Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6378

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (2):** 1601-1605 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Evaluation of Maize Germplasm for Resistance to Turcicum Leaf Blight

N. Mallikarjuna[1*], Puttaramanaik[1], N. Kiran Kumar[3], H.R. Raveendra[2] and V.B. Sanath Kumar[3]

[1]AICRP (Maize), [2]AICRP (Millets),

ZARS, V.C. Farm, Mandya – 571405, Karnataka

[3]Department of Plant Pathology, College of Agriculture, V.C. Farm, Mandya – 571405, Karnataka

*Corresponding Author E-mail: malliksmsf@gmail.com

Received: 21.03.2018 | Revised: 25.04.2018 | Accepted: 29.04.2018

ABSTRACT

Among the foliar diseases affecting maize, Turcicum leaf blight (TLB) caused by Exserohilum turcicum is of worldwide importance. In our study, a total of 135 maize genotypes were screened for two years during Kharif season (2014 and 2015) against TLB at Zonal Agricultural Research Station, VC Farm, Mandya. The mean result of two years screening data on disease severity revealed that, out of 135, none of the genotypes showed resistant, 34 genotypes expressed moderately resistant reaction, 73 showed moderately susceptible reaction and 29 genotypes exhibited susceptibility reaction to TLB disease. The checks 219 J (susceptible check) and Nithyashree (resistant check), showed susceptible and resistant reaction to the disease respectively during two years.

Key words: *Maize, Turcicum leaf blight, Exserohilum turcicum, Inbred lines*

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,[6,12,5]. Dr. Norman E. Borlaug believed that maize has the highest yield potential among cereals. In the last two decades there was a revolution in rice and wheat and the next few decades will be known as maize era[1]. Maize ranks first in world production (960 million tonnes) followed by wheat (691 million tonnes) and rice (461 million tonnes). This represents 38 per cent of the total grain production as compared to 30 per cent for wheat and 20 per cent for rice. United States is the largest maize producer followed by Brazil, Ukraine and Argentina. India ranks third in production and contributes to 2.4 per cent of world production with almost 5 per cent share in world harvested area in 2013-14. Karnataka, Andhra Pradesh, Maharashtra, Tamil Nadu, Rajasthan and Uttar Pradesh together contribute 60 per cent of area and 70 per cent of maize production in India[2].

About 61 diseases have been reported in India which affects the maize crop[10]. Based on the research efforts for the last few years under the aegis of All India Coordinated Maize Improvement Project, 16 out of 61 diseases adversely affecting this crop have been identified as major diseases.

Cite this article: Mallikarjuna, N., Puttaramanaik, Kiran Kumar, N., Raveendra, H.R. and Sanath Kumar, V.B., Evaluation of Maize Germplasm for Resistance to Turcicum Leaf Blight, *Int. J. Pure App. Biosci.* **6(2):** 1601-1605 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6378

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. *Helminthosporium turcicum* Pass.) is of worldwide importance. Turcicum leaf blight is one of the most important fungal diseases affecting photosynthesis with severe reduction in grain yield of more than 50 per cent[13,11]. The disease is prevalent in almost all maize growing areas of the state it occurs, wherever moderate temperatures and high humidity prevail[3,16].

Several disease management options have been recommended to reduce the impact of maize foliar diseases including conventional tillage that buries crop residues, crop rotation, fungicide application and planting of resistant hybrids. Among these practices, planting of resistant cultivars can effectively reduce the rate of disease development and is widely recommended[17]. Host plant resistance is considered as most practical, feasible and economical method of plant disease management. Hence, it is most important to carry out screening of parental inbred lines under artificial epiphytotic conditions to identify sources of resistance.

MATERIAL AND METHODS

During *Kharif* 2014 and 2015, a total of 135 maize inbred lines were planted at Zonal Agricultural Research Station, VC Farm, Mandya, in two rows of 4m row length along with one susceptible check 219J and one resistant check Nithyashree with a spacing of 60 x 30 cm and replicated twice. Recommended agronomic practices were followed to establish good crop stand.

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, as mentioned below. 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 dish, 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 potato dextrose agar 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 studies.

Mass multiplication of inoculum

The mass multiplication of the pathogen *E. turcicum* was prepared on sterilized sorghum grain culture[8]. 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 sterilized 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 flasks 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 inoculation technique as suggested by Shekhar and Kumar[15]. The infected sorghum grains

with pathogen inoculum was ground to fine powder and 1 to 1.5 gram 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.

Disease scoring

Disease severity was recorded based on percentage of leaf area covered at dough stage by visualizing the leaf area covered by lesions using 1-9 scale given by Chung *et al*.[4]. Based on disease severity by using 1-9 scale, the genotypes were grouped into four categories, resistant (≤ 3), moderately resistant (3.1 – 5.0), moderately susceptible (5.1 – 7.0) and susceptible (> 7.0).

RESULTS AND DISCUSSION

A total of 135 maize inbred lines along with two standard checks (219 J and Nithyashree) were evaluated for their performance against TLB in *Kharif* seasons of two years (2014 and 2015). Based on mean disease severity of two *Kharif* seasons, among 135 inbreds, none of the genotype showed resistant, 34 genotypes namely, NAI-116, NAI-124, NAI-125, NAI-137, NAI-138, NAI-142, NAI-143, NAI-147, NAI-154, NAI-170, NAI-174, NAI-175, NAI-176, NAI-179, NAI-180, NAI-193, NAI-197, NAI-204, NAI-207, NAI-208, NAI-209, NAI-214, NAI-224, NAI-226, KUI-141, KUI-1411a, CM-114, POP-61, V-351, U-139, CML-247, CML-248, CML-410 and HP-36) expressed moderately resistant reaction, 73 genotypes were found moderately susceptible and 29 genotypes resulted in susceptible reaction (Table 1). The standard checks, 219 J and Nithyashree found susceptible and resistant to TLB during two years respectively. Several maize workers [9,7,14] have studied the partial resistance for TLB and identified inbreds and hybrids which are partially resistant to TLB. Shankara and Gowda[14] screened maize inbreds for TLB resistance and identified 56 moderately resistant genotypes which included NAI-125 and NAI-137, where the same inbreds showed moderately resistant reaction in our studies also. Out of 135 inbreds screened for TLB resistance, 34 were found moderately resistance Out of these inbreds, three lines *viz.*, NAI-113, NAI-152 and NAI-137 were found moderately resistant.

Since, the TLB appears in early stage and causing high yield loss, use of resistant varieties is the only management strategy which is feasible and economical to reduce the yield loss due to TLB. Hence, the inbreds screened for three *Kharif* season and some found consistent and stable performance by the inbreds against TLB resulted in moderately resistant, can be used as breeding material for the development of partial resistant maize cultivar.

Table 1: Rating scale for maize turcicum leaf blight disease

Rating scale	Degree of infection (% Diseased leaf area)	Disease reaction
1.0	Nil to very slight infection (≤10%).	Resistant R) (Score: ≤ 3.0) (PDI: ≤ 33.33)
2.0	Slight infection, a few lesions scattered on two lower leaves (10.1-20%).	
3.0	Light infection, moderate number of lesions scattered on four lower leaves (20.1-30%).	
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%).	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%).	
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%).	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%).	
8.0	Very heavy infection, lesions abundant scattered on lower and middle leaves and spreading up to the flag leaf (70.1-80%).	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%).	

Table 1: Reaction of maize genotypes for Turcicum leaf blight of maize during *Kharif*-2014 & 2015

Grade	Reaction	Germplasm	Number of germplasm
< 3.O	Resistant (R)	Nithyashree (RC)	1
3.1-5.0	Moderately Resistant(MR)	NAI-116, NAI-124, NAI-125, NAI-137, NAI-138, NAI-142, NAI-143, NAI-147, NAI-154, NAI-170, NAI-174, NAI-175, NAI-176, NAI-179, NAI-180, NAI-193, NAI-197, NAI-204, NAI-207, NAI-208, NAI-209, NAI-214, NAI-224, NAI-226, KUI-141, KUI-1411a, CM-114, POP-61, V-351, U-139, CML-247, CML-248, CML-410, HP-36,	34
5.1-7.0	Mod. Susceptible(MS)	NAI-102, NAI-109, NAI-113, NAI-117, NAI-123, NAI-139, NAI-158, NAI-161, NAI-162, NAI-165, NAI-169, NAI-171, NAI-173, NAI-177, NAI-178, NAI-181, NAI-188, NAI-190, NAI-191, NAI-194, NAI-199, NAI-212, NAI-213, NAI-215, NAI-218, NAI-219, NAI-221, NAI-222, NAI-227, NAI-228, MAI-105, MAI-110, CM-118, CM-122, CM-123, CM-131, CM-145, WINPOP-21, WINPOP-26, POP-446, DMSC-8, DMSC-14, DMSC-20, DMSC-24, DMSC-28, DMSC-36, JCY-2-7-1, U-488, U-536, CML-154, CML-336, CML-363, CML-413, CML-436, CML-480, CML-481, HKI-PC-7, HKI-164, HKI-164-7-2, HKI-193-1, HKI-488, HKI-1344, POOL-16, DM-HOC-1, CLQ-PCY, AQO-3134, HP-35,WEP-1, WEP-6, LM-5, SHD-1-ER-6, POBLAC-61, U-295	73
>7.0	Susceptible(S)	NAI-167, NAI-217, NAI-225, CM-137, CM-139, CM-142, CM-205, NAB-(Y)-2, WINPOP-45, WINPOP-47, DMSC-15, DMSC-18, DMSC-19, U-298, CML-134, CML-300, CML-404, HKI-PC-5, HKI-209, HKI-PC-413, HKI-577, HKI-1040-5, HKI-5072, DM-HOC-15, CLQ-RC V-341, DMR-QPM-58, ENT-1219J (SC)	29

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