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IDENTIFICATION OF RESISTANT SOURCES TO TURCICUM LEAF BLIGHT CAUSED BY *EXSEROHILUM TURCICUM* (PASS.) LEONARD AND SUGGS IN MAIZE (*ZEA MAYS* L.)

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ABSTRACT
A field study was conducted to identify the sources of resistance against Turcicum Leaf Blight (TLB) in maize. A total of 128 inbred lines were evaluated under artificial epiphytotic conditions during *Kharif* 2014 using randomized block design with two replications, with a spacing of 75 x 20cm using one susceptible check 219J and one resistant check Nithyashree with recommended agronomic practices to establish good crop stand at Zonal Agricultural Research Station, College of Agriculture, V.C. Farm, Mandya. Out of these 128 inbreds, 19 inbreds were found to be resistant, 57 were moderately resistant, 35 were highly susceptible, 9 were susceptible and 9 were highly Susceptible to the TLB. The inbred lines *viz*., NAI-127, NAI-137, NAI-161, NAI-165, NAI-180, NAI-192, NAI-194, NAI-195, NAI-218, NAI-219, KUI-1414, KUI-142, CM-122, CM-133, POP-61C, DMSC-4, DMSC-14, HKI-PC-7 and HKI-163 showed high degree of resistance to TLB whereas, CM-205, NAI-179, V-351, U-298, U-488, CML-134, CML-154, CML-247 and CML-248 were found to be highly susceptible.

KEY WORDS: Turcicum leaf blight, Maize, *Exserohilum turcicum*, Resistance, Susceptible, Nithyashree.

INTRODUCTION

Maize (*Zea mays* L.) is one of the important cereal crops and it is third major crop in India after rice and wheat. Maize is native of Mexico and Central America by origin, (Galaniant, 1976, Pursglove, 1972 and Dowswell *et al*., 1996). Large proportion of maize is used as poultry and cattle feed. Maize is also used as a raw material as an ingredient to many industrial products such as starch, oil, protein, alcoholic beverage, food sweeteners, pharmaceuticals, cosmetics, paper industry etc., In few developing countries, maize grain are used for the production of ethanol which is blended with fossil fuel for use in gasoline powdered vehicles to reduce emission. In the last few years, good quantity of maize is also being exported from India to different countries. It is understood that with the increasing demand for value added foods and industrial requirements from a growing economy and population, maize will hold its share as an important cereal crop. Maize ranks first in world production (960 million tones) followed by wheat (691 million tones) and rice (461 million tones) (Anon, 2014). About 61 diseases have been reported in India which affects the maize crop (Payak and Sharma, 1985). In Karnataka, maize occupies an area of 13.22 lakh hectares with the production of 34.55 lakh tones and productivity of 28.34 q/ha, which is highest when compared to other states in the country (Anon, 2013). The major maize growing districts in the Karnataka are Davanagere, Haveri, Belgaum, Bagalkot, Shimoga, Bangalore Rural, Bellary, Bijapur, Chamarajnagar, Chitradurga, Gulbarga, Dharwad, Gadag, Kolar and Mysore. Area under maize is increasing rapidly in the state because of congenial environment, high yield and ease with which the crop is cultivated. Thus, there is scope to increase maize productivity in Karnataka to a global level of 49.20 q/ha (FAO, 2013). Among the foliar diseases affecting maize, the Turcicum leaf blight also called Northern corn leaf blight caused by *Exserohilum turcicum* (Pass.) Leonard and Suggs. (syn. *Heliminthosporium turcicum* Pass.) is of worldwide importance. Turcicum leaf blight is one of the most important fungal disease affecting photosynthesis with severe reduction in grain yield of more than 50.00 per cent (Raymundo and Hooker, 1981; Perkins and Pederson, 1987). Productivity of maize can be improved by growing the resistant cultivars and good crop management practices. Thus, investment in host plant resistance and identification of resistant sources and their utilization in breeding of disease resistant hybrids is the best option for sustainable production of maize. So, in the present study attempt has been made to identify resistant sources of maize against Turcicum leaf blight under artificial epiphytotic conditions.

MATERIALS & METHODS

To identify the source of resistance against Turcicum leaf blight in maize at Zonal Agricultural Research Station, College of Agriculture, V.C. Farm, Mandya, Karnataka. 128 maize inbreds were evaluated along with one resistant and one susceptible check. Mandya is considered as one of the hot spots for Turcicum Leaf Blight of maize. (latitude 12º30’ N and longitude 76º50’E). 128 inbred lines, were

evaluated under artificial epiphytotic conditions during *Kharif* 2014 using randomized block design with two replications, with a spacing of 75 x 20cm along with one susceptible check 219J and one resistant check Nithyashree with recommended agronomic practices to establish good crop stand.

Symptomatology

The fungus *Exserohilum turcicum* (Pass.) Leonard and Suggs is capable of infecting maize plants at all the stages of crop growth, right from seedling stage to maturity. The symptoms appears as slightly oval, water soaked, small elliptical greyish green colour spots on the leaves, at the initial stage. But, in due course such spots extends all along the length of leaf and gets enlarged. These elongated spindle shaped necrotic lesions seem to appear in straw coloured in the centre with dark margins. These lesions first appears on the lower leaves and later they spread to upper leaves and continues to increase in size, as the plants develop. The straw coloured centre of the lesion becomes darker, during sporulation. Spore of the fungus develops abundantly on both sides of the spots. The individual lesions measures 2.5 to 15 cm in length and 1 to 4 cm in width. Severely infected leaves turns to sickle shape and leaves break at the point of mid- rib. Growth of such plants are found to be very much stunted. The disease progressed upwards till maturity and destroys large photosynthetically active leaf area, giving the plant a scorched or burnt appearance and leads to premature killing of leaves. The diseased plants yield small sized, curved, partially filled malformed cobs with irregular kernel rows and shrivelled grains.

Plate 1. Typical symptoms of Turcicum leaf blight of maize

Collection of diseased samples

The leaves of affected maize plants showing typical Turcicum leaf blight necrotic lesion type symptoms were collected from susceptible genotype CM-202 grown at Zonal Agricultural Research Station (ZARS), V.C. Farm, Mandya. The pathogen *E. Turcicum* was isolated by standard tissue isolation technique.

Pathogen isolation

The fungus was isolated following standard tissue isolation technique. The necrotized leaf bits along with some healthy portions were surface sterilized in 1:1000 mercuric chloride solution for 30 seconds and washed thoroughly thrice in sterile distilled water to remove the traces of mercuric chloride, if any. Then these surface sterilized bits were aseptically transferred to each Petri dishes, containing Potato Dextrose Agar (PDA). The Petri dishes were incubated at room temperature (25±1°C) for a week and observed periodically for fungal growth. The growth of the fungus was conspicuous, after 24 hours of incubation. The pure colonies which developed from the bits were transferred to PDA slants and incubated at room temperature.

Maintenance of the culture

The cultures of the fungus were sub-cultured on PDA slants and kept in laboratory at 28±1° C for 15 days. Such mother culture slants were preserved at 5°C in refrigerator. Further, these cultures were sub-cultured once in a month and used for future purpose.

Mass multiplication of inoculum

The mass multiplication of the pathogen *E. turcicum* was prepared on sterilized sorghum grain culture as suggested by Joshi *et al*. 1969.

Procedure

Required amount of sorghum grains were soaked in water for 24hrs and excess water was drained off. Soaked sorghum grains were taken in 500 ml conical flask and the material was sterilised in autoclave twice at 24 hours interval at 1.10 kg per cm^2 pressure for one hour. The contents of the flasks were thoroughly shaken, after sterilization to prevent clumping. The flasks containing sterilized sorghum grains were aseptically inoculated with *E. turcicum* culture and incubated at 27±1° C for 20 days and the flasks were shaken every alternate day to avoid clumping. Within three weeks, the flask of sorghum grains were covered with black mycelial growth and conidia of the fungus. Such fully colonized sporulated sorghum grain culture was used for creating artificial epiphytotic conditions in the field by following leaf whorl drop method of inoculation.

Creation of artificial epiphytotic condition

To ensure uniform disease infestation, artificial inoculation was done using leaf whorl technique as suggested by Shekhar and Kumar (2012). The infected sorghum grains with pathogen inoculum was ground to fine powder and 1 to 1.5 grams of the ground inoculum was added to each leaf whorl, followed by a light spray of water to create required humidity and initiate infection and the mixture of infected leaves and water was also sprayed to create artificial epiphytotic conditions. Artificial inoculation was made twice at 20th and 30th day after sowing preferably during evening hours to create uniform disease intensity.

Methodology of disease scoring

Disease severity was recorded at dough stage on the basis of percentage of leaf area covered i.e., during 50th day of extra early maturity, 60th day of early maturity, 70th day of medium maturity and 80th of late maturity day by visualizing the leaf area covered by lesions using percentage leaf area covered in each genotype and in each replication.

The scale consisted of five broad categories designated by 0-100 per cent (James, 1971).

Disease severity (%)	Infection type	Reaction
0-10	Very slight to slight infection, one or two to few scattered lesions on lower leaves	Resistant
10.1-25	Light infection, moderate number of lesions on lower leaves only	Moderately resistant
25.1-50	Moderate infection, abundant lesions on lower leaves, few on middle leaves	Moderately susceptible
50.1-75	Heavy infection, lesions abundant on lower and middle leaves, extending to upper leaves	Susceptible
75.1-100	Very heavy infection, lesions abundant on almost all leaves, plants prematurely dry or killed by the disease	Highly susceptible

RESULTS & DISCUSSION

A total of 128 maize inbred lines were screened for TLB, among the 128 evaluated lines along with resistant and susceptible checks on the basis of disease reaction and 0-100% rating scale, the performance of all the maize inbred lines were classified into four groups. The score of 0-10 was considered as resistant, 10.1-25 was moderately resistant, 25.1-50 was moderately susceptible, 50.1-75 was susceptible and 75.1-100 was considered to be highly susceptible. While interpreting the results under artificial created disease epiphytotics, 19 inbred lines were found to be resistant. About 18 inbred lines were observed to be moderately resistant to TLB. Hooda *et al*. (2012) screened a set of 200 maize lines against 10 major diseases. Out of them, 16 lines were found to be resistant against Turcicum leaf blight. In similar way, 118 maize genotypes were screened against TLB in maize at three different locations *viz*., Almora, Nagenahalli and Varanasi and reported 26 resistant, 56 moderately resistant, 26 susceptible and 10 highly susceptible maize genotypes. Among these thirteen lines *viz*., V53, V334, V335, V336, V338, V339, V 341, V 345, V346, V 350, CM 104, CM118 and CM 145 showed high level of resistance Rajesh singh *et al*. (2014). In general, resistant and moderately resistant inbreds were greater in number than susceptible and highly susceptible genotypes. The resistant donor inbred lines / genotypes identified in the present study may be used as the source of resistance in the development of composites and hybrids.

TABLE 1. Classification of maize inbred lines based on disease reaction and rating scale

Disease Reaction	Inbred Lines
Resistant	NAI-127, NAI-137, NAI-161, NAI-165, NAI-180, NAI-192, NAI-194, NAI-195, NAI-218, NAI-219, KUI-1414 A, KUI-142, CM-122, CM-133, POP-61C, DMSC-4, DMSC-14, HKI-PC-7 and HKI-163
Moderately Resistant	NAI-102, NAI-104, NAI-113, NAI-116, NAI-117,NAI-124, NAI-125, NAI-138, NAI-142, NAI-143, NAI-154,NAI-162, NAI-163, NAI-167, NAI-169, NAI-170, NAI-171, NAI-173, NAI-175, NAI-176, NAI-177, NAI-178,NAI-181, NAI-190, NAI-191, NAI-193, NAI-199, NAI-204, NAI-209, NAI-212, NAI-215, NAI-217, NAI-222, NAI-227, NAI-228, MAI-105, CM-114, CM-118, CM-123, CM-132, CM-137, CM-145, NAB-(Y), WINPOP-21, WINPOP-26, WINPOP-45, POP-446, DMSC-8, DMSC-15, DMSC-18, DMSC-19, DMSC-24, DMSC-25 , DMSC-36, HKI-PC-5, HKI-193, HKI-209
Moderately Susceptible	NAI-109, NAI-123, NAI-139, NAI-147, NAI-158, NAI-174, NAI-188, NAI-189, NAI-196, NAI-207, NAI-208, NAI-214, NAI-216, NAI-221, NAI-224, NAI-225,NAI-226, CM-139, CM-142, CML-300, CML-360, CML-363, CML-404, CML-410, CML-413, CML-415,CML-436, CML-480, CML-481, MAI-110, WINPOP-47, DMSC-20, DMSC-28, and HKI-164
Susceptible	NAI-164, NAI-213, MAI-112, CM-131, JCY-2-7, U-139, U-295, U-536 and CML-336
Highly Susceptible	CM-205, NAI-179, V-351, U-298, U-488, CML-134, CML-154, CML-247 and CML-248

TABLE 2: Reaction of station inbred lines against Turcicum leaf blight of maize

Sl. No	GENOTYPES	PDI	REACTION
1	NAI-102	22.50	MR
2	NAI-104	25.00	MR
3	NAI-109	35.00	MS
4	NAI-113	25.00	MR
5	NAI-116	12.50	MR
6	NAI-117	23.00	MR
7	NAI-123	45.00	MS
8	NAI-124	23.00	MR
9	NAI-125	12.50	MR
10	NAI-127	10.00	R
11	NAI-137	10.00	R
12	NAI-138	12.50	MR
13	NAI-139	45.00	MS
14	NAI-142	21.00	MR
15	NAI-143	23.00	MR
16	NAI-147	45.00	MS
17	NAI-154	23.00	MR
18	NAI-158	35.00	MS
19	NAI-161	10.00	R
20	NAI-162	25.00	MR
21	NAI-163	20.00	MR
22	NAI-164	56.00	S
23	NAI-165	9.50	R
24	NAI-167	24.00	MR
25	NAI-169	25.00	MR
26	NAI-170	15.00	MR
27	NAI-171	23.00	MR
28	NAI-173	12.50	MR
29	NAI-174	43.00	MS
30	NAI-175	25.00	MR
31	NAI-176	12.50	MR
32	NAI-177	25.00	MR
33	NAI-178	16.00	MR
34	NAI-179	75.00	HS
35	NAI-180	10.00	R
36	NAI-181	24.00	MR
37	NAI-188	45.00	MS
38	NAI-189	45.00	MS
39	NAI-190	24.00	MR
40	NAI-191	23.00	MR
41	NAI-192	05.00	R
42	NAI-193	12.50	MR
43	NAI-194	10.00	R
44	NAI-195	10.00	R
45	NAI-196	45.00	MS
46	NAI-199	12.50	MR
47	NAI-204	23.00	MR
48	NAI-207	47.00	MS
49	NAI-208	44.00	MS
50	NAI-209	12.50	MR
51	NAI-212	12.50	MR
52	NAI-213	63.00	S
53	NAI-214	27.00	MS
54	NAI-215	18.00	MR
55	NAI-216	47.00	MS
56	NAI-217	12.50	MR
57	NAI-218	07.50	R
58	NAI-219	5.00	R
59	NAI-221	27.00	MS
60	NAI-222	25.00	MR
61	NAI-224	43.00	MS
62	NAI-225	45.00	MS
63	NAI-226	43.00	MS
64	NAI-227	24.00	MR
65	NAI-228	24.00	MR
66	MAI-105	12.50	MR

67	MAI-110	43.00	MS
68	MAI-112	65.00	S
69	KUI-1414A	5.00	R
70	KUI-142	10.00	R
71	CM-114	12.50	MR
72	CM-118	15.00	MR
73	CM-122	10.00	R
74	CM-123	12.50	MR
75	CM-131	65.00	S
76	CM-132	12.50	MR
77	CM-133	5.00	R
78	CM-137	12.50	MR
79	CM-139	43.00	MS
80	CM-142	43.00	MS
81	CM-145	12.50	MR
82	CM-205	81.00	HS
83	NAB-(Y)	12.50	MR
84	WINPOP-21	12.50	MR
85	WINPOP-26	23.00	MR
86	WINPOP-45	25.00	MR
87	WINPOP-47	48.00	MS
88	POP-61C	7.50	R
89	POP-446	12.50	MR
90	DMSC-4	10.00	R
91	DMSC-8	24.00	MR
92	DMSC-14	7.50	R
93	DMSC-15	24.00	MR
94	DMSC-18	24.00	MR
95	DMSC-19	25.00	MR
96	DMSC-20	45.00	MS
97	DMSC-24	12.50	MR
98	DMSC-25	16.00	MR
99	DMSC-28	43.00	MS
100	DMSC-36	25.00	MR
101	JCY-2-7	65.00	S
102	V-351	85.00	HS
103	U-139	62.00	S
104	U-295	57.00	S
105	U-298	89.00	HS
106	U-488	90.00	HS
107	U-536	57.00	S
108	CML-134	79.00	HS
109	CML-154	82.00	HS
110	CML-247	77.00	HS
111	CML-248	79.00	HS
112	CML-300	27.00	MS
113	CML-336	65.00	S
114	CML-360	45.00	MS
115	CML-363	43.00	MS
116	CML-404	45.00	MS
117	CML-410	41.00	MS
118	CML-413	37.50	MS
119	CML-415	42.50	MS
120	CML-436	32.50	MS
121	CML-480	43.00	MS
122	CML-481	26.00	MS
123	HKI-PC-5	23.00	MR
124	HKI-PC-7	8.50	R
125	HKI-163	9.50	R
126	HKI-164	41.00	MS
127	HKI-193	12.50	MR
128	HKI-209	12.50	MR
129	Nithyashree (Resistant check)	4.00	R
130	219 J (Susceptible check)	94.00	HS
S.em ±		4.74	
CD @ 5 %		9.3	
CV %		12.38	

R = Resistant, **S** = Susceptible, **MR** = Moderately resistant, **MS**=Moderately susceptible, **HS** = Highly susceptible
PDI = percentage disease incidence

PLATE 2: Field view of TLB in station inbred lines maize

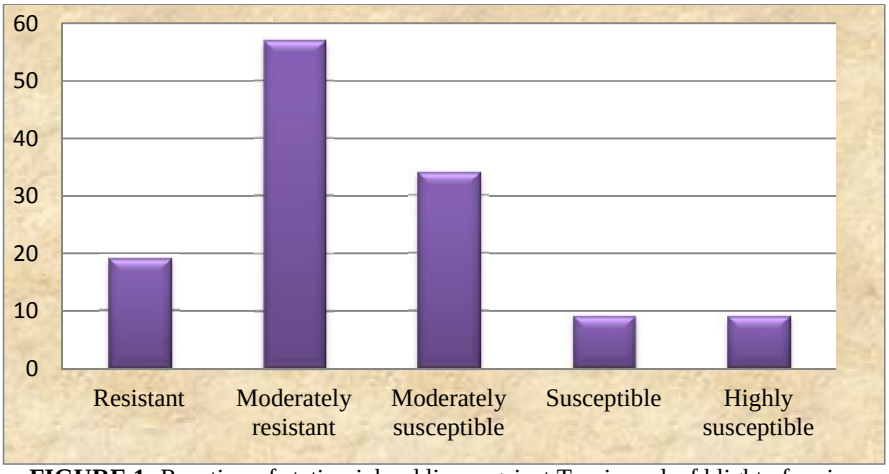

FIGURE 1: Reaction of station inbred lines against Turcicum leaf blight of maize

CONCLUSION

From the above study it can be concluded that, Out of 128 station inbred lines screened against Turcicum leaf blight, 20 genotypes were found to be resistant, 56 genotypes were found moderately resistant, 34 genotypes expressed moderately susceptible reaction, nine genotypes showed susceptible reaction and nine genotypes showed highly susceptible reaction. Thus, the identified resistant sources can be utilized as a source of resistance for breeding resistant hybrids in maize.

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