REACTION OF SOME LOCAL RICE CULTIVARS AGAINST FOUR MAJOR FUNGAL DISEASES OF RICE UNDER NATURAL EPIPHYTOTIC CONDITION

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ABSTRACT

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A total of 19 rice cultivars was screened under natural epiphytotic condition against four major diseases viz. sheath blight, leaf blast, brown spot and false smut of rice during two consecutive years in 2015 and in 2016 at HSTU, Dinajpur, Bangladesh. The experiment was carried out in RCBD design with three replications. Significant variation was recorded in respect of the number of infected tillers and disease severity, among the rice cultivars. Out of 19 cultivars tested, only one cultivar was recorded as resistant, seven as moderately resistant, two as moderately susceptible, five as susceptible and four as highly susceptible to sheath blight of rice. None of the variety was found resistant or moderately resistant to leaf blast of rice. Out of nineteen, eight, nine and two rice cultivar were recorded as moderately susceptible, susceptible and highly susceptible to the brown spot of rice, respectively. Two cultivars namely Kalogira and Kalosoro showed moderately resistant reaction against false smut, while seven, nine and one cultivars exhibited moderately susceptible, susceptible and highly susceptible reaction against false smut of rice, respectively.

Key words: Diseases of rice, Natural epiphytotic condition, Resistant, Susceptible

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food crop in Bangladesh. The production of rice is increasing in Bangladesh since last decade; however, diseases are one of the major constraints for the higher production of rice. So far, 31 diseases of rice have been identified and among them, sheath blight, blast, false smut and brown spot have been considered as the major diseases because of their widespread occurrence and ability to cause significant damage to the crop (Miah and Shahjahan 1987). Rice sheath blight and blast are the major constraints for rice production and prevalent in almost all rice growing areas and in all the seasons of Bangladesh (Miah *et al.* 1985, Kakoly *et. al*. 2014). High tillering and high nitrogen loving cultivars including local, high yielding and hybrid cultivars are comparatively more susceptible (Miah *et al.* 1985). However, 14 to 31% yield loss in rice was estimated under experimental and farmer's field condition due to sheath blight in Bangladesh (Shahjahan *et al.* 1986). False smut of rice is one of the emerging grain diseases in rice growing areas of the world. The yield losses have been estimated from 20 to 49% depending on the disease intensity and rice cultivars grown (Rush *et. al*. 2000 and Singh and Pophaly 2010). It is an important devastating disease showing disease incidence and yield losses upto 85 and 10.91%, respectively (Atia 2004; Ladhalakshmi *et al*. 2012). Brown spot caused by *Cochliobolus miyabeanus* (*Bipolaris oryzae, Drechslera oryzae, Helminthosporium oryzae*) is the predominant disease of rice which reduced both the quality and yield up to 67% (Jones *et. al*. 1993).

Control of the fungal diseases is difficult due to the complex biology of the fungal growth including both biotroph and necrotroph nature, surviving ability as soil borne and air borne etc. (Sadras *et. al*. 2009). Development and maintaining of disease resistant crops is the most important way to combat plant diseases. Hence, it is urgent to find out the source of disease resistance. Therefore, the present study has been aimed to assess the reaction of 19 rice cultivars against 4 major fungal diseases of rice to find out the resistant cultivar against the diseases.

MATERIALS AND METHODS

The experiment was carried out in the research field of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, during two consecutive years of July to December 2015 and 2016 in T. Aman season. The experimental field was prepared and fertilized by Poultry litter, Urea, TSP, MoP, Gypsum and Zinc sulphate @ 1.5 ton/ha, 150

kg/ha, 100 kg/ha, 70 kg/ha, 60 kg/ha and 10 kg/ha, respectively as recommended by BARC (Anonymous 2004). The poultry litter, TSP, MoP, Gypsum, Zinc sulphate were applied at the time of final land preparation. Nitrogen in the form of urea was applied in three equal splits at 15, 30 and 50 days after transplanting (DAT). After land preparation, 30 days old seedlings of 19 rice cultivars viz. Ranjit, Sadakatary, Badshabog, Begonbechi, Salna, Chinigura, Kalogira, BR-34, Radunipagal, Kataribog, Uknimodu, BR-49, Kalosoro, Pyjam, Malsira, Binnipakri, Bolder, Philipinekatary and Justakatari - collected from the Department of Genetics and Plant Breeding, HSTU were transplanted using 2-3 seedlings/hill. Distance of plant to plant and row to row was maintained 15 cm and 20 cm, respectively. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Crop production measures were taken as necessary. Number of infected tiller per hill was recorded at the grain filling stage of plant growth. Disease severity was evaluated by randomly selected ten hills from each unit plot on standing plants. Selected hills were tagged and sheath blight, leaf blast, brown spot and false smut disease severity was recorded by using the different disease rating scales (IRRI 1996; Anonymous 2001). Data were subjected to statistical analysis to find out the level of significance of the experimental results. The significance of differences among the treatments means were evaluated by Duncan's Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez 1984).

RESULTS AND DISCUSSIONS

Total number of infected tiller per hill and sheath blight severity varied significantly among the different varieties studied in T. Aman season of 2015 and 2016 (Table 1). In both the seasons, maximum number of infected tillers per hill were recorded in Sadakatary (7.34 and 9.00) followed by Philipinekatari (4.00 and 3.30) and Begonbechi (3.83 and 3.90) where, minimum number of infected tillers per hill were recorded in Salna (0.17 and 1.20) and Kalogira (0.17 and 0.30) variety. Rest of the variety yielded moderate number of infected tillers per hill. In the same way, maximum disease severity was recorded in Sadakatary (80.00% and 82.50%) variety followed by Begonbechi (53.35% and 42.50%), Philipinekatary (51.65% and 27.50%), Justakatary (51.65% and 35.00%) and Badsha bog (50.00% and 42.50%). However, minimum disease severity was observed in Salna (3.33%) and Kalogira (3.33%) variety during 2015 but in Uknimodu (5.00) and BR-49 (5.00) variety during 2016.

Table 1. Mean total number of infected tiller per hill, sheath blight severity and host reaction under field condition of different cultivars during T. Aman season of 2015 and 2016.

Variety	Number of infected tiller/ hill		Disease severity %		Host reaction	
	2015	2016	2015	2016	2015	2016
Ranjit	0.33 d	0.30 de	13.34 cd	10.00 cde	R	R
Sadakatary	7.34 a	9.00 a	80.00 a	82.50 a	HS	HS
Badshabog	2.67 bcd	2.40 bcd	50.00 b	42.50 b	S	MS
Begonbechi	3.83 b	3.90 b	53.35 b	42.50 b	S	MS
Salna	0.17 d	1.20 d	3.33 d	10.00 e	R	R
Chinigura	1.83 bcd	2.40 bcd	40.00 bc	40.00 bc	MS	MS
Kalogira	0.17 d	0.30 de	3.33 d	5.00 de	R	R
BR-34	2.00 bcd	1.50 de	38.34 bc	27.50 bcde	MS	MR
Radunipagal	2.50 bcd	1.80 de	36.67 bc	27.50 bcde	MS	MR
Kataribog	1.67 bcd	2.10 cde	26.67 bcd	22.50 cde	MR	MR
Uknimodu	0.33 d	0.30 de	10.00 cd	5.00 e	R	R
BR-49	0.67 cd	0.30 de	11.67 cd	5.00 e	R	R
Kalosoro	2.33 bcd	2.40 d	33.34 bcd	20.00 bcde	MS	MR
Pyjam	0.83 cd	1.20 de	15.00 cd	17.50 cde	R	R
Malsira	1.33 bcd	0.90 de	23.34 bcd	10.00 cde	MR	R
Binnipakri	0.50 cd	0.60 de	11.67 cd	7.50 de	R	R
Bolder	2.83 bcd	2.10 de	38.34 bc	25.00 bcde	MS	MR
Philipinekatary	4.00 b	3.30 bc	51.65 b	27.50 bcde	S	MR
Justakatari	3.17 bc	3.30 bc	51.65 b	35.00 bcd	S	MS

R= Resistant, HS = Highly Susceptible, S = Susceptible, MS = Moderately Susceptible, MR = Moderately Resistant at 5% level of probability

The varieties Ranjit, Salna, Kalogira, Uknimodu, BR-49, Pyjam and Binnipakri showed resistant reaction against sheath blight disease of rice but the variety Sadakatary showed the highly susceptible reaction against the disease in both the seasons. Variable reaction was observed in the rest of the variety during 2015 and 2016 cropping seasons. The genetic variability of rice cultivars and the environmental factors affecting the development of sheath blight of rice may responsible for the variation of sheath blight occurrence (Kumar *et al.* 2017). However, among all the rice varieties, Sadakatary was found as the highly susceptible against all the studied disease in terms of infected tiller and disease severity in 2015 and 2016 cropping seasons. On the other hand, Ranjit, Salna, Kalogira, Uknimodu, BR-49, Pyjam and Binnipakri rice cultivars were found as resistant against the disease. Surprisingly, Badshabog, Begonbechi, and Justakatari showed susceptible reaction in 2015 but moderately susceptible in the following year. Conversely, BR-34, Radunipagal and Kalosoro respond as moderately susceptible in 2015 but moderately resistant in the next year. The inconsistency in terms of reaction against the diseases might happen due to the climatic change for the availability of inoculum of *Rhizoctonia solani* and host response against the pathogen. Jia *et al.* (2007) also described the similar kind of phenomena where some resistant cultivars showed susceptible disease reaction under field inoculation that might the results of tests and locations due to the plant age and genetic response to local sheath blight isolates. However, similar to our results no rice variety were described as immune and highly resistant to sheath blight, only up to 36.5% of the tested varieties were found as resistant to moderately resistant to sheath blight (Kumar *et al.* 2015; Shi-mim *et al.* 2014; Chandra *et al.* 2016; Kumar *et. al.* 2017).

In case of blast infection, maximum number of infected tillers were recorded in Katari bog (6.80) and Uknimodu (6.80) which was statistically similar to Radunipagal (6.75%), Salna (6.40) and Binnipakri (5.55) in 2015 cropping season (Table 2). Whereas, maximum blast infected tillers were recorded in Binnipakri (8.40) and Katari bog (5.63) during 2016 cropping season. However, during 2015 cropping season the minimum (0.95) number of blast infected tillers were recorded in Sadakatary variety which was similar with Rangit (1.10), BR-49 (2.75), Chinigura (1.95), Kalogira (1.10), Badsha bog (2.25), Kalosora (2.60) and Justakatari (2.65) where, minimum (0.75) number of blast infected tillers were recorded in Sadakatary and Kalogira variety which was similar with Ranjit (1.05), Badshabog (1.65) and Chinigura (1.80) in 2016 cropping season. However, variety Salna and Katari bog were observed as highly infected variety and their severity were 66.15% and 53.35% in 2015 cropping season and 47.50% and 32.75% in 2016 cropping season, respectively. In both the seasons, the least affected varieties were Sada katari (3.17%, 2.50%), Rangit (5.50%, 3.75%), Chinigura (6.00%, 5.50%), Kalogira (3.67%, 2.75%), BR-49 (7.50%, 6.75%), Kalosoro (5.67%, 5.00), Philipinekatary (9.84%, 9.00%), Justakatari (10.17%, 9.25%). All the least affected variety exhibited moderately susceptible reaction against blast disease of rice. However, Salna and Kataribog were recorded as highly susceptible in 2015 but susceptible in 2016. And conversely, Badshabog and Begonbechi were found susceptible in 2015 and moderately susceptible in 2016. The different response of the same rice variety against the same disease with time might occur due to the climatic variation. Similar to our findings, none of the rice variety was found as resistant or moderately resistant against blast disease (Ghazonfar *et al.* 2009; Dar *et al.* 2015). In contrast to our findings, highly resistant to moderately resistant rice cultivars were screened including coarse and fine rice (Saifullah 1995; Khan *et al.* 2001; Haq *et al.* 2002; Arshad *et al.* 2008; Mohanta *et al.* 2003; Sabin *et al.* 2016).

Table 2. Mean number of infected tiller per hill, leaf blast severity and host reaction under field condition of different cultivars during T. Aman season of 2015 and 2016

Variety	Number of infected tiller per hill		Disease severity %		Host reaction	
	2015	2016	2015	2016	2015	2016
Ranjit	1.35 gh	1.05 c	5.50 fg	3.75 gh	MS	MS
Sadakatary	0.95 h	0.75 c	3.17 g	2.50 h	MS	MS
Badshabog	2.25 fgh	1.65 c	11.34 defg	8.50 defgh	S	MS
Begonbechi	3.65 cdef	2.18 b	13.67 def	8.50 defgh	S	MS
Salna	6.40 ab	5.03 b	66.15 a	47.50 a	HS	S
Chinigura	1.95 fgh	1.80 c	6.00 fg	5.50 fgh	MS	MS
Kalogira	1.10 h	0.75 c	3.67 g	2.75 h	MS	MS
BR-34	4.20 cde	3.75 b	13.84 def	11.50 def	S	S
Radunipagal	6.75 a	4.28 b	28.34 c	21.25 c	S	S
Kataribog	6.80 a	5.63 a	53.35 b	32.75 b	HS	S
Uknimodu	6.80 a	4.95 b	28.17 c	21.25 c	S	S
BR-49	2.75 efgh	3.15 b	7.50 efg	6.75 efgh	MS	MS
Kalosoro	2.60 efgh	2.55 b	5.67 fg	5.00 fgh	MS	MS
Pyjam	4.50 cde	2.93 b	17.50 d	11.00 defg	S	S
Malsira	4.50 cde	3.83 b	11.84 defg	10.00 defgh	S	S
Binnipakri	5.55 abc	8.40 a	17.17 d	13.50 de	S	S
Bolder	4.75 bcd	4.80 b	16.34 de	15.00 cd	S	S
Philipinekatary	3.20 defg	3.08 b	9.84 defg	9.00 defgh	MS	MS
Justakatari	2.65 efgh	2.78 b	10.17 defg	9.25 defgh	MS	MS

HS = Highly Susceptible, S = Susceptible, MS = Moderately Susceptible at 5% level of probability

Brown spot infected tiller, disease severity and host reactions varied significantly among the rice cultivars studied during T. aman season of 2015 and 2016 (Table 3). In both the season, maximum number of brown spot infected tillers were recorded in rice cultivar Uknimodu (7.53, 6.50) followed by Binnipakri (6.07, 5.40), Radunipagal (5.93, 5.90) and BR-34 (5.73, 5.30). The minimum number of infected tillers were recorded in Kalogira having 1.53 and 1.30 in 2015 and 2016, respectively. Moderate number of infected tillers in 2015 and 2016 were recorded in Rangit (4.53, 4.50), Sadakatary (5.53, 4.90), Badsha bog (5.33, 5.20), Begonbechi (5.80, 5.30), Salna (4.93, 4.50), Chinigura (4.27, 4.00) Kataribog (5.60, 5.30), BR-49 (5.60, 5.50), Pyjam (4.27, 3.60), Malsira (5.60, 4.70), Bolder (5.20, 4.60), Philiphinekatary (5.20, 4.70) and Justakatary (4.67, 3.80). The highest percentage of brown spot disease severity was recorded in BR-34 (11.60%, 36.50%) which was similar with the variety Radunipagal (11.40%, 36.00%), Kataribog (10.80%, 34.80%), Uknimodu (11.20%, 36.00%), and Pyjam (11.50%, 35.00%) in both the years. The lowest percentage of disease severity was recorded in Kalogira (2.50%, 6.50%) followed by Kolosoro (4.20%, 10.50%), Philipinekatari (7.40%, 23.50%), Chinigura (7.40%, 21.50%), Begonbechi (7.60%, 25.00%) and Justakatary (8.00%, 21.50%) during both the years. However, moderate amount of disease severity was recorded in Kataribog (10.80%, 34.00%), Badshabog (10.50%, 30.50%), Salna (9.80%, 31.50%), Binnipakri (9.80%, 31.50%), BR-49 (9.70%, 30.00), Malsira (9.50%, 31.50) Rangit (9.10%, 30.50%) and Sadakatary (9.10%, 29.00%). All the varieties exhibited moderately susceptible or susceptible reaction in 2015 and 2016 cropping season. Except Kalogira, Begonbechi, BR-34, Radunipagal, Kataribog, Uknimodu, Pyjam and Bolder exhibited susceptible reaction in 2015 and 2016 as well.

Table 3. Mean number of infected tiller per hill, brown spot severity and host reaction under field condition of different cultivars during T. Aman season of 2015 and 2016.

Variety	Number of infected tiller per hill		Disease severity %		Host reaction	
	2015	2016	2015	2016	2015	2016
Ranjit	4.53 de	4.50 cdef	9.10 ef	30.50 bcd	MS	S
Sadakatary	5.53 bcd	4.90 bcd	9.10 ef	29.00 cde	MS	S
Badshabog	5.33 bcde	5.20 bc	10.50 abcd	30.50 bcd	S	S
Begonbechi	5.80 bc	5.30 bc	7.60 g	25.00 efg	MS	S
Salna	4.93 bcde	4.50 cdef	9.80 bcde	31.50 abcd	MS	S
Chinigura	4.27 ef	4.00 def	7.40 g	21.50 g	MS	S
Kalogira	1.53 g	1.30 h	2.50 i	6.50 h	MS	MS
BR-34	5.73 bc	5.30 bc	11.60 a	36.50 a	S	S
Radunipagal	5.93 b	5.90 ab	11.40 a	36.00 a	S	S
Kataribog	5.60 bcd	5.30 bc	10.80 abc	34.00 abc	S	S
Uknimodu	7.53 a	6.50 a	11.20 a	36.00 a	S	S
BR-49	5.60 bcd	5.50 bc	9.70 cde	30.00 bcd	MS	S
Kalosoro	3.27 f	2.30 g	4.20 h	10.50 h	MS	S
Pyjam	4.27 ef	3.60 f	11.50 a	35.00 ab	S	S
Malsira	5.60 bcd	4.70 cde	9.50 de	31.50 abcd	MS	S
Binnipakri	6.07 b	5.40 bc	9.80 bcde	31.50 abcd	MS	S
Bolder	5.20 bcde	4.60 cdef	11.00 ab	28.00 def	S	S
Philipinekatary	5.20 bcde	4.70 cde	7.40 g	23.50 fg	MS	S
Justakatari	4.67 cde	3.80 ef	8.00 fg	21.50 g	MS	S

S = Susceptible, MS = Moderately Susceptible at 5% level of probability

Similar to blast diseases, none of the tested variety was found highly resistant, moderately resistant or resistant against brown spot disease. All the varieties exhibited moderately susceptible or susceptible reaction in both the cropping seasons where, Uknimodu and Kalogira were less infected in terms of tiller infection and disease severity. Similar to our findings, no brown spot resistant rice cultivars were found among the rice variety used except some of moderately resistant (Magar 2015). However, Radha-4 proved as resistant cultivars which could be used as a source of resistant variety in breeding program (Aryal *et al.* 2016).

False smut infection varied significantly among the rice cultivars during 2015 and 2016 cropping seasons (Table 4). The maximum number of infected florets was recorded in BR-49 (2.00, 7.00) during both the cropping seasons. The variety Begonbechi, Salna, Uknimodu, Pyjam, Binnipakri, Bolder and Justakatari revealed lower ranking of infection and severity in 2015 but higher ranking of infection and severity in 2016 cropping season. The disease severities in both the seasons were found highest in BR- 49 (30%, 70%) where the lowest in Begonbechi (0.60%), Uknimodu (0.60%) and Binnipakri (0.60%) in 2015 but Kalogira (0.20%) and Kalosoro (0.40%) in 2016 cropping season. The variety Begonbechi and Uknimodu showed resistant reaction in 2015 but susceptible in 2016 cropping season. Among the used nineteen variety, four variety namely Salna, Binnipakri, Bolder and Justakatari showed resistant reaction in 2015 but moderately susceptible in 2016 cropping season. Rest of the varieties showed variable reaction in both the season. None of the variety was found resistant or highly resistant against false smut disease of rice in both the season. Highly variable response was recorded among the cultivars against false smut disease of rice during two cropping seasons. Begonbechi, Salna, Uknimodu, Binnipakri, Bolder and Justakatari exhibited resistant reaction in 2015 but susceptible or moderately susceptible in 2016. BR-49 also showed susceptible in 2015 which was highly susceptible in 2016. The variety Ranjit, Sadakatari Badshabog, Chinigura, Kataribog, Pyjam and Malsira variety showed moderately susceptible reaction in 2015 while those were susceptible in 2016. The environmental variation with time, available of inoculum during the growing season may result the variation on the development of diseases. However, resistant or moderately resistant rice cultivars have been screened by several researchers against the false smut disease (Singh *et al.* 2005; Mohiddin *et al.* 2012; Lore *et al.* 2013; Yan *et al.* 2014; Kaur *et al.* 2015).

Table 4. Mean number of infected spike per panicle, false smut severity and host reaction under field condition of different cultivars during T. Aman season of 2015 and 2016.

Variety	Number of infected spike/panicle		Disease severity %		Host reaction	
	2015	2016	2015	2016	2015	2016
Ranjit	1.33 b	4.00 bc	20.00 b	40.00 b	MS	S
Sadakatary	0.67 c	2.00 cd	10.00 c	20.00 b	MS	MS
Badshabog	0.67 c	4.00 bc	10.00 b	40.00 b	MS	S
Begonbechi	0.04 d	3.00 bc	0.60 d	30.00 b	R	S
Salna	0.06 d	2.00 cd	0.90 d	20.00 b	R	MS
Chinigura	1.33 b	3.00 bc	20.00 b	30.00 b	MS	S
Kalogira	0.08 d	0.02 d	1.20 d	0.20 c	MR	R
BR-34	2.00 a	3.00 bc	30.00 a	30.00 b	S	S
Radunipagal	0.67 c	2.00 cd	10.00 b	20.00 b	MS	MS
Kataribog	0.67 c	3.00 bc	10.00 b	30.00 b	MS	S
Uknimodu	0.04 d	5.00 b	0.60 d	50.00 b	R	S
BR-49	2.00 a	7.00 a	30.00 b	70.00 a	S	HS
Kalosoro	0.08 d	0.04 d	1.20 d	0.40 c	MR	R
Pyjam	1.33 b	5.00 b	20.00 c	50.00 b	MS	S
Malsira	0.67 c	2.00 cd	10.00 c	20.00 b	MS	MS
Binnipakri	0.04 d	2.00 cd	0.60 d	20.00 b	R	MS
Bolder	0.06 d	2.00 cd	0.90 c	20.00 b	R	MS
Philipinekatary	0.10 d	4.00 bc	1.50 d	40.00 b	MR	S
Justakatari	0.06 d	2.00 cd	0.90 d	20.00 b	R	MS

R= Resistant, S = Susceptible, MS = Moderately Susceptible, MR = Moderately Resistant at 5% level of probability

CONCLUSION

The findings of the study revealed that resistant rice cultivar only available against blast disease of rice. However, none of the rice variety was recorded as highly resistant or resistant against other studied diseases of rice.

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LITERATURE CITED

Anonymous. 2001. Standard Evaluation System for Rice. INGER. Genetic Resources Center, IRRI, Manila, Philippines. Pp. 20-21.

Anonymous. 2004. Krishi Projukti Hat Boi. Bangladesh Agricultural Research Institute. Joydebpur, Gazipur. 28 p.

Arshad, H. M. I.; Khan, J.A. and Jamil, F. F. 2008. Screening of rice germplasm against blast and brown spot disease. Pak. J. Phytopath. 20(1): 52-7.

Aryal, L. Bhattarai, G. Subedi, A. Subedi, M. Subedi, B. and Sah, G.K. 2016. Response of rice varieties to brown spot disease of rice at paklihawa, rupandehi. G.J.B.A.H.S., 5(2):50-54.

Atia, M. 2004. Rice false smut (*Ustilaginoidea virens*) in Egypt. J. Plant Dis. Protec. 14: 71-82.

Dar, S.H. Rather, A.G. Najeeb, S. and Ahangar, A.M. 2015. Screening of rice germplasm against blast disease under temperate conditions, Mol. Plant Breed. 6(13) : 1-4.

Gomez, K.A. and Gomez, A. A. 1984. Statistical procedures of Agricultural Res. 2nd End. Jon Wiley and Sons, New York. P. 680.

Haq, I. Fadnan, M. M. Jamil, F.F. and Rahman, A. 2002. Screening of rice germplasm against *Pyricularia oryzae* and evaluation of various fungitoxicants for control of disease. Pak. J. Pythopath. 14 (1): 32-5.

IRRI. 1996. Standard evaluation system for rice. 4th ed. IRRI, Manila, Phillipine.

Jia, Y. Correa-Vectoria, F. McClung, A. Zhu, L. Lie, G. Wamishe, Y. Xie, J. Marchetti, M.A.; Pinson, S.R.M.; Rutger, J.N. and Corel, J.C. 2007. Rapid determination of

rice cultivar responses to the sheath blight pathogen, *Rhizoctonia solani* using a micro-chamber screening method. Plant Dis. 91:485-489.

Jones, M.P. Jeutong, F. and Tchatchoua J. 1993. A survey of rice diseases in Comeroon. Plant Dis. 77:133-136.

Kakoly, M.K.J. Rashid, M.M. Hasan, M.S. and Siddiqui, N.A. 2014. Study of Seed-borne Fungal Pathogens of Kataribhog Rice and Comparison of Field Intensity with Laboratory Counts. Int. J. Biosci. 4(1): 66-74.

Kaur, Y. Lore, J.S. and Pannu, P.P.S. 2015. Evaluation of rice genotypes for resistance against false smut. Plant Dis. Res. 30 (1),: 46-49.

Khan, J.A. Jamil, F.F. Cheema, A.A. and. Gill, M.A 2001. Screening of rice germplasm against blast disease caused by *Pyricularia oryza In*: Proc. National Conf. of Plant Pathology, held at NARC. Islamabad. Oct 1-3. pp. 86-9.

Kumar, S. Dwivedi, S.K. Kumar, R. Bhakta, N. Prakash, V. Rao, K.K. Kumar, R. Yadav, S. Choubey, A.K. and Mishra, J.S. 2017. Screening of Different Rice Germplasm against Multiple Disease under Submergence Condition in Middle Indo Gangetic Plain. Int.J.Curr.Microbiol.App.Sci. 6(5): 335-339.

Ladhalakshmi, D. Laha, G.S. Singh, R. Karthikeyan, A.; Mangrauthia, S.K. Sundaram, R.M.; Thukkaiyannan, P. and Viraktamath, B.C. 2012. Isolation and characterization of *Ustilaginoidea virens* and survey of false smut disease of rice in India. Phytoparasi. 40:171-76.

Lore, J.S. Punnu, P.PS. Jain, J. Hunjan, M.S. Kaur, R. and Mangat, G.S. 2013. Susceptibility of rice hybrids and inbred cultivars to false smut under field conditions. Ind. Phytopathol. 66:397-399.

Magar, P. B. 2015. Screening of rice varieties against brown leaf spot disease at Jyotinagar, Chitwan, Nepal. Int J Appl Sci. Biotechnol, 3(1): 56-60.

Miah, S. A. and Shahjahan, A. K. M. 1987. Mathe Dhaner Rog Nirnoy O Tar Portikar (In Bangla, Rice Disease Identification and Their control in the field) Bangladesh Rice Research Institute (BRRI), Gazipur, Bangladesh. p.60.

Miah, S.A. Shahjahan, A.K.M. Hossain, M.A. and Sharma, N.R. 1985. Survey of rice disease in Bangladesh. Trop. Pest Mana. 31(3): 208-213.

Mohanta, B.K.. Aslam, M.R., Kabir, M.E. Anam, M.K.. Alam, M.K. and Habib, M. A. 2003. Performance of different genotypes/cultivars to blast disease of rice in Boro and T. Aman crop in Bangladesh. Asian. J. Plant Sci. 2(7): 575-7.

Mohiddin, F.A. Bhat, F.A. Gupta, V. Gupta, D. and Kalha, C. S. 2012. Integrated disease management of false smut of rice caused by *Ustilaginoidea virens*. Trends Biosci. 5 (4): 301-302.

Rush, M.C. Shahjahan, A.K.M. and Jones, J.P. 2000. Outbreak of false smut of rice in Louisiana. Plant Dis. 84:100.

Sabin, K. Bijay, S. Amrit, B. Raman, G.D.; Bhuwan, S. Priyanka, N. Man, S.S. Prasad, G.S. 2016. Screening of Different Rice Genotypes against (*Pyricularia grisea*) Sacc. in Natural Epidemic Condition at Seedling Stage in Chitwan, Nepal. Adv. Crop. Sci. Tech. 4:4.

Sadras, V.O. Calderini, D.F. and Connor, D. 2009. Sustainable agriculture and crop physiology. In 'Crop physiology. Applications for genetic improvement and agronomy'. (Eds VO Sadras, DF Calderini) pp. 1-20. (Academic Press: Burlington, MA).

Saifullah, M. 1995. Comparative efficacy of some new fungicides for the control of rice blast. PI. Prot. Bull. Faisalabad. 46(2-3):39.

Shahjahan, A.K.M. Sharma, N.R. Ahmed, H.U. and Maih, S.A. 1986. Yield loss in modern varieties due to sheath blight in Bangladesh. J. Agric. Res. 11(2): 82-90.

Singh, A.K. and Pophaly, D.J. 2010. An unusual rice false smut epidemic reported in Raigarh District, Chhattisgarh. Int. Rice Res. Notes 35: 1-3.

Singh, G. Singh, Y. Singh, V.P. Johrison, D.E. and Mortimer, M. 2005. System level effects in weed management in rice-wheat cropping in India. BCPC Int. Cong. Crop Sci. Tech. 2005, SECC, Glasgow.

Chandara. S. Singh, H.K.. Kumar, P. and Yadav, N. 2016. Screening of rice (*Oryza sativa* L.) Genotypes for sheath blight (*Rhizoctonia solani*) in changing climate scenario. J. Agri. Search. 3(2): 130-132.

Kumar, M.S. Ganesh, S.K. Sakila, M. Dinakaran, D. and Senguttuvan, T. 2015. Screening for sheath blight (*Rhizoctonia solani* Kuhn) resistance in rice (*Oryza sativa* L.) Inter. J. Cur. Res. 7(12): 23901-23903.

Ghazanfar, M.U. Habib, A. and Sahi, S.T. 2009. Screening of rice germplasm against *Pyricularia oryzae*, the cause of rice blast disease**.** Pak. J. Phytopathol. 21(1): 41-44.

Yan, L. Xue-Mei, Z. De Qiang, L. Fu, H. Pei-Sing, H. and Yung-Liang, P. 2014. Integrated approach to control false smut in hybrid rice in Sichuan province, China Rice Sci. 21 (4): 354-360.

Shi-min, Z. Tian-xiao, C. Jie, Z. Hou-xiang, K. Qian-qian, L. Ya-fang, Z.; Zong-xiang, C. Xi-jun, C. Wen-de, L. Guo-liang, W. and Xue-biao, P. 2014**.** Screening of new resistant germplasm and resistance evaluation of different rice sub-population varieties to sheath blight (*Rhizoctonia solani* Kühn). Acta Phytopathol. sinica. 44(6): 658-670.