



Survey on the incidence of maydis leaf blight of maize incited by *Bipolaris maydis* in major maize growing regions in Tamilnadu

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Abstract

Maydis Leaf Blight (MLB) or Southern corn leaf blight (SCLB) caused by *Bipolaris maydis* (Nisikado) Shoemaker is a serious foliar disease of maize distributed widely in maize producing areas throughout the world where grown under warm and humid conditions. The present study was conducted with the aim of assess the MLB incidence of maize in three districts of Tamil Nadu revealed the endemic nature of the disease with incidence ranging from 5.61 to 26.41 per cent. The maximum per cent disease index (26.41%) was recorded in Keeramangalam village of Pudukkottai district. Maydis leaf blight infected leaf samples were collected and pure hyphal tip cultures of nine isolates were maintained on potato dextrose agar. The pathogenicity of the fungal pathogens was also proved after artificial inoculation of maize plants.

Keywords: survey, maize, maydis leaf blight, *Bipolaris maydis*

Introduction

Maize (*Zea mays* L.) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as queen of cereals because it has the highest genetic yield potential among the cereals. It is an important staple food crop and provides raw materials for livestock and many agro allied industries in the world. Cultivated maize, a member of the family Poaceae (Graminaceae) is believed to have been first domesticated by indigenous people in south Mexico. World maize area accounts for 182.96 million hectares with a production of 1067.21 million metric tonnes and productivity of 5.83 metric tonnes ha⁻¹ (India Maize summit, 2014). In India maize is cultivated over an area of about 8.69 Mha with a production of 26.15 MT and productivity of 6.54 t ha⁻¹. In Tamil Nadu, the area over cultivation is about 3.6 Mha with production of 23.83 MT and productivity of 6.55 t ha⁻¹ (Anonymous, 2016) [2].

Maize crop affected by a number of diseases at pre-harvest and post-harvest stages. Of these, Maydis Leaf Blight (MLB) or Southern corn leaf blight (SCLB) caused by *Bipolaris maydis* (Nisikado) Shoemaker is a serious foliar disease of maize distributed widely in maize producing areas throughout the world where grown under warm and humid conditions (White, 1999 and Harleen Kaur *et al.*, 2014) [24, 14]. Worldwide losses in maize due to fungal, nematodes, bacterial diseases were estimated to be 9 per cent in 2001-03 (Oerke, 2005) [15]. Jha and Jha (1989) reported that losses due to MLB ranged from 6.9 to 62.4 per cent depending upon the susceptibility of variety. The potential losses due to this disease also reported even up to 60% under severe conditions depending upon susceptibility of the variety (Sanjeev Kumar and Rani, 2009a) [18]. However, various workers have reported yield loss up to 41 per cent (Sharma and Rai, 2000) [19] and 40 to 70% (Hussain *et al.*, 2016) [8] depending on the variety, severity and stage of infection. The present study was undertaken with the aim of detailed field survey on incidence of maydis leaf blight in major maize growing regions in Tamilnadu, India. Subsequently diseased plant samples were collected and assessed their morphological character. Further, virulence of all the isolates was assessed under pathogenicity study.

Materials and Methods

Field survey

An intensive roving survey was conducted to find out the occurrence of disease incidence and severity of MLB in Pudukkottai, Cuddalore and Salem district, Tamil Nadu, during, 2016. In each districts three major maize growing villages were selected. In each village, five fields were selected randomly when the crop was in flowering to grain filling stage. Such fields were assessed for MLB severity by recording the disease on 1-5 disease rating scale. Further PDI was calculated by using the following formula proposed by Wheeler, 1969 [23].

The scale consists of five broad categories designated by numerical 0 to 5 (Payak and Sharma, 1985)

The percent disease index (PDI) was then calculated using the following formula (wheeler, 1969) [23].

$$PDI = \frac{\text{Sum of individual ratings}}{\text{Total number of leaves observed} \times \text{maximum disease grade}} \times 100$$

Collection of disease sample

The leaves of maize plant infected by *Bipolaris maydis* (Nisikado & Miyake) Shoemaker. Showing typical MLB necrotic lesion type symptoms were collected from 9 locations during survey.

Isolation and identification of pathogen

The fungus was isolated following standard tissue isolation technique mentioned below. The necrotic leaf bits along with some healthy portions were surface sterilized in 1% of sodium hypochlorite solutions for 30 seconds and washed thoroughly thrice in distilled water to remove the traces of sodium hypochlorite. Then the leaf bits were aseptically placed in the petriplate containing PDA and incubated at room temperature ($28 \pm 2^\circ\text{C}$) for 5 days observed periodically for fungal growth on medium.

The pathogen was confirmed by observe the conidia and coniochored under high power microscope. Observe the length, breadth and number of septa and then were confirmed by referring standard literature (Alexopolus *et al.*, 1996).

Maintenance of the culture

The hyphal tip culture of the fungus were sub cultured on potato dextrose agar slant and kept in laboratory at $28 \pm 2^\circ\text{C}$ for 15 days. The culture was preserved in slants at 5°C in refrigerator. Further this culture was sub cultured once in a month and used for further studies.

Morphological characters of *B. maydis* isolates

A nine mm culture disc from a 10 day old PDA culture of the pathogen was removed using a sterile cork borer and placed at the center of sterilized Petri dishes containing 15 ml of PDA under aseptic conditions. Seven days after incubation at room temperature ($28 \pm 2^\circ\text{C}$) the mycelial growth and morphological characters of the isolates were observed. The morphological characters *viz.*, colony color, sporulation, conidial population and number of septa were observed, measured and recorded (CMI, 1980).

Pathogenicity Test

Maize plants of susceptible cultivar NK6240 were raised from surface sterilized seeds in cement pots containing autoclaved sterilized soil. In each pot single plant were maintained. At 4-6 leaf stage the plant were inoculated with *B. maydis* isolates by the standard sorghum grain inoculation technique (Shekhar and Kumar 2012). The incidence of MLB disease was recorded 21 days after inoculation using of 0-5 scale proposed by Payak and Sharma, (1985) [17]. The pathogen was re-isolated from the artificially infected plants and compared with the original isolate maintained in the laboratory.

Result and Discussion

The data presented in table 1 on the survey conducted in three districts *viz.*, Pudukkottai, Cuddalore and Salem of Tamil Nadu, India indicated the endemic nature of maize MLB disease. The maximum per cent disease index (26.41%) was recorded in Keeramangalam village of Pudukkottai district followed by B. mutlur (18.76%) of Cuddalore district, Arputhapuram (14.32%) of Pudukkottai district, Palanipuri (12.53%) of Salem district and Appamasamuthram (10.68) of Salem district. The least incidence (5.61%) was recorded in Sivapuri of Cuddalore district. In general MLB disease incidence was more in cultivar NK6240 compared to other cultivars.

Similar such endemic nature of MLB disease of maize in Karnataka was reported by Sunaina Bisht (2015) [22] with incidences ranging 27.88-56.26% in major maize growing regions of north Karnataka. Also, Hulagappa *et al.* (2013b) [6, 7] reported 33.76%-52.13% MLB incidence in six Maize growing districts namely Bagalkot, Belgaum, Dharwad, Gadag, Haveri and Koppal with the maximum incidence (50.66%) recorded from Ranebennur from Haveri district in northern Karnataka. In a similar study in southern Rajasthan, Yadav *et al.* (2013) [25] reported the occurrence of MLB in six districts with incidences ranging from 2.5 - 4.5 disease rating scale with more severe in Udaipur, Durgapur and Banswara districts.

The results pertaining to the morphological characters of *B. maydis* has exhibited by different isolates are mentioned in table 2. Morphological characters such as colony character, colony colour, colony diameter, sporulation, conidial population and Number of septa of isolates of *B. maydis* were studied. The details of the isolates designated as BM₁ to BM₉. All the 9 isolates were showing considerable variation respective with their colony colour, sporulation, conidial population and number of septum. The mean colony diameter was ranging from 60.22 to 88.25 mm. The culture colour varied from grey, light grey, dark grey, grey to black, olivaceous green to grey colour. The conidial population ranged from 9.32 to $28.43 \times 10^4 / \text{mm}^2$ and septation ranged from 3-8 were observed under microscopic field.

Similar such variations in the morphological characters were also reported (Yadav *et al.*, 2013) [25]. Among the isolates the isolate BM₁ produced maximum growth of colony, sporulation, conidial population with number of septa of compare than other isolates. Similar to the present observations Karimi (2003) also have reported that *B. maydis* white, dull white, light grey and dark grey, smooth, and regular margins on Potato Dextrose Agar

medium (PDA). Hulagappa *et al.*, (2012) observed that the growth of *B. maydis* were grey, black, deep black, brownish black in color, poor to excellent growth with circular and irregular margin.

The data pertaining to the pathogenicity of *B. maydis* isolates are presented in table 3. Among the nine isolates, the isolate BM₁ was found as the most virulent which recorded the maximum per cent disease index (36.43%) on maize variety NK6240 which was followed by BM₆ with a PDI of 33.72 per cent, BM₂ with a PDI of 31.35 and BM₉ with a PDI of 28.62%. The least PDI (12.42%) was recorded with isolate BM₄. The isolates which showed higher virulence *viz.*, BM₁ was only selected for further studies and assessed for cultural character, growth on different temperature and pH.

In a similar study, Iffat *et al.* (2012) ^[9] reported that the isolates BM₂ and BM₃ collected from Orissa and Assam were highly virulent but the isolate collected from Udaipur was less virulent. Likewise, Ishar pal (2015) ^[10] also reported that isolate collected from Karnal (MKCh1) was the most virulent and that from Udaipur (MUCh3) was the least virulent. Manmohan Singh (2016) ^[12] found that isolate of *B. sorokiniana* collected from Chadwal, in Jammu was the most virulent and that from Rajbhag was the least virulent.

Table 1: Survey for the incidence of maydis leaf blight of maize incited by *B. maydis*

Sl. no	District	Location	Variety	PDI*
1.	Pudukkottai	Keeramangalam	NK 6240	26.41
2.		Arputhapuram	MRM4050	14.32
3.		Katthaikurichi	Local vty	7.19
4.	Cuddalore	Sivapuri	MRM4050	5.61
5.		Vallampadugai	MRM4050	5.74
6.		B.mutloor	900 M	18.76
7.	Salem	Veeraganoor	900 M gold	7.84
8.		Appamasamuthram	NK 6240	10.68
9.		Palanipuri	MRM4050	12.53

* Mean value of three replications PDI- Percent Disease Index

Table 2: Morphological characteristics of *B. maydis* isolates

Sl.No	Isolate	Colony character	Mean colony diameter (mm)*	Sporulation	Conidial population $1 \times 10^{-4} \mu\text{l}$	No of septa
1	BM ₁	Grayish to dark black mycelium regular margin raised wooly growth	88.25	++++	28.43	4-8
2	BM ₂	Good growth regular growth dark gray color mycelium	80.31	+++	20.69	3-6
3	BM ₃	Olivaceous green to gray color with regular margin smooth cottony growth	70.23	+	14.43	3-6
4	BM ₄	Poor growth light grey color turn to dark gray to black	60.22	+	7.43	3-6
5	BM ₅	Moderate regular growth white cottony growth later change into grayish shade	69.38	+	9.32	3-6
6	BM ₆	Irregular wooly growth dark gray to black color	85.88	++++	25.81	4-8
7	BM ₇	Excellent growth circular margin flat dark gray to black color	72.25	++	14.36	3-6
8	BM ₈	Dirty white turning to gray good growth	75.25	++	16.75	3-6
9	BM ₉	Poor growth olivaceous green color regular margin	78.63	+++	18.34	3-6

Table 3: Pathogenicity of *B. maydis* isolates (Pot culture)

Sl. No.	Isolate	PDI* (%)
1	BM ₁	36.43
2	BM ₂	31.35
3	BM ₃	20.14
4	BM ₄	12.42
5	BM ₅	16.81
6	BM ₆	33.72
7	BM ₇	24.22
8	BM ₈	24.71
9	BM ₉	28.62
	S. Ed	0.83
	CD (p = 0.05)	1.74

* Mean value of three replications



Fig 1: Maydis leaf blight infected by *Bipolarismaydis*



Plate 2: Pathogenicity proved by inoculated on Maize crop with *B. maydis*



Plate 3: Pathogenicity proved by inoculated on Maize crop with *B. maydis*

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