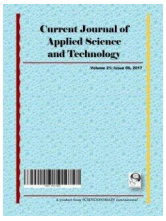

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Assessment of Virulence Diversity of *Rhizoctonia solani* Causing Sheath Blight Disease in Rice from Eastern Up

S. Lalitha Pavani[1*] and Vineeta Singh[1]

[1]Department of Mycology and Plant Pathology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India.

Authors' contributions

This work was carried out in collaboration between both authors. The author SAP designed, analyzed and interpreted and prepared the manuscript. Author VS supported and guided throughout the research of this study. Both authors read and approved the final manuscript.

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ABSTRACT

Sheath blight of rice is an important and destructive disease caused by *Rhizoctonia solani*. Fifty rice sheath blight samples were collected from different parts of eastern UP and pathogenic variability was studied on different rice cultivars *Viz.,*Pusa Basmati-1(PB-1) susceptible rice cultivar and Tetep moderately resistant cultivar. The perusal of data indicated significant differences in the aggressiveness of isolates. The total of 50 isolates was grouped into four group as weakly virulent (WV), moderately virulent (MV), virulent (V) and highly virulent (HV), representing 30, 46, 20 and 4% of isolates, respectively. Majority of the isolates were moderately virulent on susceptible cultivar (PB-1), whereas in moderately resistant cultivar (Tetep) majority of isolates were weakly virulent representing (88%) followed by moderately virulent (8%) and virulent (2%).

Keywords: Rice cultivars; sheath bligh; Rhizoctonia solani; virulence diversity.

**Corresponding author: E-mail: lalithaagrico@gmail.com;*

1. INTRODUCTION

Rice is the world's most important food crop. It is harvested from over 163 million ha in more than 100 countries (http://www.fao.org/faostat/en/#home). It is a basic food for millions of people and having considerable importance in food and nutritional security. It is the second most widely consumed food grain in the world next to wheat. Rice is subjected to the attack of over 30 fungi in our country. Major fungal diseases are blast, brown spot, false smut, bunt, sheath rot, sheath blight, leaf scald, stem rot, sheath net blotch and seedling blight [1]. Of these, rice sheath blight caused by *Rhizoctonia solani* is second only to rice blast in importance.

The importance of this disease is still tending to increase, particularly in East Asian countries Manibushanrao et al. [2]. It causes several diseases of crops of economic importance and perhaps damping off of seedlings of most crops is the principal disease of *R. solani.* Sheath Blight is considered to be an important disease next to rice blast. In China, the rice yield losses caused by sheath blight have exceeded those caused by blast, making SB the most serious disease (Zuo et al. 2008; Zeng et al. [3])

In China, the disease has affected more than 3.2 million hectares causing yield losses of over 200 million kg/year. The severity of the disease is greater when there is a large resident population of the pathogen in the soil, earlier infection, wet environmental conditions and susceptible cultivars [4]. Plants with a high genetic resistance to sheath blight are not available. Only T 141, OS 4, BCP 3, Saibham, Buhjan, Saduwee, Remadja, Ta-Poo-Cho-Z, Nangmons 4, Athebu, Phoure and ARC 15368 have been identified as donors expressing moderate resistance to sheath blight.

Zhu et al. [5] estimated that the cultivated rice contains only about 25% of the genetic diversity found in its wild progenitors depicting severe genetic erosion during domestication. Furthermore, a considerable level of genetic diversity was lost during the agronomic improvement of commonly cultivated rice. Nevertheless, identification of SB resistance becomes challenging because disease pathogenicity is highly influenced by physiological traits, variation of disease pressure with location and years, lack of appropriate method to evaluate the disease precisely, variations in the rating system among scientists, variations in experimental conditions in various studies, lack of resistant adapted germplasm, the limited efficiency and effectiveness of available screening methods, and the polygenic nature of the resistance phenotype [6]. Pathogenic variability has a great concern in *R. solani*. Variation in lesion length was observed among different isolate-rice cultivar combination and this will be a determining factor in breaking the static mechanism of the host resistance. Once the variability is defined, it will help in identification of level of resistance in germplasm and genotype characterization for resistance and it would help to choose the parents in crossing programmes. From the above fact, our main aim is to investigate the pathogenic variability in *R. solani* infecting rice.

2. MATERIALS AND METHODS

2.1 Collection, Isolation and Purification of the Pathogen Causing Rice Sheath Blight from Eastern UP

The survey was conducted during 2014-2015 cropping seasons in different areas of north India, e.g., Uttar Pradesh (Varanasi, Mirzapur, Lucknow, Faizabad, Jaunpur, Ghazipur and Chandauli). To collect the sheath blight infected samples of rice for the study of diversity within *R. solani* (Table 1). Sampling was done using stratified random sampling method (transect sampling by walking through the field) at boot stage from 7 to 10 transect, at least 10m apart, in each field [7].

2.2 Isolation and Purification of *Rhizoctonia solani*

Plant tissues of rice sheaths and leaf blades with typical sheath blight symptoms were surface disinfected with sodium hypochlorite solution (0.5%) for one minute and were rinsed three times with sterile distilled water. Pieces (0.5 cm) of sheath or leaf blade was dried on sterilized filter paper and placed on Petridish containing water agar and incubated at 26±2°C. After 2-3 days cultures were examined microscopically for hyphal characteristics typical of *R. solani.* Hyphal tip of each isolate was sub-cultured on water agar for further purification. Isolates were transferred to PDA slants and maintained at 26±2°C. Following sufficient growth and production of sclerotia, culture tubes were kept at 4°C for short term storage.

Table 1. Survey for the collection of rice sheath blight infected samples in different areas of north India during 2013-14 and 2014-15 crop seasons

Sample no.	Variety	Place	GPS Values
Varanasi, UP			
RS1	MALVYYA-105	Adalpura	Latitude : 25.176101 Longitude: 82.87617
RS2	MALVYYA-105	Adalpura	Latitude : 25.176101 Longitude: 82.87617
RS3	SAMBHA MANSOORI	Mohansorai	Latitude : 25.321684 Longitude: 82.987289
RS4	SAMBHA MANSOORI	Mohansorai	Latitude : 25.321684 Longitude: 82.987289
RS5	SAMBHA MANSOORI	BHU	Latitude : 25.267878 Longitude: 82.990494
RS6	PB1	BHU	Latitude : 25.267878 Longitude: 82.990494
RS7	CUTTACK MASURI	Narayanpur	Latitude : 25.3578 Longitude:82.9733
RS8	CUTTACK MASURI	Narayanpur	Latitude : 25.3578 Longitude:82.9733
RS9	MOTI	Akhari	Latitude : 25.243157 Longitude:82.95284
RS10	MOTI	Akhari	Latitude : 25.243157 Longitude:82.95284
Mirzapur(UP)			
RS11	SONAM	jamalpur	Latitude : 25.1305728 Longitude : 83.034787
RS12	SONAM	jamalpur	Latitude : 25.130572 Longitude : 83.034787
RS13	SONAM	jamalpur	Latitude : 25.130572 Longitude : 83.034787
RS14	DPT	Narainpur	Latitude : 25.10486 Longitude :82.86774
RS15	DPT	Narainpur	Latitude : 25.10486 Longitude : 82.86774
RS16	DPT	Narainpur	Latitude : 25.104866 Longitude : 82.86774
RS17	DPT	Narainpur	Latitude : 25.104866 Longitude : 82.86774
RS18	DHAMINI	Rajgarh	Latitude : 25.1337057 Longitude: 82.5644274
RS219	DHAMINI	Rajgarh	Latitude : 25.1337057 Longitude: 82.5644274
RS20	DHAMINI	Rajgarh	Latitude : 25.1337057 Longitude: 82.5644274
Lucknow,UP			
RS21	SARJUBHAVAN	Arjunganj	Latitude : 26.7750723 Longitude: 80.9641068
RS22	SARJUBHAVAN	Arjunganj	Latitude : 26.7750723 Longitude: 80.9641068
RS23	SARJUBHAVAN	Arjunganj	Latitude : 26.7750723 Longitude: 80.9641068
RS24	SARJUBHAVAN	Arjunganj	Latitude : 26.7750723 Longitude: 80.9641068
RS25	NDR-97	Malihabad	Latitude :26.92 Longitude: 80.72
RS26	NDR-97	Malihabad	Latitude :26.92

Sample no.	Variety	Place	GPS Values
			Longitude:80.72
RS27	NDR-97	Malihabad	Latitude :26.92
			Longitude:80.72
RS28	SARJUBHAVAN	Kakori	Latitude :26.88
			Longitude:80.79
RS29	SARJUBHAVAN	Kakori	Latitude :26.88
			Longitude:80.79
RS30	SARJUBHAVAN	Kakori	Latitude :26.88
			Longitude:80.79
Faizabad,UP			
RS31	NDR-2064	Tandauli	Latitude : 26.605
			Longitude: 82.3508
RS32	NDR-2064	Tandauli	Latitude : 26.605
			Longitude: 82.3508
RS33	NDR-2064	Haibatpur	Latitude : 28.12675
			Longitude: 78.91535
RS34	NDR-2064	Haibatpur	Latitude : 28.12675
			Longitude: 78.91535
RS35	NDR-2064	Kumarganj	Latitude : 26.5468
			Longitude : 81.8402
RS36	NDR-2064	Kumarganj	Latitude : 26.5468
			Longitude : 81.8402
Jaunpur, UP	DRR-44	Badlapur	Latitude : 25.883489
			Longitude : 82.442462
RS37	DRR-44	Badlapur	Latitude : 25.883489
			Longitude : 82.442462
RS38	DRR-44	Badlapur	Latitude : 25.883489
			Longitude : 82.442462
RS39	GOVINDBHAG	Kerakat	Latitude : 25.64776
			Longitude : 82.918429
RS40	GOVINDBHAG	Kerakat	Latitude : 25.64776
			Longitude : 82.918429
RS41	GOVINDBHAG	Kerakat	Latitude : 25.64776
			Longitude : 82.918429
Ghazipur,UP			
RS42	NDR-2008	Narsingpur	Latitude : 25.415966
			Longitude: 83.559813
RS43	MALVYYA-105	Narsingpur	Latitude : 25.415966
			Longitude: 83.559813
RS44	MALVYYA-105	Narsingpur	Latitude : 25.415966
			Longitude: 83.559813
RS45	MALVYYA-10-9	Sohilapur	Latitude : 25.587
			Longitude: 83.550
RS46	MALVYYA-10-9	Sohilapur	Latitude : 25.587
			Longitude: 83.550
Chandauli, UP			
RS47	DPT	Pritampur	Latitude : 26.521866
			Longitude: 82.777621
RS48	MANSURI	mustafapur	Latitude : 25.26297
			Longitude: 83.31718
RS49	DPT	Niyamatabad	Latitude : 25.2289
			Longitude: 83.1347
RS50	SONAM	Vijaipur	Latitude : 25.26297
			Longitude: 83.31718

Table 2. Grouping of *Rhizoctonia solani* isolates on the basis of virulence on rice variety PB-1 under artificial inoculation conditions during cropping season 2015

Virulence nature	PDI * (%)	Glasshouse conditions	No. of isolates
Weakly virulent	<22	RS5, RS21, RS22, RS26, RS27, RS29, RS31, RS32, RS38, RS39, RS41, RS44, RS45, RS46, RS48	**15**
Moderately virulent	22-43	RS3, RS4, RS6, RS9, RS12, RS13, RS14, RS15, RS16, RS17, RS18, RS19, RS20, RS24, RS25, RS28, RS33, RS34, RS35, RS36, RS37, RS42, RS43	**23**
Virulent	44-65	RS1, RS2, RS7, RS8, RS10, RS11, RS30, RS40, RS47, RS50	**10**
Highly virulent	66-87	RS12, RS49	**2**

2.3 Virulence Pattern of Different *Rhizoctonia solani* Isolates

Rhizoctonia solani isolates from diverse geographical locations of Uttar Pradesh were collected and used for the virulence characterization against rice cultivar Pusa Basmati-1 (PB-1) and Tetep. The seeds of rice cultivars were sown in earthen pots filled with rice field soil. Three seedlings per hill and three hills per pot were maintained. Three replicates were maintained for each treatment.

2.4 Inoculation of *Rhizoctonia solani*

In the glasshouse, second leaf sheath (from the top) at boot stage in rice was inoculated with a bit about 0.25 mg of four day old immature sclerotium of *Rhizoctonia solani* isolates (50) those are grown on PDA at 26±2°C. For inoculation leaf sheath was opened carefully and inoculum was placed inside the sheath. A few drops of sterilized water were added to the inoculated sheath. Inoculation was done in the evening and inoculated plants were sprayed with water in the next morning. These plants were maintained in glasshouse at 26±2°C. After 12 hours plants were examined for symptoms. The disease severity (lesion length) was assessed 21 days after inoculation. All the experiments were carried out in the three replications [8].

2.5 Incubation Period

The trial was conducted under glasshouse condition to observe the incubation period of the different isolates of *R. solani* inoculated on rice cultivar Pusa Basmati-1. The data were recorded after 12 h of inoculation.

2.6 Lesion Number

The lesion number was recorded 21 days after inoculation of different isolates of *R. solani* on the rice cultivar.

2.7 Lesion Height

The lesion height was recorded 21 days after inoculation of different isolates of *R. solani* on the rice cultivar.

2.8 Plant Height

The plant height was recorded 75 days after transplanting (DAT).

2.9 Relative Lesion Height

The Relative Lesion Height (RLH) was recorded 21 days after inoculation (DAI) of different isolates of *R. solani* on the rice cultivar.

2.10 Percent Disease Index (PDI)

PDI was calculated 21 days after inoculation by the formula given by Wheeler [9].

$$PDI = \frac{(\text{Sum of all ratings} \times 100)}{(\text{Total no. of observations} \times \text{Maximum rating scale})}$$

2.11 Virulence

Virulence of all the isolates of *R. solani* was categorized into 4 classes i.e. Highly virulent (HV), Virulent (V), Moderately virulent (MV) and Weakly virulent (WV). PDI% (2-21)=WV; PDI% (22-43)=MV; PDI% 44-65%=V; PDI% (66-87)=HV.

2.12 Data Analysis

The relative lesion height (cm) in each tiller was calculated by using the formula given by Sharma et al. [10].

RLH = Maximum height at which lesion appear/plant height x100.

Disease severity of sheath blight was scored with a scale of 0-9 based on relative lesion height on the whole plant as follows [11].

The percentage disease index (PDI) was calculated as follows.

$$PDI = \frac{(\text{Sum of all ratings} \times 100)}{(\text{Total no. of observations} \times \text{Maximum rating scale})}$$

2.13 Statistical Analysis

The experiment was laid out in completely randomized design with three replications. The values of data obtained from the glasshouse were subjected to following statistical analysis. Analysis of variance (ANOVA) on the basis of available data. The differences in data in the various experiments were tested for their significance by employing α-lattice design. Each treatment was replicated thrice for validation.

3. RESULTS AND DISCUSSION

3.1 Isolation of *R. solani*

In the present study, 50 isolates were taken for studying variability. Sheath blight infected rice plants were collected and the pathogen *R. solani* was isolated and purified by single hyphal tip / single sclerotial method. Cultures were maintained on sterile PDA slants in test tube, at 4°C for further study.

3.2 Virulence Pattern of *Rhizoctonia solani* Isolates under Glasshouse Conditions during 2015-16 Cropping Season

Pot culture experiments were conducted with different isolates of *R. solani* collected from different rice growing regions of eastern UP to find out its aggressiveness against two varieties Pusa Basmati-1 (susceptible) and Tetep (moderately resistant).

Virulence analysis of 50 *R. solani* AG-1IA isolates was carried out on susceptible rice cultivar (Pusa Basmati-1) and moderately resistant cultivar (Tetep) under glasshouse conditions. All isolates of *R. solani* were virulent to rice, being able to produce lesions on leaves, leaf sheaths and stems of both susceptible and resistant cultivars. The perusal of data indicated significant differences in the aggressiveness of isolates. The total of 50 isolates was grouped into four group as weakly virulent (WV), moderately virulent (MV), virulent (V) and highly virulent (HV), representing 30, 46, 20 and 4% of all isolates, respectively in susceptible cultivar PB-1(Table 3).Whereas in moderately resistant cultivar (Tetep) majority of isolates were weakly virulent representing (88%) followed by moderately virulent (8%) and virulent (2%).

The isolates exhibit varied incubation period, lesion number, lesion height, relative lesion height (RLH) and percent disease index. The incubation period in the cultivar PB-1ranged between 2.96 -1.26 days. Isolate RS45 showed maximum incubation period (2.96 days) Table 5.

Whereas in Tetep it ranged from 2.73-1.4 days. Isolate RS11 showed maximum incubation period (2.73 days) Table. These results are in conformity with the findings of Madhavi et al. [12].

In susceptible cultivar PB-1 the PDI ranged between (7.5 – 92.8%). Among all the 50 isolates, maximum PDI (92.8%) was displayed

by isolate RS49 followed by RS12 (70.5%), while isolate RS26 showed the least value of PDI (7.5).Lesion numbers varied in the range of (1-7.5). RS26 inoculated plant showed the minimum number of lesion (1), although maximum lesion number (7.5) was displayed by RS49. RLH varied between6.46-58.1.Maximum lesion height was displayed by RS49.

Whereas in moderately resistant cultivar Tetep the PDI ranged between (3.7 – 49.33%). Among all the 50 isolates, maximum PDI (49.33%) was displayed by isolate RS49 followed by RS12 (48.5%), while isolate RS36 showed the least value of PDI (3.7). Lesion numbers varied in the range of (1.0-8.1) RS22 inoculated plant showed the minimum number of lesion (1), although maximum lesion number (8.1) was displayed by RS45. The results also indicated that the RLH varied between 2.13- 32.6cm. Maximum lesion height was displayed by RS12.These results are in conformity with the findings of Jayaprakashvel and Mathivanan [13].

Table 3. Virulence pattern of *Rhizoctonia solani* isolates on susceptible cultivar PB-1 during 2015 cropping season under glasshouse conditions

Isolates	Incubation period (days)	Lesion Number(cm)	Lesion Height(cm)	Plant Height(cm)	Relative Lesion Height(cm)	Percent Disease Index(%)
RS1	2.40	3.5	19.3	52.4	37.5	48.8
RS2	2.07	2.1	18.6	57.6	32.3	55.3
RS3	1.93	2.2	16.9	49.5	36.3	40.8
RS4	1.60	3.0	12.1	52.6	25.0	33.8
RS5	1.90	1.9	8.8	60.3	14.9	11.2
RS6	2.20	1.9	13.2	62.7	20.9	25.7
RS7	1.53	3.4	19.0	57.1	35.8	48.8
RS8	2.10	6.1	22.2	53.3	43.8	63.2
RS9	2.43	3.9	11.8	56.0	22.0	25.8
RS10	1.77	4.8	20.5	60.0	37.3	48.6
RS11	1.93	4.7	19.0	59.0	32.2	48.8
RS12	2.03	6.2	27.0	56.8	49.7	70.5
RS13	2.60	4.4	15.5	66.5	24.8	33.0
RS14	2.73	4.3	18.5	61.5	30.5	42.2
RS15	2.33	2.1	10.5	57.1	21.0	29.2
RS16	1.50	2.6	15.0	60.2	24.2	26.0
RS17	1.47	3.6	17.3	62.0	25.8	33.5
RS18	1.87	2.8	12.3	62.6	21.0	33.0
RS19	2.33	3.5	14.0	37.8	36.8	40.7
RS20	2.47	2.8	17.7	67.7	24.7	33.3
RS21	2.60	1.5	8.7	59.8	15.2	11.2
RS22	1.80	2.0	10.0	63.3	17.4	18.8
RS23	1.67	4.2	10.7	53.8	20.0	25.7
RS24	2.57	2.3	10.7	56.0	20.2	25.8
RS25	2.23	2.5	12.2	56.5	21.4	25.3
RS26	1.60	1.0	5.0	56.8	7.9	7.5
RS27	2.33	3.1	12.8	58.2	22.2	25.8
RS28	2.37	2.7	14.7	54.7	27.3	40.7
RS29	1.60	3.5	13.5	75.0	19.7	18.7
RS30	1.83	2.6	12.3	47.0	27.8	48.5
RS31	2.27	1.9	7.2	54.3	13.8	11.2
RS32	2.47	1.6	10.3	54.2	20.0	18.8
RS33	2.67	2.9	14.1	60.7	24.5	25.7
RS34	1.40	2.1	12.7	64.7	19.5	25.7
RS35	1.67	2.9	13.0	54.3	26.7	33.7
RS36	1.67	1.6	6.5	61.1	12.7	14.8
RS37	2.60	2.2	12.8	61.3	20.3	26.5
RS38	1.67	1.8	7.6	68.8	12.2	11.2
RS39	1.50	1.8	9.3	61.7	16.7	11.5
RS40	1.50	3.4	10.7	49.5	23.0	18.4

Isolates	Incubation period (days)	Lesion Number(cm)	Lesion Height(cm)	Plant Height(cm)	Relative Lesion Height(cm)	Percent Disease Index(%)
RS41	1.77	2.0	4.7	57.7	7.9	11.2
RS42	1.47	4.6	16.3	57.7	32.3	40.3
RS43	1.80	3.5	17.8	63.2	27.5	40.4
RS44	2.57	3.0	10.0	65.5	14.7	11.2
RS45	2.27	5.5	20.7	52.2	38.2	62.7
RS46	2.03	1.2	3.5	53.8	6.5	11.2
RS47	1.90	5.5	21.2	57.0	37.0	55.5
RS48	2.57	3.0	11.7	57.7	21.5	18.5
RS49	1.80	7.5	27.2	46.8	58.2	92.8
RS50	2.07	6.3	19.4	49.2	35.8	55.2
CD	0.78	1.17	4.84	6.06	5.74	5.92
SEM	0.21	0.31	1.30	1.63	1.54	1.59

Table 4. Grouping of *Rhizoctonia solani* isolates on the basis of virulence on rice variety Tetep under artificial inoculation conditions during cropping season 2015

Virulence nature	PDI * (%)	Glasshouse conditions	No. of isolates
Weakly virulent	<22	RS2, RS3,RS4, RS5, RS6, RS7, RS8,RS10, RS11, RS13, RS14, RS15, RS16, RS17, RS18, RS19, RS20, RS21, RS22, RS23, RS24, RS25, RS26, RS27, RS28, RS29, RS30, RS31, RS32, RS33, RS34, RS35, RS36, RS37, RS38, RS39,RS40, RS41, RS42, RS43, RS44, RS46, RS47, RS48,RS50	**45**
Moderately virulent	22-43	RS1, RS9, RS45	**3**
Virulent	44-65	RS12	**1**
Highly virulent	66-87	RS 49	**1**

Table 5. Virulence pattern of *Rhizoctonia solani* isolates on the moderately resistant cultivar Tetep during 2015 cropping season under glasshouse conditions

Isolates	Incubation period (days)	Lesion Number(cm)	Lesion Height(cm)	Plant Height(cm)	Relative Lesion Height(cm)	Percent Disease Index(%)
RS1	1.53	3.9	26.17	103.67	26.17	41.33
RS2	1.50	2.3	17.50	91.00	17.93	18.50
RS3	2.00	2.1	12.17	77.33	12.83	16.33
RS4	2.30	2.1	8.67	84.00	8.57	14.83
RS5	1.63	2.3	9.50	95.00	10.23	11.17
RS6	2.40	1.7	6.73	95.67	6.87	11.67
RS7	2.80	2.7	12.83	100.00	12.72	19.17
RS8	1.77	1.7	12.33	93.33	13.33	11.17
RS9	1.90	4.1	19.33	90.00	22.50	27.50
RS10	1.40	3.8	15.33	87.33	18.00	11.83
RS11	2.37	2.0	11.33	92.00	12.17	11.50
RS12	1.33	3.0	31.33	97.83	32.67	48.50
RS13	2.50	2.0	12.33	100.67	11.48	11.17
RS14	1.80	3.0	17.00	92.67	20.50	18.67
RS15	1.43	2.1	8.17	89.00	11.00	14.50
RS16	1.50	4.8	18.33	94.67	19.50	19.17
RS17	2.47	3.2	13.67	95.00	14.50	11.33
RS18	2.73	2.1	9.50	90.33	11.00	11.17
RS19	2.77	3.4	17.33	100.33	16.17	19.67
RS20	1.80	2.8	8.77	103.00	8.10	11.17
RS21	2.20	2.0	16.67	97.67	14.83	11.17

Isolates	Incubation period (days)	Lesion Number(cm)	Lesion Height(cm)	Plant Height(cm)	Relative Lesion Height(cm)	Percent Disease Index(%)
RS22	1.50	1.0	6.67	93.33	6.43	11.00
RS23	2.77	4.8	18.33	97.00	17.43	20.17
RS24	1.50	4.3	14.67	87.67	18.17	19.83
RS25	2.23	2.4	12.00	101.00	11.48	11.17
RS26	2.80	1.0	4.33	78.00	4.77	7.50
RS27	2.83	2.8	12.00	97.67	13.17	11.07
RS28	2.47	2.0	8.67	90.00	10.43	11.00
RS29	1.40	1.8	5.00	105.33	3.90	10.67
RS30	1.83	3.2	16.00	81.00	19.33	19.67
RS31	2.13	4.9	15.17	110.67	13.75	11.17
RS32	1.47	6.9	18.17	97.33	19.75	18.50
RS33	2.40	2.8	6.67	90.33	7.70	11.17
RS34	1.80	3.7	6.17	92.00	5.73	11.17
RS35	1.77	2.1	6.00	93.67	6.73	3.83
RS36	2.33	1.6	2.50	99.83	2.13	3.70
RS37	2.10	3.8	14.17	95.67	13.17	11.17
RS38	1.53	2.8	14.00	100.00	15.83	11.17
RS39	1.60	1.9	5.67	105.00	5.73	7.33
RS40	2.50	2.1	5.17	107.67	4.70	11.07
RS41	2.43	3.4	11.67	106.33	9.83	11.17
RS42	1.93	8.1	21.00	105.67	21.33	10.67
RS43	1.27	3.5	10.00	89.67	10.92	11.17
RS44	2.57	4.4	15.50	102.00	16.00	11.17
RS45	2.97	8.1	30.67	86.33	31.83	33.33
RS46	2.10	4.9	18.17	110.33	17.17	19.50
RS47	1.83	2.4	9.83	88.67	9.63	11.17
RS48	1.83	3.0	12.67	104.67	11.50	11.17
RS49	1.80	6.9	2.50	95.67	2.37	49.33
RS50	2.07	1.3	4.83	98.33	4.63	11.17
CD	0.56	0.82	4.71	9.97	3.37	3.40
SEM	0.15	0.22	1.27	2.68	0.90	0.91

4. CONCLUSION

Present study clearly indicated that rice cultivars should be screen to the aggressive isolates and its intensity should be measured as an important parameter. It was observed that different isolate revealed different type of virulence with different varieties. It may be due to different genetic background of the cultivars to virulence of *R. solani* and this will be a determining factor in breaking the static mechanism of the host resistance. Once the variability is defined, it will help in identification of level of resistance in germplsam and genotype characterization for resistance and it would help to choose the parents in crossing programmes.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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