Research Article

Foliar Blight Disease Occurrence on *Zea maize* L. Cropin Tehsil Samahni Area of Azad Jammu and Kashmir, Pakistan

Shehzad Azam[1], Muhammad Ishtiaq[1]*, Muhammad Shahzaman[1], Fozia Aslam[2], Mehwish Maqbool[1]

[1]Department of Botany, (Bhimber Campus) Mirpur University of Science & Technology (MUST), Mirpur-10250 (AJK), Pakistan
[2]Department of Botany, Mohi-ud-Din Islamic University Nerian Sharif Azad Jammu and Kashmir, Pakistan

Abstract *Zea maize* L (corn) is prevalent and agronomic crop being ubiquitously cultivated in many areas of Tehsil Samahni of Azad Jammu and Kashmir (Pakistan), This is serving as staple food for mountainous communities of the area. The corn crop is being damaged due to many biotic and abiotic parameters. Fungal attack culminating into different severe diseases is very frequent. In this research prevalence and occurrence of foliar mycoflora was investigated and its impact on plant growth (morphology) and yield (grains) was studied. Sporadic sampling was conducted using *Randomized complete block design* (RCBD) technique from 15 different sites (fields of local farmers). The analysis depicted that leaf was prominent part of plant, being machinery of photosynthesis which was infected by different fugal biodiversity causing northern corn leaf blight (NCLB) and southern corn leaf blight (SCLB) mostly. The field data analysis by sophisticated softwares depicted that SCLB was the most prevalent disease in the area with 50% occurrence, followed by NCLB with 35.71 %. The results showed that both mycofloral diseases were more common on shady and moist places of Chowki, Bindi and Dab (near streams and mountains' shadow) experimental sites. The explored findings on incidence were behaving variation of occurrence with altitude, temperature, soil type and moisture. The fresh and dry biomass was found in more in high and wet climate zones of study than dry belts. The quantity and quality of grain was also hampered due to common occurrence of different fungal diseases on leaf which is major synthetic machinery.

Keywords Southern corn leaf blight; Corn Leaf; Mycoflora; Azad Kashmir; Samahni

Introduction

Corn crop is second in rank after wheat being the pioneer as cultivation status wise in the study area of Azad Kashmir, Pakistan. The indigenous communities of the area reside in hilly zones and primarily depend on this crop for food and as fodder too. This crop is also sold as cash crop by many farmers of the area in Pakistan agronomy markets. *Zea mays* L*.,* commonly named as "corn" and vernacularly it is designated as "makki". This crop is member of family graminae. Maize is used as multifarious crop for local farmers as it is source of grain (food), feed, fodder, oil and candy bars, beer and confectionary [1]. Corn has different varieties named as: sweet corn, dent corn and popcorn, and each has its own special economic importance [2].

Corn crop is at number 3rd in competition of cereal crops' cultivation in Pakistan [3]. Agronomical needs of the crop are cool and humid climate and Samahni is the best part of District Bhimber for its cultivation. Its grains are used as staple food by indigenous mountainous communities in the country. Currently it has huge demand in confectionary products in Pakistan [4]. In industrial production, it yields gluten, maize oil and glucose which are sold as different

product in the markets. On ethnobotanical survey analysis depicted that it is used in different local recipes of ethnomedicines and other ritual uses.

The state of AJK lies between 73-75° longitude and 33-36° latitude and the sampling of the study: Samahni is topographically plain zone surrounded by high and lofty mountains covered by conifers trees [5]. In territory of Azad Jammu and Kashmir it is grown on 0.9 million hectares area with 1.8 metric ton (MT) yield but Samahni is one the rich and ideal place of corn cultivation [6]. The area (of Samahni) under research belongs to district Bhimber of Azad Kashmir which is bounded to Gujrat, Mirpur, Kotali and Rajori (Indian Occupied Area). The climate of study area is very appropriate particularly Samahni valley. Its temperature ranges between 0 °C to 38 °C [7].

In the area (Samahni) various corn varieties are being cultivated such as "Kashmiri gold, Azam, Agati 85, and Local kisan". But it's per acre yield in Azad Jammu and Kashmir, particularly in Samahni area is very low as compared to other areas of country that is due to many reasons such as use of traditional farming system sowing conventional varieties, rural agronomic practices, poor seed quality are reasons for low production and random use of fertilizers [8]. Loss of corn yield may be attributed to environmental conditions dynamic fluctuations but presence of different microorganisms such bacteria, viruses, actinomycetes and fungi are second important plethora for it [6] and among those pathogenic fungi critically reduce large amount of grain yield [9-10]. Fungi being most parasitic and prominent in proliferation as its spore may survive in seeds for years and then grow with seed germination. Leaf is the most and first part of plant attached by pathogenic mycoflora and then other parts are invaded the germs. So, diseases like leaf cannot do photosynthesis successfully and then biomass and yield of grains is drastically reduced.

Leaf of corn are infected by different diseases named as foliar blights *i.e.* NCLB and SCLBbeing caused by *Helminthosporium* turrcicum and *Helminthosporium maydis.* Out of two diseases, one SCLB infested bydisastrous pathogen *Helminthosporium maydis* has common occurrence in many areas of world [11-12]. These all pathogens are more prevalent in the areas which have moderate temperature and high rainfall [13]. A new pathogen *Curvularia lunata* has been detected from China in a recent year. This is actively high damaging leaf disease of corn [14].

Figure 1: Map of Study area: Samahni Area (marked as red circle: sampling sites) a part of District Bhimber of Azad Jammu and Kashmir

In Azad Jammu and Kashmir, very few work has been conducted on maize agronomy but hitherto little is known on foliar diseases of fungi and their causal impacts on it [15]. This is preliminary and primary type of study conducted on maize crop from Tehsil Samahni of Azad Jammu and Kashmir, particularly exploring leafy infections of fungi and their impact on pheneticsof plant and grain yield. Objectives of this study weremultifarious: (1) to explore diversity of fungal species present onleaves of maize crop from Samahni; (2) to determine incidence level from different sampling areas of Samahniand (3) to determine severity of foliarblight diseases on maize crop and its potential threat on vegetative and floral characters of crop/plant.

Materials and Methods

Plant Sample Collection: A *randomized complete block design* (RCBD) method was carried out from 15 sampling zones of Tehsil Samahni, district Bhimber Azad Jammu and Kashmir. First survey was taken at seedling stage while 2nd and 3rd analyses were performed at young and mature level (Table 1). The samples were collected in triplicate fashion from each site by following a diagonal transect method [16-17]. Experimental samples were collected in sterile polythene bags and shifted to research laboratory for comprehensive disease analysis.

Table 1: Presence of Foliar Blight Diseases on Maize from Tehsil Samahni Azad Kashmir

S. No.	Locality and Altitude	SCLD	NCLB
01	Barow Jameera @ 795 m	+	+
02	Soona @ 700 m	-	+
03	Sabaz pir @ 630 m	-_	+
04	Baghsar @ 730 m	_-	+
05	Bandalla(chaga) @ 660 m	_-	+
06	Bandalla payana @ 645 m	+	_-
07	Sadaabad @ 560 m	+	_--
08	Barjun @ 690 m	-_	+
09	Darhal @680 m	_-	+
10	Chadroon @ 580 m	+	-_
11	Jandala @580 m	+	-_
12	Chowki @560 m	+	-_
13	Malvana @ 695 m	_-	+
14	Barrow krass @620 m	_-	+
15	Bindi @595 m	+	_-
	Sub-Total	07	09
	Grand Total		16

Key: + =   Present, - =   Absent

Exploration of Prevalence and Incidence Ratio for Corn Crop: The disease prevalence was determined by observing the presence\absence of spots on leaves of maize. Five plants were observed from each selected site by diagonal transact method. The disease incidence (%) and prevalence (%) was calculated by following formulae:

$$\text{Prevalence (\%)} = \frac{\text{Localities showing foliar blights}}{\text{Total localities of the selected area}} \times \ 100$$

$$\text{Incidence (\%)} = \frac{\text{Leaves appearing foliar blights}}{\text{Total leaves observed in a sample}} \times 100$$

Isolation of foliar pathogenic fungi: Fungi were isolated from leaves of maize by cultured a single spore. In this technique, the defected parts of leaves were cut into small pieces. Five pieces were selected from each sample for observation. The samples were first surface sterilized by using 2% Sodium hypochlorite solution. The pieces were dipped in the solution for 2-3 minutes and then washed with distilled water. Then the pieces were put in petri plates that have sterilized PDA media and incubated for 24 hours at room temperature under florescent light and then 48 hours at 15 °C in dark. After the incubation period, fungal colonies were observed under microscope. Identification was done by using protocol as described [18-20]. The identified fungi were further purified by single spore culture method by following methods of Usmani and Ghaffar (1982) [21]. In this technique, a single spore was transferred on sterilized PDA medium for growth. After complete maturation, the purified culture was preserved in refrigerator for future or specimen on slide was prepared for identification purpose.

Data Analysis: The collected data was formulated in tabular format and then taken statistical analysis according to "ANOVA" by using MVSP software and final values were compared by using LSD value at P< 0.05 level [22].

Results

Maize was known as prominent crop of Azad Jammu and Kashmir and particularly in the study area (Samahni). A mycofloral analysis was conducted on foliar paradigm for blight diseases of maize crop from different sites of Samahni Tehsil. During the research survey, 15 localities were selected as experimental zones and samples were collected from these following above-mentioned protocols. Research findings showed two different types of foliar blights named as SCLB and NCLB were very common but their prevalence and severity was variable in various sampling sites (Table 1). The analysis of maize foliar blight showed that SCLB and NCLB with both had 100 % prevalence in all five union councils (experimental areas) (Table 2).

Table 2: Prevalence (%) of Foliar Blight Diseases on Maize from Tehsil Samahni of Azad Kashmir

S. No.	Union Council	Locations	Prevalence (%)
1	Khambah	03	100
2	Bandala	04	100
3	Poona	05	100
4	Chowki	06	100
5	Samahni	05	100

The measurement of prevalence of maize blight diseases was taken by using diagonal transects technique. Foliar diseases of maize indicated low yield in all localities of maize growing areas of district Bhimber. Foliar diseases indicated 70-100% prevalence in the experimentally observed areas (Table 2). Maximum research areas showed 100% presence of foliar attack except Bindi (90%) and Dab (70%) values.

The percentage of disease incidence of SCLB and NCLB was also observed by one spore culture technique. Disease incidence of SCLB was maximum in lowest altitudinal areas (Bindi) while minimum incidence was occurred in highest altitudinal areas *i.e.,* Kambah. The foliar incidence of NCLB was occurred maximum in Kambah *i.e.*, 51.1 a± 3.91 and minimum incidence was observed in lowest altitudinal areas *i.e.*, Bindi as indicated in Table 3.

Table 3: Foliar Blight Disease Incidence on Maize from Different Growing Areas of Tehsil Samahni of Azad Kashmir

Growing Areas	SCLB DI (%) / SD	NCLB DI (%) / SD	LSD
Kahmba	8.8 b ± 3.81	51.1 a± 3.91	6.63
Bandalla	13.3 b± 2.89	36.7 a± 2.87	4.34
Poona	18.3 b± 2.89	26.7 a± 2.89	3.22
Chowki	22.2 a± 5.08	21.1 a± 1.91	2.87
Samahni	27.1 a± 3.32	14.2 b ± 4.96	3.03
Bhimber Rajani	30.0 a± Zero	6.6 b± 5.77	3.73
Kasgumma	33.3 a± 5.77	0 c± Zero	4.53

Values in each row with different letters show significance difference as determined by LSD test at P ≤ 0.05

The survey for disease incidence and severity proved that maximum foliar blight incidence and severity was observed at mature stage as compared to young and seedling stage. The highest mean incidence (68.7%) observed in Kambah and lowest mean incidence (43.3%) in Bindi (Table 4). Highest mean severity (2.87) calculated from Kambah (high altitudinal area) and lowest mean severity (1.12) calculated from Bindi (low altitudinal area). It was also observed the most prevalent (68.7±16.82) and severity (2.87±0.89) values of the foliar pathogens. These variations may be occurred due to different altitude and variable environmental factors. As the high incidence and severity of blight diseases *i.e.*, SCLB and NCLB in study area showed that some basic knowledge about blight of maize. The severity of foliar disease *i.e.*, SCLB was found highest at low altitude and lowest at more altitudinal areas while NCLB showed maximum disease severity in highest study areas. The disease severity of SCLB was noted maximum in Binid while minimum (0.15) in Kambah. On the other hand, severity of NCLB was noted maximum in Kambah and minimum in Bindi Table 4 and Fig 2.

Table 4: %age Incidence of Fungi Isolated From Corn Leaves @ seedling, young and mature stages from corn growing areas of Tehsil Samahni of Azad Jammu and Kashmir

S. No.	Disease Name	Fungi isolated	Percent incidence				LSD
			Seedling stage	Young stage	Mature stage	Total	
1	SCLB	*Harpophora maydis*	18.72b	22.86a	23.84a	65.42	1.03
2	NCLB	*Harpophora turrcicum*	18.77c	21.14b	27.14a	67.05	1.63
	Total Infection		49.73	53.69	62.34		

Values in each row with different letters show significance difference as determined by LSD test at P $\leq$ 0.05
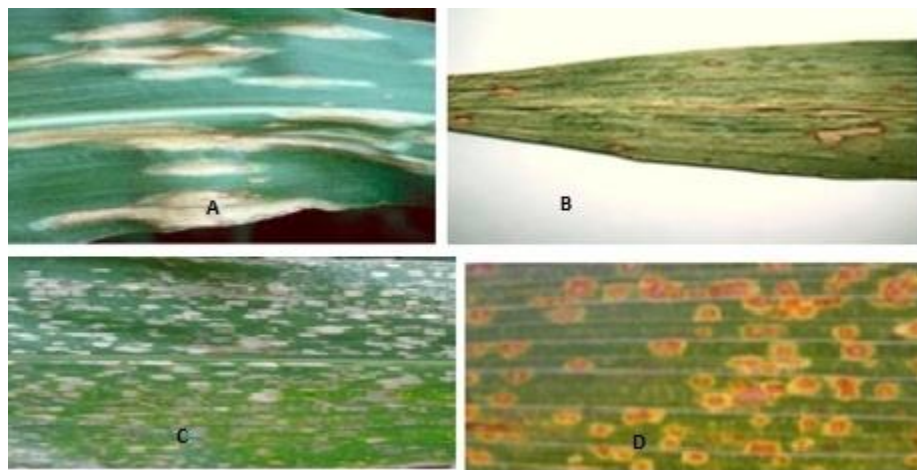

Figure 2: Phenotypic study of Northern corn leaf blight, Southern corn leaf blight

Discussion

Corn is known as cereal crop and it has close affinity with rural man's life because they not provide staple food but also are very good source of fodder for their livestock. Maize being significant crop of Azad Jammu and Kashmir area, its mycoflora analysis was conducted on foliar paradigm. There are many interesting and important findings regarding its prevalence, incidence and severity. During the research survey, 15 localities were examined from Tehsil Samahni of District Bhimber Azad Jammu and Kashmir, Pakistan. In the current study; two fungal diseases were observed more prevalent on leaf of crop. The prevalent diseases are SCLB and NCLB in all the areas of study plan. The analysis of foliar blight of maize according to symptoms was shown in Table 1. The symptoms and physiological impacts of research were in coincidence with past results were obtained by Gates *et al*., 1971, Darrah and Mukuru, 1980 [23-24]. They stated that these foliar blights were spread widely in variable climatic conditions and different altitudes and mostly attach on leaf. Synonymous results were observed in Punjab, Pakistan where fungi flora causes huge loss to plant leaf culminating into loss of yield and biomass too.

The percentage of disease incidence of SCLB and NCLB was also observed by one spore culture technique. Disease incidence of SCLB was maximum in lowest altitudinal areas (Bindi) while minimum incidence was occurred in highest altitudinal areas i.e., Kambah. The foliar incidence of NCLB was occurred maximum in Kambah i.e., 51.1 a± 3.91 and minimum incidence was observed in lowest altitudinal areas i.e., Bindi. PLS (8.8 b ± 3.87) was observed maximum in Kambah at high altitude and minimum incidence of the disease was found in Bindi at low altitude. Similar findings were obtained by Hooker *et al*., (1970). They observed the pathogen of SCLB (*H. maydis*) present in low altitudinal areas *H. turrcicum* was more prevalent in high altitudinal selected areas and vice versa. Similar results were also obtained for these diseases, respectively.

NCLB disease caused by *E. turrcicum*, present in moist and less warm regions of maize producing areas as told by Lim *et al*., (1974) [25]. Similar study was conducted by Iram and Iftikhar (2005) [26]. They obtained these results on working of rice-wheat cropping system with interaction of foliar diseases in Punjab, Pakistan.The severity of

foliar diseases i.e., SCLB was found highest at low altitude and lowest at more altitudinal areas while NCLB showed maximum disease severity in highest study areas. The disease severity of SCLB was noted maximum in Dab and Bindi while minimum (0.15) in Kambah. On the other hand, severity of NCLB was noted maximum in Kambah and minimum in Bindi. Similar type of research findings were also presented by Blanco and Nelson (1972) [27]. They explained that SCLB showed great ability to produce spores at low altitude. They also observed that NCLB was more prevalent at high altitudinal regions of study area.These variations may be occurred due to different altitude and variable environmental factors. As the high incidence and severity of blight diseases i.e., SCLB and NCLB in study area showed that some basic knowledge about blight of maize. Similar survey was reported by Nema, (1986); Raemaekers (1988); Reis, (1991); Schlider and Bergstrom, (1993), and Mehta, (1996) [28-32]. They had proposed two major possible reasons for foliar blights of maize. Firstly, the blight pathogen was appeared on crop in early stage and secondly, the infection was spread by weeds, crop debris and by affected seeds. Similar findings were obtained by Adiopla *et al*., (1993) [33] and Tilahun *et al*., (2001) [34]. Foliar Blights were more destructive diseases of warm and humid regions of Ethiopia. Other agronomist had said that changes in environmental conditions of study area mainly temperature, soil contents, moisture and rainfall had great influence on the spread of pathogens as explained by Warren (1975) [35]. Levy (1991) [36] also reported that blight diseases production, environmental conditions and pathogen fitness were the most important factors.

These foliar diseases reduced the productivity of maize crop in Samahni area of Azad Jammu and Kashmir. So we need to control these pathogens for better yield of maize. Previously, Blanco and Nelson, (1972) [27] did experiment on minimizing the losses particularly due to fungal attacks causing foliar blight diseases in maize crop and increased yield. Conclusively, it was preliminary study in order to explore the mycoflora associated with fungi seedlings, young plants and mature plants. There has been positive correlation between environment parameters and type of foliar blight in correlation with its prevalence, severity and incidence. Further research is focused on to develop mechanism for its management through chemical and biological control techniques and those results will be submitted separately for publishing.

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