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Genetic Analysis of Banded Leaf and Sheath Blight Resistance (*Rhizoctonia solani*) In Maize

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Line × tester analysis involving 12 inbred lines and 5 inbred testers were carried to study the genetics of resistance to banded leaf and sheath blight in maize incited by *Rhizoctonia solani* in Kharif 2010 at B.A.U. research farm. Out of seventeen inbreds including five testers, three lines were resistant, twelve lines were moderately resistant and two lines were moderately susceptible. Both additive and dominance components were important in the inheritance of this disease with the predominant role of additive gene action. The inbreds, BAUIM-3, BQPM-2 and BQPM-4 were good general combiners for disease resistance as well as yield. Among the testers, BAUIM-2 was found to be the best general combiner for disease resistance as well as yield. The estimate of specific combining ability effect revealed that the cross combinations, BAU1M-3× CM-150, BAU1M-1×BAU1M-2, BAU1M-4×HKI 193-1, BAU1M-4×HKI163, V341× CM150, BQPM-2× BAU1M-2 and CML161× HKI 193-1 were identified as best cross combinations in respect of disease resistance as well as yield

Keyword: Banded Leaf and Sheath Blight, Combining Ability, Line X Tester, *Rhizoctonia solani*

1. Introduction

Maize plant is affected by as many as 61 diseases, out of which 16 have been identified a major ones which occur both in tropical and temperate regions of India (Sharma and Payak, 1986). Among these, banded leaf and sheath blight (BLSB) incited by *Rhizoctonia solani* is gaining economic importance. Grain yield loss, depending on severity varies between 11 to 40 per cent (Singh and Sharma, 1976). Lal et al. (1985) reported that the losses in grain yield may vary to the extent of over 90.0 per cent. Now BLSB is considered to be one of the most serious problem threatening cultivation of maize in India. It appears on plants before flowering, which is highly favoured by warm humid weather, and it causes severe damages to leaves, leaf sheaths as well as cobs (Fig. 1). For an economic and effective control of this disease, development of resistant genotypes is of primary importance. Hence, the present investigation was carried out to study the inheritance of resistance of this disease.

2. Materials and Methods:

The genetics of resistance in banded leaf and sheath blight disease of maize was studied in 80 genotypes in Kharif 2010 using line x tester (L × T) method. The basic material for the present study comprised twelve inbred lines of diverse, vigorous and productive nature and five well adapted testers of varying genetic base. These were crossed in line x tester mating design to generate 60 hybrids. These 60 hybrids and seventeen parental lines with three standard checks viz., HQPM-1, Vivek Hybrid-9 and Suwan were sown in a randomized block design in three replications. Each entry was sown in two rows having 60 cm × 20 cm crop geometry. The plot size was single row of 3m length.

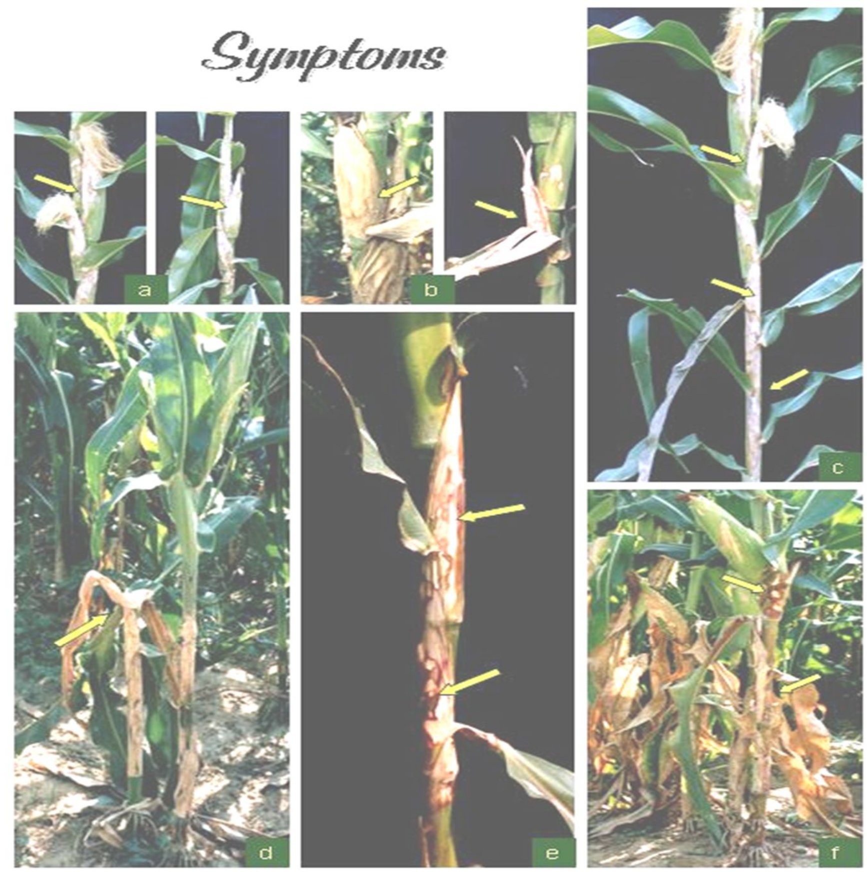

Fig. 1. Banded Leaf and Sheath Blight on maize caused by *Rhizoctonia solani* f. sp. *sasakii*
a & b- Ear infection and ear rot; c- Infection full plant; d- Toppling of plant;
e & f - Infection with discolouration on stem and sheath

For artificial inoculation, original cultures of the organisms were isolated by collecting leaf lesions and placing in moist chamber. Four to five days later, newly formed spores on the surface of the lesions were picked up with a fine flattened needle under a microscope, placed in a droplet of sterile water and streaked across the surface of hardened, acidified water agar in Petri plates. They were cut out of the agar and transferred to hard acidified potato dextrose agar and incubated for one week at 24°C. The inoculum was increased on whole sorghum grains following the method of Lim (1975 B). The inoculation was made by placing 10-20 grains into the individual leaf whorls at 7 to 9 leaf stage, in evening.

A second inoculation was made two weeks later. Required humidity was maintained by frequent watering. Observations in respect of disease intensity were recorded on the basis of five randomly selected plants from each plot in each replication. Disease severity was recorded in thirty days after inoculation using 1-5 scale where, 1 indicates no disease and 5 indicates maximum disease incidence given by Ahuja and Payak (1983) and Vimla and Mukherjee (1987).

Combining ability analysis was carried as per procedure given by Kempthorne (1957).

Table 1. ***Per se*** **performance of Disease scoring against Banded leaf and sheath blight and Grain yield**

Parents	Disease score	Disease reaction	Grain yield(q/ha)
BAUIM-3	1.13	R	34.26
CM111	2.33	MR	35.09
CM151	2.26	MR	31.23
CM152	2.13	MR	36.35
BAU1M-1	2.24	MR	36.44
BAU1M-4	2.47	MR	37.54
V341	3.30	MS	31.95
1025	2.47	MR	31.49
BQPM-2	1.18	R	36.99
BQPM-4	2.22	MR	30.73
CML161	2.26	MR	34.10
V351	2.23	MR	26.85
CM-150 (T1)	2.17	MR	28.89
BAU1M-2 (T2)	1.26	R	39.61
K1105 (T3)	3.10	MS	29.18
HKI 193-1 (T4)	2.38	MR	39.91
HKI-163 (T5)	2.33	MR	39.32
Mean	2.20		28.76
Checks			
HQPM-1	2.40	MR	41.97
Vivek Hybrid-9	2.53	MR	48.77
Suwan	2.58	MR	44.59
Mean	2.50		45.11
CD at 5%	0.14		5.85

3. Results and Discussion

The variances due to GCA as well as SCA were highly significant for disease severity. The ratio of GCA and SCA variance indicated the importance of both additive and non-additive types of gene actions involved in the inheritance of this character with the predominant role of additive gene action. The results were supported by Bhavana and Gadag (2009) and Vivek *et al.* (2010).

The disease reaction of inbreds to banded leaf and sheath blight and grain yield is presented in Table 1. The parental mean value for disease scoring ranged from 1.13 (BAUIM-3, resistant) to 3.30 (V 341, moderately susceptible) with an overall parental mean value of 2.20 (moderately resistant). Three parents (BAUIM-3, BQPM-2 and BAUIM-2) were found to be significantly resistant to the check HQPM-1. The parental mean value for grain yield ranged from 26.85 q/ha (V 351) to 39.91 q/ha (HKI 193-1). The parents, BAUIM-3, BQPM-2 and BAUIM-2 were good yielders with less disease infestation.

The estimates of gca effect (Table 2) indicated that the inbred lines BAUIM-3, BQPM-2 and BQPM-4 were good general combiners for disease resistance as well as yield. Among the testers, BAUIM-2 was found to be the best general combiner for disease resistance as well as yield.

The estimate of specific combining ability effect (Table 3) revealed that the cross combinations BAU1M-3 × CM-150, BAU1M-1 × BAU1M-2, BAU1M-4 × HKI 193-1, BAU1M-4 × HKI-163, V341 × CM150, BQPM-2 × BAU1M-2 and CML161 × HKI 193-1 were identified as best cross combinations in respect of disease resistance as well as yield. The F_1 progeny of the two crosses (BAU1M-3 × CM-150 and BAU1M-1 × BAU1M-2) involving the resistant parent and moderately resistant parent were resistant indicating dominance of resistance, the other cross (BQPM-2 × BAU1M-2) where both the parents were resistant showed resistant F_1 while others were moderately resistant (Table 4). Thus these hybrids may be utilized further for commercial cultivation to develop resistant and high yielding varieties and the identified inbreds may be further exploited in hybrid breeding programme towards development of resistant lines in maize.

Table 2. Estimates of general combining ability (gca) effects for Disease (BLSB) and Grain yield

Parents	Disease (BLSB)	Grain yield
BAUIM-3	-0.22**	2.48 **
CM111	0.10**	-8.45 **
CM151	-0.02	-3.04 **
CM152	-0.02	-1.20
BAU1M-1	0.01	-1.20
BAU1M-4	0.01	-9.84 **
V341	0.18 **	5.38 **
1025	0.06**	6.08 **
BQPM-2	-0.08**	7.99 **
BQPM-4	-0.08**	3.80 **
CML161	-0.02	1.49*
V351	-0.02	1.49*
CM-150 (T1)	-0.01	0.26
BAU1M-2 (T2)	-0.03*	2.10 **
K1105 (T3)	0.02*	-1.14**
HKI 193-1 (T4)	0.01	-0.40
HK-163 (T5)	-0.01	-0.82
CD at 5% (Lines)	0.05	1.31
CD at 5% (Testers)	0.03	0.85

***, ** Significant at p = 0.05 and P = 0.01 levels, respectively**

Table 3. Estimates of specific combining ability (sca) effects of promising hybrids for Disease (BLSB) and Grain yield

Crosses	Disease (BLSB)	Yield
BAU1M-3 × CM-150	-0.19**	6.15**
BAU1M-1 × BAU1M-2	-0.09**	7.89**
BAU1M-4 × HKI 193-1	-0.13**	6.39**
BAU1M-4 × HKI-163	-0.09**	13.26**

V341 × CM150	-0.10**	7.35**
BQPM-2 × BAU1M-2	-0.09**	6.31**
CML161 × HKI 193-1	-0.10**	6.90**

***, ** Significant at p = 0.05 and P = 0.01 levels, respectively**

Table 4. Disease reactions of Inbred combinations and their crosses

Crosses	Disease reaction of Inbred combinations	Disease reaction of Crosses
BAU1M-3 × CM-150	R x MR	R
BAU1M-1 × BAU1M-2	MR x R	R
BAU1M-4 × HKI 193-1	MR x MR	MR
BAU1M-4 × HKI-163	MR x MR	MR
V341 × CM150	MS x MR	MR
BQPM-2 × BAU1M-2	R x R	R
CML161 × HKI 193-1	MR x MR	MR

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