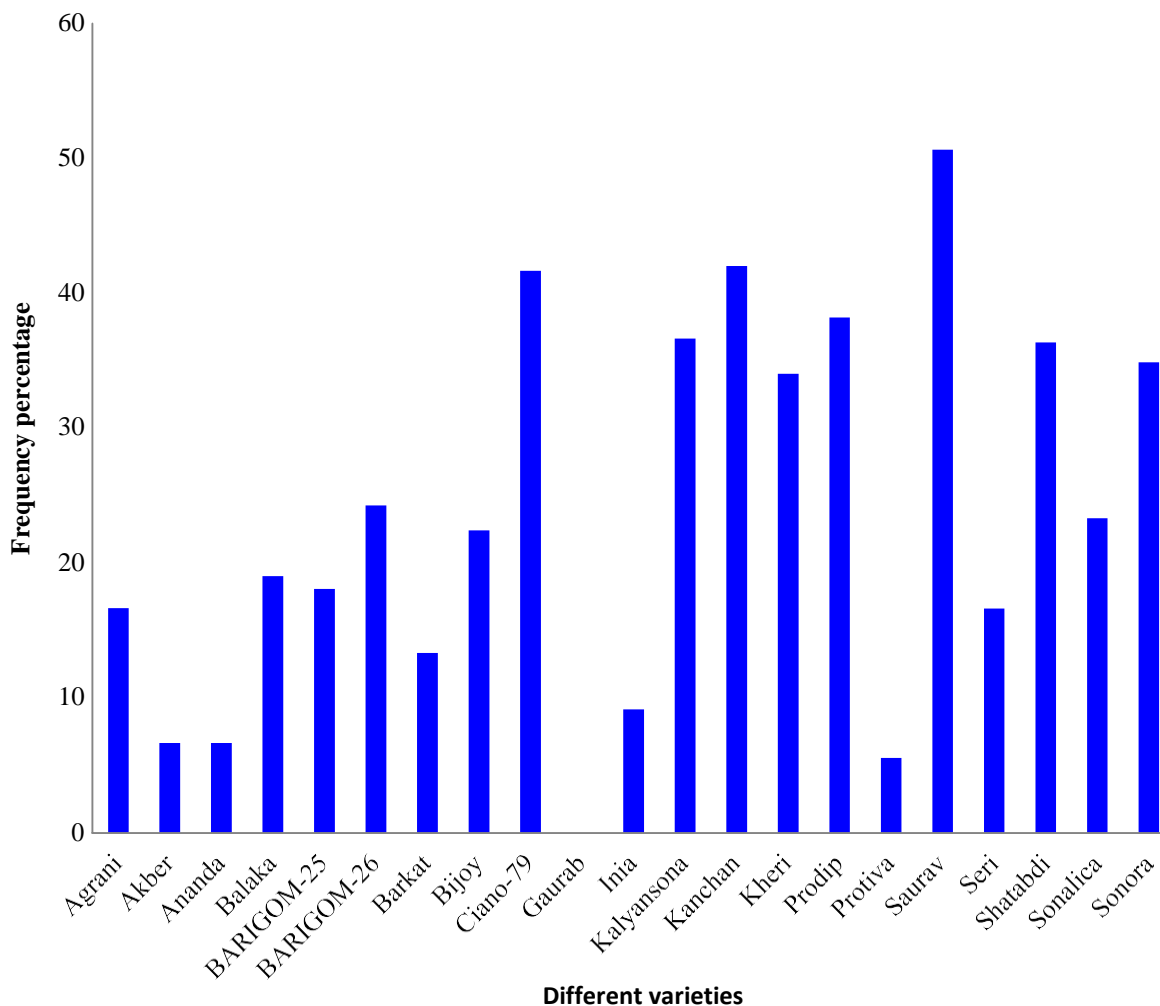
Main focus was on *Bipolaris sorokiniana*. Frequency percentage of different varieties was shown in Fig. 3. The highest frequency percentage was noticed in variety Saurav (50.65) and the lowest was in variety Protiva (5.56) (Table 4).

**Table 4.** Prevalence of major fungi associated with BpLB infected leaves of different wheat genotypes grown under field condition.

| Sl. No. | Geno types  | Prevalence of fungi (%)     |       |       |       |                              |       |       |       |                                     |       |       |       |                          |       |       |       |                            |       |       |       |
|---------|-------------|-----------------------------|-------|-------|-------|------------------------------|-------|-------|-------|-------------------------------------|-------|-------|-------|--------------------------|-------|-------|-------|----------------------------|-------|-------|-------|
|         |             | <i>Alternaria alternata</i> |       |       |       | <i>Bipolaris sorokiniana</i> |       |       |       | <i>Cladosporium cladosporioides</i> |       |       |       | <i>Curvularia lunata</i> |       |       |       | <i>Fusarium semitectum</i> |       |       |       |
|         |             | 09-10                       | 10-11 | 11-12 | 12-13 | 09-10                        | 10-11 | 11-12 | 12-13 | 09-10                               | 10-11 | 11-12 | 12-13 | 09-10                    | 10-11 | 11-12 | 12-13 | 09-10                      | 10-11 | 11-12 | 12-13 |
| 1       | Aghrani     | 33.34                       | 46.67 | —     | —     | 6.67                         | 26.67 | —     | —     | —                                   | 8.34  | —     | —     | 6.67                     | 26.67 | —     | —     | 40.02                      | 20.0  | —     | —     |
| 2       | Akber       | 20.01                       | —     | 16.67 | —     | 6.67                         | —     | 6.67  | —     | —                                   | —     | —     | —     | 13.34                    | —     | 6.67  | —     | 20.01                      | —     | 13.34 | —     |
| 3       | Ananda      | 6.67                        | 86.71 | —     | —     | —                            | 6.67  | —     | —     | 6.67                                | 13.34 | —     | —     | 13.34                    | 6.67  | —     | —     | 73.37                      | 13.34 | —     | —     |
| 4       | Balaka      | 7.14                        | 27.8  | —     | 33.34 | 21.42                        | 16.67 | —     | —     | 28.56                               | —     | —     | 7.14  | 28.56                    | 16.67 | —     | 14.34 | 49.98                      | 16.67 | —     | 21.42 |
| 5       | BARIGO M-25 | —                           | —     | 17.13 | 26.68 | —                            | —     | 22.84 | 13.34 | —                                   | —     | 5.71  | 13.34 | —                        | —     | 11.42 | 20.01 | —                          | —     | 22.84 | 13.34 |
| 6       | BARIGO M-26 | —                           | —     | 13.34 | 21.42 | —                            | —     | 20.01 | 28.56 | —                                   | —     | 6.67  | 14.28 | —                        | —     | 26.68 | 28.56 | —                          | —     | 20.01 | 14.28 |
| 7       | Barkat      | 42.84                       | 20.01 | —     | —     | —                            | 13.34 | —     | —     | 7.14                                | 53.36 | —     | —     | 14.28                    | 6.67  | —     | —     | 14.28                      | 6.67  | —     | —     |
| 8       | Bijoy       | 33.35                       | 6.67  | 5.56  | 14.28 | 20.01                        | 13.34 | 27.80 | 28.56 | 6.67                                | 33.35 | 11.12 | 3.57  | 26.68                    | 6.67  | 11.12 | 7.14  | 6.67                       | 13.34 | 16.68 | 14.28 |
| 9       | Ciano-79    | —                           | 33.34 | 33.34 | —     | —                            | 66.67 | 16.67 | —     | —                                   | 6.67  | —     | —     | —                        | 20.01 | 33.34 | —     | —                          | 13.34 | 16.67 | —     |
| 10      | Gaurab      | —                           | 53.3  | 26.67 | —     | —                            | —     | —     | —     | —                                   | —     | 6.67  | —     | —                        | 40.0  | 53.34 | —     | —                          | 33.34 | 13.34 | —     |
| 11      | Inia-66     | 26.67                       | 22.23 | 25.02 | —     | 10.0                         | —     | 8.34  | —     | —                                   | 22.23 | 8.34  | —     | 55.56                    | 44.45 | 16.68 | —     | 22.23                      | 11.11 | 16.68 | —     |
| 12      | Kalyansona  | 6.67                        | 13.3  | 73.3  | —     | 53.3                         | 20.0  | —     | —     | 6.67                                | —     | 6.67  | —     | 100                      | 45.3  | 18.33 | —     | —                          | 20.0  | 33.3  | —     |
| 13      | Kanchan     | 13.34                       | 22.2  | 8.34  | 60.0  | —                            | 44.4  | 41.7  | 40.0  | 60.0                                | —     | 14.28 | 20.0  | 13.34                    | 22.2  | 25.0  | 28.57 | —                          | —     | 25.0  | 7.14  |
| 14      | Kheri       | 20                          | 46.7  | 10.3  | —     | 73.3                         | 13.3  | 15.5  | —     | 26.7                                | —     | 5.16  | —     | —                        | 20    | 10.3  | —     | 53.3                       | 13.3  | 5.16  | —     |
| 15      | Prodip      | 60                          | 14.29 | 5.71  | 25.0  | 10                           | 57.14 | 71.43 | 14.28 | —                                   | 5.71  | 2.86  | —     | 20                       | 8.57  | 8.57  | 42.85 | 6.67                       | 5.71  | 8.57  | 10.71 |
| 16      | Protiva     | 44.5                        | 8.34  | —     | —     | 5.56                         | —     | —     | —     | 11.1                                | 16.68 | —     | —     | 33.4                     | 83.4  | —     | —     | 11.1                       | 25.02 | —     | —     |
| 17      | Saurav      | 33.34                       | 53.3  | 28.57 | 14.29 | 35.7                         | 52.63 | 28.57 | 85.71 | 6.67                                | —     | 2.86  | 5.71  | 40                       | 14.28 | 28.57 | 14.29 | 16.67                      | 7.14  | 8.58  | 14.29 |
| 18      | Seri-82     | —                           | —     | 10.0  | —     | 13.3                         | —     | 20.0  | —     | —                                   | —     | 10.0  | —     | 66.7                     | —     | 40.0  | —     | 13.3                       | —     | 30.0  | —     |
| 19      | Shatabdi    | 33.4                        | 10.53 | 28.57 | 11.42 | 33.4                         | 36.84 | 23.81 | 51.43 | —                                   | 5.26  | 7.14  | 9.53  | 11.1                     | 10.53 | 25    | 5.71  | 22.2                       | 10.53 | 10.71 | 4.76  |
| 20      | Sonalika    | 6.67                        | 66.7  | 40    | —     | 26.68                        | —     | 20.01 | —     | 6.67                                | —     | 10.0  | —     | 33.35                    | 25    | 20.0  | —     | 6.67                       | 25    | 10.0  | —     |
| 21      | Sonora-64   | 13.34                       | 7.69  | —     | —     | 46.69                        | 23.07 | —     | —     | 6.67                                | —     | —     | —     | 73.37                    | 7.69  | —     | —     | 20.01                      | 15.38 | —     | —     |

‘—’= No fungal growth





**Fig. 3.** Prevalence of *Bipolaris sorokiniana* with BpLB infected leaves of twenty one wheat genotypes.

Reports on mycoflora associated with wheat seeds are available and different research work have done in home and abroad. But mycoflora associated with BpLB infected wheat leaves are inadequate. *Bipolaris* leaf blight is a complex syndrome due to involvement of a number of pathogens<sup>21-25</sup>. *Drechslera sorokiniana*; *D. tritici-repentis*; *D. tetramera*; *Alternaria triticina* and *A. alternata*, *H. spiciferum* and *Curvularia* species are associated with foliar blight complex. Mahto *et al.*<sup>26</sup> studied 152 leaf blight and spot blotch samples from different agroecological regions in India and recorded *Alternaria alternata*, *A. triticina*, *Chaetomium* spp., *Fusarium moniliforme* [*Gibberella fujikuroi*], *Epicoccum purpurascens* [*E. nigrum*], *Paecilomyces variotii*, and *Penicillium* spp. with *Drechslera sorokiniana* [*Cochliobolus sativus*]. Singh *et al.*<sup>27</sup> also reported *Bipolaris sorokiniana*, *Alternaria triticina*, *Alternaria alternata*, *Chaetomium* spp., *Fusarium moniliforme* [*Gibberella moniliformis*], *Epicoccum*

*purpurascens* [*E. nigrum*], *Pestalotiopsis disseminata*, *Aspergillus flavus*, *Acremonium strictum*, *Curvularia lunata* [*Cochliobolus lunatus*], *Paecilomyces variotii* and *Penicillium* spp. were associated with blighted leaves of wheat. Reports of present investigation slightly differ from the previous report on fungal association of leaf blight infected wheat varieties might be due to change of location and cultivars. In this report, *Bipolaris sorokiniana* was the main pathogen associated with BpLB symptom among different *Bipolaris* and *Drechslera* species. Prevalence of *Alternaria triticina* was lower than *Alternaria alternata*, *Cladosporium cladosporioides*, *Fusarium semitectum* and *Curvularia lunata*. Moreover, different species of *Aspergillus* was frequently associated with the aforesaid symptom of wheat varieties. Present investigation will be helpful for designing management studies of BpLB infected wheat varieties.

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