

Status of Banded Leaf and Sheath Blight Disease of Maize in West Bengal

ABSTRACT

Maize is one of the most important cereal crops grown under diverse environments due to its range of plasticity. It is called “Queen of Cereals” because of its highest yield potential. This study investigated the prevalence of banded leaf and sheath blight (BLSB) in maize across the districts of West Bengal during 2020 and 2021. The Mean Percent Disease Incidence (PDI) assessed disease severity. A significant spatial and temporal variation in BLSB incidence was observed. Districts like North 24 Parganas and Paschim Medinipur exhibited consistently high PDI, while Darjeeling showed the lowest. The reduction in PDI in some districts from 2020 to 2021 might be attributed to improved disease management practices or altered environmental conditions. However, localized disease persistence was observed in regions like Uttar Dinajpur and Paschim Medinipur. The study also highlighted the variability in BLSB susceptibility among different maize varieties, with Syngenta Babycorn showing consistently high vulnerability. The decline in PDI for certain varieties between two years suggests potential influences of environmental factors or management interventions. Overall, the findings emphasize the need for integrated disease management strategies, including resistant varieties and cultural practices, to mitigate BLSB impact in West Bengal.

Keywords: Maize, Disease severity, Percent Disease Incidence, BLSB

1. INTRODUCTION

Maize is a significant cereal crop that can be cultivated in a variety of climatic environments. At the beginning of the 17th century, Americans introduced maize to India where it is now considered as one of the most significant food, forage, and industrial crops. Due to its high production potential, it is called "Queen of Cereals." Based on area and production, corn comes in third place in the globe, after wheat and rice. Around 183 Mha of the land area was under maize in 2013–14 all over the world, producing 1065 MT at a productivity of 5.82 tonnes/ha. The United States of America (USA) is the world's top producer of corn and exports the most maize due to its massive surplus. After United States, Brazil, Ukraine, and Argentina are other major producers of maize, and these four nations collectively account for 80–85 per cent of all exports of maize. After rice and wheat, maize is the third-most significant cereal crop in India, making up around 9 per cent of all food grains produced. Almost all of the states in the US cultivate it all year round for various purposes.

In addition to be used as food and animal feed, maize has numerous significant industrial uses. It is cultivated in a range of agro-ecological settings and among all food grain crops it has the highest production potential of more than 80 quintal per hectare. India must boost its maize production to meet

the growing domestic demand. It occupies in an area of 9.06 Mha during 2013-14 with a production of 24.25 MT and productivity of 2.7 t/ha. Karnataka, Andhra Pradesh, Bihar, Madhya Pradesh, Rajasthan, Gujarat, Maharashtra, Tamil Nadu, Uttar Pradesh, Chhattisgarh, West Bengal, Assam and Odisha are the major maize-growing states in India.

There have been around 112 maize diseases recorded from various regions of the world. 16 of these have been identified in India. The main ailments in various agro-climatic areas are seed rots and seedling blight, leaf spots and blights, downy mildew, stalk rots, banded leaf and sheath blight, and smuts & rusts, which cause yearly yield losses of approximately 15 to 20 per cent (Saxena, 2002). Among these, the Banded Leaf and Sheath Blight (BLSB) of maize caused by the teleomorphic *Rhizoctonia solani* f. sp. *sasakii* is highly significant in India. *Thanatephorus sasakii* (Shirai Tu & Kimbro), is gaining economic importance. It was reported for the first time in Sri Lanka under the name of sclerotial disease (Bertus, 1927). Banded leaf and sheath blight was earlier reported as a minor disease on maize. Presently, the disease is considered a major disease not only in India but also in several countries of tropical Asia where maize is grown. The disease was observed in the western central Himalayan foothill region of India in the early sixties. The importance of the disease was emphasized in early 1970's when an epidemic occurred in warm and humid foothill areas in the Mandi district of Himachal Pradesh (Payak and Renfro, 1968). This study highlights the spatial and temporal variability in the prevalence of banded leaf and sheath blight in different districts of West Bengal.

2. MATERIALS AND METHODS

2.1 Survey for BLSB in different district of West Bengal

A comprehensive field survey was carried out during the 2020 and 2021 growing season in major maize-growing agro-ecologies of different districts of West Bengal viz., Uttar Dinajpur, Dakshin Dinajpur, Darjeeling, Murshidabad, Nadia, Purba Medinipur and North 24 Parganas were assessed to determine the incidence and severity of BLSB of maize. Districts were selected based on the differences in farming systems, weather conditions, altitudes and major vegetation cover. 6 districts were surveyed when the crop was vegetative to maturity. Fifty maize plants from individual fields were randomly selected and assessed for disease incidence (Ramathani *et al.*, 2011; Nwanosike *et al.*, 2015).

2.2 Assessment of Severity of BLSB disease:

2.2.1 Severity of BLSB disease in different districts

A roving survey was conducted in different districts of West Bengal to evaluate the extent of banded leaf and sheath blight disease severity. Fields were assessed for banded leaf and sheath blight severity (Percent Disease Index) by using the formula given by Wheeler (1969) and the disease rating scale 1-9 given by Ahuja and Payak (1983).

Percent Disease Incidence formula:

The sum of the numerical rating

$$\text{PDI} = \frac{\text{Sum of numerical ratings}}{\text{Total number of plants observed} \times \text{Maximum rating}} \times 100$$

Total number of plants observed x Maximum rating

2.2.2 Severity of BLSB disease in different varieties of maize

The severity of Banded Leaf and Sheath Blight (BLSB) in maize varies significantly across different maize varieties due to genetic differences in disease resistance. The different varieties considered in this study are listed in Table 1. are cultivated in farmers' fields in the year 2020 and 2021.

Table 1. Different Maize Varieties cultivated in farmers field in the year 2020 and 2021.

Variety	Company
Sugar 75	Syngenta
Kaveri 50	Kaveri seeds
P3369	Pioneer seeds
ADV 9293	Advanta seeds
DEKALB - 900m gold	Bayer
Shaktiman	Shaktiman seeds
CP 838	CP seeds
Pioneer 1844	Pioneer seeds
DKC 9081	Bayer
JKMH 1701	JK agri genetics
JKMH 8532	JK agri genetics
Syngenta babycorn	Syngenta

3. RESULTS

A survey was conducted across various districts of maize-growing regions in West Bengal, utilizing a roving survey. The mean percentage of disease severity was assessed using the Disease Rating Scale (1-9), developed by Ahuja and Payak (1983), at multiple locations within the districts. This study aimed to ascertain the severity and distribution of banded leaf and sheath blight (BLSB) in maize. The findings from the surveys of farmers' fields indicate that the severity of BLSB in maize differs significantly from one locality to another, influenced by prevailing weather conditions, cropping patterns, and the build-up of inoculum potential. Consequently, this survey was undertaken to evaluate the disease severity across different districts of West Bengal.

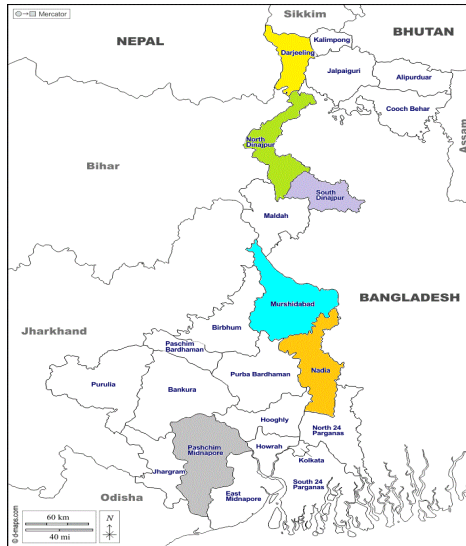


Fig. 1 Map Showing surveyed districts of West Bengal

3.1 Symptoms of Banded Leaf and Sheath Blight Disease in Maize:

Banded Leaf and Sheath Blight (BLSB), caused by the fungus *Rhizoctonia solani* f. sp. *sasakii*, is a significant disease in maize. It primarily affects the leaves and sheath but can spread to other plant parts under favourable conditions. The disease starts with small, elliptical, or irregular, water-soaked lesions on the leaf sheath. Over time, the lesions turn greyish-brown with a dark margin. The characteristic symptom is the appearance of alternating light and dark brown bands on the leaf sheath. Under humid conditions, white cottony fungal growth with brown sclerotia (tiny, hard fungal structures) may be visible on the sheath as shown in Fig. 2. Lesions can extend to the leaves, causing necrotic spots with a similar banded pattern. Leaf blight: Severe infection can cause the drying and death of leaves. The disease may spread downward to the stalk or upward to the cobs, causing rot and yield loss. Infected stalks may weaken, leading to lodging. The diseases were also identified based on the CIMMYT monograph on guide for identification of maize diseases edited by Carlos L (1984) and Singh *et al.* (2004).



Fig. 2 Symptoms of banded leaf and sheath blight In maize

3.2 Severity of BLSB disease in different districts

The study assessed the Mean Percent Disease Index (PDI) of Banded Leaf and Sheath Blight (BLSB) in maize across several districts of West Bengal during 2020 and 2021 (Fig.3). The disease survey revealed that banded leaf and sheath blight disease was scattered in maize growing areas from low to severe form with the severity ranging from 5.65 to 88.88 per cent in 2020 and 5.55 to 77.77 per cent in 2021. The findings revealed significant spatial and temporal variations in disease incidence. The Mean Percent Disease Index (PDI) for banded leaf and sheath blight in maize across districts of West Bengal shows variability between 2020 and 2021. In 2020, the highest PDI was recorded in North 24 Parganas (88.88%), followed by Paschim Medinipur (76.44%) and Nadia (66.66%), indicating these regions were most affected by BLSB. Conversely, districts like Darjeeling (5.65%) and Uttar Dinajpur (12.76%) exhibited relatively low disease incidence. In 2021, while Paschim Medinipur showed a slight increase in PDI from 76.44 to 77.77 per cent, most other districts experienced a decline in disease incidence. North 24 Parganas dropped to 75.55 per cent, and Dakshin Dinajpur reduced from 49.66 to 44.44 per cent. However, Uttar Dinajpur exhibited a marginal increase in PDI from 12.76 to 13.13 per cent, reflecting localized disease persistence. Interestingly, Darjeeling consistently displayed the lowest PDI (5.65% in 2020 and 5.55% in 2021). On the other hand, Murshidabad demonstrated a notable reduction from 14.27 to 11.11 per cent.

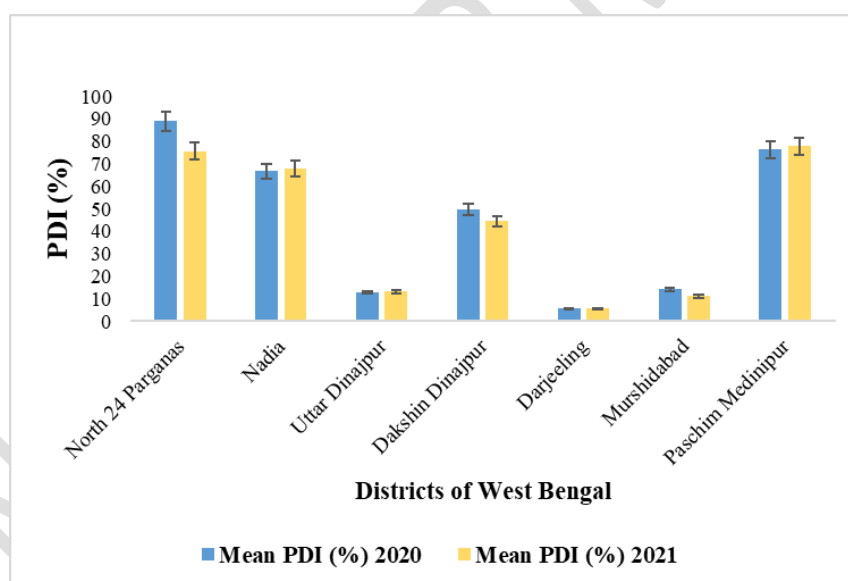


Fig. 3 Per cent disease incidence of BLSB in Districts of West Bengal

3.3 Severity of BLSB disease in different varieties of maize

The study evaluated the Mean Percent Disease Index (PDI) of banded leaf and sheath blight (BLSB) in maize across different varieties grown in West Bengal during 2020 and 2021 (Fig. 4). In 2020, the highest PDI was observed in the Syngenta Babycorn variety (89.71%), followed by Sugar 75 (88.65%) and Kaveri 50 (63.87%). The varieties with the lowest PDI were DKC 9081 (12.54%) and ADV 9293 (15.45%). In 2021, Syngenta Babycorn again recorded the highest PDI (96.99%), followed by JKMH 8532 (77.97%) and Pioneer 1844 (65.57%). Conversely, Kaveri 50 (11.15%), ADV 9293

(11.15%), and DEKALB - 900m gold (11.16%) exhibited the lowest PDI in 2021. Notably, some varieties such as Sugar 75 and Kaveri 50 experienced a significant reduction in disease severity from 2020 to 2021, while others, such as Pioneer 1844 and JKMH 8532, showed an increase.

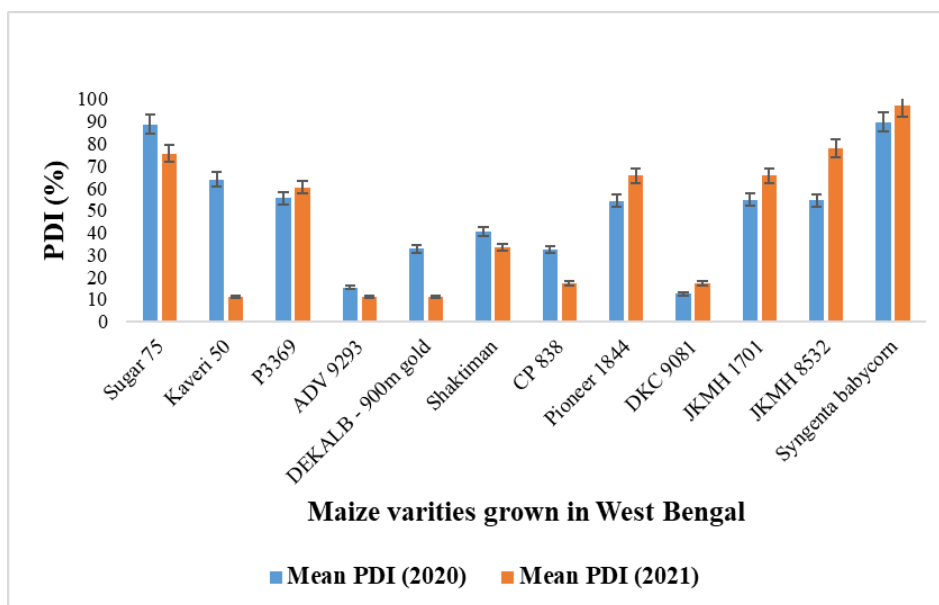


Fig. 4 Per cent disease incidence of BLSB on different maize varieties grown in West Bengal

4. DISCUSSION

The data represents the prevalence of banded leaf and sheath blight in maize across various districts of West Bengal during 2020 and 2021, measured as the Mean Percent Disease Index (PDI). A comparative analysis indicates notable variations in disease intensity across districts and between years. The study highlights significant spatial and temporal variability in the incidence of banded leaf and sheath blight (BLSB) in maize across various districts of West Bengal during 2020 and 2021. Districts like North 24 Parganas and Paschim Medinipur showed consistently high disease severity in both years, reflecting favorable environmental conditions and possibly more virulent pathogen strains. In contrast, Darjeeling consistently displayed the lowest PDI, suggesting less favorable conditions for the disease, such as cooler temperatures or different maize varieties cultivated in the region. The observed reduction in PDI in several districts, including North 24 Parganas and Dakshin Dinajpur, from 2020 to 2021 could indicate the impact of improved disease management practices or changes in environmental conditions. However, the slight increase in PDI in Uttar Dinajpur and the consistent severity in Paschim Medinipur suggest localized persistence of the disease. The findings align with earlier reports, Akhter (2009) reported widespread prevalence of banded leaf and sheath blight (BLSB) in maize across five locations in Ranchi district during the 2004 and 2005 crop seasons. Disease severity varied, with the highest intensity recorded at Hisri Chauli (80.46%), followed by Jirabar (50.30%), and the lowest at Kanke (30.30%).

Patra (2007) surveyed the incidence of banded leaf and sheath blight diseases of maize during 2005-06 indicating that, disease intensity was moderate to severe on male inbred line CML-163 and female inbred line CML-193-1 of hybrid maize (HQPM-1) at pre-flowering stage in West Bengal. That was the first report of BLSB from West Bengal. Yang *et al.* (2008) stated that banded leaf and sheath blight caused by *Rhizoctonia solani*, was widespread with the disease severity ranging from 7.6 to 64.8 per cent and gaining economic importance in the counties of Yunnan, Singh and Sharma (1976) estimated 40.5 per cent loss in grain yield with 71 per cent disease index (PDI). The magnitude of grain loss may reach as high as 100 per cent if the ear rot phase of the disease predominates. In India, losses in grain yield have been estimated in the range of 23.9 to 31.9 per cent in ten cultivars (Lal *et al.*, 1980). Payak and Sharma (1981) reported that around one per cent of the total grain yield is reduced by BLSB in India annually. Sharma *et al.* (2004) proved that banded leaf and sheath blight is a major disease of maize and grain yield loss depends on disease severity which varies between 11-40 per cent. highlighting location-based variability in disease occurrence, which indicated the widespread prevalence of BLSB and considerable variation in disease severity across locations due to differences in agro-climatic conditions and pathogen variability. Such variability is common, as *Rhizoctonia solani*, the causal agent of BLSB, exhibits high genetic and pathogenic diversity that may influence disease dynamics (Kumar *et al.*, 2021).

The observed variations in the Mean Per cent Disease Index (PDI) of banded leaf and sheath blight (BLSB) among different maize varieties reflect the diversity in genetic resistance and environmental adaptability. Consistently high susceptibility of Syngenta Babycorn, with PDIs of 89.71 % in 2020 and 96.99 % in 2021, highlights its vulnerability under prevailing agro-climatic conditions. This is consistent with prior research indicating significant variability in maize genotypes responses to BLSB. Studies emphasize that genetic factors and agronomic practices influence disease severity, with high-density planting and favourable humidity exacerbating pathogen spread and infection intensity (Chaudhary *et al.*, 2016). Significant decline in PDI for varieties like Sugar 75 and Kaveri 50 between the two years suggests that environmental factors or management interventions might have contributed to reduced disease prevalence. Conversely, the increased susceptibility in varieties such as JKMH 8532 and Pioneer 1844 could indicate either environmental stressors promoting disease or a lack of genetic resistance (Di *et al.*, 2023). The variation observed across varieties underscores the importance of breeding programs focusing on disease resistance and integrating resistant varieties into cropping systems. Integrated management strategies, including cultural, biological, and chemical controls, remain vital in mitigating disease impact, especially in regions prone to humid conditions that favour the pathogen.

5. CONCLUSION

The analysis of banded leaf and sheath blight (BLSB) in maize across West Bengal districts from 2020 to 2021 reveals significant spatial and temporal variability in disease severity. Districts like North 24 Parganas and Paschim Medinipur consistently exhibited high disease intensity, suggesting favourable environmental conditions and potentially virulent pathogen strains. In contrast, Darjeeling consistently displayed the lowest PDI, likely due to less conducive conditions. The observed fluctuations in PDI between years indicate the influence of various factors, including disease management practices

and environmental conditions. While some districts experienced reduced disease severity, others showed increased or persistent levels. These findings emphasize the need for location-specific disease management strategies. The study also highlights the impact of maize variety on disease susceptibility. Syngenta Babycorn consistently showed high susceptibility, while varieties like Sugar 75 and Kaveri 50 exhibited reduced disease severity in 2021. The prevalence of BLSB in West Bengal aligns with global trends, as the disease is a significant concern in maize-growing regions worldwide. The findings contribute to a better understanding of BLSB epidemiology and provide insights for developing effective management strategies. Integrated approaches combining cultural, biological, and chemical control measures are essential to mitigate disease impact, particularly in regions prone to humid conditions that favour the pathogen.

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