

Evaluation of Resistance Source Against Yellow Stem Borer *Scirpophaga incertulas* (Walker) in Rice under Field Conditions

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Abstract Growing of resistance varieties is the most effective and environment-friendly strategy for protecting the crop. In the present study altogether, 60 promising rice genotypes along with susceptible check variety TN-I have been screened against yellow stem borer (YSB), *Scirpophaga incertulas* (Walker) under field conditions during *kharif* 2012. The trial material was received from All India Coordinated Rice Improvement Program (AICRIP) DRR, Hyderabad. The YSB mean dead heart and infestation index varied from 3.3 to 19.2% and 15.1 to 89.1%, respectively. Rice genotypes W 1263 (ACC11057) IRRI and CB 09-125 were most promising and resistant with 15.1 and 17.6% infestation index values against YSB. Five genotypes W 1263 (DRR), HR-DRR-02, RP 4918-228 (S), CB 06-124 and CB 09-512 showed moderate resistance reaction with infestation index values of 23.9, 29.7, 21.9, 30.0 and 25.7% respectively. Rest of the genotypes were rated as moderately susceptible

or susceptible with infestation index ranging from 31.6 to 58.9 and 61.0 to 89.1, respectively against YSB.

Keywords Resistance, Rice, *Scirpophaga incertulas*, Yellow stem borer.

Introduction

Rice (*Oryza sativa* L.) continue to remain the most important and staple food crop for more than two thirds of the population of India and more than 65% of the world population [1]. The crop plays a vital role in our national food security and is a means of livelihood for millions of rural households. Currently India has achieved the rice production of 102.75 MT [2]. Among various constraints of rice production, damage due to insect pests is substantial and needs regular attention. Around, 100 species of insects to attack rice crop at various stages of its growth in India [3], out of which 20 have been found to be the major pest including yellow stem borer (YSB), *Scirpophaga incertulas* (Walker), which causes 21 to 51% yield loss in different rice agro-ecosystems [4 and 1]. Large-scale cultivation of high yielding varieties, close planting, water regime, excessive use of nitrogenous fertilizers and misuse of agrochemicals have further aggravated the pest incidence. Therefore, it is essential to evolve suitable location specific integrated pest management strategy that is environment friendly, economically viable and socially acceptable.

Until recently, the use of insecticides was considered to be the most effective tool to overcome insect pest problem in rice. In fact, among all crops, rice

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Table 1. Details of entries under AICRIP, Multiple Resistance Screening Trial (MRST)-2012.

Ent. No. Designation	Cross
1 CR 2711-76	Tapaswani/Dhobanumberi
2 CD 3005-77-2	Samba mahsuri/ Salkathi
3 CR 3005-230-5	Samba mahsuri/ Salkathi
4 CR 3006-8-2	Pusa 44/Salkheti
5 JGL 17974	MTU 1001/JGL 11470
6 RP Bio 4918-230S	Swarna/ <i>O. nivara</i>
7 IRGA 318-11-6-9-2B	-
8 W 1263 (DRR)	Donor
9 W 1263 (ACC11057) IRRI	Donor
10 TN 1	Check
11 RP Patho-01	BPT 5204/C101LAC
12 RP Patho-02	BPT 5204/C101A51
13 RP Patho-03	BPT 5204/Tetep
14 RP Patho-04	BPT5204/C101LAC/ C101A51
15 RP Bio Patho-01	B95-1/C101A51
16 RP Bio Patho-02	B95-1/Tetep
17 B 95-1	Donor
18 BPT 5204	Donor
19 C 101A 51	Donor
20 Suraksha	Check
21 C 101LAC	Donor
22 Tetep	Donor
23 HR-DRR-01	APMS 6A/PNR 2-49
24 HR-DRR-02	APMS 6A/GQ 70
25 HR-DRR-03	APMS 6A/BK 52-104
26 HR-DRR-04	PUSA 5A/BK 35-155
27 HR-DRR-05	PUSA 5A/BK 52-104
28 HR-DRR-06	PUSA 5A/B 95-95
29 HR-DRR-07	IR 79156A/BK 35-155
30 TN 1	Check
31 BG 380-2	Donor
32 RP 4918-212 (S)	Swarna / <i>O. nivara</i>
33 RP 4918-215 (S)	Swarna / <i>O. nivara</i>
34 RP 4918-221 (S)	Swarna / <i>O. nivara</i>
35 RP 4918-228 (S)	Swarna / <i>O. nivara</i>
36 CB 05-022	CO 43/ADT 39
37 CB 05-031	CO 43/TNAU 91043
38 CB 06-124	BPT 5204/Jeeraga samba
39 CB 07-540	ADT 39 Mutant
40 RP 4680-1-2-23	ACR 15831/RP2068
41 CB 09-125	BPT 5204/CO (R) 50
42 CB 09-512	OR1797-4/Varapukudanchan
43 CB 09-516	RR 4065-381-245/UPR 2893-97
44 CB 09-526	R 1152-241-264-1/CO 46 (M)
45 CB 09-537	IR 64/RR 272-662
46 CB 09-538	IR 64/RR 272-662
47 CB 09-570	ADT 45/JGL 1798
48 CB 10-504	CB 04-110/ADT 45
49 TNRH 206	COMS 23A/CB 206 R
50 TN 1	Check

Table 1. Continued.

Ent. No. Designation	Cross
51 TNRH 222	COMS 23A/CB222 R
52 TNRH 237	COMS 24A/CB 237 R
53 TNRH 241	CPMS 24A/CB 241R
54 TNRH 244	COMS 24A/ CB244R
55 TNRH 258	CRMS31A/CB258R
56 K 024	-
57 K 026	-
58 K 029	-
59 RP 4681-16-2-569	Aganni / Jhitpiti
60 TN 1	Check

is the only one which receives maximum insecticides/pesticides. Of the total pesticide consumption, 25.9% is consumed by rice. However, sole reliance on these chemicals have created adverse effects on environment as well as on many beneficial organisms in the rice ecosystem [1 and 5]. Exploitation of Host Plant Resistance (HPR) is a major component to manage this pest. The development of rice varieties that are resistant to the yellow stem borer is an important objective in current breeding programs. Growing resistant varieties is the most effective and environment-friendly strategy for protecting the crop from yellow stem borer. Thus, the present studies were conducted to identify the reaction of promising advanced cultures against yellow stem borer with a view to identify multiple resistant varieties.

Materials and Methods

The evaluation of rice genotypes of Multiple Resistant Screening Trial (MRST) against paddy stem borer *Scirpophaga incertulas* (Walker) were conducted at Norman E. Borloug Crop Research Center, GB Pant University of Agriculture and Technology, Pantnagar under field conditions during *kharif* 2012. The crop was raised under irrigated conditions in silty clay loam soil. Total sixty rice genotypes received from All India Co-ordinated Rice Improvement Program (AICRIP) under MRST were evaluated under field conditions (Table 1). TN-1 was treated as susceptible check.

For raising the nursery, seeds of all the test entries were sown in one meter row per entry and each row was marked with serial number of respective test

Table 2. Reaction of MRST-2012 entries to *S. incertulas* under field condition during *kharif*-2012. *Values in parentheses are score given at each date. Maximum value of dead heart (%) taken as check. ** I = Immune, HR=Highly Resistant, R = Resistant, MR= Moderately Resistant, MS=Moderately Susceptible, S=Susceptible.

Ent. No.	Designation	Cross	Per cent infestation by yellow stem borer						Final score	Resistance grade**
			30 DAT		45 DAT		Mean			
			Dead heart (%)	Infestation index*	Dead heart (%)	Infestation index *	Dead heart (%)	Infestation index		
1	CR 2711-76	Tapaswani/Dhobanumberi	15.2	72.9(9)	17.3	77.6(9)	16.3	75.3	9	S
2	CR 3005-77-2	Samba mahsuri/Salkathi	9.7	46.5(7)	14.8	66.5(9)	12.3	56.5	7	MS
3	CR 3005-230-5	Samba mahsuri/Salkathi	9.8	46.8(7)	14.7	65.9(9)	12.2	56.3	7	MS
4	CR 3006-8-2	Pusa 44/Salkheti	4.4	21.0(5)	22.3	100.0(9)	13.4	61.0	9	S
5	JGL 17974	MTU 1001/JGL 11470	7.3	34.9(7)	15.7	70.4(9)	11.5	52.7	7	MS
6	RP Bio 4918-230S	Swarna/O. nivara	5.2	24.7(5)	13.8	61.7(9)	9.5	43.2	7	MS
7	IRGA 318-11-6-9-2B	-	8.6	41.2(7)	7.9	35.6(7)	8.3	38.4	7	MS
8	W 1263 (DRR)	Donor	3.9	18.5 (3)	6.5	29.2(5)	5.2	23.9	5	MR
9	W 1263 (ACC11057) IRR1	Donor	2.9	13.9(3)	3.6	16.2(3)	3.3	15.1	3	R
10	TN 1	Check	2.9	13.9(3)	10.2	45.7(7)	6.6	29.8	5	MR
11	RP Patho-01	BPT 5204/C101LAC	3.7	17.6(3)	14.5	64.9(9)	9.1	41.2	7	MS
12	RP Patho-02	BPT 5204/C101A51	2.5	12.1(3)	17.6	79.1(9)	10.1	45.6	7	MS
13	RP Patho-03	BPT 5204/Tetep	6.7	32.2(7)	14.5	65.2(9)	10.6	48.7	7	MS
14	RP Patho-04	BPT 5204/C101LAC/C101A51	5.0	23.9(5)	11.3	50.5(7)	8.1	37.2	7	MS
15	RP Bio Patho-01	B95-1/C101A51	3.6	17.3(3)	13.0	58.3(7)	8.3	37.8	7	MS
16	RP Bio Patho-02	B95-1/Tetep	1.3	6.2(1)	12.9	57.9(7)	7.1	32.0	7	MS
17	B 95-1	Donor	4.1	19.8(3)	14.9	66.6(9)	9.5	43.2	7	MS
18	BPT 5204	Donor	8.8	42.1(7)	16.8	75.5(9)	12.8	58.8	7	MS
19	C101A51	Donor	11.4	54.7(7)	14.1	63.1(9)	12.7	58.9	7	MS
20	Suraksha	Check	12.7	61.0(9)	19.2	86.0(9)	15.9	73.3	9	S
21	C 101LAC	Donor	1.1	5.3(1)	14.1	63.3(9)	7.6	34.3	7	MS
22	Tetep	Donor	8.2	39.2(7)	15.9	71.1(9)	12.0	55.2	7	MS
23	HR-DRR-01	APMS 6A/PNR 2-49	6.7	32.3(7)	16.2	72.5(9)	11.5	52.4	7	MS
24	HR-DRR-02	APMS 6A/GQ70	1.0	4.8 (1)	12.2	54.6(7)	6.6	29.7	5	MR
25	HR-DRR-03	APMS 6A/BK 52-104	10.1	48.5(7)	16.7	74.7 (9)	13.4	61.6	9	S
26	HR-DRR-04	PUSA 5A/BK 35-155	12.4	59.3(7)	11.0	49.2(7)	11.7	54.2	7	MS
27	HR-DRR-05	PUSA 5A/BK 52-104	3.1	15.0(3)	19.1	85.9(9)	11.1	50.4	7	MS
28	HR-DRR-06	PUSA 5A/B 95-95	6.9	33.0(7)	14.0	62.8(9)	10.5	47.9	7	MS
29	HR-DRR-07	IR 79156A/BK 35-155	7.3	34.9(7)	14.9	66.7(9)	11.1	50.8	7	MS
30	TN 1	Check	9.1	43.5(7)	10.5	47.2(7)	9.8	45.4	7	MS
31	BG 380-2	Donor	19.7	94.1(9)	14.9	66.6(9)	17.3	80.4	9	S
32	RP 4918-212(S)	Swarna / O. nivara	5.1	24.4(3)	13.5	60.4(9)	9.3	42.4	7	MS
33	RP 4918-215(S)	Swarna / O. nivara	6.8	32.4(7)	8.0	36.0(7)	7.4	34.2	7	MS
34	RP 4918-221(S)	Swarna / O. nivara	3.6	17.2(3)	14.4	64.5(9)	9.0	40.9	7	MS
35	RP 4918-228(S)	Swarna /O. nivara	0.0	0.0(0)	9.8	43.8(7)	4.9	21.9	5	MR
36	CB 05-022	CO 43/ADT 39	7.5	35.8(7)	12.1	54.4(7)	9.8	45.1	7	MS
37	CB 05-031	CO 43/TNAU 91043	7.5	36.0(7)	13.2	59.4(7)	10.4	47.7	7	MS
38	CB 06-124	BPT 5204/Jeeraga samba	4.3	20.4(3)	9.0	40.2(7)	6.6	30.0	5	MR
39	CB 07-540	ADT 39 Mutant	6.1	29.0(5)	7.6	34.2(7)	6.8	31.6	7	MS
40	RP-4680-1-2-23	ACR 15831/RP2068	7.5	35.8(7)	10.2	45.7(7)	8.8	40.7	7	MS
41	CB 09-125	BPT 5204/CO(R) 50	7.4	35.3(7)	0.0	0.0(0)	3.7	17.6	3	R
42	CB 09-512	OR 1797-4/ Varapukudanchan	4.1	19.5(3)	7.1	31.8(7)	5.6	25.7	5	MR
43	CB 09-516	RR 4065-381-245/UPR 2893-97	12.3	59.1(7)	12.9	58.0(7)	12.6	58.5	7	MS
44	CB 09-526	R1152-241-264-1/CO 46 (M)	13.3	63.8(9)	17.5	78.7(9)	15.4	71.2	9	S
45	CB 09-537	IR 64/RR 272-662	13.5	64.7(9)	16.5	74.1(9)	15.0	69.4	9	S

Table 2. Continued.

Ent. Designation No.	Cross	Per cent infestation by yellow stem borer								Resis- tance Final score grade**
		30 DAT		45 DAT		Mean				
		Dead		Dead		Dead				
		heart	Infestation	heart	Infestation	heart	Infestation			
(%)	index*	(%)	index*	(%)	index*					
46 CB 09-538	IR64/RR 272-662	7.0	33.7(7)	13.0	58.3(7)	10.0	46.0	7	MS	
47 CB 09-570	ADT 45/JGL 1798	10.1	48.4(7)	13.7	61.5(9)	11.9	54.9	7	MS	
48 CB 10-504	CB 04-110/ADT 45	14.9	71.4(9)	6.2	27.8(5)	10.6	49.6	7	MS	
49 TNRH 206	COMS 23A/CB 206 R	19.0	91.1(9)	12.9	58.0(7)	16.0	74.5	9	S	
50 TN 1	Check	17.0	81.6(9)	10.0	44.8(7)	13.5	63.2	9	S	
51 TNRH 222	COMS 23A/CB222 R	16.8	80.5(9)	13.0	58.5(7)	14.9	69.5	9	S	
52 TNRH 237	COMS 24A/CB 237R	16.3	77.8(9)	14.5	65.0(9)	15.4	71.4	9	S	
53 TNRH 241	CPMS 24A/CB 241R	20.9	100.0(9)	17.4	78.1(9)	19.2	89.1	9	S	
54 TNRH 244	COMS 24A/CB 244R	15.0	71.5(9)	17.6	79.1(9)	16.3	75.3	9	S	
55 TNRH 258	CRMS31A/CB 258R	16.7	79.7(9)	17.3	77.8(9)	17.0	78.8	9	S	
56 K 024	-	4.1	19.8(3)	14.8	66.5(9)	9.5	43.1	7	MS	
57 K 026	-	12.4	59.1(7)	17.6	78.7(9)	15.0	68.9	9	S	
58 K 029	-	12.7	61.0(9)	13.6	61.0(9)	13.2	61.0	9	S	
59 RP 4681-16-2-569	Aganni/Jhitpity	9.1	43.5(7)	11.9	53.1(7)	10.5	48.3	7	MS	
60 TN 1	Check	15.3	73.2(9)	10.7	47.9(7)	13.0	61.0	9	S	

entry using the aluminium tags fixed on bamboo sticks. The field was well ploughed using harrow and puddled with the help of puddler and recommended doses of fertilizers were applied basally before transplanting. Twenty one days old seedlings were transplanted with each test entry comprising one row of 20 hills each with one skip row between entries. A spacing of 20 × 15 cm was followed and single row of check variety TN-1 was included after every 10 test entries.

Total number of tillers (TT) and dead hearts (DH) were counted on 10 randomly selected hills per entry at 30 DAT, 50 DAT and at peak infestation. After the formation of panicles, data were recorded on total panicle bearing tillers (PBT) and white ear heads (WE) from randomly selected 10 hills /entry prior to harvest.

The per cent dead heart and white head of the individual test entries were computed by using the formula as proposed by Heinrichs et al. [6] :

$$\text{Percent dead hearts} = \frac{\text{Total dead hearts}}{\text{Total tillers}} \times 100$$

$$\text{Infestation index} = \frac{\text{Percent infestation in test entry}}{\text{Percent infestation in susceptible check}} \times 100$$

Infestation index were assigned a corresponding rating of “0-9” scale as given below.

Infestation index	Scale	Level of resistance
No damage	0	1
1-10	1	HR
11-20	3	R
21-30	5	MR
31-60	7	MS
61 above	9	S

Results and Discussion

The infestation index values indicated that entry W 1263 (ACC11057) IRRI and CB 09-125 were resistant against yellow stem borer (YSB) during *kharif* 2012 (Table 2). Moderate resistance reaction was identified in W 1263 (DRR), HR-DRR-02, RP 4918-228 (S), CB 06-124 and CB 09-512 with index values of 23.9, 29.7, 21.9, 30.0 and 25.7, respectively. The resistant entries W 1263 (ACC11057) IRRI showed resistant reaction at both 30 and 45 DAT, whereas, CB 09-125 showed moderately susceptible reaction at 30 DAT and immune reaction at 50 DAT. Rest of the entries were rated as moderately susceptible or susceptible with infestation index ranging from 31.6 to 58.9 and 61.0 to 89.1, respectively. At Rajendranagar location,

the entry CB 09-125 was promising against stem borer [7], however, in present investigation the entries W 1263 (ACC11057) IRRI and CB 09-125 were excellent against YSB.

References

1. Mathur KC, Reddy PR, Rajamani S, Moorthy BTS (1999) Integrated pest management in rice to improve productivity and sustainability. *Oryza* 36 : 195—207.
2. Ministry of Agriculture (2011-12) <http://indiabudget.nic.in>
3. Kalode MB, Pasalu IC (1986) Pest management in rice Ind Farm 9 : 31—34.
4. Singh J, Dhaliwal GS (1996) Insect pest management in rice : A perspective. In : Dhaliwal GS, Arora Ramesh (eds). Trends in agricultural pest management, New Delhi, India, Commonwealth Publ 56—112.
5. FAO-STAT (2001) Crop protection compendium, CAB Int, UK.
6. Heinrichs EA, Medrano FG, Rapusas HR (1985) Genetic evaluation for insect resistance in rice, IRRI, Los Banos, Philippines, 356.
7. Anonymous (2013) Progress report 2012 Vol. 2. entomology and pathology. All India Cominated Rice Improvement Pogram. Directorate of Rice Res, Hyderabad, India.