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Reaction of Some Hybrid Germplasms to Major Three Diseases of Rice

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Abstract: Twenty-eight bred restored lines and four standard checks were screening for resistance to bacterial leaf blight (caused by *Xanthomonas oryzae* pv. *oryzae*), sheath rot (caused by *Sarocladium oryzae*), sheath blight (caused by *Rhizoctonia solani*), during the t. aman and boro season. The breakout and severity of percent leaf/sheath area diseased were recorded under natural infection. On the basis of disease intensity, one breeding line was found moderately resistant, 13 were moderately susceptible and 13 were susceptible and 5 were highly susceptible to BLB at t. aman season and at boro season, 5 were highly resistant, 5 were resistant, 12 were moderately resistant and 9 were moderately susceptible to BLB. In case of sheath rot, 6 were moderately resistant, 26 were moderately susceptible and 2 susceptible in t. aman season. One line was resistant, 14 moderately resistant and 17 were moderately susceptible to sheath rot in boro season. At t. aman season, 29 lines were resistant, 3 were moderately susceptible and at boro season, all cultivars including checks were resistant to sheath blight. Considering both seasons, the accession numbers 56, 57, 64, 66, 71 and 73 showed comparatively better performance against above mentioned three major rice diseases.

Key words: Reaction, germplasms, major, diseases, rice

Introduction

Rice is the most important cereal crop and also staple food of the Bangladeshi population. The climate and geographical conditions of Bangladesh are favorable for year-round rice production during aus, aman and boro seasons. But the average yield of rice is very low in Bangladesh (2.47 t ha^{-1}) compared to 6-8 t ha^{-1} in Australia, Korea, Japan and Spain (Anonymous, 1995). There are many causes of low yield of rice in Bangladesh. Diseases and pest are considered as major constrains for rice production (Fakir, 1982). Tropical and subtropical climate that favours rice production. These are also favourable for its disease development. Among the major diseases, bacterial leaf blight (BLB), sheath rot and sheath blight, cause substantial loss in quality and quantity of rice. Bacterial leaf blight attacks leaves and leaf sheaths of rice plants at tillering and booting stage (Ou, 1972a). BLB may enhance symptom development of sheath blight and stem rot (Horino, 1986). It may cause an average of 20-30% yield loss (Ou, 1985a). In Bangladesh blast affects boro and t. aman rice when the environment is favourable for its development (Shahjahan *et al.*, 1986b). Sheath blight of rice affects filling of the grains and emergence of panicles. About 28-30% yield reduction was observed in susceptible cultivars (Shahjahan et *al.*, 1986a). Sheath rot can cause 3-20% yield lose but it may be as high as 85% (Chen, 1957). The disease may weaken the seedling and older plants. The loss of grain may be 4.578-29.1% (Bedi and Gill, 1960), even there is report up 50-90% (Ghose *et al.*, 1960). Considering the above facts, disease resistant varieties/lines are needed in Bangladesh. So, the experiment was undertaken to know the severity of different diseases and to find out the resistance varieties/lines of rice.

Materials and Methods

The experiments were conducted at the Field Laboratory of Genetics and Plant Breeding of Bangladesh Agricultural University, Mymensingh, during t. aman and boro season. Twenty-eight different genotypes/advanced breeding lines and four HYVs (BR29, BR28, BR14, BINA-6) were selected for this study. Seeds were collected from Department of Genetics and Plant Breeding, Bangladesh Agricultural University, Mymensingh. The accession No./variety No. along with their sources are given below:

Accession No.	Designation	Sources
48R	Ayaja R	IRRI
49R	IR13155-60-3-1-3R	"
50R	IR29723-143-3-2-1R	"
51R	IR43342-10-1-1-3-3R	"
52R	IR56381-139-2-2R	"
53R	IR58082-126-1-2R	"
54R	IR58110-144-2-2-2R	"
55R	IR59624-34-2-2R	"
56R	IR59669-93-1-3R	"
57R	IR59682-132-1-1-2R	"
58R	IR60913-43-3-3-2-2R	"
59R	IR60997-16-2-3-2-2R	"
60R	IR62037-12-1-2-2-2R	"
61R	IR62037-129-2-3-3-3R	"
62R	IR62171-122-3-2-3-3R	"
63R	IR63870-123-2-2-2-2R	"
64R	IR63870-3-2-3-3R	"
65R	IR63877-43-2-1-3-1R	"
66R	IR63883-41-3-2-2-2R	"
67R	IR64683-87-2-2-3-3R	"
68R	IR65489H-AC2-2R	"
69R	IR68926-61-1R	"
70R	IR68926-61-2R	"
71R	BR-736-20-3-1R	BRRI
72R	IR54404R	"
73R	IR21567R	"
74R	IR44675R	"
75R	BR-168-2B-283R	"
BRRI dhan 29	Check	"
BRRI dhan 28	Check	"
BINA-6	Check	BINA
BR14	Check	BRRI

Seeds of genotype was presoaked separately in tap water for 24 h and then excess water was drained out and the seeds were incubated for 48 h for sprouting. Seedbed was prepared in a medium low land of Field Laboratory of the Genetics and Plant Breeding Department. The soil was puddled with the country plough. The previously sprouted seeds were sown on individual stripes in the seedbed on 1st July 1999. Irrigation was applied to the growing seedbed as and when required until the day before transplanting. Soil of the main land was opened by tractor. The land was ploughed and cross-ploughed several times until the soil was brought to a good tilth. All the weeds and stubble were removed from the field. Soil was kept exposed to natural weathering for 15 days before the land was finally prepared for transplanting. Fertilizer urea, TSP (triple super phosphate), MP (muriate of potash), gypsum and zinc sulphate were applied as per recommendation of BRRI (Anonymous, 1999). The following doses of fertilizers were applied to the plots. Urea (N_2) 180 kg ha^{-1}, TSP (P_2O_5) 100 kg ha^{-1}, MP (K_2O) 70 kg ha^{-1}, gypsum (S) 60 kg ha^{-1} and zinc sulphate (Zn) 10 kg ha^{-1}. The experiment was concluded in a randomized completely block design (RCBD). Thirty-days-seedlings were transplanted. Gap filling was done within 10 days

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of transplanting. Weeding was done before application of urea fertilizer. The field was irrigated to maintain 5-6 cm depth of water in each plot throughout growing season. No fungicide and bactericide were applied to the growing crops to encourage development of bacterial leaf blight, sheath blight and sheath rot disease under natural condition. Leaf/sheath area diseased (LAD) were recorded at panicle initiation stage, milk stage. Ten infected plants in each plot were selected randomly for recording the percent leaf area diseased and the selected plants were tagged. Leaf area diseased of three diseases viz., bacterial leaf blight, sheath rot and sheath blight in the t. aman season and five diseases viz., blast, brown spot, bacterial leaf blight, sheath rot and sheath blight were recorded in boro season following IRRI recommended grading scale (Anonymous, 1980). The severity of the symptoms of different diseases developed on genotypes/plants under natural condition. The data collected on the severities or leaf area diseased of different diseases were subjected to the appropriate statistical analysis to determine the level of significance. The differences of the % leaf area diseased among the rice genotypes/accessions were tested using LSD and DMRT test. The mean values of each genotype/accession were used for interpretation and discussion.

Results and Discussion

The % leaf area diseased (LAD) and sheath area diseased (SAD) due to fungi were measured using the standard evaluation system for rice. During aman season the minimum LAD (9-10%) was recorded in two germplasms. The maximum LAD was 77.67% recorded in 72R accession. There was no infection in this accession during boro season. These results indicate that accession No. 72 is susceptible to BLB particularly at aman season (Table 1). The cause (s) of having no infection during boro need to be investigate.

Table 1: Variation in % leaf area diseased (LAD) caused by BLB pathogen in different genotypes of F_5 generation and checks of 2 seasons

	% LAD by BLB at	
Accession No.	T. aman season	Boro season
48R	10.00	0.00k
49R	49.67cd	3.340-h
50R	28.67f-l	0.567ik
51R	48.33c-e	10.17c
52R	41.33e	5.80de
53R	56.00bc	4.033e-g
54R	49.33cd	0.00k
55R	18.67i-l	2.167g-k
56R	30.33h-k	0.00k
57R	21.00i-l	2.537g-l
58R	24.33h-k	1.347h-k
59R	33.67f	0.88ik
60R	27.33f-l	1.00ik
61R	10.13mn	4.90d-f
62R	21.00i-l	1.13i-k
63R	16.33k-n	15.33b
64R	9.167n	0.00k
65R	13.33l-n	6.04d
66R	62.33b	0.66ik
67R	25.00g-l	9.1c
68R	33.00fg	1.167i-k
69R	28.00f-l	1.927h-k
70R	55.00cd	10.73c
71R	26.67f-l	0.81ik
72R	77.67a	0.00k
73R	58.00b	1.66h-k
74R	43.67de	9.00c
75R	30.33f-h	29.30a
BR14	16.67k-n	3.23f-l
BRRI dhan 28	16.67k-n	16.67b
BRRI dhan 29	18.00i-m	6.70d
BINA-6	16.67k-n	1.967h-k
LSD ($P \leq 0.05$)	6.98	1.815

Means followed by the same letter in a column are not significantly different at the 1% level for t. aman and 5% level for Boro season by DMRT

Table 2: Variation in % sheath area diseased (SAD) caused by sheath rot pathogen in different genotypes of F_5 generation and checks

	% SAD by Sheath rot at	
Accession No.	T. aman season	Boro season
48R	22.96b	7.74e-g
49R	22.43b	11.67bc
50R	8.563d-j	1.26ij
51R	6.60f-j	6.56e-h
52R	4.233h-j	3.70h-j
53R	9.93c-l	4.29f-j
54R	7.27f-j	10.04c-e
55R	5.33f-j	1.50ij
56R	14.18cd	11.20b-d
57R	4.620g-j	8.06d-f
58R	15.07c	6.16f-h
59R	6.46f-j	4.67f-l
60R	6.67f-j	12.94bc
61R	7.197f-j	6.12f-h
62R	14.80c	7.00e-h
63R	10.33c-h	1.70ij
64R	10.73c-g	3.33h-j
65R	3.10j	3.26h-j
66R	5.93f-j	0.80j
67R	13.80c-e	6.70e-h
68R	2.53j	6.16f-h
69R	11.13c-f	4.26f-j
70R	8.50d-j	24.33a
71R	5.26f-j	6.25f-h
72R	3.83ij	4.60f-j
73R	27.20ab	4.17g-j
74R	10.37c-h	6.33f-h
75R	30.27a	14.07b
BR14	8.50d-j	4.32f-j
BRRI dhan 28	3.91ij	11.40b-d
BRRI dhan 29	6.53f-j	2.18ij
BINA-6	7.67e-j	3.973g-j
LSD ($P \leq 0.05$)	5.245	3.161

Means followed by the same letter in a column are not significantly different at the 1% level for t. aman and 5% level for boro season by DMRT

Accession No. 64 and 66 had lowest infection during aman season and no infection during boro season. This germplasms may be promising in accessing the sources in resistance to BLB pathogen. The reaction of accession No. 48 was very much similar and that of accession No. 54, 56, 59 and 66 had similar reaction to BLB. These germplasms had more than LAD during aman season but no infection during boro season. Most of germplasms had 15-25% LAD during aman season and 0-5% LAD during boro season. Maximum LAD was 29.30% recorded in accession No. 75 during boro season followed by 16.67 in BRRI dhan 28. There was 16-19% LAD during aman season and 1-16% during boro season recorded in the released HYVs used in this study as yield check. The results showed that disease pressure was low in boro season and high during aman season. In t. aman season, 1 accession showed resistant (R), 1 showed moderately resistant (MR), 13 showed moderately susceptible (MS) reaction, 13 accessions showed susceptible (S) and 5 showed highly susceptible reaction to BLB (Table 4). In this season, 5 entries showed better performance. On the other hand, in boro season, the accession Nos. 48, 54, 56, 64 and 72 showed highly resistant reaction (HR) and no BLB disease incidence was found (Table 4).

In t. aman season, 0.67-24% SAD was observed compared to 2.53-27.20% at boro season and the disease intensity were 1-5 and 0-5, respectively. During aman season, highest SAD was recorded in accession No. 73 while the lowest % SAD (mean) was found in the accession No. 68. Highest SAD was 30.27% during aman season in accession No. 75. This germplasm had also high infection (14.07% SAD) in boro season. Similar reaction was recorded in accession No. 48 and 49 however, accession No. 49 had 11.67 SAD in sheath rot disease of rice (Table 2). There was 5-10% SAD in most of the germplasms during aman and boro

Table 3: Variation in % sheath area diseased (SAD) caused by sheath blight pathogen in different genotypes of F_5 generation and checks

Accession No.	% SAD by sheath blight at	
	T. aman season	Boro season
48R	13.10d-h	10.73de
49R	7.267g-o	2.39kl
50R	9.70d-l	5.76h-j
51R	7.60f-n	4.19jk
52R	10.67d-j	13.58c
53R	10.61d-j	11.63d
54R	15.49de	0.38mn
55R	12.20d-h	6.39g-l
56R	2.56m-o	1.36l-n
57R	9.83d-k	0.00n
58R	0.67o	10.17de
59R	2.00no	10.78de
60R	3.56k-o	23.20a
61R	8.99e-m	13.47c
62R	11.68d-l	6.48g-l
63R	4.03j-o	17.67b
64R	5.30i-o	18.33b
65R	12.17d-l	2.19lm
66R	22.83c	10.33de
67R	9.60d-l	4.57ij
68R	16.42d	5.29h-j
69R	32.20b	14.45c
70R	13.40d-g	10.70de
71R	2.86l-o	2.63kl
72R	14.43d-f	7.24f-h
73R	16.27d	1.16l-n
74R	44.03a	11.07d
75R	29.13b	8.26fg
BR14	4.50j-o	0.00n
BRRI dhan 28	7.16g-o	8.81fg
BRRI dhan 29	7.70f-n	0.00n
BINA-6	6.28h-o	1.51l-n
LSD ($P \leq 0.05$)	5.705	1.762

Means followed by the same letter in a column are not significantly different at the 1% level for t. aman and 5% level for boro season by DMRT

season. It is evident from the results that sheath rot infection was identical in aman and boro season. The check varieties had 4-7% SAD during aman season and 2-11% SAD during boro season. In this season, 6 accessions showed moderately resistant (MR), 24 accessions were moderately susceptible (MS) and 2 were showed highly susceptible (HS) (Table 4). In t. aman season, 7 accessions showed better performance over checks BRI14, BRRI dhan 28 and BINA-6. In case of boro season, one accession showed resistant (R), 14 were found to be moderately resistant (MR) and 17 accessions were found moderately susceptible (MS) to sheath rot disease (Table 4).

In t. aman season % SAD ranged between 0.67-44.03%, whereas at boro season it was 0.00-23.20% (Table 3). In t. aman season highest % SAD was observed in the accession No. 74. In this season, out of 32 cultivars, 29 breeding lines were found to be resistant (R) and 3 lines were found moderately susceptible reaction (Table 4). In this season, 5 accessions showed better performance over all the checks. In boro season, out of 32 cultivars. All accessions were found resistant (R) to moderately resistant (MR) to sheath blight disease of rice (Table 4). The highest % SAD (mean) was observed in the accession No. 60 (23.20%) and the lowest % SAD was found in the accession No. 57 (0.00%). In this season, 16 accessions showed better performance over check BRRI dhan 28 but only 2 accessions showed better performance over all checks used in boro season. During aman season maximum DAS was 44.03% recorded in accession No. 74 and during boro season maximum SAD was 23.20% recorded in accession No. 60. During these seasons, there were some accessions had no infection that in aman season and the accession got infection of sheath blight. Maximum number of accession had

Table 4: Reaction of different cultivars of rice against 3 rice diseases at t. aman and Boro season

Acc. No.	BLB		Sheath blight		Sheath rot	
	T. aman season	Boro season	T. aman season	Boro season	T. aman season	Boro season
48R	MS	HR	R	R	MS	MS
49R	S	MS	R	R	MS	MR
50R	S	R	R	R	MS	MS
51R	S	MS	R	R	MS	MR
52R	S	MS	R	R	MR	MR
53R	HS	MS	R	R	MS	MS
54R	S	HR	R	R	MS	MR
55R	MS	R	R	R	MS	MS
56R	S	HR	R	R	MS	MS
57R	MS	MS	R	R	MR	MS
58R	MS	MS	R	R	MS	MR
59R	S	R	R	R	MS	MS
60R	S	MS	R	R	MS	MS
61R	MS	MS	R	R	MS	MS
62R	MS	MS	R	R	MS	MR
63R	MS	MS	R	R	MS	MR
64R	MS	HR	R	R	MS	MR
65R	MS	MS	R	R	MR	R
66R	HS	R	R	R	MS	MS
67R	MS	MS	R	R	MS	MS
68R	S	MS	R	R	MR	MR
69R	S	MS	R	R	MS	MS
70R	HS	MS	R	R	MS	MS
71R	S	R	R	R	MS	MR
72R	HS	HR	R	R	MR	MR
73R	HS	MS	R	R	S	MS
74R	S	MS	MS	R	MS	MS
75R	S	S	MS	R	S	MR
BR14	MS	MS	R	R	MS	MS
BRRI dhan 28	MS	MS	R	R	MR	MR
BRRI dhan 29	MS	MS	R	R	MS	MR
BINA-6	MS	MS	R	R	MS	MR

HR = Highly resistant; R = Resistant;
MR = Moderately resistant; MS = Moderately susceptible;
S = Susceptible; HS = Highly susceptible

infection on having 2-1% SAD in both the seasons. Same accessions had comparatively high infection showing more than 10% SAD. The yield checks had minimum SAD. There was no infection in BRRI dhan 29 during season. It is revealed from the data that disease pressure less in boro season than that in aman season (Table 3). Some accessions like accession No. 58 had very low SAD during but had comparatively high SAD in boro season. On the other hand, some accessions like accession 65 had low infection during boro season but infection was high during aman season.

Symptoms of bacterial leaf blight (BLB) of rice as observed in this study was in conformity to those described by Horino (1986); Ashrafuzzaman (1992); BRRI and IRRI (1985) and Reddy and Shukla (1986). During the period of the experiment (July-December 1999) i.e. t. aman season, it was observed that the natural incidence of BLB severity was fairly significant. The disease severity of BLB in terms of % LAD varied between 9.16-77-67% at t. aman season which in check BR14, % LAD was observed 15.67% (Table 1). In the same variety similar result was also found by Amin (1995) and that was 14.99%. He also found 9-60% LAD by BLB in different varieties. In boro season, 5 breeding lines were found to be resistant (R) to BLB. The result has similarity with Raj *et al.* (1987); Karaki (1989); Choi *et al.* (1985); Ram *et al.* (1995) and Kaushal *et al.* (1998). In t. aman season, 13 accessions were moderately susceptible (MS) to BLB and 5 accessions were resistant at bor season which have similarities with the findings of Cheema *et al.* (1998) that was also conducted under natural field condition.

The effect of *Rhizoctonia solani* Kuhn on the development of sheath blight disease in rice were also studied during the period of this investigation. The typical symptoms of sheath blight disease have been described by several works (Kozaka, 1975; Lee and Rush, 1983; Ou, 1985d). In this study, similar types of symptoms

were also observed. A total of 29 and 32 accessions showed resistant reaction to sheath blight disease in t. aman and boro season, respectively. This finding supported by Raj *et al.* (1987). The severity of sheath area diseased (SAD) varied between 0.67-44.03 and 0.00-23.20% at t. aman and boro season, respectively. The severity of sheath blight occurred at a considerable amount in almost all breeding lines though disease incidence was less at boro season. The high severity was probably because under humid conditions the mycelia of this fungus did grow over the surface of the leaf sheath and could spread a considerable distance.

In t. aman season, six breeding lines were moderately resistant to sheath rot pathogen and in boro season, one accession was found resistant, 14 were moderately resistant and 17 were moderately susceptible (Table 4) to sheath rot. Similar type of result was also observed by Sahu and Parida (1997).

The average leaf area diseased (LAD) due to BLB varied between 9.16 to 77.67% in t. aman season and between 0 to 29.30% in boro season. One breeding line was found moderately resistant, 13 moderately susceptible, 13 susceptible and 5 highly susceptible to BLB in t. aman season whereas, 5 entries were found highly resistant, 5 resistant, 12 moderately resistant, 9 moderately susceptible and one was found to be susceptible in the boro season. In case of sheath rot in t. aman season, no breeding line showed high resistance. In this season, six lines were moderately resistant, 24 moderately susceptible and 2 susceptible. Whereas, boro season 1 line was resistant, 14 were moderately resistant and 17 were moderately susceptible. The severity of % sheath area diseased due to sheath blight varied between 0.67 to 44.03 and 0 to 23.20 in t. aman and boro seasons, respectively. Twenty nine were found to be resistant and 3 were moderately susceptible in t. aman season and all breeding lines including checks showed resistant reaction to sheath blight in boro season. Further works will proved the opportunities to find out the resistant/immune cultivars from the test lines. For screening the varieties and breeding lines against BLB, sheath rot and sheath blight, the test maturity should be inoculated with the respective pathogen after this natural screening under field condition at optimum stage of plant growth in order to select the test materials against respective diseases.

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