Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(3): 1533-1536
Received: 15-03-2020
Accepted: 18-04-2020

R Pushpam
Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

V Ramamoorthy
Department of Plant Pathology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam, Vallanadu, Tamil Nadu, India

N Nithya
Department of Plant Pathology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam, Vallanadu, Tamil Nadu, India

S Fathima Nasrin
Department of Plant Pathology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam, Vallanadu, Tamil Nadu, India

E Meena
Department of Plant Pathology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam, Vallanadu, Tamil Nadu, India

VK Parthiban
Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

M Arumugam Pillai
Department of Plant Pathology, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Killikulam, Vallanadu, Tamil Nadu, India

Corresponding Author:
R Pushpam
Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Identification of suitable rice cultivar for sheath rot disease resistance by artificial screening in the germplasm

R Pushpam, V Ramamoorthy, N Nithya, S Fathima Nasrin, E Meena, VK Parthiban and M Arumugam Pillai

Abstract
Rice sheath rot disease caused by *Sarocladium oryzae* is one of the important diseases because the pathogen specifically infects flag leaf sheath covering the emerging panicle and also grains severely. The disease incidence is more in warm and humid conditions of tropical countries. The research work was carried out to identify promising resistant germplasm lines for sheath rot disease. Seventy nine rice germplasm were obtained from Department of Plant Breeding and Genetics, TNAU and raised at Agriculture College and Research Institute, Killikulam. The 79 rice germplasm lines were raised in pots in screen house conditions and evaluated for sheath rot resistance. The lines were artificially inoculated with sheath rot pathogen by two methods, attached tiller assay and standard grain inoculation technique. After 15 days of inoculation disease symptoms were scored and classified according to PDI index as resistant and susceptible. We observed 11 germplasm lines as resistant. Mostly tall varieties such as Katuyanam, Kichalisamba etc. was found to be resistant. The scented variety Kothamallisamba was also found to be resistant. The dwarf lines mostly come under the category of susceptible ones. The identified lines can be further used in breeding programs.

Keywords: Rice sheath rot, screening germplasm

Introduction
Rice suffers from many of the diseases caused by fungi, bacteria, viruses, phytoplasma, nematodes and other non-parasitic disorders. Among the fungal foliar diseases, blast caused by *Pyricularia grisea*, brown spot of rice caused by *Bipolaris oryzae*, sheath blight caused by *Rhizoctonia solani* and sheath rot caused by *Sarocladium oryzae* are important. Sheath rot of rice is present in all rice growing countries worldwide. Sheath rot is an important disease of rice, since the pathogen mainly affects the economic part of the rice plant *i.e.* boot leaf sheath enclosing young panicles which retards or aborts the emergence of panicles. Seeds from infected panicles become discolored and sterile, thereby reducing grain yield and quality significantly. The pathogen is a seed borne. Since, the pathogen attacks the crop at maturity during panicle initiation stage, its impact is direct to minimize the crop yields (Arunyanart *et al.*, 1981; Singh and Mathur, 1992) [2, 9]. The pathogen produces phytotoxins, *viz.*, cerulenin and helvoic acid (Shakthivelu and Gnanamanickam, 1986) [8]. These phytotoxins are responsible for production of grayish-brown necrotic lesion in flag leaf sheath and restricts translocation of photosynthates to the developing panicles, causing quantitative (chaffy grains) and qualitative yield loss (Ghosh *et al.*, 2002) [5].
Genetic variation is the rule in most of the fungi. The variation may arise following change in crop cultivation, genetic modification of hosts, environment or accidental induction of new genetic material into a region or local gene pool. It may also be a way of survival of the pathogen under adverse conditions. There is a need to identify the molecular variability in *S.oryzae* so that, the breeding for disease resistance can be taken up to a specific race in the locality. Yadav and Thrimurty (2006) observed pathogenic diversity among 22 isolates of *Sarocladium oryzae* collected from different locations of Chhattisgarh, India was studied on four test rice cultivars (Bamleshwari, Chapti, Pant-4 and IET- 8585). *S. oryzae* - isolate 10 was highly virulent and it was further used for screening of 13 wild rice to identify resistant donors. Amin *et al.* (1976) [1] screened 243 varieties and 1050 progeny lines and reported that tall varieties were highly resistance for sheath rot.
The screening for disease resistance is essential to identify the resistant variety/source for rice sheath rot disease. Cultivation using resistant variety is one of the best ways in reducing loss due to disease.

Hence, screening of genotypes for sheath rot disease was carried out with the following objectives. i) culture *S. oryzae* in artificial medium and establish sheath rot disease symptoms in screen house conditions. ii). screen for disease resistance in different rice genotypes.

Materials and Methods

Rice germplasm

The study was conducted at the Department of plant breeding and genetics at Agricultural college and research institute, Killikulam. Seventy nine germplasm lines were selected for this study supplied by Department of Plant Breeding and Genetics, Tamil Nadu Agricultural University. All the germplasms were transplanted in seventy eight separate pots of size 30 cm height and a width of 20 cm. The potting mixture was prepared by mixing field soil and Farm Yard Manure in 1:1 ratio. All recommended agronomic practices were followed and the trial conducted under irrigated condition.

The fungus *S. oryzae* was cultured in potato dextrose agar medium and it was identified based on morphology of conidiophores, phialades and conidia (Ou, 1985). Isolate was mass multiplied on potato dextrose agar and potato dextrose broth and used for standardization of disease screening protocols.

Pathogenicity assay – Attached tiller assay and standard grain inoculation techniques

Seven days old culture of *S. oryzae* cultured on potato dextrose agar was used in the experiment. Mycelial mat on potato dextrose agar medium was cut into approximately equal size using sterile blade and used for inoculation purpose. Tillers at booting stage grown in pots inside the screen house was inoculated with mycelial disc, covered with sterile moistened absorbent cotton and wrapped with paraffin film in attached tiller assay methods.

For standard grain inoculation method, the pathogen was mass multiplied on paddy grains. Twenty five to fifty ml of water was added to 200 g of chaffy grains and sterilized in 500 ml conical flasks. The mycelial discs (9 mm) of *S. oryzae* were inoculated on sterilized paddy chaffy grains separately. The cultures were incubated at 28 °C until the mycelial growth covered the grains. Single grain cultures (*Myceliated grains*) were taken from the inoculated flask and inserted between the flag leaf sheath and un-emerged panicle. The disease development was qualitatively scored as infected and immune after 15 days of inoculation. The rice genotypes were screened for sheath rot resistance after heading stage on the basis of the development of the disease symptoms by recording percent disease severity and disease score. Observations on disease severity were recorded at mature flag leaf sheath on randomly selected 10 plants tiller by using 0-9 rating scale given by standard evaluation system, IRRI (1996). The score is: 0- no incidence; 1-less than 1%; 3 -1 to 5%; 5- 6 to 25%; 7-26-50% and 9-51-100%. The Percent Disease Index (PDI) was calculated using standard formula;

$$\text{PDI \%} = \frac{\text{Sum of all disease ratings} \times 100}{\text{Total no. of sample observed} \times \text{maximum disease rating}}$$

Varietal reactions are recorded following the scale described in table 1.

Table 1: Relation between PDI index and Varietal Reaction

PDI %	Varietal reaction (VR)
0%	Immune
1-10%	Resistant
11-25%	Moderately resistant
25-50%	Moderately susceptible
50-75%	Susceptible
76-100%	Highly susceptible

Results and Discussion

Seventy nine rice cultivars including land races were screened against sheath rot under natural conditions. The severity of sheath rot was recorded on the inoculated tillers. The percent disease index (PDI) was calculated and varietal reactions presented in table 2.

Table 2: Reaction of rice germplasms for sheath rot incidence in artificial condition

S. No	Germplasm	Percent disease index (pdi %)	Varietal reaction in artificial innoculation method
1	ADT 39	52.8%	Susceptible
2	ADT 41	62.3%	Susceptible
3	ADT 45	55.8%	Susceptible
4	Abhaya	33.2%	Moderately Susceptible
5	ACK 13005	22.9%	Moderately Resistant
6	ACK 14001	80.7%	Highly Susceptible
7	AD BIO 09518	32.3%	Moderately Susceptible
8	ADT 36	79.5%	Highly Susceptible
9	ADT 37	69.9%	Susceptible
10	ADT 42	72.1%	Susceptible
11	ADT 46	23.8%	Moderately Resistant
12	ADT 47	54.1%	Susceptible
13	ADT 48	29.6%	Moderately Susceptible
14	ADT 49	5.6%	Resistant
15	Anjali	55.4%	Susceptible
16	Annada	33.8%	Moderately Susceptible
17	ASD 1	65.9%	Susceptible
18	ASD 16	66.3%	Susceptible
19	ASD 9	49.2%	Moderately Susceptible
20	Athira	22.5%	Moderately Resistant
21	BB 8	12.7%	Moderately Resistant
22	Bharathi	67.1%	Susceptible
23	BPT 5204	63.5%	Susceptible

24	Chinnapunchai	73.4%	Susceptible
25	CO 45	45.1%	Moderately Susceptible
26	CO 50	65.6%	Susceptible
27	CO 51	54.8%	Susceptible
28	CO39	64.3%	Susceptible
29	CR Dhan	24.9%	Moderately Resistant
30	IR 11L-114	65.4%	Susceptible
31	IR 11L-433	6.6%	Resistant
32	IR 11L-465	23.2%	Moderately Resistant
33	IR 12L-115	15.1%	Moderately Resistant
34	IR 12L-214	72.7%	Susceptible
35	IR 20	69.5%	Susceptible
36	IR 50	8.4%	Resistant
37	IR 64	65.8%	Susceptible
38	IR 72	78.5%	Highly Susceptible
39	IRRI 1041	73.7%	Susceptible
40	IRRI 163	55.9%	Susceptible
41	Jaya	81.1%	Highly Susceptible
42	JGL 384	34.3%	Moderately Susceptible
43	Kadaikannan	23.2%	Moderately Resistant
44	Kalakeri	65.6%	Susceptible
45	Kalinga 2	44.8%	Moderately Susceptible
46	Kalinga	4.2%	Resistant
47	Kalyani	7.5%	Resistant
48	Karudan	3.7%	Resistant
49	Karupukavuni	9.2%	Resistant
50	Kattanur	66.8%	Susceptible
51	Kattuyanam	6.3%	Resistant
52	Kavya	54.8%	Susceptible
53	Kichalisamba	3.1%	Resistant
54	Kothamallisamba	6.7%	Resistant
55	Maranellu	24.4%	Moderately Resistant
56	MDU 5	26.7%	Moderately Susceptible
57	Mulampunchan	56.2%	Susceptible
58	Navara	12.5%	Moderately Resistant
59	Poonkar	55.6%	Susceptible
60	Pusabasmathi	67.8%	Susceptible
61	PY 2	55.9%	Susceptible
62	PY 5	24.2%	Moderately Resistant
63	Rajalakshmi	49.5%	Moderately Susceptible
64	Sadabahar	74.7%	Susceptible
65	SS 2 18	24.8%	Moderately Resistant
66	Swarnamagari	69.9%	Susceptible
67	TN 1	4.1%	Resistant
68	TP 10049	68.5%	Susceptible
69	TP 10106	59.4%	Susceptible
70	TP08053	23.2%	Moderately Resistant
71	TP09028	13.6%	Moderately Resistant
72	TPS 4	72.8%	Susceptible
73	TPS 5	67.4%	Susceptible
74	Uma	85.9%	Highly Susceptible
75	Varaputha	24.3%	Moderately Resistant
76	Veethiruppa	33.1%	Moderately Susceptible
77	Virenthira	19.3%	Moderately Resistant
78	White sannam	27.7%	Moderately Susceptible
79	CO 33	79.7%	Highly susceptible

Out of 79 varieties screened against sheath rot varieties 34 varieties *viz* ADT 39, ADT 41, ADT 45, ADT 37, ADT 42, ADT 47, Anjali, ASD 1, ASD 16, Bharathi, BPT 5204, Chinnapunchai, CO 50, CO 51, CO 39, IR 11L-114, IR 12L-214, IR 20, 1R 64, IR 64, IRRI 1041, Mulampunchan, Poonkar, Pusabasmathi, PY2, Sadabahar, Swarnamagari, TP 10049, TPS 4, TPS 5, Kattanur, Kavya, Kalakeri and IRRI 163 were categorized as susceptible. 12 varieties *viz* Abhaya, AD BIO 09518, ADT 48, Annada, ASD 9, CO 45, JGL 384, Kalinga 2, MDU 5, Rajalakshmi, Veethiruppa and White sannam were categorized as moderately susceptible. 11 varieties *viz*., IR 50, Karudan, Karupukavuni, Kichalisamba, Kothamallisamba, TN1, ADT49, IR11L 433, Kalyani, Kalinga, kattuyanam were categorized as resistant. 16 varieties *viz*., ACK 13005, ADT 46, Athira, BB8, CR Dhan, IR 11L-465, IR 12L 115, Maranellu, Navara, PY5, SS2 18, TP 08053, TP 09028, Varaputha, Virenthirra, Kadaikannan were categorized as moderately resistant.

The present study clearly showed that varied resistance reaction among the different genotypes. Chung (1975) [4] observed slight to moderate incidence of sheath rot on indica varieties. Ayyadurai et al. (2005) [3] analysed *S. oryzae* isolates from North East and South India and found high variability in pathogenicity, phytotoxic metabolite production, and RAPD band patterns. Breeding for resistance to sheath rot seems the best option, but it is limited by its multiple causal agents. High-yielding nitrogen-responsive rice cultivars are highly susceptible to sheath rot. Upadhyay and Diwakar (1984) [10] reported that among the several important commercially grown rice varieties tested Asha, Usha, Sabri17, Dibraj and Madhuri showed resistant reaction to sheath rot. Lakshman and Velusamy (1991) [6] evaluated 87 lines with their pedigree in field and green house experiments and reported that among 87 lines tested, 15 showed no symptoms under natural infection while, only few exhibited high level of resistance on artificial inoculation.

Most of the tall varieties like Karupukavuni, Kichalisamba, Kattuyanam etc. are resistant to sheath rot disease. The scented variety Kothamallisamba is also found to be resistant. The dwarf germplasm lines are more susceptible to sheath rot disease. So, it can be concluded from the present experimental results that the resistant and moderately resistant varieties or germplasm lines can be used in breeding program. Continuous evaluation of different rice varieties to find out the resistance donor source for resistance to *S. oryzae* at artificial inoculated conditions will be useful to breed a resistance variety under rice breeding programme.

References

1. Amin K. Sources of resistance to *Acrocylindrium oryzae*–sheath rot of rice. Plant Dis. Rep. 1976; 60:72-73.
2. Arunyanart P, Surin A, Disthaporn S. Seed discoloration disease and its chemical control. International Rice Research Newsletter. 1981; 6(3):14-15.
3. Ayyadurai N, Kirubakaran SI, Srisha S, Sakthivel N. Biological and molecular variability of *Sarocladium oryzae*, the sheath rot pathogen of rice (*Oryza sativa* L.). Curr. Microbiol. 2005; 50:319–323. 10.1007/s00284-005-4509-6
4. Chung HS. Studies on sheath rot of rice caused by *Acrocyliandrium oryzae*. Sawada testing varietal reaction and culture filtrates of the causal fungus. Korean J plant protection 14:23-27 Directorate Rice Res., 1975, 1-2.
5. Ghosh M, Amudha R, Jayachandran S, Sakthivel N. Detection and quantification of phytotoxic metabolites of *Sarocladium oryzae* in sheath rot-infected grains of rice. Letters in applied microbiology. 2002; 34(6):398-401.
6. Lakshmanan P, Velusamy R. Resistant to Sheath rot (ShR) of breeding lines derived from *Oryza officinalis*. IRRN. 1991; 16(6):6-8.
7. Ou SH. Rice Diseases. Common Wealth Agricultural Bureaux, Central sales, Farnah, Royal, Slough, UK, 1985, 291.
8. Shakthivelu N, Gnanamanickam S. Isolation of and assay of cerulenin produced by rice sheath rot pathogen *Sarocladium oryzae* (Swada). Current Science. 1986; 55(19):988-989.
9. Singh, Mathur S. Further evidence of transmission of *Sarocladium oryzae* through rice seeds and its quarantine significance. Indian Phytopathology. 1992; 45(4):454-456.
10. Upadhyay RK, Diwakar MC. Sheath rot (ShR) in Chhattisgarh, Madhya Pradesh, India. IRRN. 1984; 9(5):6.