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Disease reaction studies of maize (*Zea mays* L.) inbred lines and single cross hybrids under artificial epiphytotic conditions against turcicum leaf blight

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Abstract
The study was carried out at college of agriculture, Dharwad during *kharif* 2018, with the objective of identifying resistant sources of maize for turcicum leaf blight caused by *Exserohilum turcicum.* In this context 16 NBPGR lines were selected based on the *per se* peformance and 48 experimental single cross hybrids were developed using three testers in line x tester mating design. These hybrids were evaluated for disease reaction along with parents and checks (DKC-9144, GH-0727 and NK-6240). Artificial inoculation was done in whorl using grounded TLB mass multiplied sorghum seeds and scoring was done using 1-9 scale during silk drying stage. Among 70 genotypes, the tester CI-4 showed resistant reaction. The line NBPGR-9 and the hybrids GPBMH-1819, GPBMH-1820, GPBMH-1821, GPBMH-1824 and GPBMH-1839 showed moderately resistant reaction. This information can be useful for selection of parents or development of resistant hybrids or utilize them as resistant sources in breeding programme.

Keywords: Maize, Single cross hybrids, resistant, artificial inocultion, turcicum leaf blight

Introduction

Maize (*Zea mays* L.) is an important cereal crop ranked third after wheat and rice across the world. It has originated in southern mexico belonging to the tribe Maydeae of family poaceae and evolved from Teosinte (*Zea mexicana* L.) a wild relative of modern corn. Maize occupies a unique place of 'Queen of cereal' as it is physiologically more efficient and has higher yield potential compared to other poaceae family members. Being C_4 plant, it is versatile photo insenitive crop with greater variability adopt to diverse enviromental conditions covering tropical, subtropical and temperate agro-climatic regions. Besides being used as human food and animal feed maize has got industrial preference as it is used for extraction of starch, maltose syrup, glucose, corn ethanol, oil etc., Despite of this global importance the crop is affected by many biotic stresses such as pest and diseases attack. Among the diseases affecting maize, turcicum leaf blight (TLB) also called Nothern corn leaf blight caused by the fungus *Exserohilum turcicum* (Pass) Leonard and Suggs., is the most important foliar disease causing moderate to severe losses in yield. The disease takes heavy toll during *kharif* season when conditions of high relative humidity coupled with low night temperature. The disease is more prevalant in Andhra Pradesh, Karnataka, Bihar, Himachal pradesh and Maharastra. TLB is endemic in all the maize growing areas of Karnataka with great yield loss of 28 to 91 per cent (Kachapur and Hegade, 1988 [1]; Harlapur *et al.,* 2000) [2]. In Karnataka state, Arabhavi, Sankeshwar, Devihosur, Dharwad and Nagenahalli were identified as 'hot spots' for TLB. The diseased plants are photosynthetically affected and yield small sized, curved, partially filled malformed cobs with irregular kernel rows and shrivelled grains and ultimately reduce the grain yield (Harlapur *et al.,* 2008) [3]. TLB can be managed by foliar applications of many fungicides but growing of resistant cultivars is a most eco-friendly and cost effective approach. Host plant resistant is an appropriate, practical and economically feasible disease management practice. So, while breeding for disease resistance selection of resistant sources is important pre requisite. With this aim, the study was conducted to identify resistant sources of maize for turcicum leaf blight.

Materials and Methods

In the context of identfying the resistant sources of turcicum leaf blight disease, 16 elite inbreds of NBPGR were selected based on *per se* performance and these lines were crossed with three testers (CM-501, KDMI-16 and CI-4) in line x tester mating design during *rabi*

2017-18. The 48 experimental single cross hybrids were screened against the disease during *kharif* 2018 along with parents and checks (DKC-9144, GH-0727 and NK-6240) under artificial disease epiphytotic conditions.

Mass multiplication and application of inoculum

The mass multiplication of *Exserohilum turcicum* was prepared on sterilized sorghum grains (Joshi *et al.*, 1969) [4]. One hundred grams of sorghum grains were soaked in tap water for 24 hr in 500 ml conical flask. The excess water was drained off and the material was sterilized twice at 24 hr interval. To prevent the clumping of the material the flasks were shaken thoroughly. The flasks were inoculated with *E. turcicum* culture in aseptic conditions and incubated at 25 ± 1 ^{0}C for 20 days. To avoid the clumping every alternate day the flasks were shaken. With in three weeks, the blackish brown mycelial growth and conidia of the fungus was observed on the sorghum grains. Fully colonized sorghum grain culture was grounded and used for creating artificial epiphytotic conditions in the field following whorl method of inoculation. The inoculation of mass multiplied culture was done at 35 and 55 DAS and light irrigation was given to create the humid conditions to facilitate the growth of the pathogen.

Recording of observations

The intensity of turcicum leaf blight was recorded by scoring all randomly selected ten plants in each treatment at silk drying stage as per the 1-9 disease rating scale (Annual progress report, *Kharif* maize, 2016, AICRP on maize). Disease rating scale for TLB (1-9) given in Table.1.

Table 1: Disease rating scale for TLB (1-9)

Rating scale	Degree of infection	Disease reaction
1	Nil to very slight infection (≤10%)	Resistant (Score: ≤ 3.0)
2	Slight infection, a few lesions scattered on two lower leaves (10.1-20%)	
3	Light infection, moderate number of lesions scattered on four lower leaves (20.1-30%)	
4	Light infection, moderate number of lesions scattered on lower leaves, a few lesion scattered on middle leaves below the cob (30.1-40%)	Moderately resistant (Score: 3.1-5.0)
5	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	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%)	Moderately susceptible (Score: 5.1-7.0)
7	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	Very heavy infection, lesions abundant scattered on lower and middle leaves and spreading up to the flag leaf (70.1-80%)	Susceptible (Score: >7.0)
9	Very heavy infection, lesions abundant scattered on almost all the leaves, plant prematurely dried and killed (>80%)	

Results and Discussions

Host plant resistance is considered as the most practical and cost effective approach of plant disease management. Hence, it is most important to carry out screening of parental lines and hybrids under artificial disease epiphytotic conditions to identify best tolerant maize genotypes. Continuous efforts to locate resistant sources and utilization in resistance breeding programme are imparative to manage the disease in long run. Field screeing studies indicated that there was clear cut differential disease response of inbred lines to turcicum leaf blight due to good infection. The genotypes which scored ≤ 3.0 and 3.1-5.0 were considered as resistant and moderately resistant respectively. They remained green and look healthier till maturity, while susceptible lines (> 7.0 score) were produced small sized, curved and partially filled malformed cobs.

The screening trail has revealed that out of 48 experimental single cross hybrids only five showed moderately resistant reaction, 27 showed moderately susceptible reaction and 16 were susceptible for the disease. Among 16 lines, only one line NBPGR-9 exhibited moderately resistant reaction, seven showed moderately susceptible reaction and eight were susceptible for TLB. Among the testers, CI-4 was resistant, KDMI-16 showed moderately susceptible reaction and CM-501 was susceptible for the disease. Of the three checks, NK-6240 was moderately resistant, while DKC-9144 was moderately susceptible and GH-0727 was susceptible to the disease (Table. 2). These findings were in agreement with the results of Dharanendra (2003) [6], Harlapur (2005) [7] and Panda *et al.* (2017) [8]. These lines and hybrids hold excellent potential to use in breeding programmes as resistant sources against *Exserohilum turcicum*. Hence, these can be used for developing resistant hybrids and synthetics in future programme of breeding for disease resistance. However, reconfirmation of resistance is required. Further development of resistant single cross hybrids using potential sources would ultimately increases the productiviy of the crop by reducing the cost of cultivation.

Table 2: Reaction of maize parental lines, experimental single cross hybrids and checks against turcicum leaf blight disease under artificial epiphytotic conditions

Disease rating	Disease reaction	Number of parental lines and checks	Parental lines and checks
≤ 3.0	Resistant	1	CI-4
3.1-5.0	Moderately resistant	2	NBPGR-9, NK6240
5.1-7.0	Moderately susceptible	9	NBPGR-1, NBPGR-6, NBPGR-7, NBPGR-10, NBPGR-15, NBPGR-17, NBPGR-18, KDMI-16, DKC 9144
>7.0	Susceptible	10	NBPGR-2, NBPGR-4, NBPGR-8, NBPGR-11, NBPGR-12, NBPGR-13, NBPGR-14, NBPGR-16, CM-501, GH-0727

Disease rating	Disease reaction	Number of Crosses	Crosses
≤ 3.0	Resistant	-	-
3.1-5.0	Moderately resistant	5	GPBMH-1819, GPBMH-1820, GPBMH-1821, GPBMH-1824, GPBMH-1839
5.1-7.0	Moderately susceptible	27	GPBMH-1802, GPBMH-1803, GPBMH-1807, GPBMH-1809, GPBMH-1810, GPBMH-1811, GPBMH-1812, GPBMH-1813, GPBMH-1814, GPBMH-1815, GPBMH-1816, GPBMH-1817, GPBMH-1818, GPBMH-1822, GPBMH-1823, GPBMH-1825, GPBMH-1826, GPBMH-1830, GPBMH-1833, GPBMH-1836, GPBMH-1837, GPBMH-1838, GPBMH-1840, GPBMH-1841, GPBMH-1842, GPBMH-1843, GPBMH-1846
>7.0	Susceptible	16	GPBMH-1801, GPBMH-1804, GPBMH-1805, GPBMH-1806, GPBMH-1808 GPBMH-1827, GPBMH-1828, GPBMH-1829, GPBMH-1831, GPBMH-1832, GPBMH-1834, GPBMH-1835, GPBMH-1844, GPBMH-1845, GPBMH-1847, GPBMH-1848

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