

Original Research Article

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Screening of Rice Cultivars against False Smut [*Ustilagoideia virens* (Cooke) Takahashi] of Rice

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ABSTRACT

A total eighteen rice cultivars were screened against false smut disease of rice under natural conditions in wetland field at Navsari during 2017 and 2018. Eighteen cultivars evaluated, out of seven cultivars viz., GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1 and Dandi were found completely false smut free during 2017 and 2018. Whereas, highest per cent disease incidence i.e., 9.09, 7.02 and 8.06 per cent and disease severity index i.e., 15.00, 7.79 and 11.12 was found in cv.TN-1 whereas, highest average smutted ball i.e., 1.65, 1.11 and 1.38 per cent was found in US-312 during 2017, 2018 and mean of two years, respectively. The cultivars evaluated were based on grouped their resistance reaction against false smut. Out of the eighteen cultivars, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1 and Dandi were found highly resistant i.e., completely false smut free and visual score zero whereas, GNR-4, Tapeswari, Masuri, Jaya, Gurjari, Sambha-Masuri, GR-4 and GR-7 were found moderately resistant i.e., visual score three. However, TN-1, GR-11 and US-312 were found moderately susceptible i.e., visual score five were found in mean of two years. Out of eighteen cultivars, none of these was found to susceptible and highly susceptible to false smut disease.

Keywords

False smut,
Screening,
Ustilagoideia
virens, Rice

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Introduction

False smut due to *Ustilagoideia virens* (Cooke) Takahashi, it is a serious disease in rice cultivation areas throughout the world. The false smut disease affects the grains within the panicles and reduces rice yield and quality. Recently, false smut change of its status from minor to major causing concern in almost all the rice growing countries across the global (Nessa *et al.*, 2015). A “major” disease usually affects yield, as has been

reported for rice false smut in many literature (Rashmi *et al.*, 2014). Besides, a disease, when impacts yield, also reduces the economic sustainability of a crop by lowering farmers’ income (Nessa *et al.*, 2015). Apart from yield reduction, the pathogen causes qualitative losses and health problems as well (Rashmi *et al.*, 2016). The fungus produces two types toxins viz., *Ustiloxins A* and *Ustilaginoidins* (Lu *et al.*, 2014; Zhou *et al.*, 2012) causing rumination stopping in cows, suppression of tubulin of mammals and

necrosis of liver, kidney and bladder tissues (Ji, 2000; Sinha *et al.*, 2003). It is also dangerous to the health of human (Ladhakshmi *et al.*, 2012). Most of the commercial grown hybrid's cultivars are susceptible to the false smut. The disease can be partially managed by fungicides, but continuously use of fungicides cause, pathogen developed resistant against fungicides and hazardous for human consumption and environment. So, now a day for eco-friendly management of disease to identification of resistant lines/cultivars is highly desirable. In this context, eighteen cultivars were evaluated to identify resistant sources against false smut.

Materials and Methods

The experiment was conducted at N. M. College of Agriculture farm, NAU, Navsari, during *kharif* 2017 and *kharif* 2018. It's Latitude 20° 57' 07.05" N, Longitude 72° 55' 16.50" E and altitude is 12.33 meter above

sea level. Eighteen rice cultivars were screened for resistance under natural conditions against false smut disease of rice in wet land field condition. Twenty-five days old seedlings of eighteen cultivars were transplanted in a fixed plot with two rows, 2m long at a distance of 20cm × 15cm. In between the varieties, a space of 0.4m was maintained. Two seedlings in each hill were planted. Fertilizers and other agronomical practices were followed according to the recommendations for growing high-yielding varieties. The natural incidence of the disease was recorded at the grain hardening stage. Five plants of each cultivars were tagged for observations. During each season, per cent disease incidence (PDI), average smutted ball per panicle (ASB), disease severity index (DSI) and visual score of false smut disease of rice observations were recorded on each cultivar infected by false smut. The observations calculated as per the following formula were given by Singh and Dube (1978).

(i) Per cent infected tillers

$$\text{Per cent disease incidence} = \frac{\text{Total number of infected tillers/m}^2}{\text{Total number of tillers/m}^2} \times 100$$

(ii) Per cent infected grains

$$\text{Per cent infected grains} = \frac{\text{Total number of infected grains/panicles}}{\text{Total number of grain/panicles}} \times 100$$

(iii) Disease severity

$$\text{Disease severity} = \text{Per cent infected tillers} \times \text{Per cent infected grains}$$

Results and Discussion

Eighteen rice cultivars were screened for resistance under natural conditions against false smut disease of rice in wet land field at Navsari during 2017 and 2018. The details of the varieties screened were given in table 1. The varieties screened were grouped based on their resistance reaction in to five groups *i.e.*, highly resistant (completely free from the disease with infected panicles value 0.0%),

resistant (infected panicles value < 1.0%), moderately resistant (infected panicles value 1.1 to 5.0%), moderately susceptible (infected panicles value 5.1 to 25.0%), susceptible (infected panicles value 25.1 to 50.0%) and highly susceptible (infected panicles value > 50.0%). The details of the disease reaction were given in table 2. The results indicated that the per cent disease incidence ranged from 0.0 to 9.09, 0.0 to 7.02 and 0.0 to 8.06 per cent in 2017, 2018 and mean of two years,

respectively. The average smutted ball per panicle ranged from 0.0 to 2.08, 0.0 to 1.20 and 0.0 to 1.64 in 2017, 2018 and mean of two years, respectively. The disease severity index ranged from 0.0 to 15.00, 0.0 to 7.79 and 0.0 to 11.12 in 2017, 2018 and mean of two years, respectively.

Effect of varietal screening on per cent disease incidence of false smut of rice

A total eighteen cultivars were evaluated, out of seven cultivars *viz.*, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1 and Dandi were found completely false smut free. The next best in order of merit with respect to minimum per cent disease incidence was found in Gurjari *i.e.*, 1.69 per cent followed by Tapeswari, GR-7, Sambha-Masuri, GNR-4, Masuri, Jaya, GR-4, GR-11, and US-312 *i.e.*, 1.75, 1.79, 1.79, 3.39, 3.57, 3.64, 3.77, 5.45 and 6.67 per cent, respectively during 2017. Per cent disease incidence were observed in different ranges in different cultivars as compared to previous year. A total eighteen cultivars were evaluated, out of eight cultivars *viz.*, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1, Dandi and GR-7 were found completely false smut free. The next best in order of merit with respect to minimum per cent disease incidence was found in GNR-4 *i.e.*, 1.64 per cent followed by Gurjari, Tapeswari, Sambha-Masuri, Masuri, GR-4, Jaya, US-312 and GR-11 *i.e.*, 1.67, 1.69, 1.72, 1.75, 1.82, 3.57, 4.84 and 5.17 per cent, respectively during 2018. In case mean of two years, total eighteen cultivars were evaluated, among them, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1 and Dandi were found completely false smut free. The next best in order of merit with respect to minimum per cent disease incidence was found in GR-7 *i.e.*, 0.90 per cent followed by Gurjari, Tapeswari, Sambha-Masuri, GNR-4, Masuri, GR-4, Jaya, GR-11 and US-312 *i.e.*, 1.68, 1.72, 1.76, 2.52,

2.66, 2.80, 3.61, 5.31 and 5.76 per cent, respectively. While, maximum per cent disease incidence *i.e.*, 9.09, 7.02 and 8.06 per cent was found in TN-1 during 2017, 2018 and mean of two years, respectively.

Effect of varietal screening on average smutted ball per panicle of rice

A total eighteen cultivars were evaluated, out of seven cultivars *viz.*, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1 and Dandi were found completely false smut free. The next best in order of merit with respect to minimum average smutted ball per panicle was found in GR-7 *i.e.*, 0.53 per cent followed by GR-4, Masuri, Sambha-Masuri, Tapeswari, GNR-4, Gurjari, Jaya, GR-11 and TN-1 *i.e.*, 0.85, 0.86, 1.08, 1.09, 1.11, 1.14, 1.18, 1.28 and 1.65 per cent, respectively during 2017. Average smutted ball per panicle were observed in different ranges in different cultivars as compared to previous year. A total eighteen cultivars were evaluated, out of eight cultivars *viz.*, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1, Dandi and GR-7 were found completely false smut free. The next best in order of merit with respect to minimum average smutted ball per panicle was found in Sambha-Masuri *i.e.*, 0.55 per cent followed by GR-4, Gurjari, Jaya, GNR-4, GR-11, TN-1, Tapeswari and Masuri *i.e.*, 0.56, 0.56, 0.87, 1.10, 1.10, 1.11, 1.12 and 1.14 per cent, respectively during 2018. In case mean of two years, total eighteen cultivars were evaluated, among them, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1 and Dandi were found completely false smut free. The next best in order of merit with respect to minimum average smutted ball per panicle was found in GR-7 *i.e.*, 0.27 per cent followed by GR-4, Sambha-Masuri, Gurjari, Masuri, Tapeswari, GNR-4, GR-11 and TN-1 *i.e.*, 0.71, 0.82, 0.85, 1.00, 1.11, 1.11, 1.19 and 1.38 per cent, respectively. While, maximum average

smutted ball *i.e.*, 2.08, 1.20 and 1.64 per cent was found in US-312 during 2017, 2018 and mean of two years, respectively.

Effect of varietal screening on disease severity index of false smut of rice

A total eighteen cultivars were evaluated, among them, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1 and Dandi were found completely false smut free. The next best in order of merit with respect to minimum disease severity index was found in GR-7 *i.e.*, 0.95 followed by Tapeswari, Sambha-Masuri, Gurjari, Masuri, GR-4, GNR-4, Jaya, GR-11 and US-312 *i.e.*, 1.91, 1.93, 1.93, 3.07, 3.20, 3.76, 4.30, 6.98 and 13.87, respectively during 2017. Disease

severity index were observed in different ranges in different cultivars as compared to previous year. A total eighteen cultivars were evaluated, among them, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1, Dandi and GR-7 were found completely false smut free. The next best in order of merit with respect to minimum disease severity index was found in Gurjari *i.e.*, 0.94 followed by Sambha-Masuri, GR-4, GNR-4, Tapeswari, Masuri, Jaya, GR-11 and US-312 *i.e.*, 0.95, 1.02, 1.80, 1.89, 2.00, 3.11, 5.69 and 5.81, respectively during 2018. In case mean of two years, out of eighteen cultivars, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1 and Dandi were found completely false smut free.

Table.1 Screening of rice cultivars against false smut of rice during kharif 2017 and kharif 2018

Cultivars	Per cent disease incidence (PDI)			Average smutted ball / Panicle (ASB)			Disease severity index (DSI)			Varietal reaction
	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	
GNR-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HR
GNR-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HR
GNR-4	3.39	1.64	2.52	1.11	1.10	1.11	3.76	1.80	2.78	MR
GNR-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HR
GNRH-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HR
Tapeswari	1.75	1.69	1.72	1.09	1.12	1.11	1.91	1.89	1.90	MR
Masuri	3.57	1.75	2.66	0.86	1.14	1.00	3.07	2.00	2.66	MR
Jaya	3.64	3.57	3.61	1.18	0.87	1.03	4.30	3.11	3.70	MR
Gurjari	1.69	1.67	1.68	1.14	0.56	0.85	1.93	0.94	1.43	MR
Mahisagar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HR
NAUR-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HR
TN-1	9.09	7.02	8.06	1.65	1.11	1.38	15.00	7.79	11.12	MS
GR-11	5.45	5.17	5.31	1.28	1.10	1.19	6.98	5.69	6.32	MS
US-312	6.67	4.84	5.76	2.08	1.20	1.64	13.87	5.81	9.44	MS
Sambha-Masuri	1.79	1.72	1.76	1.08	0.55	0.82	1.93	0.95	1.43	MR
GR-4	3.77	1.82	2.80	0.85	0.56	0.71	3.20	1.02	1.97	MR
GR-4	1.79	0.00	0.90	0.53	0.00	0.27	0.95	0.00	0.24	MR
GR-7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HR

HR: Highly resistant, MR: Moderately resistant and MS: Moderately susceptible

Table.2 Disease reaction of rice cultivars under field conditions during kharif 2017 and kharif 2018

Visual score	Infected panicle	Resistant Level	Cultivars		
			2017	2018	Mean
0	No Disease	Highly resistant (HR)	GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1, Dandi	GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1, GR-7, Dandi	GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1, Dandi
1	< 1 %	Resistant (R)	-	-	-
3	1.1–5 %	Moderately resistant (MR)	GNR-4, Tapeswari, Masuri, Jaya, Gurjari, Sambha-Masuri, GR-4, GR-7	GNR-4, Tapeswari, Masuri, Jaya, Gurjari, US-312, Sambha-Masuri, GR-4	GNR-4, Tapeswari, Masuri, Jaya, Gurjari, Sambha-Masuri, GR-4, GR-7
5	5.1–25 %	Moderately susceptible (MS)	TN-1, GR-11, US-312	TN-1, GR-11	TN-1, GR-11, US-312
7	25.1–50 %	Susceptible (S)	-	-	-
9	> 50 %	Highly susceptible (HS)	-	-	-

The next best in order of merit with respect to minimum disease severity index was found in GR-7 *i.e.*, 0.24 followed by Gurjari, Sambha-Masuri, Tapeswari, GR-4, Masuri, GNR-4, Jaya, GR-11 and US-312 *i.e.*, 1.43, 1.43, 1.90, 1.97, 2.66, 2.78, 3.70, 6.32 and 9.44, respectively. While, maximum disease severity index *i.e.*, 15.00, 7.79 and 11.12 were found in TN-1 during 2017, 2018 and mean of two years, respectively.

The cultivars evaluated were based on grouped their resistance reaction against false smut is presented in table 2. Out of the eighteen cultivars, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1 and Dandi were found highly resistant *i.e.*, completely false smut free, visual score zero whereas,

GNR-4, Tapeswari, Masuri, Jaya, Gurjari, Sambha-Masuri, GR-4, GR-7 were found moderately resistant *i.e.*, visual score three. However, TN-1, GR-11, US-312 were found moderately susceptible *i.e.*, visual score five during 2017. Same trend was observed during 2018, out of eighteen cultivars, GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1, GR-7 and Dandi were found highly resistant *i.e.*, completely false smut free, visual score zero whereas, GNR-4, Tapeswari, Masuri, Jaya, Gurjari, US-312, Sambha-Masuri and GR-4 were found moderately resistant *i.e.*, visual score three. However, TN-1 and GR-11 were found moderately susceptible *i.e.*, visual score five. In case of mean of two years data, showed that GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1, Dandi were found

highly resistant *i.e.*, completely false smut free, visual score zero whereas, GNR-4, Tapeswari, Masuri, Jaya, Gurjari, Sambha-Masuri, GR-4 and GR-7 were found moderately resistant *i.e.*, visual score three. However, TN-1, GR-11, US-312 were found moderately susceptible *i.e.*, visual score five.

These results support with Mandhare *et al.*, (2008) tested 19 genotypes incidence of false smut of rice and ranged from 0.00 to 72.92 per cent. Among them, Kundlika genotype showed the highest false smut incidence with 72.92 per cent and 6 genotypes were found resistance to false smut of rice. Sanghera *et al.*, (2012) tested 10 varieties among them, 2 varieties were found resistance and other 8 varieties are infected to false smut of rice. Among 10 genotypes, the maximum incidence with 34.11 per cent and severity index with 14.47 was recorded in Pusa Sungandha-3. Rashmi (2014) evaluated twenty rice varieties against false smut of rice. Out of twenty varieties screened, the varieties of Harsha and Vaishak were found highly resistant and the varieties, Makom, Thekkancheera, Pavizham and Karthika were found resistant to the disease. The varieties Kanakom, Revathi and Prathyasha showed moderate resistance. El-Naggar *et al.*, (2015) they tested 11 genotypes for severity of rice false smut. Out of 11 genotypes, maximum severity with 20.30 per cent was recorded in Giza-181, while least was in Sakha 102 (0.2%), whereas Sakha 101 was found resistance against false smut. Kaur *et al.*, (2015) studied artificial inoculation of false smut was done and identified nine hybrids resistance to false smut among 125 rice genotypes screened. Hybrids VNR-211, GK-5025, HRI-140, IRH-74, PRSH-9018, KPH-467, RH-10428, 27P64 and KRH-4 were shown complete resistance to rice false smut. Singh and Sundar (2015) tested 123 non-scented inbred and hybrid genotypes and identify of the source of resistance to false

smut of rice. Among them, 20, 91 and 12 genotypes were found resistant, intermediate and susceptible, respectively during 2010. However, only nine genotypes *viz.*, HKR 05-10, HKR 05-22, HKR 07-95, HKR 07-239, HKR 08-12, HKR 08-17, HKR 08-71, HKR 08-110 and HKR 08-118 showed consistent resistance during 2010 and 2011. Rani *et al.*, (2016) tested 31 germplasm lines evaluated against false smut of rice during the cropping season 2013. Among them, ten inbred lines were found to be completely free from the disease. Maximum per cent infected panicles with 25.86 per cent and the maximum smutted ball per panicle with 0.55 was observed in genotype PR116. Whereas, during the cropping season 2014, five germplasm lines were found to be completely free from the disease. Maximum per cent infected panicles with 26.56 per cent and maximum smutted balls per panicle with 1.08 were observed in genotype PR116. While in pooled, disease reaction data inferred that three germplasm lines were highly resistant (HR), two varieties were resistant (R) whereas eleven lines were moderately resistant (MR). Thirteen lines were moderately susceptible (MS) whereas two lines were susceptible (S). Raji *et al.*, (2016) tested twenty rice varieties were screened in the field to assess their resistance to false smut under natural disease pressure in field condition. Among them, seven varieties showed no incidence of disease and the rest of varieties were infected to false smut. Kumar *et al.*, (2017) evaluation of twenty-one rice genotypes for resistance against false smut of rice. Among them, four genotypes were immune or highly resistant to false smut. Maximum per cent infected panicles with 65.00 per cent were observed in genotype Sabbhagi Dhan. Baite *et al.*, (2017) tested fifteen cultivars to evaluate the incidence of false smut of rice. Among them, seven cultivars were found to be susceptible to false smut. However, highest disease incidence with 55.61 per cent and infected

tillers with 8.77 per cent was recorded in Pooja, whereas Geetanjali was free from infection.

It is concluded that the differences between tested rice cultivars to false smut might be attributed to differences in genetic makeup of tested cultivars in addition to the environmental factors that might affect host-pathogen interactions. Eighteen cultivars evaluated, out of seven cultivars viz., GNR-2, GNR-3, GNR-5, GNRH-1, Mahisagar, NAUR-1 and Dandi were found completely false smut free during experimentation which were prevent against false smut of rice.

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