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Screening of genotypes against false smut of rice in Hill Zone of Karnataka

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Abstract
Rice (*Oryza sativa* L.) is the principal staple food for more than two billion people; most of them live in rural and urban areas of tropical and subtropical Asia. The experiment was conducted during *Kharif* 2017-18 at AHRS, Ponnampet. To identify the resistant sources against the any disease in order to breed resistant varieties is of primary importance. Hence, in the present study 102 genotypes were screened against false smut disease of rice under natural epiphytotic condition at AHRS, Ponnampet. Among 102 genotypes/varieties screened, 11 genotypes/varieties *viz.,* (IET 24956, IET 25530, IET 26273, IET 26218, IET 26275, IET 25798, IET 24995, IET 25523, Varshadhan, IET 27274 and IET 27277) were showed highly resistant reaction, none of them were showed resistant reaction, only one variety of IR-64 showed moderately resistant reaction, 53 genotypes were found moderately susceptible reaction and 34genotypes/varieties were showed susceptible reaction. However only three genotypes/varieties, i.e., IET 26219, IET 24518 and IET 25191 showed highly susceptible reaction to false smut disease.

Keywords: screened, false smut, disease, reaction and rice

Introduction
Rice. (*Oryza sativa* L.) is the most extensively cultivated food crop of the asia and forms a major part of nourishment for half of the world's population. It is the primary source of energy and protein for 4.5 billion peoples in the most populous nations of Asia. Rice is a. staple of in parts of Asia, Africa and South America to some extent of United States (Janick *et al*., 1981) [9]. More than 90 per cent of the world's rice is grown and consumed in Asia, where 60 per cent of the world's population lives. It accounts for 35-60 % of the caloric intake of three billion Asians (Guyer *et al*., 1998) [7].

Worldwide, rice is cultivated in an area of about 161.4 million hectares, production of about 506.3 million tonnes and productivity of 3.14 tonnes per hectare. In India area under rice cultivation is 43.39 million hectare and production of about 104.32 million tonnes with 2.40 tonnes per hectare productivity. In Karnataka, it is grown in area of 1.06 million hectares with a production of 2.70 million tonnes and productivity of 2.67 tonnes per hectare (Annon, 2016) [2]. In India, rice crop is produced in almost all the zones including southern, northern and north-eastern zones. The major rice producing states of India are West Bengal, Andhra Pradesh, Tamil Nadu, Karnataka and Punjab. Rice not only a staple food but also a way of living in Asia, with more than 250 million farm households dependent on the crop for their livelihood. The crop growth and production are affected by various biotic and abiotic factors. Biotic stresses include insect pests and diseases caused by fungi, bacteria, viruses, phytoplasmas and nematodes. Abiotic stresses, drought, cold, heat, chemical injury, salinity and other non-parasitic disorders are also responsible for significant reduction in production and productivity. Fungal diseases like, blast (*Pyricularia oryzae*), sheath blight (*Rhizoctonia solani*), brown spot (*Helminthosporium oryzae*), bakanae disease or foot rot (*Gibberella fujikuroi*), sheath rot (*Sarocladium oryzae*), leaf scald (*Microdochium oryzae*), narrow leaf spot (*Cercospora* oryzae), leaf smut (*Entyloma oryzae*) and udbatta disease (*Balansia oryzae*), bacterial diseases such as bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae*) and bacterial leaf streak (*Xanthomonas oryzae* pv. *oryzicola*) are of economical importance. Viral disease such as rice tungro disease (*Rice tungro bacilliform virus* and *Rice tungro spherical virus*) is more prevalent and destructive under Indian condition. In addition to all these diseases, rice crop in recent past is prone to the false smut disease, which is one of the most emerging disease causing significant damage of rice yield and quality worldwide (Abbas *et al*., 2014) [1].

False smut. occurs in. most of the rice growing areas of the world including India, China, Japan, Southeast Asian countries, North and South America, Myanmar, Sri Lanka, Fiji, and Africa. Among the floral diseases of rice, false smut is gaining importance which is a post-flowering disease prevalent mostly during *Kharif* season.

It is also known as Lakshmi disease and was believed to be a mark of a bumper harvest. Earlier it was regarded as sporadic but from the year 2000 onwards; it has been reported as an epidemic disease (Rush *et al.*, 2000, Singh and Pophaly, 2010) [15, 17].

False smut disease is caused by the pathogen *Ustilaginoidea virens* (Cooke) Takahashi, Whose teleomorph is *Claviceps Oryza sativa* (Hashioka), was first reported from Tirunelveli in Tami Nadu (Cooke, 1878) [6] and most recently *Villosiclava virens* has been proposed as the new name for the teleomorph of the false smut fungus (Tanaka *et al.*, 2008) [23]. The fungus transforms individual grains of the panicle into greenish spore balls of velvety appearance. The spore. Balls are small at first and grow to a size two inches or more in diameter. They are smooth and are yellow covered by a membrane. Later, the membrane bursts and the colour of the ball becomes orange/yellow. When cut open, the ball is white in the center with three outer layers (Sciumbato and Street, 2000) [16].

The fungus attack some of the weed species that commonly occur in rice fields and may also serve as sources of inoculum (Atia, 2004) [3]. The main reason for losses being incited is that the fungus attacks the panicles. About 15-20 percent losses have been reported by different workers from different provinces (Singh, 1998) [20].

It is an important devastating disease causing yield losses from 1 to 11 per cent (Atia, 2004) [3]. Disease incidence of 10-20 per cent and 5-85 per cent respectively has been reported from Punjab and Tamil Nadu on different rice cultivars (Ladhalakshmi *et al.*, 2012) [13]. Reports showed that rice false smut pathogen could produce two kinds of mycotoxins, namely Ustiloxins and Ustilaginoidins (Zhou *et al.*, 2012) [24]. This disease results in yield loss contaminated rice grains and. even more important, generating toxins poisoning to humans and domestic animals (Koiso *et al.*, 1994 and Zhou *et al.*, 2012) [10, 24].

Yield loss estimates due to *U. virens* were ranged from 0.2 to 49 per cent on different rice varieties in different regions of the country (Baruah *et al.*, 1992, Singh *et al.*, 1992 and Biswas, 2001a) [4, 21, 5]. In Karnataka, rice hybrids cultivation is becoming very popular and farmers are adopting the technology easily and obtaining a good yield. Hybrid rice is mostly affected by the incidence of minor diseases like false smut incidence and the crop yield are badly affected by high fertility levels in an irrigated ecosystem. Looking to the expansion of hybrid rice area in Karnataka region, where the farming community almost depends on this important food crop, there is an urgent need to address the biotic stress like false smut. Very meager information is available about disease incidence, resistance cultivars and management aspect of false smut disease under field condition. Therefore the present research studies entitled "Screening of rice genotypes against false smut of rice in Hill Zone of Karnataka" is undertaken with the following objective:

Material and Methods

The experiment was conducted during *Kharif* 2017-18 at Agricultural and Horticultural Research Station, Ponnampet. Screening of rice genotypes against *U. virens* was carried out to know the source of resistance against false smut disease under natural epiphytotic condition.

100 rice germplasm lines were evaluated against false smut disease. These germplasm lines were sown on 06-08-2017 in field nursery and Fertilizers were applied at the rate of 75:75:90 Kg/ha *i.e* basal application at the rate of 37.5:75:45 Kg/ha and top dressing of 37.5:0:45 Kg/ ha respectively. Tunga and IR-64 serve as susceptible and resistant check respectively. One line of 25 days old seedlings were uprooted from the nursery bed and planted in the main field over a length of 1.5 meters in two lines with a spacing of 15 x 15 cm for screening against false smut resistance and disease reactions were recorded using 0-9 scale given below (Plate-1).

Scoring for false smut was done at maturity stage by using following scale given by IRRI (2002), Rating scale of false smut of rice on the basis of infected panicle

Visual score	% of infected panicles	Host response
0	0 (No disease)	Highly Resistant
1	<1 %	Resistant
3	1.1-5 %	Moderately Resistant
5	5.1-25 %	Moderately Susceptible
7	25.1-50 %	Susceptible
9	>50%	Highly Susceptible

Plate 1: Scale (0-9) used for scoring against false smut of rice

Results and Discussion

A total of hundred and two genotypes/varieties were screened against false smut disease and using with susceptible check Tunga and resistant check IR-64. The data presented in Table 1. Indicated that, the disease severity varied from genotype/variety to genotype/variety. The maximum panicle infection was recorded in genotype/variety IET 24518 (66.03 %) followed by IET 25191 (64.54 %) and IET 26219 (57.40 %). Among 102 genotypes/varieties, only 11 genotypes / varieties *viz*., (IET24956, IET25530, IET26273, IET26218, IET26275, IET25798, IET24995, IET25523, Varshadhan, IET 27274 and IET 27277) were showed highly resistant reaction, there is no any genotypes/varieties showed resistant reaction and only one genotype/variety IR-64 (C) was showed moderately resistant reaction and 53 genotypes (IET 25341, IET 25310, IET 24855, IET 24977, IET 24952, IET 24950, IET 24951, IET 24985, IET 25295, IET 24983, IET 25358, IET 24968, IET 24967, IET 25342, IET 25323,IET 25345, IET 25331, IET 25337, IET 26418, IET 26406, IET 25535, Jaya, IET 26420, IET 26408, IET 26419, IET 25800, IET 26227, IET 26243, IET 25804, IET 25793, IET 26274, IET 26222, WGL 14, IET 25515, BPT 5204, DRR H-3, IET 25521, IET 25355, NDR 359, IET 24933, HRI 174, IET 25289, IET 24486, Sabita, IET 25209, Gayatri, IET 26748, Sarala, IET 26750, IET 26751, IET 27275, IET 27276 and Tellahamsa) were found moderately susceptible and 34 genotypes / varieties (IET 24931, US 312, IET 25284, IET 26263, IET 25796, IET 26258, IET 26231, IET 26267,IET 25795,IET 26269, IET 25802,IET 25495,IET 25508, IET 24990,IET 25489, IET 24963, IET 24958, IET 24973, IET 25330,IET 24505, IET 24496, IET 24495, IET 25212, Purnendu, IET 26747, IR 49830-7, IET 26749, IET 26752, Samba Mahsuri, MTU 1010, NLR 145, IET 27278, IET

27279 and Tunga (C)) were showed susceptible reaction and remaining 3 genotypes (IET 26219, IET 24518 and IET 25191) showed highly susceptible reaction to false smut disease (Table 2.).

Similar studies were also conducted by earlier by various workers and wide variation in response of genotypes against false smut disease (Singh and Kang, 1987, Sugha *et al.*, 1992 and Kurauchi *et al.*, 2006) [19, 22]. Lore *et al.*, (2013) [14] reported that two cultivars *viz.* PR-113 and PR-114 were having the lowest level of disease intensity and two hybrids *viz.*, NPH-369 and NPH-909, consistently had the highest level of disease intensity. Based on the reaction of 41 rice hybrids to false smut. Biswas (2001a) [5] reported that eight hybrids were free from the disease. Singh and Singh (2005) [18] also screened 98 genotypes against false smut and reported that 27 were highly resistant and 45 were resistant while remaining 26 had infection from 5 to 70%.The differences in resistance among rice cultivars to false smut might be attributed to differences in genetic makeup of the cultivars and environmental factors that might have affected the host-pathogen interactions.

Table 1: Screening of promising rice genotypes against rice false smut disease during 2017-18

Sl. No.	Genotypes	% of infected panicles	Visual disease score (0-9)	Disease reaction
1	IET 25341	13.83	5	MS
2	IET 25310	14.48	5	MS
3	IET 24855	14.02	5	MS
4	IET 24977	11.12	5	MS
5	IET 24952	12.03	5	MS
6	IET 24950	11.92	5	MS
7	IET 24931	39.99	7	S
8	IET 24951	15.50	5	MS
9	IET 24985	15.06	5	MS
10	IET 25295	13.05	5	MS
11	IET 24983	20.63	5	MS
12	IET 25358	10.64	5	MS
13	IET 24968	17.42	5	MS
14	IET 24967	16.12	5	MS
15	IET 24956	0.00	0	HR
16	IET 25342	14.16	5	MS
17	IET 25323	10.53	5	MS
18	US 312	25.19	7	S
19	IET 25345	12.63	5	MS
20	IET 25331	10.06	5	MS
21	IET 25337	14.21	5	MS
22	IET 26418	14.48	5	MS
23	IET 26406	14.17	5	MS
24	IET 25535	17.45	5	MS
25	Jaya	8.58	5	MS
26	IET 25530	0.00	0	HR
27	IET 26420	13.37	5	MS
28	IET 26408	11.92	5	MS
29	IET 26419	11.95	5	MS
30	IET 25284	43.07	7	S
31	IET 25800	30.11	7	MS
32	IET 26273	0.00	0	HR
33	IET 26219	57.40	9	HS
34	IET 26263	28.31	7	S
35	IET 25796	32.61	7	S
36	IET 26258	33.13	7	S
37	IET 26227	20.55	5	MS
38	IET 26231	39.52	7	S
39	IET 26243	17.72	5	MS
40	IET 26267	29.05	7	S
41	IET 25804	15.78	5	MS
42	IET 25795	37.30	7	S
43	IET 26218	0.00	0	HR
44	IET 25793	15.50	5	MS
45	IET 26275	0.00	0	HR
46	IET 25798	0.00	0	HR
47	IET 26274	10.90	5	MS
48	IET 26222	12.63	5	MS
49	IET 26269	33.02	7	S
50	IET 25802	32.50	7	S
51	WGL 14	21.29	5	MS
52	IET 25495	26.09	7	S
53	IET 25515	21.14	5	MS
54	BPT 5204	25.00	5	MS

55	IET 25508	46.51	7	S
56	IET 24990	29.03	7	S
57	IET 24995	0.00	0	HR
58	IET 25523	0.00	0	HR
59	DRR H-3	22.77	5	MS
60	IET 25521	10.27	5	MS
61	IET 25489	34.52	7	S
62	IET 25355	21.86	5	MS
63	IET 24963	36.50	7	S
64	IET 24958	26.19	7	S
65	NDR 359	23.14	5	MS
66	IET 24973	31.94	7	S
67	IET 24933	19.02	5	MS
68	IET 25330	46.67	7	S
69	HRI 174	24.83	5	MS
70	IET 25289	18.09	5	MS
71	IET 24505	27.50	7	S
72	IET 24486	14.02	5	MS
73	IET 24518	66.03	9	HS
74	IET 24496	30.63	7	S
75	IET 24495	42.43	7	S
76	Sabita	19.63	5	MS
77	IET 25212	36.78	7	S
78	IET 25209	21.80	5	MS
79	Purnendu	45.76	7	S
80	IET 25191	64.54	9	HS
81	IET 26747	26.93	7	S
82	Gayatri	20.65	5	MS
83	IET 26748	24.39	5	MS
84	IR 49830-7	26.69	7	S
85	IET 26749	33.72	7	S
86	Sarala	22.40	5	MS
87	IET 26750	19.02	5	MS
88	IET 26751	16.39	5	MS
89	Varshadhan	0.00	0	HR
90	IET 26752	27.85	7	S
91	Samba Mahsuri	26.85	7	S
92	IET 27274	0.00	0	HR
93	MTU 1010	25.26	7	S
94	IET 27275	17.72	5	MS
95	NLR 145	36.94	7	S
96	IET 27276	12.63	5	MS
97	IET 27277	0.00	0	HR
98	Tellahamsa	14.48	5	MS
99	IET 27278	45.30	7	S
100	IET 27279	32.77	7	S
C	Tunga	25.60	7	S
C	IR 64	4.85	3	MR

HR- Highly resistant **R**- Resistant **MR**- Moderately resistant
MS- Moderately susceptible **S**- Susceptible **HS**- Highly susceptible **C**- Check.

Table 2: Grouping of rice genotypes/varieties based on their disease reaction to the false smut under field condition-2017-18

Sl. No.	Visual score (0-9)	Disease reaction	Name of the genotypes/varieties	No. of genotypes
1	0	HR	IET 24956, IET 25530, IET 26273, IET 26218, IET 26275, IET 25798, IET 24995, IET 25523, Varshadhan, IET 27274 and IET 27277	11
2	1	R	-	00
3	3	MR	IR-64(C)	01
4	5	MS	IET 25341, IET 25310, IET 24855, IET 24977, IET 24952, IET 24950, IET 24951, IET 24985, IET 25295, IET 24983, IET 25358, IET 24968, IET 24967, IET 25342, IET 25323, IET 25345, IET 25331, IET 25337, IET 26418, IET 26406, IET 25535, Jaya, IET 26420, IET 26408, IET 26419, IET 25800, IET 26227, IET 26243, IET 25804, IET 25793, IET 26274, IET 26222, WGL 14, IET 25515, BPT 5204, DRR H-3, IET 25521, IET 25355, NDR 359, IET 24933, HRI 174, IET 25289, IET 24486, Sabita, IET 25209, Gayatri, IET 26748, Sarala, IET 26750, IET 26751, IET 27275, IET 27276 and Tellahamsa	53
5	7	S	IET 24931, US 312, IET 25284, IET 26263, IET 25796, IET 26258, IET 26231, IET 26267, IET 25795, IET 26269, IET 25802, IET 25495, IET 25508, IET 24990, IET 25489, IET 24963, IET 24958, IET 24973, IET 25330, IET 24505, IET 24496, IET 24495, IET 25212, Purnendu, IET 26747, IR 49830-7, IET 26749, IET 26752, Samba Mahsuri, MTU 1010, NLR 145, IET 27278, IET 27279 and Tunga (C)	34
6	9	HS	IET 26219, IET 24518 and IET 25191	03

Conclusion

102 rice genotypes/varieties were screened against false smut disease, 11 genotypes/varieties were found highly resistant, none of them found to be resistant and only one genotype/variety of IR-64 showed moderately resistant reaction, 53 genotypes/varieties were found moderately susceptible, 34 genotypes/varieties were found susceptible. Howeveronly three genotypes/varieties found highly susceptibleto false smut.

References

1. Abbas HK, Shier WT, Cartwright RD, Sciumbato GL. *Ustilaginoidea virens* infection of rice in arkansas: toxicity of false smut galls, their extracts and the ustiloxin fraction. Amer. J Pl. Sci 2014;5:3166-3176.
2. Anonymous, Statistical database 2016. http://www.fao.org
3. Atia MMM. Rice false smut in Egypt. J Pl. Dis. Prot 2004;111:71-82.
4. Baruah BP, Senapoty D, Ali MS. False smut: a threat to rice growers in Assam. Ind. J Mycol. Pl. Pathol 1992;22:274-77.
5. Biswas A. Field reaction of hybrid rice varieties to false smut and kernel smut disease in West Bengal India. Environ. Ecol 2001a;19:299-30.
6. Cooke MC. Some extra-European fungi. Grevillea 1878;7:13-15.
7. Guyer D, Tuttle A, Rouse S, Volrath S, Johnson M, Potter S, Gorlach J *et al*., Activation of latent 171 transgenes in arabidopsis using a hybrid transcription factor. Genetics 1998;149:633-639.
8. International Rice Research Institute (IRRI). Standard evaluation system for rice, Los Banos, Manila, Phillipine 2002, 14.
9. Janick J, Schery R, Woods F, Ruttan V. Plant science. An introduction to world crops. W.H. Freeman and Company (New York) 1981, 868.
10. Koiso Y, LI Y, Iwasaki S, Hanaoka K, Kobayashi T, Sonoda R *et al*., Ustiloxins, antimitotic cyclic peptides from false smut balls on rice panicles caused by *Ustilaginoidea virens*. J Antibiot 1994;47:765-773.
11. Kumar DM. Studies on false smut of rice caused by *Claviceps oryzae sativae* Hashioka. M. Sc. Thesis. Univ. Agric. Sci. Dharwad, Karnataka (India) 2015.
12. Kurauchi K, Kudo Y, Kimura T, Uemura T. Difference in resistance to false smut disease between rice cultivars in Aomori prefecture. Ann. Rep. Plant Prot. North Jpn 2006;57:17-21.
13. Ladhalakshmi D, Laha GS, Krishnaveni D, Prakasam V, Prasad MS, Evaluation of selected fungicides against rice false smut disease. 3rd Int. Confer. Agric. Horti. Hyd. Int. Conv, Centre, India 2014.
14. Lore JS, Pannu PPS, Jain J, Hunjan MS, Kaur R, Mangat GS. Susceptibility of rice hybrids and inbred cultivars to false smut under field conditions. Indian Phytopathol 2013;66:397-99.
15. Rush MC, Shahjahan AKM, Jones JP. Outbreak of false smut of rice in Louisiana. Pl. dis 2000;84(1):100.
16. Sciumbato G, Street JE. Mississippi rice diseases. Delta Res. Ext. center 2000. Http: www.msstate.edu/dept/drec.
17. Singh AK, Pophaly DJ. An unusual rice false smut epidemic reported in Raigarh District, Chhattisgarh, India. Int. Rice Res. Notes 2010;35:1-3.
18. Singh AK, Singh RN. Screening for resistance to false smut (*Ustilaginoidea virens* Takahashi) of rice (*Oryza sativa* L.). Ind. J Gen 2005;65:49-50.
19. Singh N, Kang MS. Effect of different levels of nitrogen and dates of transplanting on the incidence of false smut of paddy in Punjab. Ind. J Ecol 1987;14:167-167.
20. Singh RS. Plant Diseases. Sev. Ed. Oxf. IBH Publ., New Delhi 1998, 283-286.
21. Singh S, Vijai P, Panwar MS. False smut of rice-its impact on yield components. Crop Res 1992;5:246-48.
22. Sugha SK, Sharma OP, Kaushik RP. Performance of rice genotypes against false smut pathogen under rainfed conditions. Plant Dis. Res 1992;8:76-77.
23. Tanaka E, Tanaka C. Phylogenetic study of clavicipitaceous fungi using acetaldehyde dehydrogenase gene sequences. Mycosci 2008;49:115-125.
24. Zhou L, Lu S, Shan T, Wang P, Sun W, Chen Z *et al*., Chemistry and biology of mycotoxins from rice false smut pathogen. In Mycotoxins: Properties, Applications and Hazards; Melborn BJ, Greene JC, Eds.; Nova Science Publishers: New York, NY, USA 2012, 109-130.