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Evaluation of rice hybrids for resistance to false smut and yield of rice

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Abstract

Rice is one of the most important cereal food crops and the primary source of livelihood for about half of the global population. Out of twenty hybrids tested, highest grain yield of 71.8 q ha⁻¹ was recorded in NPH 8899. This treatment also showed 331 tillers /m², plant height of 109.5 cm, Days to 50% flowering of 86 days, panicle length of 26.4, effective grains panicle⁻¹ of 243.8, per panicle weight of 6.47 g. This treatment was followed by PAC 835 which recorded grain yield of 67.7 q ha⁻¹, number of tillers /m² of 309, plant height of 107.9 cm, per panicle weight of 5.64 g whereas, the check hybrid, PA 6444 recorded grain yield of 65.8 q ha⁻¹, number of tillers /m² of 299, plant height of 112.7 cm, Days to 50% flowering of 96.7 days, panicle length of 26.9, effective grains panicle⁻¹ of 238.8, per panicle weight of 5.15 g. Out of twenty hybrids, only three hybrids *i.e.*, Arize Tej, DRH 834 and JKRH 401 showed moderately resistant reaction against false smut of rice under artificial condition of inoculation. The hybrids, DRH 834, JKRH 401 and Arize Tej recorded panicle affected with false smut disease of 3.3%, 4.3% and 5.0%, respectively. Whereas, the hybrids, Arize Tej, DRH 834 and JKRH 401 gave grain yield of 59.8, 53.3 and 62.7 q ha⁻¹ respectively

Keywords: False smut, hybrids, management, *Oryza sativa*, resistant, *Ustilaginoidea virens*

Introduction

Rice (*Oryza sativa* L.) is one of the most important food crops forever 75% of Asian population and 2.4 million of world population. The population will increase 4.6 billion by 2050. The projected demand for rice can only be met by maintaining steady increase in production over the years (Khush, 1996; Honamejad *et al.*, 2000). Several breeding strategies are being employed in increasing the yield potential of rice and those among the available strategies; hybrid rice offers an immediate opportunity to break the yield plateau set by the semi-dwarf rice varieties after the first Green revolution. At present, change of climatic condition, cropping intensity, cropping pattern, crop management(s), increased application of nitrogen fertilizers and large scale planting of hybrid rice (Zhou *et al.*, 2008), false smut caused by *Ustilaginoidea virens* (Perfect stage- *Claviceps oryzae sativae*) is an alarming or serious threat to hybrid rice cultivation in India, particularly in Jharkhand State, because the disease affects the yield loss both in terms of quality and quantity (Barnwal *et al.*, 2012). Although the area of hybrid rice cultivation is increasing year after year in Jharkhand. In earlier days importance was not given to this disease because of occurrence was irregular, sporadic and the symptoms were mostly restricted to one or few grains per panicle. The disease appeared in epidemic form in 2001 and 2002 on cultivar PR 116 and has been endemic, causing losses ranging from 2 to 85% in different parts of India (Pannu *et al.*, 2010; Ladhakshmi *et al.*, 2012). Commercial hybrids/HYV of rice in India has been known to possess only low levels of resistance (Murlidharan, 2006). Information on the genetic source of resistance to the disease is very scarce and gene(s) responsible for resistance are yet to be categorically documented under artificial epiphytotic conditions. Though, breeding for resistance is being attempted in India, so far there has been little success essentially due to non availability of donor lines with high level of resistance. Hence systemic evaluation and identification of potential resistance genotypes of the rice is the key to success of any breeding programme. Thus, in the present study an attempt was made to evaluate different hybrid rice for resistance to false smut under artificial inoculation of the pathogen under field condition.

Materials and Methods

Field trials were conducted during *Kharif* season, 2011 and 2012 at Darisai research farm of Birsra Agriculture University, Ranchi, Jharkhand. The trials were laid out in RBD with three replications. Twenty days old seedlings of twenty hybrids of rice (as mentioned in Table 1) were transplanted @ one seedling per hill in 4th week of July in the main field of the crop. The

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plot size was 4.0 m X 3.6 m and spacing of 20 cm X 15 cm. The distance between two replications was 50 cm each. Fertilizers (N: P₂O₅:K₂O) were applied @ 120: 60:90 Kg ha⁻¹. The plots were fertilized with FYM two ton ha⁻¹. 1/3rd of nitrogen and full doses of P₂O₅: K₂O were applied at the time of transplanting as basal and rest nitrogen were applied in two equal split doses *i.e.*, 25 and 50 days after transplanting (DAT). The necessary agronomic inputs were provided during the crop seasons. Artificial inoculation of the pathogen (Chlamydo-spore of *Ustilaginoidea virens*) in the booting stage of the crop. Observation of panicle affected with false smut (%) was taken randomly samples of per square meter per plot whereas, false smut affected florets per panicle was recorded randomly on 20 panicles per plot at 10 days before harvesting. Grain yield was also recorded for each plot after harvesting, threshing and six days sun drying. Disease reaction was recorded by using 0-9 Scale as per SES scale of rice (Anonymous, 1996) with disease symbol., where 0= No incidence (I); 1=Less than 1% incidence (R); 3= 1- 5% incidence (MR); 5= 6-25% incidence (MS); 7= 25-50% incidence (S); 9= 50-100% incidence (HS). All possible care was taken to prevent pest attack by spraying insecticide according to the necessity. All the data of field trials (RBD) were subjected to standard statistical analysis as per Gomez and Gomez (1984). All possible care was taken to prevent pest attack by spraying insecticide according to the necessity.

Results and Discussion

Among twenty hybrids, highest grain yield of 71.8 q ha⁻¹ was recorded in NPH 8899. This treatment also showed 331 tillers /m², plant height of 109.5 cm, Days to 50% flowering of 86 days, panicle length of 26.4, effective grains panicle⁻¹ of 243.8, per panicle weight of 6.47 g. This treatment was followed by PAC 835 which recorded grain yield of 67.7 q ha⁻¹

¹, number of tillers /m² of 309, plant height of 107.9 cm, Days to 50% flowering of 83 days, panicle length of 27.8, effective grains panicle⁻¹ of 184, per panicle weight of 5.64 g whereas, the check hybrid, PA 6444 recorded grain yield of 65.8 q ha⁻¹ number of tillers /m² of 299, plant height of 112.7 cm, Days to 50% flowering of 96.7 days, panicle length of 26.9, effective grains panicle⁻¹ of 238.8, per panicle weight of 5.15 g (Table 1.) Rabindrababu *et al.* (2013) conducted a trial of 21 hybrids of rice, they reported that CORH -3 was an early maturing hybrid (78 days), while sahyadri-1 was a late maturing hybrid (108 days). Highest plant height was exhibited by CRHR-7 (116.9 cm) while lowest by sahyadri-2 (83.7 cm). The length of the panicle was highest for CRHR-7 (29.56 cm) while it was lowest for PA 6129 (23.8 cm) with a mean value of 26.1cm among the hybrids. Number of productive tillers per plant was observed to be more in DRRH-2 (11.7) and lowest in CRHR-7 (6.7). The mean value of productive tillers per plant was observed to be around 9.3. Suruchi exhibited the lowest 1000 grain weight (19.1g), while HSD-1 recorded the highest values (28.4 g). The mean 1000 grain weight was observed to be around 24.1 g among the hybrids. Highest grain yield was produced by PUSA RH-10 (8.04 t ha⁻¹) and least by CRHR-7 (6.93 ton ha⁻¹)

Out of twenty hybrids, only three hybrids *i.e.*, Arize Tej, DRH 834 and JKRH 401 showed moderately resistant reaction against false smut of rice. The hybrid, DRH 834 recorded panicle affected with false smut disease of 3.3% and false smut affected florets/panicle of 8.6% whereas, JKRH 401 recorded panicle affected with false smut disease of 4.3% and false smut affected florets/panicle of 8.8% and Arize Tej recorded panicle affected with false smut disease of 5.0% and false smut affected florets/panicle of 8.1%.The hybrids, Arize Tej, DRH 834 and JKRH 401 gave grain yield of 59.8, 53.3 and 62.7 q ha⁻¹ respectively (Table 1 and 2).

Table 1: Evaluation of different hybrids against yield and yield attributing character of rice (Mean of two years)

S. No.	Treatments	No. of tillers/m ²	Plant height (cm)	50% Flowering (days)	Panicle length (cm)	No of effective tillers/panicle	Per panicle wt. (g)	Grain yield (q/ha)
1	NPH 8899	331	109.5	86.0	26.4	243.8	6.47	71.8
2	BS 110	308	110.7	84.7	25.6	229.0	5.72	62.5
3	PRH 122	216	107.5	84.0	24.3	146.2	5.02	53.7
4	NPH 369	237	19.9	78.3	26.1	150.2	5.34	56.7
5	RH 9009	325	112.5	87.3	27.1	200.2	5.42	62.5
6	Arize Tej	261	110.6	88.7	28.4	180.6	5.04	59.8
7	Shanti	222	107.4	68.7	26.5	164.2	5.26	55.9
8	PAC 801	240	97.8	81.0	23.9	196.4	4.74	54.5
9	S 201	317	109.0	79.3	27.3	198.0	5.82	61.5
10	US 315	228	106.0	73.7	24.7	184.4	5.14	49.9
11	VRH 606	237	110.3	75.3	26.3	80.0	4.84	57.1
12	DRH 834	231	113.3	73.0	24.5	198.4	5.65	53.3
13	BIO HY795	250	110.2	92.0	24.8	174.6	5.52	56.2
14	SRH 5151	282	112.2	84.7	35.4	157.4	5.38	57.9
15	RH 1531	261	109.6	82.3	24.4	145.8	4.97	48.8
16	PAC 835	309	107.9	83.0	27.8	184.6	5.64	67.7
17	PA 6444	299	112.7	96.7	26.9	238.8	5.15	65.8
18	NK 5251	289	104.2	85.7	26.5	171.4	5.34	62.2
19	Kaveri 9090	241	108.0	86.7	25.4	164.2	5.18	57.1
20	JKRH 401	304	110.0	84.3	26.9	188.1	5.54	62.7
	CD(P=0.05)							12.5
	CV (%)							12.8

Table 2: Evaluation of different hybrids against resistance to false smut of rice (Mean of two years)

S No.	Treatments	False smut affected florets/panicle (%)	Panicle affected with false smut (%)	Reaction
1	NPH 8899	15.1	11.0	MS
2	BS 110	10.7	7.3	MS
3	PRH 122	10.6	6.0	MS
4	NPH 369	9.7	6.7	MS
5	RH 9009	9.6	7.7	MS
6	Arize Tej	8.1	5.0	MR
7	Shanti	10.5	5.7	MS
8	PAC 801	13.5	7.7	MS
9	S 201	17.3	12.3	MS
10	US 315	10.8	6.3	MS
11	VRH 606	11.5	6.7	MS
12	DRH 834	8.6	3.3	MR
13	BIO HY795	14.3	7.3	MS
14	SRH 5151	10.4	8.7	MS
15	RH 1531	14.7	7.7	MS
16	PAC 835	8.6	5.3	MS
17	PA 6444	14.7	9.3	MS
18	NK 5251	8.6	7.0	MS
19	Kaveri 9090	11.6	7.7	MS
20	JKRH 401	8.8	4.3	MR

Vakiti *et al.* (2017) tested 40 varieties of rice and they found that seven varieties (Erra Malallu, JR 201, JGL 201, JGL3828, Kavya, Kudrat, Varalu and WGL 32183) were free from infection of false smut pathogen at Jabalpur. Out of 19 rice hybrids, only three hybrids *i.e.*, JRH 76, JRH 85 and PA 6444 were found to be free from infection of false smut pathogen.

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