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Assessing the Status of Banded Leaf and Sheath Blight Disease of Maize (*Zea mays* L.) Caused by *Rhizoctonia solani* f. sp. *sasakii* in West Bengal, India

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Authors' contributions

This work was carried out in collaboration among all authors. Authors RP wrote the first draft of the manuscript. Author DC performed the statistical analysis and wrote the protocol. Authors YD and MB managed the analyses of the study. Author SD designed the study and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Maize is one of the most important cereal crops grown under diverse environments due to its range of plasticity. It is called the "Queen of Cereals" because of its highest yield potential. Various diseases significantly affect maize crops, with banded leaf and sheath blight being particularly impactful, leading to substantial reductions in crop yield. This study examined the prevalence of

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banded leaf and sheath blight (BLSB) in maize across various districts of West Bengal during 2020 and 2021. The findings revealed significant spatial and temporal variations in the incidence of BLSB. Districts such as North 24 Parganas and Paschim Medinipur demonstrated consistently high levels of disease severity, whereas Darjeeling recorded the lowest incidence. However, localized disease persistence was observed in regions like Uttar Dinajpur and Paschim Medinipur. The research underscored the considerable variability in susceptibility to BLSB across various maize cultivars. Notably, the Syngenta Babycorn variety exhibited a consistently elevated vulnerability to this pathogen, indicating a potential area for targeted mitigation strategies. The findings emphasize the need for integrated disease management strategies, including resistant varieties and cultural practices to mitigate BLSB.

Keywords: Maize; disease severity; BLSB; West Bengal; banded leaf; sheath blight disease.

1. INTRODUCTION

Maize (*Zea mays* L.) 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." Maize is a highly potential cereal among all the cereals and it is easy to produce hybrids with high productivity because flowers are heteroecious. A versatile crop that thrives in a different range of climates, from the tropics to temperate regions. It is the second most widely cultivated crop in the world, with various types such as field corn, sweet corn, popcorn and baby corn. Field corn alone has multiple subtypes, including quality protein maize, waxy maize and high-oil maize. Maize serves as a crucial source of food, feed, and raw material for billions of people globally. India ranks fourth in the world in maize-growing areas and seventh in maize production. In the 2018-19 growing season, maize was grown on 9.2 Mha of land in India, resulting in a production of 27.8 million MT (ICAR-ICMR Ludhiana, 2024). 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.

Several diseases have been reported in maize crop worldwide but main ailments in various agro-climatic areas like seed rots, seedling blight, leaf spots, downy mildew, stalk rots, banded leaf and sheath blight, smuts and rusts which caused the varied level of yield losses. Among these, the banded leaf and sheath blight (BLSB) is a major disease of maize which caused by *Thanatephorus sasakii* (Shirai) Tu and Kimbrough (St. Imp. *Rhizoctoniz solani* Kühn f. sp. *sasakii* Exner). This is one of the widest spread, destructive and versatile pathogen found in most parts of the world and infecting a vast range of host plants, including maize causing seed decay, damping-off, stem canker, root rot, aerial blight, and seed or cob decay (Ogoshi, 1987). 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 the early 1970s when an epidemic occurred in warm and humid foothill areas in the Mandi district of Himachal Pradesh (Payak and Renfro, 1968; Rajput, 2013). The objectives of this study were to assess the prevalence and severity of banded leaf and sheath blight (BLSB) in maize across various districts of West Bengal during 2020 and 2021. The study aimed to identify variations in disease severity and the susceptibility of different maize cultivars for the development of effective management strategies.

2. MATERIALS AND METHODS

2.1 Survey for BLSB Disease in Different Districts of West Bengal

A comprehensive field survey was carried out during the 2020 and 2021 rabi season in major maize-growing districts of West Bengal *viz.,* Uttar Dinajpur, Dakshin Dinajpur, Darjeeling, Murshidabad, Nadia, Purba Medinipur and North 24 Parganas were assessed to determine the severity of BLSB in maize. 6 districts were surveyed when the crop was vegetative to maturity.

2.2 Assessment of Severity of BLSB Disease

2.2.1 Severity of BLSB disease in different districts

Fifty maize plants from individual fields were randomly selected and assessed for disease Severity (Ramathani et al., 2011; Nwanosike et al., 2015). The disease was assessed according to rating scale (1-9) by Ahuja and Payak (1983) And disease severity was calculated following formula (Wheeler, 1969).

$$Disease\ severity\ (\%) = \frac{The\ sum\ of\ the\ numerical\ rating}{Total\ number\ of\ plants\ observed\ x\ Maximum\ rating\ in\ scale} x\ 100$$

2.2.2 Severity of BLSB disease in different varieties of maize

The disease severity was also recorded in various maize varieties which were grown at farmer's field during *Rabi* season of 2020 and 2021. The list of maize varieties and their source mentioned in Table 1.

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

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 (Hooda et al., 2017). 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).

3.2 Severity of BLSB Disease in Different Districts

The disease was observed in maize-growing areas ranging from low to severe forms, with severity levels fluctuating between 5.65 and 88.88 per cent in 2020, and between 5.55 and 77.77 per cent in 2021. In 2020, the highest disease severity was noted in North 24 Parganas at 88.88%, followed by Paschim Medinipur at 76.44 and Nadia at 66.66 per cent, highlighting these regions as the most affected by BLSB. In contrast, districts such as Darjeeling (5.65%) and Uttar Dinajpur (12.76%) reported relatively low disease incidences. In 2021, while Paschim Medinipur saw a slight increase in severity from 76.44 to 77.77 per cent, many other districts experienced a decrease in disease severity. Specifically, North 24 Parganas fell to 75.55 per cent and Dakshin Dinajpur decreased from 49.66 to 44.44 per cent. However, Uttar Dinajpur showed a small uptick in severity, rising from 12.76 to 13.13 per cent, indicating localized persistence of the disease. Notably, Darjeeling maintained the lowest severity, recording 5.65 in 2020 and 5.55 per cent in 2021. Meanwhile, Murshidabad exhibited a significant decline from 14.27 to 11.11 per cent.

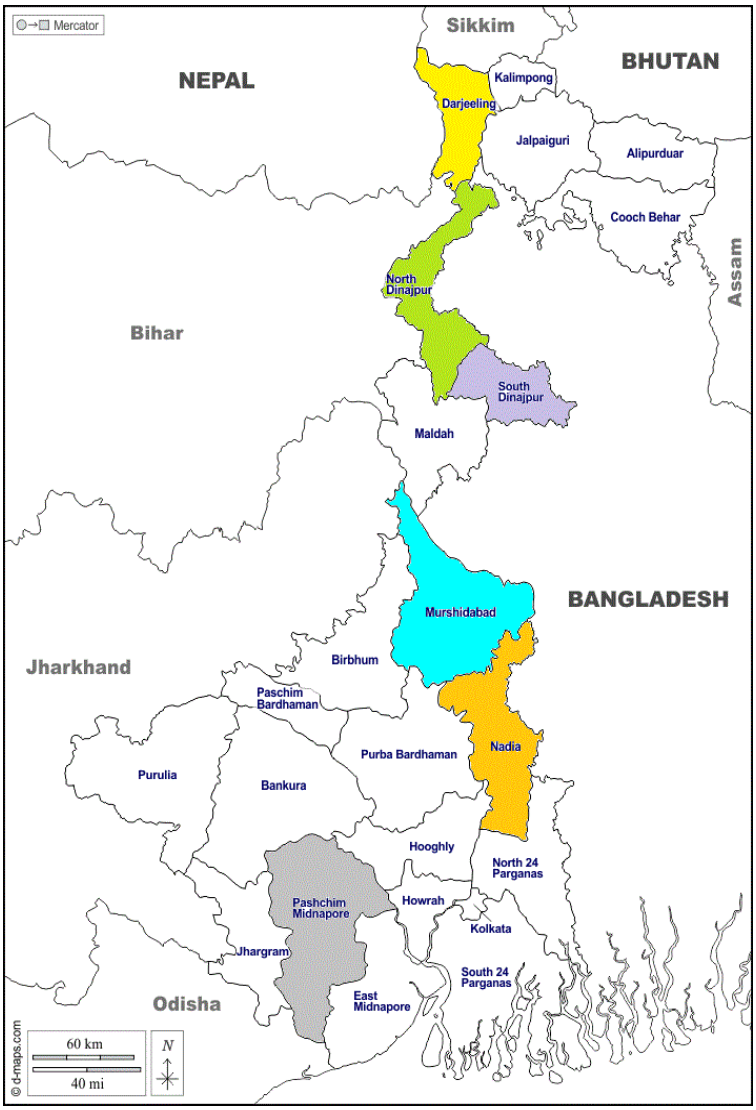

Fig. 1. Map showing surveyed districts of West Bengal

Fig. 2. Symptoms of banded leaf and sheath bight in maize

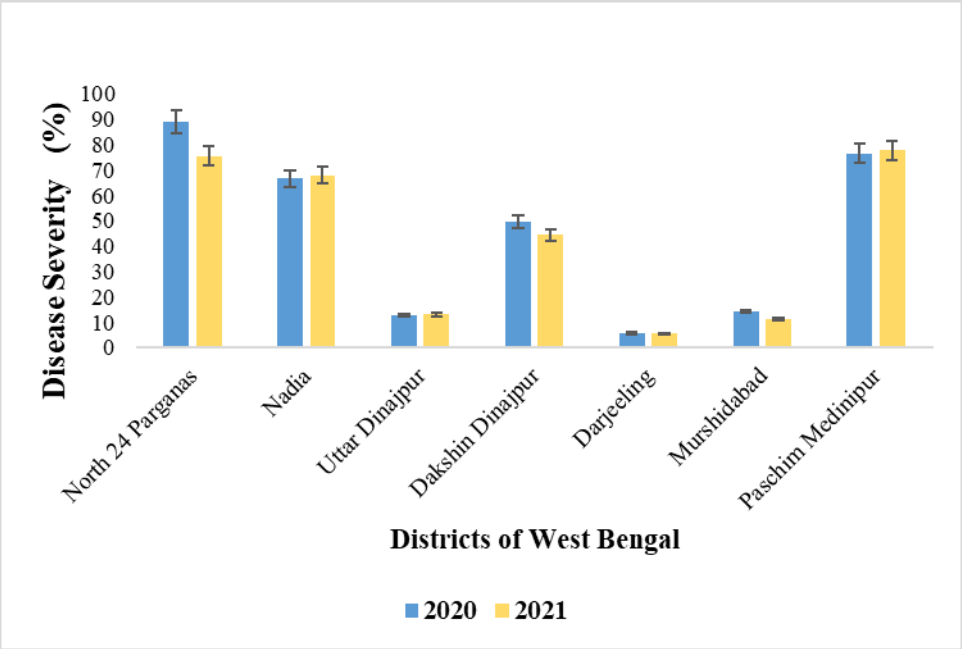

Fig. 3. Disease Severity of BLSB in Districts of West Bengal during *Rabi* season of 2020 and 2021

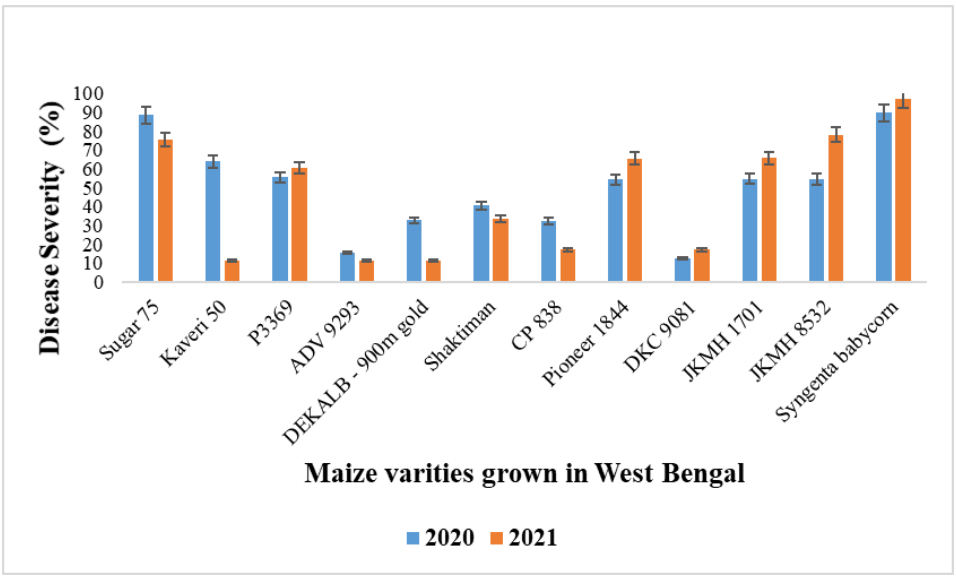

Fig. 4. Disease severity of BLSB on different maize varieties grown in West Bengal during *Rabi* season of 2020 and 2021

3.3 Severity of BLSB Disease in Different Varieties of Maize

The study assessed disease severity in maize varieties cultivated in West Bengal during the *Rabi* season of 2020 and 2021 (Fig. 4). In 2020, the Syngenta Babycorn variety exhibited the highest disease severity at 89.71 per cent, followed closely by Sugar 75 at 88.65 per cent and Kaveri 50 at 63.87 per cent. The varieties with the lowest severity were DKC 9081 at 12.54 per cent and ADV 9293 at 15.45 per cent. In 2021, Syngenta Babycorn again recorded the highest severity, reaching 96.99 per cent, followed by JKMH 8532 at 77.97 per cent and Pioneer 1844 at 65.57 per cent. Conversely, Kaveri 50 (11.15%), ADV 9293 (11.15%), and DEKALB - 900m gold (11.16%) demonstrated

the lowest severity in 2021. Notably, some varieties, such as Sugar 75 and Kaveri 50, experienced a significant reduction in disease severity from 2020 to 2021, whereas others, like Pioneer 1844 and JKMH 8532, showed an increase.

4. DISCUSSION

Banded leaf and sheath blight (BLSB), caused by *Rhizoctonia solani* f. sp. *Sasakii*, is a significant fungal disease affecting maize production worldwide. This disease poses a considerable threat to maize crops, especially in regions with conducive climatic conditions such as high humidity and warm temperatures. Understanding the prevalence and severity of BLSB is crucial for devising effective management strategies to ensure sustainable maize cultivation. To assess the impact and spread of BLSB, a systematic survey was conducted across major maize-growing areas of West Bengal during the *Rabi* seasons of 2020 and 2021. The data represents the prevalence of banded leaf and sheath blight in maize across various districts of West Bengal during the *Rabi* season of 2020 and 2021, measured as the Mean disease severity. A comparative analysis indicates notable variations in disease intensity across districts and between years. The study highlights significant spatial and temporal variability in the severity of banded leaf and sheath blight (BLSB) in maize across various districts of West Bengal. Districts like North 24 Parganas and Paschim Medinipur showed consistently high disease severity in both years, reflecting favourable environmental conditions and possibly more virulent pathogen strains. In contrast, Darjeeling consistently displayed the lowest Severity, suggesting less favourable conditions for the disease, such as cooler temperatures or different maize varieties cultivated in the region. The observed reduction in severity 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 severity 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) and Rajput (2013) 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 severity”. “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 disease severity of banded leaf and sheath blight (BLSB) among different maize varieties reflect the diversity in genetic resistance and environmental adaptability. The consistently high susceptibility of Syngenta Babycorn, with a severity of 89.71 in 2020 and 96.99 per cent 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 disease severity 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 study examined BLSB severity in West Bengal's maize fields during the *Rabi* season of 2020 and 2021. Districts like North 24 Parganas and Paschim Medinipur consistently showed high disease intensity, while Darjeeling had minimal severity. Some districts experienced reduced severity in 2021, possibly due to improved management or environmental factors. However, localized persistence, as seen in Uttar Dinajpur, requires targeted interventions. Varietal susceptibility, like in Syngenta Babycorn, highlights the need for resistant cultivars. Integrated management strategies, combining cultural, biological, and chemical methods, are crucial for sustainable maize production in BLSB-prone regions. Continuous monitoring and adaptive approaches are essential to mitigate disease impact under changing agro-climatic conditions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

The authors have declared that no competing interests exist.

REFERENCES

Ahuja, S. C., & Payak, M. M. (1983). A rating scale for banded leaf and sheath blight of maize. *Indian Phytopathology, 36*, 338–340.

Akhtar, J., Kumar, J., Kumar, V. A., & Lal, H. C. (2009). Occurrence of banded leaf and sheath blight of maize in Jharkhand with reference to diversity in *Rhizoctonia solani*. *Asian Journal of Agricultural Sciences, 1*(2), 32–35.

Alemu, N., Fikre, L., & Gezahegn, B. (2016). Distribution and importance of maize grey leaf spot (*Cercospora zeae-maydis*) in South and Southwest Ethiopia. *Journal of Plant Pathology and Microbiology, 7*(7), 1000362.

Angelique, J. P., Paul, D. E., Carl, B. A., Alison, R., & Pierce, A. P. (2008). Corn foliar diseases identification and management field guide. In *Development of IPM-based corn fungicide guidelines for the North Central States of USA*.

Bertus, L. (1927). A sclerotial disease of maize due to *Rhizoctonia solani*. *Yearbook, Department of Agriculture, Ceylon, 46*, 485.

Bock, K. R. (1974). Maize Streak virus. *Annals of Applied Biology, 77*, 289–296.

Carlos, L. D. (1984). Maize diseases: A guide for field identification. *Maize Program, CIMMYT*.

Chaudhary, S., Sagar, S., Tomar, A., Sengar, R. S., & Kumar, M. (2016). Banded leaf and sheath blight: A menacing disease of maize (*Zea mays* L.) and its management. *Journal of Applied and Natural Science, 8*(3), 1720–1730.

Chemeda, F., & Jonathan, Y. (2001). Association of maize rust and leaf blight epidemics with cropping systems in Hararghe highlands, eastern Ethiopia. *Crop Protection, 20*, 669–678.

Di, R., Liu, L., Shoaib, N., Xi, B., Zhou, Q., & Yu, G. (2023). Sheath blight of maize: An overview and prospects for future research directions. *Agriculture, 13*(10), 2006

Groth, D. E., & Bond, J. A. (2006). Initiation of rice sheath blight epidemics and effect of application timing of azoxystrobin on disease incidence, severity, yield, and milling quality. *Plant Disease, 90*(8), 1073–1076.

Hooda, K. S., Khokhar, K. M., Parmar, H., Gogoi, R., Joshi, D., Sharma, S. S., & Yadav, O. P. (2017). Banded leaf and sheath blight of

maize: Historical perspectives, current status, and future directions. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences, 87*(4), 1041–1052.

Kumar, S., Kaur, H., & Hunjan, M. S. (2021). Genetic diversity and virulence spectrum of *Rhizoctonia solani*, the incitant of banded leaf and sheath blight of maize. *Journal of Phytopathology, 169*(7–8), 486–499.

Lal, S., Baruah, P., & Butchaiah, K. (1980). Assessment of yield losses in maize cultivars due to banded leaf sclerotial disease. *Indian Phytopathology, 29*, 129–132.

Nwanosike, M. R. O., Mabagala, R. B., & Kusolwa, P. M. (2015). Disease intensity and distribution of *Exserohilum turcicum*, incitant of northern leaf blight of maize in Tanzania. *International Journal of Pure and Applied Biosciences, 3*(5), 1–13.

Patra, D. K. (2007). Occurrence of banded leaf and sheath blight diseases of maize in West Bengal. *Journal of Mycopathological Research, 45*(1), 137–138.

Payak, M. M., & Renfro, B. L. (1968). Combating maize diseases. *Indian Farmer Digest, 1*, 53–58.

Payak, M. M., & Sharma, R. C. (1981). Disease and pest situation in high-yielding hybrids and composites of maize with special reference to India. In *FAO Regional Office: A Review of Pest, Diseases, and Weed Complexes in High Yielding Varieties in Asia and Pacific* (pp. 94–102). Bangkok, Thailand.

Ramathani, I., Biruma, M., Martin, T., Dixelius, C., & Okori, P. (2011). Disease severity, incidence, and races of *Setosphaeria turcica* on sorghum in Uganda. *European Journal of Plant Pathology, 131*, 383–392.

Saxena, S. C. (2002). Bio-intensive integrated disease management of banded leaf and sheath blight of maize. In *Proceedings of the 8th Asian Regional Maize Workshop: New Technologies for the New Millennium* (p. 380–388).

Sharma, R. R., Gour, H. N., & Rathode, R. S. (2004). Etiology of banded leaf and sheath blight symptoms of maize. *Journal of Mycology and Plant Pathology, 34*(1), 57–59.

Singh, A., & Shahi, J. P. (2012). Banded leaf and sheath blight: An emerging disease of maize. *Maydica, 57*, 215–219.

Singh, B. M., & Sharma, Y. R. (1976). Studies on banded leaf and sheath blight of maize. *Indian Phytopathology, 27*, 88–86.

Singh, R., Mani, V. P., Koranga, K. S., Bisht, G. S., Khandelwal, R. S., Bhandari, P., & Pant, S. K. (2004). Identification of additional sources of resistance to *Exserohilum turcicum* in maize (*Zea mays* L.). *SABRAO Journal of Breeding and Genetics, 36*(1), 45–47.

Wheeler, B. E. J. (1969). An introduction to plant disease. *Wiley, London*, 616–619.

Yang, G. H., Conner, R. L., Chen, Y. Y., Chen, J. Y., & Wang, Y. G. (2008). Frequency and pathogenicity distribution of *Rhizoctonia spp.* causing sheath blight on rice and banded leaf disease on maize in Yunnan, China. *Journal of Plant Pathology, 90*(2), 387–392.

Ogoshi, A., 1987. Ecology and pathogenicity of anastomosis and intraspecific groups of Rhizoctonia solani Kühn.

Rajput, L. S. (2013). Studies on Banded Leaf and Sheath Blight of Maize Caused by Rhizoctonia solani f. sp. sasakii EXNER (Doctoral dissertation, University of Agricultural Sciences).

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