Reaction of a number of popular Rice cultivars and some donor lines to Sheath blight (*Rhizoctonia solani* Kühn) disease in Odisha

RINI PAL, DIPANKAR MANDAL, MOHAN KUMAR BISWAS AND BHIMA SEN NAIK

J. Mycopathol, Res, 55(4) : 359-363, 2018;
ISSN 0971-3719

**Department of Botany,
University of Calcutta,
Kolkata 700 019, India**

J. Mycopathol. Res. ***55(4)*** *: 359-363, 2018;* (ISSN 0971-3719)

Reaction of a number of popular Rice cultivars and some donor lines to Sheath blight (*Rhizoctonia solani* Kühn) disease in Odisha

RINI PAL, DIPANKAR MANDAL*, MOHAN KUMAR BISWAS AND BHIMA SEN NAIK
All India Co-ordinated Rice Improvement Project, Regional Research and Technology Transfer Station (R.R.T.T.S), Orissa University of Agriculture and Technology(O.U.A.T), Chiplima 768025, Sambalpur, Odisha

Received : 04.09.2017 Accepted : 15.09.2017 Published : 29.01.2018

A study was conducted at All India Coordinated Rice Improvement Project, RRTTS, Chiplima, Sambalpur, Odisha to find out a few popular cultivars and donor lines resistant to sheath blight pathogen both under field and laboratory conditions. Out of eighteen popular varieties of Odisha screened against sheath blight under field condition, three varieties (Tejaswini, Pratikshya and Mrunalini) were categorized as moderately resistant. Most of the varieties screened were either moderately susceptible (five varieties) or susceptible (six varieties). Four varieties were designated as highly susceptible. None of the entry in the present study was recorded as immune or resistant. The three cultivars (Tejaswini, Pratikshya and Mrunalini) graded as moderately resistant after field screening gave same result under in vitro conditions also confirming them as moderately resistant to sheath blight pathogen, *Rhizoctonia solani*. Thirty four donor entries were simultaneously screened against sheath blight pathogen after artificial inoculation under field condition. Among them, three donor entries DRR- BL-257-2, DRR-BL-295-1 and DRR-BL-295-2 showed good results consecutively for two years of screening and were considered to be moderately resistant to the disease. Five donor lines were graded as moderately susceptible, nine lines exhibited susceptible reactions to the disease while 17 donor lines were graded as highly susceptible to the disease. None of the lines screened was found highly resistant or immune to *Rhizoctonia solani*. The three cultivars which were found moderately resistant to the disease will be beneficial to the farmers in sheath blight endemic areas to reduce the extent of crop damage as well as yield loss. The three donor lines identified as moderately resistant will be helpful in resistant breeding programme.

Key words: Cultivars, donors, resistance, sheath blight, rice

INTRODUCTION

Sheath blight disease of rice is now prevalent on many improved varieties grown in Odisha being a major constraint in profitable rice production especially in intensive production systems. Crop intensification has increased the frequency of incidences of diseases and insect pests and sheath blight is also not an exception thus threatening the productivity level. The disease has become a problem in recent years on all the major high yielding rice cultivars grown in the state. Management of the disease is difficult due to viability of sclerotia in the soil for several years and moreover, crop intensification is providing host plants for the pathogen throughout the year. Strategies for the control of sheath blight disease through resistance breeding became limited due to lack of cultivars with significant level of resistance. At present, no rice variety was found either immune or highly resistant to the disease and especially long grain semi dwarf rice cultivars are considered most susceptible in commercial fields (Groth, 2005). The major problem in sheath blight resistance breeding is the lack of suitable donors having high degree of resistance to the pathogen. Several Quantitative Trait Loci (QTL) for sheath blight resistance have been identified from *indica* or *japonica* rice. A total of 33 QTL was found associated with sheath blight resistance (Srinivasachary *et al.* 2011). Resistance breeding works need to be continued to achieve some good varieties immune to the disease as resistant cultivars are the most durable, economical and practical means of tackling the pathogens being compatible with all other components of disease control. Many popular varieties of Odisha may have resistant genes against the disease but the farm-

*Corresponding author: rinipatho@gmail.com

ers are unaware of that. Taking all these factors into consideration, the present study was carried out to find out suitable popular rice cultivars and some donor lines resistant against sheath blight pathogen especially for areas which are endemic to sheath blight disease.

MATERIALS AND METHODS

The research work was carried out both under laboratory and field conditions. Laboratory experiments were carried out at Pathology laboratory of RRTTS, Chiplima, Sambalpur, Odisha. All the field experiments were conducted in experimental fields of All India Coordinated Rice Improvement Project (20^0 21'N latitude and 80^0 55'E longitude with an elevation of 178.8 m above mean sea level), Chiplima, Sambalpur, Odisha during *kharif* season of 2013 and 2014.

Field screening of popular rice varieties against sheath blight

A total of eighteen popular rice varieties of the state were selected for this study. Each variety was sown in a plot of $20m^2$ and a spacing of 15x20 cm with two replications each. All the varieties were artificially inoculated six weeks after transplanting by putting mycelial mass and sclerotia of 7 days old culture of *R. solani* in between the leaf sheath just above the water line. Then they were screened for sheath blight resistance about 15 days after inoculation on the basis of the development of the disease symptoms by recording the percent disease severity and disease score (Anon, 1996).

IRRI SES Scale (1996) for Sheath blight

0= No infection
1=Vertical lesions upto 20% of plant height
3= Vertical lesions upto 21-30% of plant height
5= Vertical lesions upto 31-45% of plant height
7 = Vertical lesions upto 46-65% of plant height
9= Vertical lesions upto 66-100% of plant height

In vitro screening of popular varieties by detached leaf method

The varieties were also tested under laboratory condition for assessing reaction to sheath blight following detached leaf assay (Vijay *et al*. 2011). For this, leaves were detached using scissors from 5 week old plants and brought to the laboratory.

Table 1: Field evaluation of some popular rice varieties against sheath blight disease of rice

Name of the variety	Disease severity %			Score (0-9)	Grade
	2013	2014	Pooled		
Swarna	61.9	63.3	62.6	7	HS
MTU 1001	41.7	45.1	43.4	5	S
MTU 1010	41.4	37.4	39.4	5	S
Lalat	25.2	22.6	23.9	3	MS
Jaya	46.1	32.7	39.4	5	S
Pratikshya	11.9	19.6	15.8	1	MR
Tejaswini	22.5	8.7	15.6	1	MR
Rajeswari	30.0	30.0	30.0	3	MS
Mrunalini	19.6	15.8	17.7	1	MR
Hiranmayee	25.8	28.6	27.2	3	MS
Jyotirmayee	73.9	68.4	71.2	9	HS
Rudra	68.3	76.8	72.6	9	HS
Konark	37.4	42.7	40.1	5	S
Savita	47.2	41.9	44.6	5	S
Bhoi	23.9	28.3	26.1	3	MS
Sebati	24.7	20.5	22.6	3	MS
Jagabandhu	27.4	35.6	31.5	5	S
Abhay	64.6	67.8	66.2	9	HS

*R=Resistant, MR=Moderately Resistant, S=Susceptible, MS= Moderately Susceptible, HS= Highly Susceptible

Table 2: *In vitro* evaluation of some popular rice varieties against sheath blight disease of rice by detached leaf method

Name of the variety	Disease severity %	Score (0-9)	Grade
Swarna	64.7*****	7	HS
MTU 1001	29.2	3	MS
MTU 1010	58.2	7	HS
Lalat	26.9	3	MS
Jaya	57.4	7	HS
Pratikshya	15.1	1	MR
Tejaswini	5.4	1	MR
Rajeswari	39.9	5	S
Mrunalini	6.8	1	MR
Hiranmayee	28.2	3	MS
Jyotirmayee	73.8	9	HS
Rudra	75.2	9	HS
Konark	62.5	7	HS
Savita	34.7	5	S
Bhoi	37.1	5	S
Sebati	26.2	3	MS
Jagabandhu	26.9	3	MS
Abhay	87.2	9	HS

***** average of three replications

Table 3: Reaction of some donor entries to sheath blight of rice

Designation	Source	Disease severity %			Score (0-9)*	Grade
		2013	2014	Mean		
IET 21423	IIRR	74.2	60.5	67.4	9	HS
IET 21347	,,	58.3	40.8	49.6	7	HS
IET 22164	,,	37.9	28.7	33.3	5	S
IET 21341	,,	34.6	24.2	29.4	3	MS
RP Patho-1	,,	53.8	41.3	47.6	7	HS
RP Patho-2	,,	40.9	37.2	39.1	5	S
RP Patho-3	,,	33.1	25.7	29.4	3	MS
RP Patho-4	,,	54.6	43.2	48.9	7	HS
RP Patho-5	,,	68.3	44.1	56.2	7	HS
RP Patho-6	,,	39.8	35.5	37.7	5	S
RP Patho-7	,,	57.4	42.4	49.9	7	HS
RP Patho-8	,,	71.0	58.7	64.9	7	HS
RP Patho-9	,,	43.1	35.3	39.2	5	S
RP Patho-10	,,	59.6	47.5	53.6	7	HS
RP Patho-11	,,	86.1	63.7	74.9	9	HS
RP Patho-12	,,	75.2	56.5	65.9	9	HS
DRR-BL-31-1	,,	57.3	39.6	48.5	7	HS
DRR-BL-31-2	,,	46.8	43.2	45.0	5	S
DRR-BL-150-1	,,	26.7	22.9	24.8	3	MS
DRR-BL-150-2	,,	25.5	23.2	24.4	3	MS
DRR-BL-155-1	,,	27.9	25.0	26.5	3	MS
DRR-BL-155-2	,,	41.6	36.5	39.1	5	S
DRR-BL-159-1	,,	44.4	50.2	47.3	7	HS
DRR-BL-159-2	,,	75.0	63.4	69.2	9	HS
DRR-BL-257-1	,,	82.5	77.8	80.2	9	HS
DRR-BL-257-2	,,	18.8	11.5	15.2	1	MR
DRR-BL-295-1	,,	15.3	19.1	17.2	1	MR
DRR-BL-295-2	,,	19.5	17.0	18.3	1	MR
DRR-BL-368-1	,,	38.6	31.4	35.0	5	S
DRR-BL-368-2	,,	42.8	57.5	50.2	7	HS
DRR-BL-420-1	,,	37.3	33.9	35.6	5	S
DRR-BL-420-2	,,	44.0	49.1	46.6	7	HS
DRR-BL-444-1	,,	28.6	35.4	32.0	5	S
DRR-BL-444-2	,,	77.5	60.8	69.2	9	HS
Pratikshya	RC	18.8	13.5	16.2	1	MR
Swarna	SC	72.6	63.0	67.8	9	HS

*RC= Resistant check, SC= Susceptible check, R=Resistant, MR=Moderately Resistant,S=Susceptible, MS= Moderately Susceptible, HS= Highly Susceptible.

They were then surface disinfected with 2 % sodium hypochlorite solution and cut into 6-8 cm long pieces. They were placed in sterilized glass petridishes containing moistened filter paper. Two pieces of leaf per petridish was replicated thrice. A mycelium block of 6 cm diameter was placed on the abaxial surface of the leaf section. Leaves sprayed with sterile distilled water served as control. The petridishes were incubated at 28 ± 2^0C. Water soaked lesions appeared after 24 hours and clear cut lesions were observed 48 hours after inoculation. Sheath blight severity % was recorded 72 hours after inoculation by the relative lesion area calculated as the total lesion area divided by the total leaf area and varieties were rated following SES Scale (Anon, 1996).

Screening of some donor entries against sheath blight pathogen

The study was conducted at the experimental site of All India Coordinated Rice Improvement Project, RRTTS, Chiplima during the kharif season of 2013 and 2014. Thirty four donor lines were collected from IIRR, Hyderabad for this study. About 30 days old seedlings of each test entry along with two local checks were transplanted in a plot of two rows measuring 2 m each in length. The two rows were 20cm apart and the distance between two plants in a row was 15cm. All recommended agronomic practices were followed and the trial was conducted under irrigated condition. The cultivars were artificially inoculated at tillering stage by straw bit method (Rao and Kannaiyan, 1973). For this, the rice stem bits were cut into small bits of 1-2 cm and sterilized in conical flasks. These flasks were inoculated with sclerotia and incubated in a BOD incubator at 28 ± 2^0 C for 7-8 days. Mycelial mass and sclerotia developed on these stem bits were used for inoculation by putting 2-3 pieces in between the leaf sheath just above the water line. Then they were screened for sheath blight resistance about 15 days after inoculation on the basis of the development of the disease symptoms by recording the percent disease severity and disease score. Observations on disease severity were recorded on randomly selected 10 plant tillers by using 0–9 rating scale given by IRRI standard evaluation system (Anon,1996).

Field screening of popular rice varieties against sheath blight

Eighteen popular varieties were screened against sheath blight under field conditions. The varieties were screened against sheath blight during kharif season of 2013 and 2014 after artificial inoculation. The severity of sheath blight was recorded on selected infected tillers. The pooled PDS (Percent Disease Severity) of two years i.e. 2013 and 2014 was calculated and varietal reaction was also recorded. Out of eighteen varieties screened against sheath blight, three varieties (Tejaswini, Pratikshya and Mrunalini) were categorized as moderately resistant all scoring 1 with a pooled PDS of 15.6 %, 15.8 % and 17.7 % respectively (Table 1). Most of the varieties screened were either mod-

erately susceptible (five varieties) or susceptible (six varieties). The rest four varieties in the present screening (Swarna, Jyotirmayee, Rudra and Abhay) were designated as highly susceptible scoring 7 and 9. None of the entry in the present study was recorded as immune or resistant.

In vitro screening of popular varieties by detached leaf method

The above mentioned eighteen varieties were screened under laboratory condition following detached leaf assay. The three varieties (Tejaswini, Pratikshya and Mrunalini) graded as moderately resistant in field screening, scored 1 under laboratory condition further confirming them as moderately resistant against the sheath blight pathogen, *Rhizoctonia solani*. These three varieties namely, Tejaswini, Pratikshya and Mrunalini exhibited mean PDS values of 5.4%, 15.1% and 6.8% respectively (Table 2). Seven varieties were found highly susceptible to the disease scoring 7 and 9 where as majority of the varieties were either moderately susceptible or susceptible. So, it can be said that, laboratory screening compared well with the field screening except a little bit differences in few cases.

Screening of some donor entries against sheath blight pathogen

Thirty four donor entries along with two check varieties were screened against sheath blight pathogen, *Rhizoctonia solani* after artificial inoculation . Among them, the susceptible check Swarna (MTU 7029) exhibited a mean Percent Disease Severity (PDS) of 67.8 (score 9) rendering it highly susceptible against the disease. The resistant local check Pratikshya showed a mean PDS of 16.2 (Score 1) and designated itself as moderately resistant.

The severity of sheath blight on 34 donor entries varied from the scale of 1 to 9 (Table 3). Among them, three donor entries DRR- BL-257-2, DRR-BL-295-1 and DRR-BL-295-2 showed good results consecutively for two years of screening with a mean PDS of 15.2, 17.2 and 18.3 respectively all with a score of 1. They accounted for 8.33% of the total donor entries. Five donor lines (IET 21341, RP Patho-3, DRR-BL-150-1, DRR-BL-150-2 and DRR-BL-155-1) were graded as moderately susceptible based on their mean PDS values with score 3. On the basis of mean PDS values, nine lines (25 % of total entries) exhibited susceptible reactions to the disease scoring 5 while 17 donor lines recorded scores of 7 and 9 accounting for 47.22 % of the total entries and graded as highly susceptible to the disease. Some of the donor entries showed higher PDS values than the susceptible check Swarna. None of the lines screened was found highly resistant or immune to *R. solani*. However, the three entries which were on the scale of 1 were considered to be moderately resistant to the disease. The line DRR-BL-257-2 recorded a mean PDS of 15.2 and thus performed better than the local resistant check Pratikshya (mean PDS 16.2).

Breeding for sheath blight resistance has been difficult, mainly because of lack of identified resistant donors in cultivated varieties (Bonmann *et al*. 1992). Till date, no rice variety has been found to be highly resistant or immune to *R. solani*, although cultivars with varying levels of resistance have been reported by many workers (Li *et al*. 2000; Singha and Borah, 2000 ; Jia *et al*. 2009). Rice sheath blight resistance among the varieties currently ranges from very susceptible to moderately resistant. The yield losses were reported to be 8% in moderately resistant (cv. Jupiter) and up to 30% in very susceptible (cv. Trenasse) in rice fields with artificial inoculation (Groth, 2008). Tang Qi Yuan *et al*. (2007) observed that varieties with taller stature, fewer tillers, and lower leaf nitrogen concentration generally had lower sheath blight lesion height, sheath blight index, and consequently lower yield loss from the disease. The disease was found to be severe on cultivars that are short, highly tillering and more erect as compared to the tall cultivars with fewer tillers. Singh *et al*. (2004) reported that sheath blight is usually more severe in high yielding dwarf indica cultivars than in traditional tall indica cultivar. Meena *et al*. (2000) found that out of 120 test accessions, only 7 lines were moderately resistant while remaining accessions were found to be moderately susceptible to sheath blight. A number of moderately resistant cultivars were observed in the medium and late maturity groups (Biswas, 2001) though, those genotypes identified as moderately resistant were not yet been used in breeding programmes as donors of resistance in most of the cases.

Out of eighteen popular varieties screened against sheath blight, three varieties namely Tejaswini, Pratikshya and Mrunalini were categorized as moderately resistant. The three varieties which

were found moderately resistant to the disease both in vitro and in vivo conditions will be beneficial to the farmers in sheath blight endemic areas to reduce the extent of crop damage as well as yield loss. Three donor entries DRR- BL-257-2, DRR-BL-295-1 and DRR-BL-295-2 showed good results consecutively for two years of screening and were considered to be moderately resistant to the disease. These three donor lines identified as moderately resistant will be helpful in resistant breeding programme.

REFERENCES

Anon; 1996 1996. *Standard Evaluation System for rice*. Manila, Philippines, 25 pp.

Biswas, A. 2001. Reaction of hybrid rice varieties to sheath blight (ShB) disease in West Bengal, India. *J. Mycol. Plant Pathol*. **31**: 360–361.

Bonmann, J.M.; Kush, G.S. and Nelson, R.J. 1992. Breeding for resistance to pests. *Ann. Rev. Phytopathol*. **30:** 507–523.

Groth, D.E. 2005. Azoxystrobin rate and timing effects on rice sheath blight incidence and severity and rice grain and milling yields. *Plant Disease*. **89**:1171-1174.

Groth, D. E. 2008. Effects of cultivar resistance and single fungicide application on rice sheath blight, yield, and quality. *Crop Protection*. **27**: 1125-1130.

Jia, L.M.; Agrama, H.; Yeater, K.; McClung, A. and Wu, D. 2009. *Evaluation of the USDA rice core collection for sheath blight disease using micro-chamber*. In: Int Annu Meet Footprints in the Landscape: Sustainability through Plant and Soil Sciences. Pittsburgh.

Li, H.; Song, C.Y.; Cong, W.B. and Wang, G.L. 2000. Evaluation and screening of Keng (*Japonica*) rice varieties to sheath blight. *Plant Prot*. **26**: 19-21.

Meena, B.; Ramamoorthy, V.; Banu, J.G.; Thangavelu, R. and Muthusamy, M. 2000. Screening of rice genotypes against sheath blight disease*. J. Ecobiology*. **12**: 103-109.

Rao, A.V. and Kannaiyan, S. 1973. An easy method of screening rice varieties for resistance to sheath disease. *Ind. J. Mycol. Pl. Pathol*. **3**: 106-107.

Singh, S.K.; Shukla,V.; Singh, H. and Sinha, A.P. 2004. Current status and impact of sheath blight in rice (*Oryza sativa* L*.)* - a review. *AgrJc. Rev.* **25** : 289 – 297.

Singha, K.D. and Borah, P. 2000. Screening of local upland cultivars of Assam against sheath blight. *Ann. Biol*. **16**: 161–162.

Srinivasachary, L.; Willocquet, L. and Savary, S. 2011. Resistance to rice sheath blight (*Rhizoctonia solani* Kuhn) [Teleomorph: *Thanatephorus cucumeris* (A. B. Frank) Donk.] disease: current status and perspectives. *Euphytica*. **178**: 1–22.

Tang QiYuan., Peng ShaoBing., Buresh, R. J., Zou YingBin., Castilla, N. P., Mew, T. W. and Zhong XuHua. 2007. Rice varietal difference in sheath blight development and its association with yield loss at different levels of N fertilization. *Field Crops Research*. **102**: 219-227.

Vijay, K.K.; Reddy, M.S.; Yellareddygari, S.K.; Kloepper, J.W.; Lawrence ,K.S.; Zhou, X.G.; Sudini, H. and Miller, M.E. 2011. Evaluation and selection of elite plant growth-promoting rhizobacteria for suppression of sheath blight of rice caused by *Rhizoctonia solani* in a detached leaf bio-assay. *International Jounal Applied Biology and Pharmaceutical Technology*. **2**: 488-495.