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Short Communication

Screening of maize inbred lines under artificial epiphytotic conditions for *Turcicum* leaf blight (*Excerohilum turcicum*)

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A study on reaction of ten inbred lines of maize to northern leaf blight mainly caused by *Exserohilum turcicum* (Pass) Leonard and Suggs, was conducted under artificial epiphytotics conditions in green house. Among 10 inbred lines evaluated, three were found moderately resistant viz, NAI-113, NAI-152 and NAI-137, five lines moderately susceptible viz, NAI-123, NAI-142, NAI-143, NAI-147 and NAI-116, and the rest two, W3 and W5 inbreds were severely affected by TLB and rated as susceptible. The lines identified to possess low disease severity score against *Turcicum* leaf blight in the present study could be used successfully in developing genotypes having desirable level of resistance in disease endemic areas to aim for sustainable productivity.

Key words: Maize (*Zea mays* L.), northern leaf blight, inbred lines, screening.

INTRODUCTION

Maize (*Zea mays* L.) is an important staple food crop and provides raw materials for the livestock and many agro-allied industries in the world (Bello et al., 2010; Randjelovic et al., 2011). The area, production and productivity of maize has increased significantly in the last few decades. India registered a growth rate of more than 7% in production and more than 6% in productivity in the last 5 years. Maize production in India is 21.73 million tones with 8.55 million ha with productivity of 2.6 t/ha (DMR, 2012). Due to moderate low temperature and high humidity during the maize growing period, Turcicum leaf blight (TLB) is major diseases for highland maize farmers in the Himalayan region. Maize is one of the most important cereal crop. For many years, it is used as food for human and different animals. Therefore, maize breeders give great and continuous efforts to improve and increase the yielding ability of this crop. Several pathogens are known to cause diseases in maize plants. The diseases of maize caused by fungi are of great economic importance. TLB of maize caused by *Exserohilum turcicum* is an important foliar disease. The disease (TLB) is endemic in all maize growing areas and

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considered as a limiting biotic factor for successful cultivation of maize, which results in significant yield losses in the range of 28 to 91% (Pant et al., 2000; Singh et al., 2004).

TLB caused by *E. turcicum* (Pass.) Leonard and Sugs, is known to infect maize from the seedling stage to maturity. The symptoms first start as small elliptical spots on the leaves as grayish green with water soaked lesions parallel to leaf margins, the spots turn greenish with age and increase in size, finally attaining a spindle shape with long elliptical grayish or tan lesions. If the disease starts at an early stage, it causes premature death of blighted leaves. As a result, the crop loses their nutritive value as fodder (Payak and Renfro, 1968), have reduced germination capacity, vigor, GY and total sugar content (Ferguson AND Carson, 2004), have restricted starch formation, chaffy kernels and infected plants are liable to infection with stalk rots (Henry and Kettelewell, 1996). The fungus has a wide host range and a high pathogenic variability with several races already reported in different parts of the world (Agrios, 2005). The genetics of resistance is determined in most of maize genotypes quantitatively and has been used for control of this disease (Sangit et al., 2011). Resistance was partially dominant and controlled by many genes (Vanderplank, 1963).

Turcicum is a major foliar disease of maize in the Himalayan region, especially Jammu and Kashmir. Production and productivity of maize in hilly areas is low as compared to the other areas of the country. Therefore, this study was undertaken to identify the lines that determine resistance against *E. turcicum* to be used further in breeding programmes.

MATERIALS AND METHODS

The basic materials screened in the present study comprised 10 diverse maize inbred (*Z. mays*) lines. Among 10 inbreds, 8 lines viz. NAI-113, NAI-152, NAI-137, NAI-123, NAI-142, NAI-143, NAI-147 and NAI-116 were selected from the germplasm collection obtained from Zonal Agricultural Research Station V. C. Farm, Mandya, Karnataka and 2 inbreds viz. W_3 and W_5 from SKUAST-Kashmir. The screening work and determination of resistance was done in the division of Plant Breeding and Genetics during Kharif 2010 at SKUAST-Kashmir, Shalimar.

Isolation of pathogen

Turcicum leaf blight pathogen (*E. turcicum*) was isolated from diseased tissue of maize showing typical *turcicum* leaf blight symptoms. The diseased leaves were obtained from 2 different locations of Bandipora and Shalimar. The diseased tissue were cut into small bits and were surface sterilized by 0.1% mercuric chloride ($HgCl_2$) followed by three serial washings in sterilized double distilled water. After drying the diseased tissue bits with the help of sterile filter paper towels, the bits were inoculated on sterilized agar media. The plates were incubated at 24± 2°C for 7 days. Development of colonies was observed every day. The fungal colonies developed were taken into separate PDA slants and incubated again. Colonies showing typical features of *E. turcicum* were maintained on PDA slants.

Pathogenicity

Pathogenicity was proved by following standard Koch's postulates. The fungal colonies showing typical morphological and microscopic characters of fungus *E. turcicum* were inoculated on host grown in plastic pots in the laboratory and were kept in growth chamber for 72 h at optimum relative humidity and temperature. Thereafter, the inoculated plants were shifted in green house and were observed daily for development of symptoms. Plants showing typical symptoms of TLB were used for re-isolation of the pathogen and after re-isolation, the fungus were compared with the earlier ones and those matching were selected for further germplasm screening.

Germplasm screening

Ten genotypes of maize viz, NAI-113, NAI-152, NAI-137, NAI-123, NAI-142, NAI-143, NAI-147, NAI-116, W_3 and W_5 were grown in plastic pots. 3 seeds were sown in each pot and for every genotype, 5 pots were sown. All the agronomic practices were followed.

Preparation of inoculum

Forty millilitres of molten PDA (previously autoclaved at 15 PSI for 20 min in 250 ml flasks) were poured in sterile 90 mm Petri plates and were inoculated with 2 isolates of *E. turcicum* (5 plates were inoculated for each isolate) and separated. The plates were incubated for 5 days at 24±2°C. After 7 days of incubation, the fungal mat was dissolved in sterilized distilled water to make the spore suspension. After thoroughly mixing the fungal colonies with sterile distilled water, the suspension was filtered through muslin cloth. The spore suspension used for inoculation was adjusted at 4 x 10^4 CFU (colony forming units) ml^{-1} with the help of haemocytometer.

Inoculation of pathogen on host

The inoculum of *E. turcicum* was sprayed on maize plants maintained in green house. Three consecutive sprays of inoculum were carried after every 5 days starting from 6 leaf stage. Inoculations were made in the evening by spraying the conidial suspension on the leaves and into the whorl of each plant with the help of hand sprayer. Plants were screened for disease symptoms after silking stage. The percent disease incidence was calculated as per the standard formula n / N x 100, Where, 'n' number of diseased plants, 'N' total number of plants. The intensity was calculated by the formula $\{\sum (nV) / (NG)\} \times 100$, Where, $\sum (n \times v)$ = sum of the score, N = total number of leaves counted and G = highest score. A scale of 0-5 was used to estimate severity following the CIMMYT procedure, that is, 0 for no lesions and 5 for nearly blighted leaves. '0' no symptom, '1' 10% leaf area affected, '2' 11-25% leaf area affected, '3' 26-50% leaf area affected, '4' 51-75% leaf area affected and '5' 76-100% leaf area affected.

RESULTS AND DISCUSSION

Continuous efforts to locate resistant source and utilization in resistant breeding programme are imperative

Table 1. Classification of genotypes based on different reactions to *E. turcicum* (Pass) Leonard and Suggs.

Genotype	Disease Intensity	Reaction	Disease score
NAI-113	12.66	M.R	2
NAI-152	16.88	M.R	2
NAI-137	23.10	M.R	2
NAI-123	27.99	M.S	3
W3	52.22	S	4
W5	55.96	S	4
NAI-142	28.22	M.S	3
NAI-143	29.99	M.S	3
NAI-147	47.77	M.S	3
NAI-116	27.11	M.S	3

M.R = moderately resistant: M.S = moderately susceptible: S = susceptible.

to manage the disease in the long run. The screening trial revealed that none of the tested inbred lines was completely free from *Turcicum* leaf blight infection. However, significant variations in disease severity index for TLB was observed in inbred lines. The present study revealed that out of 10 inbred lines tested, three lines viz, NAI-113, NAI-152 and NAI-137 have disease score of 2 thereby exhibited moderate resistance reaction (MR), five lines viz, NAI-123, NAI-142, NAI-143, NAI-147 and NAI-116, recorded the disease score of 3 and were found moderately susceptible (M.S) to the disease and the rest two W3 inbreds and W5 having disease score of 4 were severely affected by TLB 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). The results are in accordance with Ramdutta et al. (2005) who screened maize inbred lines under glasshouse condition and observed that the lines were resistant to *E. turcicum.* These findings were in agreement with results obtained by Harlapur (2005), Dharanendra (2003) and Chandrashekara et al. (2011a, 2014b) while working with *Turcicum* leaf blight of maize.

Thus, the promising high yielding *Turcicum* leaf blight resistant genotypes identified through this investigation would be helpful for their deployment in breeding program and as donors for different basic and applied research programmes and could be used to develop lines for *Turcicum* disease endemic areas to aim at sustainable productivity.

Conflict of interests

The authors did not declare any conflict of interest.

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