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Evaluation of some elite inbred lines of maize for resistance to turcicum leaf blight in Karnataka, India and their prospect on hybrid development

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Thirty seven elite inbred lines of maize, originating from different countries, were tested for resistance to Turcicum Leaf Blight *(Exserohilum turcicum)* by the standard whorl inoculation method under the field condition during the *kharif* season of 1987, 1988 and 1989 at the National Research Centre for Turcicum Leaf Blight Disease of maize, Nagenahalli. Mysore. Among them 10 inbreds, namely CM 104, CM 118, CM 401, Tzi 24, Tzi 35, Hi 39, MIT 2, H-632-F, TZMI 308 and ICAL 27 were resistant, while 12 inbreds namely CM 105, CM 110, CM 115, CM 119, CM 120, CM 201 Suwan, Pla-2-At-115, TzMi 102, TzMi 103, TzMi 107 and RN 6 were moderately resistant. The remaining inbreds were moderately susceptible to highly susceptible in disease reaction. These inbreds showing resistant reaction may be utilized in the breeding programme for the development of synthetic varieties resistant to *E. turcicum*.

Keywords : Inbred line, Hybrid, *Zea mays*, *Exserohilum turcicum*, Resistant, Susceptible

Turcicum leaf blight of maize (*Zea mays* Linn.) caused by *Exserohilum turcicum* (Pass.) Leonard & Suggs. (= *Helminthosporium turcicum* Pass.) has gained its importance in India during the recent years as it acts as a major constraint of maize production resulting significant loss in grain yield upto 66.0% under the favourable climatic conditions (Payak and Sharma, 1978 ; 1985). The disease appears on this crop in both *Kharif* season (summer/monsoon) and *Rabi* season (winter spring), and it may attack all types of corn.

Among the various approaches of maize diseases in India highest importance

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has been accorded to the exploitation of host resistance. Since 1961, All India Coordinated Maize Improvement Project (AICMIP) has, so far, released about 15 double-cross and three-way or double top cross hybrids on National level for cultivation (Singh, 1987). The National Seed Corporation and other private agencies have also marketed certified seeds of about 6 hybrids. The Southern States of Karnataka and Tamil Nadu exclusively grow hybrids, mostly Ganga 5, Deccan, Deccan 101 and Deccan 103. In Andhra Pradesh the hybrids Deccan, Deccan 101 and Deccan 103 are also popular, while the hybrids Ganga Safed 2 and Hi-starch are popular in Bihar. Hybrid Ganga 5 is also popular in some parts of Assam and West Bengal. But it has been observed that, so far, among the hybrids released for cultivation in India, most turn out to be susceptible to Turcicum leaf blight and other diseases in different parts of the country. For example, virulent strains of *E. turcicum* appeared in 1974 on hybrids Ganga 5, Deccan, Pio x 104 and Pio x 114 resulting a major epidemic in many parts of India (Sharma and Payak, 1981). The main reason for this outbreak is the break up of resistance to *E. turcicum* due to involvement of the susceptible inbred lines as male or female parent in the production of those hybrids. For example, inbred line CM 202 which is highly susceptible to *E. turcicum*, was used as a parent in the production of hybrids Ganga 5 and Deccan (Singh, 1987). So there is an urgent need for the identification of inbred lines resistant to *E. turcicum* and to concentrate on the development of disease resistant hybrids. Keeping these points in view the present study was undertaken.

MATERIALS AND METHODS

A total number of 37 inbred lines of maize (including one check) originating from India, USA, Nizeria and Thailand, were evaluated for resistance to *E. turcicum* during the months from June to September *(kharif* season) of 1987, 1988 and 1989 at the National Research Centre for Turcicum Leaf Blight Disease of Maize, University of Agricultural Sciences, Nagenahalli, Mysore (Karnataka). The seed material was obtained from the Project Coordinator, AICMIP, IARI, New Delhi-12. The inbred lines were planted in a randomised block design in 2 rows plot with 3 replications. Each row was 5 metres long and contained 20 plants. A highly susceptible inbred line CM 202 used as check was raised as border plants to each plot. Normal agronomic practices were followed and no plant protection measure was undertaken.

The standard whorl inoculation method (Joshi *et al.*, 1969) was followed to create uniform disease intensity using a virulent isolate from the same susceptible inbred line CM 202. Inoculum from the stock culture was multiplied on sterilized sorghum grains and was used for field inoculation. The inoculum was

placed into the whorl of the testing plants at weekly interval for 3 weeks begining when they were about 45 cm high.

The data on the disease incidence were recorded about 21 days after silking on individual plant basis following the 1 (very slight infection) to 5 (very heavy infection) scale developed by Ullstrup *et al.* (1945) and modified by Herd (1956). After calculating the average disease index per plant the type of disease reaction in an inbred line was determined as follows.

Average disease index	Intensity of infection	Reaction
1.0 to 1 5	*Very slight to slight infection*, one or two to few scattered lesions on lower leaves	Resistant
1.6 to 2.5	*Light infection*, moderate number of lesions on lower leaves only	Moderately resistant
2.6 to 3.5	*Moderate infection*, lesions abundant on lower leaves, few on upper leaves	Moderately susceptible
3.6 to 4.5	*Heavy infection*, lesions abundant on lower and middle leaves, extending to upper leaves	Susceptible
4.6 to 5.0	*Very heavy infection*, lesions abundant on almost all leaves, plants prematurely dry or killed	Highly susceptible

The individual inbred, however, did not exhibit any variation in respect of disease reaction from one year to another. Hence the disease reaction is presented here after taking the average of 3 years data.

RESULTS AND DISCUSSION

Superiority of a hybrid in respect of resistance to diseases completely depends upon the type of the inbred lines involved in the development of that particular hybrid. The first step then in the development of a new disease resistant hybrid is to develop the superior inbred lines having good combining ability and resistance to that particular disease. The results on the reaction of different inbred lines of maize to *E. turcicum* (Table 1) in the present study show that out of 37 inbred lines tested 10 inbreds, namely CM 104, CM 118, CM 401, Tzi 24, Tzi 35, Hi 39, MIT 2, H-632-F, TzMI 308 and ICAL 27 were resistant, while 12 inbreds namely CM 105, CM 110, CM 115, CM 119, CM 120, CM 201, Suwan, Pla-2-At-115, TzMi 102, TzMi 103, TzMi 107 and RN 6 were moderately resistant. Among the remaining inbred lines, 7 inbreds, namely CM 111, CM 114,

Table 1. Reaction of maize inbred lines to *E. turcicum*

Inbred line	Source	Reaction
CM 104, CM 118, CM 401	CMIP (India)	Resistant
CM 105, CM 110, CM 115, CM 119 CM 120, CM 201, RN 6	CMIP (India)	Moderately resistant
CM 111, CM 114, CM 300, CM 500	CMIP (India)	Moderately susceptible
CM 206, CM 400	CMIP (India)	Susceptible
CM 202 (check), CM 600	CMIP (India)	Highly susceptible
Hi 39, MIT 2, H-632-F, TzMi 308, ICAL	USA	Resistant
Pla-2-At-115, TzMi 102, TzMi 103, TzMi 107	USA	Moderately resistant
TzMi 101	USA	Moderately susceptible
Tzi 24, Tzi 35	Nizeria	Resistant
Tzi 9, Tzi 28	Nizeria	Moderately susceptible
Tzi 12, Tzi 13, Tzi 25, Tzi 27	Nizeria	Susceptible
Suwan	Thailand	Moderately resistant

CMIP - Coordinated Maize Improvement Project

CM 300, CM 500, Tzi 9, Tzi 28 and TzMi 101 were moderately susceptible and 6 inbreds namely CM 206, CM 400, Tzi 12, Tzi 13, Tzi 25 and Tzi 27 were susceptible, while 2 inbreds CM 202 (check) and CM 600 were highly susceptible in disease reaction. Importance of inbred lines of maize as sources of resistance to diseases have been reported by many workers. Ullstrup (1950), Jugenheimer (1958) and Zuber *et. al.* (1972) from USA recorded leaf blight resistance in a large number of inbred lines of maize. Payak and Sharma (1979) from India also recorded resistance to Turcicum leaf blight in some inbred lines of maize such as CM 103, CM 104, CM 105, CM 106, CM 113, Eto 28, PhDMR 1, PhDMR 5 and CuZco obtained from different sources of India, Philippines and Thailand. Against maydis leaf blight (*Drechslera maydis*) also the sources of resistance were recorded by them in the inbreds CM 103, CM 104, CM 105, CM 111, CM 113, CM 201, Eto 28A, Eto 81, Eto 128C, PhDMRS and CuZco. Sources of resistance to Turcicum leaf blight were also recorded to be common in some of the inbred lines such as CM 104, CM 105, CM 115, CM 120 and RN 6 under West Bengal condition. Using these inbreds

as parents in different cross combinations with the following inbreds CM 202, CM 300 and CM 500 possessing various degree of susceptibility the resultant F_1 hybrids were always resistant (Kaiser, 1988). Singh and Sharma (1976) also reported resistance to banded leaf and sheath blight (*Rhizoctonia solani*) of maize in the inbreds CM 103, CM 105, CM 300 and CM 600. Therefore from the results of the present study as well as from the evidences produced here it may be concluded that in addition to the different inbred materials from India some other inbreds from USA, Nizeria and Thailand may also provide for additional sources of resistance to *E. turcicum*.

From the pedigree list of some of the maize hybrids (Deccan, Deccan 101, Ganga Safed 2, Ganga 3, Ganga 4, Ganga 5, Ganga 9, Hi-Starch, Him 123 and Ranjit) released in India (Table 2) it appears that one or more of the following inbreds viz. CM 111, CM 114, CM 202, CM 206, CM 300,

Table 2. Pedigree of some maize hybrids developed in India (Singh, 1987) showing the involvement of susceptible inbred lines

Hybrid	Pedigree
Deccan	(CM 104 x CM 105) x (CM 202 x CM 201)
Deccan 101	(CM 202 x CM 206) x (CM 115 x CM 114)
Ganga Safed 2	(CM 400 x CM 300) x (CM 600)
Ganga 3	(CM 109 x CM 110) x (CM 202 x CM 111)
Ganga 4	(CM 400 x CM 300) x (CM 602)
Ganga 5	(CM 202 x CM 111) x (CM 500)
Ganga 9	(CM 202 x CM 117) x (CM 116 x CM 207)
Hi-starch	(CM 400 x CM 300) x (CM 601)
Him 123	(CM 202 x CM 205) x (CM 113 x CM 112)

'—' denotes susceptibility to *E. turcicum*

CM 400 and CM 500 susceptible to *E. turcicum*, were involved in their development. Therefore the possibility of break up of resistance of the above hybrids to *E. turcicum* cannot be ignored. As already indicated that the involvement of a highly susceptible inbred line CM 202 in the production of the hybrids Ganga 5 and Deccan resulted a severe outbreak of *E. turcicum* in many parts of India in 1974 (Sharma and Payak, 1981). Therefore further improvement of these hybrids by incorporating resistance to *E. turcicum* seems to be highly justified. This may be accomplished by the effective utilization of the inbred lines resistant to *E. turcicum*.

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