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VARIABILITY FOR LEAF BLIGHT RESISTANCE IN INDIAN SPRING WHEAT (*TRITICUM AESTIVUM*) GERMPLASM

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ABSTRACT
The present investigation on wheat was conducted during the Rabi season 2008-09 with the objective to study variability for leaf blight resistance and to find out the distribution of resistance across various plant height, test weight and days to maturity groups. Seeds of 147 diverse bread wheat (*Triticum aestivum*) genotypes were sown by following the Lattice Design (7× 7) and in two rows of two meter length of each genotype. The field was highly fertilized and frequently irrigated to provide a congenial environment for the development of the leaf blight disease. Observations based on 0-9 scale were shown that a wide variability was observed for resistance to leaf blight in the wheat lines screened in one year of testing based on maximum leaf score.AUDPC value varies from the 92.6 to 123.5 across the resistant lines. Line K0810 shows least value, while PBW 640 shows highest value among the resistant lines. Most of the wheat lines showed moderately susceptible reaction. But, differential reactions was also observed in some lines, thus the differential reaction of leaf blight severity in some of the genotypes supported the idea of independent gene control.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the world's major cereal crops and staple food of many regions, grown under both irrigated and rain-fed conditions. It belongs to family Poaceae or Graminae (Yadawad *et al.*, 2015). Wheat contains more protein than other cereal and has a relatively high content of niacin and thiamine. It is basically concerned in providing the characteristics substance "Glutin" which is very essential for bakers (Kumar *et al.*, 2013). The importance of wheat as a staple food of South Asia is well known. Its enhanced productivity in the post Green Revolution period played a key role in ensuring food security in this thickly populated part of the world, which mainly comprises of India, Pakistan, Nepal and Bangladesh (Evenson *et al.*, 1999; Joshi *et al.*, 2007).

The three species of wheat namely *Triticum aestivum* (bread wheat), *T. durum* (Macaroni wheat), and *T. dicoccum* (Emmer wheat) grown on commercial basis in the Indian subcontinent from prehistoric times are of spring type. Successful production of bread wheat (*Triticum aestivum* L.) in the warmer regions of South Asia is constrained by several biotic and abiotic stresses (Chaurasia *et al.*, 1999). The most important disease is foliar blight, also referred to as Helminthosporium leaf blight (HLB). It occurs as a complex of spot blotch, caused by *Cochliobolus sativus* (anamorph *Bipolaris sorokiniana*) and tan spot caused by *Pyrenophora tritici-repentis* (anamorph, *Drechslera tritici-repentis*). Globally, an estimated 25 million ha of wheat land is affected by spot blotch. Of these, around 10 million ha are in the Indian Subcontinent, including 9 million ha in India alone, mostly in the rice-wheat cropping system (Joshi *et al.*, 2007).

For the past several years, HLB severity on wheat has been high in the entire eastern plain zone of the Indian Subcontinent, where millions of resource-poor people rely on wheat. In South Asia, yield losses due to HLB have been reported to reach up to 20 to 30% in farmers' fields and experiment station. In years when rain occurs late in the crop cycle, especially during grain filling, complete crop loss has been observed (Sharma *et al.*, 2004). Leaf blight present the wheat areas of eastern India was considered to be a complex caused by *Alternaria triticina* and *Bipolaris sorokiniana*. Occasionally, two or more species of *Bipolaris* and *Alternaria* were also reported to be associated with the disease (Prabhu and Prasad, 1966). However recently it has been proved that *B. sorokiniana* is the actual pathogen causing leaf blight in NEPZ (North east plain zone) of India (Joshi and Chand 2002). There are reports suggesting availability of resistant genetic stocks (Joshi *et al.*, 2002; Sharma *et al.*, 2004), further investigation is needed to explore the variability in Indian germplasm. The present investigation was initiated to find out association of leaf blight severity with plant height, days to maturity and 1000 grain weight.

MATERIALS AND METHODS

The present investigation was conducted during Rabi season of 2008-2009 at the agricultural research farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. This farm is situated about 52.2°N latitude and 83°E longitude. Experimental materials consisted of 147 diverse and elite lines of All India Coordinated Wheat Improvement Project. Seed of each of the 147 lines were sown in field according to Lattice Design (7×7). Each genotype was sown in six rows of three meter length with row to row and plant to plant space being 25 cm and 5 cm, respectively. Recommended management practices adopted to raise a good crop. The field was highly fertile and frequently irrigated to provide congenial environment for the development of leaf blight.

Experimental trial was conducted under natural conditions. Observations are recorded on the various morphological and yield traits *viz.*, Plant height (cm), spike length (cm), days to maturity, flag leaf angle, days to 75 % spike emergence, number of grains / spikes, 1000 seed weight / Test weight (g) etc. Disease scores were visually scored for each plot at 10 days interval with the (0-9) scale developed as a modification of Sarri and Prescott's severity scale to assess wheat foliar disease (Sarri and Prescott, 1975). The first digit (D_1) indicates the disease progress in height, and second digit (D_2) refers to severity measured as the diseased leaf area. Three individual scores were recorded over a period of 20 days. For each score, percentage disease severity was estimated. AUDPC was calculated using percent severity of the disease.

Statistical analysis

Area under disease progress curve (AUDPC) was calculated by using computer software obtained from CIMMYT, Mexico that uses following formula:

$$AUDPC = \sum_{i-1}^{a} [\{(Yi + Yi\text{-}1)/2\} \times (ti\text{-}1 - ti)]$$

Where

Y = Disease level at a certain time

(ti + 1 - ti) = Time (days) between two disease scores.

Percent severity was calculated with the help of following formula

$$\% \text{ Severity} = \frac{D_1}{9} \times \frac{D_2}{9} \times 100$$

Where

D_1 = the first digit of score given in 0-9 scale

D_2 = the second digit of score given in 0-9 scale

The means of all observations were calculated and frequency distribution was done based on frequency (percent) of different types of genotypes in the population.

RESULTS AND DISCUSSION

Observation on leaf blight severity was recorded on 147 diverse lines of wheat (*Triticum aestivum*) to determine the variability for leaf blight resistance. Based on over all leaf score of 0-9 scale, 13 lines were found to be resistant. Out of total 147 lines, 34 were moderately resistant. Highest numbers of lines were found moderately susceptible that comprises 60 lines. In susceptibility group there were 40 lines (Table 1).

The frequency distribution for leaf blight severity and days to maturity duration of germplasm lines has been presented in table 2. It was observed that the resistant lines as well susceptible lines belong to early, medium and late maturity groups. The resistant lines are distributed equally among all maturity groups. The observations showed that out of 76 early maturing lines 4 were resistant, 10 moderately resistant, 28 moderately susceptible and 34 were susceptible. In the medium maturity group, out of 46 genotypes, 5 lines were resistant, 16 lines moderately resistant and 20 lines were moderately susceptible and 5 lines were susceptible; out of 25 late maturity lines, 4 lines were resistant, 8 lines were moderately resistant, 12 lines were moderately susceptible, while 1 line was susceptible.

The frequency distribution for disease severity (over-all score) and plant height has been presented in table 3.Susceptible as well as resistant and moderately resistant lines belong to single dwarf, double dwarf and triple dwarf and do not belong to tall group. The proportion of resistant lines was almost equal in single, double and triple dwarf category. All 3 tall lines are moderately resistant.Among the 28 single dwarf lines 4 line showed resistance, 9 lines moderate resistance, 13 lines are moderate susceptible and 2 lines showed susceptibility. Among the 43 double dwarf genotypes 5 lines showed resistance, 17 lines moderate resistance, 18 lines are moderate susceptible and 13 lines showed susceptibility. Whereas, in case of 63 triple gene dwarf genotypes 4 lines showed resistance, 8 lines moderate resistance, 26 lines are moderate susceptible and 25 lines showed susceptibility.

The frequency distribution of different test weight groups and their respective disease score given in table 4. Out of 40 genotypes having <30 gm test weight 4 genotypes showed resistance 10 lines moderate resistance 13 lines are moderate

Table 1: Leaf blight response of wheat genotypes based on maximum score (0 to 9 scale)

Leaf blight score and frequency of genotypes				
0-3 (R)	4-5 (MR)	6-7 (MS)	8-9 (S)	Total
13(8.84%)	34(23.12%)	60(40.81%)	40(27.21%)	147

Table 2: Frequency distribution for maturity duration and leaf blight response of wheat genotypes

Disease score and frequency of lines Maturity duration (days)	0-3(R)	4-5(MR)	6-7(MS)	8-9(S)	Total
Early (<120)	4	10	28	34	76
Medium (121<125)	5	16	20	5	46
Late (>125)	4	8	12	1	25
Total	13	34	60	40	147

Table 3: Frequency distribution for plant height and maximum leaf blight score

Plant height (cm)	Disease Score and frequency of lines				
	0-3(R)	4-5(MR)	6-7(MS)	8-9(S)	Total
Tall (>105 cm)	0	0	3	0	3
Single dwarf (95-105 cm)	4	9	13	2	28
Double dwarf (85-95 cm)	5	17	18	13	43
Triple dwarf (<85 cm)	4	8	26	25	63
Total	13	34	60	40	147

Table 4: Frequency distribution for test weight and maximum leaf blight score

Test weight (gm)	Disease Score and frequency of lines				
	0-3 (R)	4-5 (MR)	6-7 (MS)	8-9 (S)	Total
<30	4	10	13	13	40
30-40	8	17	38	21	84
40-50	1	6	7	6	20
>50	0	1	2	0	3
Total	13	34	60	40	147

Table 5. Frequency distribution of wheat germplasm lines for AUDPC scores of leaf blight disease

AUDPC	Number of genotypes
0-200	40 (27.21%)
200-400	79 (53.74%)
400-600	26 (17.68%)
600-800	2(1.36%)
Total	147

Table 6: Resistant lines and their respective AUDPC values

Sr. No.	Resistant line	AUDPC value
1.	K 0810	92.59
2.	HD 3028	114.28
3.	DBW 55	116.39
4.	NW 4091	116.49
5.	HD 3024	116.78
6.	HI 1566	117.28
7.	HD 3034	117.28
8	HD 3032	117.28
9.	HD 3041	118.82
10.	DBW 160	119.59
11.	NIAW 1548	120.56
12.	PBW 343	121.67
13.	PBW 640	123.45

susceptible and 13 lines showed susceptibility. Out of 84 genotypes belonging to test weight range of 30 to 40 grams, 8 lines were showed resistance, 117 lines moderate resistance, 38 lines moderate susceptible and 21 lines were susceptible. 20 lines having test weight range between 40 to 50 gram, out of which 1 line showed resistance, 6 lines moderate resistance, 7 moderate susceptible and 6 lines were susceptible; while 3 genotypes belonging to extra high test weight (>50 gm), out of which 1line was moderately resistance, 2 moderately susceptible and no one was susceptible.

The frequency distribution of genotypes for AUDPC is given in the table5. It was observe that 27.21% genotypes showed AUDPC value ranges from 0 to 200, 53.74% genotypes showed AUDPC ranges from 200 to 400, 17.68% genotypes had a range of AUDPC between 400 to 600 and 1.36% genotype showed high AUDPC ranges from 600 to 800. The present investigation also revealed that no genotype was immune to leaf blight disease caused by *Alternaria triticina*. AUDPC values of the resistant lines are given in the table 6, show that resistant lines have a low AUDPC value. It varies from the 92.6 to 123.5 across the resistant lines. Line K0810 shows least value, while PBW 640 shows highest value among the resistant lines.

The evaluation of germplasm showed that there was wide variability for resistance to leaf blight in the Indian germplasm/ lines/ genotypes based on maximum score of testing, 13 genotypes were found to be resistant. These genotypes may be utilized in breeding programmes for enhancing resistance to leaf blight disease which is now considered as a major disease in the NEPZ (North east plain zone) of India. The presence of substantial variability for leaf blight resistance is an indirect indicator that some success can be achieved towards enhancement of leaf blight resistance as indicated by Bhatta (1997).

The leaf blight severity has been reported to increase with growth stages (Chaurasia *et al.*, 1999), late varieties are reported to display less disease (Dubin *et al.*, 1991). Dubin *et al.*, 1991 reported that heading date and plant height is negatively correlated with AUDPC on wheat. However, it has been suggested that further studies are needed to understand the effect of earliness and plant height on disease development (Duveiller *et al.*, 2005). Although there is lack of adequate information about leaf blight resistant genotype, but on the light of present investigation it has been suggested to wheat breeders, to select dwarf and late maturing genotypes for securing more resistance to leaf blight. In the present study it have been seen that the resistant genotypes possessed variable plant height, test weight and maturity duration.

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