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Evaluation of some inbred lines against southern corn leaf blight of maize under natural condition during kharif season of West Bengal

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Abstract
Maize is a cross pollinated crop, having thermo & photo insensitive property, third most important cereal crop of India and called the "Queen of Cereals" because of its highest yield potential. Southern Corn Leaf Blight (SCLB) is one of the important biotic stresses of maize crop and it is caused by an Ascomycetous fungi – *Cochliobolus heterostropus* / *Bipolaris maydis* which is a necrotrophic pathogen and also very much difficult to manage. Management of plant diseases can be done by using resistant cultivars, practicing cultural methods, by using synthetic chemicals or biological & natural products. Among them use of resistant cultivar is very much effective and less hazardous. For developing resistant cultivars, study of inbred lines is of utmost importance. In West Bengal southern Corn Leaf Blight is very much important specially during kharif season. Present study was done during kharif season of 2018 and 2019 with ten inbred lines to identify resistant / tolerant lines against Southern Corn Leaf Blight under natural condition. Among these ten inbreds (CM 400, CM 500, CM 501, CM 600, BML 6, BML 7, SURYA, Early Composite, LM 14 and IIMRSBTPOOL) only LM 14 showed resistant reaction and CM 501 & IIMRSBTPOOL showed Moderately Resistant reaction.

Keywords: Southern corn leaf blight, inbred lines, necrotrophic, resistant, moderately resistant

Introduction
Maize (*Zea mays*), also called corn, is believed to have originated in central Mexico 7000 years ago from a wild grass, and Native Americans transformed maize into a better source of food. Maize (*Zea mays* L) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Under the changing climate and farming scenario, maize being a thermo and photo insensitive crop has been emerging as one of the potential crops that address several issues like food and nutritional security, climate change, water scarcity, farming systems and bio-fuels. Maize is an important food crop and an important raw material for livestock and many agro allied industries throughout the world (Bello *et al.* 2010; Randjelovic *et al.* 2011) [3, 10].

Globally, maize is known as queen of cereals because it has the highest genetic yield potential among the cereals. It is cultivated on nearly 150 m ha in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 36% (782 m t) in the global grain production. Maize contains approximately 72% starch, 10% protein, and 4% fat, supplying an energy density of 365 Kcal/100 g and is grown throughout the world, with the United States, China, and Brazil being the top three maize-producing countries in the world, producing approximately 563 of the 717 million metric tons/year. Maize can be processed into a variety of food and industrial products, including starch, sweeteners, oil, beverages, glue, industrial alcohol, and fuel ethanol. In the last 10 years, the use of maize for fuel production significantly increased, accounting for approximately 40% of the maize production in the United States. Low production costs, along with the high consumption of maize flour and cornmeal, especially where micronutrient deficiencies are common public health problems, make this food staple an ideal food vehicle for fortification. Maize production in India is 21.73 million tones with 8.55 million ha with productivity of 2.6 t/ha (DMR, 2012) [7].

In West Bengal maize crop is also getting importance. The limitation of rising temperature during grain filling of wheat particularly in eastern India, the declining yield of boro rice in West Bengal and Orissa and water scarce areas in peninsular India (AP and Tamil Nadu) affecting yield of rabi rice has shown a path to maize as better option.

There are so many biotic stresses affecting the potential yield of maize. In West Bengal Maydis leaf blight is very much important disease affecting maize crop.

The famous epidemic in USA because of SCLB disease was very much severe and this is an example of huge economic loss by a plant disease (Strobel, 1975) [12]. It is a severe problem of maize in warm and humid weather conditions (White, 1999) [17]. Upto 70% yield loss is recorded due to SCLB (Wang *et al*. 2001; Ali *et al.* 2011) [15, 16]. Among three races (race O, race T & race C) of *Bipolaris maydis* (Smith *et al*., 1970; Wei *et al*. 1988) [11, 16] in India race O is the important one. In India this disease was first reported from Maldah district of West Bengal by Munjal & Kapoor in 1960 [9]. The Southern Corn Blight spreads from the basal leaves to the developing ear and then flag leaf of maize plant (CIMMYT 1985). Yield losses of maize up to 40 percent or more have been demonstrated in inoculated yield trails (Byrnes *et al*., 1989) [5]. The best way of bypassing these hazardous effect of diseases is use of resistant hybrids. Resistance against Southern Corn Leaf Blight is quantitative in nature with a predominance of additive gene action as well as significant dominance effects present in some populations (Thompson and Bergquist 1984, Burnette and White 1985[4], Holly and Goodman 1989) [14, 4, 8]. Development of resistant hybrids is dependent on selection of suitable resistant Inbred Lines. For identifying the resistant Inbred Lines this study was conducted under natural condition.

Materials and Methods

The basic materials screened in the present study comprised 10 diverse maize inbred (*Z. mays*) lines. All 10 inbreds are CM 400, CM 500, CM 600, CM 501, BML 6, BML 7, SURYA, Early Composite, LM 14, IIMRSBTPOOL were received from the Winter Nursery Center, Indian Institute of Maize Research, Hyderabad during kharif season of two consecutive years of 2018 & 2019. The work of disease screening and determination of resistance was done under AICRP on maize, Kalyani, Bidhan Chandra Krishi Viswavidyalaya, West Bengal. The Inbred Lines were sown in a randomized block design with plot size of 4.8 m^2 spaced at 60 x 20 cm and replicated twice. Recommended agronomic practices and insect pest control measures were followed as per schedule. The disease severity on test entries was scored at silk drying stage using 1-9 disease rating scale (Balint-Kurti *et al.* 2006) [2] (Table-1). The reaction of various lines was recorded. The Inbred Lines were grouped into the different reaction categories *viz*., highly resistant, resistant, moderately resistant, susceptible and highly susceptible.

Table 1: Disease scoring scale (1-9) of MLB

Rating scale	Degree of infection (% Diseased leaf area)	PDI	Disease reaction
1.0	Nil to very slight infection (≤10%).	≤11.11	Resistant (R) (Score: ≤ 3.0) (PDI: ≤ 33.33)
2.0	Slight infection, a few lesions scattered on two lower leaves (10.1-20%).	22.22	
3.0	Light infection, moderate number of lesions scattered on four lower leaves (20.1-30%).	33.33	
4.0	Light infection, moderate number of lesions scattered on lower leaves, a few lesions scattered on middle leaves below the cob (30.1-40%).	44.44	Moderately resistant (MR) (Score: 3.1–5.0) (PDI: 33.34-55.55)
5.0	Moderate infection, abundant number of lesions scattered on lower leaves, moderate number of lesions scattered on middle leaves below the cob (40.1-50%).	55.55	
6.0	Heavy infection, abundant number of lesions scattered on lower leaves, moderate infection on middle leaves and a few lesions on two leaves above the cob (50.1-60%).	66.66	Mod. susceptible (MS) (Score: 5.1-7.0) (PDI: 55.56-77.77)
7.0	Heavy infection, abundant number of lesions scattered on lower and middle leaves and moderate number of lesions on two to four leaves above the cob (60.1-70%).	77.77	
8.0	Very heavy infection, lesions abundant scattered on lower and middle leaves and spreading up to the flag leaf (70.1-80%).	88.88	Susceptible (S) (Score: >7.0) (PDI: >77.77)
9.0	Very heavy infection, lesions abundant scattered on almost all the leaves, plant prematurely dried and killed (>80%).	99.99	

Table 2: Effect of infection of *Cochliobolus heterostropus* on different Inbred Lines

Sl. No.	Name of Inbred	2018		2019		Average (Two Years)	
		Disease Score	Reaction	Disease Score	Reaction	Disease Score	Reaction
1	CM 400	7.6	S	9.0	S	8.3	S
2	CM 500	6.9	MS	7.4	S	7.2	S
3	CM 501	4.8	MR	4.8	MR	4.8	MR
4	CM 600	8.1	S	8.6	S	8.3	S
5	BML 6	4.6	MR	6.0	MS	5.3	MS
6	BML 7	5.0	MR	5.8	MS	5.4	MS
7	SURYA	5.4	MS	5.4	MS	5.4	MS
8	Early Composite	6.0	MS	6.0	MS	6.0	MS
9	LM 14	2.8	R	2.8	R	2.8	R
10	IIMRSBTPOOL	4.9	MR	5.0	MR	5.0	MR

Results and Discussion

Efforts for location of resistant source and their utilization in resistant breeding programme are very much important to manage the disease in the long run. The screening trial revealed that none of the tested inbred lines was completely free from Southern Corn Leaf Blight (SCLB) / Maydis Leaf Blight (MLB) disease infection caused by *Bipolaris maydis*. However, significant variations in disease score and severity for MLB was observed in inbred lines. The present study revealed that out of 10 inbred lines tested, only one line LM 14 (Score – 2.8) showed Resistant reaction against MLB disease. CM 501 and IIMRSBTPOOL showed disease score of 4.8 and 5.0 respectively thereby exhibited Moderately Resistant reaction (MR), four lines BML 6, BML 7, SURYA and Early Composite recorded disease score of 5.3, 5.4, 5.4 & 6.0 respectively and were found Moderately Susceptible (MS) to the disease and the rest three inbreds CM 400, CM 500 and CM 600 having disease score of 8.3, 7.2, 8.3 respectively

were severely affected by MLB and rated as susceptible (S). Disease reaction indicating satisfactory level of disease development and the categorization of materials into different classes was appropriate (Table 1). According to Chandrashekara *et al*. (2012) [6] the inbred lines *viz*., V373, V398, V407, V418, VQL2 and CM 145 showed high degree of resistance to MLB and V351, V414, VQL1 & CM212 were found to be highly susceptible. Goudar & Harlapur (2019) [13] reported that among the 34 inbred lines, only two lines, *viz*., BM-55 and BM-148, registered highly resistant reaction, five lines were identified as resistant, ten lines were found moderately resistant and remaining were susceptible. So, the promising high yielding Maydis leaf blight / SCLB resistant genotypes identified in present study would be helpful for their deployment in breeding programmme and as donors for different research programmes and could be used to develop lines for Maydis leaf blight disease endemic areas to aim at sustainable productivity.

Conclusion

Results in present study showed significant effect of Southern Corn Leaf Blight (SCLB) on different Inbred lines of maize. All Inbred lines showed disease incidence & severity due to windborne inoculum of pathogen of the disease. In each and every Inbred line disease symptom of SCLB was present but only one (LM 14) showed Resistant reaction that can be deployed in breeding programme and as donors in various basic and applied research programmes aiming at sustainable productivity in SCLB disease endemic areas.

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