

Original Research Article

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Screening of QPM Maize Genotypes against Maydis Leaf Blight (*Helminthosporium maydis*) under Natural Epiphytotic Conditions

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ABSTRACT

Maydis leaf blight is considered the most devastating disease of maize crop, which causes noticeable reduction in crop yield. The present studies were undertaken to find out the stable sources of *maydis* leaf blight resistance. A set was obtained by crossing ten QPM inbred lines in 10×10 half diallel fashion excluding reciprocals. In total sixty lines including parents, F₁'s and standard check (HQPM-1, HQPM-4, HQPM-7, PRATAP QPM-1 and VIVEK QPM-9) were evaluated against leaf blight (*Exserohilum turcicum*) of maize under field conditions during *kharif* 2016 and 2017. One QPM inbred CML162, two QPM check VIVEK QPM-9, HQPM-1 and 17 hybrids viz., CML189 × CML163, CML180 × CML170, CML193 × CML170, CML170 × CML163, BAJIMQ-08-26 × CML189, BAJIMQ-08-27 × CML171, CML180 × BAJIMQ-08-27, CML193 × CML171, CML180 × CML163, CML170 × CML161, CML189 × CML162, CML193 × CML163, CML180 × BAJIMQ-08-26, CML193 × BAJIMQ-08-26, CML189 × CML171, BAJIMQ-08-26 × CML170, CML180 × CML162 showed resistant reaction against *maydis* leaf blight. Twenty three crosses, seven parents and two checks were found moderately resistant and five crosses one QPM check and two inbreds were found moderately susceptible Thus, the identified resistant genotypes could be utilized for developing promising maize hybrids with inbuilt resistance to *maydis* leaf blight disease of maize.

Keywords

Maydis leaf blight, QPM, Natural epiphytotic, Resistant

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Introduction

Maize (*Zea mays* L. 2n=20) is one of the oldest and most important cereal crops in the world and cultivated in almost 150 countries. The foremost producing countries are USA, China, Brazil, Mexico, France and India. Maize contributes to food security in most of the developing countries and globally, maize grown in an area of 197.20 million hectare

with production of 1148.49 million tonnes and productivity 58.24 quintals per hectare (FAO STAT, 2019).

India is the 2nd most important maize growing country in Asia and world's 6th largest producer and the 5th largest consumer and cultivated in an area of 9.63 million hectare with production of 25.90 million tonnes and productivity of 26.89 quintals per hectare

(*kharif* and *rabi*). In Himachal Pradesh, it is an important *kharif* crop grown in an area of 0.29 million hectares with a total production of 0.78 million tonnes and productivity of 26.72 quintals per hectare as compared to the national average of 24.13 quintals per hectare in *kharif* season (Anonymous, 2017). It is potentially proficient of producing large quantities of food grain in short duration and can effectively solve the food problems of soaring population of our country (Upadhyay and Palanivel, 2011). In India maize is used as for feed (63%), food (23%), starch industries (12%), seed and miscellaneous use (2%).

Maize is prone to as many as 112 diseases in different parts of the globe, out of which about 61 diseases have been reported to affect the crop in India (Wani, 2015). Primary diseases include seed rots and seedling blights, root and stalk rots, foliar diseases and ear rots etc. (Kumar *et al.*, 2013). Out of these *maydis* leaf blight caused by the fungus *Helminthosporium maydis* Nisikado (teleomorph *Cochliobolus heterostrophus* Dreshch.) is a serious foliar disease of maize distributed widely in maize growing area across the world and has attained the status of the economically important disease (Malik *et al.*, 2017).

Leaf blight leads to yield reduction (41%) and also deteriorate the value and quality of the maize grain. Symptoms of *maydis* leaf blight on leaf appears initially as small and diamond shaped lesions, as they mature lesion get elongated. *Maydis* leaf blight also known as South Corn Leaf Blight (SCLB) because of its preponderance in the South America.

The disease is widely distributed in India during *kharif* season. In India, *maydis* blight appears in hills, plains and peninsular parts and require warm (20 to 32°C) and humid (more than 80%) conditions to grow. Three

rices of *Cochliobolus heterostrophus* known as O, T and C has been described and currently predominant form of *Cochliobolus heterostrophus* is Race O, in severity, which can cause yield losses of up to 40% (Gregory *et al.*, 1978; Byrnes *et al.*, 1989).

The literature related to dominance of the pathogen causing *maydis* leaf blight under Himachal Pradesh is limited and also there is an urgency to identify the *maydis* leaf blight resistance source. Therefore, research was aimed to determine the resistance level of different maize inbred lines genotype against the disease through the process of screening and evaluation because of its prime importance to address the fungal disease. As a consequence the knowledge acquired from the study might be of vital use for the scientific research of phytopathologists, plant breeders and also for the farmers.

Materials and Methods

The materials screened in the present study comprised ten QPM inbred lines (Table 1) and inbred lines were crossed in a 10×10 half diallel mating system excluding reciprocals during *kharif* 2015.

Field experiment was conducted at Experimental Farm of the Department of Crop Improvement, College of Agriculture, CSK HPKV, Palampur situated at 1290.8 m amsl having latitude 32°6' N and longitude 76°3' E during *kharif* 2016 and 2017.

The experiment was designed in RBD with single replications in a plot size of 2.0 × 0.60 m (1.2 m²) at spacing of 60 × 20 cm. Seeds of eight QPM inbred lines *viz.*, CML161, CML162, CML163, CML170, CML171, CML180, CML189 and CML193 from Indian Institute of Maize Research (IIMR), New Delhi and two lines were procured from HAREC Bajaura (Kullu). The chemical

fertilizer was applied at the rate of 120:60:40 kg NPK/ha through urea (46% N), DAP (18% N and 46% P₂O₅) and MOP (60% K₂O) along with FYM @ 10 t/ha. Half dose of nitrogen and full dose of phosphorus and potassium were applied as a basal dose during final land preparation and remaining half dose of N was top dressed 45 days after sowing (DAS). Thinning was done 30 days after sowing in all plots to maintain desired plant population.

To control borer, 3 to 4 furadane granules were applied once to the whorl of each plant manually at 45 DAS. Two manual weedings and hoeings were done at knee high stage and before tasseling to control weeds. Disease reaction of the lines and crosses were recorded for turicum leaf blight. The disease reaction were recorded for leaf blight as per scale used 0-5 (Chenulu and Hora, 1962).

Results and Discussion

All the genotypes showed significant variation in disease reaction. Perusal of data presented in Table 2 indicated that all the genotypes showed resistant to susceptible reaction against maydis leaf blight of maize.

The results revealed that the maydis leaf blight reaction during both the years *kharif* 2016 and 2017 varied from 1.0 to 3.5, indicating good segregation among genotypes. Out of 60 genotypes, one parent CML162, two QPM check VIVEK QPM-9, HQPM-1 and 17 hybrids viz., CML189 × CML163, CML180 × CML170, CML193 × CML170, CML170 × CML163, BAJIMQ-08-26 × CML189, BAJIMQ-08-27 × CML171, CML180 × BAJIMQ-08-27, CML193 × CML171, CML180 × CML163, CML170 × CML161, CML189 × CML162, CML193 × CML163, CML180 × BAJIMQ-08-26, CML193 × BAJIMQ-08-26, CML189 × CML171, BAJIMQ-08-26 × CML170,

CML180 × CML162 showed resistant reaction against *maydis* leaf blight. Twenty three crosses viz., CML170 × CML162, CML193 × BAJIMQ-08-27, CML170 × CML162, CML171 × CML162, CML189 × CML161, BAJIMQ-08-26 × CML163, CML180 × CML171, CML163 × CML161, CML171 × CML170, CML180 × CML93, CML171 × CML163, BAJIMQ-0-27 × BAJIMQ-08-26, BAJIMQ-08-26 × CML171, BAJIMQ-08-27 × CML161, BAJIMQ-08-26 × CML189, CML180 × CML161, CML193 × CML161, CML193 × CML189, BAJIMQ-08-26 × CML162, CML171 × CML161, BAJIMQ-08-26 × CML161, BAJIMQ-08-27 × CML163, CML180 × CML189, seven parents namely BAJIMQ-08-26, CML170, CML180, BAJIMQ-08-27, CML161, CML193, CML171 and two checks viz., PRATAP QPM-1 and HQPM-7 were found moderately resistant with disease score of 2.0 (Table 3) and five crosses viz., BAJIMQ-08-27 × CML170, CML163 × CML162, CML193 × CML162, CML189 × CML170, BAJIMQ-08-27 × CML162, one QPM check i.e. HQPM-4 and two inbreds viz., CML163, CML189 were found moderately susceptible with mean disease score 3.0. None of the crosses, parents and checks was found susceptible/highly susceptible during *kharif* 2016 and 2017.

Various research findings on *maydis* leaf blight were reported, which support the present results (Kumar and Saxena, 2008; Chandrashekara *et al.*, 2014; Goudar and Harlapur, 2016; Singh *et al.*, 2018). Kumar and Saxena (2008) reported that one genotype was moderately resistant and seven genotypes were moderately susceptible. Rai *et al.*, (2010) evaluated fifty one genotypes and found twenty six resistant, eight moderately resistant, thirteen moderately susceptible, two susceptible and two highly susceptible.

Table.1 Description of the QPM inbred lines used in the investigation

Sr. No.	Material	Pedigree	Source
1.	CML161 (P ₁)	G25Q _C 18MH520	IIMR, New Delhi
2.	CML162 (P ₂)	G25Q _C 1HC18-8-1-2-B-B-2-B-B-B	IIMR, New Delhi
3.	CML163 (P ₃)	G26QMH31-2-2-#-2-2-1-B-1-B-B-#	IIMR, New Delhi
4.	CML170 (P ₄)	G26Q _C 22MH9-3-1-5-1-B-B	IIMR, New Delhi
5.	CML171 (P ₅)	G25Q54B-MH13-5-B-1-1-2-B-1-B-B-B	IIMR, New Delhi
6.	CML189 (P ₆)	G34QMH17-2-1-1-B	IIMR, New Delhi
7.	BAJIMQ-08-26 (P ₇)	Baj Pool95-⊗-26-8-4-1-6-1-1-B-B-B-Q	CSK HPKV, Palampur
8.	BAJIMQ-08-27 (P ₈)	Baj Pool98-⊗-83-10-1-6-1-1-B-B-Q	CSK HPKV, Palampur
9.	CML193 (P ₉)	CY0162-B-1-1-B	IIMR, New Delhi
10.	CML180 (P ₁₀)	(C32Q/EV8444SRBC4)#-B-#-B-B-21-2-BB	IIMR, New Delhi

*BAJIMQ- Bajaura QPM converted inbred maize, CML- CIMMYT maize lines

Table.2 Disease score of maize genotypes to *maydis* leaf blight (MLB) under natural epiphytotic conditions during *kharif* 2016 and 2017

Sr. No.	Genotypes	MLB (Natural epiphytotic conditions)		
		2016	2017	Mean
1.	CML162 × CML161	2.00	2.00	2.00
2.	CML163 × CML161	2.00	2.00	2.00
3.	CML170 × CML161	1.00	1.00	1.00
4.	CML171 × CML161	2.00	2.00	2.00
5.	CML189 × CML161	2.50	1.50	2.00
6.	BAJIMQ-08-26 × CML161	2.00	2.00	2.00
7.	BAJIMQ-08-27 × CML161	2.00	2.00	2.00
8.	CML193 × CML161	2.00	2.00	2.00
9.	CML180 × CML161	1.50	2.50	2.00
10.	CML163 × CML162	3.00	3.00	3.00
11.	CML170 × CML162	2.00	2.00	2.00
12.	CML171 × CML162	2.00	2.00	2.00
13.	CML189 × CML162	1.00	1.00	1.00
14.	BAJIMQ-08-26 × CML162	2.00	2.00	2.00
15.	BAJIMQ-08-27 × CML162	3.50	2.50	3.00
16.	CML193 × CML162	3.00	3.00	3.00
17.	CML180 × CML162	1.00	1.00	1.00
18.	CML170 × CML163	1.00	1.00	1.00

19.	CML171 × CML163	2.00	2.00	2.00
20.	CML189 × CML163	1.00	1.00	1.00
21.	BAJIMQ-08-26 × CML163	2.00	2.00	2.00
22.	BAJIMQ-08-27 × CML163	2.00	2.00	2.00
23.	CML193 × CML163	1.00	1.00	1.00
24.	CML180 × CML163	1.00	1.00	1.00
25.	CML171 × CML170	2.00	2.00	2.00
26.	CML189 × CML170	2.50	2.50	2.50
27.	BAJIMQ-08-26 × CML170	1.00	1.00	1.00
28.	BAJIMQ-08-27 × CML170	3.00	3.00	3.00
29.	CML193 × CML170	1.00	1.00	1.00
30.	CML180 × CML170	1.00	1.00	1.00
31.	CML189 × CML171	1.00	1.00	1.00
32.	BAJIMQ-08-26 × CML171	2.00	2.00	2.00
33.	BAJIMQ-08-27 × CML171	1.00	1.00	1.00
34.	CML193 × CML171	1.00	1.00	1.00
35.	CML180 × CML171	2.00	2.00	2.00
36.	BAJIMQ-08-26 × CML189	1.00	1.00	1.00
37.	BAJIMQ-08-27 × CML189	2.00	2.00	2.00
38.	CML193 × CML189	2.00	2.00	2.00
39.	CML180 × CML189	2.00	2.00	2.00
40.	BAJIMQ-08-27 × BAJIMQ-08-26	2.00	2.00	2.00
41.	CML193 × BAJIMQ-08-26	1.00	1.00	1.00
42.	CML180 × BAJIMQ-08-26	1.00	1.00	1.00
43.	CML193 × BAJIMQ-08-27	2.00	2.00	2.00
44.	CML180 × BAJIMQ-08-27	1.00	1.00	1.00
45.	CML180 × CML193	2.00	2.00	2.00
46.	HQPM-4	3.00	3.00	3.00
47.	HQPM-7	2.00	2.00	2.00
48.	Pratap QPM-1	2.00	2.00	2.00
49.	CML161	2.00	2.00	2.00
50.	CML162	1.00	1.00	1.00
51.	CML163	2.50	3.50	3.00
52.	CML170	2.00	2.00	2.00
53.	CML171	2.00	2.00	2.00
54.	CML189	3.00	3.00	3.00
55.	BAJIMQ-08-26	2.00	2.00	2.00
56.	BAJIMQ-08-27	2.00	2.00	2.00
57.	CML193	1.50	2.50	2.00
58.	CML180	2.00	2.00	2.00
59.	HQPM-1 (SC-1)	1.00	1.00	1.00
60.	Vivek QPM-9 (SC-2)	1.00	1.00	1.00

Table.3 Disease Reaction of QPM maize genotypes to *maydis* leaf blight (MLB) during *kharif* 2016 and 2017 under natural epiphytotic condition

Disease Score	Reaction	Parents/hybrids/QPM checks	Crosses
0	Highly resistant	-	-
1	Resistant	CML162, VIVEK QPM-9, HQPM-1	CML189 × CML163, CML180 × CML170, CML193 × CML170, CML170 × CML163, BAJIMQ-08-26 × CML189, BAJIMQ-08-27 × CML171, CML180 × BAJIMQ-08-27, CML193 × CML171, CML180 × CML163, CML170 × CML161, CML189 × CML162, CML193 × CML163, CML180 × BAJIMQ-08-26, CML193 × BAJIMQ-08-26, CML189 × CML171, BAJIMQ-08-26 × CML170, CML180 × CML162
2	Moderately resistant	BAJIMQ-08-26, PRATAP QPM-1, CML170, CML180, BAJIMQ-08-27, CML161, HQPM-7, CML193, CML171,	CML170 × CML162, CML193 × BAJIMQ-08-27, CML170 × CML162, CML171 × CML162, CML189 × CML161, BAJIMQ-08-26 × CML163, CML180 × CML171, CML163 × CML161, CML171 × CML170, CML180 × CML93, CML171 × CML163, BAJIMQ-0-27 × BAJIMQ-08-26, BAJIMQ-08-26 × CML171, BAJIMQ-08-27 × CML161, BAJIMQ-08-26 × CML189, CML180 × CML161, CML193 × CML161, CML193 × CML189, BAJIMQ-08-26 × CML162, CML171 × CML161, BAJIMQ-08-26 × CML161, BAJIMQ-08-27 × CML163, CML180 × CML189
3	Moderately susceptible	CML163, CML189, HQPM-4	BAJIMQ-08-27 × CML170, CML163 × CML162, CML193 × CML162, CML189 × CML170, BAJIMQ-08-27 × CML162
4	Susceptible	-	-
5	Highly susceptible	-	-

Note: Scale used 0-5 (Chenulu and Hora 1962)

Similarly screened 35 short-duration maize inbred lines against MLB under natural conditions and found 19 resistant lines. Goudar and Harlapur (2016) also observed that two genotypes were highly resistant, five were resistant, ten were moderately resistant, eleven were susceptible and six were highly susceptible against *maydis* leaf blight under field conditions. The lines so identified to possess low disease score are a valuable source and can be utilized in resistance breeding programmes. The cross combinations can be further evaluated for

yield and other characters and can be released as promising hybrid varieties.

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