*Pak. J. Bot.*, 37(4): 973-980, 2005.

# PREVALENCE AND DISEASE INCIDENCE OF FOLIAR BLIGHT OF WHEAT IN RICE WHEAT CROPPING SYSTEM OF PUNJAB

**SHAZIA IRAM AND IFTIKHAR AHMAD**

*Institute of Plant and Environmental Protection,*
*National Agriculture Research Centre, Islamabad, Pakistan.*

**Abstract**

Foliar blight is a major biotic constraint to wheat in the Indo-Gangetic plains of south Asia, particularly in the rice-wheat system .The disease occurs as a complex of spot blotch and tan spot caused by *Cochliobolus sativus* and *Pyrenophora tritici-repentis*, respectively. A survey was conducted for the assessment of foliar blight of wheat in main rice-wheat cropping areas of Punjab, Pakistan. Foliar samples were collected at the maturity stage of wheat crop from 20 key locations of 4 districts viz., Gujranwala, Sheikhupura, Sialkot and Narowal. The foliar fungi were isolated using blotter method. Prevalence of foliar blight was 100% in the four surveyed districts Gujranwala, Sheikhupura, Narowal and Sialkot. From leaf samples, *Alternaria alternata, Pyrenophora tritici-repentis, Bipolaris sorokiniana, Stemphylium* spp., and *Cladosporium* spp., were isolated. Foliar blight was more prevalent fungal disease and it could not be differentiated from spot blotch, tan spot and alternaria blight but was confirmed in laboratory after the isolation of fungi. The source of primary inoculum in rice-wheat systems are still not well documented but indications suggest that seed may play an important role in disease transmission. Seed treatment may prove useful as a part of an integrated disease management approach based on improved resistance and good agronomy.

## Introduction

Wheat (*Triticum aestivum* L.) is the most important cereal crop of Pakistan and spring wheat is grown during winter from November-December to March-April. It is the basic food for most of the people and occupies more farmland than any other crop in the country. It accounts for 37.1% of the crop area, 65% of the food grain acreage and 70% of the production. Mainly grown under irrigated conditions, its water requirements range from 20-21 acre feet. The Indus Plains with their favorable topography, rich soil and good agricultural facilities have a much greater acreage planted to wheat. A number of diseases are known to occur on this crop. Among these rusts, smuts, bunts, leaf spots or blights, mildews, seedling blight and root rot are reported to be important. Information about the foliar diseases of wheat in Pakistan is rather scanty (Bhutta & Hussain, 1999). Survey of wheat crop in the main rice-wheat cropping areas of Punjab was done at the booting stage of the crop for assessment of foliar blight. In South Asia, Saari (1998) pointed out that the most widely applied rice-wheat cropping system provided a favorable environment for the survival and multiplication of foliar blight pathogens because rice serves as a host species for the spot blotch and tan spot fungi and rice stubble also may play a role as a substrate for the fungi after rice harvest. Crop growth stage and weather, in particular high temperatures and humidity favoring long duration of leaf wetness, are considered to be associated with foliar blight development (Nema & Joshi, 1973; Sentelhas *et al.,* 1993). Preliminary epidemiological observations suggest that the combined effects of high temperature, high relative humidity and long periods (>12 h) of

leaf wetness caused by rainfall or dew are conducive to foliar blight development in the Indo-Gangetic Plains where wheat is grown from November to April (Duveiller, 2004). The disease often occurs as a complex of spot blotch and tan spot caused by *Cochliobolus sativus* (Ito & Kurib.) Drechsler ex Dastur (anamorph *Bipolaris sorokiniana*) and *Pyrenophora tritici-repentis* (Died.) Drechsler (anamorph *Drechslera tritici-repentis*), respectively (Maraite *et al.*, 1998; Dubin & Duveiller, 2000). Old names of fungi are still widely used and *Helminthosporium* leaf blight (HLB) is commonly referred to this disease complex. The tan spot pathogen teleomorph stage is found in cropping systems where the stubbles decompose slowly and remain on the soil during the next crop season, a situation that is not occurring in rice-wheat system since paddy fields are flooded. However, no detailed epidemiological study on the rice-wheat system is available for either pathogen. It is equally important to understand changes in disease severity associated with differences in seeding time that affect agronomic traits and critical growth stages of wheat sown on the optimum and late seeding dates. The interaction between crop growth stage and the level of airborne inoculum of foliar blight pathogens and as a result disease severity and poor agronomic performance are not well understood in South Asia. The present study was conducted to (i) isolate and identify the fungi from the infected samples of foliar blight (ii) observe floiar blight prevalence and (iii) foliar blight incidence and severity in the rice-wheat cropping areas of Punjab. This information is useful to know about the status of disease in Punjab and an efficient integrated crop management strategy to control leaf blights caused by *C. sativus* and *P. tritici-repentis* in warmer wheat-growing areas of the world.

## Materials and Methods

**General protocol of foliar blight of wheat:** Foliar blight samples of wheat crop were collected from various field of 20 locations, sample were taken at 10 points along a diagonal transect (Anon., 1996). In each field, an overall view of the crop obtained and made general observations of the presence or absence of disease symptoms, prevalence and severity of the foliar blight. At each sampling site, the foliar blight samples were collected and put in paper bags and transferred to the laboratory for further analysis.

**Assessment of foliar blight in rice-wheat cropping areas of the Punjab:** Wheat survey was conducted in 4 major rice-wheat districts of the Punjab province viz., Gujranwala, Sheikhupura, Narowal and Sialkot. Wheat survey was conducted at heading stage covering 20 key locations (Fig. 1). During this survey samples were collected for the isolation of fungi for further study.

**Assessment of prevalence, incidence and severity of foliar blight disease:** The sampling was done with general protocol in the diagonal transect as mentioned. Ten plants were selected to assess disease prevalence and severity. Prevalence and disease index (D.I) were calculated with the help of the following formula:

$$(\%)\ \text{Prevalence} = \frac{\text{Locations showing foliar symptoms}}{\text{Total locations}} \times 100$$

$$\text{D.I} = \frac{(\text{Foliar in class 1}) + (\text{Foliar in class 2}) + (\text{Foliar in class 3}) + (\text{Foliar in class 4}) + (\text{Foliar in class 5})}{\text{Total foliar in sample}} \times \frac{100}{5}$$

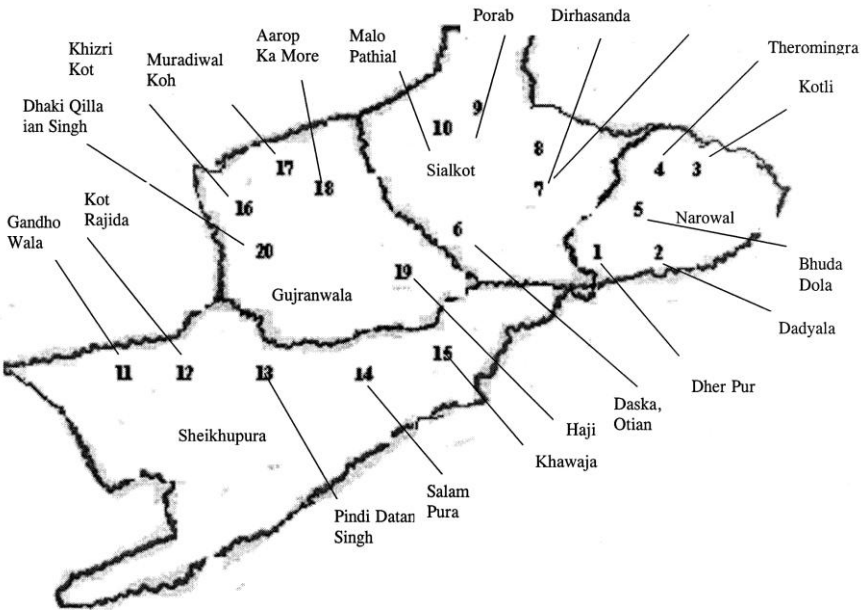


Fig. 1. Locations surveyed for foliar blight in four districts of Punjab in the rice-wheat cropping areas at the maturity stage of wheat.

For foliar spot 0-5 scale was used, where 0= no symptoms, 1= 1-5% few spots on <50% of leaves, 2=5-20% spots on <50% of leaves, 3= 5-20% spots on >50% of leaves, 4= 20-50% spots on <50% leaves and 5= >50%spots on >50% leaves (Anon., 1996).

**Isolation of fungi:** Foliar samples that possessed disease symptoms were cut into small pieces. The identity of the sample was recorded on the dry filter paper previously placed in the bottom of each Petri plate. Enough autoclaved sterilized distilled water was added to moisten the filter paper. Leaf sections were surface sterilized by dipping them in 3% Clorox for 1 min., and then three times rinsed with autoclave distilled water. Plates were placed for 24 hours at 25ºC under photoperiod and then 24 hours at 18ºC in dark period. After continuous light and dark period, the presence of fungi on leaf sections was recorded under stereomicroscope (De Wolf *et al.,* 1998).

**Preservation and identification of fungi:** After the full growth of fungi, fungal cultures were cut into small pieces with the help of cork borer, dried in laminar flow cabinet overnight and the sections preserved in small tubes.

## Results

**Prevalence, incidence and severity of foliar blight of wheat during 2000:** During the wheat survey of the year 2000, twenty key locations were examined and the disease was found prevalent in all the 4 districts viz., Gujranwala, Sheikhupura, Narowal and Sialkot (Table 1). Highest mean incidence of foliar blight was 98% in Sialkot and lowest 76% in Narowal. Similarly, highest mean severity 2.16 of foliar blight was found in Sialkot and lowest in Sheikhupura (Table 2). Among the five locations, surveyed in Gujranwala, the incidence of foliar blight was 100% in Khizri Kot, Haji and Dhaki Oillaian Singh, where

as it was 30% in Muridwal Koh, five locations were surveyed in Sheikhupura. When 100% incidence of foliar blight was in Kot Rajida, Pindi Datam Singh and Salam Pura and lowest 10% incidence in Gandho Wala. In Narowal 100% incidence of foliar blight was in Theromingra while lowest 40% in Dher Pur. In Sialkot, the incidence of foliar blight was 100% in all locations except in Porab where it was 90%. In Gujranwala, highest 3.9 severity of foliar blight was found in Kizri Kot and lowest 1.2 in Muradiwal Koh. In Sheikhupura, highest 2.5 severity was in Kot Rajida and lowest 0.1 in Gandho Wala. In Narowal, highest 2.1 severity was in Theromingra and lowest 0.4 in Dher Pur.

**Table 1. Prevalence of foliar blight of wheat in main rice-wheat cropping areas of Punjab during year 2000.**

| **Districts** | **Locations** | ***Prevalence(%)** **Percent locations with foliar blight** |
|---|---|---|
| Gujranwala | 5 | 100 |
| Sheikhupura | 5 | 100 |
| Narowal | 5 | 100 |
| Sialkot | 5 | 100 |

*Prevalence= Percent locations showing foliar bight.

**Table 2. Disease incidence and severity of foliar blight of wheat in main rice-wheat cropping areas of Punjab during year 2000.**

| **Districts** | **Locations** | ***Incidence (%)** | ***Severity (0-5)** |
|---|---|---|---|
| | | **Mean** | **Mean** |
| Gujranwala | Khizri kot | 100 | 3.9 |
| | Muradiwal Koh | 30 | 1.2 |
| | Aarop Ka More | 80 | 1.5 |
| | Haji | 100 | 1.7 |
| | Dhaki Qillaian Singh | 100 | 1.4 |
| | **Mean** | **82** | **1.9** |
| Sheikhupura | Gandho Wala | 10 | 0.1 |
| | Kot Rajida | 100 | 2.5 |
| | Pindi Datam Singh | 100 | 1.9 |
| | Salam Pura | 100 | 1.5 |
| | Khwaja | 90 | 0.9 |
| | **Mean** | **80** | **1.3** |
| Narowal | Dher Pur | 40 | 0.4 |
| | Dadyala | 90 | 1.9 |
| | Kotli | 60 | 1.3 |
| | Theromingra | 100 | 2.1 |
| | Bhuda Dola | 90 | 1.9 |
| | **Mean** | **76** | **1.5** |
| Sialkot | Daska, Oatian | 100 | 1.2 |
| | Jesarwal | 100 | 1 |
| | Dirhasanda | 100 | 4 |
| | Porab | 90 | 1.9 |
| | Malo Pathial | 100 | 2.7 |
| | **Mean** | **98** | **2.16** |

*Incidence=Percentage of plants infected with foliar blight.
*Severity= Foliar blight symptoms assessed on a visual 0-5 rating scales

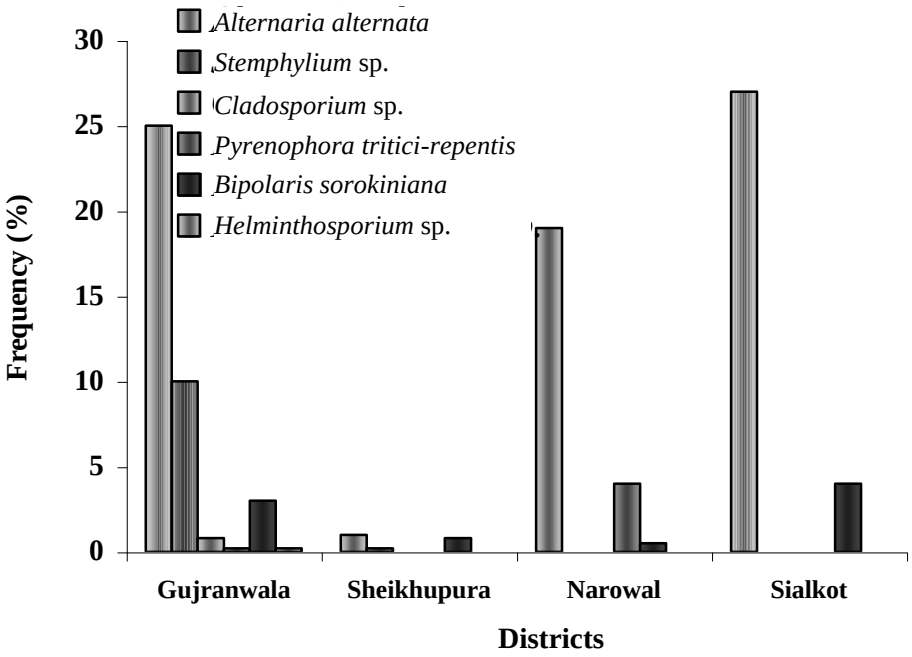


Fig. 2. Foliar fungi recovered from the main rice-wheat cropping areas of Punjab.

**Isolation of fungi from foliar blight samples of wheat crop:** Different fungi were isolated from diseased wheat foliar samples collected from 20 key locations of four districts of Punjab. Frequency percentage of *Alternaria alternata* was highest as compared to other foliar derived fungi (Fig. 2). In Gujranwala, maximum types of fungi were recovered where *Alternaria alternata* had highest frequency followed by *Stemphylium* sp., *Drechslera tetramera, Bipolaris sorokiniana* and *Pyrenophora tritici-repentis.* From Sheikhupura, only *Alternaria alternata*, *Stemphylium* sp., and *Bipolaris sorokiniana* were isolated.

From Narowal *Alternaria alternata* followed by *Pyrenophora tritici-repentis* and *Bipolaris sorokiniana* and from Sialkot only *Alternaria alternata* and *Bipolaris sorokiniana* were recovered.

**Discussion**

There are few published reports in Pakistan regarding foliar blight and its prevalence in rice-wheat system in Punjab. Four districts (Sheikhupura, Gujranwala, Narowal and Sialkot) were chosen because most of the farmers practice rice-wheat cropping system and most of them intercrop with minor cereals, legumes and vegetables. The foliar blight diseases collectively known as *Helminthosporium* leaf blight (HLB). Two of most common diseases of *Helminthosporium* leaf blight are spot blotch and tan spot (Zillinsky, 1983; Prescott *et al.,* 1986; Wies, 1987; Mathur & Cunfer, 1993). Spot blotch and tan spot are caused by the fungi *Bipolaris sorokiniana* and *Pyrenophora tritici-repentis* respectively. *Bipolaris sorokiniana*

and *Pyrenophora tritici-repentis* were found on the infected tissues. *Alternaria* is also a common leaf blight fungus and also isolated from the infected tissues. The prevalence of *Alternaria alternata* was more as compared to other fungi and is considered to be important in wheat. *Alternaria alternata* was associated with blight lesions and some times appeared as heterogeneous. Joshi *et al.,* (1986); Nema, (1986) and Siigh & Srivastava (1997) reported that *Alternaria alternata* can cause significant losses in wheat crop. During survey the number of foliar samples with *Alternaria alternata, Stemphylium* sp., and *Bipolaris sorokiniana* number were more as compared to *Pyrenophora tritici- repentis*. Maraite *et al*., (1997) analyzed infected samples of wheat in hot and humid areas and found that *Bipolaris sorokiniana* was found associated with 81% of the analyzed samples and *Pyrenophora tritici-repentis* detected in 29% samples. Our results are similar to the reports of Maraite e*t al.,* (1997). During the survey, we noted that it was too difficult to distinguish the three foliar blights symptoms (spot blotch, tan spot and alternaria blight) in the field with the naked eye or with the help of magnifying glass because of range of variation in symptoms induced by both pathogens. During isolation, it was observed that *Bipolaris sorokiniana* and *Pyrenophiora titici-repentis* sporulation occurred on the same leaf and were so similar that they could only be differentiated under stereomicroscope. Hafiz (1986) and Kiswar *et al*., (1992) reported that *Bipolaris sorokiniana* is a principal fungus involved in the seedling blight and root rot of wheat in Pakistan. However, foliar blight diseases of wheat are considered to be of minor importance in Pakistan (Bajwa, 1985). Bhatti & Iiays (1986) and Hafiz (1986) also reported that in southern province of Sindh, where winter temperatures are warmer, *Helminthosporium* leaf blight has been noted. During our survey and isolation time, the temperature was high but we isolated *Pyrenophora tritici-repentis* and *Bipolaris Sorokiniana* from Gujranwala and Sheikhupura. The reason of isolation of fungi was humid conditions in Gujranwala and Sheikhupura with no humid conditions in other two districts. In present study the above mentioned fungi, were isolated by using blotter method. Tinline *et al*., (1975); Wies (1987) and Aftabuddin *et al.,* (1991) reported frequency of occurrence of *Helminthosporium* spp was more from the foliar spot of wheat. Singh *et al., (*1997) reported in India where foliar blight affected samples were found to be infected more with *Helminthosporium* spp., *Alternaria alternata* and *Cuvularia* spp. Similarly Joshi *et al.,* (1978) analyzed wheat samples which were collected from different states of India and observed that *Alternaria* and *Helminthosporium* were the most common pathogens isolated from infected samples. Seed and soilborne inoculum are important in the establishment of leaf blight, seedling blight and root rot (Lapis 1985a; Mehta 1991; Mehta 1993). There are two possible reasons of the majority of foliar leaf blight disease. The wheat crop was infected at an early growth stage and primary inoculum comes from several sources such as weeds, soil, crop debris and seed borne infection, as reported by many workers in different parts of the world (Nema 1986; Raemaekers 1988; Reis 1991; Schilder & Bergstrom 1993; Mehta, 1996). In India, Misra (1973) also reported that rice is a host species for the tan spot and spot blotch fungus in inoculated trial. We analyzed in survey the Punjab that most of the farmer adopted rice-wheat cropping system. One of the reasons may be rice as a passive host and supporter of *Helminthosporium* leaf blight fungus. Rice stubble may also play an important role as a substrate for the fungi after rice harvest is completed and that these isolated fungi are seed borne in nature and in the absence of seed health testing and fungicidal seed treatment, seed may become infected by of these fungi. Therefore it is advocated that disease free seed of wheat and rice may be produced through the seed health certification system (Sharma *et al.,* 2003). Numerous reports have stressed the importance of

HLB and, in particular, spot blotch caused by *C. sativus* as major biotic constraint to growing wheat in warmers areas (White & Rodriguez-Aguilar, 2001). However, this is the first detailed study in the rice-wheat cropping farming system in a warmer climate of Punjab, Pakistan aimed at understanding the status of foliar blight.

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(Received for publication 10 April 2004)