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Short Communication

Screening of rice genotypes against *Ustilaginoidea virens*, an incitant of false smut

Preeti[1], Sachin Upmanyu*, D.K. Banyal[1] and Neelam Bhardwaj
Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya
Rice and Wheat Research Centre, Malan-176 047, India.

*Corresponding author: sachinupmanyu1974@gmail.com
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Abstract

A field experiment was conducted to evaluate rice genotypes against false smut during *Kharif*-2022 under artificial inoculation conditions at the experimental farm of Rice and Wheat Research Centre, Malan. Out of sixty one genotypes, seventeen genotypes (HPR 3236, HPR 3239, HPR 3243, HPR 3248, HPR 3250, HPR 3251, HPR 3253, HPR 3254, HPR 3260, HPR 3261, HPR 3262, PB 1121, Kasturi, HPR 2612, HPR 3228, HPR 3218, HPR 3226) showed highly resistant reaction, seven (HPR 3256, HPR 3259, HPR 2929, HPR 3213, HPR 3211, HPR 2703, HPR 2696) resistant, twenty three moderately resistant, five moderately susceptible while all the nine hybrids (Arize 6129, Arize 6444, Arize Swift, AZ 6508, BS 10008, DR 8101, PAC 834, PAC 807 Plus, Arize 6129 Gold (susceptible check) showed susceptible reaction to false smut on the basis of disease incidence. The promising rice genotypes obtained after evaluation against false smut can be utilized in breeding programme for false smut resistance.

Key words: False smut, Rice, Screening, Genotypes artificial inoculation

Rice is one of the major food crops of the world and is the staple food for more than half of the world's population. India ranks second after China in rice production and has the largest area providing food for about a quarter of Asia's total production (Moya *et al*. 2004). In India, the area under rice is 45 million hectare with 122.27 million tonnes production and 4.09 metric tonnes/ha productivity (Anonymous 2021a). In Himachal Pradesh, total coverage of rice is 75 thousand hectare with 0.146 million tonnes production and 1.94 metric tonnes/ ha productivity (Anonymous 2021b).

Rice productivity is adversely affected by various abiotic and biotic stresses. Cultivation of rice is impeded by many fungal, bacterial and viral diseases. Many diseases which were earlier considered as minor in the state, have become economically important assuming serious proportions in many rice growing areas of which false smut of rice has become widespread and may pose threatening problems in many areas, especially where extensive cultivation of hybrids is carried out. It is caused by *Ustilaginoidea virens* (Cke.) Tak. (Teleomorph: *Villosiclava virens*) which was first reported in India by Cooke in 1878 from Tirunelveli district of Tamil Nadu. In India, the disease has been reported from most of the rice growing states (Dodan and Singh 1996). The false smut pathogen mainly attacked at the late booting stage and affected the young ovary of the individual spikelet and transformed it into large, yellow to green balls (Ladhalakshmi *et al*. 2012).

Yield losses due to this disease has been reported to vary between 0.5-0.75 per cent depending on the weather conditions during the crop growing period (Osada 1995). In Himachal Pradesh, false smut is regularly occurring in low to moderate and sometimes severe form in many rice growing areas (Upmanyu and Rana 2013). Attempts have been made to study different aspects of this pathogen in India and

[1]Department of Plant Pathology, College of Agriculture, CSK HPKV, Palampur.

standardization of artificial inoculation technique has created opportunity to screen number of rice germplasm against this disease. Considering the information mentioned above, investigations were made to identify sources of resistance against false smut of rice adopting the standard artificial inoculation technique. Total sixty one rice genotypes were screened against this disease under artificial inoculated conditions at experimental farm of Rice and Wheat Research Centre, Malan during *kharif*-2022. Twenty-five days old seedlings of each genotype were transplanted on 20th July, 2022 in single row of 1 m length adopting a spacing of 20 x 15 cm. A susceptible check (Arize 6129 Gold) was planted after every 10 entries and around the border of whole germplasm. Disease incidence and per cent infected grains were calculated using the formula given by Singh and Dube (1978). The genotypes were characterized based on the disease reaction using SES (0-9) scale (IRRI, 2014) as given below:

$$\text{Disease incidence (\%)} = \frac{\text{Number ofinfected tillers / m}^2}{\text{Total number of tillers / m}^2} \times 100$$

$$\text{Per cent infected grains} = \frac{\text{Number of diseased grains / panicle}}{\text{Total number grains / panicle}} \times 100$$

Scale	Incidence (% infected floret)	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 classified as highly resistant (score 0), resistant (score 1), moderately resistant (score 3), moderately susceptible (score 5), susceptible (score 7) and highly susceptible (score 9) on the basis of per cent disease incidence.

The perusal of the data (Table 1) revealed that the disease incidence ranged between 0.00 to 30.33 per cent. It was also apparent from the data that none of the varieties was highly susceptible to false smut. Among sixty one genotypes evaluated, seventeen genotypes (HPR 3236, HPR 3239, HPR 3243, HPR 3248, HPR

Table 1. Evaluation of rice genotypes against false smut of rice

Sr. No.	Genotypes	Disease incidence (%)	Infected grains (%)	Disease reaction
1	HPR 3236	0.00	0.00	HR
2	HPR 3237	1.25	0.08	MR
3	HPR 3238	1.90	0.25	MR
4	HPR 3239	0.00	0.00	HR
5	HPR 3240	1.70	0.51	MR
6	HPR 3241	1.12	0.08	MR
7	HPR 3242	3.40	0.34	MR
8	HPR 3243	0.00	0.00	HR
9	HPR 3244	2.67	0.17	MR
10	HPR 3245	1.00	0.17	MR
11	HPR 3246	7.05	1.45	MS
12	HPR 3247	3.68	0.60	MR
13	HPR 3248	0.00	0.00	HR
14	HPR 3249	1.00	0.25	MR
15	HPR 3250	0.00	0.00	HR
16	HPR 3251	0.00	0.00	HR
17	HPR 3252	2.08	0.17	MR
18	HPR 3253	0.00	0.00	HR
19	HPR 3254	0.00	0.00	HR
20	HPR 3255	1.70	0.17	MR
21	HPR 3256	0.40	0.08	R
22	HPR 3257	1.25	0.08	MR
23	HPR 3258	1.66	1.20	MR
24	HPR 3259	0.50	0.17	R
25	HPR 3260	0.00	0.00	HR
26	HPR 3261	0.00	0.00	HR
27	HPR 3262	0.00	0.00	HR
28	PB 1121	0.00	0.00	HR
29	PB 1509	1.00	0.25	MR
30	Kasturi	0.00	0.00	HR
31	HPR 2612	0.00	0.00	HR
32	HPR 2929	0.62	0.08	R
33	HPR 3224	1.00	0.08	MR
34	HPR 3221	6.67	1.11	MS
35	HPR 2774	3.25	0.85	MR
36	HPR 3220	1.67	0.08	MR
37	HPR 3213	0.83	0.17	R
38	HPR 3227	3.45	0.42	MR
39	HPR 3211	0.50	0.08	R
40	HPR 3228	0.00	0.00	HR
41	HPR 3106	7.50	2.05	MS
42	HPR 3210	2.20	0.17	MR

43	HPR 3223	2.90	0.25	MR
44	HPR 3107	8.25	1.37	MS
45	HPR 3217	2.00	0.17	MR
46	HPR 3218	0.00	0.00	HR
47	HPR 3230	5.90	0.77	MS
48	HPR 3212	2.50	0.42	MR
49	HPR 3209	2.25	0.85	MR
50	HPR 3226	0.00	0.00	HR
51	Arize 6129	26.20	3.25	S
52	Arize 6444	26.12	3.02	S
53	Arize Swift	27.94	3.49	S
54	AZ 6508	29.01	4.01	S
55	BS 10008	26.85	3.26	S
56	DR 8101	29.97	4.10	S
57	PAC 834	29.56	4.02	S
58	PAC 807 Plus	27.19	3.96	S
59	HPR 2703	1.24	0.09	R
60	HPR 2696	2.16	1.25	R
61	Arize 6129 Gold (susceptible check)	30.33	4.56	S

3250, HPR 3251, HPR 3253, HPR 3254, HPR 3260, HPR 3261, HPR 3262, PB 1121, Kasturi, HPR 2612, HPR 3228, HPR 3218, HPR 3226) showed highly resistant reaction, seven (HPR 3256, HPR 3259, HPR 2929, HPR 3213, HPR 3211, HPR 2703, HPR 2696) resistant, twenty three moderately resistant, five moderately susceptible while all the nine hybrids (Arize 6129, Arize 6444, Arize Swift, AZ 6508, BS 10008, DR 8101, PAC 834, PAC 807 Plus, Arize 6129 Gold (Check) showed susceptible reaction to false smut on the basis of SES (0-9) scale (Table 2). All the moderately resistant and resistant genotypes exhibited per cent infected grains below 1 per cent barring HPR 3258 and HPR 2696.

Many attempts have been made by various workers to screen rice genotypes against false smut under different ecosystems to find out resistant donors. Lore *et al*. (2013) evaluated 25 hybrids and 10 inbred for resistance to false smut. Among inbred two cultivars PR-113 and PR-114 exhibited the lowest level of disease intensity while two hybrids NPH-369 and NPH-909 possessed the highest disease intensity. However, Rani *et al*. (2016) tested 31 germplasm lines against false smut of which ten inbred lines were found to be completely free from the disease. Kumar *et al*. (2017) evaluated twenty one rice genotypes for

Table 2. Categorization of rice genotypes based on disease reaction

Score	Incidence (%)	Disease reaction	Genotypes	Number of genotypes
0	No incidence	Highly resistant (HR)	HPR 3236, HPR 3239, HPR 3243, HPR 3248, HPR 3250, HPR 3251, HPR 3253, HPR 3254, HPR 3260, HPR 3261, HPR 3262, PB 1121, Kasturi, HPR 2612, HPR 3228, HPR 3218, HPR 3226	17
1	Less than 1	Resistant(R)	HPR 3256, HPR 3259, HPR 2929, HPR 3213, HPR 3211, HPR 2703, HPR 2696	7
3	1-5	Moderately resistant (MR)	HPR 3237, HPR 3238, HPR 3240, HPR 3241, HPR 3242, HPR 3244, HPR 3245, HPR 3247, HPR 3249, HPR 3252, HPR 3255, HPR 3257, HPR 3258, PB 1509, HPR 3224, HPR 2774, HPR 3220, HPR 3227, HPR 3210, HPR 3223, HPR 3217, HPR 3212, HPR 3209	23
5	6-25	Moderately susceptible (MS)	HPR 3246, HPR 3221, HPR 3106, HPR 3107, HPR 3230	5
7	26-50	Susceptible(S)	Arize 6129, Arize 6444, Arize Swift, AZ 6508, BS 10008, DR 8101, PAC 834, PAC 807 Plus, Arize 6129 Gold (Susceptible check)	9
9	51-100	Highly susceptible (HS)	Nil	0

resistance against false smut and found four genotypes highly resistant to false smut. In the present investigation the hybrids namely, Arize 6129, Arize 6444, Arize Swift, AZ 6508, BS 10008, DR 8101, PAC 834, PAC 807 Plus, Arize 6129 Gold were observed to be susceptible to false smut which is in conformity with the findings of Ladhalakshmi *et al*. (2012) and Lore *et al*. (2021) who reported higher disease intensity in hybrids as compared to inbred cultivars/ pure lines. Hence, the promising rice genotypes obtained after evaluation against false smut can be utilized and exploited in breeding programme for false smut resistance.

Conflict of interest: The authors declare that there is no conflict of interest in this research paper.

References

Anonymous. 2021a. Food and Agricultural organization of the United Nations. http://www. FAOstat.fao.org.

Anonymous. 2021b. Statistical outline of Himachal Pradesh.Directorate of Economics and Statistics, Government of Himachal Pradesh, India.

Dodan DS and Singh SR. 1996. False smut of rice: present status. Agricultural Review **17**(1): 227-240.

Kumar S, Dwivedi SK, Kumar R, Bhakta N, Prakash V, Rao KK, Samal SK, Yadav S, Jaiswal KK, Kumar SS, Sharma BK and Mishra JS. 2017. Evaluation of rice genotypes for resistance against false smut of rice (*Oryza sativa* L.) under middle IGP of Bihar. International Journal of Current Microbiology and Applied Sciences **6** (4): 537-543.

Ladhalakshmi D, Laha GS, Ram Singh, Krishnaveni D, Srinivas Prasad M, Mangrauthia SK, Prakasam V, Yugander A and Viraktamath BC. 2012. False smut – A threatening disease of rice. Technical Bulletin No. 63. ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad (Telangana State)-500 030, India.p 32.

Lore JS, Jain J, Kumar S, Kamboj I, Khanna R, Dhillon BS, Zaida NW and Singh US. 2021. Prevention of false smut (*Ustilaginoidea virens*) on rice hybrids and pure-line cultivars by manipulating planting date. Journal of Phytopathology **169** (10): 597-606.

Lore JS, Pannu PPS, Jain J, Hunjan M, Kaur S and Mangat GS. 2013. Susceptibility of rice hybrids and inbred cultivars to false smut under field conditions. Indian Phytopathology **66**(4): 397-399.

Moya PF, Dawe D, Pabale D, Tingco M, Chien NV, Devarajan S, Djatiharti A, Lai NX, Niyomvit L, Ping HX, Redondo G and Wardana P. 2004. The economics of intensively irrigated rice in Asia. International Rice Research Institute (IRRI), Los Banos, Philippines. pp. 29-58.

Osada S. 1995. Effect of false smut occurrence on yield and quality of rice (in Japanese). Annual Report of the Society of Plant Protection of North Japan **46** (1): 30–32.

Rani R, Sharma VK, Lore JS, Pannu PPS and Kaur Y. 2016. Screening of rice germplasm against *Ustilaginoidea virens*, the incitant of false smut. Agricultural Research Journal **53** (1): 134-137.

Singh RA and Dube KS. 1978. Assessment of loss in seven rice cultivars due to false smut. Indian Phytopathology **31** (1): 186 88.

Upmanyu S and Rana SK. 2013. Status of false smut in major rice growing areas of Himachal Pradesh. Himachal Journal of Agricultural Research **39** (2): 176-178.