Himachal Journal of Agricultural Research 47(1): 110-115 (2021)

Short Communication

Screening of genotypes for resistance against *Sarocladium oryzae* causing sheath rot of rice

Aanchal Titaria, Sachin Upmanyu*, S.K. Rana[1] and Daisy Basandrai[2]

CSK Himachal Pradesh Krishi Vishvavidyalaya
Rice and Wheat Research Centre, Malan-176 047, India.

*Corresponding author: sachinupmanyu1974@gmail.com
Manuscript received: 28.10.2020; Accepted: 04.01.2020

Abstract

A field experiment was conducted to screen rice genotypes against sheath rot during *kharif* 2019 under natural epiphytotic conditions at the farm of Rice and Wheat Research Center, Malan. Out of one hundred eight genotypes, ten genotypes exhibited moderately susceptible reaction while ninety eight showed susceptible reaction when categorized on the basis of disease incidence whereas when these genotypes categorized on the basis of disease index, five genotypes showed resistant reaction, twenty four showed moderately resistant reaction, sixty one showed moderately susceptible reaction and eighteen genotypes showed susceptible reaction while none of the genotypes was immune in any category.

Key words: Sheath rot, Rice, Screening, Genotypes.

Rice is the most important staple food crop in the Asian population, particularly India and is generally termed Asian rice. Rice is the primary source of food for more than half of the world's population. In India, rice supports more than 60 % of the population as the primary source of nutrition and is grown in 43.8 million hectares with production of about 116.4 million tons (Anonymous 2019). In Himachal Pradesh, rice is cultivated over an area of 73.7 thousand hectares with a production of 129.9 thousand tones (Anonymous 2017). Diseases are one of the major constraints in rice production. There is a great scope of increasing rice production in the state; but some biotic constraints like diseases hamper the successful rice cultivation besides other factors. In Himachal Pradesh, blast, bacterial blight, false smut, sheath rot, sheath blight and brown spot appear regularly in various rice producing areas and pose a potential threat to the crop production. Besides this, many diseases previously considered minor have become severe in the State, of which sheath rot appears to be an important disease appearing at the time of booting or panicle emergence. It is a seed-borne disease which is mostly witnessed on the entire seed and the lemma and/or palea (Mew and Gonzales 2002). The pathogen attacks the crop at maturity during panicle initiation stage or boot stage thereby diminishing the crop yields. The pathogen mainly attacks the uppermost flag leaf sheaths which enclose the emerging panicle during the booting stage. Yield loss due to sheath rot has been reported to vary between 2.7-89.8 per cent in India (Rao 1996) with an average yield loss of 14.5 per cent (Ou 1985). In Himachal Pradesh, the disease is regularly occurring in a moderate form in many rice- growing areas. However, the information on various aspects of this disease viz., distribution, losses, resistance, epidemiology and management is unavailable. Regular monitoring should be undertaken to check the status of sheath rot among the cultivars. Hence, the present study was undertaken to evaluate some genotypes against sheath rot under natural epiphytotic

[1] Department of Plant Pathology, [2] Department of Genetics and Plant Breeding, CSK HP Krishi Vishvavidyalaya, Palampur

conditions to identify resistant sources which can be used as potential donors for sheath rot resistance breeding programme. One hundred eight genotypes were screened against sheath rot under natural epiphytotic conditions at the experimental farm of Rice and Wheat Research Centre, Malan during *kharif* 2019. Twenty-five days old seedlings of each genotype were transplanted on 12th July, 2019 in rows of 1 m length adopting a spacing of 20 x 15 cm. A susceptible check (Arize 6129 Gold) was planted after every 20 entries and around the border of whole germ plasm. Disease scoring was done after first appearance of the disease at weekly intervals and percentage of infected tillers showing different grade infection were calculated till maturation of the crop on the basis of 10 plant tillers. Disease index were calculated using the formula given by Narayanaswamy and Vishwanathan (1990) while scoring was done by following SES scale i.e. 0-9 (IRRI 2013).

Disease index as given by Narayanasamy and Vishwanathan (1990):

Description	Grade
Small brown lesions on boot leaf sheath and panicle emergence normal.	1
Lesions enlarge or coalesce and cover about 5 per cent of the leaf sheath and panicle emergence normal.	3
Lesions cover about 6-15 per cent of the leaf sheath area and 75 per cent of panicle exserted	5
Lesions cover about 16-50 per cent of the leaf sheath area and 50 per cent of panicle exserted.	7
Lesions cover more than 50 per cent of the leaf sheath and panicle emergence completely affected or only about 25 per cent of panicle exserted.	9

Disease Index = (1 X A) + (3 X B) + (5 X C) + (7X D) + (9 X E)

Where;

A = Percentage of tillers showing grade 1

B = Percentage of tillers showing grade 3

C = Percentage of tillers showing grade 5

D = Percentage of tillers showing grade 7

E = Percentage of tillers showing grade 9

On the basis of disease index the genotypes were categorized as under:

Sr No.	Disease index values	Reaction
1	0	Immune
2	1-100	Highly resistant
3	101-200	Resistant
4	201-300	Moderately resistant
5	301-500	Moderately susceptible
6	501-700	Susceptible
7	>700	Highly susceptible

On the basis of disease incidence the genotypes were categorized following Standard Evaluation System for Rice scale (IRRI, 2013)

Scale	Incidence (% diseased tillers)	Reaction
0	No incidence	Highly resistant (HR)
1	Less than 1%	Resistant (R)
3	1-5%	Moderately resistant (MR)
5	6-25%	Moderately susceptible (MS)
7	26-50%	Susceptible (S)
9	51-100%	Highly susceptible (HS)

The genotypes were further classified into immune (grade 0), highly resistant (grade1), resistant (grade 3), moderately susceptible (grade 5), susceptible (grade 7) and highly susceptible (grade 9) based on their reaction to disease incidence. These were also classified on the basis of disease index, as immune (0), highly resistant (1-100), resistant (101-200), moderately resistant (201-300)/ moderately susceptible (301-500), susceptible (501-700) and highly susceptible (>700).

The perusal of the data (Table 1) revealed that the incidence of sheath rot ranged between 21.75-45.50 percent while the disease index varied between 125-629 among the genotypes. It was also apparent from the data that none of the varieties was immune against the disease. On categorizing these genotypes on the basis of disease incidence, it was found that ten genotypes showed moderately susceptible reaction while ninety - eight exhibited susceptible reaction (Table 2) whereas, on the basis of disease index, five genotypes showed resistant, twenty - four moderately resistant, sixty one moderately susceptible and eighteen genotypes showed susceptible reaction to sheath rot, respectively (Table 3). Many workers have

attempted to screen genotypes against sheath rot under different ecosystems in order to identify resistant donors. Sharma *et al*. (2013) tested thirty-three varieties against the disease under natural conditions and only two varieties, Type-3 and Basmati-370 were found to be immune while most of the varieties were found to be resistant. Kindo *et al*. (2015) also evaluated twenty two scented rice varieties collected from different areas of Chhattisgarh region of which Jeera Phool, Tarun Bhog, Jeera Basmati, Bisni, Gopal Bhog, Chinnor, Pusa-83, Pusa-677, Chinor and Dujai exhibited low disease severity. Similar results were obtained by Rini Pal *et al*. (2015) and Singh and Das (2016). It can be inferred from the studies that the promising genotypes exhibiting resistance after further confirmation can be exploited in breeding programme for the development of sheath rot resistant rice varieties.

Table 1. Evaluation of rice genotypes against sheath rot of rice

Sr. No.	Genotypes	Mean disease incidence (%)	Mean disease index
1	HPR 1156	41.50 (31.07)	362
2	HPR 2774	28.35 (25.75)	286
3	Pusa 1637	25.65 (24.41)	308
4	HPR 2720	32.50 (27.69)	382
5	Pusa 1121	24.00 (23.56)	526
6	HPR 2686	25.20 (24.14)	352
7	HPR 2863	40.00 (31.05)	437
8	HPR 2696	29.00 (26.06)	401
9	Pusa 1612	37.00 (29.70)	317
10	HPR 2910	28.60 (25.87)	399
11	HPR 2912	29.55 (26.33)	538
12	HPR 3105	24.60 (23.84)	344
13	HPR 3111	25.50 (24.31)	432
14	HPR 3109	30.00 (26.55)	377
15	PB 1509	43.50 (32.55)	303
16	HPR 2143	40.00 (30.97)	305
17	HPR 2865	36.00 (29.27)	265
18	HPR 2880	28.45 (25.80)	296
19	HPR 3101	33.50 (28.16)	348
20	HPR 3110	35.00 (28.83)	290
21	HPR 2864	30.00 (26.55)	463
22	HPR 2908	28.50 (25.83)	403
23	HPR 2922	27.20 (25.17)	346
24	HPR 1068	36.50 (29.49)	399
25	HPR 2421	42.00 (31.89)	468
26	HPR 3107	21.75 (22.28)	476
27	HPR 2795	33.50 (28.16)	331
28	HPR 2656	28.00 (25.58)	343
29	VL 221	23.55 (23.22)	502
30	HPR 3103	34.50 (28.62)	265
31	HPR 3102	27.00 (25.07)	595
32	HPR 3106	32.50 (27.43)	405
33	Kasturi	25.35 (24.25)	320
34	HPR 3108	31.50 (27.19)	525
35	HPR 2612	25.35 (24.25)	607
36	HPR 2913	32.30 (27.62)	527
37	HPR 2800	33.00 (27.91)	376
38	Deval	32.00 (27.46)	541
39	Vallabh Basmati 21	32.25 (27.58)	409
40	Pusa Basant 6	33.70 (28.24)	394
41	Naggar Dhan	35.80 (29.17)	243
42	HPR 2001	45.50 (33.37)	344
43	HPR 894	28.45 (25.78)	530
44	Bhigu Dhan	31.10 (27.06)	439
45	HPU 741	34.15 (28.45)	440
46	Norin 18	30.00 (26.55)	403
47	Koshihikari	29.85 (26.47)	168
48	China 988	30.85 (26.94)	561
49	HPR 2072	28.85 (25.95)	344
50	HPR 2373	29.85 (26.46)	261
51	HPR 842	32.30 (27.61)	372
52	Vandana	27.85 (25.48)	257
53	IR 72	29.75 (26.41)	320
54	IR 36	36.50 (29.49)	369
55	HPR 1149	30.65 (26.84)	493
56	HPR 2362	28.00 (25.55)	367
57	HPR 2590	29.05 (26.07)	347
58	PR 124	34.60 (28.65)	259
59	HPR 2928	32.60 (27.76)	321
60	HPR 2086	34.05 (28.38)	332
61	HPR 868	30.00 (26.55)	294
62	VL 81	34.30 (28.53)	287
63	Basmati 564	36.00 (29.27)	369
64	Karam	37.00 (29.70)	515
65	Vallabh Basmati 24	30.00 (26.55)	335
66	Haryana Basmati 2	29.00 (25.99)	225
67	Lal Narkanda	29.75 (26.40)	377
68	Vallabh Basmati 23	28.75 (25.89)	228
69	HPR 2512	31.70 (27.34)	364
70	HPR 2605	26.70 (24.92)	514
71	Megha Rice 2	30.00 (26.55)	214

72	VL 4561	37.00 (29.69)	370	92	HPR 2886	25.80 (24.46)	240
73	Vinek Dhan 82	32.50 (27.70)	328	93	HPR 2883	29.40 (26.22)	169
74	VL 93 – 2767	29.85 (26.44)	378	94	HPR 2557	30.00 (26.48)	135
75	VL Dhan 85	29.95 (26.47)	285	95	HPR 2604	36.10 (29.33)	295
76	Skau 27	30.45 (26.73)	404	96	HPR 2885	30.00 (26.55)	583
77	Skau 382	34.35 (28.54)	356	97	HPR 2890	29.25 (26.13)	171
78	VL 3400	32.95 (27.90)	315	98	HPR 2891	30.55 (26.79)	365
79	VL Dhan 207	32.00 (27.47)	437	99	HPR 2555	37.00 (29.75)	300
80	Skau 105	32.50 (27.68)	360	100	HPR 2603	31.00 (26.89)	565
81	Bhalin 1	34.00 (28.38)	300	101	HPR 3010	33.15 (28.02)	369
82	VL 30424	30.55 (26.79)	285	102	DGRT – 3379	22.55 (22.68)	629
83	VL 30425	30.40 (26.72)	305	103	HPR 2619	32.65 (27.79)	362
84	Skau 356	32.80 (27.85)	300	104	HPR 2640	33.50 (28.14)	285
85	Skau 357	33.50 (28.17)	308	105	HPR 2614	30.70 (26.83)	563
86	HPR 2675	34.20 (28.48)	411	106	HPR 2917	28.05 (25.49)	405
87	HPR 2676	34.05 (28.42)	544	107	HPR 2663	33.60 (28.22)	572
88	HPR 2674	33.00 (27.90)	481	108	HPR 2660	30.90 (26.97)	471
89	HPR 2679	29.85 (26.46)	299	C.D.		2.65	9.67
90	HPR 2677	31.05 (27.03)	408	S. Em		0.953	3.466
91	HPR 2673	33.40 (28.12)	125	Check	Arize 6129 Gold	50.0 (45.0)	393

Table 2. Categorization of genotypes on the basis of disease incidence

Sr. No	Incidence	SES Score	Disease reaction	No of genotypes	Genotypes
1	No	0	Immune	0	-
2	Less than 1%	1	Highly Resistant (HR)	0	-
3	1-5%	3	Resistant (R)	0	-
4	6-25%	5	Moderately Susceptible (MS)	10	Pusa 112, HPR 2686, HPR 3105, HPR 3111, VL 221, HPR 3107, HPR 2612, Kasturi, HPR 894 and DGRT – 3379
5	26-50%	7	Susceptible (S)	98	HPR 1156, HPR 2774, Pusa 1637, HPR 2720, HPR 2863, HPR 2696, Pusa 1612, Pusa 1612, HPR 2910, HPR 2912, HPR 3109, PB 1509, HPR 2143, HPR 2865, HPR 2880, HPR 3101, HPR 3110, HPR 2864, HPR 2908, HPR 2922, HPR 1068, HPR 2421, HPR 2795, HPR 2656, HPR 3103, HPR 3102, HPR 3106, HPR 3108, HPR 2913, HPR 2800, Deval , Vallabh Basmati 21, Pusa Basant 6, Naggar Dhan, HPR 2001, Bhigu Dhan, HPU 741, Norin 18, Koshihikari, China 988, HPR 2072, HPR 2373, HPR 842, Vandana, IR 72, IR 36, HPR 1149, HPR 2362, HPR 2590, PR 124, HPR 2928, HPR 2086, HPR 868, VL 81, Basmati 564, Karam, Vallabh Basmati 24, Haryana Basmati 2, Lal Narkanda, Vallabh Basmati 23, HPR 2512, HPR 2605,

					Megha Rice 2, VL 4561, VinekDhan 82, VL 93 – 2767, VL Dhan 85, Skau 27, Skau 382, VL 3400, HPR 3010, VL Dhan 207, Skau 105, Bhalin 1,VL 30424, VL 30425, Skau 356, Skau 357, HPR 2675, HPR 2676, HPR 2674, HPR 2679, HPR 2677, HPR 2673, HPR 2886, HPR 2883, HPR 2557, HPR 2604, HPR 2885, HPR 2890, HPR 2891, HPR 2555, HPR 2603, HPR 2619, HPR 2640, HPR 261, HPR 2917, HPR 2663 and HPR 2660
6	51-100%	9	Highly Susceptible (HS)	0	-

Table 3. Categorization of genotypes on the basis of disease index

Sr. No	Disease index values	Disease reaction	No. of genotypes	Genotypes
1	0	Immune	0	-
2	1-100	Highly resistant (HR)	0	-
3	101-200	Resistant (R)	5	Koshihikari, HPR 2673, HPR 2883, HPR 2557 and HPR 2890
4	201-300	Moderately resistant (MR)	24	HPR 2774, Pusa 1637, HPR 2865, HPR 2880, HPR 3110, HPR 3103, Naggar Dhan, HPR 2373, Vandana, PR 124, HPR 868, VL 81, Haryana Basmati 2, Vallabh Basmati 23, Megha Rice 2, VL Dhan 85, Bhalin 1, VL 30424, Skau 356, HPR 2679, HPR 2604, HPR 2886, HPR 2555 and HPR 2640
5	301-500	Moderately susceptible (MS)	61	HPR 2686, HPR 2863, HPR 2696, HPR 3111, HPR 3109, PB 1509, HPR 3101, HPR 2143, Pusa 1612, HPR 2910, HPR 1156, HPR 2720, HPR 2910, HPR 3105, HPR 2864, HPR 2908, HPR 2922, HPR 1068, HPR 2421, HPR 3107, HPR 2795, HPR 3106, Kasturi, HPR 2800, Deval , Vallabh Basmati 21, Pusa Basant 6, Bhigu Dhan, HPU 741, Norin 18, HPR 2072, HPR 2656, HPR 2001, HPR 842, IR 72, IR 36, HPR 1149, HPR 1149, HPR 2362, HPR 2590, HPR 2928, HPR 2086, Basmati 564, Vallabh Basmati 24, Lal Narkanda, HPR 2512 , VL 4561, Vinek Dhan 82, VL 93 – 2767, Skau 27, Skau 382, VL 3400, VL Dhan 207, Skau 105, VL 30425, Skau 357, HPR 2675,HPR 2674, HPR 2677, HPR 2891, HPR 3010, HPR 2917 and HPR 2660
6	501-700	Susceptible (S)	18	Pusa 1121, HPR 2912, VL 221, HPR 3102, HPR 3108, HPR 2612, HPR 2913, HPR 894, China 988, Karam, HPR 2605, HPR 2676, HPR 2885, HPR 2619, DGRT – 3379, HPR 2603, HPR 2614 and HPR 2663
7	>700	Highly susceptible (HS)	0	-

Conflict of interest : There is no conflict of interest among the authors.

References

Anonymous. 2017. Statistical year book of Himachal Pradesh 2016-17. Directorate of Economics and Statistics, Himachal Pradesh. p 68-70

Anonymous. 2019. Agricultural Statistics. Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi. p 74-78

IRRI. 2013. *Standard Evaluation System for Rice*. 5th Edition, International Rice Research Institute, Manilla, Philipines. p 55.

Kindo D, Bhagat RK and Tiwari PK. 2015. Screening of aromatic rice entries against sheath rot of rice under field condition. Trends in Biosciences **8** (2) ISSN 0974-8, 462-46.

Manibhushan Rao K. 1996. Sheath Rot Disease of Rice. *Daya Publishing House*, Delhi.

Mew TW and Gonzales P. 2002. A hand book of rice seed-borne fungi. IRRI Science Publishers. p 83.

Narayanasamy P and Viswanathan R. 1990. A new scoring system for sheath rot of rice. Madras Agriculture Journal 77 (**4-5**): 256-257.

Ou SH. 1985. Rice Diseases. 2nd Edition, *Commonwealth Mycological Institute*, Kew, Surrey, England. p 380.

Rini Pal, Mandal D and Naik BS. 2015. Screening of rice cultivars for resistance against sheath rot disease of rice caused by *Sarocladium oryzae*. Journal of Interacademicia **19 (3)**: 349-354.

Sharma L, Nagrale DT, Singh SK, Sharma and Sinha AP. 2013. Potential application of botanicals, essential oils and natural products against *Sarocladium oryzae*. Annals of Plant Protection Science **21(1)**: 109-113.

Singh M and Das BC. 2016. Screening of aromatic rice (Joha) genotype against sheath rot disease of rice and its management under field condition. International Journal of Advanced Research **4**: 922-925.